NAVSARI AGRICULTURAL UNIVERSITY

Compendium of
PG Seminar Gists

(Horticulture, Year 2016-2020)

Let's Bloom Human Fruition

ASPEE College of Horticulture and Forestry
Navsari Agricultural University
Navsari Gujarat

University Publication No.: 14/2021-22

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PG Seminar Gists

(Horticulture, Year 2016-2020)

Compiled By

Alka Singh
R V Tank

ASPEE College of Horticulture and Forestry

Navsari Agricultural University

Navsari Gujarat

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Deans Message

Dr. P. K. Shrivastava
Principal and Dean

Since last two decades Horticulture has emerged as one of the potential agro based enterprise in India with significant contribution towards Indian Agricultural GDP. Available diversity in Horticulture is emerging as supplementary and dependable source of income in every Agro climatic situation for achieving sustainability to farmers including those having small holdings. Horticulture growth is not only helping in achieving nutritional security, but also possesses enormous export potential through Value addition with the help of Post-Harvest Technologies. There is a need to adopt technologies with precision along with ameliorating/fine tuning the available recommendations as per climatic changes for cultivation and postharvest handling of horticultural crops in order to obtain quality production for getting better returns. The sector has scope to provide job opportunities to graduating students, having rural / urban back ground, to initiate their own businesses according to the available resources in their hand.

PG Seminar being an integral part of PG course curriculum, the series have been regularly and efficiently conducted at ASPEE College of Horticulture and Forestry. The Post Graduate students with the help of their guides devote their time to prepare seminars with latest research on selected topics and ensuing discussion is helpful in igniting interest among students, teachers and professionals in the field. I feel happy to share that these important technologies, strategies and innovations have been covered in the PG seminar series at ASPEE College of Horticulture and Forestry. This compilation "Compendium of PG Seminar Gists” gives a summary of the PG seminars being conducted in Horticulture during the year 2016-2020.I complement the seminar coordinators Dr. Alka Singh and Dr. R.V. Tank for meticulously conducting the seminar and compiling this compendium.

ASPEE College of Horticulture and Forestry
Navsari Agricultural University, Navsari

Preface

A Seminar provides a platform for deliberation, interaction and discussion on specific and relevant topic amongst a group of specified field. PG Seminar, a prerequisite for the award of M.Sc. Horticulture and PhD Horticulture degree has been reorienting students of Horticulture subject towards knowledge intensiveness and building skills in communication and presentation. Attending and participation in a seminar has numerous benefits, including improving communication skills, gaining expert knowledge, networking with others and renewing motivation and confidence.

Horticulture has emerged as one of the potential agricultural enterprise in accelerating the growth of economy in India. It plays a key role by contributing towards Indian Agricultural GDP and provides ample scope for sustaining large number of Agro-industries which generate huge employment opportunities. Horticulture has been evolving in form of horticulture industry in our country owing to its significant role in nutritional security, poverty alleviation and employment generation. Horticultural crops for which the Indian topography and agro climates are well suited is an ideal way of achieving sustainability of small holdings, increasing employment, improving environment, providing an enormous export potential and above all achieving nutritional security. There is need of adoption of smart and hi-tech strategies with precision for cultivation as well as postharvest handling for horticultural crops in order to obtain higher good quality production with sustainable approach. Smart strategies include an array of hi-tech technologies right from farm level emphasizing nutrient use efficiency with integrated approach, precision in management, adoption of HDP, rejuvenation of old orchards, enhanced and précised irrigation systems, organic farming strategies, efficient postharvest handling and processing technologies as well as new interventions in environmental controls systems in protected cultivation, vivid & versatile approaches in floriculture including bio-aesthetic purpose, environmental, edible as well as use of nanotechnology, amendments like use of soilless rooting/growing media, modification in grafting techniques for fruits, vegetables and flowers.

Reflection of these important and interesting topics being perceived in PG seminar – Horticulture series at ASPEE College of Horticulture &Forestry, depicts appropriate selection of seminar topics aiming at creation of broad knowledge base among students. This compendium consists of PG seminar gists delivered by MSc Horticulture and PhD Horticulture students during the year 2016-2020. It will be helpful to get quick glance at the topics covered in the PG seminar series and a useful document for selection of seminar topics giving future seminars

Dr. Alka Singh
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ASPEE College of Horticulture and Forestry
Navsari Agricultural University, Navsari

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GROUP : I

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Chavan Sachin	**Course : FLA -692**
Reg. No. : 1020214004	**Date : 17-12-2016**
Major Guide : Dr. Alka Singh	**Time : 11.00 to 12.00 noon.**
Co- Guide : Dr. T.R. Ahlawat	**Venue : Swami Vivekananda Hall**

Advances in breeding and biotechnology of papaya

Papaya (*Carica papaya* L.) is an important fruit crop of tropical and sub tropical regions of the world, belongs to family Caricaceae with 6 genus namely Carica, Vasconcella, Jarillla, Jacartia, Cyclimorpha and Horovitzia. India contributes ten per cent of the global fruit production and is largest producer of papaya in the world. Papaya is cultivated on an area of **1.33 Lakh ha** with **56.39 Lakh MT of** production and **42.40 MT/ha** productivity (Anonymous, 2016)**.** In Gujarat, it is cultivated on **19,590 ha** area with production **of 11,850 MT** and **60.50 MT/ha** productivity (Anonymous, 2015).

Rich source of carotenoids has drawn attention of horticulturists towards commercialization of papaya. Papaya is now well spread crop and has pancontinental existence. Systematic efforts have been done to breed papaya varieties having high productivity and resistance for various biotic as well as abiotic stress. Conventional as well as modern approaches of plant breeding have envisaged a new range of papaya cultivars through interspecific and intergeneric hybridization.

Brief Review of Research Work

Biotechnology

Fredah *et al.* (2007) studied anther derived triploid papaya strains and evaluated their usefulness in commercial fruit production and breeding. The anther derived papaya strains were variable in height and classified into dwarf, semi dwarf and tall. All the anther derived papaya strains produced fruits parthenocarpically. Two dwarf strains produced parthenocarpic fruits with an average weight of 670 g and 871.3 g as compared to the diploid cultivar, 'Wonder Blight', whose fruits weighed 696.4 g.

Silva (2007) studied sex conversion of genotype 'Cariflora', from the dioecious to gynoecious and andromonoecious stage, by means of RAPD marker assisted introgression of the M^2 allele. Hierarchic clustering in the BC_2 generation showed three plants close to the recurrent parent with desirable phenotypic traits. The genetic divergence matrix indicated that this similarity was 84, 81 and 76%, respectively.

Tamaki *et al.* (2011) shortened the breeding cycle of papaya by three months using embryo culture, using embryos qualitatively improved by ethrel treatment. Embryo development was enhanced by ethrel treatments in 55 DOF (10 DET). The ethrel treated embryos progressed to the mature cotyledon stage earlier than those in the control.

Asudi *et al.* (2013) studied genetic diversity of papaya using seven SSR markers through computing allelic richnes, frequency, expected heterozygosity and cluster analysis. Markers were highly polymorphic among the accessions, with polymorphic information content (PIC) varying from 0.75 to 0.852 with an average of 0.81. The genetic similarity among the 42 papaya accessions ranged from 0.764 to 0.932 with an average of 0.844, showing that most papaya accessions used in this study were closely related.

Patel *et al.* (2013) in papaya micro propagation study observed the maximum shoot multiplication in MS medium + 0.5 mg/L BAP + 0.1 mg/L NAA. Sucrose 30 g/L in medium was found to be more favorable for maximum number of shoot and length of shoots. Rooting treatment of half MS medium with 1.0 mg/L IBA was found to be the best for early induction of roots.

Interspecific Hybridization-

Jayavalli *et al.* (2011) studied breaking of intergeneric crossing barrier in *Carica papaya* cultivars and *Vasconcellea cauliflora* through various nutrient combinations. Among the combinations used, Sucrose 5% + boron 0.5% + $CaCl_2$ 0.5% improved the fruit set and seed set percentage. Out of 29 F_1 hybrid plants from CO 7 x *V. cauliflora* cross, only six plants were free from PRSV symptoms. Pusa Nanha x *V. cauliflora* plants had higher yield under PRSV infected conditions, however, total soluble solids and total sugars were found lesser than the CO 7 x *V. cauliflora* cross.

More over they, confirmed the hybridity of the intergeneric hybrid progenies of *Carica papaya* cultivars as female and *Vasconcellea cauliflora* as male by using ISSR primers by amplification of DNA from progenies and their parents. ISSR primers UBC 856, UBC807 and ISSR primer combinations UBC 856-817, UBC 810-817, UBC 861-817, UBC 856-810, UBC 861-810 and UBC 856-817 clearly amplified specific bands of the male parent, which were present in F_1 progenies, but were was absent in female parents.

Sudha *et al.* (2013) studied intergeneric F_2population of papaya to estimate the mean performance, genetic parameters governing different traits and reaction to the PRSV. Among the crosses, F2 population of Pusa Nanha × *V. cauliflora* recorded superior mean performance for fruit yield, number of fruits per tree and fruit biochemical parameters. Mean performance for papain recovery per fruit and the enzyme activity were high in CP 50 × *V. cauliflora* F_2 population.

Backcross breeding-

Cynthia *et al.* (2003) Studied a backcross generation of papaya 9-1(D) by crossing cv.CO.2 and cv.Red Anthered Male (M_1R) for five generations from 2000 to 2007. In the fifth generation, the red pulp population of 9-1(D) segregated in the ratio of 4:1. The culture 9-1(D) had a potential of producing 79.5 fruits weighing 198.5 kg/tree in a cropping period of two years.

Genetic Diversity and Heterosis-

Kamalkumar *et al.* (2010) studied heterosis breeding in papaya. The hybrids CO 2 × Pusa Giant and CO 5 × 9-1(D) registered significantly favorable negative heterosis for days to flowering. The hybrids CO 2 × Pusa Giant, 9-1(D) × CO 5, Pusa Dwarf × 9-1(D) registered high positive significant heterosis for number of fruits. Higher flesh thickness with maximum heterosis was observed in the cross CO 3 × CO 7.

Singh and Kumar (2010) studied the genetic variability in 18 papaya cultivars under Bihar conditions. Wide range of variability was observed in fruiting node, plant height, fruiting height, fruiting length, fruit weight, number of fruit per plant and fruit yield per plant. Phenotypic coefficient of variation for all the characters was higher than that of genotypic coefficient of variation. Higher estimate of heritability and genetic advance were observed for fruit weight, fruiting length and fruit yield.

Das and Dinesh (2014) studied genetic diversity of papaya genotypes. Varieties Sunrise Solo, Waimanalo and the hybrid No.39 and No.57 had medium sized fruits. Sunrise Solo recorded the highest plant height and the least was observed in Pusa Dwarf. The weight of the fruits was found to vary from 486.67 g in Sunrise Solo to 1380.33 g in Pusa Dwarf. The pulp thickness, TSS and ascorbic acids were found to be maximum in the hybrids No.39 and No.57.

Conclusion:

Conventional as well as modern approaches of plant breeding holds immense scope for crop improvement of papaya. Use of embryo, ovule and anther culture are of paramount importance for interspecific hybridization, triploid development and reducing time of breeding cycle. Clonal multiplication by advanced techniques can be used to fix heterosis and for further commercial plant production without wasting time and resources for pollination and hybrid seed production. Marker assisted breeding is useful to identify sex of papaya as well as to confirm hybridity at seedling stage.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Mr. Hitesh V. Vasava	**Course : VSC -692**
Reg. No. : 1020214016	**Date : 3-12-2016**
Major Guide : Dr. K. N. Chaudhari	**Time : 4:00 to 5:00 pm**
Co- Guide : Dr. R. V. Tank	**Venue : Swami Vivekananda Hall**

Precision farming in papaya

Papaya (*Carica papaya* L.) is an important fruit crop of tropical and sub tropical regions of the country belong to the family of Caricaceae. India accounted for about 10 per cent of the global production of the fruits and is supposed to be highest producer of papaya in the world. It is cultivated on an estimated area of 1.33 Lakh ha with 56.39 Lakh MT production and 42.40 MT/ha productivity (Anon., 2016). In Gujarat, it is cultivated 19,590 ha area with production of 11,850 MT and 60.50 MT/ha productivity (Anon., 2015).

Precision farming is about doing the right thing, in the right place, in the right way, at the right time. Managing crop production inputs such as water, seed, fertilizer etc. to increase yield, quality, profit, reduce waste and becomes eco-friendly. The intent of precision farming is to match agricultural input and practices as per crop and agro-climatic conditions to improve the accuracy of their applications.

BRIEF REVIEW OF RESEARCH WORK

Growing media for seedling

Patel (2015) reported that media M_3 (Red laterite soil + vermicopost + cocopeat) and seed treatment chemical C_2 (GA_3 200mg/l for 12 hr) were significantly influenced growth parameters of papaya seedlings.

Drip irrigation and Fertigation

Tank *et al.* (2011) reported that treatment T_9 (drip irrigation @ 0.8 PEF + N and K_2O @ 100 per cent RD) gave maximum yield and better quality of papaya fruits. However, maximum cost: benefit ratio was observed with treatment T_8 (drip irrigation @ 0.8 PEF + N and K_2O @ 80 per cent RD).

Deshmukh and Hardaha (2014) revealed that significantly highest plant height (140cm) was observed in treatment T_5 (80% CPE and 80 % RDF) and T_6 (80% CPE and 100 % RDF). Whereas, significantly maximum yield and yield attributing parameters were observed in treatment T_9 (100% CPE and 100% RDF).

Thakor *et al.* (2014) reported that GIS map shown good quality soil of Anand district area as compare to other South Gujarat area.

Mulching

Solia *et al.* (2010) observed that growth and yield attributes were significantly higher with treatment drip irrigation @ 0.6 PEF + BPM @ 20% coverage (50 micron) in papaya.

Precise space utilization

Kumar *et al.* (2012) found that maximum no. fruit/plant, fruit weight and yield were recorded in treatment nitrogen (N 200 g/pit), potassium (K 300 g/pit) and spacing (S_2: 1.5 x 1.5 m) in papaya.

Intercropping

Singh *et al.* (2010) reported that intercropping of summer ground nut (cv. Dh-86) in papaya cv. S-1 displayed the better compnionship for yield of both crops.

Integrated nutrient management (INM)

Singh and Varu (2013) revealed that yield and physico-chemical parameters were significantly influenced and noted higher with treatment T_8 (½ RDF + Azotobacter 50 g/plant + PSB 2.5 g/m^2) in papaya cv. Madhu bindu.

Srivastava *et al.* (2014) manifested that maximum yield and better quality fruits were found with the treatment T_{10} (FYM + 100% NPK + *Azotobacter* 20 g/pit + PSB 20 g/pit) in papaya.

Micronutrients

Bhalerao and Patel (2015) revealed that among the different micronutrients treatments, treatment T_{10} (calcium nitrate 1000 mg/l + borax 30 mg/l + zinc sulphate 200 mg/l + ferrous sulphate 200 mg/l) was found significantly higher in yield and quality parameters of papaya cv. Red Lady.

Plant growth regulators

Pusdekar and Pusdekar (2009) reported that spraying of MH @ 600 ppm gave maximum fruit weight, fruit volume and yield of papaya. However, maximum TSS, ascorbic acid and minimum acidity were noted due to application of MH @ 400 ppm, CCC @ 500 ppm and etherel @ 250 ppm, respectively.

Varietal performance

Das and Dinesh (2014) noted maximum plant height (237.77 cm) of papaya cv. Sunrise Solo. Whereas, Pusa Dwarf was found better with respect to fruit volume (1367.00 ml) and fruit breath (15.23 cm). Maximum pulp thickness (3.27 cm), TSS (14.83 ^{0}B) and the carotenoids (3.27 mg/100g) were found in papaya cv. H-39.

Micro Propagation

Patel *et al.* (2013) reported that MS medium with 1.0 mg/l IBA resulted in maximum rooting under micropropagation in papaya.

Economics

Solia *et al.* (2010) revealed that maximum net realization found with drip irrigation @ 0.6 PEF + Black plastic mulch @ 20% coverage (50 micron) as compared to drip alone.

Conclusion:

Papaya seed treated with GA_3 200mg/l for 12 hr and shown in media of red laterite soil + vermicopost + cocopeat was found better seedling growth. Fertigation in papaya @ 0.8 PEF + N and K_2O @ 80 per cent RD, saved 20 % N and K_2O and gave maximum cost benefit ratio with better yield and quality of papaya. GIS map shown good quality soil of Anand district area as compare to other South Gujarat area. Drip @ 0.6 PEF+BPM (50 micron) 20% coverage was fond economically viable technology with increased yield of papaya. Under precise space utilization, papaya planted at distance of 1.5 x 1.5 m and fed with nitrogen (200 g/pit) and potassium (300 g/pit) resulted in higher yield and yield attributing parameters. Inter cropping of summer groundnut cv. Dh 86 in papaya cv. S-1 was found beneficial with respect to yield of both the crops. Application of INM ½ RDF + Azotobacter 50 g/plant + PSB 2.5 g/m_2 increased the yield and quality of papaya cv. Madhu bindu. Yield and quality of papaya also can be increased with the application of FYM 20 kg/plant + 100% NPK + Azotobacter 20 g/pit + PSB 20 g/pit. Foliar spray of micronutrient like calcium nitrate 1000 mg/l + borax 30 mg/l + zinc sulphate 200 mg/l + ferrous sulphate 200 mg/l increased the yield and quality of papaya cv. Red Lady. Spraying of plant growth regulators like MH @ 600 ppm increased the growth and yield of papaya. Under the varietal performance cultivar Pusa Dwarf and H-39 was found better in terms of physico-chemical parameters of papaya. Use of MS medium with 1.0 mg/l IBA was found better for rooting in papaya under micro propagation.

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NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Tanveer Ahmad Qadeer Ahmad	**Course : PHT- 692**
Reg. No. : 1020214015	**Date : 19-11-2016**
Major Guide : Dr. Dev Raj	**Time : 3:00 to 4:00 pm**
Co- Guide : Dr. Y. N. Tandel	**Venue : Swami Vivekananda Hall**

Application of hot water treatment in banana, mango and papaya

Introduction:-

India is second largest producer of fruits in the world and also largest producer of banana, mango and papaya with production share of 27.8, 45.1 and 43.7 per cent, respectively. Despite such huge production, the post harvest losses are reported in the range of 20-25 % for banana, 25-40 % for mango and 40% for papaya (Anon., 2015). These post harvest losses are mainly due to microbial infection, insect infestation, physiological changes as well as physical damage. Among various spoilage causing factors insect infestations as well as microbial infection play an important role in augmenty post harvest losses. These fruit infestation/infection hinder the export potential of these fruits, thus causes heavy monitory losses. These losses can be minimized by application of irradiation, vapor heat treatment, waxing and hot water treatment.

Among these treatments, irradiation is banned in Japan; however, vapor heat treatment is costly treatment while hot water treatment is easy and simplest for its application. This technology involves dipping of commodities in mild hot water (50-55°C) for certain time to control fungal pathogen and insect in the harvested produce. Hot water treatment also helps to reduce the respiration rate, ethylene bio-synthesis and improve the post harvest quality of fruits. Dose of hot water treatment vary according to commodity and purpose of application to enhance the storability of fresh produce. Fungal spores and latent infections are either on the surface or in the first few cell layers under the peel of the fruit or vegetable. Most important feature of this technology is that the pathogenic microbes are killed by thermal processing treatment and produce may be popularised as chemical free. Thus hot water treatment is being easily applied as quarantine treatment before export.

Review of Research work:-

Banana (*Musa paradisica*):

Dissanayake *et al.* (2015) conducted an experiment to study effect of hot water treatment with different temperature and time duration for extension of shelf life of banana. They reported less microbial growth at 55°C for 10 and 5 minutes which was at par with 50°C. They also reported better colour retention of fruit at 40°C for 10 and 5 minutes.

Wall (2004) studied the effect of hot water treatment with different temperature (48, 49 and 50°C) and different time duration (5, 10 and 15 minutes) and reported that hot water treatment at 50°C for 10 minutes resulted better quality retention of banana fruit with maximum delay for ripening and minimum physiological loss in weight.

Varit and Songsin (2011) experimented to study effect of hot water treatment on chlorophyll content and firmness of banana. Hot water treatment of banana was given at 45°C temperature for 5, 10 and 15 minutes and 50°C for 10 minutes. They reported that hot water treatment at 50°C for 10 minutes resulted maximum firmness and chlorophyll content on banana fruit than the rest of treatment combination.

Promyou *et al.* (2008) conducted an experiment to study the effect of hot water treatment on retention of colour of banana peel. Hot water treatment of banana was performed at 42°C for 5, 10, 15 minutes and they recorded minimum banana peel blackening at 42°C when treatment given for 15 minutes.

Mango (*Mangifera india* L.):

Savani (2009) conducted an experiment to study the effect of hot water treatment, vapor heat treatment and pre-cooling for extension of shelf life of mango and reported that hot water treatment at 55±1°C for 6 minutes had less disease incidence and minimum ripening percentage of mango on 12th days of storage.

Lizada *et al.* (1986) studied the effect of hot water treatment on disease incidence (anthracnose and stem end rot) of mango. The hot water treatment was conducted at 51±2°C and 53±2°C temperature for 10 minutes and compared with control. They reported that hot water treatment at 53±2°C completely inhibited the stem end rot while anthracnose was inhibited at 51±2°C. They reported that hot water treated mango fruits possessed non-significant difference for organoleptic score as compared to control.

Kumah *et al.* (2011) conducted an experiment to reduce the disease incidence of anthracnose during storage of mango treated with hot water treatment. In this experiment three temperatures *viz.*, 48°C, 50°C and 52°C for 5 and 10 minutes were studied along with control treatment and they reported that 52°C for 5 minutes had no disease incidence of anthracnose on 21 day of storage.

Waskar and Gaikwad (2005) reported that hot water treatment at 52°C along with 0.1% bavistin for 10 minutes and low cost cold storage at 24±3°C had minimum physiological loss in weight and maximum shelf life and organoleptic score. In biochemical parameters, hot water treatment at 52°C with 0.1% bavistin for 10 minutes along and storage at room temperature had minimum change in total soluble solid, total sugar and acidity when stored at room temperature.

Verghese *et al*. (2011) conducted an experiment to study the effect of hot water treatment on fruit fly at different regimes (Stages). Mango fruits were immerse in hot water at different temperature of 45°C & 48°C for 30, 45 & 60 minutes and 52°C for 10 & 20 minutes. They reported that hot water treatment of 48°C for 60 showed 100% mortality in all four regimes *i.e.* egg, 1st instar maggots, 2nd instar maggots and 3rd instar maggots with better sensory quality.

Anwar and Malik (2007) studied the effect of hot water treatment on biochemical and sensory characteristic of mango and reported that hot water treatment at 48°C for 60 minute had maximum biochemical composition and sensory score.

Papaya (*Carica papaya*):

Li *et al.* (2013) conducted an experiment to study the effect of hot water treatment on disease incidence of papaya and reported hot water treatment at 54°C for 4 minutes more effective to reduce the incidence of anthracnose and stem end rot of papaya. They also study effect of hot water on wax retention of papaya and reported that due to hot water treatment wax was evenly spread on fruit surface and resulted reduced disease incidence.

Zhao *et al.* (2005) studied the effect of hot water treatment on fruit yellowness index, respiration rate, ethylene production and firmness of papaya fruit during storage at 25°C and reported that hot water treatment have positive effect on metabolism during storage.

Lay-yee *et al.* (1998) reported hot water treatment at 48.5°C for 60 minutes better with respect to physico-chemical changes and organoleptic score and low disease incidence.

Conclusion:-

From above forgoing review it can be concluded that hot water treatment can help to increase the shelf life and reduced the incidence of pest and disease in banana, mango and papaya. In banana microbial growth can be reduced by hot water treatment at 50°C for 5 to 10 minutes. Mango fruit fly can be control by hot water treatment at 48°C for 60 minutes and while Incidence of anthracnose and stem end rot of papaya can be reduced by hot water treatment at 54°C for 4 min.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker	**: Kachhadia Palak Arvindbhai**	**Course**	**: FSC 691 (1+0)**
Reg. No.	**: 1020216005**	**Date**	**: 30/12/2017**
Major Guide	**: Dr. B.N. Patel**	**Time**	**: 09.00 to 10.00 a.m.**
Co-Guide	**: Dr. D.R. Bhanderi**	**Venue**	**: Swami Vivekananda Hall**

Soil stress management in fruit crops with respect to abiotic stress

Abiotic stresses become the major threat to agriculture production worldwide. Drought, heat, cold and salinity are among the major abiotic stresses that adversely affect plant growth and productivity. In general, abiotic stress often causes a series of morphological, physiological, biochemical and molecular changes that unfavorably affect plant growth, development and productivity. Drought, salinity and extreme temperatures (cold and heat) are often interrelated; these conditions singularly or in combination induce cellular damage. To cope with abiotic stresses, of paramount significance is to understand plant responses to abiotic stresses that disturb the homeostatic equilibrium at cellular and molecular level in order to identify a common mechanism for multiple stress tolerance.

Effect of water stress:

Drought:

Luvaha *et al.* (2007) conducted experiment on response of mango root stock seedlings to water stress and they observed that transpiration rate and leaf stomatal conductance were higher in well watered plants (W) as compared to extremely stressed plants (Z). There was a steady increase in CO_2 assimilation with time except on D42 where a decline occurred. In the highly stressed plants (Z) a decline was observed from D56 to D70.

Khattab *et al.* (2012) investigated the effect of humic acid and amino acids on pomegranate trees under deficit irrigation. They observed that highest leaf area, number of flowers per shoot and number of fruits per tree were obtained in treatment of $9m^3$ irrigation water + 48 g humic acid/tree/season. However, it was at par with control ($11m^3$ irrigation water only) with respect to number of flowers per shoot and number of fruits per tree.

Tavousi *et al.* (2015) studied the effects of drought and salinity on yield of pomegranate tree. The results showed that deficit irrigation causes a significant decrease in crop yield compared to full irrigation whereas, the salinity stress had no significant effect on crop yield.

Rekha and Ramanjinappa (2016) evaluated different banana genotypes for moisture stress tolerance. They applied irrigation in three categories: i) well watered for three months (3-4 days interval), ii) withholding water for 45 days and iii) recovery with well watered condition (regular irrigation was resumed at 3-4 days interval) in the experiment. The maximum shoot length and leaf length were observed after stress imposition in genotype Rasthali whereas maximum root length was observed in Karibale.

Flood:

Schaffer *et al.* (2006) studied effect of O_2 concentration in the flood water on ethylene evolution from hypertrophide stem lenticels of mango trees. They noted that when mango trees were grown hydroponically, ethylene concentration in the space around the stem lenticels was significantly higher when roots were submerged in water with 1-2 $mg.L^{-1}$ O_2.

Insausti and Gorjon (2013) noted that 40 days and 60 days of flooding shown significant differences of reduction in diameter of fruits, diameter of branches and length of branches in flooded treatment in 'Red Globe' peach plants as compared to control.

Effect of salt stress:

Zuazo *et al.* (2003) conducted experiment on salt tolerance of two mango root stocks, Gomera-1 and Gomera-3 with the cultivar Osteen. Grafted plants were exposed to salinized irrigation waters measured by electrical conductivity (1.02, 1.50, 2.00 and 2.50 dS m^{-1}). They found that maximum height, stem width and fresh weight under 1.02 dS m^{-1} in both the root stocks, but Gomera-1 was most tolerant as compared to Gomera-3.

Musyimi *et al.* (2007) studied the effect of five levels of NaCl (0, 15, 30, 45 and 60 mM) in avocados. The result showed that irrigating avocado plants with saline water and increase the concentration of saline water may inhibit growth and photosynthetic parameters as compared to control. However, the growth and photosynthetic parameters of avocado were decreased with increasing the levels of NaCl.

Rahimi and Biglarifard (2011) studied the influence of salinity and substrate interaction on fruit yield of strawberry cv. Camarosa. The maximum yield was observed in 0 level of NaCl and 70% coco peat + 30% perlite. They also observed that low Na and high K, K/Na, Ca and Mg in shoot under control while all the nutrients are low in higher concentration of NaCl (90 mM) except Na.

Montana *et al.* (2014) conducted an experiment on effect of NaCl salinity on seed germination and seedling emergence of purple passion fruit. They noticed that the root and shoot growth of newly emerged passion fruit seedlings was significantly reduced at higher salinity levels 90 mM and 120 mM NaCl treatments.

Pandey *et al.* (2014) reported that the fresh and dry weight of plant were decreased with increasing concentration of NaCl in rootstocks. The maximum fresh and dry weight were observed under control in both Olour and Chandrakaran root stocks and minimum in higher level of NaCl (150 mM).

Effect of salt stress on nutrients:

Musyimi *et al.* (2007) evaluated the effect of different salinity levels on the growth and nutrients uptake of 8 months old avocado seedling and they observed that nutrients uptake was inhibited by plant with increasing salinity levels.

Effect of temperature stress:

Sakamoto *et al.* (2016) observed that total plant biomass expressed as dry weight was higher in plants exposed to low root-zone temperature (10^o C) whereas, it was remarkably decreased in plants exposed to high-root zone temperature in strawberry.

Conclusions:

From the above foregoing discussion it can be concluded that drought stress reduced growth, yield and dry matter content in fruit crops. Plant physiological parameters like photosynthetic rate, transpiration rate, stomatal conductance and CO_2 assimilation rate also adversely affected by abiotic stresses. Humic acid play positive role to mitigate drought and it improved growth and yield of pomegranate. Rasthali, genotype of banana have good growth under water deficit condition. Flooding caused anoxia (lack of oxygen) condition and produced high ethylene gas which is harmful. Salinity reduced plant growth, yield and nutrients uptake in avocado. Gomera-1 was proved resistant root stock of mango under salt stress condition. Salinity also adversely affected on seed germination and seedling growth of passion fruit. High temperature reduced dry weight of plant as well as plant parts in strawberry and 10^oC temperature of root-zone was good for growth.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
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POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker	**: Kalariya Vijaysinh Dhanjibhai**	**Course**	**: VSC-692**
Reg. No.	**: 1020215004**	**Date**	**: 16/12/2017**
Major Guide	**: Dr. D.R. Bhanderi**	**Time**	**: 10.00 to 11.00 a.m.**
Co-Guide	**: Dr. R. V. Tank**	**Venue**	**: Swami Vivekananda Hall**

Dehydrin, a scavenger against abiotic stress in fruit crops

Introduction:

Stress in terms of biology is an adverse force or a condition, which inhibits the normal functioning and growth of a biological system of plants. Stress can be broadly classified as biotic and abiotic. Abiotic stress includes temperature, salinity, water, radiation, chemical, etc. Among which cold, salinity and drought are the major stresses, which adversely affects plants growth and productivity. Water availability for plant is highly affected by three environmental stresses which include salinity, low temperature (freezing) and drought (Mahajan and Tuteja, 2005).

Dehydrin

Dehydrin belongs to group II of late embryogenesis abundance (LEA) protein. These proteins are most commonly found in higher plants, algae, yeast and cynobacteria. Currently, dehydrins are considered all the proteins which have at least one copy of the lysine rich amino acids sequence known as K segment. Apart from K segment dehydrins also contain S segment, Y segment and $— segment. Molecular weight of dehydrins ranges from 9 to 200 kDa. They are water soluble and thermo stable. Dehydrins are classified according to the combinations of highly conserved segments (K, Y and S segments). There are mainly 5 types of dehydrins *viz.*, YpSKp9 Kp9 SKn› KnS and Y K, (Close, 1996). Dehydrin found in cell cytoplasm and nucleus (Houde *et al.*, 1995), near to plasma membrane (Danyluk *et al.*, 1994), also found in cell organelles, such as mitochondria (Borovskii *et al.*, 2000) and vacuoles (Heyen *et al.*, 2002).

Mode of action of dehydrin

K segment of dehydrins imparts structural modification when translocated to the plasma membrane and it forms o—helix which is amphipathic in nature. It combines with water molecules at hydrophilic side and lipid molecules at the other side. Thus the liquid crystalline state is maintained during cold stress and at the same time water loss due to disturbed osmotic potential can be prevented. By this means prevention of hexagonal II phase transition from liquid crystalline state can be greatly achieved (Allagulova *et al.* 2003).

Review of research work:

Salt and Drought Stress

Hanana *et al.* (2014) identified and isolate genes related to abiotic stress (salinity and drought) tolerance in grapevine, a candidate gene approach led to the isolation from Cabernet Sauvignon cultivar of a full-length cDNA of dehydrin gene. The expression study of VvDhn was carried out within plant organs and tissues as well as under drought and salt stresses. VvDhn was not detected in vegetative tissue, whereas it was only expressed during seed development (during late embryogenesis) at extremely high levels and was induced by salt stress.

Cold Stress

Xu *et al.* (2014) reported that the role of EjDHNs in freezing resistance in loquat fruitlets. Two cultivars of loquat, the freezing-sensitive ‘Ninghaibai’ (FS-NHB) and the freezing-tolerant ‘Jiajiao (FT-JJ) were analysed under induced freezing stress. Freezing stress led to obvious accumulation of reactive oxygen species, they also found seven DHNs, showing four different structure types from loquat fruitlets and used to study the characteristics of different EjDHN proteins.

Parmentier-Line *et al.* (2002) monitored two dehydrins of 65 and 30 kDa were detected with a polyclonal antibody raised against the 65 kDa dehydrin of blueberry. Using a full-length cDNA clone of blueberry dehydrin 1 as a probe, one mRNA of 0.75 kb, an appropriate size to encode the 30 kDa dehydrin, was detected on RNA blots.

Yang *et al.* (2012) identified the *DHN* gene family in *V. vinifera* and the corresponding homologues were isolated from *V. yeshanensis*. The four grapevine *DHN* genes shared a low sequence identity, and exhibited clear differences in physicochemical properties and expression profiles, which indicates functional diversification within the grapevine *DHN* family. *DHN-1* appeared to be the principal stress-responsive gene in grapevine species, and was induced not only by various abiotic stresses.

Hara *et al.* (2001) identified CuCOR19 mRNA or protein by Northern or Western hybridization, respectively. A small amount of CuCOR19 mRNA was present in leaf when it was detached and the mRNA level decreased during the control experiment.

Monica *et al.* (2009) identified a DHN of the class Y_2SK_4 with a deduced amino acid sequence with 79– 98% identity among the cultivars “Royal Gala”, “Goldrush‟ and the M9 rootstock that showed high identity to our DHN from “Golden Delicious” (92–98%).

Houde *et al.* (2004) The WCOR410 protein was expressed in transgenic strawberry at a level comparable with that in cold-acclimated wheat. Freezing tests showed that cold-acclimated transgenic strawberry leaves had a 5 °C improvement of FT over wild-type or transformed leaves not expressing the WCOR410 protein.

Conclusion:

From forgoing discussion it can be concluded that the genes which encode these proteins are expressed during late embryogenesis, as well as in vegetative tissues subjected to drought, low temperature and high salt conditions. Fascinating, over-expression of DHN genes in transgenic plants has been found to enhance resistance of the transgenic lines to various adverse environments, such as cold, drought, salinity and osmotic stress, which has raised significant interest in their putative application for crop improvement. While it is generally accepted that DHNs function to protect cells from damage caused by stress-induced dehydration, their precise mechanism remains elusive.

Future thrust

- To understand the underlying molecular mechanism of how a plant cell modulates its protein expression network to cope with the stress, an in-depth study of the organelle proteome is of great contribution toward development of stress tolerant crop varieties to meet the increasing demand of food supply worldwide
- Attempts should be made to design suitable vectors for stacking relevant genes of one pathway or complementary pathways to develop durable tolerance
- It is desirable that appropriate stress inducible promoters should drive the stress genes as well as transcription factors, which will minimize their expression under a non-stressed condition thereby reducing yield penalty

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker	**: Ashish. H. Patel**	**Course**	**: FSC-691 (1+0)**
Reg. No.	**: 1020215009**	**Date**	**: 18/11/2017**
Major Guide	**: Dr. Virendra Singh**	**Time**	**: 09.00 to 10.00 a.m.**
Co-Guide	**: Dr. D. R. Bhanderi**	**Venue**	**: Swami Vivekananda Hall**

Effect of different pre and post harvest treatments on shelf life of sapota fruits

Sapota [*Manilkara achras* (Mill.) Fosberg] is the fifth popular fruit crop, in both production and consumption. It produces fruits throughout the year in Gujarat and Maharashtra. Being a climacteric fruit, sapota is highly perishable and cannot be stored for longer period as it becomes over ripe and spoiled within 5 to 7 days under ordinary conditions. This results in high respiration rate, ethylene production and weight loss leading to deterioration in the quality of the fruit. The post harvest losses happening in sapota is about 30-40%. Many technologies have been developed to prolong shelf-life and to prevent post harvest losses of fresh sapota fruits by pre harvest treatments like appropriate application of irrigation, manure and fertilizer, combination of organic matter with inorganic fertilizers, micronutrients, proper stage of harvesting and post harvest treatments like pre-cooling, rubbing, dipping, packaging, use of ethylene absorbent, coating, cold storage and irradiation. Moreover, lack of proper post harvest handling knowledge and adequate infrastructure facilities lead to extensive damage to the sapota fruits (Chundawat, 1998). Hence, it becomes necessary to find out some suitable pre and post harvest solutions to extend the shelf life and reduce post harvest losses of sapota fruits.

Review of research work:

Pre Harvest:

Foliar Spray

Sudha *et al.* (2007) observed significantly minimum physiological loss in weight, highest firmness and shelf life of sapota cv. PKM-1 treated with pre harvest spray of GA_3 @50 ppm.

Thippeshappa *et al.* (2014) reported that the foliar application of potassium silicate @4 ml/l gave significantly maximum shelf life and minimized the physiological loss in weight.

Gondaliya (2015) observed highest shelf life in sapota fruits cv. Kalipatti treated with pre harvest spray of $CaCl_2$ 1% and post harvest dip in $CaCl_2$ 1% + Bavistin 0.2%.

Thirupathaiah *et al.* (2017) found that the application of 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ + 0.3% B/tree increased the days taken to ripening and significantly maximize shelf life of sapota cv. Kalipatti.

Soil Application

Patel and Naik (2010) observed more number of days to ripening and highest days of shelf life in sapota fruits cv. Kalipatti when tree fertilized with 5 kg vermicompost (organic manure) combined with 400:60:300 g NPK/tree (inorganic fertilizer).

Khopade (2015) recorded highest shelf life and days to ripening in fruits under treatment of 75% RDF + Biofertilizers (Azospirillum + PSB) @ 40 ml/tree + GA_3 @ 50 ppm + micronutrient mixture Grade 4 @ 0.5%.

Harvesting stage

Minimum loss in weight and less decay per cent was noted in sapota cv. Kalipatti at 13 days of storage in ambient temperature when mature fruits were harvested and stored with ethylene absorbent compared to fruit harvested at half ripe, ripe stage and without ethylene absorbent (Bhutia *et al.*, 2011).

Post Harvest:

Pre cooling

Kajal Rathva (2016) noted highest days taken for ripening in sapota fruits cv. Kalipatti which were precooled at 10°C for 8 hrs, packed in LDPE bag and stored at 12°C temperature.

Raut *et al.* (2016) found maximum shelf life and highest score in overall acceptability of sapota fruit when fruits were hydro-precooled at 10±1ºC + packing treatment.

Dipping

Dhua *et al.* (2006) reported minimum physiological loss in weight and maximum number of days required to attain eating ripe stage at ambient temperature after 16 days of cold storage of sapota fruits when infiltrated with 8% $CaCl_2$.

Tsomu and Patel (2014) noted highest shelf life and minimum physiological loss in weight, spoilage percent in sapota cv. Kalipatti fruits treated with dipping in $CaCl_2$ @10,000 ppm.

Coating

Dey *et al.* (2014) found significantly minimum decay percentage of sapota fruits coated with 2.5% corn starch after 3, 6 and 9 days of interval.

Komal Patel (2014) observed lowest physiological loss in weight and highest shelf life in fruit coated with 75 % Aloe vera gel followed by coating with 50 % Aloe vera gel.

Ahlawat *et al.* (2015) noted the minimum weight loss and respiration rate in sapota fruits coated with 1.5% chitosan + 0.5% glacial acetic acid + 0.1% glycerol + 0.1% tween-80 in 14 days of storage at 21±1ºC.

Ethylene Absorbent

Zhong *et al.* (2006) recorded lowest ethylene production and longest storage period of sapota fruits treated with 1-MCP @80 ηL/L and storage at 20ºC with 80-90% RH.

Kamthe (2011) noted highest shelf life days in sapota fruits which were treated with KMnO4 + Silica gel packaged in polythene bag with ZECC storage.

Victor *et al.* (2013) observed that sapota fruits treated with 1-MCP @1µL/L without refrigerated had minimum production of ethylene and take maximum days to ripen the fruits.

Packaging

Praveena Bindu *et al.* (2013) reported significantly highest shelf life and lowest spoilage percentage of sapota fruits packed in 200 gauge LDPE bag with 1.2% vent at 12±1ºC temperature.

Antala *et al.* (2014) recorded the minimum physiological loss in weight of sapota fruits packed in 40µ LDPE bag with 10% CO_2 concentration at 6ºC temperature after 49 days of storage period.

Srinu *et al.* (2014) observed significantly highest shelf life and minimum spoilage per cent of sapota fruits which transferred to ambient temperature after 15 days of storage at 15ºC temperature, packed in 100 gauge polypropylene bag with 0.1% perforation.

Irradiation

Srinu *et al.* (2015) observed significantly highest shelf life of sapota fruit packed in 100 gauge bag with 0.1% perforation and 0.2 kGy irradiation after transferred from 15ºC for 20 days storage.

Conclusion:

Integrated pre and post harvest management practices can prevent the problems of accelerated deterioration of sapota fruit and assist wider distribution in national and international markets for a longer period. Pre harvest treatments like foliar application of micronutrients (Zn, Fe, B and Si) and PGRs (GA_3), soil application of organic manure (Vermicompost) with combination of inorganic fertilizer and harvesting at proper maturity stage found effective for prolonging shelf life of sapota fruits. Post harvest treatments like dipping (Calcium), coating (Chitosan or Starch), MAP, use of 1-MCP and Irradiation can enhance the shelf life of sapota fruits as well as reduce physiological loss in weight and decay percentage. All these treatments are utilize alone or in combination with each other to maintain the quality and enhance the shelf life of sapota fruits. Further, research on sapota is still needed to understand the overall effect of both pre and post harvest treatments on the shelf life.

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POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker	**: Patel Ronakbhai J.**	**Course**	**: FSC-691 (1+0)**
Reg. No.	**: 1020215012**	**Date**	**: 16/12/2017**
Major Guide	**: Dr. S. J. Patil**	**Time**	**: 09.00 to 10.00 a.m.**
Co-Guide	**: Dr. D. R. Bhanderi**	**Venue**	**: Swami Vivekananda Hall**

Problems of Pollination in Fruit Crops and their Remedies

Introduction

India being the second largest producer of fruits in the world, still the productivity per unit area compared with developed countries is quite low. Pollination still remains one of the most critical, complex and less understood subject in fruit production. Adequate pollination is mandatory for most of fruit crops except in mangosteen, pineapple and banana.

Breif Review of Research Work

Mango

Sant *et al*. (1976) observed that Bombay Green and Dashehari were the best pollinizer varieties for Dashehari and Chausa, respectively. Maximum number of crossed fruits attained harvest maturity in Dashehari X Bombay Green (9.53 %) as compared to Chausa X Dashehari (6.79 %).

Munj *et al.* (2017) observed major pollinators intensity of stingless bee and found that *Tetragonula sp.*intensity was high (11.50/h) followed by honey bee, *Apis indica* Fab. (6.40/panicle/h) and blow fly, *Chrysomya sp*. (5.85/panicle/h) during flowering period and the peak intensity of these pollinators were observed during 4^{th} to 6^{th} SMW.

Yadav *et al.* (2017) reported that total no. of 461 pollinators (60.09 %) of Hymenoptera order in Alphonso variety. Whereas, in Kesar variety total no. of pollinators were 435 (64.34 %) of Diptera order.

Sapota

Mulla and Desle (1990) found that number of fruits set (34, 30 and 44) was maximum in hand cross pollination. Maximum in CO-2, Cricket Ball and Kalipatti, respectively.

Citrus

Malerbo-Souza *et al*. (2004) found that uncovered flowers gave significantly maximum number of fruits (23) and weight of fruit (180.21 g) in cv. Sweet Orange.

Phartiyal *et al.* (2012) recorded maximum fruit setting in panicles open/unbagged for pollination, whereas there were 40 %, 28 %, 64 %, 24 % and 60 % increased in fruit setting in Tree 1, Tree 2, Tree 3, Tree 4 and Tree 5, respectively compared to bagged condition.

Litchi

Usha *et al.* (2010) found that unbagged panicles had significantly higher per cent fruit set (39.68 and 38.38) in litchi during 2007 and 2008, respectively.

Kumar and Kumar (2014) reported that fruit set percentage (1.68), mass of fruits per panicle (442.2 g), fruit yield (63.80 kg/tree) and fruit yield (9.18 t/ha) were found maximum in trees located at 25 m from apiculture shed.

Loquat

Wani *et al.* (2010) found that California Advance variety was the best pollinizer for improved fruit set in Golden Yellow and Pale Yellow (56 and 50% respectively) was observed when pollination was occurred.

Datepalm

Iqbal *et al.* (2004) reported maximum fruit set two days after spathe opening (95.33 %). Whereas, maximum average fruit weight was found in pollination on spathe opening day (26.267 g). in cv. Dhakki.

Awad (2010) recorded significantly maximum fruit set in both spray pollination at 1.5 g/l and 2.0 g/l. Whereas, significantly maximum bunch weight (kg) and yield (kg/tree) was found in all the spray pollination compared to traditional pollination in cv. Khenazy. Also spray pollination showed minimum utilization of time (9.5 min./palm) and amount of pollens (0.35 g)

Iqbal *et al.* (2010) recorded significantly maximum fruit set (89.3 %) and (88.9 %) in placement of male spathe, respectively during both years of study in cv. Dhakki.

Iqbal *et al*. (2014) recorded significantly highest fruit set (91 and 89.67 %) and fruit weight (18.00 and 18.34 g) when pollination was carried out at 12:00 PM in both the years, respectively in cv. Dhakki.

Mustafa *et al.* (2014) found significantly highest fruit set (86.0 and 85.3 %), fruit retention (57.0 and 62.0 %), bunch weight (18.9 and 20.3 kg) and yield (151.2 and 162.1 kg/palm) with Noubaria pollinizer in both the years, respectively in cv. Amhat.

Apple

Sharma *et al.* (2004) reported maximum per cent fruit set in orchards with bee colonies having both insufficient and sufficient pollinizer proportion at both the location during both the years of study.

Khan *et al*. (2012) found maximum weight of fruit (166.19 g), per cent increased in weight of fruit over control (112.13), number of fruits per panicle (5.167) and highest percent increased in fruits per panicle over control (1451.65) in combination of natural pollination + augmentation of honey bee.

Mattu and Hem Raj (2013) reported that maximum per cent of fruit set was observed in honeybees pollinated flowers in Golden Delicious, Red Gold, Royal Delicious and Red Delicious at three different places *i.e*. Shilaroo, Matiana and Narkanda.

Mushtaq and Sheikh (2016) found that controlled released pollination of 3 hives in orchard with 10% polliniser ratio was superior with high initial fruit set (42.288 ± 0.902), per cent fruit set after June drop (70.075 ± 0.939), fruit retention at maturity (35.188 ± 0.515) and yield (303.70 kg/tree).

Conclusion

Crops	Conclusion
Mango	• Bombay Green was found suitable pollinizer in Dashehari and Dashehari in Chausa. • *Apis florae, Chrysomya megacephala, Stomorhina discolor, Eristalinus arvorum and Trigona iridipennis* were found as suitable pollinators. • Hymenopterans insects, different species of honey bee were the most efficient flower-visiting insect.
Citrus	• *Apis cerana indica Fab., Apis dorsata Fab., Trigona spp.* were effective pollinators.
Sapota	• Hand cross pollination were found effective in cvs. CO-2, Cricket Ball and Kalipatti in terms of number and per cent fruit set.
Litchi	• Unbagged panicles and tree location at 25 m from apiculture shed were found beneficial.
Loquat	• California Advance was found to be the best pollinizer variety for both improved Golden Yellow and Pale Yellow varieties with maximum fruit setting percentage.
Date palm	• Pollination on one day before spathe opening upto 4 day after spathe opening, Placement of male spathe and pollination at 12 PM were found beneficial in cv. Dhakki. Whereas spray pollination at 0.5 to 2.0 g/l were found beneficial in cv. Khenazy and Noubaria was found as the best pollinizer for cv. Amhat
Apple	• Orchards with bee colonies and insufficient and sufficient amount of pollinizers, natural pollination + augmentation of honey bees, honey bee pollination and 10% pollinizer ratio + 3 hives were found beneficial.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker	**: Ganta Koteswara Rao**	**Course**	**: VSC-692**
Reg. No.	**: 1020216003**	**Date**	**: 05/05/2018**
Major Guide	**: Dr. N. B. Patel**	**Time**	**: 09.30 to 10.30 a.m.**
Co-Guide	**: Dr. T. R. Ahlawat**	**Venue**	**: Swami Vivekananda Hall**

Fruit based agroforestry systems in drylands

Crop production on drylands in particular results in low, unstable and often uneconomic yields because of aberrant monsoon behavior. These marginal lands are not able to sustain arable crops particularly during the drought conditions. Tree component in dryland agriculture increases production and income, besides imparting stability to the farming system. Among the alternate land use system developed, fruit based agroforestry systems are readily picked up by the fruit growers due to cash benefits derived from these system. The fruit based agroforestry system can be defined as a planting system comprising combinations of plants with various morpho-phenological features to maximize the natural resource use efficiency and enhanced total factor productivity. Fruit based cropping system is now considered to be the most ideal strategy to provide food, nutrition and income security to the people (Chundawat, 1993). Integration of annual crops with fruit trees yields multiple outputs that ensure production and income generation in a sustainable manner (Randhawa, 1990). The main components of fruit based agroforestry systems are main crop, filler crop and inter crop. There are different kinds of fruit based systems using across the country *viz,* mango, guava, ber, aonla, sapota etc. Several researchers reported that fruit based agroforestry systems were useful for improving economic returns of the farmers, generating employment, higher production, soil fertility status and quality characters of fruits under drylands.

Review of Research work

Growth, Yield, Quality and Soil fertility status

Ahmad *et al.* (2018) conducted an experiment on forage grass/legume mixtures as a means of orchard floor management and for augmenting forage resource availability in apple based agroforestry systems. The results revealed that growth and soil nutrient parameters were high under red clover + apple followed by white clover + apple combinations than control.

Shweta *et al.* (2015) studied the effect of different types of leguminous intercrops on guava growth under guava based agri-horti system at research farm of CCS Haryana Agriculture University, Hisar. Results showed that intercropping with mung bean increased guava tree height as compared to other crops (cowpea and guar) as well as mono cropping.

Swain (2014) conducted an experiment to assess the effect of various intercrops on the performance of mango in the rainfed uplands of Odisha. The results of the study revealed that the mango + guava +cowpea intercropping system exhibited better performance which has been reflected in the form of plant height, fruit weight and fruit yield of mango closely followed by mango + guava + french bean system.

Rathore *et al.* (2013) conducted an experiment on performance of mango based agri-horticultural models under rainfed situation of Western Himalaya in two phases. In the first phase, mango + cowpea + toria system, in the second phase mango + turmeric system significantly improved the fruit quality and soil properties as compared to initial values.

Das *et al.* (2011) studied the effect of different intercrops on aonla based agri-horticultural systems. Among different treatments, the treatment aonla + turmeric significantly increased the growth, fruit characters of aonla and soil properties.

Mutanal *et al.* (2007) conducted an experiment to assess the mixed cropping of trees with tamarind at Forest Research Station, Prabhunagar (Dharwad) during 1985. At the end of 20^{th} year of experimentation it was found that tamarind growth (ht and dbh) was higher with *C. equisetifolia* (10.46 m and 20.85 cm respectively) and *E. tereticornis* (10.63 m and 19.32 cm respectively) as compared to other tree species. Among tree species, height and dbh were higher in *C. equisetifolia* (21.60 m and 23.70 cm respectively) and *E. tereticornis* (18.34 m and 18.21 cm respectively) as compared to *D. sissoo* (8.46 m and 11.36 cm respectively).

Singh and Singh (1999) studied the influence of horti-pasture systems on soil quality. Among different pastures, available nitrogen was high under stylo compared to no pasture.

Economics

Meena *et al.* (2017) reported that the cropping sequence fenugreek- okra inter cropped with ber exhibited highest net return (Rs. 8,09,215 ha^{-1}) and BCR (4.68) followed by intercropping of ajwain- tinda cropping sequence with ber which resulted a net return of Rs.7,22,075 ha^{-1}. Thus, it is inferred that intercropping of fenugreek- okra cropping sequence with ber is recommended for realizing higher system productivity, net returns and BCR.

Mutanal *et al.* (2016) reported that among the different treatments, higher net returns and B:C ratio were recorded in the V-2 tamarind clone + curry leaf (Rs. 9,764.5 ha^{-1} and 2.16) followed by the clone PKM-2 + curry leaf (Rs. 8,561.8 ha^{-1} and 1.85) as compared to other clones.

Arya *et al.* (2011) observed that the maximum benefit: cost ratio of 3.48:1 when crops were grown under combination of aonla + ber + karonda + moth bean + mustard. They also noticed higher benefit: cost ratio of 2.22:1 for ber alone among the perennial components.

Solanki and Ramnewaj (1999) studied the performance of *Zyziphus* based agri-horticultural systems on yield of *Zyziphus* at AICRPDA, Dantiwada. They reported that the yield and gross income of ber was more under *Ziziphus* + mung bean and *Ziziphus* + sorghum systems.

Conclusion

Mounting pressure on our natural resources due to rocketing population rise has ushered in large scale degradation of our environment and ecosystem thus calling for immediate attention for seeking newer approaches in cropping system to meet the food, fibre, fire wood and timber requirement of the 21st century. For sustainable management of dry lands and for enhancing the economic viability of the cropping system, partial shift from the existing high input requiring rotation to low input requiring system is the need of time. The fruit based agroforestry systems have potential in generating income, employment, soil improvement, higher production and waste land reclamation.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker	**: Zinzala Paresh Bhikhabhai**	**Course**	**: PHT 692**
Reg. No.	**: 1020216010**	**Date**	**: 21/04/2018**
Major Guide	**: Dr. Dev Raj**	**Time**	**: 09:00 to 10:00 am**
Co-Guide	**: Dr. B. N. Patel**	**Venue**	**: Swami Vivekananda Hall**

Post-harvest management and value addition of dry land fruit crops (bael, tamarind, custard apple)

The dry lands are considered marginal due to poor soil quality (shallow and stony soils with poor water holding capacity), inadequate and erratic rainfall and short growing period. Various fruit crops grown in dry land are pomegranate, custard apple, aonla, ber, bael, tamarind, date Palm, jamun, etc. Bael (*Aegle marmelos* Corr.) is an indigenous fruit of India and belongs to family Rutaceae. Bael fruit is rich source of vitamins, amino acids and minerals as compared to other fruits, and it can contribute significantly to the daily nutrient needs of the individual. Thus value added products can be produced by using various technology to reduce post harvest losses, increase shelf life, value addition and increase the income. In other words, this will promote the utilization of bael fruit in every season. Tamarind is a multipurpose dry land tree used primarily for its fruits, which are eaten fresh or processed. Fruit contains up to 73% edible pulp in which major constituents are tartaric acid and invert sugar. Pulp is rich source of calcium, phosphorous, riboflavin, niacin and thiamin. Pulp of tamarind in India is used in the preparations of chutney, tamarind powder, puree, juice concentrate, jam, jelly, candy, pickles and fruit bar. Custard apple is most widely cultivated among all the species of Annona, being grown throughout the tropics and warmer subtropics such as Australia, Indonesia, Thailand, Taiwan, Brazil, southern Florida, India, West Indies. Custard apple is a very delicious fruit and valued for flavour and texture of pulp. The pulp is widely used for preparation of ice creams and other products. It is an excellent source of vitamins, carbohydrates and minerals. The physiological changes in fruits remain continue even after harvesting due to which fresh fruitscannot stored for more than 2 days at ambient temperature. To check such problem, an appropriate technology is needed by processors and farmers.

Brief Review of Research Work

Bael (*Aegle marmelos* Corr.)

Charoennsiddhi and Anprung (2009) studied the effect of enzyme treatment on quality of bael pulp and reported that treatment of bael pulp with commercial pectinase enzymeresulted increase in soluble dietary fiber in pulp.

Jana and Madhumita (2015) studied the effect of packaging material on storage of bael (*Aegle marmelos* Corr.) fruit cv. Pant Sujata and found that packaging of fruits in CFB box resulted minimum PLW (21 %) during storage period of 28 days. Minimum change in TSS were also reported in fruits packed in CFB boxes during 28 days of storage. They also reported minimum change in TSS (21.87 ^{0}B) and acidity (0.56%) of bael pulp during 2 months storage at 4 °C when preserved with 800ppm benzoic acid.

Tiwari and Deen (2015) investigated the organoleptic quality of RTS prepared from different blends of bael pulp and *Aloe vera* gel. They found that most acceptable blended RTS beverage can be prepared by using75 % bael pulp and 25 % *Aloe vera* gel.

Tamarind (*Tamarindus indica* L.)

Obulesu and Bhattacharya. (2011) studied the effect of maturity days on colour and acidity of tamarind fruit pulp and they reported increase in colour value and decrease in acidity of tamarind pulp upto 360 days.

Joshi *et. al.* (2012) studied the effect of enzyme concentration (0.5, 1.0, 1.5 and 2.0 per cent Biotropicase) on recovery of pulp from tamarind flesh and revealed higher pulp recovery with hot enzymatic extraction using 0.5 % enzyme concentration.

Ajumodi (2013) conduct an experiment to study the effect of blending tamarind wine with soursop wine on sensory quality and reported higher overall acceptability score in wine prepared from 30% soursop and 70% tamarind blend.

Khan *et. al.* (2017) studied the effect of blending on sugar acid ratio of tamarind plum blended squash during storage and found significant effect on blended squash of tamarind and plum during storage.Minimum increase in sugar acid ratiowas found onsquash prepared fromtreatment having 250ml tamarind juice and 500ml plum juice.

Kiranmai *et. al.* (2017) conduct experiment to study the effect of blending tamarind and mango on sensory quality of blended squash and reported that among all the treatments highest acceptability was observed in squash prepared with 80% tamarind pulp and 20% mango pulp.

Custard apple (*Annona squamosa* L.)

Broughton and Guat (1978) studied the effect of storage temperature on quality of custard apple fruit and found that storage of fruits athigh temp. (25°C) enhanced ripening but reduced shelf life of fruits. Temperature of 15°C and below were not favorable for storage. They reported ideal temperatures range 15 to 20°C for both storage and ripening of fruit.

Chikhalikar *et. al.* (2000) conduct experiment to study the effect of different cryoprotectantson ascorbic acid retention of frozen custard apple pulp during storage and found maximum retention of ascorbic acid(%) in custard apple frozen pulp treated by 0.5% Propylene Glycol + 10% Glucose Syrup + 10% Maltodextrin.

Vyash *et. al.* (2015) studied the combined effect of chemical and physical elicitors on post harvest quality of custard apple and concluded that hot water treatment at 50°C with 2mM salicylic acid and 1% calcium chloride preserved the custard apple for up to 8 days.

Ridhi (2015) studied on feasibility of blending custard apple with banana for preparation of nectar and reported that organoleptically acceptable nectar can be prepared by using 5% custard apple and 15% banana pulp with respect to changes in Brix acid ratio.

Kumar *et. al.* (2016) studied the effect of maturation on physico-chemical quality of custard apple wine and they found that 6 months maturation of custard apple wine had better quality attributes of wine as compared to fresh wine.

Conclusion

Proper post harvest management can prevent the post harvest loss of bael, tamarind and custard apple. Storage of bael fruits in CFB box packing keep fruit fresh for 28 days and bael pulp can be stored up to two months without any spoilage when treated with benzoic acid at 800ppm. Tamarind pulp with higher recovery can be extracted after by giving heat treatment to Biotropicase L enzyme treated pulp. Custard apple can be stored at a temperature at 15 to 20 °C for ideal storage quality and ripening of fruit. Hot water treatment of custard apple fruit with 2mM salicylic acid and 1% calcium chloride can preserved fruits during 8 days storage. Pulp of tamarind, custard apple and bael can be exploited for blending purpose with mango, banana, *Aloe vera* and soursop to increase the acceptability of these fruits.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Mamilla Sindhuja**	**Course**	**: FLA 692 (1+0)**
Reg. No.	**: 1020217006**	**Date**	**: 06/12/2019**
Major Guide	**: Dr. Alka Singh**	**Time**	**: 04:00 to 05:00 pm**
Co-Guide	**: Dr. B. N. Patel**	**Venue**	**: Swami Vivekananda Hall**

Mechanization and robotics in fruit crops

Mechanization is a crucial input for horticultural crop production and one that historically has been neglected in the context of developing countries. Factors that reduce the availability of farm power compromise the ability to cultivate sufficient land and long been recognized as a source of poverty. Robotics in horticulture is undoubtedly in an immature stage right now. The use of robotics or automated machines in orchard operations is associated primarily with insufficient labour availability and rapidly increasing labour costs in fruit production and is critical for improving yield of high-quality fruit minimal dependence on seasonal human labour. Primarily, mechanized or robotic orchard management operations include weeding, pruning, thinning, spraying, harvesting, *etc.* Applying new technologies that are environment friendly enables farmers to produce crops more efficiently by using less power.

Review of research work

Mechanization

Razeto *et al.* (2005) studied hand and machine pollination of kiwifruit and revealed that higher fruit set (77.5 %), fruit weight (87.1 %), fruit length/width ratio (1.13) was obtained in dusting machine compared to hand pollination.

Schupp *et al.* (2011) investigated on Golden Delicious, York and Pink Lady cvs. of apple demonstrated increase in efficiency ofvaccum assist harvest system per acre by 10 to 49 per cent. The fruit quality of machine-harvested fruit was better than hand harvested fruit in the cv. York, whereas, quality of machine-harvested was equal to hand harvested fruit in the cv. Golden Delicious and Pink Lady.

Kurtural *et al.* (2012) reported that traits *viz.*, count shoots, count clusters, total shoots,total cluster, clusters harvested (no./vines), cluster weight, berry weight and yield weight were recorded maximum in mechanical box-pruning with mechanical shoot thinning (MP+MT) in grape cv. Cabernet Sauvignon during 2009 and 2010compared to hand pruning (HP). There were no effect on treatments applied on TSS, pH, titrableacidty, total phenolics, anthocyanin and tannins. The MP+MT method reduced the labour operationcost and time per acre compare to MP+HT and HP management methods.

Pflanz *et al.* (2016) reported significantly higher fruit weight by 14 g and 12 g in apple cvs. Pinova and Elstar at the optimum rotational speed of 280 rpm when compared to 200 rpm and alsosignificantly increased in fruit flesh firmness (9.05 kg cm^{-2}), SSC (14.96 ^{0}B) and streif index (0.13) with the same rotational speed, whereas, starch index (6.74) was significantly maximum at 240 rpm in cv. Pinova. Fruit flesh firmness (8.14 kg cm^{-2}), SSC (13.61^{0}B), starch (3.83) and streif index (0.24) were significantly maximum at 320, 200, 280 and 240 rpm respectively, in the cv. Elstar.

Robotics

Bulanon and Kataoka (2010) studied performance of fruit recognition system and found 100 per cent accuracy in single fruit detection in apple cv. Fuzi. For each image processing step,309 ms execution time was required with 100 per centrelative percentage. End effector showed more than 90 per cent success rate in detaching the fruit.

Oberti *et al.* (2014) observed 84 per cent reduction in pesticide use by robotic system as compared to a conventional homogeneous spraying of canopy, where it sprayed 25 spots which actually covered all the disease foci in grape.

Yamamoto *et al.* (2014) confirmed that the harvesting success rate for mature fruit was 67.1 per cent, detection 89 per cent, maturity assessment 83.4 per cent and picking 90.3 per cent withstationary robotic strawberry harvester in strawberry.

Amatya *et al.* (2017) reported that maximum fruit removal efficiency of 92.9 per cent and 86.6 per cent was achieved using up to five shaking and four shaking events per branch in Y-trellis system and vertical trellis system respectively in cherry.

Duke *et al.* (2017) studied the automated pollination of kiwifruit flowers and reported that the robotic pollination system detected 89.3 per cent of flowers, correct localized 71.9 per cent of flowers and hit an estimated 80.1 per cent whilst driving at a speed of 0.36 m/s through kiwi orchard rows.

Mu *et al.* (2019) studied the design and simulation of an integrated end-effector for picking kiwifruit and reported that in the experiment, with total 240 kiwifruit samples picked in total, the average success rate was 94.2 per cent. This success rate was calculated as the number of fruits successfully picked divided by the number of attempted picks.

Conclusions

A number of benefits have been foreseen through mechanization and robotics application in fruit crops. Higher fruit set, fruit weight and fruit length/width ratio were obtained in dusting machine as compared to hand pollination in kiwi fruit. The fruit quality of machine-harvested fruit was better than hand harvested fruit in the cv. York. Count shoots, count clusters, total shoots,total cluster, clusters harvested (no./vines), cluster weight, berry weight and yield weight were recorded maximum in mechanical box-pruning with mechanical shoot thinning (MP+MT) as well as reduced the labour operation cost and time per acre compared to MP+MT and HP management methods in grape.Fruit weight,fruit flesh firmness, SSC and streif index was significantly maximum in apple cvs. Pinova and Elstar at the optimum rotational speed of 280 rpm.Apple cv. Fuzitooks 309 ms execution time for each image processing step with 100 per cent relative percentage and detected single fruit with 100 per cent accuracy with no false detection.84 per cent reduction in pesticide use by robotic system as compared to a conventional homogeneous spraying of canopy, where it sprayed 25 spots which actually covered all the disease foci. Success rate for mature fruit was 67.1 per cent, detection 89 per cent, maturity assessment 83.4 per cent and picking 90.3 per cent with stationary robotic strawberry harvester.Maximum fruit removal efficiencywas achieved by five shaking and four shaking per branch in Y-trellis system and vertical trellis system respectivelyin cherry.Automated pollination detected 89.3 per cent of flowers, 71.9 per cent correct localized of flowers and 80.1 per centhit an estimated of kiwifruit flowers. 94.2 per cent success rate was reported by end-effector for picking kiwifruit. Thus, application of mechanization and robotics appears to be highly efficient and precise technology with regard to inputs reduction and time saving, specially for commercial cultivation of fruit crops on large scale.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Patel Prasulkumar R**	**Course**	**: FSC 691 (1+0)**
Reg. No.	**: 1020216009**	**Date**	**: 04/05/2019**
Major Guide	**: Dr. B. N. Patel**	**Time**	**: 10:00 to 11:00 am**
Co-Guide	**: Dr. Dev Raj**	**Venue**	**: Swami Vivekananda Hall**

Role of foliar application of potassic fertilizer in tropical fruit crops

Foliar feeding has been used as a means of supplying supplemental doses of major and minor nutrients, plant hormones, stimulants and other beneficial substances. Foliar fertilization has positive effects on yield increases, resistance to diseases and insect pests, improved drought tolerance and enhanced crop quality. Plant response is dependent on species, fertilizer form, concentration and frequency of application, as well as the stage of plant growth. Foliar applications are often timed to coincide with specific vegetative or fruiting stages of growth and the fertilizer formula is adjusted accordingly. Applications may also be used to aid plants in recovery from transplant shock, hail damage or the results of other weather extremes. In terms of nutrient absorption, foliar fertilization can be 8 to 20 times efficient as compared to soil application.

What is potassium and its management?

Potassium is one of the essential nutrients for plant growth and vital for sustaining high yield in horticulture. The crucial role of potassium in quality formation of photosynthates and transport to fruits, grain, tuber and storage organs and to enhance their conversion into starch, protein, vitamins, oils, *etc*. With storage of potassium in many metabolic processes are affected like rate of photosynthesis, rate of translocation and enzyme system. Potassium is highly mobile in plant and has high demand during fruit development.

Source of potassium:

The consumption of N, P_2O_5 and K_2O fertilizers in India reached 462.20 LMTs during 2017-18 (Anonymous, 2018). There are two major potassic fertilizers, Potassium Chloride or Muriate of Potash (MOP) and Potassium Sulphate or Sulphate of Potash (SOP). Each has different characteristics for composition.

Review of Research Work

Quantitative Effect

Application of paclobutrazol @ 5.0 g *a.i.* per tree at 1st fortnight of August in soil and two foliar spray of KNO_3 @ 2% during third week of October and November increased the fruit retention, number of fruits/tree, fruit weight and yield of fruits in mango cv. Alphonso (Anonymous, 2019).

Patil *et al*. (2018[a]) studied the yield and economics of banana cv. Grand Naine influenced by foliar spray of water soluble fertilizer on banana bunch at complete opening of the bunch and seven days after first spray. They found that minimum days taken for flowering, maximum length of bunch, girth of bunch, weight of 3rd hand, length of finger, girth of finger, weight of bunch and yield ha^{-1} were found in treatment SOP @ 1.5% with higher net realization.

Monika *et al.* (2018) revealed that plants treated at 3rd, 5th and 7th MAP with 0.5% Ca $(NO_3)_2$ + 0.5% K_2SO_4 + 0.5% zinc sulphate + 0.1% boric acid along with the recommended dose of fertilizers registered significantly maximum no. of fruits per plant, fruit weight (g), fruit length (cm), fruit circumference (cm) and yield (kg/plant) in papaya cv. TNAU papaya CO-8.

Dombale *et al.* (2018[a]) observed that foliar application of SOP 2% + 1 % urea significantly increased yield contributing attributes and yield as compared with other nutrient treatments in banana cv. Grand Naine.

Kachhadia Palak *et al.* (2017) revealed that foliar application of potassic forms at complete opening of the bunch and 15 days after first spray on banana cv. Grand Naine significantly shorten the maturity period and gave maximum fruit traits and yield over control.

Patoliya *et al*. (2017) revealed that foliar application of KNO_3 @ 2% during first fortnight of October and November gave maximum flowering shoots (93.83 %), panicle length (45.36 cm), minimum days required for full bloom (20 days), maximum number of fruit set at pea stage per panicle (19.00), maximum number of fruit set at marble stage per panicle (4.47) and fruit yield (32.49 kg/tree) in mango cv. Dashehari under ultrahigh density plantation.

Chaudhari *et al.* (2016[a]) observed that soil application of paclobutrazol @ 2.50 g *a.i.* per tree with foliar spray of KNO_3 @1.0 % was superior in fruit retention at pea stage, marble stage and at harvest stage per panicle, number of fruits per tree, fruit yield, fruit weight, fruit length and fruit volume in mango var. Sonpari.

Sharma (2015) noticed highest fruit retention percentage (25.02%), number of fruit per tree (431.67), fruit yield (46.28 kg/tree) and minimum fruit drop percentage (74.98%) in the treatment of foliar application of 2% KNO_3 in October month on sapota cv. Kalipatti.

Baiea *et al*. (2015) conducted an experiment on effect of different forms of potassium on growth, yield and fruit quality of mango cv. Hindi. They revealed that four foliar spray of 2% mono potassium phosphate at full bloom, after fruit set, during fruit growing and before harvesting (one month from the third spray) were very effective in improving fruit retention, yield, number of fruit and increased fruit weight and pulp weight.

Then (2014) studied the effects of foliar fertilizers on the 'Red Pitaya' of dragon fruit and revealed that foliar application of potassium nitrate (1% w/w) at weekly intervals for twelve months significantly increased yield (kg/pillar) and fruit weight (g/fruit) while, total fruit (no./pillar) was maximum in Folar-K (01% w/w).

Haldankar *et al.* (2014) noticed that soil application of PBZ@ 3 ml/m canopy diameter and foliar application of 1% urea at fruit set + 0.5% mono potassium phosphate at 20 days after fruit set significantly increased total yield (no.), harvested fruits before rainfall and fruit yield (kg/plant and t/ha) in jackfruit.

Kumar and Kumar (2007) revealed that foliar application of SOP @1.5% on banana cv. Neypoovan at complete opening of last hand and 30 days after first spray, significantly increased total chlorophyll content and bunch traits of banana fruits.

Qualitative Effect

Application of paclobutrazol @ 5.0 g *a.i.* per tree at 1st fortnight of August in soil and two foliar sprays of KNO_3 @ 2% during starting of third week of October and November improved quality and increased shelf life of fruits in mango cv. Alphonso (Anonymous, 2019).

Patil *et al.* (2018[b]) conducted an experiment on response of foliar spray of water soluble fertilizers on quality parameter of banana cv. Grand Naine at complete opening of the bunch and seven days after first spray. They found that reducing sugar and total sugar were maximum in foliar spray of SOP @1.5% while, maximum TSS, shelf life and organolaptic taste were recorded in SOP@ 1% and non reducing sugar in KNO_3 @ 0.5%.

Dombale *et al.* (2018[b]) observed minimum acidity, maximum TSS, reducing sugar, non-reducing sugar, total sugar and shelf life in foliar application of SOP 2% + 1 % urea as compared with other nutrient treatments in banana cv. Grand Naine.

Chaudhari *et al.* (2016[b]) revealed that the maximum TSS (20.22 °Brix), minimum acidity (0.13%), maximum total sugar (18.92%) and maximum non reducing sugar (8.82 %) were recorded in soil application of paclobutrazol @ 1.25 g *a.i.* per tree with foliar spray of KNO_3 @1 % treatment. While, maximum shelf life (18.67 days), net realization and higher benefit cost ratio were obtained in paclobutrazol @ 2.50 g *a.i.* per tree + KNO_3 1 % treatment in mango var. Sonpari.

Manju and Kumar (2015) revealed that foliar application of potassium 2% along with zinc 0.5%, boron 0.1% and brasinostiroids 2 ppm had positive emphasis on the sugar content of papaya cv. TNAU papaya CO-8.

Dutta *et al.* (2011) conducted an experiment on foliar application of different source of potassium fertilizers from September to December (four times) on mango cv. Amrapali. They found maximum fruit shelf life, minimum physiological loss in fruit weight, minimum phenol content and maximum total soluble solids, total sugar and ß carotene content of fruit in foliar application of K_2SO_4 @ 1.0% treatment as compared to control in mango cv. Amrapali.

Kumar and Kumar (2007) found foliar application of SOP @1.5% banana cv. Neypoovan at complete opening of last hand and 30 days after first spray significantly increased quality traits of banana fruits *i.e* TSS (28.9%), reducing sugar (19.96%), non reducing sugar (2.44%), total sugar (22.36%), sugar acid ratio (97.64) and maximum fruit self life (8.7 days).

Conclusion:

Foliar application of potassic fertilizers can be use efficiently as alternative source of plant nutrition to enhance vegetative growth, quantitative as well as qualitative growth of fruit crops. Foliar application of KNO_3@ 2% or SOP @1% from September to December (single or four sprays) on mango gives quality production. In case of banana two foliar sprays, first at complete opening of bunch and second 7 or 15 or 30 days after first spray of SOP @ 1.0 to 2.0 % improves quality with higher production. Foliar application of KNO_3@ 2% in October increased yield in sapota. The quality of papaya may also improved with foliar application of KNO_3@ 2% while, plants treated at 3rd, 5th and 7th MAP with 0.5% Ca $(NO_3)_2$ + 0.5% K_2SO_4 + 0.5% zinc sulphate + 0.1% boric acid along with the recommended dose of fertilizers gave maximum yield traits and yield (kg/plant) in papaya cv. TNAU papaya CO-8. Foliar application at weekly intervals for 12 months of potassium nitrate (1% w/w) increased yield of dragon fruit. Soil application of PBZ@ 3 ml/m canopy diameter and foliar application of 1% urea at fruit set + 0.5% mono potassium phosphate at 20 days after fruit set gave total yield (number), harvested fruits before rainfall and fruit yield (kg/plant and t/ha) in jackfruit.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Suchismita Jena**	**Course**	**: FSC 691 (1+0)**
Reg. No.	**: 1020217012**	**Date**	**: 20/04/2019**
Major Guide	**: Dr. T. R. Ahlawat**	**Time**	**: 09:00 to 10:00 am**
Co-Guide	**: Dr. S. L. Chawla**	**Venue**	**: Swami Vivekananda Hall**

Molecular aspects of flowering behavior in perennial fruit crops

Flowering is the major phenological event of plants that exerts direct influence on survival and existence of the species and it is the most sensitive and vulnerable stage with respect to climatic variability. Understanding of flowering regulation in plants leads to breed climate resilient varieties. Though the progress inknowledge of molecular regulation of flowering in food grain crop is substantial, in fruit crops, there is lack of information on natural variations in gene expression and even less is known about the functional significance of the existing gene expression variations in relation to flowering, owing to their perennial nature. Different classical models like ABC (Guo*et al*., 2015), ABCE (Krizek and Fletcher, 2005) and ABCDE (Dornelas and Dornelas, 2005)have been developed in *Arabidopsis thaliana*in which the key transcription factors promote identity of floral organs patterning. Most of the genes of ABCDE model are MADS box genes and are present in almost all the flowering plants. By binding promoter regionswith common DNA sequences, MADS box genes activate transcription of a set of downstream genesnecessary to produce each floral organ type. These ABCDE groups of genes also target plant growth hormone biosynthesis pathways and thereby regulate flower meristem formation.The changes in floral development genes may also promote new species formation (Ruelens*et al*., 2017). An attempt has been made to review the research work on molecular aspects of flowering in different fruit crops across the globe.

Brief review of research work

Apple

Wada *et al*. (2002) conducted an experiment, where two orthologues of *FLORICAULA/LEAFY*, *AFL1* and *AFL2* (apple *FLO/LFY*), were isolated from the floral budsof apple trees cv. Jonathan and their expression was detected in various tissues and during differentiation of the floral buds.RNA blot analysis showed that *AFL1* was expressed only in floral buds during the transition from vegetative to reproductive growth. Whereas,*AFL2* wasexpressed in vegetative shoot apex, floral buds, floral organs and root. Furthermore, the flowering effectiveness of each gene was assessed with transgenic *Arabidopsis*, where over-expressed *AFL2*showed accelerated flowering and gave rise to several solitary flowers from rosette axils directly. *AFL1* had similareffects, but the phenotypes with *AFL1* were weaker than those with *AFL2*in transgenic *Arabidopsis*.

Kotoda *et al*. (2006) carried out an experiment on expression of *MdTFL1*antisense RNA in transgenic Orin apple and suggested that *MdTFL1*is involved in maintenance of the juvenile phase of apple.The transformed plant flowered only in 8 months after transfer to the green house as against in 6 years in case of non transformed (control) plants. The expression of endogenous *MdTFL1* was suppressed in transgenic lines that showed precocious flowering. Flower organs of the transgenic apple trees were normal in appearance with precocious flowering and set fruits and seeds. Interestingly, some flowers of the transgenic apple trees developed without undergoing dormancy.

Pear

Non-germinated wizenedflower buds(WB) drop from the branchin spring reducing pear production in China. Physiological indices relating to plant hormones and antioxidases were responsible for the mechanismof WB formation in pear. Liua*et al*. (2016) found that activities of peroxidase (POD) and superoxidedismutase (SOD) were higher and lower, respectively, in WBs than in normal flower buds (NBs) of cv. Yuluxiang. The contents of Indole Acetic Acid (IAA), Gibberellin (GA) and Cytokinin (CTK) werelower in WBs, while the level of addition of abscisic acid (ABA) was higher in WBs than in NBs.Because POD andSOD are stress-response enzymes, the differences in POD and SOD activities between NBs andWBs indicated that WB formation in pear could result from ambient environmental stressesthat influence expression levels of hormone biosynthesis genes.

Mango

Nakagawaa *et al*. (2012) isolated a *FLOWERING LOCUS T*-like (*FT*-like) gene (*MiFT*) from a biennial bearing mango cv. Irwin and characterized it. The *MiFT* expression increased only in the leaves under floral-inductive conditions and showed that *MiFT* expression strongly increased only in no crop load (NC) trees under cool temperature compared to the heavy crop load (HC) mango trees. Further, HC trees had lower starch content in the shoots than NC trees. Besides, application of 250-ppm GA_3 completely inhibited flowering and expression of *MiFT* in both HC and NC trees. GA metabolism genes were also isolated from mango and their expression patterns were investigated. They reported that gibberellin-3-oxidase (GA_3-ox) controls the final step of biosynthesis of active GA and its gene expression surged only in HC trees under cool temperature and consequently flowering is reduced in the following year.

Banana

Chaurasia *et al*. (2017) isolated twelve *FLOWERING LOCUS-T* (*FT*) and two*TWIN SISTER*of*FT* (TSF) members from banana cv. Grand Naineand Hill banana. They found that expression of at least 3 genes namely *MaFT1*,*MaFT2* and *MaFT5* (and to some extent *MaFT7*) increases just prior to initiation of flowering and induce early flowering. Thesefour genes and five others (*MaFT3*, *MaFT4*, *MaFT8*, *MaFT12* and *MaTSF1*) could suppress the delayedflowering defect of Arabidopsis *ft-10* mutant. Subtle aminoacid changes in these *FT/TSF*-like proteins provide interesting insights into the structure/functionrelationships of banana *FTs* vis-a-vis Arabidopsis.

Papaya

Yu *et al*. (2008)have clonedtwo *AGAMOUS* (*AG*) subfamily genes, *CpPLE* and *CpSTK*and one *AP1* subfamily gene, *CpFUL*- a *FRUITFUL*homolog in trioecious papaya cultivars (SunUp, Kapoho and AU9). Both*CpPLE* and *CpSTK* were expressed only in flowers, not inroots and leaves.Specifically, *CpPLE* was detected only in the stamens andcarpels of flowers of all three sex types, from a very earlystage of flower development through full maturity. *CpSTK*isthe only gene found so far that shows sex-type-specificexpression in papaya as it was detected in female and hermaphroditeflowers, but completely absent in male flowers. *CpFUL* was expressed in leaves and all parts of the flowersexcept stamens.

Grape

Carmona *et al*. (2002) have cloned the grapevine *FLORICAULA/LEAFY* (*FLO*/*LFY*) ortholog*VFL* and analyzed its expression pattern in cv. Tempranillo. *VFL* is expressed in lateral meristems that give rise to inflorescence and flower meristems, consistent with a role inreproductive development. Furthermore, *VFL* is also detected in other meristematic regions such as the vegetative shootapical meristem, the lateral meristems that will give rise to tendrils, leaf primordia and ingrowing leaf margins until later stages of development. Accumulation of *VFL* transcripts in cell-proliferating regionssuggests the role of*VFL* not only in flower meristem specification, but also in the maintenance of indeterminacy before thedifferentiation of derivatives of the apical meristem: flowers, leaves or tendrils.

Conclusions

It is inferred from the foregoing discussion that, there are particular genes involved in flowering of fruit crops as in mango*MiFT* expression strongly increased only in NCtrees under cool temperature compared to the HC. In apple *AFL1* wasexpressed only in the floral bud, whereas *AFL2* wasexpressed in vegetative shoot apex, floral buds, floral organs and root and antisense RNA of *MdTFL1*expression showed precocious flowering (8 months) in transgenic Orin apple. HigherPOD andABA while lower SOD, IAA, GA and CTK were found in WBs than in NBs of pear. In banana, *MaFT1*, 2, 5 & 7 increased just prior to initiation of floweringand induced early flowering. In papaya,*CpPLE* was found in stamens andcarpels of all sexes,*CpSTK* was found only in female and hermaphrodite flowers and*CpFUL* was expressed in leaves and all parts of the flowersexcept stamens. Grape*VFL*gene was not only found in flower meristem, but also in apical meristem of leaves or tendrils.Hence,understanding of specific genes involved in control of flowering, assisted localization of flowering, comparison of hormone-related genes and their positioning with QTLs are thus crucial for deciphering the functional significance of gene expression.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Ahir Tejaskumar Rambhai**	**Course : FLA 692 (1+0)**
Reg. No.	**: 1020216001**	**Date : 15/11/2019**
Major Guide	**: Dr. S. L. Chawla**	**Time : 03:00 to 04:00 pm**
Co-Guide	**: Dr. R. V. Tank**	**Venue : Swami Vivekananda Hall**

Role of biostimulants in fruit crops

Biostimulants are substances or microorganisms applied to plants with the aim to enhance nutritional efficiency, abiotic stress tolerance and crop quality traits, regardless of its nutrient content. Biostimulants may either directly interact with plant signaling cascades or act through stimulation of endophytic and non-endophytic bacteria, yeast and fungi to produce molecules of benefit to the plant. The benefit of the biostimulant is derived from the reduction in assimilated that are diverted to non productive stress response metabolism. Biostimulants foster plant growth and development throughout the crop life cycle from seed germination to plant maturity. These are available in humic substance, hormonal containing products and amino acid containing products for commercial utilization.

Brief Review of Research

Mango

Damodhar and Shinde (2010) revealed that six foliar sprays (at pea stage, marble stage and egg stage of fruit development each stage two spray at 15 days interval) of 55 % cow urine resulted maximum fruit weight (255.16 g), number of fruits/tree (351.68) and yield (90.28 kg/tree and 9.02 t/ha) in mango cv. Alphonso.

Ahmed *et al*. (2013) revealed that the significantly higher fruit weight (223.6 g), fruit length (10.66 cm), fruit width (7.75 cm), fruit thickness (5.97 cm), number of fruits/tree (302.00) and yield (67.5 kg/tree) were recorded with combined application of 60 % inorganic N (1.8 kg ammonium nitrate/tree/year) + spraying seaweed extract at 2% (at growth start, just after fruit setting and 1 month interval) on mango cv. Ewaise.

Ahmed and El-Sehrawy (2013) reported that highest fruit yield (213.00 kg/tree) of mango cv. Hindy Bisinnara were obtained with foliar spray of 0.4% seaweed extract four times (at growth start, just after fruit setting and after 21 days) under Egypt condition.

Ngullie *et al*. (2014) reported that foliar application 0.1 % humic acid at flower bud initiation stage gave higher yield of mango cv. Kesar. Whereas, application of 2000 ppm salicylic acid was found better for quality of mango fruits.

Sathe and Patil (2014) noted that five times (October to February) foliar spray of 1 % vermiwash to mango, increased fruit production from 1.00 (control) to 8.5 (treated) and 1.00 (control) to 2.5 (treated) fruits/fruiting body in Indigenous and Hapus varieties, respectively. Percentage of flowering was also increased from 62.00 % (control) to 95 % (treated) in Indigenous variety and 70 % (control) to 100 % (treated) in Hapus variety of mango in Kolhapur region.

Sau *et al*. (2017) observed that soil application of *Azotobacter chorococcum* @ 250 g + *Azospirillum brasilense* @ 250 g + AM @ 250 g in month of October along with foliar application of *panchagavya* 3% immediately after fruit set significantly increased plant growth, yield and quality of mango cv. Himsagar.

Patel *et al*. (2018) revealed significantly maximum organoleptic evaluation score, TSS (20.44 ^{0}B), total sugars (13.73 %), reducing sugars (5.38 %), ascorbic acid (52.86 mg/100g), shelf life (18.24 days) and lower acidity (0.23 %) in mango cv. Kesar with foliar application of 2 % Novel organic liquid fertilizer at induction of flowering and full bloom stage.

Banana

Hussain *et al*. (2015) revealed that maximum number of hands/bunch (10.75), numbe of fruits/bunch (156.50), fruit girth (14.37 cm), bunch weight (24.53 kg/plant) and yield (68.02 t/ha) were obtained with an application of 80 % RDF + 20 % RDN through FYM + 50 g *Azospirillum* + 50 g PSB + 25 g KMB in banana cv. Grand Naine.

Chhuria *et al*. (2016) recorded higher number of hands/bunch (9.45), number of fingers/bunch (152.40), weight of finger (133.67 g), length of finger (22.31 cm), bunch weight (24.86 kg) and yield (76.72 t/ha) in the plants treated with 100 % RDF (300:100:300 g N:P:K/plant) + 125 g *Azotobacter* + 125 g *Azospirillum* + 125 g PSB on ratoon crop of banana cv. Grand Naine.

Kumar and Nair (2016) reported maximum shelf life (8.25 days) in fruits obtained from banana cv. Nendran with bunch application of *jeevamrut* 3 % at 15 and 30 days after emergence + bunch cover.

Patil *et al*. (2017) noted that foliar application of Novel organic liquid fertilizer @ 1 % at 3rd, 5th and 7th month after planting of banana cv. Grand Naine obtained maximum number of fingers/bunch (171.08), number of hands/bunch (9.63), bunch weight (31.09 kg/plant) and yield (107.85 t/ha).

Papaya

Parmar *et al*. (2017) noted that papaya cv. Red Lady plants treated with 80 % RDNK (160:200 g/plant) applied in 8 equal splits at monthly interval + spraying of 1 % Novel organic fertilizer at 2nd, 4th, 6th and 8th month after planting resulted significantly highest yield (106.57 t/ha), TSS (12.03 ^{0}B), reducing sugar (9.28 %) and total sugar (10.87 %) with longer shelf life (7.61 days).

Patel Dharmishtha (2019) stated that the foliar application of potassium silicate 0.4 % + seaweed extract 4 % resulted significantly maximum fruit diameter (17.88 cm), fruit weight (1.81 kg/plant), number of fruits/plant (36.07) and yield (161.48 t/ha) in papaya cv. Red Lady.

Acid lime

Patel *et al*. (2019) revealed that the maximum height of seedlings (47.32 cm), number of leaves (36.31), stem diameter (3.12 mm), fresh weight of seedling (17.97 g), dry weight of seedling (10.02 g), survival percentage (75.20) and minimum mortality percentage (24.82) were noted at 180 DAS with the foliar spray of *panchagavya* 3 % at 60 and 90 days after seed sowing of acid lime.

Custard apple

Sindha *et al*. (2018) stated that the foliar application of humic acid @ 1% at marble stage and 15 days after first spray resulted maximum fruit yield (23.25 kg/plant), shelf life (6.57 days) and TSS (25.35 ^{0}B) on custard apple cv. Local.

Sapota

Baviskar *et al*. (2011) noted that soil application of 1125:750:375 g NPK/tree + 15 kg vermicompost + 250 g *Azotobacter* + 250 g PSB increased number of fruits per tree (1569.33), fruit yield (197.53 kg/tree), fruit weight (125.87 g) and TSS (23.16 ^{0}B) in sapota.

Conclusion

From the foregoing discussion, it can be concluded that biostimulants enhance the nutrient efficiency, growth, yield and quality of fruit crops. In mango, six foliar sprays of 55% cow urine at different flowering stages maximize yield. Application of 60 % inorganic N along with 2 % seaweed extract give higher yield and quality. Humic acid @ 0.1 % and salicylic acid 2000 ppm at bud initiation stage can also be used for better yield and quality. Flowering and fruiting can also be improved by spraying of 1% vermiwash five times. The combine application of biofertilizer + *panchgavya* 3 % is better for yield and quality. Novel organic liquid fertilizer @ 2 % at induction of flowering and full bloom stage increase quality of fruits. In banana, the application of 80 % RDF + 20 % RDN through FYM + 50 g *Azospirillum* + 50 g PSB + 25 g KMB increase yield. Moreover, spraying of Novel liquid fertilizer @ 1 % and *jeevamrut* 3 % can be used for higher yield and shelf life, respectively. Yield and quality of papaya can be improved through split application of fertilizer along with 1 % Novel organic fertilizer. Potassium silicate (0.4 %) + seaweed extract (4 %) also maximize yield of papaya. *Panchgavya* 3 % at 60 and 90 days after sowing increases growth of acid lime seedlings. Higher yield and quality of custard apple can be achived through spraying of humic acid @ 1 % at marble stage and 15 days after 1st spray. Soil application of 1125:750:375 g NPK/tree + 15 kg vermicompost + 250 g *Azotobacter* + 250 g PSB is beneficial for sapota yield.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Naik Bhoomi Parimal**	**Course**	**: FLA 692 (1+0)**
Reg. No.	**: 1020218007**	**Date**	**: 05/12/2020**
Major Guide	**: Dr. Alka Singh**	**Time**	**: 08:30 to 09:30 am**
Co-Guide	**: Dr. R. V. Tank**	**Venue**	**: Online**

Advances in fruit packaging techniques

India is a country with wide agro-climatic conditions with different climatic condition in different parts of the country throughout the year. India ranks 2nd in fruit production in world after china. Packaging is one of the important considerations in fruit market to reduce post-harvest losses. The use of properly designed container for transporting and marketing of fruits can maintain their freshness succulence and quality for longer period. Packaging is required not only for preservation but also for safe transportation of product during handling and storage. Packaging is the system by which a fresh produce or processed product reaches from the production centre to ultimate consumer in safe and sound condition at an affordable price. Changes in consumer preference for safe food have led to innovations in packaging technologies. Different materials like LDPE, HDPE, CFB boxes, cling film, cellophane paper film, newspapers, teff straw, dried banana leaf, wooden boxes, plastic bags are used for packaging of fruits. Further, various smart packaging systems including sensors and specific indicators are also been reported. Modified atmosphere packaging and edible coatings are effective way of internal packaging that prolong shelf life and quality of fruits. There is need to adopt complete packaging technology to ensure good post-harvest quality of fruits at the consumer end at an affordable price.

Review of research work

Polyfilm Packaging

Kardile *et al*. (2014) studied the effect of packaging material and storage conditions on storage behaviour of sapota fruits. They found that minimum ripening and spoilage (%) were recorded when sapota fruits kept in LDPE bag + CFB and cold stored at 120 C temperature.

Ankalagi *et al*. (2017) studied the effect of packaging material on organoleptic evaluation of sapota var. Cricket Ball during storage. They reported that highest organoleptic score (7.313) was recorded in treatment 75 micron LDPE which was followed by 100 micron LDPE (7.057); whereas, lowest score (5.954) was observed in control.

Pratap *et al*. (2017) studied the impact of different packaging materials on the shelf life of sapota fruits. They reported that minimum physiological loss in weight and decay loss were observed when fruits packed in shrink material. Whereas, maximum fruit pulp and peel ratio was observed with shrink and maximum specific gravity with cling film (23μ).

Suchismita *et al*. (2019) studied the effect of different packaging films on shelf life and qualitative attributes of pomegranate fruit cv. Mridula under ambient environment and reported that among all the packaging materials, the pomegranate fruits packed in LDPE 25 micron film had the least reduction in physiological loss in weight at 3rd, 6th, 9th, 12th days of storage (0.38, 1.36, 4.19, 5.17 %, respectively) and minimum decay loss 3.71 and 10.51 % on 9th and 12th days of storage, respectively.

Avesh *et al*. (2019) studied the effect of different packaging materials on organoleptic rating during storage of transported guava cv. Hisar Safeda. They revealed that guava fruits packed in corrugated fibre board box lined with newspaper cutting had maximum organoleptic rating (7.94).

Avesh *et al*. (2019) studied the effect of different packaging materials on change in colour during storage of transported guava cv. Hisar Safeda and reported that guava fruits packed in perforated poly bags, wooden box lined with paddy straw and corrugated fibre board box line with newspaper cuttings maintained fruits colour in acceptable limit at the end of the storage.

Martha and Daniel (2019) studied the effect of different packaging materials on shelf life of banana (*Musa paradisiaca* L.) and found that highest moisture content (93.39, 96.86 and 98.28 %) were observed in banana packed with polythene bag at 4th, 8th and 12th days of storage, respectively.

Modified Atmosphere Packaging

Antala *et al*. (2014) studied the effect of MAP on shelf life of sapota fruits. They observed that maximum overall acceptability and marketable fruits of sapota was found when fruits were packed in 25 micron LDPE bags with 5 % O2 + 10 % CO2 concentration on 49 days of storage.

Sahel *et al*. (2018) studied the effect of modified atmosphere packaging on biochemical properties of pomegranate (*Punica granatum* L.) fruits. They reported that maximum ascorbic acid content and total antioxidant activity of pomegranate fruits was noted when fruits were packed in silver nano bag during all the days after storage.

Edible Coatings

Hazarika *et al*. (2017) studied the influence of edible coatings on physico chemical characteristics and shelf life of papaya (*Carica papaya* L.) fruits during ambient storage. They reported that minimum physiological loss in weight (7.83 %) and maximum fruit firmness (3.84 %) were recorded when papaya fruits coated with liquid paraffin wax at 16th days of storage.

Active Packaging

Mir *et al*. (2018) studied the effect of active packaging on quality and shelf life of peach fruits and they found significantly highest retention of ascorbic acid (9.73 mg/100g) and maximum mean score of overall acceptability (7.50) were observed with ethylene absorber + 4 perforations in peach fruits.

Conclusion

On the basis of above findings it can be concluded that adaptation of proper packaging techniques by the industry can be useful for extending the shelf lie, improve quality and safety of different fruits for marketing and consumption. Fruits packed in LDPE 25 micron film had least reduction in physiological loss in weight and minimum decay loss. Corrugated fibre board boxes had significantly overall positive influence on different parameters. Banana fruits packed with plastic bag showed better result for moisture content. 75 micron is the advisable packaging material for sapota fruits because of their higher organoleptic score during storage. Sapota fruits kept in LDPE bag + CFB and cold stored at 120 C temperature recorded significantly minimum ripening and spoilage percent. Shelf life of sapota fruits could be increased up to 49 days by packaging in 25 micron LDPE bags at concentration 5% O2 + 10% CO2 and stored at 60 C with maximum sensory score. Pomegranate fruits packed with different MAP bags and stored in low temperature prolonged the storage and shelf life. Paraffin wax was the most efficient edible coatings for extending the shelf-life and delaying the ripening of papaya fruit. Highest retention of ascorbic acid and highest mean score of overall acceptability were observed with ethylene absorber + 4 perforations in peach fruits.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Christian Hetal Jayantilal**	**Course**	**: FSC 691 (1+0)**
Reg. No.	**: 1020218002**	**Date**	**: 24/07/2020**
Major Guide	**: Dr. R. V. Tank**	**Time**	**: 09:00 to 10:00 am**
Co-Guide	**: Dr. D. R. Bhanderi**	**Venue**	**: Online**

Effect of rootstock in citrus crop

Citrus is the third most important fruit crop in India after banana and mango.It is the leading tree fruit crop of the world and refers to all edible and rootstock species. The genus Citrus includes more than 162 species belonging to the order Geraniales, sub family Aurantoideae and family Rutaceae. Rootstocks have a profound effect on the vigour, precocity, productivity, internal quality and longevity of the scion varieties. They influence the susceptibility of trees to various diseases and pest also its performances depends on growing conditions. The selection of rootstock is important in all major fruit crops, it is of even more in citrus crops due to more chances of various diseases. It is also possible that citrus decline in India may be partly due to stionic incompatibilities.

Review of research work

Seed germination and polyembryony

Kashyap*et al*. (2018) observed that in Khasi mandarin, polyembryony varied from 50.0% to 83.3% during three years and recorded highest (83.30%) in the seeds harvested in November 2013 and have high possibility of obtaining zygotic plants from them.The highest germination percentage (83.37%) was in year 2015. The average number of embryos (clutch size) per polyembryonic seed ranged from 2.27 ± 0.03 to 2.70 ± 0.10 and per total seed ranged from 1.13 ± 0.19 to 2.30 ± 0.12 with maximum in November 2013 in both polyembryonic seed (2.70 ± 0.10) and total seed (2.30 ± 0.12), respectively.

De Carvalho and Carvalho Silva (2013) stored seeds of five different rootstocks in cold storage for 10 months and noted highest polyembryony rate (18.8%) and germination rate (98.52%) in CitrumeloSwingle and Sunki mandarin, respectively.

Kishore *et al.* (2012) noticed that the germinability varied from 61.8 to 84.6% among citrus genotypes. *C. jambhiri* exhibited highest germination (84.6%) whereas, Thornton had the lowest (61.8%). The maximum polyembryony was observed in *C. jambhiri* (91.4%) followed by Sikkim mandarin (86.6%) whereas; *C. medurensis* had the lowest percentage of polyembryony. The genotypes showed significant difference in clutch size in polymbryonic seeds as well as in total seeds. The maximum clutch size was recorded in *C. jambhiri* in both polymbryonic seeds (3.48 ± 0.47) and total seeds (3.26 ± 0.42), respectively.

Growth, yield and quality

Polu *et al.* (2018) studied the effect of Rough lemon rootstock on growth, yield and quality of sweet orange varieties. They found highest plant height (4.42 m), plant mean spread (4.17 m), plant volume (40.31 m^3), number of fruits per plant (232.76), fruit yield (32.75 kg/plant) as well as fruit quality parameters like juice percentage (53.15), TSS (12.56 ºBrix), acidity (1.01%) and ascorbic acid (57.86 mg/100 ml juice) when Valencia Late was budded on Rough lemon rootstock.

Sau *et al.* (2018) revealed that the maximum plant height (393.33 cm) and canopy volume (81.26 m^3) of Nagpur mandarin was recorded when budded on Karnakhatta rootstock. The maximum number of fruits per plant (238.33), fruit weight (158.94 g) and yield (37.52 kg /tree) were recorded when Rough lemon was used as rootstock. Fruits with highest TSS (9.50 ºBrix), total sugar (7.17%) and ascorbic acid

(34.28 mg/100g) with minimum granulation (3.08%) were produced when Nagpur mandarin was budded on Kumquat rootstock while, minimum acidity (0.42%) was noted in Karnakhatta rootstock.

Al-Hosni *et al.* (2011) studied the effects of different citrus rootstocks on yield and granulation of 'Hamlin' Orange in Oman. They obtained maximum yield (65.0 kg/tree) and minimum granulation percentage (≤%) when Hamlin Orange was grafted on Acid lime.

Bassal (2009) found that tree height (3.53 m) and girth of stock (39.83 cm) was maximum when Carrizo Citrange was used as a rootstock for Marisol Clementine, while canopy diameter (2.97 m), tree volume (7.03 m^3), scion girth (37.17 cm) and girth ratio (0.97) was found maximum in Sour Orange rootstock at 5^{th} year after planting. Whereas, at 6^{th} year after planting tree height (4.13 m), canopy diameter (3.10 m), tree volume (9.96 m^3), scion girth (40.17 cm) and girth ratio (0.97) was maximum with Sour Orange as root stock and maximum stock girth (41.72 cm) with Cleopatra mandarin as rootstock for Marisol Clementine. The average fruit yield of tree (44.1 kg) and feddan (17.6 ton.) with average yield efficiency of 5.31 kg/m^3 canopy from both the years was maximum in Sour Orange while, the minimum alternate bearing index (7.03 %) was found with Carrizo Citrange rootstock.

Ahmed *et al*. (2007)studied theeffect of different rootstocks on yield of Kinnow mandarin at Faisalabad and noted highest (1037.16) and lowest (184.49) number of Kinnow fruits per tree on Brazillian Sour Orange and Carrizo Citrange rootstock, respectively. While, maximum (139.52 kg/tree) and minimum (27.83 kg) yield was recorded when Volkamariana and Carrizo citange was used as rootstocks, respectively.

Srivastav *et al.* (2005) found highest plant height (229.80 cm), canopy volume (25.05 m^3), fruit weight (183.88 g), fruit volume (182.32 ml) and fruits per plant (86.30) in sweet orange *cv*. Mosambi when budded on Karnakhatta rootstock.

Nutrient uptake pattern

Khan *et al*. (2020) studied the influence of citrus rootstocks on leaf nutrition of 'Salustiana' sweet orange andnoted maximum leaf N (3.55 %), P (0.19 %), K (1.76 %), Ca (3.54 %), Mg (0.90 %), Fe (99.33 mg/kg), Cu (26.95 mg/kg), Zn (105.0 mg.kg) and Mn (31.25 mg/kg) when Salustiana' grafted on 'Rough lemon' rootstock.

Ahmed *et al*. (2007) studied leaf nutrient status of Kinnow mandarin grafted on different rootstocks and recorded maximum N 2.60 and 2.67 % during 2005 and 2006, respectively and P (0.16 %) in 2005 and 2006 on Rough lemon rootstock as compared to other rootstocks. However, maximum K 1.65 and 1.63 % during 2005 and 2006, respectively was noted when Kinnow grafted on Carrizo Citrange rootstock.

Srivastav *et al.*(2005) found maximum leaf N (2.67 %), P (0.16 %), K (1.79 %), Zn (5 1.42 ppm) and Fe (299.40 ppm) in the leaf tissue of sweet orange cv. Mosambi, where 'KarnaKhatta' was used as rootstock.

Disease resistance

Kamble *et al.* (2017) observed that lowest greening percentage (0.00) was noted in *Poncirus trifoliate*, Troyer Citrange Australia, *Aeglemarmelos* and *C. medica* and thus showed resistant against citrus greening disease under field condition wheras, highest citrus greening (90.0 %) was observed in *C. sinensis*, *C. reticulata*, Tangelo, *C. limon* and *C. grandis* exhibiting highly susceptible.

Dhakad *et al.* (2014) tested 11 rootstocks against kinnow foot rot pathogen, among them Cleopatra and Rough lemon showed maximum per cent decrease in no. of leaves, seedling height, feeder root volume, feeder root length, tap root length, root weight exhibiting susceptible reaction, while Citrumelo, Pectinifera, Sour orange and X639 showed minimum decrease in these parameters and found to be tolerant reaction. Feeder root rot index was highest for Cleopatra and Rough lemon showed highly susceptible. However minimum was observed in Sour orange and Pectinifera found to be tolerant against pathogen.

Javed *et al*. (2008) concluded that among the different 13 rootstocks, Citrumello, Carrizo Citrange and Grape fruit rootstocks were found resistant against citrus root nematode (*Tylenchulussemipenetrans*Cobb.). Whereas, root stocks of Bitter sweet orange, Brazilian sour orange, Sour orange,Chakotra, Rough lemon were found to be susceptible.

Conclusion

From the foregoing discussion, it can be concluded that rootstock development is an unending process for citrus species. In case of polyembryony and seed germination, Khasi mandarin, CitrumelloSwingle, Sunki mandarin and *C. jambhiri* rootstocksgave better results. For sweet orange *cv.* like Valencia late and Mosambi and for Nagpur mandarin, Rough lemon, Karnakhatta, Cleopatra mandarin and Mosambi rootstocks can be successfully used for better growth, yield and quality. Acid lime rootstock for Hamlin Orange and Carrizo Citrange and Sour orange rootstock for Marisol Clementine and Kinnow mandarin performed better. Sour orange and Pectinifera rootstocks found tolerant against kinnow foot rot whereas, Citrumello, Carrizo Citrange and Grape fruit rootstocks were found resistant against citrus root nematode (*Tylenchulussemipenetrans*Cobb.).Poncirus trifoliate, Troyer Citrange Australia, *Aeglemarmelos* and *C. medica* showed resistant against citrus greening.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Der Mayur L.**	**Course**	**: FSC 691 (1+0)**
Reg. No.	**: 1020218003**	**Date**	**: 17/07/2020**
Major Guide	**: Dr. S. J. Patil**	**Time**	**: 10:30 to 11:30 am**
Co-Guide	**: Dr. N. B. Patel**	**Venue**	**: Online**

Bunch management practices in banana

Banana (*Musa paradisiaca* L.) is herbaceous, monocotyledonus and monocarpic tropical fruit crop belongs to Musaceae family. India leading first position in banana production. Second most important fruit crop in India next to mango. To increase the production with quality for export purpose advance production technologies like sleeving, foliar spray of nutrients and PGRs, hand management and pouch feeding is very essential. Which reduces sun scald, cracking, splitting and insect damage, improve quality, better feeling of fingersand increase shelf life.

Review of research work:

Debnath *et al.* (2001) revealed that sleeving of transparent polythene on banana bunch after complete opening gavemaximum finger length, diameter and weight, weight of hand and bunch and yield (t/ha) in banana cv. Giant Governor.

Amani *et al.* (2014) reported that banana bunch cover increased the average weight of hand, bunch weight and minimize disease infection in banana.

Sarkar *et al.* (2016) reported that the banana bunch cover increased the yield, weight of bunch and fruit and minimizethe days between shooting to harvesting. It also gave more remuneration in banana.

Pathak *et al*. (2017) resulted that the banana bunch cover with white non-woven polypropylene bag gave maximum finger length, girth, volume and weight in banana.

Santosh *et al.* (2017) found that the bunch cover practice significantly minimize days to harvesting and maximize bunch weight, finger girth, yield, fruit firmness, TSS and reducing sugar in banana.

Rubel *et al.* (2019) reported that banana cv. Meher Sagar bunch covered with blue polythene bag gave maximum bunch weight, finger length and finger diameter.It also minimizes disease and insect infestation and physiological disorder.

Parmar and Chundawat (1984) revealed that the blue poly sleeve covered with banana cv. Basrai bunch took minimum days required flowering to harvesting and weight loss during ripening and gave maximum hands/bunch, yield/plant and pulp:peel ratio. While, foliar spray of $GA_3$100 ppm on bunch gave maximum finger/bunch, TSS and days to ripening after harvest.

Kotur and Murthi (2010) resulted that the de-navelling at last hand plus dipping in cow dung + 5 g A.S. + 2.5 g SOP gave maximum bunch weight and fruit weight at top and bottom in banana cv. Ney Poovan.

Adinarayana *et al.* (2017) demonstrated that the recommended practices gave maximum yield and yield attributing characters than the farmer practices in banana.

Kumar (2016) reported that the de-navelling and feeding nutrients through the stalk-end with the dipping the cut end in the cow dung slurry 100 ml water + 15 g A.S. + 10 g SOP increased the finger length, girth and weight, hand weight, bunch weight and yield (t/ha) in banana cv. Grand Naine.

Goenaga and Irizarry (2001) revealed that the maiden plantain with pruned to six hands gave maximum number of fruits per bunch, bunch weight, fruits per ha and yield per ha in banana.

Digal (2015) studied the effect of hand management and foliar spray of chemicals on banana cv. Grand Naine and revealed that foliar application of GA_3 100 mg l^{-1} increased yield and yield attributing characters. While, 9 hands per bunch increased yield and 7 hands per bunch increased length and girth of fruit and finger weight.

Thanuram *et al.* (2018) reported that the bunch feeding with the 500g fresh cow dung + 7.5 g Urea + 7.5 g K_2SO_4gave maximum bunch weight, yield (t/ha), finger weight, length and girth in banana cv. Barjahaji.

Garasangi *et al.* (2018) revealed that the bunch feeding with the cow dung slurry 500 ml + K_2SO_4 @ 20 g increased the bunch weight, yield, green life, shelf life and minimize PLW% in banana cv. Rajapuri.

Patel *et al.* (2011) reported that the post shooting practice with the sleeving and foliar spray of GA_3 100 mg/l increased the bunch length and girth, weight of 3rd hand, weight of finger, length and girth, weight of finger and yield (t/ha) in banana cv. Grand Nain.

Kachhadia *et al.* (2017) concluded that the post shooting bunch spray with the GA_3 100 mg/l increased the bunch length and girth, finger length, girth and weight, weight of 3rd hand, bunch weight and yield (t/ha) in banana cv. Grand Naine.

Rajni Rajan *et al*. (2017) revealed that foliar spray of brassinosteroid @ 2.0 mg/l on banana cv. Grand Naine bunch gave maximum bunch length and girth, finger length, girth and weight, weight of hand, bunch weight and yield (t/ha).

Gamit *et al.* (2017) concluded that foliar spray of SOP 1% on banana cv. Grand Nain bunchincreased TSS and shelf life while, SOP 1.5% increased reducing sugar and total sugars.

Patil *et al*. (2018) recommended that the foliar spray of SOP 1.5% took minimum days taken from flowering to harvesting and maximize bunch length, girthand weight, weight of 3rd hand, finger length, and girth,bunch weight and yield (t/ha) in banana cv. Grand Nain.

Conclusion

From the foregoing discussion, it can be concluded that the banana yield can be increase maximum with the various bunch management practices. Use of sleeving materials like transparent polythene, non-woven polypropylene and blue polythene when covered on banana bunch after complete opening increased yield, yield attributing characters and quality. It also minimizes disease and insect infestation and physiological disorder. Pouch feeding with cow dung slurry + A.S. (5 to 15 g) + SOP (2.5 to 20 g) or urea (7.5 g) increased the bunch weight and bunch characters with quality. Maintained six to nine hands on banana bunch significantly increased yield. Post shooting foliar spray of GA_3 100 mg l^{-1} or brassinosteroid 2 mg l^{-1} or SOP 1.5 % significantly increased bunch length, girth and weight, weight of 3rd hand, finger length and girth and yield (t/ha) in banana.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
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POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Khalasi Devangbhai Natvarbhai**	**Course**	**: FSC 691 (1+0)**
Reg. No.	**: 1020218006**	**Date**	**: 04/07/2020**
Major Guide	**: Dr. T. R. Ahlawat**	**Time**	**: 09:00 to 10:00 am**
Co-Guide	**: Dr. N. B. Patel**	**Venue**	**: Swami Vivekananda Hall**

Mitigation strategies for drought stress in fruit crops

Drought stress is emerging as a major threat to sustaining food security under current and more so in future climates. It induce stomatal closure, decrease transpiration and photosynthetic rates and thereby leads to poor productivity. To minimize the negative effect of water stress, plants have various signaling pathways and respond by changing their growth pattern, up-regulation of antioxidants, accumulation of compatible solutes and by producing stress protein. (Anjali *et al*., 2017). Plants acclimatize with drought stress using various strategies which include drought escape, drought avoidance and drought tolerance. Keeping in mind challenges of drought and demand for good quality fruits in stress prone areas, the present need before researchers and growers is to overcome the challenges posed by drought. There are multiple approaches like mulching, drip irrigation, water conservation, use of growth retardants, proper nutrient management, use of antitranspirants and drought tolerant rootstock through which we can manage the challenges posed by drought. Research done on these aspects is reviewed as under.

Review of research work:

Irrigation system

Kumar *et al.* (2008) recorded the maximum canopy volume (51.96 and 55.76 m^3), no. of fruits/tree (271.39 and 308.20) and fruit yield (45.00 and 65.72 kg/tree) when tree were irrigated through 75 % pan evaporation replenishment and fruit weight (166.12 and 248.11 g) in 100 % pan evaporation replenishment in mango hybrid 'Arka Anmol' during 2005-06 and 2006-07.

Noitsakis *et al*. (2016) recorded higher fruit weight (449.1 g), fruit diameter (101.2 mm), aril weight (17.1 g), juice percent (30.2) and TSS (16.60 %) with minimum fruit cracking (8.31 %) and titrable acidity (21.4 %) under partial root zone drying (100 % on one side only) in pomegranate cv. 'Wonderful'.

Soil moisture conservation

Patil *et al*. (2005) observed higher fruit yield (41.71 kg/tree), no. of fruits/tree (214.75) and fruit circumference (16.83 cm) in circular basin with 5% inward slope + locally available mulch in mango cv. 'Alphonso'. Whereas, maximum fruit weight (194.81 g) and fruit length (8.87cm) were found in circular basin system with 5% inward slope.

Panigrahi *et al*. (2009) found the maximum plant height (0.35 m), stem girth (2.4 cm), canopy volume (0.846 m^3), no. of fruits/plant (69), fruit weight (139.2 g) and total yield (9.60 kg/plant) under continuous trenching in citrus cv. 'Nagpur mandarin'.

Iqbal *et al*. (2015) recorded the maximum fruit weight (41.46 g), fruit length (3.73 cm), fruit diameter (4.42 cm) and fruit volume (39.80 cm^3) in aonla cv. 'NA-7' under application of black polythene mulch.

Mycorrhiza

Hosseini and Gharaghani (2015) observed highest root colonization and shoot height in all three rootstocks (MM106-75.33^{a} %, 56.33^{cd} cm, MM7-76.00^{a} %, 66.66^{a} cm and MM9-67.00^{cd} % 49.66^{fg} cm) with *G. versiformae* inoculation. Largest leaf size in MM106 (36.38^{c} cm^2) was observed following inoculation with *G. versiforme*; in M7 (34.22^{d} cm^2) with *R. intraradices* and in M9 (40.42^{a} cm^2) with inoculation by *C. etunicatum*. Higher shoot fresh weight was recorded on rootstock MM106 (37.01^{a} g/plant) and M7 (33.80^{b} g/plant) when inoculated with *G. versiforme* and in M9 (34.36^{b} g/plant) rootstock on inoculation with *C. etunicatum*.

Antitranspirant

Mahmoud *et al*. (2010) reported that spraying of Kaolin 1% in apple cv. 'Anna' resulted in the maximum yield (33.1 kg/tree), fruit weight (120.2 g), fruit diameter (6.37 cm), fruit length (7.00 cm) and fruit color (3.8 -1 to 5).

Rehman (2010) recorded the highest berry weight (9.08^{a} g and 9.91^{a} g) and yield/vine (4.33^{a} kg and 4.38^{a} kg) no. of berry/cluster (2009-469.2^{a}), cluster weight (2008-125.5^{a} g) and cluster no./vine (2008- 2.29^{a})

by the application of cycocel @ 1000 ppm in Barrani grapevines. While cycocel @ 500 ppm resulted in the highest no. of berry/cluster (2008-480.8[a]), cluster weight (2009-127.1[a] g) and cluster no./vine(2009-2.34[a]).

Roussos *et al*. (2011) observed that drought stress resulted in lower trunk cumulative width growth in olive compared to that measured under irrigation. However, trees treated with kaolin clay particles exhibited a significant trunk width expansion under drought stress as compared to rest of the treatments. Kaolin particles exerted positive effects under drought on shoot growth and plant height.

Masoud (2012) found that foliar spray of Green miracle at 4.0 % in apricot cv. 'Hamawy' lead to minimum pre harvest fruit drop (5.7 % and 5.8 %), higher no. of fruit/tree (381.0 and 388.0), fruit weight (83.0 g and 81.0 g) in 2010 and 2011, respectively. While yield/tree was reported maximum by the application of Kaolin at 1.0 % (2010-32.2 kg) and green miracle at 4.0 % (2011- 31.4 kg).

Dipika *et al*. (2018) noted the maximum height of graft (60 days -24.71 cm, 120 days- 26.78 cm and 180 days -28.89 cm) relative water content (60 days- 98.13 %, 120 days -98.23 % and 180 days- 98.70 %) and survival (83.33 %) in mango cv. 'Kesar' on treatment with spraying of kaolin 2.5 %.

Hydrogel

Pattanaaik *et al*. (2015 [a]) observed that treatment (80 g of stockosorb) resulted in highest moisture retention in citrus cv. 'Khasi mandarin' .

Pattanaaik *et al*. (2015 [b]) reported higher mean yield of fruits numbers (283.00), mean increase in plant height (4.40 %), reducing sugar content (7.167 %) and ascorbic acid content (106.613 mg/100g) in citrus cv. 'Khasi mandarin' with the application of 60 g of stockosorb.

Kalhapure *et al*. (2016) recorded the lowest BD (1.543 g/cm^3) and pH 7.27 with maximum total porosity (41.77 %) and WHC (27.00 %) by the application of Hydrogel @ 48 kg/ha.

Abobatta and Khalifa (2019) reported maximum no. of flower/shoot (133.90 and 135.47), no. of fruit/shoot (41.42 and 42.45), initial fruit set/shoot (29.89 % and 29.55 %), final fruit set/shoot (2.36 % and 2.49 %) and retained fruits (10.02 % and 10.75 %) in citrus cv. 'Washington Navel' during 2016-17 using hydrogel @ 1500 g/tree.

Conclusion

From the foregoing discussion, it can be concluded that use of drip irrigation at 75 % PER promoted fruit yield and number of fruits/tree in mango hybrid 'Arka Anmol'. Partial Root zone drying at 100 % through drip irrigation reduced fruit cracking and increased fruit weight in pomegranate cv. 'Wonderful'. In aonla, cv. NA-7 application of black polythene mulch increased the fruit weight and fruit size. A 5 % inward slope coupled with locally available mulch increased fruit yield in mango cv. 'Alphonso'. Apple plants inoculated with *G. versiforme* had the maximum root colonization, shoot height and leaf size. Application of Kaolin at 1 % increased fruit yield in apricot cv. 'Hamawy' and apple cv. 'Anna". Kaolin at 2.5 % gave the maximum graft height and survival percentage in grafts of mango cv. Kesar. Hydrogel at 1500g/tree increased fruit retention in citrus cv. Washington Navel. Further, Stockosorb at 80 g/plant increased moisture retention and at 60 g/plant improved fruit yield as well as quality in citrus cv. 'Khasi Mandarin'. Addition of Hydrogel (48 kg/ha) improved the total porosity and WHC of the soil. It can be concluded that different approaches involving drip irrigation, soil moisture conservation, using mycorrhiza, antitranspirants and hydrogel can be employed to tackle drought stress in fruit crops.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Patel Malhar V.**	**Course : FSC 691 (1+0)**
Reg. No.	**: 1020218011**	**Date : 24/07/2020**
Major Guide	**: Dr. B. R. Parmar**	**Time : 10:30 to 11:30 am**
Co-Guide	**: Dr. D. R. Bhanderi**	**Venue : Online**

Graft incompatibility- causes and remedial measures in fruit crops

The inability or failure of rootstock and scion grafted together to produce a successful graft union is called as graft incompatibility. In contrast, if the graft union is successful, it is called as graft compatibility. The distinction between a compatible and an incompatible graft union is not clear cut. Graft incompatibility is reported due to the structural or anatomical reasons, physiological and biochemical reasons, nutritional deficiency and presence of viruses at an early phase all these factors may be responsible for incompatible reactions. Various method *i.e.* electrophoresis, In-vitro callus fusion, histological detection, phenol analysis, MRI and breaking strength test used for detect the graft incompatibility combinations. For overcome of this problem many remedies suitable like a double working, proper time and methods of grafting, bridge grafting, remove and top work of the root stock, use of correct rootstock and virus free planting materials.

Review of Research Work

Causes and detection methods of graft incompatibility

Kiran *et al.* (2019) noted that wedge grafting and veneer grafting was better and significant in the month of August and October, respectively in success rate percent of Sufaid Chaunsa grafting on seedling mango.

Dolgun and Zenginbal (2017) observed that in apple stocks and scions fits very well, less necrotic tissues formation and wounds heal more quickly in chip budding as compared to “T” budding in cold climate and high altitude conditions.

Hudina *et al*. (2015) observed that the phenolic contain flavanols, flavonols and hydroxycinnamic acid present in graft union it responsible for graft incompatibility in peach.

Hossein *et al.* (2008) recorded that Beurre Hardy, Passa Crassana and Tabrizi scion cultivars match the peroxidase band A and Isozyme band B with the Quince A root stock banding pattern due to graft compatibility with each other.

Errea *et al*. (2001) concluded that callus cells at contact surface of a compatible graft union the cells exhibit an orderly, homogeneous disposition and no lipids compounds are detected. While, incompatible graft union callus cells remained in a disorganized disposition and presence of lipid compounds in apricot.

Methods to overcome graft incompatibility

Gotur *et al.* (2017) found that wedge grafting in guava during the month of August with scion var. Lalit gave minimum days taken to sprouting, maximum sprouting per cent and graft survival percentage as compared to var. Shweta.

Rahmati *et al*. (2015) recorded that ‘Williams’ cultivar showed better status in the graft viability percentage compare to ‘KS10’ and ‘Beurre Bosc’ cultivars. While, highest and lowest graft viability percentage, were observed in Pear and Hawthorn seedling rootstocks, respectively.

Shinde *et al*. (2015) observed that minimum days taken for sprouting (12.33), maximum sprouting percent (76.89), length of scion (28.45) and graft success percent (71.46) in softwood grafting was achieved by Chandsili rootstock in custard apple.

Talukder *et al.* (2015) recorded that, cleft grafting followed by veneer method of grafting showed higher survivability when mandarin scion grafted on Rangpur lime (89.80% and 83.20%, respectively) as well as on Rough lemon (87.40% and 85.10%, respectively) rootstock at 180 days after grafting.

In cleft grafting of mango, Shaban (2010) noticed that scion of Ewais, Zebda and Keitt showed the highest grafting success and more growth of scion when grafted on Zebda rootstock, meanwhile the lowest value were recorded with “13-1”.

Heenkenda *et al.* (2009) found that atemoya grafted on cherimoya had highest percentage of grafting success and bud take on by using wedge grafting technique in custard apple.

Salimia and Hamdan (2009) concluded that Halawani scion produced the best results of callus development, Halawani-Baladi was intermediate and Red-Romi was low in callus development in grape.

Verma *et al.* (2000) noticed that the dwarfing rootstock Jhar ber showed incompatibility with inverted bottleneck symptoms budded with Gola cultivar. The budding success was significantly lesser on rootstock Jhar ber as compared to *Z. mauritiana* Ecotype Assam Guahati and *Z. mauritiana* Ecotype-291.

Conclusion

From the foregoing discussion it can be concluded that, presence of flavanols, flavonols and hydroxycinnamic acid at graft union are responsible for graft incompatibility in peach. Chip budding is best propagation method for apple in cold climate and high altitude conditions. In mango high success rate was observed in wedge grafting during August and veneer grafting in October months, respectively. Mango scion of Ewais, Zebda and Keitt showed the highest grafting success when grafted on Zebda rootstock. Pear cultivars Beurre Hardy, Passa Crassana and Tabrizi were found compatible with Quince A root stock and cv. Williams had better graft viability percentage compared to KS10 and Beurre Bosc. In incompatible graft union the callus cells remains disorganized and presence of lipid compounds is observed in apricot. In Mandarin cleft grafting shows highest survivability when grafted on Rangpur lime and Rough lemon. Halawani scion produced the best results of callus development in grape. Wedge grafting in guava best performed in the month of August with scion var. Lalit. In custard apple, Atemoya grafted on Cherimoya had highest percentage of grafting success whereas, Chandsili rootstock better performed in softwood grafting. The budding success in ber was significant with *Z. mauritiana* Ecotype Assam Guahati and *Z. mauritiana* Ecotype-291 compared to Jhar ber rootstock.

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POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Pawar Ravindra Dadabhau**	**Course**	**: FLA 692 (1+0)**
Reg. No.	**: 1020218012**	**Date**	**: 06/11/2020**
Major Guide	**: Dr. S. L. Chawla**	**Time**	**: 03:00 to 04:00 pm**
Co-Guide	**: Dr. S. J. Patil**	**Venue**	**: Online/ Swami Vivekananda Hall**

Advances in production technology of pomegranate

India is the world's largest producer of pomegranates produced over 2.34 lakh ha area with an annual production of 28.45 lakh tonnes and productivity of 12.15 t/ha (Anon., 2018). In spite of this, India exports only 2.55 % of its total production. There is a tremendous potential for exports of pomegranate from India. Pomegranate has several salient features unique to its credit. It's ability to withstand heat, drought and moisture deficit, versatile adaptability, hardy nature, low maintenance cost, steady but high yields, better keeping quality, fine table and therapeutic values and possibilities to throw the plant into rest period when irrigation potential is generally low, indicate the avenues for increasing the area under pomegranate in India. It has immense medicinal and nutritional value. Pomegranate is one of the richest sources of antioxidants. It observed decreasing trend in area, production and productivity since 2009-10 owing to mainly the oily spot infestation and various other reasons. Since 2012-13, an increasing trend is witnessed. In the quality fruit production of pomegranate, varieties, propagation methods, training and pruning, mulching, water and nutrient management, mulching, use of plant growth regulators, fruit bagging, *etc.* play a very important role.

Brief review of research work

Propagation

Ahire *et al.* (2016) assessed eleven genotypes (rootstocks) and two propagation methods *viz*., wedge grafting and patch budding for cv. Phule Bhagwa Super and observed that wedge grafting was superior over patch budding in all aspects whereas among rootstocks, Bedana Suri and Alandi took the minimum time for bud sprout. The highest bud sprout at 30 day after grafting/budding, *per cent* survival of grafts/buds at 60 and 90 DAG/DAB, longest shoot length, maximum number of internodes, maximum girth at graft/bud union, highest fresh shoot and root weight were registered in Bedana Suri while, highest number of shoots and shoot: root weight ratio recorded in Ganesh and Kandhari, respectively.

Panjavarnam (2019) approved that plants raised through tissue culture improves the production and productivity of pomegranate and offers the possibility to obtain high quality fruits as it performed best in terms of maximum plant height, canopy volume, number of flowers and fruits/plant, fruit yield/plant, average fruit weight, fruit length and girth, rind weight, aril weight, rind to aril ratio, minimum days to first ripe fruit and quality attributes *viz*., total soluble solids, and anthocyanin content while, lowest titrable acidity over plants raised through grafts and air layers.

Training & Pruning

Hiremath (2017) studied the influence of pruning intensities in cv. Phule Bhagwa Super under organic conditions during *Hasta bahar* treatment and reported that pruning the shoot tips by 30 cm after one month rest period but before withholding of irrigation water; produced maximum number of secondary branches and length of fruit and recorded significantly maximum shoot length at 150 DAP, individual fruit weight, diameter and fruit yield per plant and per ha, whereas, unprunned control treatment possessed maximum number of flowers per shoot, significantly earlier flowering and fruit set with maximum number of fruits per plant registering maximum primary branches.

Sharma and Singh (2018) recorded the maximum shoot extension, fruit size (diameter, length, fruit weight), fruit volume, superior fruit qualities and reduction in fruit drop and fruit diseases in the treatment of retention of 15 cm fruiting shoot length + thinning. Whereas, control treatment recorded maximum values for plant height, tree volume, plant spread, fruit set percentage, number of fruits and yield per plant and marketable yield. All pruning treatments also proved beneficial in controlling fruit cracking, bacterial blight on fruit and leaf surface to some extent.

Irrigation

Haneef *et al.* (2014) conducted an experiment on four-year-old pomegranate orchard of cv. Bhagwa planted under HDP system at 2 m x 2 m spacing with four fertigation levels *viz.*, 50, 75, 100 and 125 % RDF and three drip irrigation levels *viz.*, 50, 75 and 100 % on pan evaporation basis and inferred that treatment combination 100 % RDF and 100 % drip irrigation at alternate day resulted in higher marketable yield and maximum net returns per ha with quality fruits having high juice content and organoleptic rating. Treatment combination 125 % RDF and 75 % drip irrigation gave maximum vegetative growth parameters.

Meshram *et al.* (2019) studied the effect of various micro-irrigation treatments on pomegranate cv. Bhagwa. Maximum number of flowers, number of fruits, average fruit weight, yield per plant, juice content, minimum fruit losses due to sun burn and cracking and maximum water use efficiency was recorded in subsurface drip irrigation system with 2-inline laterals (30 cm x 30 cm).

Nutrition

Thanari and Suma (2018) studied the effect of different fertigation levels of major nutrients on the fruit quality and yield of pomegranate during *Hasta bahar* season on Bhagwa variety and observed maximum number of hermaphrodite flowers, number of fruits per plant, fruit length and yield per plant and per ha in 75 % fertigation with schedule-2, while, 100 % fertigation treatment recorded maximum individual fruit weight and diameter.

Thanari *et al.* (2019) recorded the superior fruit quality parameters with 100 % fertigation treatment in terms of higher values of titrable acidity, ascorbic acid content, phenol contents and antioxidant activities in peel and juice and juice mineral content (N, P, K, Ca, Mg, S).

Kurer *et al*. (2017) investigated the efficacy of organics on growth behaviour and fruit yield of pomegranate cv. Super Bhagwa during *Hasta bahar* season in which RDN was applied through the different organic sources. Results revealed that 100 % RDN through vermicompost recorded significantly maximum vegetative growth (number of shoots/plant, shoot length, plant height and plant canopy spread in N-S and E-W directions) whereas 100 % RDN through poultry manure recorded significantly highest number of productive flowers, fruit set and yield.

Mulching

Sharma *et al*. (2017) applied five orchard floor management treatments in pomegranate cv. Kandhari Kabuli of which black polythene mulch proved to be most effective in increasing fruit set, yield (number and weight basis) of superior quality fruits with reduction in fruit drop and cracking percentage. Grass mulch was better in terms of fruit size and average fruit weight over other treatments.

Yograj *et al.* (2017) evaluated the effect of seven organic and inorganic mulch materials and reported that black polythene mulch (100 micron) was effective to improve the all aspects of fruit growth and yield of pomegranate cv. Bhagwa.

Plant growth regulators

Anawal *et al.* (2016) studied the beneficial effects of ethrel, GA_3 and NAA on induction of flowering in pomegranate cv. Bhagwa and revealed that application of ethrel at 250 ppm gave significantly maximum number of hermaphrodite flowers, minimum days taken for 50 and 100 % flowering and minimum losses due to intermediate and hermaphrodite flower drop whereas, NAA at 100 ppm resulted in maximum length and diameter of the flowers as against control.

Jhade *et al.* (2019) sprayed ethephon at different concentrations (600, 800, 1000 and 1200 ppm) on pomegranate cv. Bhagwa plants during stress period for *Ambia* crop (Jan-Feb) and reported significant defoliation to a tune of 81.63 % to 96.53 % after 7 days of spraying in all treatments over untreated control and advised ethephon spraying @ 1200 or 1000 ppm for quick defoliation.

Fruit bagging

El-Wafa (2014) applied 7 bagging treatments 21 days after fruit set and sustained till harvest time and observed that bagging fruits with prgmen bag increased fruit weight, total and marketable yield/tree, fruit firmness while reduced the percentage of cracked fruits and sunburn fruits/tree as compared to the other treatments. Increased in TSS, total soluble sugars, vitamin C content and total anthocyanin content and reduction in acidity in fruit juice were also recorded over other bagging treatments.

Sarkomi *et al.*(2019) evaluated two bagging types and different months of bagging and reported that white and brown bag effectively reduced fruit sunburn and cracking and decreased the total damaged fruits, particularly when fruits were bagged in the month of August and increased juice volume and weight when fruits bagged from July as compared with non-bagged control.

Conclusion:

The quality planting material raised through tissue culture should be preferred for improved growth, fruit quality and productivity of pomegranate whereas, among budding and grafting methods, wedge grafting on rootstocks Bedana Suri and Alandi is advocated. Pruning the shoot tips by 30 cm produced better growth, quality fruits and higher yields while retention of 15 cm fruiting shoot length followed by thinning in rejuvenation pruning reduced fruit drop and fruit diseases along with superior fruit qualities. The micro-irrigation through subsurface drip irrigation system with 2-inline laterals should be followed at 100 % of PE at alternate day and fertigation of major nutrients with 100 % fertigation for quality fruit production. For organic pomegranate production, 100 % RDN through poultry manure was best for superior yield and quality. For better orchard floor management, black polythene mulch (100 micron) was effective to improve the all aspects of fruit growth, quality and yield. Spray application of ethrel at 250 ppm during induction of stress produced significantly early and maximum number of hermaphrodite flowers and reduced flower drop, NAA at 100 ppm produced larger flowers, ethephon at 1200 ppm for quick defoliation during bahar regulation. Pre harvest fruit bagging at 21 days after fruit set with prgmen bag produced larger and nutritionally superior fruits with higher marketable fruits and reduced yield losses due to abiotic and biotic stresses.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker	**: Patel Bhoomikaben Ashokbhai**	**Course**	**: FSC 691 (1+0)**
Reg. No.	**: 1020218009**	**Date**	**: 06/11/2020**
Major Guide	**: Dr. T. R. Ahlawat**	**Time**	**: 04:15 to 05:15 pm**
Co-Guide	**: Dr. S. L. Chawla**	**Venue**	**: Online**

Recent advances in bending and pruning techniques of fruit crops

India is bestowed with diverse agro climatic conditions ideal for the cultivation of fruit crops across the country with a wide window of availability. The national productivity of fruit crops is about 14.96 MT/ha (Anon., 2019) which can be further improved by adopting bending and pruning techniques. Bending induces profuse flowering and fruiting and fetches greater returns (Sarkar *et al.,* 2005). In case of bending, wood tension of branch increases and phloem formation decreases. As a result photosynthetic product pass slowly from the shoots of bent branches to the other parts, increasing C: N ratio and thereby inducing more flowering and fruit set. Bending in guava is commercially practised in few pockets of West Bengal and was found to be a cost effective technique (Nandi *et al.,* 2017).

Apart from this, different pruning techniques like tip pruning can be used to encourage frequent flushing and branching of young trees to bring them into commercial production years early. It can also stimulate timely flushes of lateral stems in an annual program to maintain tree size and prepare trees for synchronous flowering. Severe pruning coupled with subsequent tip pruning of huge, non-productive trees facilitates rapid restoration of orchard production. Each of these types of pruning can be used to get fruit trees into production quickly and thereafter maintain maximum annual production while maintaining their desired size. Work done in this regard is reviewed as under.

Review of research work

Bending

Guava (B.N.: *Psidium guajava* L. Family: Myrtaceae)

Bagchi *et al.* (2008) opined that bending of lateral branches and partial removal of old leaves resulted in the highest mean number of fruits retained per branch as well as per tree, fruit weight and yield parameters in guava cv. 'Allahabad Safeda'.

Mamun *et al.* (2012) reported that variety 'Chiang Mai' (round) showed higher fruit yield during on-season. Higher yield during off-season and maximum shoots per branch during both seasons were observed in 'Swarupkathi' variety. Individual fruit weight and TSS were recorded higher in Chiang Mai (round). Among all treatments, 50% fruit thinning showed the highest fruit yield during on-season. However, during off-season highest yield and maximum shoot per branch during both seasons were observed in shoot bending. Whereas, 75% fruit thinning treatment resulted in highest TSS and individual fruit weight during on-season. During off-season, 100% fruit thinning registered maximum individual fruit weight and TSS.

In case of combined effect of variety and different management practices, 50% fruit thinning in 'Chiang Mai' (round) produced highest yield during on-season and 75% fruit thinning gave the highest fruit weight and TSS during on-season. 100% fruit thinning combined with 'Chiang Mai' (round) showed highest TSS and fruit weight during off-season. However, shoot bending treatment combined with 'Swarupkathi' gave the highest yield (off-season) and maximum number of shoot per branch (both season).

Samant *et al.* (2016) showed that branch bending treatment resulted in the highest number of shoots per branch, flowering intensity and recorded the highest yield in guava cv. 'Lucknow-49'. The longest non-flowering and flowering shoots as well as fruit weight were observed in 70% pruning. Fruit set percentage was maximum with 50% pruning treatment.

Nandi *et al.* (2017) opined that bending in June resulted in early emergence of new shoots, flower initiation and fruit set from the date of bending as well as the same treatment showed maximum fruit weight, fruit length, fruit diameter, pulp thickness and nitrogen percentage. Bending in the month of

October resulted in maximum C: N ratio of leaf with maximum flowering shootlets per branch, number of fruits per branch, number of fruits per plant and yield of guava cv. Khaja.

Mandarin (B.N.: *Citrus reticulata* L. Family: Rutaceae)

Budiarto *et al.* (2018) recorded that bended trees produced the longest flush, the highest number of leaves per flush, highest total branches and leaf area. The unbent tree had an ellipsoid canopy, while bent ones tended to have obloid shape. The maximum flowering trees (%), number of flowers, flower retention, higher fruit set and maximum number of fruits were observed with bending treatment in mandarin cv. 'Borneo Prima'.

Pruning

Mango (B.N.: *Mangifera indica* L. Family: Anacardiaceae)

Mango cv. 'Chausa' had the maximum shoot girth, flowering percentage and yield on heading back up to tertiary branches. Maximum tree height was observed in control and shoot length was noticed in heading back up to secondary branches. Whereas, the highest average fruit weight, fruit dimension and TSS were obtained in thinning out of central leader branches by Lal and Mishra (2007).

Uddin *et al.* (2014) observed that moderate pruning showed earlier new flushes in mango cv. 'BARI Aam-3'. The highest number of panicle emergence was seen in control whereas, severe pruning gave the highest yield of mango.

Solanki *et al.* (2016) showed that the minimum days taken to vegetative shoot emergence, earlier flowering, percentage of flowering, hermaphrodite flowers per panicle, percentage of fruit set at harvest and yield were observed when pruning was done in 1st fortnight of July. Whereas, minimum days taken to vegetative shoot emergence, earlier flowering, percentage of flowering, percentage of fruit set at harvest and maximum yield were reported with 25 cm of pruning intensity. In case of interaction effect, maximum percentage of fruit set at harvest and yield were observed during 1st fortnight of July with 25 cm of pruning intensity in mango cv. 'Kesar'.

Anonymous (2020) reported that foliar spray of 4% KNO_3 at 4th and 5th month after tip pruning recorded early emergence of panicle and number of fruits per tree in mango cv. 'Kesar'.

Guava (B.N.: *Psidium guajava* L. Family: Myrtaceae)

Thakre *et al.* (2016) reported that RLF induced the maximum new shoot emergence per branch in guava cv. 'Pant Prabhat'. The minimum tree height was registered under OLPS whereas the minimum crown spread and fruit volume were observed under FBTT treatment. The minimum trunk diameter, yield and fruit weight were reported with OLPF (One leaf pair pruning of fruited shoots) treatment. Further, FBT resulted in maximum fruit length and fruit diameter.

Lian *et al.* (2019) found that pruning of 25% of the shoot length in mid April was found best for plant height, collar girth, minimum days taken for first vegetative bud burst, longest shoot length, maximum number of fruit/plant and fruit yield. Whereas pruning of 50% of the shoot length in mid May recorded maximum fruit yield in guava cv. 'L-49'.

Phalsa (B.N.: *Grewia subinequalis* L. Family: Tilliaceae)

Meghwal (2006) observed that when pruning was done on 31st December at 120 cm height from ground level, phalsa showed the maximum plant height, number of branches pruned per shoot, total number of nodes, number of fruit per branch and fruit yield.

Lakra *et al.* (2018) opined that pruning and PGR's (90 cm + GA_3@200ppm + NAA@200ppm) gave significantly higher number of canes, early shoot sprouting, all flowering parameters and leaf parameters in phalsa.

Ber (B.N.: *Zizyphus mauritiana* L. Family: Rhamnaceae)

Kumar *et al.* (2014) reported that earlier sprouting, maximum shoot emergence and highest shoot length were observed with 60% pruning on previous season growth in ber cv. 'Banarasi Karaka'. Whereas, highest girth of primary shoot and yield were observed with 30% pruning on previous season growth of ber.

Gupta and Gill (2015) reported that yield of ber cv. 'Umran' decreased with an increase in pruning intensity. The maximum fruit length, fruit weight, fruit breadth and pulp percentage were obtained in trees pruned at 8th bud level followed by the trees pruned at 10th bud level. The fruit yield and stone weight were reported maximum in control treatment.

Conclusions

From the above discussion, it can be inferred that bending can be applied to improve flowering and fruit yield in mandarin and guava. The best time for bending in guava is October or June for higher profit from spring-summer or winter crop, respectively. Bending can also be combined with fruit thinning to improve yield and quality parameters.

Pruning techniques like heading back, thinning out and tip pruning (mango), pruning intensity (mango, guava, ber, phalsa etc.) at different levels either alone or in combination with PGR's can be used to improve growth, hasten flowering, improve fruit yield as well as quality parameters. Pruning intensity of 25 cm and pruning in 1st fortnight of July resulted in early and increased flowering with improved fruit set and yield in mango. Heading back up to tertiary branches and thinning out of central leader branches increased flowering, fruit weight and yield in mango. The best time of pruning guava was from mid April to May and for phalsa it was December. Further, 30% pruning on previous season growth promoted fruit yield in ber. Thus, there is ample scope for increasing productivity and quality in fruit crops by resorting to bending and pruning.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Sandeepkumar Labhubhai Sangani	**Course : PHT- 691**
Reg. No. : 1020214014	**Date : 30-12-2016**
Major Guide : Dr. Dev Raj	**Time : 4:00 to 5:00 pm**
Co- Guide : Dr. Virendra Singh	**Venue : Swami Vivekananda Hall**

Application of pre and probiotics in food industry

Health, fitness, well being, nutrition and freshness of the food are likely to drive the Indian food processing industry in the year ahead. So for the fulfillment of these needs; health oriented functional foods are urgently required. Functional foods may be fortified food or dietary supplements. Thus, a functional food is a foodstuff that provides health benefits in addition to its basic nutritional value. The functional foods can be classified into five different categories like conventional foods (whole foods), prebiotics (fibre incorporated foods), probiotics (useful microbes incorporated food), synbiotics (useful microbes and fiber incorporated food) and designer foods (nutraceuticals incorporated food) (Raj *et al.*, 2016). Among these prebiotics and probiotics are the most important. These are naturally occurring food compounds derived from a plant, animal or marine source which impart specific health benefits to human. Prebiotic foods are chemical or environmental precursors of life *e.g.* fibre and pectin etc. They are non-digestible or less digestible food ingredients that benefit the host organism by selectively stimulating the growth or activity of one or a limited number of probiotic bacteria in the colon. Pre-biotics are not digested in the upper part of gastrointestinal tract and reach the colon, where these are metabolized by bacteria residing in the colon and imparting beneficial effect to the host. Prebiotics are an alternative for probiotics. Probiotics are live- bacteria and yeasts that are called "the good" microorganisms because they benefit the body, specifically the digestive system. These are generally present in the guts of human intestine. Food preparation containing live bacteria and taken orally to restore beneficial bacteria in the body are called probiotic foods. Prebiotics and probiotics are available in various forms such as powder, liquid, gel, paste, granule and capsule *etc*. A synbiotic is a product containing both probiotic and prebiotic in which the prebiotic compound specifically favors probiotic compound.Combined mixtures of prebiotics and probiotics are often used because of their synergic effects. Thus, combination of prebiotic and probiotic often called synbiotic food possesses great potential for growth of the processing industry.

Brief Review of Research Work:

Effect on physico chemical properties

Renuka *et al*. (2009) conducted an experiment to know the changes in fructo-oligosaccharides in different fruit juices during storage. They reported significant decrease in fructo-oligosaccharide during storage period of six months and juice was found stable at 4^0C during six months storage.

Daneshi *et al*. (2012) studied the effect of probiotic strains on acidity of milk-carrot juice during storage at 4^oC. They observed that *Bifidiobacterium lactis* gave significantly minimum changes in acidity during storage period. They also reported minimum sedimentation in sample having *B. lactis*.

Deepa and Krishnaprabha (2014) conducted an experiment to study the effect of probiotic microorganism on nutrient content of muskmelon squash and revealed maximum phosphate, protein and calcium in treatment (V_1) having 50% whey water and 50% muskmelon juice, while treatment (V_2) having 60% whey water and 40% muskmelon juice gave high iron, beta carotene and total antioxidant value.

Gomah *et al*. (2014) conducted an experiment to study the effect of probiotic bio-yoghurt samples fortified with pomegranate juice, pith and debis on vitamin content. They concluded that bio-yougurt having 15 % pomegranate juice and 2% ABT (*Lactobacillus acidophilus, B. bifidum, Streptoccocus thermophilus*) culture gave maximum vitamin A and E.

Davim *et al.* (2015) studied the effect of fructo-oligosaccharides on fructose, sucrose, total sugars and pH of jam during storage. They concluded that there were decrease in fructose, sucrose while increase in total sugars and pH during storage period. Same trend was observed in juice. Further juice of different fruits gave increase in fructose, sucrose and total sugars while pH remain stable during 60 days of storage

Dacosta *et al*. (2016) observed that orange juice fortified with 2% oligofructose gave increasing trend in turbidity while decreasing trends in acidity and TSS during storage period.

El-Baily (2016) studied the effect of probiotic formulation on total polyphenols and flavonoids contents on rosella probiotic juice during storage period of 21 days at (4±1°C). They revealed that formula 4 having milk permeate+ *Bifidobacteria*+6% rosella gave minimum decreasing total polyphenoles and flavonoids.

Effect on Sensory quality

Pimentel *et al.* (2015) conducted an experiment to study the effect of different pre and probiotic formulation on sensor quality (9 point hedonic scale) of apple juice. They concluded that prebiotic having oligofructose having 20 g/liter gave higher appearance, flavour, texture and overall acceptability.

Bakr *et al.* (2015) studied the influence of storage period on the sensory properties of fennel honey bio-yoghurt. They revealed that bio-yoghurt having 5% honey gave higher value of flavor, body, appearance and overall score among different treatments.

Effect on Microbial quality

Kyung *et al.* (2005) studied the effect of fermentation time on viability of probiotic bacteria in beet juice. They reported non-significant increase in viable count for *L. casei, L. plantarum* and *L. delbrueckii* after 48 hour of fermentation in beet juice at 30 ^{0}C. They reported that there was decrease in viable count during the 4 week storage period but beet juice having *L. delbrueckii* gave higher viability during storage period of four weeks at 4^{0}C.

Kyung *et al.* (2006) conducted an experiment on effect of fermentation time on viability of probiotic bacteria in cabbage juice. They reported non significant increase in viable count for *L. casei, L. plantarum* and *L. delbrueckii* after 48 hour of fermentation in cabbage juice at 30 ^{0}C. They also concluded that there was decrease in viable count during the 4 week storage period but cabbage juice having *L. delbrueckii* gave higher viability during storage period of four weeks at 4^{0}C.

Pereira *et al.* (2012) studied response surface graph for biomass formation and viability of *L. acidopharus* in cashew apple juice during fermentation period. They reported maximum biomass growth at 35 ^{0}C with 6.5 pH while maximum viability was found at 30 ^{0}C with pH 6.5. Viability decreased above temperature of 35 ^{0}C. They also conducted an experiment on effect of inoculums concentration and fermentation time on viability (CFU/ml) of *L. casei* in cashew apple juice. They concluded that 14 hour of fermentation time viable count is maximum. They also observed that pH is decrease and viable count is increase up to 25 days of during storage period of 42 days.

Daneshi *et al*. (2012) conducted an experiment on the evaluation of different probiotic bacteria species in milk-carrot juice during storage period of 20 days. They reported that *L. acidophilus* having higher viability during storage period.

Gaanappriya *et al*. (2013) studied the activity index of probiotic (*L.acidophilus)* cultured pulp of different fruit against pathogens they reported that grape pulp and watermelon pulp having higher *S. aureus*, sapota and orange pulp having *Salmonella* higher activity index.

Bakr *et al.* (2015) conducted an experiment on bacteriological analysis of bio-yoghurt fortified with fennel honey during storage period. They reported that bio-yoghurt having 5% honey gave maximum value of total plate count, *thermophillus* count and *Bifidobacteria* count.

Effect on Human health

Conway (2001) conducted an experiment to study the effect of prebiotic food consumptionon faecal microflora (*Bifidiobacterium*) and reported increase in faecal microflora (*Bifidiobacterium*) after consumption of prebiotics.

Saavedra and Tschernia (2002) studied the effect of oligofructose supplemented food on various gastrointestinal related symptoms for one year. They reported that significant decrease in emesis, regurgitation, discomfort, flatulence and constipation during year.

Ooi and Liong (2010) conducted an experiment to study the effect of different prebiotics on lipid profiles and reported that consumption of inulin @10 g/day up to 3 weeks decrease triglycerides while consumption of chito-oligosaccharides @ 15g/day up to 20 days increased the density of lipo protein cholesterol. The consumption of galacto-oligosaccharides @ 5.5 g/day up to 10 weeks resulted no improvement in lipid profile.

Conclusions:

From the above research results, it can be concluded that prebiotics and probiotics foods derived from naturally occurring food sources can impart specific health benefits to human. Prebiotic foods having fibre, inulin, pectin, oligosaccharides are known to be chemical or environmental precursors of life. Prebiotics are non-digestible or less digestible food ingredients that benefit the host organism by selectively stimulating the growth or activity. For stimulating growth or activity probiotic foods play an important role. Thus, prebiotics are an important alternative for probiotics. Prebiotics and probiotics can be available in various forms such as powder, liquid, gel, paste, granule and capsule etc. Functional components like fibre, inulin, pectin, oligosaccharides can be used for fortification of the fruit juices and such fortified food (prebiotic) possess better nutritional and sensory quality even after storage period of 4 to 6 months. Probiotic microorganism like *Bifidiobacterium*, *L. acidophilus*, *L. plantarum*, *L. casei*, *L. delbrueckii*, *S.thermophillus*, *S. aureus* can be used for preparation of probiotics foods and possess significant effect on physico-chemical and sensory quality of foods although possess shorter shelf life. Prebiotics and probiotics foods are reported to have significant effect on human health. Thus, combination of prebiotic and probiotic often called synbiotic food are gaining momentum as one of the fastest growing functional ingredients.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Tanveer Ahmad Qadeer Ahmad.	**Course : PHT- 692**
Reg. No. : 1020214015	**Date : 19-11-2016**
Major Guide : Dr. Dev Raj	**Time : 3:00 to 4:00 pm**
Co- Guide : Dr. Y. N. Tandel	**Venue : Swami Vivekananda Hall**

Application of hot water treatment in banana, mango and papaya

Introduction:-

India is second largest producer of fruits in the world and also largest producer of banana, mango and papaya with production share of 27.8, 45.1 and 43.7 per cent, respectively. Despite such huge production, the post harvest losses are reported in the range of 20-25 % for banana, 25-40 % for mango and 40% for papaya (Anon., 2015). These post harvest losses are mainly due to microbial infection, insect infestation, physiological changes as well as physical damage. Among various spoilage causing factors insect infestations as well as microbial infection play an important role in augmenty post harvest losses. These fruit infestation/infection hinder the export potential of these fruits, thus causes heavy monitory losses. These losses can be minimized by application of irradiation, vapor heat treatment, waxing and hot water treatment.

Among these treatments, irradiation is banned in Japan; however, vapor heat treatment is costly treatment while hot water treatment is easy and simplest for its application. This technology involves dipping of commodities in mild hot water (50-55°C) for certain time to control fungal pathogen and insect in the harvested produce. Hot water treatment also helps to reduce the respiration rate, ethylene bio-synthesis and improve the post harvest quality of fruits. Dose of hot water treatment vary according to commodity and purpose of application to enhance the storability of fresh produce. Fungal spores and latent infections are either on the surface or in the first few cell layers under the peel of the fruit or vegetable. Most important feature of this technology is that the pathogenic microbes are killed by thermal processing treatment and produce may be popularised as chemical free. Thus hot water treatment is being easily applied as quarantine treatment before export.

Review of Research work:-

Banana (*Musa paradisica*):

Dissanayake *et al.* (2015) conducted an experiment to study effect of hot water treatment with different temperature and time duration for extension of shelf life of banana. They reported less microbial growth at 55°C for 10 and 5 minutes which was at par with 50°C. They also reported better colour retention of fruit at 40°C for 10 and 5 minutes.

Wall (2004) studied the effect of hot water treatment with different temperature (48, 49 and 50°C) and different time duration (5, 10 and 15 minutes) and reported that hot water treatment at 50°C for 10 minutes resulted better quality retention of banana fruit with maximum delay for ripening and minimum physiological loss in weight.

Varit and Songsin (2011) experimented to study effect of hot water treatment on chlorophyll content and firmness of banana. Hot water treatment of banana was given at 45°C temperature for 5, 10 and 15 minutes and 50°C for 10 minutes. They reported that hot water treatment at 50°C for 10 minutes resulted maximum firmness and chlorophyll content on banana fruit than the rest of treatment combination.

Promyou *et al.* (2008) conducted an experiment to study the effect of hot water treatment on retention of colour of banana peel. Hot water treatment of banana was performed at 42°C for 5, 10, 15 minutes and they recorded minimum banana peel blackening at 42°C when treatment given for 15 minutes.

Mango (*Mangifera india* L.):

Savani (2009) conducted an experiment to study the effect of hot water treatment, vapor heat treatment and pre-cooling for extension of shelf life of mango and reported that hot water treatment at 55±1°C for 6 minutes had less disease incidence and minimum ripening percentage of mango on 12^{th} days of storage.

Lizada *et al.* (1986) studied the effect of hot water treatment on disease incidence (anthracnose and stem end rot) of mango. The hot water treatment was conducted at 51±2°C and 53±2°C temperature for 10 minutes and compared with control. They reported that hot water treatment at 53±2°C completely inhibited the stem end rot while anthracnose was inhibited at 51±2°C. They reported that hot water treated mango fruits possessed non-significant difference for organoleptic score as compared to control.

Kumah *et al.* (2011) conducted an experiment to reduce the disease incidence of anthracnose during storage of mango treated with hot water treatment. In this experiment three temperatures *viz.*, 48°C, 50°C and 52°C for 5 and 10 minutes were studied along with control treatment and they reported that 52°C for 5 minutes had no disease incidence of anthracnose on 21 day of storage.

Waskar and Gaikwad (2005) reported that hot water treatment at 52°C along with 0.1% bavistin for 10 minutes and low cost cold storage at 24±3°C had minimum physiological loss in weight and maximum shelf life and organoleptic score. In biochemical parameters, hot water treatment at 52°C with 0.1% bavistin for 10 minutes along and storage at room temperature had minimum change in total soluble solid, total sugar and acidity when stored at room temperature.

Verghese *et al*. (2011) conducted an experiment to study the effect of hot water treatment on fruit fly at different regimes (Stages). Mango fruits were immerse in hot water at different temperature of 45°C & 48°C for 30, 45 & 60 minutes and 52°C for 10 & 20 minutes. They reported that hot water treatment of 48°C for 60 showed 100% mortality in all four regimes *i.e.* egg, 1st instar maggots, 2nd instar maggots and 3rd instar maggots with better sensory quality.

Anwar and Malik (2007) studied the effect of hot water treatment on biochemical and sensory characteristic of mango and reported that hot water treatment at 48°C for 60 minute had maximum biochemical composition and sensory score.

Papaya (*Carica papaya*):

Li *et al.* (2013) conducted an experiment to study the effect of hot water treatment on disease incidence of papaya and reported hot water treatment at 54°C for 4 minutes more effective to reduce the incidence of anthracnose and stem end rot of papaya. They also study effect of hot water on wax retention of papaya and reported that due to hot water treatment wax was evenly spread on fruit surface and resulted reduced disease incidence.

Zhao *et al.* (2005) studied the effect of hot water treatment on fruit yellowness index, respiration rate, ethylene production and firmness of papaya fruit during storage at 25°C and reported that hot water treatment have positive effect on metabolism during storage.

Lay-yee *et al.* (1998) reported hot water treatment at 48.5°C for 60 minutes better with respect to physico-chemical changes and organoleptic score and low disease incidence.

Conclusion:-

From above forgoing review it can be concluded that hot water treatment can help to increase the shelf life and reduced the incidence of pest and disease in banana, mango and papaya. In banana microbial growth can be reduced by hot water treatment at 50°C for 5 to 10 minutes. Mango fruit fly can be control by hot water treatment at 48°C for 60 minutes and while Incidence of anthracnose and stem end rot of papaya can be reduced by hot water treatment at 54°C for 4 min.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Vaghashiya Jaysukhbhai Manjibhai	**Course : PHT- 692**
Reg. No. : 1020215013	**Date : 18-03-2017**
Major Guide : Dr. Dev Raj	**Time : 3:00 to 4:00 pm**
Co- Guide : Dr. S. J. Patil	**Venue : Swami Vivekananda Hall**

Processing and value addition of *aloe vera*

Aloe vera (*Aloe barbadensis* Miller) belongs to the family Liliaceae, is the oldest medicinal plant ever known. The plant is native to North Africa and the desert regions of Arabia. It is grown in most of the tropics and warmer areas of the world including India, West Indies, Mediterranean countries, China and Sri Lanka. *Aloe vera* is perennial, short-stemmed succulent xerophytes. *Aloe vera* leaf structure is made up of three layers *viz,* outer layer (rind), middle layer (sap) and inner layer (gel). *Aloe* gel consists primarily of water 99 % and remaining 1 % solid material consist of polysaccharides, sugars, minerals, protein, lipid and phenolic compounds (Liu *et al.*, 2013). *Aloe vera* has medicinal properties like wound healing, anti-inflammatory, anti-aging, anti-cancer, anti-microbial etc. *Aloe* juice is utilized as functional foods especially for the preparation of health drinks with no laxative effects. It is also used in other food products including milk, ice cream, confectionery etc. *Aloe* is also used as flavoring component and preservative in some foods. *Aloe vera* gel processing and whole leaf processing are two methods for preparation of *Aloe* juice. Among these *Aloe vera* gel processing can be performed by either traditional hand filleting method or mechanical method. Time and temperature are necessary to preserve biological activities of *Aloe vera* gel. This process not only preserves the natural biological activities of *Aloe vera* but also enhances the physical stability of the finished products. Purified juice can be further used for making various value added products having long shelf life like gel, candy, jelly, pickle etc. However, crude *Aloe* juice has less acceptability due to the presence of Aloin. Aloin, also known as barbaloin, is a bitter and yellow-brown colored compound noted in the exudate of at least 68 *Aloe* species at levels from 0.10 to 6.6 % (3 % to 35 % of the total exudate). The compound is present in *Aloe* latex that exudes from cells adjacent to the vascular bundles; found under the rind of the leaf and in between it and the gel. Aloin increases peristaltic contractions in the colon, which induces bowel movements. In higher doses, these effects may lead to electrolyte imbalance, diarrhoea, and abdominal pain, which are common side effects of the drug. Extraction of aloin done by conventional and non-conventional method. For certification of *Aloe vera* products International *Aloe* Science Council (IASC) set up limit for different compound of processed *Aloe vera* products.

Review of Research Work

Beverages

Elbandy *et al.* (2014) studied the effect of different levels of *Aloe vera* juice (5, 10, 15, 20 and 25 %) on the microbial properties of mango nectar and reported a dramatic fall in the levels of total bacterial counts. Total bacterial counts decreased from $\log_{10}$ 3.9 ± 0.06 cfu/ml in control treatment at zero time point to $\log_{10}$ 2.05 cfu/ml as a result of higher *Aloe vera* juice addition.

Rani and Rao (2014) studied storage stability of *Aloe vera* based sapota blended squash. They observed higher per cent inhibition of peroxidation with higher level of *Aloe vera* in blends and after 90 day of storage per cent inhibition of peroxidation significantly higher in 40 % *Aloe vera* based sapota squash.

Vaghashiya (2015) standardized formulation of health drink (Nectar) by blending of *Aloe vera*, bitter gourd, aonla and guava. He observed significantly higher taste, flavour and overall acceptability (9 point hedonic scale) in 12 % *Aloe vera* based health drink.

Drying

Miranda *et al.* (2010) investigated the drying kinetics characteristics of *Aloe vera* gel at the five drying temperature (50, 60, 70, 80 and 90°C) and observed that higher drying temperature resulted higher decrease in the drying time. They also studied effect of drying temperature on rehydration ratio and observed that drying at higher temperature resulted decrease in rehydration ratio.

Intermediate moisture food

Rashid *et al.* (2014) studied the physico-chemical (fat & fibre) properties of orange marmalade supplemented with *Aloe vera* powder (0, 2, 4, 6, 8 and 10 per cent). They observed that fat content of marmalade decreased while fibre contents increased with increase in *Aloe vera* powder concentration.

Edible coating

Athmaselvi *et al.* (2013) investigated the effect of coating with different solid concentration (0, 1, 2 and 3 per cent) of *Aloe vera* on physiological loss in mass of tomato and reported lower physiological loss in mass of tomato coated with 2 % solid *Aloe vera* gel. They further studied the effect of coating with 2% solid concentration of *Aloe vera* on firmness, chrome value and lycopene content of tomato. They observed gradual decrease in firmness while gradual increase in Chroma value and lycopene content during storage of tomato when coated with 2% solid *Aloe vera* gel.

Aloin removal

Chang *et al.* (2006) studied the effects of thermal treatment (60, 70, 80 and 90°C) on the stabilities of barbaloin in *Aloe vera* juice. They observed that higher temperature and longer period of heat treatment may provide more effect on the instability of barbaloin and most rapid decline was obtained at 90°C, while the least declines was obtained at 60°C under the present conditions. They also studied influence of solvents (methanol) on the stability of barbaloin at refrigerated temperature (4°C) and observed that barbaloin content decreased gradually and the amount of aloe emodin generated with time, however, these two substances are in a quantitative imbalance of mole, *i.e.* more barbaloin disappeared than aloe-emodin is produced.

Aloin extraction

Jawade and Chattopadhyay (2011) optimized batch extraction parameters (solvent) for aloin extraction from *Aloe vera*. They extracted aloin from dry *Aloe* gel in different solvents like methanol, ethanol, isopropyl alcohol (IPA) & water by giving treatment for one hour in batch extraction at 30°C and reported maximum extraction of aloin in methanol. It decreased gradually with ethanol following water and comparatively low in IPA.

Conclusions

Aloe vera crop possess great potential for processing and value addition owing to its medicinal properties and importance. *Aloe vera* gel show promise in usefulness for value addition of *Aloe vera* because gel increase overall acceptability and nutritional value of process products. *Aloe vera* gel inhibits peroxidation and reduces total plate count. *Aloe vera* can be used for preparation for different value added products like powder, juice, beverage, jam, jelly, marmalade, pickle, candy etc. Coating of tomatoes with *Aloe vera* gel reduce physiological loss, retains colour & glossy appearance and decelerated ripening process. Thus, processing and value addition of *Aloe vera* can drive the *Aloe* beverage industry in future to augment the income of farmers. Further, these techniques can improve product quality and safety by preserving the bioactive chemicals naturally present in the intact *Aloe vera* leaf.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Vaghashiya Jaysukhbhai Manjibhai	**Course : PHT- 691**
Reg. No. : 1020215013	**Date : 26-11-2016**
Major Guide : Dr. Dev Raj	**Time : 10:00 to 11:00 am**
Co- Guide : Dr. S. J. Patil	**Venue : Swami Vivekananda Hall**

Applications of ozonization in food processing industry

The growing demand for high quality fresh and processed food leads to development of several processing methods. In food processing, food sanitation is one of the best approach to extend the self-life of food with better quality attributes. The sanitation helps to control infection and disease in food, thus reducing emission of microbial contaminants and hazardous substances. Food sanitation can be achieved by various technologies *viz.* simple water washing, washing with chlorine and hydrochlorides, UV light treatment or ozone treatment *etc.* Ozone (O_3) is a best alternative to chlorine and other chemical disinfectants for cleaning and disinfection of food. This operations is based on high oxidation-reduction potential of O_3 (2.07 V) compared to chlorine (1.36 V) and chlorine dioxide (1.27 V). Ozone inactivates microorganisms through oxidization. Residual O_3 spontaneously decomposes to non-toxic product *i.e.* oxygen, thus making it an environment friendly anti-microbial agent for use in the food industry (Kim *et al.*, 1999). The biocidal characteristic of O_3 is due to combination of its high oxidizing potential and its ability to diffuse through biological membranes. Global legislation governing ozonization has been developed in response to the increasing use of O_3. Ozone applications can be used for water treatment, surface and equipment cleaning, food produce washing, controlled atmospheric storage and more recently as a direct food additive. Ozone is generated by reaction of free radicals with diatomic oxygen to form triatomic oxygen molecules. There have been significant developments in methodologies of O_3 production including corona discharge and UV radiation which make ozonization a more environment friendly for application in food processing. Ozone (O_3) treatment can be applied in food either by the washing using ozonated water (aqueous application), the use of gaseous O_3 during storage (gaseous application) or direct application as food additives. O_3 is approved by Food and Drug Administration (FDA) for successfully applications including surface decontamination to extend the shelf life of fresh produce, decontamination of packaging materials, disinfection of process water, sanitization of processing equipment, disinfection of food storage areas etc.

Brief Review of Literature

Aqueous application

Alexandre *et al.* (2011) investigated the effect of ozonated water washing on log-reduction of total mesophiles in strawberries & total coliform in watercress and revealed that the impact of ozone in reducing total microbial load was significantly higher at 2.0 ppm ozone concentration when treated for 2 to 3 min.

Keivanloo *et al.* (2013) investigated the effect of ozonated water on mortality of egg & larvae of Indian meal moth in stored products. Ozone was applied in aqueous form at four different concentrations (0, 2, 3 and 5 ppm) for four different periods (30, 60, 90 and 120 min) and revealed that the rate of mortality increased with increasing of concentration and exposure time.

Marzouk and Mohamed (2014) studied the effect of ozonated water treatments on the reduction of insecticides residues (chlropyrifos) in potato. Potato samples were treated with ozonated water at 10 ppm and 20 ppm for 30 min and observed that ozonated water had profound effect in reducing insecticides residues and the potency of reduction was increased with increasing ozonated water concentration.

Beltran *et al.* (2005) investigated the effect of ozonated water as a sterilizer on the anti-oxidant constituent (Vitamin C) of fresh cut lettuce. Fresh-cut iceberg lettuce was washed at 4°C using three different ozonated water dips treatments [10 mg l^{-1}, 20 mg l^{-1}, and 10 mg l^{-1} activated by ultraviolet C (UV-C) light] and the dips were compared with water and chlorine rinses (80 mg l^{-1}). Treated lettuce was packed in modified atmosphere packaging (MAP) and stored for 13 days at 4 °C. The results revealed that the shredded lettuce washed with 20 mg l^{-1} ozonated water possess the lowest content of vitamin C but remained stable during storage.

Gaseous application

Feliziani *et al.* (2014) studied the influence of ozone concentration on growth of gray mold on different varieties of grapes 'Thompson Seedless', 'Flame Seedless' and 'Princess Seedless' during storage at 2°C when packed within uncoated paper corrugate boxes and observed that ozone application significantly reduced the natural incidence of gray mold among different varieties of grapes up to approximately 65% after 5-8 week of storage.

Alencar *et al.* (2014) evaluated the effect of ozone (100 ppm for 60 min) on total count of aerobic mesophilic, mould and yeast in pear during storage at 25°C for 13 days and observed rapid growth of aerobic mesophilic colony in non-ozonated pear up to 9th day of storage followed by decrease in count which might be due to decrease in pH while for mould and yeast rapid growth was observed after day 9 of storage. Aerobic mesophilic, mold and yeast count in ozonated pears were lower than untreated pears during storage period, thus confirming the ozone microbicidal effect for its application as most potent sanitizer. Circular brown spots of anthracnose were appeared on untreated pear fruits after six day of storage.

Yaseen *et al.* (2015) studied the effect of gaseous ozone (0.5 µL/L) on *Penicillium expansum* during storage of apple cv. Fuji at 1°C and 95% RH for 2 month and observed that untreated fruits stored in conventional atmosphere (1°C & 95% RH) showed 75% infection. While, ozone treated fruits observed less than 5% infection after 60 day of storage period. Ozone treated fruits observed no patulin production up to 60 days.

Tran *et al.* (2013) studied the effect of ozone fumigation on ethylene production in mango fruit and observed that ozone treatments (2 $\mu L\ L^{-1}$ for 20 min or 10 $\mu L\ L^{-1}$ for 10 min) significantly reduced ethylene production immediately after treatment and the ethylene production of untreated fruit were about 1.5-fold higher than treated fruit after ozone fumigation. They also observed that high ozone application significantly reduced respiration rate of mango fruits after 4th day of storage.

Meyer *et al.* (2014) studied the effect of different treatments (air storage, controlled atmosphere storage or ozone chamber storage) on weight loss of blueberries during storage at 4°C and 12°C for 10 days and observed the significant differences in weight loss in treatments stored at 12°C. Significantly less weight loss was observed in ozone treated blueberries at 12°C. Weight loss of fruit stored at 4°C showed no significant difference among different treatments.

Direct application as food additives

Torres *et al.* (2011) compared ozone (4.8% w/w for 10 min to achieve 5-log reductions for E.coli) treated apple juice with fresh apple juice to study the effect of ozone treatment on quality parameter. Application of ozone resulted increase in 'L' & 'b' value of colour while decrease in 'a' colour value. Decreases in phenolic content were observed in the treated juice which might be due to oxidation of the phenols in presence of ozone.

Conclusion:

It can be concluded that 'ozonization' known to be a novel technology possess great potential for cleaning of fruit surface, decontamination of packaging material, disinfection of water, reducing microbial contamination and killing insects to extend self life of some of the food products. Continuous exposure of fresh food commodities to O_3 during storages can reduce postharvest decay and microbial spoilage of fruits and vegetables. The ozone can also be applied as direct food additives and can be considered for its application as a preservation technique. Thus, due to its enormous advantages over other disinfectant agent, this novel application *i.e.* ozonization is recommended for the processor to use food processing industries.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker : Zinzala Paresh Bhikhabhai	**Course : PHT- 691 (1+0)**
Reg. No. : 1020216010	**Date : 07/10/2017**
Major Guide : Dr. Dev Raj	**Time : 3:00 to 4:00 pm**
Co- Guide : Dr. B. N. Patel	**Venue : Swami Vivekananda Hall**

Recent advances in application of extrusion technology

Today's lifestyles are vastly different from those of the past, due to increase in number of single person households and gender equality rights. Such changes in lifestyle lead to changes in food preparation and consumption habits especially during morning hours as peoples do not have time to cook their own food. A outcome of this has resulted rapid advancement in food technology. Further increase demand for non-meat, high-protein products have made food processing industry a highly profitable ventures. Extrusion-technology is gaining popularity in the global agro-food processing industry, particularly in the food and feed sectors. Extrusion cooking technologies are being used for cereal and protein processing in food industry. Extrusion processing functions includes conveying, mixing, shearing, separation, heating or cooling, shaping, co-extrusion, venting, volatiles and moisture, flavor generation, encapsulation and sterilization. It has become an important technique for increasing variety of food. The extrusion technology have several benefits like inactivation of anti-nutritional factors, versatility, high productivity, low cost, variable product shapes, high quality production of new food and even without effluents. Extrusion cooking is being increasingly used to manufacture a diverse range of food. This technology has significant contribution to the diet of sub groups in the population who may be potentially vulnerable to mineral deficiencies. In the extrusion of snacks and other food products, proper control of the extrusion process is of vital importance to maintain the quality of the final product. Now a day's consumers do choice for nutritionally rich, therapeutic benefits and for attractiveness especially in case of baby foods. Thus to obtain above mentioned designer food, application of extrusion technology is of almost importance. (Raj *et al.* 2016)

Brief Review of Research Work

Pracha and Chulalak (2000) studied the development of nutritious soy fortified snack by extrusion cooking and reported that with the increase in the content of defatted soy flour (DFS) from 0 to 6, 12, 18, 24% there as increase in protein from 42.39, 82.75, 110.14, 145.84%, respectively as compared to control. They also studied the sensory property of soy fortified snack prepared by extrusion cooking and found higher acceptance for soy fortified snack prepared from 6% DSF.

Altan *et al.* (2008) evaluated snack foods prepared from barley–tomato pomace blends by extrusion processing and found that the overall acceptability of the barley flour and tomato pomace extrudate ranged lowest (3.94) in extrudate A (0% pomace level, 150 °C, 175 rpm) and highest (5.23) in extrudate D (10% pomace level, 160 °C, 200 rpm).

Altan *et al.* (2009) studied the effect of extrusion process on antioxidant activity, total phenolics and β-glucan content of extrudates developed from barley-fruit and vegetable by-products and found lowest antioxidant activity (13.65) in extrudate B (2% pomace level, 200 °C, 160 rpm) and highest (18.18) in extrudate D (10% pomace level, 160 °C, 200 rpm).

Dehghan *et al.* (2010) investigated the physico-chemical characteristics of extruded snacks enriched with tomato lycopene and concluded that the moisture content of the extruded products varied between 5.63% and 12.33% across all treatments and the greatest loss of water occurred in the extruded products made with tomato skin. They also found significant effect of starch and lycopene source on expansion of extruded products.

White *et al.* (2010) studied the polyphenolic composition and antioxidant capacity of extruded cranberry pomace and reported that the anthocyanin losses were dependent upon the level of pomace in the extruded mixture. The least loss in anthocyanins was observed in the mixture containing 30% pomace and an increase in total flavonols was observed upon extrusion at all conditions when compared to an unextruded control. They also reported that the antioxidant capacity of cranberry pomace was increased with the increasing of temperature.

Larrea *et al.* (2005) conducted an experiment to study the effect of some operational extrusion parameters on the constituents of orange pulp and showed that the total dietary fiber content decreased with higher barrel temperatures and lower moisture contents with the screw speed fixed at 160 rpm and they also reported significant influence of moisture content and screw speed on the total pectin of the orange pulp.

Sibel and Fahrettin (2009) studied the development of extruded snack from food by-products by response surface analysis and found the highest sensory score of extruded snack made from 8% durum clear flour, 15% partially defatted hazelnut flour and 7% fruit waste.

Meng *et al.* (2010) studied the effect of extrusion conditions on system parameter and physical properties of a chickpea flour-based snack and they reported that extrusion condition having 16.0 % feed moisture, 320rpm screw speed and 170 °C barrel temperature possess maximum expansion ratio (4.99) , low bulk density (0.130 g/cm^3) and hardness (198 N) of chickpea flour-based snack.

Chaovanalikit *et al.* (2003) reported that ascorbic acid fortification reduces anthocyanins in extruded blueberry-corn cereals. The total anthocyanin content in blueberry extrudates ranged from 10.8 to 11.9 mg/100g whereas the mixture of corn plus blueberry concentrate contained 34.9 to 36.7 mg/100g.

Conclusion

Extruders permit the production of many foods of nutritional importance. The ability of extruders to blend diverse ingredient in novel foods can be exploited for the development of functional foods. The quality of traditional snacks or breakfast cereal can be enhanced by fortification with fiber or whole grain flour. For getting maximum quality of extruded products, the process parameter like 16.0 % feed moisture, 320rpm screw speed and 170 °C barrel temperature can be used.

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NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker	**: Gurjar R. A.**	**Course**	**: FLA 692**
Reg. No.	**: 1020215003**	**Date**	**: 21/04/2018**
Major Guide	**: Dr. S. L. Chawla**	**Time**	**: 10:00 to 11:00 am**
Co-Guide	**: Dr. Dev Raj**	**Venue**	**: Swami Vivekananda Hall**

Effect of edible coating on shelf life of horticultural produce

Nowadays, fruits and vegetables are highly demanded in the market because of its nutritional value. Fruits and vegetables have short shelf life due to its perishable nature. About 30% fruits and vegetables are affected or damaged by insects, microorganisms, pre and post harvesting conditions during different stages; thus, leading to heavy post-harvest losses of the fresh horticultural produce. Efforts are being made constantly to extend the shelf life of fresh fruits and vegetables by means of low temperature, modified atmosphere packaging, irradiation, coating, etc. Among various measures, edible coating is one of the promising method because of its peculiar properties to avoid moisture and aroma loss, inhibit the oxygen penetration to the produce tissue and prevent microbial growth. In addition, edible coating is convenient, biodegradable, eco-friendly and conforms to food safety. Many materials such as polysaccharides, proteins, lipids and resins, etc. are being utilized as edible coatings for extension of shelf life of horticultural produce.

Brief Review of Research Work

Polysaccharide based coating

Kalindi and Patil (2016) reported that coating of the harvested fruits with 5% acacia gum minimized the physiological loss in weight and increased the shelf life of fruits without deteriorating quality in terms of aroma, colour and flavor of mango cv. 'Kesar'.

Khaliq *et al.* (2016) demonstrated that combine application of gum Arabic (GA) 10% and chitosan (CH) 1% coatings delayed the ethylene production and respiration rate of mango (*Mangifera indica* L. cv. Choke Anan) fruit. Significant ($P \leq 0.05$) differences were observed in fruits treated with GA 10% and CH 1% as compared to the control. The ethylene production and respiration peak was observed in the control fruits after 14 days of storage. On the other hand, fruit treated with GA 10 % + CH 1% showed the same peak after 21 days of storage and afterward the ethylene production and respiration rate decreased up to 28 days.

Ganvit (2014) found that among the different coating treatments, the fruits of mango cv. Kesar coated with 15 % acacia gum had significantly higher shelf life. Coating with 15% acacia gum as well as 75% *Aloe vera* gel found better coating materials with respect to economic feasibility.

Padmaja and Bosco (2014) studied the effect of *Aloe vera* proportion on quality attributes *viz*., visual aspects, firmness, crunchiness, juiciness, sweetness and sourness of coated jujube fruits. Based on the sensory scores, coating of jujube fruits with *Aloe vera* having proportion of 1:3 (water : *Aloe vera*) possess higher overall acceptability.

Ali *et al*. (2013) reported that tomato fruits coated with 10% gum arabic retained higher total lycopene content and total carotenoids during storage as compared to the uncoated tomatoes.

Adetunji *et al*. (2012) studied the effect of coating of pineapple fruits with *Aloe vera* gel. Significantly higher firmness was recorded in *Aloe vera* gel coated pineapple fruits when compared to uncoated pineapple fruits during seven week storage period at ambient temperture of 27± 2°C. The weight loss of the coated fruits was significantly lower than the uncoated fruits during seven week storage. The Ascorbic acid content of *Aloe vera* gel coated fruits were significantly higher than the uncoated fruits during seven week storage.

Zhu *et al*. (2008) investigated the effects of chitosan coating on disease incidence and firmness of mango fruits (*Mangifera indica* L. cv. Tainong). They reported that loss of firmness and disease incidence in mango fruits was efficiently inhibited by 2.0% chitosan coating during storage.

Lipid/Mineral oil based coating

Bisen *et al*. (2012) studied the effect of different treatments on quality of lime fruits and concluded that the lime fruits coated with pure coconut oil had minimum PLW and maximum (70.1%) marketable fruits after 18 days of storage.

Chaudhary (2011) conducted an experiment to study the effect of coating under two different storage conditions in guava and reported that significantly maximum shelf life in treatment combination of 10% wax emulsion stored in ZECC. The respiration rate in fruits at 3rd day of storage was observed significantly minimum.

Ghadage (2011) reported that coating of papaya fruits with 8 % wax emulsion had resulted significantly minimum PLW, during storage period of four days.

Composite coating

Amiri *et al.* (2018) evaluated the effect of different coating treatments on TSS of the apple slices. They reported that coating of apple slices with BF2 (gelatin, 1.0%; citric acid, 0.1%; calcium chloride, 0.5%; and ascorbic acid, 0.5%) along with 150% *Aloe vera* extract showed a slight increase in TSS compared to the control sample to sixteen days storage period.

Radi *et al.* (2017) evaluated the effect of gelatin coating incorporated with aloe vera gel (50, 100%) and green and black tea extracts (5, 10%) on fresh-cut oranges at 4°C for 17 days. The weight loss was increased with time, but the coating treatment especially with 100% *Aloe vera* had significant effect on the prevention of weight loss. Coating with gelatin incorporated with *Aloe vera* and green tea extracts successfully retarded the microbial growth and therefore extended the shelf life of fresh-cut oranges during cold storage.

Chitravathi *et al*. (2014) reported that shellac plus sodium alginate coating on *Capsicum annum* significantly reduced weight loss, respiration rate, maintain color and firmness. Shellac plus sodium alginate coating had the highest ascorbic acid value. Shellac sodium alginate based coating extended the shelf life of capsicum fruits by 12 days under ambient storage conditions against 5 days in the case of uncoated ones.

Fakhouri *et al.* (2014) studied the ability of gelatin coatings containing cellulose nanocrystals (CNC) to extend the shelf-life of strawberry fruit (*Fragaria ananassa*) over 8 days. The weight loss after 8 days of storage observed around 65% in uncoated samples, while coated samples loss was in the range of 31-36%.

Commercial coating

Baldwin *et al.* (1999) reported that Tropical Fruit Coating (TFC) coated mango fruits showed less weight loss (1.4 %) and loss decay percentage (1%) when stored in glass jars during 19 days storage at 15°C with 99 % RH and four days at 20°C with 56 % RH.

McGuire and Hallman (1995) revealed that 5% carnauba wax consistently retarded weight loss in stored guava fruits more effectively than formulation of hydroxypropyl cellulose.

Conclusion

Among various measures, edible coating is one of the promising method to extend the shelf life of horticultural produce because of its peculiar properties to avoid moisture loss, aroma loss, inhibit the oxygen penetration to the produce tissue and prevent microbial growth. In addition, edible coating is convenient, biodegradable, eco-friendly and conforms to food safety. Edible coatings such as polysaccharides based *viz.*, Acacia gum (10%, 15%), *Aloe vera* 75%, chitosan (2%), etc., lipid (waxes)/ mineral oil based, composite and commercial coatings can extend shelf life and maintain quality of produce by reducing PLW, respiration rates, postharvest disease incidence etc. and by retaining quality attributes like firmness, aroma, color, nutrient content and marketability etc.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker	**: Bharai Rambhai Boghabhai**	**Course**	**: PHT- 691 (1+0)**
Reg. No.	**: 1020217004**	**Date**	**: 04/05/2019**
Major Guide	**: Dr. Dev Raj**	**Time**	**: 09:00 to 10:00 am**
Co-Guide	**: Dr. B. N. Patel**	**Venue**	**: Swami Vivekananda Hall**

Applications of freeze dehydration in food processing

Freeze dryingis relatively new process of drying high value food in vacuum at low temperatures to ensure the preservation of all thermolabile compounds present in the fresh raw material.Low moisture content in freeze dried food provides microbiological stability and thus helps in permanent preservation of products.The process of freeze drying is one of the important methods for preservation of raw materials of plant origin viz. fruits, vegetables, spices and herbs. The main principle involved in freeze drying is a phenomenon called sublimation, where water passes directly from solid state (ice) to the vapor state without passing through the liquid state. Thus,freeze drying is a process in which water is removed from a frozen food (-18˚C)by dryingunder a vacuum at relatively low temperature (30˚ to 50˚C), allowing the ice to change directly from solid to vapor without passing through a liquid phase. This process is also called lyophilization. Freeze dried products are very hygroscopic in nature and thus do require special storage conditions *e.g.* absence of light, packaging materials with low gas permeability, inert atmosphere, *etc*.Freezedehydratedfoods are of high value with delicate aroma *e.g.* mushrooms, herbs and spices, fruit juices, meats, seafood or complete diets for military use. These freeze dried products can be used for preparation of instant soups, bakery, dairy and confectionery products. Thusfreeze-drying is one of the most important method for preservation of high value food with higher retention of their nutritional composition.

Review of research work:

Tea

Mahanom *et al*. (1999) studied the stability of phyto-chemicals in relation of different drying methods on herbal tea. Freeze drying was found superior to oven drying at 50°C ± 1°C for 9 hour and 70°C ± 1°C for 5 hour on the basis of higherretention ofchlorophyll, riboflavin, niacin, ascorbic acid and carotenoids.

Tomato

Chang *et al.* (2005) carried outcomparisons of ascorbic acid contents in fresh, freeze-dried (FD), and hot- air-dried (AD) Sheng-Neu (SN) and I-Tien-Hung (ITH) tomatoes and reported lower decrease of ascorbic acid content in freeze dried tomato(8.2 and 10%) as compared to air dried (61% and 56%) samples of both variety.

Papaya and pineapple

Marques *et al*. (2007) studied vitamin C content of fresh, freeze and air-dried papaya and pineapple fruits. They reported minimum decrease in ascorbic acid in freeze dried papaya and pineapple as compared to convective dried samples.

Pandey *et al.* (2014) studied the effect of different drying methods on quality parameters of papaya powder and observed that freeze dried papaya powder had better quality in terms of color, taste, flavor, appearance, texture and nutrient retention as compared to oven dried papaya powder.

Mango

Mahendran (2008) conduct the experiment to study the effect of different drying methods on the quality characteristics of mango powder and found higher sensory quality score in freeze dried mango powder as compare to other drying methods and also observed higher stability of ascorbic acid and total carotenoid content. The retention of carotenoid and ascorbic acid contentswas found higher in freeze dried mango powder.

Jack fruit

Kumar *et al*. (2008) evaluated jack fruit powder prepared by different drying methods on the basis of sensory score like colour, taste, flavor, texture, overall acceptability and reported higher score in freeze dried powder compared to hot air oven drying method.

Carrot

Yan *et al*. (2010) conducted the experiment to study the effect of different dying methods on retention of vitamin C content and β-carotene in carrot slices. The β-carotene content varied significantin carrots samples which were dried by different drying methods. They reported that the β-carotene content in microwave-assisted freeze drying (MWFD) carrot pieces was the highest and the value was close to that of fresh carrot. However, the β-carotene contents inmicrowave- enhanced spouted bed drying (MWSD) and microwave-assisted vacuum drying (MWVD) carrot pieces decreased about 70% when compared to fresh carrots. The retention of vitamin C in dried carrot slices was also highest in MWFD samples, while the vitamin C content was relative low in MWVD and MWSD samples.

Aonla

Bhattacherjee *et al*. (2012) observed theeffect of drying methods on the ascorbic acid content of dried aonla powder.Maximum ascorbic acid content was found in freeze dried powder (3593 mg/100g) followed by spray dried (3282 mg/100g) and cabinet dried (3243 mg/100 g) powder.The lowest amounts of ascorbic acid were observed in sun dried powder (2233 mg/100 g).The oxidation reaction in cut pieces of aonla during sun drying might be the cause for low ascorbic acid content and high NEB (1.98 OD) with dark brown colour (whiteness index –160.70) in powder.

Guava

Ali *et al.* (2016) studied the influence of different drying treatments on ascorbic acid content of driedguava.The highest concentration of ascorbic acid was found in freeze dried samples followed by sample dried in microwave (100 W) and oven (80°C) treatments. They revealed freeze drying as the best method for the dehydration of guava with respect to retention of ascorbic acid content.

Shishir*et al.* (2018)studied the effect of different drying methods on quality attributes of pink guava powder and reported that lycopene content and vitamin C were higher in FD powder than SD powder. The retention of vitamin C and lycopene contents were higher at lowmaltodextrin concentration(MDC) in FD powder. A higher MDC increased the content of maltodextrin in FD powder, which resulted in lower values of vitamin C and lycopene content in powder.

Blueberry

Hien *et al*. (2016) studied theeffect of drying methods on the anthocyanidin content of dried blueberry.Anthocyanidin content in dried blueberry by the freeze drying method was observedsimilarto fresh blueberry. Other drying methods resulted reduction in anthocyanidin content in dried blueberry, especially with hot-air drying method.

Date

Asma *et al.* (2018) observed theeffect of drying methods ontotal phenolics content in date fruits. Maximum value of TPC (290 mg GAE/100g DW) was observed for freeze drying, while (265.7 mg GAE/100g DW) for sun drying and TPC wasreported lowest in oven drying (242.23 mg GAE/100g DW). Total flavonoid content was also reported highest for freeze drying, followed by (46.711 mgQEQ/100g DW) in oven drying and the minimum concentration was observed in sun drying.

Hawthorn

Hacer *et al*. (2018) observed browning index of fresh and dried hawthorn fruit.Maximum browning was observed in microwave pre-treated oven drying (245.43 OD) and followed by oven drying (200.72OD). Minimum browning was observed in hawthorn fruits dried withfreeze drying (149.9OD) as compared to microwave pretreated oven drying.

Conclusion:

From the foregoing discussion it can be concluded that 'freeze drying'is comparatively better drying method than conventional drying method, because of retention of bettercolour, flavour, taste, texture and overall acceptability. Besides this freeze drying resulted better nutrient retention and minimum loss of heat sensitive nutrients. Freeze drying process is one of the most convenientfood preservation methods for drying of high value food commodities like blueberry, hawthorn, herbal tea, mushroom, strawberry, guava, papaya, date, mango *etc*., ascompared to other commercial preservation techniques.

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NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker	**: Patel Prasulkumar Rameshbhai**	**Course**	**: FSC 692 (1+0)**
Reg. No.	**: 1020216009**	**Time**	**: 04:00-05:00 pm**
Major Advisor	**: Dr. B. N. Patel**	**Date**	**: 15/11/2019**
Co-guide	**: Dr. Dev Raj**	**Venue**	**: Swami Vivekanand Hall**

Advances in application of edible coatings in fruit crops

Introduction

Presently, fresh fruit are most demanded in the market because of its good nutritional value. Due to perishable nature of fruit, it has a very short shelf life. Major losses in quality and quantity of fresh fruit occur by microorganisms, insects, pre storage and post harvesting conditions during transport . In the modern era, the application of bio-based material as a way of enhancing the shelf life of highly perishable produce is promising. Edible coatings can provide an additional protective coating for fresh produce and can also give the same effect as modified atmosphere storage in modifying internal gas increase composition. Edible coating as an upcoming technique is a good alternative to the shelf-life of fresh-cut fruits, offering a semi-permeable hurdle against moisture, gases, aroma, and flavor compounds; thus maintaining the fruits quality during storage. In addition, edible coatings can be utilized as carrier of active compounds, such as antimicrobial agents, to decrease the population of pathogenic and spoilage microorganisms. Recently, various coatings are being used for preserving fruit such as mango, sapota, plums, peach, apples, jack fruit, papaya, orange, grape, banana and strawberries.

Owing to various advantages such as maintenance of fruit quality in the form of firmness, freshness and nutrients; the demand for minimally processed food gave rise to rapid development of the fresh-cut fruit and vegetables in the recent years. This is mainly because of busy lifestyles, an upsurge in health awareness and increased procuring capacity of the customer. Among different post-harvest management strategies of fresh fruit handling, use of edible coatings have been reported to be very useful. Edible coating is an environment friendly technology applied on many products to control moisture transfer, gas exchange or oxidation processes. They provide an additional protective coating to the produce. The coatings form a semi-permeable barrier to water vapor and gas exchange, leading to weight loss reduction, respiration rate modification, and delay of senescence.

Edible coating

Edible coatings are thin layer of edible material formed as a coating on a fresh produce and is usually applied by immersing the product in a coating solution.

Review of Research

Mango

Kalindi Patel *et al.* (2017) observed that coating of mango fruit with 5% *Acacia* gum increased acidity, TSS: acid ratio, firmness, shelf life and reduced PLW while 75% *Aloe vera* gel decreased total sugar, reducing sugar, non reducing sugar and increased ascorbic acid in mango.

Amulya *et al*. (2016) showed that reduction in respiration rate, PLW, moisture content and increased in TSS of mango fruit up to 20 days storage was obtained when fruit were treated with the edible wax coating and packed in LDPEpacking.

Banana

Shaik *et al*. (2017) recorded that edible coating of Chitosan + Tween 80 + Lactic acid increase firmness, total sugar, reducing sugar and reduce weight loss in banana during storage up to 10 days

Sapota

Komal Patel (2014) noted minimum TSS (19.08 %), total sugar (11.74 %), reducing sugar (5.05 %), non reducing sugar (6.69 %), maximum acidity (0.15 %) and ascorbic acid (12.21 %) were observed in sapota fruit coating with 75 % *Aloe vera* gel + 5 % tapioca starch.

Papaya

Marpudi *et al.* (2011) found that edible coating with PLEG (papaya leaf extract incorporated *Aloe* gel) increase TSS, fruit colour, firmness, taste with reducing, PLW and titratable acidity in papaya fruits stored up to 15 days at 30 ± 3 ^{0}C.

Guava

Ola (2018) revealed that application of edible coating of guava fruit with Chitosan 2 % and calcium gluconate 2 % shown lower fruit decay percentage and higher fruit firmness and ascorbic acid content at 21 days of cold storage over control.

Jackfruit

Teja *et al*. (2016) found that fruits coated with pectin increases taste, flavour and overall acceptability in jackfruit

Custard apple

Van *et al.* (2018) observed that minimum weight loss, TSS, respiration rate, titratable acidity and maximum fruit firmness were recorded in custard apple fruit coated with 1% CMC or gum *Arabica*.

Jamun

Neeta gol *et al*. (2015) reported that edible coating of jamun fruit with CMC 1.5 % reduces weight loss (%) and decay (%) of fruit at 16 days storage compare with control.

Apple

Yousuf and Singh (2018) reported that minimum yeast /mould count in fresh cut apples was found with edible coating of 0.50 % soybean oil and sago @ 4 % at 12 days of storage period while aroma, taste, colour, juiciness and texture were register in oil 0.5 % with 3, 4, 5 % sago on fresh cut apple.

Peach and Plum

Guillen *et al.* (2013) found that reduction in ethylene production, respiration rate, weight loss and delay in ripening with better colour and firmness in peach and plum fruits were coated with either *Aloe vera* or *Aloe arboresence* gel and allowed to ripen at 20^{0}C for six days.

Strawberry

Velickova *et al.* (2013) found that edible coating of Chitosan beewax was reduced the visually decay (%), fruit weight loss (11%) at seven days storage period and respiration rate (227.9 ml CO_2/kgh) for the coated samples obtained after 0.5 h in fresh strawberry.

Grape

Ghasemzadeh *et al.* (2008) found that edible coating of pectin increased colour, texture, stickiness and moisture (%) while increase flavour with gum coating in Shahani variety of grape.

Orange

Youssef *et al*. (2015) revealed that application of postharvest coating in Novel orange fruit with Chitosan 1 % and mango leaf extract with gelatin 2 % could be more effective in keeping fruit firm with the least respiration rate during storage period at 5^0 C.

Conclusion

From the forgoing discussion it can be concluded that application of 5 % *Acacia* gel increase acidity, TSS, firmness, self life and reduce PLW and 75 % *Aloe vera* gel increase ascorbic acid, non reducing sugar and total sugar in mango, while coating with edible wax and packed in LDPE baging reduce PLW, respiration rate for 20 days storage. Application of Chitosan + Tween 80 + Lactic acid increase firmness, total sugar, reducing sugar and non reducing sugar and reduce in weight loss in banana during storage up to 10 days. Edible coating of 75 % *Aloe vera* gel + 5 % tapioca starch improve the quality of sapota fruits while, in papaya coated with PLEG improve the quality and minimum PLW of fruit up to 15 days at 30 ± 3 ^{0}C. Application of Chitosan 2 % and calcium gluconate 2 % has shown lower fruit decay percentage, higher fruit firmness and ascorbic acid content at 21 days of cold storage in guava. In jackfruit, coating with pectin increase fruit colour, flavor, taste and overall acceptability and fruit coated with 1% CMC or gum *Arabica* improve the custard apple fruit quality. In jamun edible coating with CMC 1.5 % reduces weight loss (%) and decay (%) of fruit at 16 days storage.

Edible coating of 0.5 % soya bean oil and sago 4 % improves the quality in cut apple. In peach and plum application of *Aloe vera* and *Aloe arboresence* gel delay ripening with better colour and firmness. While, in strawberry Chitosan + beewax reduce visually decay (%), physiological weight loss and respiration rate. Coating with pectin in grape resin variety shahani improve texture, moisture (%) and coating of mango leaf extract with 2% gelatin increase TSS, firmness and decrease respiration rate at 5 ^{0}C up to 60 days in navel orange.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Ashuqullah**	**Course**	**: PHT-691(1+0)**
Reg. No.	**: 1020218001**	**Time**	**: 09:00-10:00 am**
Major Advisor	**: Dr. Dev Raj**	**Date**	**: 03/07/2020**
Co-guide	**: Dr. D. R. Bhanderi**	**Venue**	**: Swami Vivekanand Hall**

Application of pulse electric field in food processing

Pulsed electric fields PEF is a non-thermal method of food preservation that uses short pulses of electricity for microbial inactivation (electroporation) and causes minimal detrimental effect on food quality attributes. PEF technology aims to offer consumers high-quality foods. For food quality attributes, PEF technology is considered superior to traditional thermal processing methods because it avoids or greatly reduces detrimental changes in the sensory and physical properties of foods. PEF treatments effects on the microbial inactivation in milk, milk products, egg products, juice, liquid and semi-liquid foods. The basic principle of the PEF technology is the application of short pulses of high electric fields with duration of microseconds to milliseconds and intensity in the order of 10-80 kV/cm between two electrodes causing microbial inactivation at temperatures below those used in thermal processing. PEF processing is restricted to food products with no air bubbles and with low electrical conductivity. PEF has ability to inactivate microorganisms in the food, reduce enzymatic activity and extend shelf-life with negligible changes in the quality of the final product as compared to the original one.

Review of research work:

Dziadek *et al.* (2019) found that apple juice treated with PEF of 400 pulses was free from mesophilic bacteria, microscopic fungi and yeasts (0.00, 0.00 and 0.00 cfu cm^{-3} respectively) meanwhile untreated apple juice (control) has the highest average number of mesophilic bacteria (4450.5×10^4cfu cm^{-3}), microscopic fungi (993.2×10^4cfu cm^{-3}) and yeasts (396.9×10^4cfu cm^{-3}) after 72 h of storage.They alsoreported that PEF treated apple juice significantly increased the total polyphenols (295.66 mg ml^{-1}) as compare to control (234.83 mg ml^{-1}) when applied 400 pulse after 72 hours of storage.

Ignat *et al.* (2014) observed that potato cubes treated with PEF had lower total energy moisture (0.125 J), higher lightness (73.78 L^*) and green to red parameters (-5.23 a^*) than untreated dipped potato (0.131 J), lightness (69.22 L^*) and green to red parameters (-1.34 a^*). This indicate that PEF technology avoid the need for chemical and reduces not only process time but also water and energy consumption.

Xiang *et al.* (2013) evaluated carrot juice physicochemical properties and observed that PEF treated carrot juice retained higher amounts of ascorbic acid, α-carotene, β-carotene and lutein than the thermal pasteurization treated carrot juice.

Pena *et al.* (2011) compared fruit juice soyamilk beverage treated by high intensity PEF and thermal treatments and found that overall changes observed in HIPEF treated beverage were less with higher shelf life than those in the thermal processed beverage.

Altuntas *et al.* (2010) measured the change in the concentration of metal ions in cherry juice and found that among studied metal ions, K was found highest (1330.43 ppm) in sour cherry juice followed by Ca (58.99 ppm), Mg (53.85 ppm) and Al (36.97 ppm) when compare to control.

Walkling-Ribeiro *et al.* (2010) described that high intensity PEF treated smoothie-type beverage achieved better stability of Brix, better colour, viscosity, shelf life and overall acceptability than the mild pasteurisation processed.

Mosqueda-Melgar *et al.* (2008) reported that population of Mesophilic , Molds and yeasts enteritidis and Psychrophilicwere reduced by more than 5.0 log^{10}CFU/ml in high intensity PEF treated melon and watermelon juice than the control treatment.

Riener *et al.* (2008) reported that the activities of protease, lipase, alkaline phosphate and lactoperoxidase were slightly affected when treated with PEF and had no effects on the levels of thiamine, riboflavin, retinol and α-tocopherol in the milk with respect to control.

Evrendilek *et al.* (2004) observed significant increase in the amount of Cr, Zn, Fe, Cu, Ca and Mn ions in the beer samples after PEF treatments as compared to untreated beer samples i.e., control.

Min *et al.* (2003) prepared tomato juice by hot break (88 ^{o}C for 2 min), cold break (68 ^{o}C for 2 min), thermally processed (92 ^{o}C for 90 s) and PEF processed (40 kV/cm for 57 μs). PEF processed juice retained more ascorbic acid, lycopene content, flavour and higher overall acceptability preferred to those of thermally processed juice.

Min and Zhang (2003) prepared tomato juice by hot break (88 ^{o}C for 2 min), thermally processed (92 ^{o}C for 2 min) and PEF processed (40 kV/cm for 57 μs). The PEF processed tomato juice retained more flavour compounds of trans-2-hexenal, 2-isobutylthiazole, cis-3-hexanol higher redness and flavour than thermally processed or unprocessed control tomato juice.

Eshtiaghi and Knorr (2002) showed that HELP-pre-treatment led to higher relative gain (97.70 %) while no HELP pre-treatment showed lower relative gain (35.85 %). This shows that the two step pressing produce high sucrose content in juice and less sugar remained in pulp as compare to conventional thermal process.

Yeom *et al.* (2000) assess the quality of orange juice treated by PEF and heat pasteurization and reported that PEF treatment prevented the growth of microorganism for 112 days and inactivate 88% of pectin methyl esterase activity, retained higher amounts of vit. C, flavour, lower browning index and higher whiteness than the heat pasteurized treatment.

Conclusion:

From the research result of various researchers on this aspect, it can be concluded that application of PEF has greater effects on physico-chemical properties, shelf life, antioxidant properties, nutrients and food quality than the conventional thermal process. Shelf life of various juice can be increased through various PEF treatments. PEF is a fast non-thermal process to inactivate the spoilage microorganism as compare to thermal process and reduced time and total energy required during food processing. Analysis of the previous experimental studiesindicate that PEF treatment is a promising and highly efficient method of intensifying juice yield. The use of 400 pulses allows one to store the juice for 72 h under refrigeration and ensures microbiological stability for 48 h. PEF processed tomato juice with more retention of the flavour compounds, less non-enzymatic browning, higher redness and higher fresh quality than thermally processed tomato juice. The thermal pasteurization treatment caused significant losses in the ascorbic acid, α-carotene, β-carotene and lutein content of carrot juice, while the PEFtreated juice retained physico-chemical properties as such as color, viscosity and total acidity. The activity of four indigenous enzymes present in fresh milk showedmodest decrease when subjected to PEF treatment, while lactoperoxidase activity was totally unaffected,although the vitamin status of the milk was unaffected by the PEF treatments.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Bharai Rambhai Boghabhai**	**Course : PHT 692 (1+0)**
Reg. No.	**: 1020217004**	**Date : 17/01/2020**
Major Guide	**: Dr. Dev Raj**	**Time : 05:00 to 06:00 pm**
Co-Guide	**: Dr. B. N. Patel**	**Venue : Swami Vivekananda Hall**

Advances in vegetative propagation of minor fruit crops

Minor fruits are a group of fruits presently growing in a scattered and unattended way on roadsides, homestead land, wasteland, *etc*. In Minor fruits are grown to a limited extent only and are not usually cropped in organized plantations with application of artificial agro-inputs. They are in general hardy and grow well even in fragile soil; having potential for intensive exploitation. In these fruit crops, the attack of pests and diseases are relatively less. They multiply and grow spontaneously rather than coming to extinction. Since, the area under each of these fruit trees is insignificant; they are popularly known as 'minor fruits'. These are highly nutritious and contribute to poverty elevation, household food security and play a significant role in herbal medicine. Important minor fruits are aonla, bael, custardapple,jamun,jackfruit,tamarind, wood apple *etc*.Minorfruits play an important role in maintaining livelihood and nutritional security and provide vitamins, minerals, fiber, antioxidants and other compounds of nutritional importance.

Plant propagation is the perpetuation or increase in the number of plants. Plant propagation is an integral part of horticultural development. Propagation is broadly grouped into sexual and asexualmethods. Asexual propagation involves reproduction of plants from vegetative parts to obtain true to type plant which possesses all the characteristics of the mother plant from which it has been collected.

Review of research work:

Cashew nut

Thimmappaiah *et al*. (2002) studied the effect of micro grafting techniques on union and growth of scion. They reported that no significant difference between the two, higher grafting success was observed in side grafts than shoot- tip grafts.

Sundri *et al*. (2002) observed the success percentage of softwood grafting in cashew nut by Bapatla and Puttur after 30, 60 and 90 days of grafting. They reported that grafting after 30 days had higher success parentage of soft wood grafting in Bapatla (74.1%) as compared to Puttur (70.3%) rootstock of cashew nut.

Mahunu *et al*. (2009) observed the comparative studies on ages of rootstock seedling and grafting in cashew. They reported that wedge grafting higher percentage of survival (82.8%) at 8 week age of rootstock as compared to apical side - veneer grafting and side grafting.

Tamarind

Palande *et al*. (2004) studied the effect of different seasons and genotypes on initial success and final survival in patch budding of tamarind. They reported higher initial success (74.44%) in red type of genotype at 15th May and final survival percent (66.66%) as compared to soft wood grafting.

Singh *et al.* (2007) observed the effect of time and method of propagation on bud sprouting, time taken for bud sprout and success per cent in tamarind. They reported that patch budding had higher success (46%), bud sprout (53.00%) and took minimum days for bud sprout (22.00) as compared to soft wood grafting. Patch budding carried out in the month of August had higher success rate in tamarind.

Arif *et al*. (2019) studied the effect of age of rootstock on graft survival in soft wood grafting of tamarind. They revealed that maximum graft survival (70.95%) with using 6 months age of rootstock.

Wood apple

Kadam *et al.* (2005) studied the age of rootstocks on bud grafting in wood apple. They reported that 90 days old root stock had higher final survival after 120 days (90.67%), number of leaves per graft after 60 days (17.40), sprout length of scion after 60 days (19.60 cm) and higher bud take (99.34%), minimum days (75 days).

Jackfruit

Khatun *et al*. (2006) recorded that effect of grafting on success rate and growth of jackfruit grafts. They reported that little bit higher success (38.14%), less time required to 1st flush, longer scion, higher diameter of scion, maximum number of leaves, longer and border leaf was found with cleft grafting as compared to veneer grafting.

Ashrafuzzaman *et al*. (2012) studied the effect of different concentration of IBA in half strength MS medium on the initiation and development of jack fruit roots. They revealed that the early induction (10-15 days) of jack fruit root was obtained with IBA at 2.0 mg/L as compared to other treatments.

Aonla

Govinda *et al*. (2006) studied the effect of different nutrient media on the bud initiation and number shoots. They reported that earliest(7.07 days) bud initiation and higher number of shoot (3.28) was observed on MS medium containing kinetin 2.0 mg + GA3 0.5 mg per liter as compared to other nutrient media.

Haridayal *et al*. (2010) observed the effect of variety, time of budding and method of budding on performance of aonla. Among different time of budding; 15th July recorded highest survival (51.38%). Two budding methods revealed higher success (48.14%) rate by patch budding as compared to T budding (37.95%) in aonla var. Chakiya. Among methods var. Chakiya possess highest bud take (58.33%) in patch budding.

Jalal *et al.* (2018) studied the effect of variety and propagation techniques on growth parameters of aonla. They reported that patch budding had maximum success (51.67%) as compared to cleft grafting (43.33%), tongue grafting (35.00%) and T budding (35.00%) .

Custard apple

Shinde *et al.* (2015) observed the effect of different rootstocks on softwood grafting of custard apple. They reported that ‘Chandsili’ rootstock had maximum graft take (94.83%), minimum days for sprouting (12.33), maximum sprouting per cent (76.89%) and higher length of scion (28.45 cm), higher success (71.46%), higher number of branches (2.24), higher salable grafts (69.14%) as compared to other rootstock of custard apple.

Pawar *et al*. (2018) studied the success rate of softwood grafting in different cultivars of custard apple. They reported that ArkaSahan required minimum days (10 days) for sprouting, maximum number of sprouted graft (28.67) and final survival was highest (89.47%) as compared to other cultivar in softwood grafting of custard apple.

Jamun

Kaur and Kaur (2018) observed the effect of time and methods of propagation on success percentage of jamun. They reported that patch budding proved to be the best in terms of success percentage (40.82%), Minimum days taken for bud sprouting (21.87) and final survival percentage (39.50%). Among the plantingtime, 1-15th August proved to be the most suitable for propagation as compared to other methods.

Conclusion

From the foregoing discussion it can be concluded thattamarind, jamuncan becommerciallypropagated by the method of patch budding and grafting. Cashew nut better perform inwedge grafting, side grafting as compared to micro propagation and custard apple can be propagated by soft wood grafting as compared to other methods of propagation. Jackfruit can be propagatedby cleft grafting method possesses higher survival rate of graft and better root initiation with using 2.0 mg/L IBA concentration.Wood applebud can be grafted on 90 days old root stock of get higher success rate.Aonlapropagated by the methods of patch budding and MS with kinetin 2.0 + GA3 0.5 mg/l minimum days taken to bud initiation.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Naik Pooja R.**	**Course**	**: PHT-691(1+0)**
Reg. No.	**: 1020218008**	**Time**	**: 10:30 to 11:30 a.m.**
Major Advisor	**: Dr. Dev Raj**	**Date**	**: 03/07/2020**
Co-guide	**: Dr. N. B. Patel**	**Venue**	**: Swami Vivekanand Hall**

Application of ohmic heating for food preservation

Ohmic heating is advanced non- thermal processing method wherein the food material which serve as electrical resistor and is heated by passing electric current through it. It is direct heating method, where food is in contact with the electrodes and AC voltage applied to electrodes at both ends of product body. It is possible to heat the product containing large particles up to 2.5 cm in size which is mostly damaged in conventional heating equipment, to sterilization temperature of up to 140°C in less than 90 sec. Ohmic heating works on the principle of Ohm's law of electricity. In the nineteenth century, several processes were patented that used electrical current for heating flowable materials. Within the past two decades, new improved materials and designs for ohmic heating have become available. Ohmic heating can be used for sterilization and aseptic packaging of large particulate food, heat sensitive food, military food, space food etc. Extraction, thawing, blanching, fermentation, waste water treatment and enzyme inactivation are recent uses of ohmic heating for food products.

Review of research work:

Cokgezme and Icier (2019) studied the effect of ohmic thawing methods and TSS of sour cherry juice on thawing time and revealed that ohmic thawing with voltage gradient of 20V/cm significantly decreased the thawing time when sour cherry juice concentrate have TSS of 50^0B.

Abedelmaksoud *et al.* (2018) compared the effect of ohmic heating and conventional heating with fresh juice on PPO and PME activity of mango juice and revealed that ohmic heating have higher inhibition of PME (95.7%). They also reported significantly higher ascorbic acid, carotenoides content and phenolics content along with L*, a* and b* values as compared to conventional heating.

Hamed and Zorhreh (2018) studied the effect of different voltage gradients (30-60 V/cm) and Aloe vera gel concentrations (0.5%-2%) on time required for ohmic heating and revealed that with increased in voltage gradient and concentration of aloe vera gel, there is decreased in time required for ohmic heating.

Ayoub *et al.* (2017) carried out work on ohmic heating of pomegranate juice and sweet orange juice and found that the physico-chemical properties and sensory quality of ohmically heated pomegranate and sweet orange juice were maintained in ambient storage condition as compared to conventionally heated juices.

Athmaselvi *et al.* (2016) found that in ohmic heating, used titanium electrode with low voltage gradient at low temperature for short time have highest retention of ascorbic acid during storage period for different tropical fruits like, guava, sapota and papaya pulp.

Chakraborty and Athmaselvi (2016) observed that the pH of water melon juice decreased with the increase in voltage gradient during storage and retains the physico-chemical properties for a longer time than conventional heating.

Solanki (2014) reported that the ohmically heated processed guava pulp have higher ascorbic acid as compared to conventionally heated guava pulp. They also reported that ohmic heated guava pulp have lower enzymatic activity and total viable count during 90 days of storage. Further they reported that sensory analysisof ohmically heated pulp have process higher acceptable scores during 90 days of storage

Chakraborty and Athmaselvi (2014) studied effect of different voltage gradients during ohmic heating on TSS, acidity and ascorbic acid of guava juice and reported that ohmically heated guava juice at voltage gradient of 23.33V/cm have less changes in ascorbic acid content during storage period of 21 days.

Gomathy *et al.* (2014) conducted experiment on ohmic heating of papaya pulp and documented minimum bacterial and yeast load (1.00 log cfu/ml) at a voltage gradient of 13.33V/cm and with a holding time of 2 min after storage period of 30 days.

Darvishi *et al.* (2011) studied the effect of different voltage gradients during ohmic heating of lemon juice. The voltage gradient of 55V/cm in ohmic heating resulted linear increased in temperature at minimum time of 10 seconds of lemon juice.

Anderson (2008) compared the effect of ohmic heating and conventional heating with respect to growth parameters at different fermentation temperature and observed that at 30^0C, the lag period of fermentation was less under low voltage (15V) ohmic heating as compared to conventional heating.

Conclusion:

From the foregoing discussion, it can be concluded that ohmic heating can be used for thawing, nutrient retention and preservation of food by decreasing the microbial load. High voltage gradient (20V/cm) in ohmic heating can be used to thaw sour cherry juice concentrate having high TSS of 50^0 B. Ohmic heating can result higher inhibition of PME and higher ascorbic acid, carotenoides content and phenolics content along with L*, a* and b* values as compared to conventional heating. With increased in voltage gradient and concentration of Aloe vera gel, there is decreased in time required for ohmic heating. The physico-chemical properties and sensory quality of ohmically heated pomegranate juice and sweet orange juice can be maintained in ambient storage condition. In ohmic heating use of titanium electrode with low voltage gradient at low temperature for short time can results highest retention of ascorbic acid during storage period for different tropical fruits like, guava, sapota and papaya pulp. The pH of water melon juice decreased with the increased voltage gradient in ohmic heating and retains the physico-chemical properties for a longer time than conventional heating. The ohmically heated processed guava pulp can higher ascorbic acid as compared to conventionally heated guava pulp and lower enzymatic activity and total viable count during 90 days of storage. In ohmically heated guava juice at higher voltage gradient process less changes in ascorbic acid content during storage period of 21 days. The lag period of fermentation can be decreased under low voltage ohmic heating as compared to conventional heating at lower temperature.

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Speaker : Mehta Nidhika D.	**Course : Horti. Path. 692**
Reg. No. : 1020214010	**Date : 17-09-2016**
Major Guide : Dr. P. R. Patel	**Time : 2:00 to 3:00 pm**
Co- Guide : Dr. H. V. Pandya	**Venue : Swami Vivekananda Hall**

Morphological basis of resistance against insect pests in vegetables

Introduction

Vegetables are an integral part of daily food to ensure nutritional security. They are vital sources of minerals, vitamins and dietary fiber and plays an important role in human nutrition. Among the major constraints in successful cultivation of vegetables, insect pest infestation causes heavy losses. Keeping in view the economic importance of vegetables in daily use, where use of insecticide is not desirable because, the massive overuse and frequent misuse of insecticides has led to problems of 3R's *viz.*, **Resistance, Resurgence and Residues** as well as toxicity hazards to human, plants, domestic animals and wildlife resulting in environmental contamination, bioaccumulation and biomagnifications of toxic residue (Dhaliwal and Arora, 2001). Hence, there is need to develop alternate solution *i.e.* Host Plant Resistance (HPR). HPR is one of the basic components of Integrated Pest Management (IPM). The resistance mechanism for direct plant defense against herbivorous insect pests comprise of plant traits *viz.*, morphological that negatively affect insect preference (host plant selection, oviposition, feeding behavior) and biochemical factors that affect the life cycle (survival, development or reproduction) resulting in increased plant fitness in a hostile environment.

Host Plant Resistance (HPR):- Painter (1951) defined 'HPR' as the relative amount of heritable qualities possessed by a plant which influence the ultimate degree of damage done by the insect. He grouped the mechanism of resistance into three main categories *viz.*, non-preference (antixenosis), antibiosis and tolerance.

Brinjal (*Solanum melongena,* Family: Solanaceae)

Soundararajan and Baskaran (2001) observed that the brinjal accessions TS 00018 possessed the maximum trichome density (2725.40/cm^2), trichome length (714.20/µm) and trichome breadth (29.62/µm) with minimum population of whitefly nymph (18.25/leaf) and adults (11.25/leaf) followed by TS 00052.

Rath *et al*. (2002) observed that the brinjal pipli 5 with the maximum trichome density (56.2 no./unit microscopic) and length (0.56 mm) showed its resistance against *Epilachna beetle* compared to other varities.

Bhatt (2004) found that high trichome density and length showed its resistance against for sucking pest complex.

Naqvi *et al*. (2008) observed that maxmum trichome density (1068.5 cm^2) with the minimum pest population (16.4/30 leaves) of leafhopper in Pusa Purple Round, which was at par with Arka Sheel.

Naqvi *et al.* (2009) recorded lowest per cent shoot infestation by shoot and fruit borer in brinjal genotype Pusa purple long (6.7%) and had narrow diameter of shoot pith (1.00 mm), while, this cultivar possessed more lignified tissues and compact vascular bundles which played an important role in morphological basis of resistance. Further, they studied the biophysical characters of brinjal genotypes in relation to fruit borer and found that lowest fruit infestation was in genotypes *viz.*, Pusa Purple Long (14.7%), Pusa Purple Cluster (16.5%) and Arka Nidhi (17.71%) having narrow thickness of pericarp (0.8, 0.9 and 0.9 cm) and mesocarp (2.0, 2.2 and 2.2 cm), respectively. However, these varieties showed more fruit length (9.0 to 11.7 cm) with minimum diameter (2.8 to 3.3 cm), compact seed rings with closely arranged seeds. They also found that maximum thickness of pericarp (1.8 cm) and mesocarp (4.8 cm) recorded maximum infestation (42.6%) of *Leucinodes orbonalis* in Pusa Purple Round variety of brinjal. Moreover, they also recorded maximum infestation (42.6%) of brinjal shoot and fruit borer in round shape brinjal variety Udaipur Local which is at par with oblong variety Pusa Upkar. Whereas minimum (24.0%) infestation found in long shape variety Pusa Purple Long. Furthermore, they found that Udaipur Local variety of brinjal have significant negative association of fruit length (5.1cm) and significant positive association of fruit diameter (5.6 cm) with the brinjal shoot and fruit borer infestation. They also noticed that purple coloured variety Pusa Purple Cluster and Arka Nidhi were less susceptible compared to other coloured varieties. They also found that varieties like Pusa Purple Long, Pusa Purple Cluster, IC112358 and Bikaner Local having narrow shoot pith, compact seed rings with closely arranged seeds in mesocarp and more lignified tissues with compact vascular bundles had low degree of fruit infestation by *L. orbonalis*.

Potato (*Solanum tuberosum,* Family: Solanaceae)

Medeiros *et al*. (2005) observed that there was no leaf hopper nymph and adult survival on potato genotype PI 473331 and found to be resistant. They recorded higher trichome density (17.1 ± 3.1 mm) and maximum gland diameter (83.6 ± 1.3) on adaxial surface whereas, higher trichome density (19.61 ± 2.1 mm) and maximum gland diameter (74.2 ± 1.8) on abaxial surface in genotype PI 473331 followed by PI 473334.

Silva *et al*. (2008) observed that positive association of potato glandular trichomes with number of whitefly eggs.

Tomato (*Solanum lycopersicum,* Family: Solanaceae)

Amutha and Manisegaran (2005) observed Accession LE4 and EC238308 significant negative correlation of length of fruits and significant positive correlation of fruit diameter with the *Helicoverpa armigera* damage in tomato. They also observed that Accession LE4 have maximum trichome density which was significanty negative association with fruit borer, *H. armigera* (Hubner)

Rath and Tripathy (2006) recorded the lowest tomato per cent fruit infestation by fruit borer on both number (8.89%) and weight (9.23%) basis in BT-10 and found to be resistant followed by BT-12. The morphological characters *viz.,* maximum trichome per calyx (18.4 number), length of calyx (2.06 cm) and pericarp thickness (0.37 cm), minimum plant height (60.58 cm), branches per plant (9.4 number), fruits per plant (15.0 number) and fruit diameter (3.16 cm) impart the non-preference mechanism of resistance.

Oriani *et al*. (2011) found that adult and egg laid by *Bemicia tabaci* had negative correlation with number of trichomes and non-glandular trichomes.

Ashfaq *et al*. (2012) reported that Sahil variety of tomato had minimum fruit infestation (10.7%) of *H. armigera* (Hubner) which was observed to be maximum hair density (49.8/ cm^2) and length of hair (32.5 µm) on lower leaf with maximum thickness of leaf lamina (6.1 µm) followed by Pakit and Novamecb.

Ambule (2014) observed that in germplasms NTL-14, NTL-7 and NTL-1 maximum Plant height, stem diameter, number of branch per plant, number of fruits per plant, fruit pericarp thickness, fruit diameter, number of locules per fruit, number of calyx per fruit decrease the fruit infestation of fruit borer. She got the same result in second season also.

Chilli (*Capsicum frutesence* L, Family: Solanaceae)

Yadwad *et al.* (2008) recorded negative association of trichome density with thrips population in chilli.

Rai *et al.* (2012) studied the biophysical basis of resistance against thrips and chilli yellow mite and reported that chilli genotype CO-5617 had minimum population of thrips (1.14/3 leaves) and mite (6.42/3 leaves). Among biophysical characters, the total leaf area had positive significant correlation (r = 0.983) with both the pests population and trichome density, leaf length, leaf width were found non-significant.

Okra (*Abelmoschus esculentus,* Family: Malvaceae)

Anitha and Nandihalli (2009) recorded the least number of leafhopper population on Arka Anamika at 45 DAS (9.63 leaf hopper/3 leaves) and 60 DAS (8.09 leaf hopper/3 leaves), number of aphids at 45 (16.12 aphids/3 leaves) and 60 DAS (12.97 aphids/3 leaves), respectively. The variety had the highest number of hair density on lamina (18.17/cm^2).

Sultani *et al*. (2011) studied the morphological characters of seven genotypes of okra for their resistance against *Earias vitella* (Fabricius) and observed that genotype HB-03-29-7B had lowest number of larval survival (33.00 ±1.15 %) with maximum number of trichomes (29.26/microscopic field), length of trichomes (0.15±0.06 mm) and thickness of pericarp (1.93±0.026 mm) which was followed by genotype HBT-1-19-1-1-2.

Conclusion:

Morphological characters *viz*., trichome, thickness and toughness of tissue, shape and size, colour, anatomical characters, plant cuticle and plant types are influencing insect population in vegetables. Amongst the various morphological characters trichome density, length and types were found as outstanding component to restrict feeding, oviposition, development, attachment of tissue and locomotion of different pests.

Future thrust:

There is need to identify the morphological markers imparting resistance against insect pests to facilitate selection process in breeding programmes. There is need to develop a reliable, rapid and efficient screening method for identifying genotypes having resistance to the important pests. Identify plant type with stable and diverse sources of resistance. Interdisciplinary approach should be followed for development of high yielding pest resistant varieties of crops.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Dave Parthkumar P.	**Course : HENT 692**
Reg. No. : 1020214005	**Date : 31-12-2016**
Major Guide : Dr. H. V. Pandya	**Time : 10:00 to 11:00 am**
Co- Guide : Dr. P. R. Patel	**Venue : Swami Vivekananda Hall**

Role of AM fungi in disease management of horticultural crops

Arbuscules are minute, tree like, dichotomously hyphal branched much like haustoria which grow intracelluraly in the cortical cell. It helps in absorbing nutrients from the plant cell and also release mineral elements for the plants.

The word Mycorrhiza originated from the Greek word "Mykes" means fungus and "Rhiza" means roots. Mycorrhiza is a symbiotic relationship between soil fungi and fine plant roots. Since, the association is mutualistic, both the organisms gets benefited from the association. (Muchovej, 2007). The fungus receives carbohydrates (sugars) and growth factors from the plants, which in turn receives many benefits, including increase nutrients absorption. In this association the fungus takes over the role of the plants root hairs and act as an extension of the root system. Among important plants that associate with mycorrhizal fungi are corn, carrot, potato, bean, soybean, other legumes, tomato, pepper, onion, garlic, sunflower, strawberry, citrus, apple, peach, grape, cotton, coffee, tea, cocoa, sugarcane, forest *spp*., wild plants and even weeds. Some plant *spp*. with thick poorly branched roots, and with few root hairs are usually more dependent on mycorrhiza for normal growth and development. These sp. Include onions, grapes, citrus and tropical legumes.

Since the 'first green revolution', less attention has been given to beneficial soil microorganisms in general and to AM fungi in particular. In 1997, a team of researchers from the USA, Argentina and the Netherlands put an average price tag of US $33 trillion a year on these fundamental ecosystem services. The symbiosis can play key role as an ecosystem service provider to guarantee plant productivity and quality in emerging systems of sustainable agriculture (Gianinazzi *et al.*, 2010).

Brief Review of Research Work

Lisette *et al.* (2004) observed the key differences between mycorrhizal association types and found that VAM possess hyphae, arbusculs and chlorophyll in it while the presence of septate hyphae, hyphal coils and vesicles are not certain.

Fungal disease:

Odebode and Tredway (1997) studied severity of disease incidence in pepper inoculated by *Pythium aphanidermatum* with *Glomus deserticolum* and found that inoculation with VAM before pathogen, gives maimum VAM colonization percent with less clorosis, defoliation and flower abortion.

Declerck *et al.* (2002) reported the effect of four Glomus strain on disease severity of banana root rot and they recorded minimum disease seviarity in *Glomus sp.*

Reddy *et al*. (2006) measured damping off resistance status in two cultivars of tomato under field conditions and found that the treatment content VAM (*Glomus fasciculatum*) has minimum disease percent and maximum disease control in both tomato cultivar.

Wanjiru (2009) observed the effect of *Trichoderma harzianum* and Arbuscular Mycorrhizal fungi on disease management in tomato seedlings and found that the combination of P52 with AMF gives best control even up to twelve weeks.

Bacterial disease:

Kumar and Sood (2002) studied the effect of biocontrol agents and VAM on bacterial wilt of tomato and found that treatment combination of Solan Gola, *Pseudomonas fluorescens* and VAM had very less incidence of bacterial wilt in tomato.

Nematodes management:

Labeena *et al.* (2002) reported that *Glomus fasciculatum* with *Meloidogyne incognita* had minimum number of nematode and low root klnot index on tomato.

Rao *et al.* (2003) reported that *Glomus fasciculatum* with *Verticillium chlamydosporium* gives better growth of brinjal and less infestation of *Meloidogyne incognita* under field condition and in nursery beds also.

Borah and Phukan (2004) studied the effect of *Glomus fasciculatum,* neem cake and carbofuran on the development of *Meloidogyne incognita* on brinjal and maximum percent reduction over control was found in the combined effect of VAM and carbofuran @ 1.5 kg a.i./ha.

Bagyaraj (2014) found that *Glomus spp*. with *Meloidogyne spp*. had less gall count in both *Meloidogyne incognita* and *Meloidogyne javanica* on tomato crop.

Conclusion:

Different species of VAM fungi *viz. Glomus fasciculatum, Glomus monosporum, Glomus etunicatum* differ in their ability to manage the fungal and nematode diseases in plants. After application of AM fungi the inoculum multiplies in the rhizosphere, decrease the population of targeted pathogen and survive in the root-zone area. Pre-inoculation with AM fungi was found effective in reducing disease severity and enhanced the nutrient absorption capacity and improved the vigour of the plants.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker	**: Chaudhary Ashok T.**	**Course**	**: HENT 691**
Reg. No.	**: 1020216002**	**Date**	**: 02/06/2018**
Major Guide	**: Dr. H. V. Pandya**	**Time**	**: 09:00 to 10:00 am**
Co-Guide	**: Dr. P. R. Patel**	**Venue**	**: Swami Vivekananda Hall**

Bemisia tabaci (gennadius) – a serious threat to vegetable crops and its management

There are more than 1100 whitefly species in the world. Among them sweet potato whitefly (*Bemisia tabaci*) is one of the most pestiferous of the group (Verma *et al.*, 2004). It is a polyphagous and thermophilic in nature and very destructive pest in the northern and western regions of the Indian subcontinent. In India, it is considered as a major pest in many states, including Gujarat. In recent years, *B. tabaci* has become a major pest of world agriculture as crop infestations and viral diseases transmitted by it have also proliferated. It is a well known sucking pest of vegetable crops in several parts of India (Balaji and Veeravel, 1995).

Bemisia tabaci was first described in 1889 by Gennadius as a pest of tobacco in Greece and designated as *Aleyrodes tabaci* (Gennadius) by Brown *et al.* (1995). Its center of origin was suggested as the Indian subcontinent, but tropical Africa is also being considered to be as plausible center of origin (Henneberry and Castle, 2001). It was first noticed on cotton in India in 1905. In 1957, this species and 18 other previously described whitefly species were synonymized into a single taxon, *B. tabaci* (Brown *et al.*, 1995).

The number of host plant of *Bemisia tabaci* were more than 700 plant species throughout the world (Henneberry and Castle, 2001). In India its presence has been recorded in 74 plant species belonging to 17 families, out of which 21 plant species were vegetables belonging to 9 families (Naresh and Nene, 1980). Patel and Jhala (1992) stated that the pest was recorded on 20 host species in south Gujarat, out of which 11 were vegetables. Estimated losses of $ 140 million in tomato industry were reported in Florida due to outbreak of the pest in 1986. In 1991, losses for vegetable in Texas were estimated to be $ 29 million (Hennberry and Castle, 2001). It causes widespread damage in cotton and vegetable crops by direct feeding and by spreading viral diseases that can lead to yield reduction up to 75 % (Borad and Puri, 1995). Loss may be even 80-90 % in okra as well as in tomato (Chadha, 2001). The pest causes direct damage by sucking cell sap, indirect damage by honeydew secretion and by transmitting viral diseases (Srivastava and Butani, 1998).

Population Daynamics

Pimpale and Summanwar (1983) reported whiteflies occurence in different crop plants including vegetables, weeds and ornamental plants in four phases during the year. Average population of *B. tabaci* nymphs was found to be highest on brinjal crop (Patel and Jhala, 1992).

Management

Cultural:

Borah and Bordoloi (1998) concluded that tomato crop planted from October 25 to November 25 had minimum whitefly population and disease incidence, however as the planting date advanced, there was increase in whitefly population and disease incidence and decrease in yield. Krishnan (2002) reported that mulching with silver plastic mulch (25 micron) gave lowest population of whitefly as well as TLCV in tomato. Brinjal transplanted on 1^{st} August had lowest incidence of whitefly and gave higher yield as compared to other date of transplanting (Anon., 2005). Kalita *et al.* (2005) reported lowest whitefly population and disease incidence in mid-may sown okra. Islam and Siakia (2008) reported that plant spacing of 30 cm and row spacing of 60 cm in tomato had significantly lower whitefly population, lower TLCV incidence and highest yield. Saha *et al.* (2012) concluded that intercropping of cucumber was best for control of whitefly in chilli as it reduced its infestation up to 46.27% as compared to control.

Host Plant Resistance:

Singh *et al.* (1998) screened seven varieties of chilli including local check (Balihati). Amongst these, Pusa Sadabahar was found to be superior in suppressing *B. tabaci* infestation as well as other sucking pests and produced highest yield. However, it was at par with Jawahar Mirchi 218 and Pant C-2. Gosh *et al.* (1999) evaluated different six varieties of okra and reported that varieties Kamdhenu and LBH-55 had lower incidence of sucking pests and also gave significantly higher yield. Brinjal genotypes ABR-00-4, ABR-98-13 and ABR-00-5 had significantly less incidence of whitefly as compared to Morvi 4-2 (Anon.,2002).

Biological :

Studies of Praveen and Dhandapani (2001) revealed that three releases of *Chryoperla carnea* @ 50,000 grubs/ha/release were effective for whitefly control in tomato.

Botanical:

Studies of Chowdhury *et al.* (1992) revealed that mortality of whitefly ranged from 20-80 % when treated with different plant extracts. Somasekhara *et al*, (1997) reported that Replin (2%) in combination with triazophos (0.15%) gave per cent mortality of whitefly up to 8 days after spray and the per cent TLCV transmission was also less in tomato. Nonitadevi *et al.* (2003) found *Artimesia vulgaris* more effective as compared to other plant extracts.

Chemical:

Bhagat *et al.* (1997) reported a soil application of carbofuran 3G @ 1 kg a.i./ha once at the time of sowing and the other 20 days after sowing, followed by one spray of oxydemeton methyl @ 250 g a.i./ha at 45 days after sowing had lowest cumulative whitefly population and gave 45.6 % more yield as compared to control. Singh and Jaglan (2001) reported root dip treatment with imidacloprid 0.04 % for 24 hrs soaking in brinjal had significantly less whitefly population. Seed treatment of okra with imidacloprid 3 ml/kg seed had lower whitefly population and gave higher yield (Anon., 2004). Seeds treated with either imidacloprid 5 g/kg seed or 9 ml/kg seed or thiomethoxam 5 g/kg seed were equally effective in reducing whitefly infestation, but imidacloprid 5 g/kg seeds gave higher yield as compared to other treatments (Anon., 2005).) Three sprays of imidacloprid had successfully reduced infestation of whiteflies in chilli and gave higher yield (Jain and Ameta, 2006). Sudhakar *et al.* (2013) concluded that bifenthrin 0.01 % recorded highest per cent reduction of whiteflies and jassids in brinjal over control.

Integrated Pest Management :

Module M_1 found most effective as compared to other modules as well as control in reducing whitefly population in okra (Chauhan, 2001). Six different IPM modules were evaluated for pest complex in brinjal and revealed that the module consisting of maize as barrier crop, shoot clipping, application of endosulfan 700 g a.i./ha sprayed alternatively with cypermethrin 50 g a.i./ha at 45, 60, 75, 90 and 105 days after transplanting was the best for suppressing the pest (Anon., 2004). Lakra (2014) reported that IPM module consisting of seed treatment with imidacloprid 0.004 % and its one spray and oat as trap crop, was most effective in reducing whitefly population and gave highest yield in potato.

Conclusion

Whitefly is responsible for major yield losses in vegetable crops by both i.e. direct feeding and acting as vector for viral diseases. Chemicals, like imidacloprid, thiomethoxam, bifenthrin were most effective for reducing its infestation. Alternatively, other nonchemical methods viz. growing resistant varieties, cultural practices (intercroping, sowing periods, use of barrier/trap crop), release of biocontrol agent also offer an attractive venue for reducing whitefly infestation either alone or in combination with chemical.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Surela Vipul A.**	**Course**	**: HENT 691 (1+0)**
Reg. No.	**: 1020218013**	**Date**	**: 17/07/2020**
Major Guide	**: Dr. H. V. Pandya**	**Time**	**: 09:00 to 10:00 am**
Co-Guide	**: Dr. P. R. Patel**	**Venue**	**: Swami Vivekananda Hall**

Potential of Rock bee, *Apis dorsata* fabricius in pollination of horticultural crops

Honey bees are social insects belonging to order Hymenoptera, family Apidae, tribe Apini and genus *Apis*. About 20,000 bee species are reported in the world, among them nine species are recognized as "Honey Bees" by the entomologist. In India, among the nine honey bee species mainly four species like *Apis dorsata* F., *Apis florea* F., *Apis cerana* F. *and Apis mellifera* L. are of major importance. Among them, *A. dorsata* is commonly known as rock bee or giant bee which make single comb in open. They make nest in trees, rocks and roof of the buildings (About 6ft long and 3ft deep). The rock bee is widely distributed throughout South-East Asia, ranging from the Indian subcontinent, up to Southern China and down throughout Indonesia and Malaysia.The rock bee is an efficient pollinator of agricultural and horticultural crops. Rock bees are ferocious and difficult to rear. They produce about 36 Kg honey/comb/year.

About one-third of the human diet comes from insect-pollinated plants, and the honeybee is responsible for 80 per cent of that pollination (FAO, 1995). More than 65 per cent of all flowering plants are dependent on insects for pollination among them 55 million hectares cropped area is under bee dependent crops. Foraging activity by honey bees stimulates germination of pollen, increases viability of seed embryo, increases vegetative mass, stimulates faster growth of plants, increases numbers and size of seeds and fruits and reduces fruit dropping. The economic value of honey bees as pollinators of crop was estimated at about $14.6 billion and yield of fruits, seed, and nut crops would be significantly reduce without the pollination services that bees are providing.(Morse and Calderone, 2000).

Review of literature:

Sawarkar (2017) studied the foraging behavior of rock bee, *Apis dorsata* on bottle brush and they reported that maximum foraging rate and higher time spends by the *Apis dorsata* at 08:30 to 09:30 am.

Jacob and Rao (2016) studied the hourly foraging activity of bees on *Pavetta tomentosa* and reported that bees showed a gradual increase in foraging visits until 11:00 h and a gradual decrease thereafter until they ceased foraging for the day.

Patil and Pastagia (2014) studied the 24 morphological characters of worker bees of *A. dorsata* and reported that its body length was varied from 18.00 mm to 19.00 mm with an average of 18.50 ± 0.477 mm.

Kumar *et al.* (2013) studied the foraging behavior of pollinator fauna on litchi and revealed that the foraging rate of pollinators was highest (16.53 flowers/min) at 10: 00 h. Among the foragers, it was highest with *A. dorsata* F. (15.16 flowers/min) followed by *Episyrphus balteatus* (14.76 flowers/min).

Krishnan *et al.* (2012) studied the different flower visitors of the coffee and recorded that honey bees were the most common visitors. Among them, *A. dorsata* (58%), *A. cerana indica (*23.4%), and *Tetragonulairi dipennis*(18%).

Das *et al.* (2019) studied the abundance of different insect pollinators on litchi flowers and they reported that *A. dorsata* (50.11%) was predominant visitor followed by *A. cerana indica* (11.80%), *A. florea* (8.68%) and *A. mellifera* (7.12%).

Panwar, Lalita. (2014) studied abundance of different honey bee species on pumpkin cultivar and revealed that abundance of *A. dorsata* was the highest between 6:30 to 7:30 am followed by *A. mellifera, A, cerana*. Also found that average seed germination percentage was maximum in five visits by *A. dorsata* followed by four, three, two and one visit.

Saeed *et al.* (2012) studied the effect of different pollinators on bitter gourd and they revealed that fruit resulting from a visit of *A. dorsata* produced the maximum number of seeds followed by *A. florea*, *Eristalinus laetus* and *E. aeneus*. Fruit weight and seed weight was greater in flowers visited by *A. dorsata* and *A. florea*.

Hussain (2011) studied the foraging activity of different species of honey bees on guava flowers and revealed that the maximum foraging rate was found in *A. dorsata* followed by *A. cerana* and *A. florae*. Also studied the pollen carrying capacity of different honeybee's species and found that maximum carrying capacity was found in *A. dorsata* followed by *A. cerana* and *A. florae.* Also studied the effect of number of *A. dorsata* visits to a single flower on quantitative parameters of guava and he recorded that the per cent flower drop decreased significantly, when *A. dorsata* visits increased from zero bees per flower to six bees per flower.

Selvakumar *et al.* (2011) studied the contribution of honey bee pollination in cauliflower seed production and observed that honey bees were the most dominant pollinator (85.23%) and among them, *A. dorsata* constituted 28.23 per cent followed by *A. mellifera* 26.32 per cent.

Sihag (2011) studied the abundance of different insect visitors on three cultivar of plum and reported that maximum abundance of *A. dorsata, A. mellifera, A, cerana* and *A. florae* was observed in Titron.

Neupane *et al.* (2006) studied the foraging number of *A. dorsata* worker bees at different times of a day during late flowering periods of selected horticultural crops and reported that highest mean number (2.21/min/m^2) of *A. dorsata* workers was observed on litchi flowers at 07:30 h followed by (1.79/min/m^2) on bottle brush.

Conclusion:

Pollination is one of the most important ecological processes on the planet. Among pollinators, Honey bee has gained importance as an efficient pollinator due to potential for long hour's activities, body to pick up many pollen grains and flower fidelity and constancy and it give quality or quantity of crop product. In nature, as like other bees *A. dorsata*is also playing a decisive role in crop pollination, efforts should be made to conserve this important pollinator in nature.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Mehta Nidhika D.	**Course : Horti. Path. 691**
Reg. No. : 1020214010	**Date : 21-05-2016**
Major Guide : Dr. P. R. Patel	**Time : 11:00 to 12:00 am**
Co-Guide : Dr. H. V. Pandya	**Venue : Swami Vivekananda Hall**

Management of diseases in turfgrass

Turfgrass means any species of grasses designed for residential lawns and certain sports areas. Whether for a home or golf course, turf grass is the lush green grass that blankets the ground surroundings of various venues. There are two types of turf grass:1. Cool season grasses2.Warm season grasses. (Tredway, 2004)

Diseases play a major role in determining the success or failure of a turfgrass stand. It is often the most important single factor limiting the successful growth of a cultivar or species, a fact that you must keep in mind when selecting a turfgrass species or cultivar. The best textured, nicest-coloured, and fastest-germinating grass, if it is susceptible to a major pathogen, will turn into the worst-looking and poorest-coloured grass when it becomes decimated by a disease. There are five major groups of organisams that are causing diseases in turfgrass:- fungi, bacteria, viruses, nematodes, and mycoplasma. Among them fungi are the most important cause of turfgrass diseases and of great economic importance. It is difficult to get exact figures, but the turfgrass industry spent 80 million dollars on fungicides annually. More fungicides are used on turfgrass than on any other single crop. (Vargas,2002)

Research work:-

Dollar spot: *Sclerotinia homeocarpa*

Lo *et al*. (1997) studied that conidial suspensions of *Trichoderma harzianum* strain 1295-22 when applied as a spray without Triton X-100 can control dollar spot effectively only for about 4 week but with addition of Triton X-100 @ 0.1%, a high level of control were obtained with *T. harzianum* strain 1295-22 throughout the experimentin green house.

Nelson (2002) conducted an experiment to compare the biological and chemical control to suppress the dollar spot and reported that propiconazole@ 174 mg/m^2recorded the minimum spots per plot with maximum control which was followed by *Enterobacter cloacae*.

Powell *et al.* (2000) conducted a field experiment using Phenazine Carboxylic Acid (PCA), a metabolites of *Pseudomonas aurufaciens* and triadimefon against dollar spot of creeping bentgrassand found that PCA did not provide disease control equal to that of triadimefon but disease control with PCA was significantly better than the control treatment.

Powell *et al.* (2000) conducted a greenhouse experiment on efficacy and phytotoxicity of PCA, triadimefon and chlorothalonil on dollar spot management and found that PCA @ 0.48 g a.i./m^2provided cent percent disease management equal to that of triadimefon and chlorothalonil.

Popko *et al.* (2012) reported that propiconazole is effective in controlling dollar spot disease of turfgrass when applied at 21 days interval @ 0.44, 0.88,1.32 and 1.76 kg a.i. /ha for both the year 2009 and 2010.

Fairy ring:Basidiomycetes

Miller *et al.* (2012) tested triadimefon and tebuconazole with different concentration against fairy ring and found that triadimefon @ 0.33 g/m^2 recorded minimum AUDPC during 2007,tebuconazole @ 0.15g/m^2 recorded minimum AUDPC during 2008 and tebuconazole @ 0.08g/m^2 recorded minimum AUDPC during 2009.

Damping-off disease, Pythium blight, Pythium root rot:*Pythium* sp.

Lo *et al*. (1997) studied that conidial suspensions of *Trichoderma harzianum* strain 1295-22 when applied as a spray with Triton X-100 @ 0.1% resulted in great reduction of pythium root rot (*Pythium graminicola*) as compared with other treatments.

Nelson (2002) studied antagonistic effect against pythium blight and found that good suppression of pythium blight on creeping bentgrass can be achieved by a bio control agent *Enterobacter cloacae*EcCT 501 under growth chamber condition.

Cook *et al.* (2009) studied the effect of phosphonate fungicides on pythium blight development on creeping bentgrass and ryegrass in the year 2004 and 2005 and found that all phosphonate treatment provided significant suppression of pythium blight symptoms on creeping bentgrass while in case of pythium blight on perennial ryegrass mefonoxam provided significantly superior control of disease compare to all other phosphonate treatment.

Kerns *et al.* (2009) evaluated various fungicides in field condition as preventive measures for management of pythium root dysfunction caused by *Pythium volutum* and found that pyraclostrobin, azoxystrobin and cyazofamid when applied twice in the fall (September and October) three times in the spring (March, April, and May) provided good preventive control of disease as compared to the rest of the treatment throughout the year.

Brown patch: *Rhizoctonia solani*

Lo *et al*. (1997) studied that conidial suspensions of *Trichoderma harzianum* strain 1295-22 when applied as a spray with Triton X-100 @ 0.1% resulted in great reduction of brown patch as compared with other treatment.

Nelson (2002) studied about the antagonistic effect against the brown patch found that suppression of brown patch on creeping bentgrass by a bio control agent *Enterobacter cloacae* E-1 under growth chamber condition.

Rust: *Puccinia* spp.

Kennelly and Obasa (2015) concluded that azoxystrobin, propiconazole and tridiamefon gave consistently good to excellent results for the control of rust disease of perennial ryegrass.

Dead spot: *Ophiosphaerella herpotricha.*

Walker (2009) studied effect of propiconazole application timing on management of bermudagrass spring dead spot and demonstrated that two fall or one spring and one fall application of propiconazole appeared to be the most effective and economic disease control.

Conclusions

Various diseases in turfgrass which plays a significant role in determining the success or failure of turfgrass stand and quality. Among the various diseases caused by fungi, bacteria and viruses, fungal diseases are causing significant loss in terms of quantity and quality. From various fungal diseses like dollar spot, fairy ring, dead spot, rust, brown patch and damping off /pythium blight can be effectively control by spraying the fungicides like propiconazole, triadimefon, tebuconazole, azoxytrobin, and fosetyl-Al at proper time and interval. For the eco – friendly management we can use the bio agents like *Trichoderma harzianum, Enterobacter cloacae* and metabolites of *Pseudomonas aurieofaciens* (Phenazine Carboxylic Acid). Along with chemical and biological control one can also incorporate cultural practices like recommended use of nitrogen application, regular irrigation and lawn moving practices for an integrated approach in managing the turfgrass diseases.

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M. Sc.

ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Ahir Hetalbahen Keshavbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020215001	**Date : 30-12-2016**
Major Guide : Dr. S. S. Gaikwad	**Time : 11:00 to 12:00 am**
Co- Guide : Dr. S. T. Bhatt	**Venue : Swami Vivekananda Hall**

Role of micronutrient in arid fruit crops

India is the second largest producer of fruits in the world with an annual production of 81.2 million tonne and the total area under fruit cultivation is 6.4 million hectare. (Anonymous, 2015) .Arid fruit crops contribute a major share and the important fruits are ber, aonla, pomegranate, custard apple, fig and bael. The elements like Cu, Zn, Mn and B are necessary for healthy growth and development and plays an important role of enhancement in photosynthetic and metabolic activities which leads to an increase in various plant metabolites for cell division and cell elongation. Photosynthetic reactions are accelerated in the presence of Cu .Boron increses photosynthetic activity and respiration in plants thus improves growth. Zinc is an essential component of various enzyme systems for energy production, protein synthesis and growth regulation. Iron is involved in the production of chlorophyll. Iron also is a component of many enzymes associated with energy transfer, nitrogen reduction and fixation and lignin formation. Manganese is necessary in photosynthesis. The role of chloride in decreasing the incidence of various diseases in plants.

Review of Research Work:

Ber (B.N.: *Zizyphus mauritiana* Lamk., Family: Rhamnaceae)

Meena *et al*. (2008) conducted a trail on foliar application of ferrous sulphate and borax at pea stage at different concentrations (0.3, 0.6 and 0.9% each). They observed that foliar spray of 0.9 % ferrous sulphate and 0.9% borax increased all the characters in ber.

An investigation was undertaken by Samant, Deepa *et al.* (2008) to study the effect of micronutrients on ber yield, quality and storage life at ambient conditions. The treatments consisted of various concentrations of Cu, Fe and Zn (0.1, 0.2 0.3 and 0.4% each). All the treatments had marked influence on yield and quality of fruits. The maximum yield (94.5 kg/tree) was recorded with the application of 0.4 % $ZnSO_4$. However, the post harvest quality of fruits was also enhanced by the same treatment.

Aonla (B.N.: *Emblica officinalis* L., Family: Euphorbiaceae)

Verma *et al.* (2008) revealed the minimum fruit drop (52%), maximum fruit size length (4.41cm) and breadth (5.07cm), weight (48.16g), fruit volume (45.57cm^3), specific gravity (1.091g/cm^2) and yield (104.50 kg/tree) when the foliar spray was done with 0.2% borax +0.5% zinc sulphate in aonla cv. Banarasi.

Chandra and Singh (2015) observed that the combined foliar application of zinc sulphate, magnesium sulphate and copper sulphate at 0.5 % gave the higher fruit yield (59.70), production and better fruit quality of aonla fruits.

An experiment was conducted by Verma *et al.* (2016) to study the foliar application of micronutrients like $ZnSO_4$, borax, $CuSO_4$ and $CaCl_2$. Among all treatments application of zinc sulphate 0.1%+ borax 0.6% proved most effective in reducing fruit drop (35.31%) and highest fruit retention (64.72%). They also observed the fruit quality traits like ascorbic acid (589 mg/100g) TSS (9.2%) and yield (80 kg/tree) were maximized under the treatment of zinc sulphate 0.1% + borax 0.6% + calcium chloride 0.1% in aonla.

Pomegranate (B.N.: *Punica granatum* L., Family: Punicaceae)

Eaida and Mustafa (2013) studied the effect of foliar application with manganese and zinc on growth, yield and fruit quality.They found that all the characters in pomegranate cv. Salemi were observed maximum when the trees were sprayed with 0.3% zinc + manganese @ 60 mg/L.

Custard apple (B.N.: *Annona squamosa* L., Family: Annonaceae)

Makhmale *et al*. (2016) studied the effect of foliar spray of zinc, iron and boron on flowering, yield and quality of custard apple. Among all treatments the combination of zinc sulphate (0.5%) + ferrous sulphate (0.5%) + borax (0.3%) recorded maximum number of flowers/shoot (26.57%), fruit set (20.30%), fruit retention (87.75%), minimum fruit drop (12.25%), fruit yield(20.06kg/tree), fruit weight(173.56g), girth of fruit(7.33cm), fruit length (6.86cm) pulp weight (93.53g), quality parameters like TSS (16.29%), reducing sugars (14.29%) and non reducing sugars (2.73%) in custard apple cv.Sindhan.

Fig (B.N.: *Ficus carica* L., Family: Moraceae)

Tamboli *et al*. (2015) studied the effect of foliar and soil application of iron, zinc and boron on yield and quality of fig.The maximumfruit length (7.03cm), fruit diameter (5.30cm), average fruit weight (56.1g) and yield (13.8kg/tree) were found maximum with soil application of ferrous sulphate + zinc sulphate @ 20kg/ha + borax @ 5kg/ha. However, the quality parameters like TSS (22.28%), lower acidity (0.15%) and maximum sugar (16.41%) were increased significantly in the same treatment as compared to control.

Bael (B.N.: *Aegle marmelos* Corr., Family: Rutaceae)

Dhaker *et al*. (2013) revealed that foliar application of borax @ 0.6% increased the fruit weight (962g), no. of fruits/tree (23.55), yield kg/tree (21.21), minimum fruit cracking (2.14%), and quality parameters like maximum fruit diameter (16.43cm), length (16.38cm), TSS (32.55^0B), Ascorbic acid (17.77mg), Total sugar (18.48%) and reducing sugar (3.91%) in bael.

Conclusions:

From the foregoing discussion it can be concluded that application of micronutrients improved the plant growth, yield and quality parameters in arid fruit crops. The combination of 0.9% ferrous sulphate + 0.9% borax and 0.4% zinc sulphate improved fruit character, yield and quality of ber. Similarly, the combination of 0.2% borax + 0.5% zinc sulphate, 0.5% zinc sulphate + 0.5% magnesium sulphate + 0.5% copper sulphate, 0.1% zinc sulphate + 0.6% borax + 0.1% calcium chloride improved physical, chemical and yield parameters of aonla. The applicationof Zn 3.0 % + Mn 60 mg/L improve the fruit set, quality and yield of pomegranate. The combine effect of 0.5% zinc sulphate + 0.5% ferrous sulphate + 0.3%borax improved flowering parameter, physicalparameter, yield and quality parameter of custard apple. The soil application of ferrous sulphate + zinc sulphate @ 20kg/ha + borax @ 5kg/ha improved yield and quality of fig. Application of borax 0.6% as foliarspray improved the quality parameter of bael.

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NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Ahir Unnatibahen Jayantilal	**Course : FSC 591 (1+0)**
Reg. No. : 2020215002	**Date : 16-12-2016**
Major Guide : Dr. B. M. Tandel	**Time : 10:00 to 11:00 am**
Co- Guide : Dr. N. K. Patel	**Venue : Swami Vivekananda Hall**

Role of calcium and boron for enhance the production of tropical fruit crops

India is the second largest producer of fruits in the world with an annual production of 88.9 million tonnes and the total area under fruit cultivation is 7.2 million hectare. The growing population and realization of commercial and nutritional values, the demand and requirement for fruits has increased manifold globally in India. Since then, India has managed a steady growth in area expansion and production of fruits. Tropical fruits are contributing major share in India's production and the important fruits are mango, banana, papaya, citrus, guava, pineapple, litchi, sapota and pomegranate.

The production and productivity of fruit crops are mainly depending upon the nourishment of the plant. For better growth & development of the fruit crops requires both macro & micronutrient in adequate amount. Elements like nitrogen, phosphorus and potash play a vital role in promoting the plant vigour and production. Micronutrients like Fe, Zn, Mn, Cu and B are not only essential but they are equally important like other macronutrients. Micronutrients are key elements in plants growth and development. In the absence of these elements, the plants are known to suffer from physiological disorder.

Calcium is extremely important to fruit trees as it increases root and leaf growth, as well as increases fruit yield. Reduces disease by building resistance and maintains fruit quality, firmness, and flavour. It also helps to strengthen the cell wall and its degradation. Fruits which are high in calcium often have a stronger and thicker peel.

Boron is the most wide spread micronutrient deficiency around the world and causes large losses in crop production and crop quality. It is relate to cell wall strength and development, cell division, fruit and seed development, sugar transport and hormone development.

Brief Review of Research Work

Mango (*Mangifera indica* L.): Family: Anacardiaceae

Negi *et al.* (2011) concluded that the foliar application of Boric acid 200 ppm + Sorbitol 2000 ppm are most effective treatment to increased pollen viability (%), pollen germination (%), higher fruit set on hermaphrodite flower basis (%), minimum fruit drop (%) and maximum yield (kg/tree). The treatment calcium nitrate 600 ppm + sorbitol 2000 ppm maximized fruit weight and boric acid 200 ppm gave higher percentage of hermaphrodite flower in mango cv. 'Dashehari'.

Foliar application of Boric acid (0.02 %) + sorbitol (2.0 %) gave higher fruit set (%) while, calcium nitrate (0.06 %) + sorbitol (2.0 %) at 50 % flowering stage induced maximum no. of fruit/tree and yield (kg/tree) in mango cv. 'Kesar' at AES, Paria. (Anon., 2012).

Sankar *et al.* (2013) recorded maximum fruit length (cm), breadth (cm), fruit weight (g), fruit volume (cc), No. of fruit/plant and yield (kg/tree) in boric acid (0.02%) as foliar spray in Mango cv. 'Alphanso'.

Dutta (2004) revealed that application of 3000 ppm boric acid significantly increased hermaphrodite flower (%), length of panicle (cm), fruit weight (g) and fruit retention (fruit/panicle) in mango cv. 'Himsagar'.

Nehete *et al.* (2011) observed that treatment combination of $ZnSO_4$ 1 % + $FeSO_4$ 1 % + Borax 0.5 % took significantly minimum days to 50 % flowering, increased fruit weight (kg), total no. of fruit/tree and yield (kg/tree) in mango cv. 'Kesar'.

Papaya (*Carica papaya* L.): Family: Caricaceae

Bhalerao *et al.* (2014) revealed that the foliar application of Calcium nitrate 1000 mg/l + Borax 30 mg/l + zinc sulphate 200 mg/l + ferrous sulphate 200 mg/l obtained significantly higher number of fruit/plant, fruit yield/plant and yield/hectare. Borax 30 mg/l was relieved earliness in initiation of flowering (day) of papaya cv. 'Taiwan Red Lady'.

Kavitha *et al.* (2001) concluded that significantly maximum no. of fruits/plant, fruit yield (kg) and latex yield (g/fruit) were observed in combination of Zn (0.5 %) + B (0.1 %) foliar spray at 4^{th}, 8^{th}, 12^{th} and 16^{th} month after planting in papaya cv. Co-5.

Banana (*Musa paradisica* L.), Family:Musaceae

Pathak *et al.* (2011) found that bunch weight (kg), hands/bunch, fingers/bunch and yield (t/ha) were increased with foliar application of $ZnSO_4$ (0.5 %) + $FeSO_4$ (0.5 %) followed by Borax (0.1 %) in banana cv. 'Martaman'.

Balaji *et al.* (2016) observed that foliar application of Zn (0.5 %) + B (0.1 %) gave maximum plant height (cm). They also found that maximum bunch weight (kg) and flowering percentage (%) with application of B (0.1 %) + Fe (0.2 %) in banana cv. 'Poovan'.

Sapota (*Manilkara achras* (Mill.) Fosberg), Family: Sapotaceae

Saraswathy *et al.* (2004) revealed that application of $ZnSO_4$ 50g/tree + Borax 25g/tree (soil application) + $ZnSO_4$ (0.5%) + Borax (0.3 %) (foliar spray) were significantly increased tree height(m), fruit girth (cm), single fruit weight (g), no. of fruit /tree, yield (kg/tree), TSS ($^{\circ}$Brix), total sugar (%), reducing sugar (%) and ascorbic acid (mg/100g) in sapota cv. 'PKM 1'.

Bhalerao *et al.* (2009) observed that significantly minimum physiological loss in weight (%) in all storage days and maximum fruit firmness (kg/cm^2) and self life (days) in pre-harvest application of calcium chloride (1%) in sapota cv. 'Kalipatti'.

Guava (*Psidium guajava* L.), Family: Myrtaceae

Yadav *et al.* (2011) found that foliar application of Borax @ 0.1 % gave significantly maximum fruit retention (%), fruit width (cm), fruit length (cm), fruit weight (g), fruit yield (kg/plant), TSS ($^{\circ}$Brix), ascorbic acid (mg/100g), total sugar (%) and minimum fruit drop in guava cv. 'L-49'.

Pineapple (*Annanas comosus* L.), Family: Bromeliaceae

Razzaque and Hanafi (2000) revealed that fruit weight increased until the application of 32 kg CaO/ha and decline thereafter with further increased Ca level in pineapple cv. 'Gandul'.

Conclusions

From the foregoing discussion, it can be concluded that the application of calcium and boron improves growth, yield and quality of fruit crops. Foliar spray of boron in form of boric acid in mango for the increasing reproductive growth like pollen viability, pollen germination, fruit set, fruit weight, length of panicle and fruit retention. In papaya, combination of foliar application of calcium nitrate 1000 mg/l + borax 30 mg/l + zinc sulphate 200 mg/l + ferrous sulphate 200 mg/l gave better yield. Whereas, Borax 30 mg/l was induced earliness of flowering and combination of Zn (0.5 %) + B (0.1 %) foliar spray at 4th, 8th, 12th and 16th month after planting increased yield and quality of papaya. $ZnSO_4$ (0.5 %) + $FeSO_4$ (0.2 %), B (0.1 %) + Fe (0.2 %) and Borax (0.1 %) as a foliar spray in banana found better for yield and quality. Whereas, Zn (0.5%) + B (0.1 %) better for plant height and flowering. Soil application of $ZnSO_4$ 50 g/tree + Borax 25 g/tree and foliar application of $ZnSO_4$ (0.5 %) + Borax (0.3%) were useful for plant height, yield and quality of sapota while, calcium chloride (1 %) increased postharvest life and quality of fruit. Borax @ 0.1 % increased yield, yield attribute character, flowering attribute character and quality of guava. Fruit weight increased until the application of 32 kg CaO/ha and decline thereafter with further increased Ca level in pineapple.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
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POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Patel Ankitkumar K.	**Course : FSC 591 (1+0)**
Reg. No. : 2020195039	**Date : 30-12-2016**
Major Guide : Dr. S. S. Gaikwad	**Time : 02:00 to 03:00 pm**
Co- Guide : Dr. S. S. Masaye	**Venue : Swami Vivekananda Hall**

Importance of rootstocks and its compatibility with scion in tropical fruit crops

Horticultural crops are propagated commercially through asexual or vegetative means. Generally fruit crops propagated through vegetative method gives true- to-type plants which are uniform in growth, early in flowering, higher yield and superior quality. We can also grow number of varieties on single plant and the trunk of tree can be repaired through various grafting methods like bridge grafting.

Rootstock plays an important role in propagation of fruit crops. The role of rootstocks in commercial fruit production considerably increased the influence on the growth habit, fruit yield and quality of fruits. We can establish orchard on saline or alkaline soil and also in drought or water logging conditions and we can also used pest, disease and nematode resistant rootstocks for establishment of orchard. It is essential to assess the rootstocks performance before choice of rootstock because, it is very important for healthy and productive establishment of orchard.

Review of Research Work:-

Mango

Reddy *et al.* (2003) tried various rootstocks for grafting with Alphonso cultivar. Nuclear seedlings of Muvandan and Bappakai are increased the vigour of the tree. However, Vellaicollumban imparted dwarfing. The highest yield was recorded in Muvandan and Olour. Chandan *et al.* (2006) studied the influence of polyembryonic and monoembryonic rootstock performance on Dashehari. They recorded significantly the maximum height of scion, number of branches, number of leaves, diameter of stock and scion and higher stock: scion ratio when Dashehari was grafted on Bappakai rootstock.

Singh and Kanpure (2006) reported maximum height, canopy height, circumference of rootstock and scion and tree volume in Langra cultivar grafted on Bappakai rootstock. Whereas, growth characters were recorded minimum on Olour rootstock.

Cashew

While working on cashew grafting Patel (2012) observed that when Vengurla -4 grafted on Vengurla -3 recorded the higher percentage of survival as compared to other rootstock with respect to four different grafting techniques.

Adiga *et al*. (2014) recorded the 100 percent grafting success of V-4 on NRC 492, VRI-3 on V-4, NRCC Selection-2 on V-4 and V-4 on V-4 rootstock whereas, to significantly the maximum nut yield was recorded when VRI-3 was grafted on NRC-492 rootstock as compared other stionic combinations.

Annona *spp*.

Yu Fu *et al*. (2012) observed the zero wilting percentage in continue and periodic flooding conditions when the African Pride was grafted on Pond apple rootstock and AP/AR/G.

Citrus

Mehrotra *et al.* (1981) recorded maximum trunk girth of stock and scion, scion: stock ratio, tree volume and yield (fruits/tree) when Jaffa cultivar of sweet orange was budded on Jatti Khatti rootstock as compared to other rootstocks.

Josan and Thatai (2008) reported that when Kinnow Mandarin budded on Jatti Khatti rootstock significantly gave the maximum yield (number of fruits/tree) after 14, 15, 16, 17 and 18 years after planting as compared to other rootstocks.

Ghosh *et al.* (2012) observed the maximum plant growth (5 year after planting), average number of fruits per plant and average yield per plant of sweet orange cv. Mosambi budded on Karna Khatta rootstock as compared to another rootstocks.

Singh *et al.* (2012) noted minimum days required for first sprouting and days required for 50 percent sprouting when Nagpur Mandarin was budded on Rangpur Lime rootstock. However, significantly the maximum budding success percentage was observed when Nagpur Mandarin was budded on Rough Lemon rootstock.

Guava

Gill *et al.* (2014) revealed that Sardar and Allahabad Safeda cultivars of guava when grafted on Portugal rootstock produced significantly the higher fruit yield per tree as compared to other rootstocks in the both the seasons.

Conclusions

The proper selection of rootstock should be done carefully which greatly influence the graft compatibility and success. For mango polyembryionic rootstocks like Vellaicollumban and Olour rootstocks are used for dwarfness whereas, Muvandan and Bappakai can be used to increase the vigour. In cashew Vengurla- 4 and Vengurla-3 rootstock are compatible and they are high yielding rootstock. In Annona *spp.* Pond Apple rootstock may be use as a flood resistant rootstock. In citrus Jatti Khatti and Karna Khatta rootstocks are vigorous and compatible rootstocks. Rough Lemon rootstock can be use as a vigorous, trizteza tolerant, salt and calcareous tolerant, adaptable to various soil conditions. In guava Portugal rootstock might be use as a high yielding rootstock.

References

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POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Chauhan Bhathibhai V.	**Course : FSC 591 (1+0)**
Reg. No. : 202015015	**Date : 16-12-2016**
Major Guide : Dr. D. K. Sharma	**Time : 03:00 to 04:00 pm**
Co- Guide : Dr. S. S. Masaye	**Venue : Swami Vivekananda Hall**

Advances in farming system in fruit crops

Over the years, horticulture has emerged as one of the potential agricultural enterprise in accelerating the growth of economy. Its role in the country's nutritional security, poverty alleviation and employment generation programmes are becoming increasingly important. It offers not only a wide range of options to the farmers for crop diversification, but also provides ample scope for sustaining large number of agro-industries which generate huge employment opportunities.

The concept of sustainable Horticulture can be described as a "three-legged stool", with legs of economic viability, environmental soundness, and social acceptability.

About 49% of the total area of the Gujarat state is under faming cultivation. The Gujarat ranked third in fruit production of 84.13 lakh metric tonne and share in fruit production was 10% in the country after the Andhra Pradesh and Maharashtra (Anonymous, 2015).

Brief Review of Research Work

Components of farming system

Cropping system:

Kumar *et al.* (2012) recorded the inter-cropping okra – *Gladiolus* with litchi fetched highest net profit and better cost: benefit ratio.

Raut *et al.* (2013) found the maximum mango yield and maximum net return in blackgram + mango in mango orchard.

Agro forestry:

Das *et al.* (2011) reported that highest average yield and better cost: benefit ratio was found under Agri-horticulture system of aonla with turmeric.

Types of farming system:

Organic farming:

Banerjee (1999) reported that the use of organic materials in banana crop gave the more benefit and gave higher gross profit as compared to inorganic materials.

Integrated farming system:

Biswas (2012) studied the economics and employment generation of integrated farming system.

Precision farming:

Solia *et al.* (2010) observed that growth and yield attributes were significantly higher with treatment drip irrigation @ 0.6 PEF + BPM @ 20% coverage (50 micron) in papaya.

Tank *et al.* (2011) reported that drip irrigation @ 0.8 PEF + N and K_2O @ 100 per cent RD gave maximum yield of papaya. However, maximum cost: benefit ratio was observed with drip irrigation @ 0.8 PEF + N and K_2O @ 80 per cent RD.

Godage (2012) observed the more number of fruits and fruit yield in treatment 75% N + 75 % P + 100 % K +*Azatobacter* 5 ml/tree + PSB 5 ml/tree in guava cv. Allahabad Safeda.

Ram *et al.* (2012) revealed that the treatment (100g urea + 120g SSP + 20g MOP + 8 kg FYM + *Azatobactor* + PSB) and (50g urea + 60g SSP + 10g MOP + 10 kg FYM + *Azatobactor* + PSB) performed better in terms of quality parameters of phalsa.

Kaur *et al.* (2013) revealed that the application of 100%N + 100% P + Azospirillum + PSB + 10 kg vermicompost significantly influenced the chemical parameters of guava fruit cv. L-49.

Srivastava *et al*. (2014) manifested that maximum yield and better quality fruits were found with the FYM + 100 % NPK + azotobacter 20 g/pit + PSB 20 g/pit) in papaya.

Balakrishnamurthy and Shanmugasundaram (2015) indicated 50% recommended dose of fertilizers through fertigation resulted in maximum number of fruits per plant, average fruit weight, fruit volume and fruit yield per plant in pomegranate cv. Mridula.

Conclusion

A farming system fulfils the multiple objectives of making farmers self-sufficient by ensuring the family members. It also improves the standard of living through maximizing the total net return and providing more employment, recycling of crop residues, optimizing resource use, minimizing risks and keeping harmony with the environment by comprising a combination of carefully selected components/enterprises under a given set of agro-climatic condition. Although effectiveness of farming system in different agro-climatic regions need to be determined and greater awareness about the additional benefits of farming system need to be created amongst farmer fruit crops**.**

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POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Chaudhari Asha M.	**Course : FSC 591 (1+0)**
Reg. No. : 202015012	**Date : 17/12/2016**
Major Guide : Dr. T. R. Ahlawat	**Time : 10:00 to 11:00 am**
Co- Guide : Dr. Sanjeev Kumar	**Venue : Swami Vivekananda Hall**

Recent interventions in regulation of citrus flowering

Citrus is the most widely produced fruit, as a group of several species and is grown in more than 80 countries. Citrus cultivation is not only remunerative but also generates employment and fruits have nutritive as well as therapeutic value. In India, citrus fruits occupy 10.77 lakh ha area with a production of 111.47 lakh MT and a productivity of 10.3 MT/ha. Acid lime, mosambi and mandarin are the most widely cultivated citrus fruits in India. Gujarat is the second largest producer of acid lime in the country accounting for about 16% of the total production. The productivity of acid lime in Gujarat is nearly 10.5 MT/Ha (Anonymous, 2015). Acid lime flowers thrice in a year *i.e.* January-February (*Ambe bahar*), June-July (*Mrig bahar*) and September-October (*Hasta bahar*). Fruit of *Hasta bahar* flowering, harvested in April-May are the most remunerative. During April-May, there is a huge demand for these fruits, especially in metropolitan cities, which are difficult to fulfill, resulting in higher prices. To make citrus farming imperative, it is therefore important not only to study its floral biology but also to regulate its flowering. Hormonal regulation, withholding irrigation and pruning are some practices followed to regulate flowering in fruit crops. Several studies in this regard have been conducted on acid lime in different parts of the country, the available literature of which is reviewed as under.

Review of research work

Ingle *et al*. (2001) reported significant improvement in yield and quality of acid lime fruits when subjected to 30 days soil moisture stress along with 50 ppm spray of ascorbic acid.

Thirugnanavel *et al*.(2007) found that application of GA_3 (50 ppm) in June + cycocel (1000 ppm) in September + KNO_3 (2%) in October increased the number of flowers per shoot, initial fruit set, fruit retention, number of fruits and fruit yield per tree in acid lime.

Soil application of paclobutrazol at 2.50 g *a.i* /tree recorded the highest number of flowers per shoot (8.04 and 7.86) and 3.75 g *a.i* /tree recorded the lowest number of days taken for flowering in the main and off season (66 and 69 days) in acid lime (Baskaran *et al*., 2010).

Devi *et al.* (2011) noticed that application of bromouracil, 2,4-D and paclobutrazol in variable doses where effective for induction of flowering in acid lime.

Fuentes *et al.* (2011) found that paclobutrazol (1 g per tree) application during the floral bud inductive period (November) significantly increased flowering intensity (70%) in 'Hernandina' Clementine mandarin (70 flowers per 100 nodes) as compared to untreated trees (40 flowers per 100 nodes).

Deshmukh *et al.* (2014) reported that cycocel @1000 ppm in the month of September followed by application of 2% KNO_3 in October increased the number of flowers per shoot (250.50), fruit set (43.31%) and number of fruits per tree (905.75) in acid lime.

Foliar application of paclobutrazol @ 5 ml/m canopy resulted in higher number of flowers per shoot (8.21), fruit set per shoot (4.86%) and number of fruits per tree (143.14) in acid lime (Sarkar *et al.*, 2014).

Debbarma and Hazarika (2016) concluded that acid lime trees when sprayed with GA_3 (100 ppm) + Cycocel (1000 ppm) + KNO_3(1%) recorded higher number of flowers per shoot (6.62), fruit set (65.51%), number of fruits per tree (149) and average fruit yield (4.64 kg/tree).

Kumatkar *et al*. (2016) concluded that Jaffa cultivar was earliest to start flowering (19.8 days) and also highest fruit set observed under open pollination(32.84 %).

Pawar *et al.* (2016) reported that combin application of GA_3(50 ppm) in June and cycocel (1000 ppm) in September followed by KNO_3 (1%) in October, significantly increased number of flowers per shoot (37.05), number of fruits per tree (307.06), fruit weight (40.28g) and yield (11.86 kg/tree and 3.27 t/ha) in acid lime.

Conclusion

Citrus fruits are very popular in the Indian subcontinent and grown throughout the country. To regulate flowering in citrus numerous technological interventions are recommended, some of which have been reviewed in the scientific literature quoted above. Experimental evidence implicates moisture stress, plant growth regulators (GA_3), plant growth retardants (paclobutrazol, CCC) and other chemicals (KNO_3, bromouracil, 2, 4- D) in improving the number of flowers per shoot and ultimately fruit yield. Particularly in acid lime, GA_3 (50-100 ppm), cycocel (1000 ppm) and KNO_3 (1-2%) have contributed significantly towards increasing the number of flowers per shoot, fruit set and fruit yield. Soil as well as foliar application of paclobutrazol also induced flowering and improved yield in crops like mandarin and acid lime. Thus, for regulation of flowering in citrus fruits, moisture stress and plant growth chemicals can be successfully employed. However, there is a need to standardize the concentration, frequency and time of application for the plant growth chemicals mentioned above in different citrus fruits for different agro climatic regions.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : M. Jnanendra	**Course : FSC 591 (1+0)**
Reg. No. : 202015025	**Date : 16-12-2016**
Major Guide : Dr. B. N. Patel	**Time : 09:00 to 10:00 am**
Co- Guide : Dr. Dipal S. Bhatt	**Venue : Swami Vivekananda Hall**

Architectural modelling in fruit crops

Plant architecture, the dynamical organization of plant components and their three-dimensional (3-D) distribution, plays a pivotal role in gathering multiple resources from the environment and model is an attempt to describe a certain process or system through the use of a simplified representation, preferably a quantitative mathematical expression, that focuses on a relatively few variables that control the process or system. A plant deploys its photosynthetic apparatus in a 3-D space in order to optimize the interception of incoming radiation (Yang and Hwa, 2008). The architecture of the plant is modified through the allocation of assimilate, which determines the growth rates of different organs (Hu and Jaeger, 2003). Analysing, modelling and simulating plant architecture has become an important challenge during the last decade in the context for global climate change and rapid population increase; there is an urgent need to solve the serious problems of world food security and environmental deterioration. By efficiently using resources can be achieved by improving aerial morphological traits, for instance to maximize radiation harvesting and nutrient uptake. Computer models and simulations of plant growth and architecture provide efficient tools to achieve these objectives. Advance development of computer resources and the sharing of experiences between biologists, mathematicians and computer scientists, the development in plant growth models has progressed enormously during the last two decades. The use of an interdisciplinary approach is necessary to advance research in plant growth modelling and simulation.

There are 3 types of architectural models
1. Process based model
2. Structural plant model
3. Functional- Structural plant models

Brief Review of Literature:

Tombesi *et al.* (1993) investigated the effects of different source-sink ratios on fruit growth and quality by defoliating *Actinidia deliciosa* vines with varying intensity and calculated the effect on fruit carbon content for defoliated and undefoliated canes. Based on the field data Cieslak *et al.* (2010) simulated the defoliation treatments and stated that there was a potentiality of the model reproduces the carbon content of the fruits for *Actinidia* species.

Snowball (1997) collected data for the season cycle of shoot development and calculated the frequency distribution of shoot node number for *Actinidia deliciosa* and *A. Chinensis* vines. Based on the field data given by snowball (1997), Cieslak *et al.* (2010) simulated the branching patterns of *Actinidia chinensis* and *Actinidia deliciosa* and stated that there was a potentiality of the model to reproduce the shoot node number distribution for two *Actinidia species.*

Piller *et al*. (1998) performed girdling experiments on parent canes to manipulate the amount of resources available to the shoot and calculated the distribution of node number per shoot for *Actinidia deliciosa.* According to field data of Piller *et al*. (1998), Cieslak *et al.* (2010) simulated the node number distribution for kiwi fruit shoots although direct comparison between shoot length from data and node number distribution from the model is not feasible, qualitatively the model is able to simulate the effect of carbon reserve on shoot growth.

Greaves *et al.* (1999) studied the effect of carbon reserve distribution in parent canes on axillary shoot growth and calculated the amount of structural carbon in vegetative components of a pair of shoots for *Actinidia deliciosa* on the basis of field data given by Greaves *et al.* (1999), Cieslak *et al.* (2010) simulated the amount of structural carbon in vegetative components for a pair of identical shoots and stated that on the centrally located shoot pair, growth of the apical shoot was slowed down by competition for reserves from the basal shoot the simulation of an offset shoot pair showed a similar effect, but the difference was larger.

Seleznyova *et al.* (2002) collected architectural data on two years old branches of an unpruned *Actinidia chinensis* and calculated the probability of different shoot types along the parent cane. Based on the field data given by the Seleznyova *et al.* (2002) Cieslak *et al.* (2010) simulated the branching pattern of *A. deliciosa* and reported that the potentiality of the model to reproduce the axillary shoots growth of *A. deliciosa*.

The L-Peach plant model was expressed by Allen *et al.* (2004) on the bases of functional structural model related to rate of assimilation of carbohydrates, light intensity, source strength, carbon allocation, water stress index and they resulted that there was a source-sink relationship as final fruit size was increased, there was a decrease in the total amount of carbon partitioned to fruit growth, lower variance in fruit size within a tree and greater partitioning of carbon to vegetative growth. They also reported that effect of water stress to the plant was a reduction in shoot elongation and girth growth for two-year-old trees. So L-Peach system for modelling the architecture and physiology of growing trees can be considered for simulating complex interaction within trees including growth, carbon partitioning among organs and responses to management factors.

Dejong *et al.* (2008) investigated the concept of shoot growth and architecture to understand and predict responses of peach trees to pruning and found that using Hidden semi-markov chain concept, FSPM successive able to reproduce the effect of tree responses to training.

Cieslak *et al*. (2013) investigated the effect of fruit architectural properties on fruit quality by means of a 3D functional–structural model that integrates the architectural and physiological perspectives in fruit quality development and found that model was capable of simulating the observed effects of architectural features, like skin micro cracking, on the quality of the fruit.

Conclusion:

From the foregoing discussion it can be concluded that, L-PEACH to be an L-system based template for simulating complex interactions within trees, including growth, carbon partitioning among organs and responses to environmental, management factors. The FSPM is able to reproduce differences in vine and fruit growth arising from various experimental treatments. This implies it will be a valuable tool for refining our understanding of kiwi fruit growth and for identifying strategies to improve production. It is possible to investigate the important architectural features that affect fruit quality by using FSPM. Models allow us for experiments testing our hypotheses of the behavior of the real plant.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Patel Manoliben Rajendrakumar	**Course : FSC 591(1+0)**
Reg. No. : 2020215043	**Date : 31-12-2016**
Major guide : Dr. R. V. Tank	**Time : 9 to 10 a.m.**
Co-guide : Dr. D. R. Bhanderi	**Venue : Swami Vivekananda Hall**

Effect of pre harvest treatments of chemicals on yield and quality of fruit crops

India is a second largest producer of fruits in the world (88.97 MT) followed by China (137.06 MT) but the productivity of fruits in India (12.3 MT/ha) is higher than China (11.6 MT/ha) (Anon., 2015). Fruits are perishable in nature so after harvest 30-40 % per cent losses are there due to the lack of knowledge regarding pre and post-harvest management. Post harvest management starts with pre-harvest management. Pre-harvest spray of plant growth regulators and micronutrients either alone or in combinations are common practices adopted by farmers to increase yield, quality and shelf-life of the fruit crops.

Review of research work

Mango

Vejendla *et al.* (2008) revealed that spraying of $ZnSO_4$ @ 0.75 % at pea and marble stage produced significantly highest fruit weight (216.83 g), TSS (19.67 °Brix), total sugars (15.91 %), reducing sugar (4.96 %) and TSS/acid ratio (115.01) in mango cv. Amrapalli.

Nehete *et al.* (2011) accessed that combine spray of $ZnSO_4$ @ 1 % + $FeSO_4$ @ 1 % + Borax @ 0.5 % spray at flowering and pea stage gave significantly highest fruit weight (0.295 kg), total number of fruits/tree (168.00), yield (49.54 kg/tree), reducing sugar (6.03 %), total sugar (16.67 %) and ascorbic acid (32.80 mg/100g pulp). Whereas, maximum TSS (19.60 °Brix) was observed with borax @ 0.5 % in mango cv. Kesar.

Karemera and Habimana (2014) revealed that $CaCl_2$ @ 1.5 % spray at 30 and 15 days before harvest gave significantly highest fruit length (9.81 cm), thickness (8.16 cm), weight (315.23 g), pulp weight (205.33 g) and peel weight (37.89 g) in mango cv. Alphonso.

Patel *et al.* (2015) reported that 2, 4-D @ 20 ppm + $ZnSO_4$ @ 0.05 % spray at marble stage and 30 days before harvest gave significantly maximum fruit weight (194.10 g), girth (6.50 cm) and yield/tree (129.89 kg). Where as maximum fruit length (9.56 cm) was noted with 2, 4-D @ 20 ppm + $CaCl_2$ @ 2 % in mango cv. Kesar.

Guava

Rajput *et al.* (2008) revealed that maximum yield (19907 kg/ha) was noted with Boron @ 0.2 % + NAA @ 150 ppm spray at flowering and 2nd at three weeks after first spray. Maximum TSS (°Brix) and total sugar (%) were observed due to the application of Boron @ 0.2 % + Ethrel @ 1000 ppm. Whereas, minimum titrable acidity (0.50 %) and maximum ascorbic acid (189.33 mg/100g of pulp) was noted with Boron @ 0.2 % + GA_3 @ 90 ppm in guava.

Goswami *et al*. (2012) accessed that 0.4 % zinc sulphate spray at 45 and 25 DBH, significantly gave maximum fruit length (6.18 cm), fruit diameter (5.46 cm) and fruit volume (120.28 cc). However maximum fruit weight (120.87 g) was observed with 0.4 % boric acid in guava.

Garasiya *et al.* (2013) revealed that NAA @ 40 ppm spray during last week of June and second week of July significantly improved quality parameters of guava fruit cv. L-49.

Manivannan *et al.* (2015) reported that K_2SO_4 @ 1 % spray in August and 30 days before harvest gave maximum fruit length (9.0 cm), fruit weight (138.3 g), number of fruits/tree (145.1), yield (20.06 kg/tree), TSS (9.5 °Brix), total sugars (9.25 %), reducing sugar (4.76 %), ascorbic acid (130 mg/100g of pulp) and minimum acidity (0.25 %).

Sapota

Bhalerao *et al*. (2009) concluded that pre harvest spray of $CaCl_2$ @ 1.0 % at 21 days before harvest exhibited maximum firmness (9.10, 8.00, 5.90 kg/cm^2) and minimum physiological weight loss (3.51, 7.55, 12.47 %) at 3rd, 6th and 9th days after harvest of sapota fruit cv. Kalipatti. Maximum shelf life (13.75 days) was also noted in this treatment.

Sharma *et al*. (2016) revealed that spraying of micronutrient mixture 4-Grade @ 2 % at marble stage and 2nd at 2 months after 1st spray gave significantly maximum fruit firmness (0.56 kg/cm^2), TSS (21.36 °Brix) and ascorbic acid (19.17 mg/100g) in sapota cv. Kalipatti.

Pomegranate

Heshi *et al.* (2001) revealed that pre harvest spray of KH_2PO_4 @ 2 % at 90 Days after full anthesis exhibited maximum arils (68.93 %), juice (54.67 %) and total sugars (15.21 %). Whereas, maximum TSS (16.36 ˚Brix) and ascorbic acid (5.88 mg/100g of pulp) was noted with spray of $Ca(N0_3)_2$ @ 2 % in pomegranate cv. G137.

Reddy and Prasad (2012) revealed that 2,4-D @ 40 ppm spay during flowering and at 45 and 90 days after fruit set significantly improved fruit characters and yield in terms of fruit diameter (8.91 cm), fruit weight (262.23 g), aril weight (188.90 g), aril (72.03 %) , no. of fruits/tree (64.0) and yield/tree (16.78 kg) in pomegranate cv. Ganesh.

Goswami *et al*. (2013) found that application of NAA @ 50 ppm at 2nd september and at minimum 20 fruit set was effective in increasing fruit weight, yield, number of fruits per plant and minimize the fruit drop in pomegranate.

Anawal *et al.* (2015) revealed that NAA @ 40 ppm spray at after full bloom gave significantly maximum number of fruits/plant (62.44), yield (15232.70 kg/ha), fruit length (8.66 cm), fruit weight (262.23 g), TSS (16.76 ˚Brix), reducing sugar (13.83 %), non-reducing sugar (1.75 %), total sugars (15.58 %) and shelf life (29.00 days) in pomegranate cv. Bhagwa.

Ber

Karole and Tiwari (2016) concluded that combine application of NAA @ 60 ppm + GA_3 @ 30 ppm + urea @ 2.0 % spray at 11th October and at 30 days after 1st spray gave significantly highest fruit length (3.58 cm), pulp thickness (1.21 cm), fruit weight (22.0 g), number of fruits/tree (1366.67), yield/tree (31.75 kg), TSS (19.68 °Brix) and minimum acidity (0.12 %) in ber cv. Gola.

Conclusions:

From the foregoing discussion it can be concluded that pre-harvest spray of chemicals improved the yield and quality of fruit crops. Yield and quality of mango fruits can be improved with the application of either $ZnSO_4$ @ 0.75 % at pea and marble stage or $ZnSO_4$ @ 1% + $FeSO_4$ @ 1% + Borax @ 0.5% or $CaCl_2$ @ 1.5% at 30 DBH or 2, 4-D 20 ppm + $ZnSO_4$ @ 0.05 %. The combine application of Boron @ 0.2% + NAA @ 150 ppm increased yield of guava cv. Sardar. Yield and quality of guava fruits can be improved with the foliar application of either 0.4 % $ZnSO_4$ or NAA 40 ppm or K_2SO_4 @ 1 %. Pre-harvest spray of either $CaCl_2$ 1.0 % or micronutrient mixture 4- Grade @ 2% found to be better in improving the yield and quality of sapota fruits. Yield and quality parameters of pomegranate fruits can be increased either with spray of KH_2PO_4 @ 2 % or 2, 4-D @ 40 ppm or NAA @ 40 ppm or NAA @ 50 ppm. Yield and quality of ber can also be increased with the application of NAA @ 60 ppm + GA_3 @ 30 ppm + urea @ 2.0 %.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Patel Vrutti K.	**Course : FSC 591(1+0)**
Reg. No. : 2020215048	**Date : 31-12-2016**
Major guide : Dr. C. R. Patel	**Time : 2:00 to 3:00 p.m.**
Co-guide : Dr. D. R. Bhanderi	**Venue : Swami Vivekananda Hall**

Advances in propagation of tropical and subtropical fruit crops through cutting

Propagation through cutting is one of the most common asexual method of plant propagation in which adventitious roots develops on plant part like stem, leaf or roots. Propagation through cutting is cheap, easy to do, round the year propagation cycle and capacity to produce high number of plants in short time. Use of plant growth regulators specially auxins are commonly used for better rooting in difficult to root plants. In addition to the PGRs, practices like wounding, alteration of media, climate control structures, favourable periods, mother plant nutrition, use of root growth enhancers (Ethrel, humic acid, pseudomonas, VAM) can be used alone or in combination to obtain better rooting. These practices are reported to improve root morphogenesis and roots growth in many tropical and subtropical fruit crops like pomegranate, grape, mulbrerry, karonda, phalsa, fig, citrus, wax apple, etc .

Review of Research Work:

Pomegranate (*Punica granatum* L.) (Family: Punicaceae)

Spraying of ethrel 1000 ppm to mother plants before 3 days of taking the cuttings, significantly increased length of shoot per cuttings (cm), number of roots per cutting and length of roots per cutting (cm) in pomegranate cv. Bhagwa. In another experiment, they also studied on effect of portion of shoots and combinations of media on shoot and root growth of pomegranate cuttings and recommended that the cuttings taken from the sub-apical portion (leaving 30 cm from top) and planted in vermiculite: poultry manure (1:1) + *Pseudomonas fluorescens* media mix resulted in significantly higher in length of shoot per cuttings (cm), number of roots per cutting and length of roots per cutting (cm) (Anonymous, 2015).

Sharma *et al.* (2009) studied on effect of different combinations of PGRs and Borax on rooting parameters of hardwood and semi hardwood cuttings of pomegranate cv. Ganesh. They recorded highest rooting per cent (78.33%) and number of roots (27.12) in hardwood cuttings with treatment combination of IBA 500 ppm + 1% Borax.

Ansari (2013) studied the effect of different media on rooting characteristics of pomegranate cv. Malas Torsh hardwood cuttings and recorded highest rooting per cent (72.10%) and dry weight to fresh weight ratio of roots (88.76) in sand + vermiculite medium (1:1).

Sarrou *et al.* (2014) noted that IBA exerted a positive influence on percentage of rooting and root number per cuttings both in wounded and nonwounded semi hardwood cuttings, compared to the control.

Grape (*Vitis vinifera* L.) (Family: Vitaceae)

Somkuwar *et al.* (2013) concluded that application of Zn @ 20.0 g/mother vine before two month of taking cuttings resulted in higher shoot length (12.69cm), inter nodal length (3.07cm), number of leaves per shoot (8.56) and leaf area (24.52cm^2) of cuttings of grape rootstock Dog Ridge.

Mulberry (*Morus alba* L.) (Family: Moraceae)

Singh *et al.* (2014) concluded that among various concentrations of IBA and NAA, 2000 ppm IBA was found most effective in terms of number of sprouted cuttings (9.67), length of sprouts (15.27cm), diameter of sprouts (2.00mm), number of leaves per cutting (7.67), percentage of rooted cuttings (96.67%), number of primary roots (15.67), number of secondary roots (27.33) and length of roots per cutting (11.93cm) of mulberry hardwood cuttings.

Singh *et al.* (2015) concluded that hardwood cuttings planted in mid August under mist chamber resulted in increased number of primary roots (16.33), length of longest roots (15.67cm), fresh weight of roots (13.82gm) and dry weight of roots (3.48gm) in mulberry.

Karonda (*Carissa carandas* L.) (Family: Apocynaceae)

Negi, Deepika and Vanajalatha (2015) found that among the various growth regulator treatments, 8000 ppm IBA resulted in maximum shoot height (14.57cm), length of longest root per cutting (6.56 cm) and highest rooting percentage (34.44%) of semi hardwood cuttings of karonda.

Phalsa (*Grewia asiatica* L.) (Family: Tiliaceae)

Singh and Tomar (2015) revealed that hardwood cuttings planted in mid June and treated with IBA @ 2000 ppm found best for highest length of longest roots (11.38cm) and diameter of thickest roots (2.44cm).

Singh *et al.* (2015) opined that phalsa propagated through hardwood cuttings treated with 2000 ppm IBA and kept under mist chamber resulted in increased survival percentage (70.00%), length of longest sprout (8.16cm), diameter of thickest sprout (2.41mm) and number of leaves (3.96) of sprouted cuttings of phalsa.

Fig (*Ficus carica* L.) (Family: Moraceae)

Pipattanawong *et al*. (2008) found that 1.8-2.0 cm thick cuttings of fig planted with plastic pavilion covering had better result in parameters like bud emergence percentage (78.13%), root emergence percentage (100.00%) and average longest root length (8.13cm).

Citrus spp. (Family: Rutaceae)

Bhatt and Tomar (2011) concluded that semi hardwood cuttings of Kagzi Lime (*Citrus aurantifolia* Swingle) treated with 500 ppm IBA and placed under poly house condition resulted in increased length of longest sprouts (12.33cm), diameter of thickest sprouts (0.40cm), and maximum number of leaves on new sprouts (14.33).

Satpal *et al.* (2014) concluded that semi hardwood cuttings of Lemon (*Citrus limon* Burm) cv. Pant Lemon-1 planted in the month of December among the time of planting along with 600 ppm IBA among the concentrations of IBA showed higher percentage of rooted cuttings (72.59%), number of primary roots (6.63), number of secondary roots (59.26), length of longest roots (8.50cm), diameter of thickest roots (0.28cm), fresh weight of roots (0.82g), and dry weight of roots (0.13g).

Wax apple (*Syzygium samarangense* L.) (Family: Myrtaceae)

Patel, Apeksha (2016) revealed that among the various types of cuttings and IBA concentrations, hardwood cuttings and 5000 ppm IBA increased number of shoots per cutting, number of leaves per cutting, number of primary roots and fresh weight of roots compared to other types of cuttings and IBA concentrations in wax apple.

Conclusion

From the foregoing discussion, it can be concluded that the effective concentrations of plant growth regulators is crop specific and must be precisely standardized to obtain required results. Different practices in combination with PGRs can be used for better rooting of cuttings of tropical and subtropical fruit crops. In pomegranate, sub-apical portion of cutting taken after 3 days of spraying of ethrel @1000 ppm and planted in the media of vermiculite: poultry manure (1:1) + *Pseudomonas fluorescens* produce better root and shoot growth. IBA combined with Borax (500 ppm IBA + Borax 1%) gave better rooting in hardwood and semi hardwood cuttings. Vermiculite + sand (1:1) were also found better media for rooting of cuttings in pomegranate. Foliar application of Zn 20 g/mother vine sprayed two month before taking cuttings increased shoot growth in hardwood cuttings of grape. Hardwood cuttings of mulberry taken during mid August, treated with 2000 ppm IBA and kept under mist chamber found most effective.

Semi hardwood cuttings of karonda treated with 8000 ppm IBA produced better shoot and root growth. Hardwood cuttings of phalsa taken during mid June, treated with IBA 2000 ppm and kept under mist chamber produced better root and shoot growth. In fig, 1.8-2.0 cm thick cuttings placed in plastic pavilion covering found superior for root parameters. Semi hardwood cuttings of Kagzi Lime treated with 500 ppm IBA and placed under poly house produced better shoot growth while semi hardwood cuttings of Limon planting in the month of December and treated with 600 ppm IBA produced better root growth. Wax apple hardwood cuttings treated with 5000 ppm IBA resulted in better root and shoot growth.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Patoliya Rahulkumar M.	**Course : FSC 591(1+0)**
Reg. No. : 2020215050	**Date : 26-11-2016**
Major guide : Dr. B. M. Tandel	**Time : 9:00 to 10:00 a.m.**
Co-guide : Dr. N. K. Patel	**Venue : Swami Vivekananda Hall**

Enhancing productivity in mango and guava fruit crops through pruning techniques

Pruning is one of the most essential cultural practices to maintain quality and quantity of fruits crops. Pruning is an operation of removal of part of plant in order to maintain and manipulate the crop canopy and bearing. The main objectives of pruning are to regulate the shape and growth of tree to influence the production and quality of fruit. There are many type of pruning like shoot thinning, heading back, bud removal- nicking or notching, bark ringing, root pruning, chemical pruning, summer pruning *etc.*

Mango (*Mangifera indica* L.) is an important fruit crop in the tropical and sub-tropical regions of the world. Pruning is one of the oldest horticultural practices adopted in temperate fruit crops, but it is rarely practiced in evergreen tropical fruits like mango. Mango trees need not have to be pruned annually to bring on flowering or increase yield as is the case with deciduous fruit trees. The pruning strategies in mango have been developed to prevent trees from getting large through annual pruning as part of a production management programme; reshape intermediate size trees to smaller or more manageable size and completely rejuvenate large trees that are no longer productive due to their size and height (Davenport, 2004).

In guava (*Psidium guajava* L.), judicious pruning can be useful to make guava trees bear profitable crops year after year. Pruning of guava is one of the most important practices that influence the vigour, productivity and quality of the fruits (Gadgil and Gadgil, 1933). Pruning help in maintaining the fruit to shoot ratio and improve fruit yield and quality in guava and also it is a most important operation in guava cultivation, because blooming always comes out from the new branch. Pruning begins at an early stage of plant growth to develop single trunk trees with well spaced scaffold branches to form the frame work. Guava trees should be dwarfed for better field management. Three different types of pruning like regular pruning, medium pruning and heavy pruning are practiced in guava (Singh, 2008).

Brief Review of Research Work

Mango (B.N.: *Mangifera indica* L., Family: Anacardiaceae)

Pratap *et al.* (2003) observed that the maximum light penetration was noted in severely pruned plants at both 0-1 and 1-2 m distance from the crotch. The maximum fruit weight (220.20 g) and canopy temperature (24.17 °C) and fruit yield (21.45 kg/tree) were found in severe and moderate pruning respectively, in mango cv. 'Amrapali'.

Lal and Mishra (2007) revealed that the maximum flowering (58.40%) and cumulative fruit yield (317.50 kg/tree) were obtained from heading upto secondary branches. Whereas, maximum fruit weight (210.15 g) was observed in center opening in mango cv. 'Chausa'.

Yadav *et al.* (2007) revealed that the maximum flowering (26.20 %) and fruit yield (6.98 kg/tree) were found in November pruning. The maximum hermaphrodite flowers (11.44 %), fruit set at peanut stage (10.25 %) and fruit set at egg stage (0.57 %) were observed in December pruning in mango cv. 'Alphonso'.

Lal and Mishra (2008) recorded that the maximum fruit weight (233.20 g), fruit length (13.7 cm) and fruit width (7.2 cm) were observed in branches existing on third order branches. The maximum fruit yield (57.99 kg/tree) and girth of shoots (32.74 cm) were found in branches existing on second order branches and pruning of branches existing on main trunk respectively in mango cv. 'Dashehari'.

Experiment was conducted on heading back and training on mango and found that maximum plant height (8.39 m), no. of fruits/tree (139.33) and fruit yield (50.08 kg/tree) were observed in 5 m from ground level pruning treatment. While, minimum harvesting cost (2886 Rs/ha) was registered in M_0S_1. Whereas, maximum yield (22303 kg/ha) and BCR (2.80) were found in M_3S_3 and M_2S_3 respectively in mango cv. 'Kesar'. (Anonymous, 201 4)

Gopu *et al*. (2014) found that the highest number of new shoots emerged from pruned branch (8.20) was observed in T4 (Heavy pruning). The highest shoot length (51.03 cm and 57.09 cm in 3rd and 6th month, respectively), average number of new flushes emerged after pruning till flowering (2.00) and fresh weight of pruned branches (7.86 kg/plant) were registered in T6 treatment (total removal of past season's growth) in mango cv. 'Alphonso'.

Ghosh *et al*. (2016) recorded that the maximum fruit yield (89.20 kg/plant), TSS (26.10 °B) and ascorbic acid (36.60 mg/100g) were found in the 15th June shoot pruned trees. The maximum fruit weight (361 g) was recorded in plants pruned on 15th September in mango cv. 'Mallika'.

Solanki *et al.* (2016) recorded significantly highest percentage of vegetative shoot emergence at 45 and 60 DAP (17.50 % and 72.50 %, respectively), fruit set at harvest (0.45 %) and yield (50.98 kg/tree) with treatment combination 1st fortnight of July with 25 cm of pruning intensity in mango cv. 'Kesar'.

Guava (B.N.: *Psidium guajava* L., Family: Myrtaceae)

Mohammed *et al.* (2006) noted that maximum shoot length (74.0 cm and 78.0 cm), number of leaves/shoot (69.8 and 74.0) during rainy and winter season respectively, number of flower/shoot (3.8 during winter season), minimum flower drop (2.0% during rainy season), fruit length (5.8 cm), fruit breath (5.4 cm), fruit weight (95.5 cm) and yield (13108 kg/tree) were observed in 60 cm pruning intensity during rainy season. While, maximum fruit length (7.0 cm), fruit breadth (6.6 cm) and fruit weight (168.0 g) were observed in 30 cm pruning intensity during winter season in guava cv. 'Lucknow-49'.

Brar *et al.* (2007) noticed that maximum fruit set (65.6 % and 71.6 % during rainy and winter season, respectively) was observed in 45cm pruning intensity. The maximum number of fruits/tree (430 and 496) and yield/tree (72.2 kg and 82.3 kg) during rainy and winter season, respectively were observed in 15 cm pruning intensity in guava cv. 'Sardar'.

Kumar and Rattanpal (2010) revealed that minimum tree height (4.7 m), tree spread (4.8 m^3) and maximum yield (54.4 t/ha) were found in pruning by removal of ½ vegetative growth at 6×4 m spacing. The maximum no. of fruits (436.0) was observed in control at 6×5 m spa cing. The maximum fruit length (6.8 cm and 7.0 cm), fruit diameter (5.9 cm and 6.1 cm), fruit weight (179.1 g and 189.1 g), TSS (10.40 °B and 11.5 °B), total su gar (7.9 % and 9.4 %) were found in pruning by removal of ½ vegetative growth at 6×4 m spacing during rainy and w inter season crops, respectively in guava cv. 'Sardar'.

Sah *et al.* (2015) observed that maximum fruit retention (84.78 %), number of fruits per plant (22.0) and yield (2.99 kg/plant) were recorded in half shoot pruning in April and April & July and April, July and October respectively in guava cv. 'Pant Prabhat'.

Conclusions

From the foregoing discussion, it can be concluded that pruning is the reliable practices for better quality and enhance productivity. In case of mango, it is an evergreen, it requires light pruning *viz.*, moderate pruning, heading up to secondary branches, heading back from 4 m from ground level and maintain 6 tertiary limbs/ each secondary branch for better growth and quality production. Best time for pruning is 15th June shoot pruning, 1st fortnight of July month with 25 cm pruning intensity.

In case of Guava, Pruning is essential for flowering which resulted in large sized fruits with quality. Removal of 1/3rd vegetative growth in April-July and October with 15 to 60 cm pruning intensity is also resulted quality production while, sever pruning reduces yield.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Rajni Rajan	**Course : FSC 591(1+0)**
Reg. No. : 2020215053	**Date : 03-12-2016**
Major guide : Dr. S. S. Gaikwad	**Time : 10:00 to 11:00 a.m.**
Co-guide : Dr. S. T. Bhatt	**Venue : Swami Vivekananda Hall**

Role of transgenics in fruit crops

The major goal of plant scientists is to develop crop with enhanced nutritional value and find ways to maintain high productivity under stress in the era of increasing human population and climate change. By conventional breeding method the productivity has been reached to plateau level, therefore transgenic crops can prove to be powerful complements to those produced by conventional methods for meeting the worldwide demand for quality foods. Crops developed by transgenes can not only be used to enhance yield and nutritional quality but also for increased tolerance to various biotic and abiotic stress (Datta, 2013). Although there have been some expressions of concern about biosafety and health hazards associated with GM crops, there is no reason to hesitate in consuming genetically-engineered food crops that have been thoughtfully developed and carefully tested. Till date transgenic crops are grown on 181 million hectare area worldwide and it‟s increasing day by day. Integration of modern biotechnology, with conventional agricultural practices in a sustainable manner can fulfil the goal of attaining food security for present as well as future generations (Khan and Liu, 2009).

Review of Research Work

Papaya (B.N.: *Carica papaya* L. , Family: Caricaceae)

Gonsalves *et al.* (1998) conducted an experiment on comparative infection of PRSV (papaya ring spot virus) in non-transgenic and transgenic papaya by inserting *CP* (coat protein) genes of mild PRSV isolate and found that all non-transgenic plants were infected within 11 months of starting the field trail while none of the transgenic test plants were infected.

Ferreira *et al*. (2002) conducted an experiment on comparison of bimonthly fruit yield of transgenic rainbow (with *CP* gene) and non-transgenic sunrise cultivar of papaya and recorded that 17 to 28 months after planting the rainbow gave yield of 2,242 Kg/ha as compared to 419 Kg/ha of sunrise plant annually.

Sakuanrungsirikul *et al.* (2005) studied PRSV resistance, fruit production and *CP* gene reaction (by PCR) of R3 (set 1) transgenic papaya line under field conditions and noticed that in selection set 1, the three R3 lines initially derived from transgenic papaya showed excellent resistance to PRSV (97%) and had a yield 70 times higher than non-transgenic papaya.

Plum (B.N.: *Prunus domestica* L., Family: Rosaceae)

Ravelonandro *et al*. (2013) carried out pomological evaluation of external characteristics of transgenic plum „Honey Sweet‟ with the conventional plums and noted highest fruit balance, appearance, weight, length, width, thickness, shape, colour and flesh thickness in all transgenic lines as compared to conventional plums. Further they carried out plum fruit compositional analysis and the analyses showed that “Honey Sweet” (transgenic) fruit composition was in the range of other plum cultivars tested.

Pear (B.N.: *Pyrus communis* L., Family: Rosaceae)

Malnoy *et al*. (2005) conducted an experiment on fire blight susceptibility by incorporating *EPS depolymerase* gene in *in vitro* transgenic clones (9A–10Q) compared to non-transgenic „Passe Crassane‟ (PC) and observed that fifteen days after inoculation of *E. amylovora,* 80% of non-transgenic PC plant affected by necrosis while less than 3% of the „OH" shoots (resistant control) were infected with low severity and also the three clones (9X, 9M, 10M) showed a significant diminution of fire blight susceptibility compared to the non-transgenic control.

Pineapple (B.N.: *Ananas comosus* Merr., Family: Bromeliaceae)

Trusov *et al*. (2006) investigated the silencing of *ACC synthatase* gene *ACACS2* in transgenic and non-transgenic lines and observed significant delayed flowering in transgenic pineapple by 69.4 and 52.1 days for line 1 and line 2, respectively, as compared with non-transgenic control.

Apple (B.N.: *Malus* X *domestica* Borkh., Family: Rosaceae)

Murata *et al*. (2001) conducted an experiment on PPO activities of transgenic (As-a) and non-transgenic apple callus by regulating the expression of PPO using antisense method and found that the PPO activity (0.25 ± 0.05), browning potential (0.022 ± 0.006) and the amount of expressed PPO protein in line As-a was about 50% less than of that in non-transgenic callus.

Artlip *et al*. (2014) assessed freezing tolerance of non-acclimated leaves collected from non-transformed RG/M.26, RG/T166 and transformed T166 own-rooted trees by incorporating *PpCBF1* gene. Results indicated that LT_{50} of leaves obtained from own-rooted T166 transgenic trees displayed a significant enhancement in freezing tolerance of -4◦C.

Wisniewski *et al*. (2015) carried out phenological disparities between non-transformed M-26 and transformed T166 line by inserting *PpCBF1* gene and found the difference in the time of bud break being offset by approximately 2 weeks however in the non-transformed M-26 trees bud breaks early while the expression in buds of T166 trees was induced about 2 weeks later and rose to higher relative levels.

Strawberry (B.N.: *Fragaria* X *ananassa* Duch., Family: Rosaceae)

Jimenez-Bermudez *et al*. (2002) conducted an experiment on external and internal firmness in controls and transgenic *Apel* plants by inserting antisense *pectate lyase gene* and revealed that 50% of the *Apel* clones analyzed showed a higher external fruit firmness.

Also they found that the most of the *Apel* lines displayed a statistically significant increment in the internal fruit firmness than fruits obtained from control plants.

Khammuang *et al*. (2005) conducted PCR analysis and revealed that all seven strawberry plants, transformed with the pSW1 gave band corresponding to antifreeze protein gene (400bp) however all three strawberry plants, transformed with pBB, also produced a band corresponding to antifreeze protein gene while there were no bands of the *AFP* gene size appearing in control or nontransformed strawberry plants.

Mango (B.N.: *Mangifera indica* L., Family: Anacardiaceae)

Chavarri *et al*. (2010) studied PCR analysis of mango in transformed (lanes 3, 4, 5 and 6) and non-transformed (lane 2) somatic embryo by the insertion of *Agrobacterium rhizogenes rolB* gene and found that in the agarose ethidium bromide gels, the expected band (720bp) corresponding to the amplification of *rol B* gene, was observed in the transformed embryos.

Walnut (B.N.: *Juglans regia* L., Family: Juglandaceae)

Walawage *et al*. (2013) studied inhibition of root lesion nematode in roots of co-transformed somatic embryo genotype RR4 by silencing *iaaM*, *ipt* and *Pv010* genes and found that RR4 transgenic lines had significant reduction in number of nematodes per root (79-84%) than the untransformed RR4 control.

Banana (B.N.: *Musa paradisiaca* L., Family: Musaceae)

Kumar *et al*. (2006) studied the expression of Hepatitis B surface antigen in transgenic banana plants and found that the maximum expression level of 0.7 $\mu g\ g^{-1}$ fresh weight of leaf of *HBsAg* in pEFE HBs transformed plants grown under *in vitro* condition.

Conclusions:

From the foregoing discussion, it can be concluded that there is a possibility of transforming fruit crop for a desired trait. Single insertion of *CP* genes of mild PRSV isolate enhances PRSV resistance in papaya plant. Transgenic plum along with PPV virus resistance shows the high quality fruit as well as nutritional value and hence reducing the environmental risk. Constitutive expression of an *EPS-depolymerase* transgene in pear decreases the susceptibility to fire blight by degradation of a significant amount of the EPS forming the bacterial capsules. Silencing of ACC synthase gene *ACACS2* causes delayed flowering in pineapple. Antisense method is useful for regulating the expression of PPO in transgenic apple. Overexpression of *PpCBF1* delays bud break, shorten the plant height and increase the freezing tolerance in apple. Post harvest life of strawberry enhanced by using antisense pectate lyase gene. The *AFP* antifreeze protein gene from Antarctic fish gives a major possibilities for the resistance against frost in crops.The study of *rol B* gene for mango transformation can play a major role in changing the desired traits. Resistance can be stacked to both crown gall and nematode in walnut rootstock using co-transformation with multiple gene *iaaM*, *ipt* and *Pv010*. Also, vaccine can be developed by the expression of surface antigen of virus against hepatitis B in banana. Though there are many ethical issues related to the growing and consumption of transgenic crops but they hold potential to increase the nutritional value, stress resistance and the productivity of crops and at the same time provide food security and environmental safety. To overcome the biosafety issues of transgenic crop there should be stringent biosafety regulation before approving a transgenic event.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker : Halpati Ankitaben Prakashbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020216009	**Date : 18/11/2017**
Major Guide : Dr. C. R. Patel	**Time : 11:00 to 12:00 am**
Co-Guide : Dr. Dipal S. Bhatt	**Venue : Swami Vivekananda Hall**

Salt tolerance in tropical and subtropical fruit crops

Salt affected soil is one of limiting factor faced by agriculture in many regions of world. The area under such soil in country is about 6.72 million hectarewhile in Gujarat 2.22 million hectare. Salinity is caused due to high accumulation of Na^{+}, Ca^{2+}, Mg^{2+}, K^{+}, SO_4^{-2},CO_3^{-2}, $HCO_3^{-}$and Cl^{-}salts. It reduces water potential andmaking soil solution unavailable to plants. The deleterious effects of salinity on plants may involve morphological, physiological and biochemical changes that adversely affect seed germination, plant growth, productivity as well as quality of fruits. The plants may suffer from physiological drought, nutritional imbalance and deficiency or toxicity of excessiveions. Mechanism of salt tolerance in plantsare osmoregulation, selectivity of ion transport, production of glycinebetain andproline, avoidance mechanisms involves exclusion, excretion or dilution of salts etc. Reclamation of salt affected soil can be done by physical methods (scraping, flushing), biological methods (organic matter application, green manuring, use of salt tolerant crops), chemical methods (amendment, soli conditioning).

Review of literature:

Citrus (*Citrus spp.* Family: Rutaceae)

Navarro *et al.* (2010) studied two level of sainity (0, 30mMNaCl) on two rootstocks (Carrizo, Cleopatra) of mandarin (*Citrus reticulata* L.) andobserved that decreased in fruit yield and mean fruit weight of both rootstocks with increased salinity whereas, at 30mM salinity maximum fruit yield was noted in Carrizo at 30mM salinity level.

Singh *et al*. (2014) compared three rootstocks (Attani-1, Attani-2, JattiKhatti) at different levels of salinity (0, 25 and 50mM). They recorded minimum membrane injury index in JattiKhatti while highest relative water content and maximum proline content in Attani-1 and concluded that rootstock Attani-1 tolerate more salinity than Attani-2 and JattiKhatti.

Mango (*Mangifera indica* L.Family: Anacardiaceae)

Pandey *et al*. (2014) studied the effect of NaCl stress (0, 50, 100, 150mM) on growth of mango seedlings and observed minimum reduction ofplant height in Moovandan (15.78%)while maximum reduction of plant height in Chandrakaran (32.02%). They also observed maximum reduction of number of leaves in Chandrakaran (70.59%) while minimum reduction inNekkare (30.58%) at 150mM salinitylevel.

Banana (*Musa spp.*Family: Musaceae)

Palaniappan and Yeririswamy (1996) evaluated different levels of salinity (0.3, 2.5 and 5.0 dS/m) and observed that biomass, bunch yield, finger weight, pulp weight, peel weight were decreased with increased salinity level in banana cv. Robusta.

Ansuya *et al*. (2015) studied the effect of different levels of salt (100, 150, 200 mMNaCl) stress on carotenoid content and stated that carotenoid content was decreased with increased salinity. At higher salt concentration (200mM NaCl) variety Ney Poovan and Poovan registered least reduction (24.1% and 25.9%) of carotenoids than other varieties.

Sapota (*Achraszapota*Family: Sapotaceae)

Patil and Patil (1983) studied the effect of salinity (0.35, 4, 8, 12, 16, 20 EC) on fresh and dry weight of root and shoot of sapota cv. Kalipatti. They evaluated that fresh and dry weight of root and shoot of sapota decreased with increased salinity and reported maximum fresh and dry weight of rootat 0.35 EC whereas, maximum fresh and dry weight of shoot were observed at 4EC salinity level. The minimum root, shoot dry and fresh weightwas recorded at 20 EC.

Bael (*Aeglemarmelos* L. Family: Rutaceae)

Singh *et al.* (2015) evaluated three levels of salinity (1.3, 6.5 and 10.7 dS/m) on four cultivars (NB-5, NB-9, CB-1 and CB-9) of baeland reported maximummembrane injury index, minimum relative water content, minimum chlorophyll in NB-9 and CB-2 at 10.7 dS/m salinity whereas maximum relative water content and maximum TSS, minimum membrane injury index in NB-5 at 10.7 dS/m salinity. They concluded that NB-5 has tolerate higher salinity than other cultivars.

Cashew (*Anacardiumoccidentale*L.Family: Anacardiaceae)

Silva *et al.* (2008) studied different salt concentration (0, 50, 100, 150, 200 mM) on two cashew genotypes (CCP 06 and CCP 09) and observed that the tolerant CCP 09 genotype showed greater dry mass accumulation in both roots and shoots than the sensitive CCP 06. They also observed that at 200mM NaCl level shoot dry mass was reduced by 42% and 35% in sensitive and tolerant genotypesrespectively.

Guava (*Psidiumguajava*Family: Myrtaceae)

Francisco *et al.* (2016) studied the germination percentageand height of guava rootstock as irrigated with different levels (0.6, 1.2, 1.8, 2.4 and 3.0 dS/m) of saline water and theyobserved maximum germination 67% at 1.2 dS/m salinity while minimum at 3 dS/m. They also observed plant height were decresed with increased salinity levels.

Fig (*Ficuscarica*Family: Moraceae)

Alswalmeh *et al*. (2015) compared two varieties of fig (Brown Turkey andRoyal) at different salinity level (0.8, 2.5, 4.6 and 5.2 dS/m and its combination). They observed that higher proline (2.07 μ mole/g) at 5.2 dS/m in Brown Turkey whereas, highest total chlorophyll wasnoted in Royal (2.36 mg/g) at 0.8 dS/m salinity. Maximum plant height, root length and leaf area were noted invariety Brown Turkey at 0.8 dS/m salinity.

Aonla (*Emblicaofficinalis* L.Family: Euphorbiaceae)

Rao and Singh (2006) evaluated four level of ESP (9.12, 15, 30, 45, 60 ESP) and different cultivars (Chakaiya, NA-6, NA-7, NA-10, NA-18 and Anand 1) of Aonla. They observed that 100% plants were survivedupto 30 ESP, while more than 50 % plants survived at 45 ESP in all cultivars. At 60 ESP minimum survival percentage was observed in cv. NA-18 and Anand-1, whereas maximum survival percentage wasobserved in cvs. Chakaiya, NA-6 and NA-7.

Datepalm (*Phoenix dactylifera* L.Family: Palmaceae)

Abdoulhadi*et al.* (2011) studied the effect of salinity levels (0, 50, 100, 200 and 400mM) on leaf length of three datepalm cultivars (Madjool, Barhi and Khalas) and they reported that leaf length was reduced in all cultivars with increasing salt level. The minimum leaf length was obtained at 400mM NaCl salinity whereas at same salinity level leaf injury effect were more severe in *cv.*Madjool and Barhi than Khalas.

Jamun (*Sizygiumcuminii* Family: Myrtaceae)

Patil and Patil (1983)studied different salinity levels (0, 4, 8, 12, 16 and 20 mmhos/cm) and observed that the spread of plant and total leaf area were decreased with increased salinity level. The reductionwas most pronounced at the 16-20 mmhos/cm. Highest salinity levelcaused smallest leaf areas. The plant were worst affected at 20 mmhos/cm. They also reported that Zn and Fe contents of leaves and roots were low at higher salinity levels, whileMn and Cu contents of leaves and root did not differbetween the various treatments.

Ber (*Zizyphus spp.* Family: Rhamnaceae)

Hooda *et al.* (1990) took different treatments (1.45, 5, 10 and 15 dS/m) and observed maximum trunk diameter andyieldwere obtained at 1.45 dS/m, whereas maximum plant height was reported at 5.0 dS/m salinity. They also revealed that Na, Ca, Mg, Cl were increased with increased salinity while K was decreased with increased salinity in ber cv. Umran.

Conclusions

It can be concluded that fruit crops as well as their cultivars differ in their tolerance against salinity. Therefore, crops and cultivars should be selected on the basis of their ability to tolerate salinity or sodicity while planting in salt affected regions. Mandarin rootstock, Carrizo is more yield efficient than Cleopatra. Among the indigenous citrusrootstocks, Attani-1 is more salinity tolerant than Attani-2 and Jatti Khatti. In mango, Olour and Nekkare tolerate high salinity than other cultivars studied.Banana cvs.Poovanand Ney Poovanregistered least reduction in carotenoid content in leaves indicating that the cultivars involving *Musa balbisiana* genome had higher tolerance against salinity than cultivars having *Musa acuminate*. Banana cv. Robusta can growwell up to 2.5 dS/m salinity level.Sapota cv. Kalipatticanwell grown up to 12 EC.Bael, cultivar NB-5 can be considered as more salinity tolerant than other cultivars studied.In cashew,genotype CCP 09 tolerates more salinity than CCP 06.Maximum seed germination in guavawas recorded at 1.2 EC salinityand the seedling height decreased with the increasein salinity.In fig,cultivar 'Brown Turkey' was less affected by salinity than Royal. In Aonla, cultivars Chakaiya, NA-6, NA-7 tolerate more sodicity than NA-18 and Anand-1 cultivars.In datepalm, cultivar Khalas tolerates high salinity than Madjool and Barhi. Jamun can grow well upto12 mmhos/cm. In ber, cv. Umran, trunk diameter, plant height and yield were decreased with increase in salinity levels higher than 5 dS/m whereas Na, Cl, Mg, Ca content in leaves increased with increased salinity.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker : Khalasi Devang N.	**Course : FSC 591 (1+0)**
Reg. No. : 2020216011	**Date : 16/12/2017**
Major Guide : Dr. A. K. Pandey	**Time : 11:00 to 12:00 am**
Co-Guide : Dr. Sanjeev Kumar	**Venue : Swami Vivekananda Hall**

Role of soil and water conservation for sustainable fruit production

Land and water are natural essential resources for the existence of life and provide food, fuel, fodder and shelter besides supporting secondary and other economic life supporting system for which management has become most essential (Yadav *et al*., 2004). Indian agriculture accounts for 90% water use due to fast track ground water depletion and poor irrigation systems (Vibha Dhawan, 2017). Soil and water are the more valuable natural resources for raising fruit plants successfully, so shortage in any of these factors limits growth and development of crop species.

Therefore, the best way to protect these natural resources (soil & water) against deterioration in quality or erosion is **'**Conservation**'**. Water and wind are the two natural factors that cause soil erosion can be reduce by adopting physical, agronomical and biological measures. Different practices like contour farming, zero tillage and residue management are also adopt for conservation of soil and water. Water storing or harvesting must be the feature of today's farming. Mulches also play an important role in reducing soil erosion, improving soil structure, organic matter, microbial flora and soil aeration, regulating soil temperature, conserving moisture in-situ, controlling weeds and reducing nutrient removal by weeds.

Review of Research Work:

Mango

The experiment conducted at soil and water management research farm, NAU and the study revealed the maximum stem girth (54.8 cm), no. of fruits/plant (192.7), fruit yield (36.3 kg/tree) and WUE (20.5 mm) when plants were irrigated through MIS laid/installed at 50 cm depth. (Anon. 2014).

Mhaske *et al.* (2014) observed that application of water through drip at 48 litres water per alternate day per plant gave more response in cashewnut over control followed by mango crop with 40 l water/day/plant and sapota had show more response by 60 litres water per alternate day per plant in respect to tree canopy.

Patil *et al*. (2005) found that the fruit yield (41.71 kg/tree), no. of fruits/tree (214.75) and fruit circumference (16.83 cm) higher in circular basin with 5% inward slope + locally available mulch. Maximum fruit weight and fruit length (194.81 g) and (8.87 cm) respectively were found in circular basin system with 5% inward slope. More over they also noted higher soil moisture content at 0-15cm, 15-30cm, 30-60cm and 60-90cm depth in circular basin with 5% inward slope + locally available mulch.

Mandarin

Panigrahi *et al*. (2009) found that the plant height (0.35 m), stem girth (2.4 cm), canopy volume (0.846 m^3), no. of fruits/plant (69.00), fruit weight (139.2 g), total yield (9.60 kg/plant), juice (40.42%), and TSS (10.10 ^{0}Brix) higher under treatment with continuous trenching while acidity (0.82%) under control in cv. Nagpur mandarin. They also noted significantly minimum annual runoff (249 mm), soil (3.74 t/ha/yr) and nutrient loss (N-0.62, P-0.13 and K-1.09 kg/ha) in treatment continuous trenching.

Avinash *et al.* (2012) observed that the tree volume (65.96 m^3), fruit yield (51.85 kg), no. of fruits (266.00), fruit weight (194.65 g) was higher with minimum flower drop (59.26%) and fruit drop (48.41%) in continuous trench + 100 kg FYM + 20 kg dried weed mulch in Kinnow mandarin.

Acid lime

Panigrahi *et al.* (2008) reported maximum soil water content at 0-30 cm in treatment of continuous trenching during the period from Nov. to June.

Shirgure (2012) found plant height, stem girth and tree canopy volume was higher with black polythene mulch (100 micron).

Guava

Deepa Samant *et al*. (2016) found that the maximum no. of fruits/plant, average fruits and weight of fruits was higher in cup and plate in-situ water harvesting structure while in mulching, no. of fruits/plant, weight of fruits was higher in organic mulch and average fruit weight was higher in inorganic mulch.

Ber

Chovatia *et al*. (1992) found that the fruit set (22.9%), fruit yield (61 kg/tree), TSS (17.9 ^{0}Brix) and ascorbic acid content (149 mg) was recorded to be higher in black polythene mulch while maximum pulp: stone ratio (21.9) and acidity (0.31%) was recorded under wheat straw with minimum fruit drop in castor shell.

Cashewnut

Mane *et al*. (2009) observed minimum runoff (18.29 mm) and soil loss (0.65 t/ha/yr) in treatment continuous contour trench of 0.60 m depth.

Sapota

Tiwari *et al.* (2014) recorded maximum plant height (4.82 m), stem girth (39.10 cm), no. of primary branch (14.00), canopy volume (4.34 m^3) and yield (16.10 t/ha) in 100% irrigation requirement met through drip irrigation with plastic mulch.

Aonla

Iqbal *et al*. (2015) recorded fruit weight (41.46 g), fruit length (3.73 cm), fruit diameter (4.42 cm) and fruit volume (39.80 cm^3) with black polythene mulch.

Conclusion

It can be concluded that continuous trenching helps conserve rainwater, reduces runoff, soil and nutrients losses and increases soil water in the profile and is a superior soil and water conservation technique for cultivation of fruits in terms of higher plant canopy volume, stem girth, fruit yield and quality. Mulching in organic horticultural produce has great export potential. Recent trends have shifted to integrate use of mulches with nutrients for control of weeds, maintenance of soil fertility and conservation of moisture for sustainable production of fruit crops. Due to higher soil water and nutrient content in the profile will result in better quality fruits with greater size. Adoption of rainwater conservation measures also reduced soil and nutrients losses and maintains soil productivity in fruits orchards.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Tandel Jinal Jagjivanbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020217035	**Date : 15/09/2018**
Major Guide : Dr. S. J. Patil	**Time : 11:00 to 12:00 am**
Co-Guide : Dr. Sanjeev Kumar	**Venue : Swami Vivekananda Hall**

Role of paclobutrazol in fruit crops

India is the second largest fruit producer in the world. Alternate and irregular bearing in fruits is a major problem faced by fruit growers, which causes high economic loss to the growers. Alternate bearing and tree vigour can be overcome by various horticultural practices, out of these use of paclobutrazol (PBZ) is commonly practiced by the horticultural growers. PBZ is a growth retardant which intercepts the gibberellins synthesis pathway, has been effectively used to induce and manipulate flowering, fruiting and tree vigour in several fruit crops. However its use in mango is quite common. Soil application of PBZ has been efficacious in promoting flowering and increase yield in many fruit crops. However, there are some conflicting reports on its impact on fruit quality. Besides reducing gibberellins level, it increases cytokinin contents, root activity and C:N ratio, whereas its influence on nutrient uptake lacks consistency. Its residue could not be detected above quantified level (0.01 ppm) in soil and fruits when applied in optimized rate.

Review of Research Work

Mango (B.N.: *Mangifera indica* L., Family: Anacardiaceae)

Desai (1993) reported that soil application of paclobutrazol in mid of August-September @ 4.0, 8.0 and 12.0 g a.i./tree was found effective to increase flowering, fruiting and yield as compared to control in mango cv. Alphonso.

Padhiar (2000) observed that soil application of paclobutrazol @ 40 ml/tree in first fortnight of August was found more effective to induce profuse and early flowering in different cultivars of mango.

Tandel and Patel (2011) found that soil application in different cultivars of mango with cultar @ 20 ml/tree in mid of July suppressed vegetative growth and induced early flowering, improved quality and also gave economic yield with highest cost benefit ratio.

Reddy *et al.* (2013) revealed that soil drenching with paclobutrazol @ 3 ml/m canopy diameter, applied during 3^{rd} week of August increased fruit weight and produces more fruits with high quality attributes in mango cv. Totapuri.

Shinde *et al.* (2015) reported that soil application of paclobutrazol at second fortnight of July @ 3 ml/canopy m^2 caused highest suppression of vegetative growth, early flowering (51.58 days) and harvesting (35.39 days) with maximum yield (45.73 kg/tree) in mango cv. Alphonso.

Srilatha *et al.* (2015) reported that when different cultivars of mango pruned at 3^{rd} week of July (current season growth) and soil application of paclobutrazol @ 3 ml/m canopy diameter during last week of September declined GA_3 content and increased ABA level at 45 and 75 days after paclobutrazol application.

Chaudhari *et al.* (2016) found that soil application of paclobutrazol @ 2.50 g *a.i.*/tree before first fortnight of August with foliar spray of KNO_3 @ 1 % on first fortnight of October was superior for enhancing flowering, fruit retention, yield, quality and also more remunerative in respect to net realization and benefit cost ratio in mango cv. Sonpari.

Patel *et al.* (2016) observed that application of paclobutrazol @ 9.2 g a.i./tree as soil drench during first fortnight of August was found better on the basis of economics, maximum net realization and BCR (benefit cost ratio) without any phytotoxic effect on leaves and fruit surface in mango cv. Alphonso.

The maximum yield and higher number of fruits per tree were recorded in paclobutrazol application @ 10 g a.i./tree/year as soil drench during 2^{nd} fortnight of August in mango cv. Alphonso (Anon., 2018).

Cashew nut (B.N.: *Anacardium occidentale* L., Family: Anacardiaceae)

Meena *et al.* (2014) revealed that soil application of PBZ @ 2.0 to 3.0 g a.i./plant at pre-flushing stage was found to be effective in reducing plant height, internodal length and increasing the yield.

Pistachio nut (B.N.: *Pistachia vera* L., Family: Anacardiaceae)

Ak (1998) found that foliar application of PBZ @ 4000 ppm after completion of current season growth was found more effective to reduce the vegetative growth of male pistachio trees.

Grape (B.N.: *Vitis vinifera* L., Family: Vitaceae)

Christo *et al.* (1995) observed that maximum yield was attained by the foliar application of paclobutrazol @ 1% and 0.1% (250 g/L^{-1} a.i.) at the time of bud bursting and two weeks before anthesis.

Jamun (B.N.: (*Syzygium cumini* L., Family: Myrtaceae)

Hegde *et al.* (2018) reported that the soil application of paclobutrazol at the time of emergence of new flush @ 3.0 g a.i./plant resulted less increment in plant height (23.67 cm) and canopy spread in N-S (38.50 cm) and E-W (50.83 cm) direction. They also observed that paclobutrazol @ 1.5 g a.i./plant resulted highest fruit number and fruit yield per plant (47.13 kg).

Litchi (B.N.: *Litchi chinensis* Sonn., Family: Sapindaceae)

Bhutia *et al.* (2017) revealed that soil appication of PBZ @ 2.5 ml/tree in the month of October showed better result in case of fruit set and yield. They also reported that vitamin-C, TSS:acidity ratio, total sugar and TSS was highest with the application of PBZ at 2.5, 5.0, 7.5 and 10 ml/tree, respectively.

Apple (B.N.: *Malus domestica* Borkh. nom. illeg., Family: Rosaceae)

Naira *et al.* (2017) revealed that foliar application of 750 ppm paclobutrazol 4 weeks after full bloom + summer pruning-I 8 weeks after full bloom + summer pruning-II 12 weeks after full bloom was found to be effective for maximum TSS, sugars, anthocyanin and reduced fruit acidity.

Peach (B.N.: *Prunus persica* L., Family: Rosaceae)

Monge *et al.* (1994) reported that soil application of paclobutrazol, 11 days after full bloom @ 2.0 g a.i. restrict vegetative growth and increased yield as compared to control.

Pear (B.N.: *Pyrus pyrifolia* L., Family: Rosaceae)

Kundu (2013) revealed that soil application of paclobutrazol by TSLP (trunk soil line pour) during late fall stage @ 0.2 g/cm trunk diameter of the tree found better in improving fruit TSS, reducing sugar, ascorbic acid and reduced titrable acidity in pear.

Conclusion

From the foregoing discussion it can be concluded that soil application of paclobutrazol is effective to restrict vegetative growth, induce early flowering, increase yield and improve fruit quality. An application of PBZ @ 3 ml/m canopy reduced endogenous gibberellin and promotes abscisic acid in mango. Application of PBZ @ 3 ml/canopy m^2, 2.50, 4.0, 5.0, 8.0, 10.0, 12.0 g a.i./tree in mid of July, August and September suppressed the vegetative growth, induced early flowering which also leads to early harvesting, improved quality and also highest economic yield with highest cost benefit ratio in mango. Application of PBZ @ 3.0 g a.i./plant in cashew nut and jamun, @ 4000 ppm in pistachio nut, @ 2.0 g a.i./plant in peach restrict the vegetative growth. PBZ increased yield when applied 2.0 g a.i./plant in cashew nut, @ 1% and 0.1% (250 g/L^{-1} a.i.) in grape, 1.5 g a.i./plant in jamun and 2.5 ml/tree in litchi. It improves quality parameters like TSS, RS, NRS, taste, flavour and reduced acidity on application @ 750 ppm with summer pruning in apple; 2.5, 5.0, 7.5, 10 ml/tree in litchi and 0.2 g/cm in pear. Thus, use of PBZ restricts plant height and overcomes alternate bearing. It also produce early and synchronized flowering which leads to increase yield and improve quality.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Rathod Khushbuben Dhirubhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020217030	**Date : 17/11/2018**
Major Guide : Dr. Binayak Chakraborty	**Time : 09:00 to 10:00 am**
Co-Guide : Dr. K. D. Desai	**Venue : Swami Vivekananda Hall**

Strawberry cultivation practices in soilless growing substrates

The strawberry cultivation practices have witnessed severe production losses caused by soil-borne diseases. Therefore, to avoid such type of diseases, a trend towards the use of soilless growing media in strawberry is increasing day by day throughout the world (Jansen, 1997). This system avoids sterilization of the soil, which has negative impact on the environment and human health. Further, this technique allows the growers to extend the cropping period and thereby increasing the fruit yield many fold with a minimum effort given in management practices (Jafarnia *et al*., 2010). Soilless cultivation is highly suitable for areas with contaminated or unfavourable soil condition for strawberry cultivation.

The physical, biological and chemical properties of soilless growing media are somewhat advantageous over soil (Wang *et al*., 2016). These kinds of media are more porous, lighter in weight, possess no or negligible amount of harmful chemical compounds, contain very less amount of phytopathogenic microorganism and easier to fertilize according to crop demand. It also has unique water holding and moisture retention capacity (Giménez *et al*., 2008). The soilless growing substrates can broadly be classified into two categories *viz.* media other than soil (solid substrate) and water (hydroponics). Sometimes, solid growing media are also used in hydroponic culture to hold the plant in right position.

Review of research work

Performance of strawberry in soilless growing substrates

Ercisli *et al.* (2005) evaluated the performance of two strawberry cvs. Camarosa and Fern in different growing media and reported that the peat media was the most promising for improving the above and below ground vegetative characters of strawberries.

Caso *et al*. (2009) found that growing media consisted of 100 % rice husk significantly increased the length and weight of roots; fresh weight, length and diameter of fruits and yield of strawberry cv. Chandler. However, plants grown in 100 % pumice exhibited the maximum fresh and dry weight and area of leaves.

Jafarnia *et al.* (2010) recorded that the number of fruits plant^{-1} , fruit dry weight, number of leaves and number of flowers plant^{-1} were the highest in 60 % perlite + 40 % peat moss, 100% perlite and 80 % perlite + 20 % peat moss in Frenso, Selva and Kordestan cultivars of strawberry, respectively.

Ameri *et al.* (2012) reported that growing media prepared with vermicompost + perlite + cocopeat in a ratio of 5:45:50 significantly improved the number of leaves, leaf area, length of petiole, number of runners plant^{-1}, number of crowns plant^{-1}and fruit yield in strawberry cv. Sweet Charlie.

Tariq *et al.* (2013) examined that plants grown in silt, sand and FYM (1:1:1) with wide planting density (60 cm × 30 cm) exhibited the maximum plant height, number of leaves plant^{-1}, leaf area, crown diameter, canopy spread and fruit set, plant fresh and dry weight whereas, the minimum days required to flowering, number of flowers and fruits plant^{-1}, fruit weight, fruit size were registered the highest in plants grown in peat moss with low planting density (30 cm × 15 cm) in green house floor. The peat moss substrate was also found to be the best for improving the fruit quality parameters like TSS, titratable acidity and Vitamin C content of strawberry fruits when grown at low planting densities (30 cm × 15 cm).

Wang *et al.* (2016) compared the most popularly used growing mediums against soil and reported that the strawberry (cv. Albion) grown in peat-rice hull mix media resulted the maximum dry weight of plant. The highest marketable yield of strawberry was reported in the plants cultivated in media containing 100 % coconut coir.

Thakur and Shylla (2018) studied the performance of Chandler strawberry in different growing media under protected condition and reported that media consisted of perlite + FYM (1:1) increased the plant height , number of flowers, leaf area, number of crowns, length of root, number of runners and yield.

Growing techniques

Ramirez-Gomez *et al.* (2012) evaluated the performance of different growing techniques in strawberry cv. Camino Real and found that vertical hydroponic pots system could accommodate maximum number of plants per unit area and resulted the highest yield of strawberry fruits.

Murthy *et al.* (2016) investigated the performance of strawberry cv. Festival in four different tire positions and noted that the earliest flowering, the maximum number of flower and fruits plant^{-1}, fruit weight , yield , fruit length , fruit diameter, marketable fruits, the maximum TSS and the minimum titratable acidity were in the fruit harvested from plants grown in top most tier.

Nutrient and water management

Nutrients in strawberries, cultivated in growing media are supplied in the form of solution. Hence, the pH (5.5 to 6.5), salinity level (1.4 dS m^{-1}) and temperature (25 °C) of the solution should be strictly maintained (Economakois and Krulji, 2001; Trejo-Téllez and Gómez-Merino, 2012). The frequency and amount of irrigation water varied according to growing media used. The water containing Fe more than 10 µmol l^{-1} would be harmful for strawberry cultivation under substrate culture (Trejo-Téllez and Gómez-Merino, 2012).

Disease and pest management

Strawberries in soilless substrate culture are sometimes encountered with crown rot and *verticillium* wilt and that could easily be managed by addition sterilized sand with nutrient solution at early stages of detection (Martínez *et al*., 2010). No severe pest attack was reported in soilless substrate culture of strawberry. However, use of yellow or blue sticky cards is found to be beneficial to manage the spider mite and thrips (Takeda, 1999).

Conclusion

From the above discussion, it can be concluded that soilless cultivation is a profitable venture that enhances the yield and quality of strawberry many fold and requires minimum efforts in management practices than soil grown strawberries. However, the selection of growing media depends upon the availability of materials and physical properties of the substrates. Use of mixed growing media along with either compost or vermicompost in optimum ratio could be suggested for strawberry cultivation instead of using single growing media. Although, investigations on the use of mixed growing media are meager, that opens a new door of strawberry research and development.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Morasada Ameeben Dineshbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020217017	**Date : 29/09/2018**
Major Guide : Dr. C. R. Patel	**Time : 09:00 to 10:00 am**
Co-Guide : Dr. N. K. Patel	**Venue : Swami Vivekananda Hall**

Nutritional disorders / anomaly in fruit crops

The abnormalities in plant or plant parts caused due to deficiency or excess of nutrients are referred as nutritional disorders. Depletion of nutrients due to intensified agricultural practices, unbalanced fertilizer application and very less use of organic amendments are the major causes for micronutrient deficiencies. Many disorders /anomaly were reported in fruit crops which are associated with deficiency or excess of one or more nutrient element. Soil and foliar application of nutrientsat appropriate stage of plant growth and development correct the deficiencies of nutrients and helps in obtaining higher yield with good quality of fruits.

Brief review of research work

Mango

Amin *et al.* (2007) recorded minimum soft nose incidence (13.3%) when foliar sprayof 4% $CaCl_2$done at 15 days prior to harvest. They also proved that when the fruits treated with 4% $CaCl_2$for 10 minutes as post-harvest dipping reduced the incidence of soft nose (16.7 %) over control in mango cv. Samar BahistChaunsa.
Zhang *et al.* (1995) observed that dipping the fruitsinhydrogen fluoride solution at a concentration of 3250 and 1200 mg/kg (4 and 6 dippings, respectively) 15 days before harvest caused severe damage including black tip symptoms on fruits. Dipping in 600 mg/kg (8 dippings) produced symptoms identical to black tip disorder while the fruits did not produced symptoms of black tip on dipping in 30 and 60 mg/kg hydrogen fluoride.
Ram *et al.* (1988) revealed that percentage of necrotic fruits was reduced from 20% (control) to 1.18% with pre-harvest foliar spray of boron @ 0.1%. They also observed that intensity of necrosis increased at higher doses of soil applied nitrogenous fertilizer in mango cv. Dashehari.

Citrus

Sandhu and Bal (2012) observed that two spray of K_2SO_4 @8 % in the month of May was most effective in controlling fruit cracking with improved fruit quality in lemon cv. Baramasi.

Sajid *et al.* (2010) recorded minimum incidence of dieback (13.77%), chlorosis (9.66%) and rosette (2.89%) with maximum yield (99.83 kg/tree) in sweet orange cv. Blood Orange was obtained with the foliar spray of Zn (0.05%) + B (0.04%) applied at three stages of plant growth *viz.*, before flower initiation, after fruit set (berry size) and 40 days interval of 2nd spray.

Papaya

Saran *et al.* (2017) noticed that soil application of borax @ 5 g/plantwas most effective in decreasing fruit deformity up to 0%in papaya cv. Pune Selection-3.

Aonla

Ram *et al.* (1975) found that internal fruit necrosis in aonla cv. Francis was completely controlled by foliar spray of borax (0.6 %) during the month of September.

Grape

Christensen and Boggero (1985) opined that minimum water berries were obtained when the clusters were dipped in $MgSO_4$ (5% MgO) solution. They also noticed that affected berries had higher level of N (2.50%) than normal berries (1.85%).

Pomegranate

Sheikh and Manjula (2012) observed that pre-harvest spray of 0.2% boric acid resulted in the lowest percentage of cracked fruits (3.33%) along with maximum yield in pomegranate cv. Ganesh.

Mangosteen

Pechkeo*et al.* (2013) recorded that pre-harvest spray of 10 % $CaCl_2$ at 6 to 8 weeks after full bloom reduced the number of gamboge affected fruits in both outer and inner canopies of mangosteen.

Litchi

Ihsan-ul-haq and AbdurRab (2012) recorded minimum fruit cracking (11.34 %), maximum skin strength(3.01 kg/cm^2) and maximum calcium and boron content in fruit skinwith the foliar application of $CaCl_2$ (3 %) + (borax 1.5 %) done at 21 days interval starting from fruit set till harvest.

Kumar *et al.* (2009) found that foliar application of borax (0.4%) before initiation of inflorescence resulted in minimum fruitcracking with maximum fruit set (42.50%) and fruit retention (22.60%) in litchi cv. Purbi.

Apple

Ullah *et al.* (2007) concluded that incidence of cork spot and shrinkage decreased while rottening and core rot increased significantly as the concentrationof $CaCl_2$ increased from 0% to 6% applied as fruit coating in apple cv. Kingstar.

Reid and Padfield (1975) recorded minimum incidence of bitter pit (7%) and water core (5 %)in apple cv. Cox's Orange Pippin through post harvest dip treatment of$Ca(NO_3)_2$ (2.5%) + lecithin (1%) over control.

Pear

Raese*et al.* (1999) observed that foliar sprays of $CaCl_2$ (681 g / 379 liter) completely controlled the incidence of cork spot in Anjou pears.

Cherry

Wojcik *et al.* (2013) opined that foliar spray of $CaCl_2$ @ 5 kg/ha before 21 days of harvest reduced fruit cracking in sweet cherry cv. Burlat.

Conclusion

It can be concluded that nutritional disorders severely affect the quality fruit production. Crop specific approach in terms of soil and foliar application of nutrientseither alone or in combination is necessary to obtain good quality fruits and higher yield.**In mango**, 4 % $CaCl_2$ as pre-harvest spray orpost harvest dipping reduced the incidence of soft nose whereasfoliar spray of 0.1% boric acid reduced internal necrosis.Foliar spray of K_2SO_4(8%)**in lemon**, boric acid (0.2%)**in pomegranate**, $CaCl_2$ @ 5 kg/ha **in sweet cherry** andurea (1%) + borax (1%) **in litchi** can be done to reduce incidence of fruit cracking.**In sweet orange**, severity of dieback, chlorosis and rosette was reduced by foliar spray of Zn (0.05%) + B (0.04%). Soil application of borax @ 5g/plant completely eliminated fruit deformity up to 0% **in papaya**.Foliar application of borax @ 0.6% in September month completely controlled fruit necrosis **in aonla**. **In grape**, foliar spray of 5% $MgSO_4$ was effective forreduction of water berry. **In mangosteen**, pre harvest spray of $CaCl_2$ (10 %)reduced gambogeaffected fruits. In post harvest disorders of**apple**, coating the fruits by 6 % $CaCl_2$ through vacuum infiltration method minimized cork spot disorders, whereasdipping the fruits insolution containing $Ca(NO_3)_2$ (2.5%) + lecithin (1%) reduced water core and bitter pit disorders.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Patel Nikshita Rohitbhai	**Course: FSC 591 (1+0)**
Reg. No. : 2020217022	**Date : 01/09/2018**
Major Guide : Dr. Y. N. Tandel	**Time : 09:00 to 10:00 am**
Co-Guide : Dr. V. K. Parmar	**Venue : Swami Vivekananda Hall**

Spongy tissue in mango: causes and remedies

Spongy tissue (ST) is the most important physiological disorder in mango. It is commonly observed in Alphonso, Vanraj, Swarnarekha, Vellaikolamban and Fernandin which characterized by the development of yellowish white corky patches, soft or spongy in nature with or without air pockets accompanied with an unacceptable flavor which ultimately deteriorates the quality of fruits. The formation of spongy tissue in mango has put a damper in the demand for mangoes in the market. It is common only in the Indian subcontinent, especially in South India.

The occurrence of this disorder was first noted in Alphonso mango in 1932 (Cheema and Dani, 1934). They described three kinds of abnormalities *viz.,* blemishes on all parts of fruits, browning of tissue around the stone and breakdown of tissue around stone. The overall loss due to this malady is about 30 per cent, the annual loss amount to Rs 135 million (Katrodia, 1988).The probable causes and remedies of malady have been reviewed here as under.

Brief review of research work

Causes

Vasanthaiah *et al.* (2008) observed that prolonged duration of artificial light exposure from 18 to 114 h at 43° C increased the spongy tissue occurrence in Alphonso mango. However, respiration rate and transpiration rate of fruits were not significantly affected up to 66 h of exposure time.

Katrodia and Sheth (1988) revealed that half an hour (12.30 to 13.00 h) of Alphonso fruits to sun exposure treatment could not produce any external as well as internal symptoms of damage. But one hour (12.30 to 13.30 h) sun exposure could produce 100 per cent occurrence and 75 per cent intensity of damage in fruits. Katrodia and Rane (1988) studied the distribution pattern of damage in spongy tissue affected Alphonso fruits under Paria vs Gandevi and Junagadh vs Vengurla conditions and observed the maximum damage on the lower part of the fruit as compared to other parts of the fruit.

Mehta *et al.* (2013) tried to develop a non destructive method to identify spongy tissue affected Alphonso mango fruit using a soft X- ray imaging system and investigated that the machine could best detect and sort ST affected fruits on fourth day after harvest.

Cracknell *et al.* (2004) recorded the maximum IFB incidence in mango fruits harvested at full maturity stage than green-ripe stage. All the varieties showed susceptibility to IFB except Edward, Gomera-1 and Ah Pingh at full maturity stage.

Raja (2009) revealed that zone Ⅰ (Konkan, MS) characterized by soil type acidic altisols, average rainfall 2500 mm/ year and humidity 60-70% had maximum incidence of spongy tissue (25-30%) over zone Ⅱ (Bangalore, KA) and Ⅲ (Dharampuri,TN).

Remedies

Shinde *et al.* (2018) recorded significantly minimum occurrence of ST in T_9 [soil application of recommended dose of NP and 1 kg K_2O through SOP tree^{-1} in June + 0.9% K_2SO_4 through foliar application at pea, marble and egg stage] in compare to rest of the treatments.

All pre-harvest fruit bagging treatments at 40 to 50 days after fruit set reduced the chances of ST incidence in mango cv. Mishribhog except control. However, brown and white paper bag produced ST free fruits (Islam *et al.*, 2017).

Malshe *et al.* (2017) reported that ST incidence could be minimized by pre harvest bagging at egg/ marble stage and retained up to 45-75 days.

Haldankar *et al.* (2015) studied on effect of pre-harvest bagging at 30 days after fruit set with various types of bag and recorded ST free fruits in bagging with newspaper bag and brown paper bag and all other bagging treatments showed minimum incidence of ST as compared to no bagging.

Shivashankar and Sumathi (2014) found that incidence of ST was minimum in PBZ 3g/l (4.2 %) followed by PBZ 1 g/l (12.8 %) and control (54.3 %).Among the fruit maturity treatments, the lowest incidence of ST in Alphonso mango (4.1 to 4.3 %) was noted in 60 to 70 % fruit maturity as compared to other maturity treatments. Pre-harvest dip treatment of nutrient mix at 60 % fruit maturity had recorded the lowest incidence of ST (4.2 %) which was at par with sea water (4.8%),whereas the control (54.3%) treatment noted the highest ST incidence.

Burondkar *et al.* (2013) reported that 1- MCP treatment significantly reduced overall incidence of ST by 66.10 % from 26.55 in control to 9.90 % in treated fruits. Among 1-MCP treatment, the lowest incidence of ST (5.00 and 7.99 %) was observed in treatment T_7 (TSt_{14} SL_0)and T_8 (TSt_{14} SL_5), respectively. Ravindra *et al.* (2010) observed that ST incidence was significantly reduced by pre-harvest dip treatment of PBZ (2.5%) to 60 % mature fruit in compare to GA_3 (61.5%) and control (38.5%).

Shinde *et al.* (2005) observed minimum per cent ST in 16 Ana mature Alphonso fruits (14.83 %) treated with chelated Ca 0.02 per cent + NAA 20 ppm as foliar spray (at egg stage and 10 days after 1st spray) as compared to other treatments under study. Moreover, they revealed that per cent ST could be reduced significantly by multinutrients (Dolomite @ 2 kg + KNO_3 or KCl @ 500 g/tree soil application)along with irrigation over control.

The Alphonso mango fruits harvested from mulched and sod cultured plot showed significantly lowest incidence of ST *i.e.* 25.33 and 24.42 %, respectively as compared to control plot (Burondkar *et al.*, 1994).

Katrodia and Bhuva (1993) registered no occurrence of ST and intensity in Alphonso mango under sod culture treatment as compared to clean cultivation.

Katrodia and Sheth (1988) opined that the occurrence of ST was reduced to the extent of 0.55 per cent by applying paddy straw as mulch treatment and 1.11 per cent occurrence by dry mango leaves under Paria condition. Similar trend was also observed under Ghadoi condition.

Lad *et al.* (1985) reported that dipping in 500 ppm Ethephon solution considerably reduced the occurrence of ST in Alphonso mango and developed good colour with desirable keeping quality as well.

Conclusions

It is inferred from the foregoing discussion that the transfer of heat by radiation, convection and conduction seems to have greater impact in causing ST. However, the incidence of ST varies with location, varieties, maturity of fruit, *etc.* This malady can be controlled by sod culture and mulching with dry paddy straw, dry mango leaves, *etc*. The soil application of recommended dose of NP (*i.e.*1.5 kg N, 0.5 kg P_2O_5) + 1 kg of K_2O through SOP tree^{-1} + 0.9 % K_2SO_4(foliar spray at pea, marble and egg stage); and multinutrient application through Dolomite (2 kg/tree) and KNO_3 or KCl (500 g/tree) with irrigation which reduced incidence of ST by enhancing the nutrients availability. The foliar application of chelated Ca (0.02 %) + NAA (20 ppm) at full maturity; and PBZ (3g/l) and nutrient mix (3 %) at 60-70% fruit maturity stage reduced occurrence of ST. Bagging of fruits with brown, white and newspaper bag at marble to harvesting stage also prevented chances of ST. Post harvest treatments of 1-MCP (1000 ppb) and Ethephon (500 ppm) were also found to be effective in reduction of ST because it helps in maintaining quality attributes of fruits during ripening.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Patel Dhiralbahen Sureshbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020217019	**Date : 01/12/2018**
Major Guide : Dr. S. S. Gaikwad	**Time : 10:00 to 11:00 am**
Co-Guide : Dr. S. S. Masaye	**Venue : Swami Vivekananda Hall**

Underutilized fruits: bael, jamun and phalsa

Underutilized plant species have local or regional importance, but generally lack national recognition and appreciation. The under-utilized crops are the plant species that are traditionally used for their food, fiber, fodder, oil or medicinal properties. These crops possess poor shelf life and less consumer awareness toward its consumption.

The increasing demand for reappraisal of nutritional traits, culinary value, adaptation to climate change, etc. can overcome different constrains being faced by growing underutilized crops. They continue to play an important role in the subsistence and economy of poor people in developing world. Amongst them the bael, jamun and phalsa are highlighted for the production due to their high nutritional values. The importance of such fruits are due to their medicinal properties to cure and prevent degenerative diseases of human being through natural resources.

Brief Review of Research Work

Bael (*Aegle marmelos* L.)

Genetics diversity:

Dutta *et al.* (2010) studied the local genotype of bael and found that spherical shape type fruit have a maximum weight (770 g), TSS (36.40˚B) and total sugar (18.99%).

Salinity tolerance

Shukla and Singh (1996) reported that increase in salinity delayed and depressed the seed germination and caused reduction in plant growth but the bael seedlings can be grown successfully with 71 % seed germination and satisfactorily with plant growth in saline soil up to 10.3 dS m^{-1} EC.

Propagation

Singh and Singh (2009) reported that patch budding during mid June showed maximum survival (94.27 %).

Nutrient management

Sharath *et al.* (2016) reported that highest yield (14.7 kg /plant), TSS (48˚B), pulp content (74.9 %) was found when plant received yearly application of FYM 16 kg + mustard cake 2.4 kg.

Plant growth regulator

Kundu and Ghosh (2017) reported that twice foliar application of NAA @ 20 ppm at 50 % flowering stage and 21 days later helps to increase fruit yield and quality of bael fruits.

Storage

Sharma *et al.* (2011) reported that fresh and untreated bael seeds with 18.9 % moisture content stored at 30 ˚C with 80 % RH showed more viability and similarly give higher germination (97 %).

Human Health

Aarti, Sankhla *et al.* (2009) reported that bael patra extract given for eight weeks in daily dosage of 4 g, can lower the serum and urine glucose levels in human.

Jamun (*Syzygium cuminii* L.)

Genetics diversity:

Dutta *et al.* (2010) studied the local genotype of jamun and found that cylindrical type jamun showed maximum diameter (2.41 cm), fruit weight (4. 22 g), TSS (7.8 ˚B), total sugar (4.17 %) and edible portion (76 %).

Propagation

Patil *et al.* (2018) noticed that the seeds soaked in water for 24 hrs promote initiation of germination (7.13) and germination percentage (95.73 %) whereas, maximum height (82.60 cm) and number of leaves (42.63) of seedlings were recorded in GA_3 @ 200 mg l^{-1} for 10 min.

Chavda *et al.* (2018) reported that defoliated and one day stored scion stick of jamun var. Goma Priyanka, superior in all the growth parameters like minimum days required to leaf emergence, girth, length of sprouted scion shoot, number of shoot and graft survival percentage.

Unnati, Ahir *et al.* (2018) recorded that grafting done in month of June with wedge grafting gave maximum survival percentage (78.33 %).

Shelf life

Dalvadi *et al.* (2018) studied the effect of chemicals on shelf life of jamun. They observed that fruits treated with $CaCl_2$ 1.5 % significantly reduced physiological loss in weight, spoilage loss, late shrivelling initiation and the highest marketable fruits.

Human Health

Neha, Ayya *et al.* (2015) reported that 2 g jamun seed powder given for 60 days reduced the blood glucose level in diabetic subject.

Phalsa [*Grewia subinaequalis* L.]

Propagation

Singh *et al.* (2015) reported that phalsa propagated through hardwood cuttings under mist chamber with 2000 ppm of IBA treatment combination produced best results within a short period of time.

Nutrient management

Yadav *et al.* (2009) observed maximum number of fruits/node (21.0) and fruit yield (5.79 kg) per plant with the soil application of 110 g urea + 125 g SSP + 26 g MOP with 10 kg FYM.

Saravanan *et al.* (2017) reported maximum number of fruiting nodes/shoots (24.85), number of fruits/bush (2511.88) and fruit yield (68.40 q/ha) of phalsa when plant were sprayed with 0.4 % boron + 0.4 % ferrous sulfate + 0.4 % zinc sulfate.

Plant growth regulater

Kacha *et al.* (2014) revealed that application of NAA @ 150 ppm increase the number of flowers per shoot (151.21), number of fruits per shoot (60.74) and maximum yield (5800 kg/ha).

Pruning

Meghwal (2006) reported that maximum fruit yield (1867 g/plant) was obtained by pruning the bushes at 120 cm from ground level on 31th December.

Shelf life

Pinal, Vyas *et al.* (2016) reported that 0.1% sodium benzoate increases the shelf life of phalsa fruit to 14 days in low temperature (10 ± 1˚C) storage conditions.

Human Health

Kour *et al.* (2016) noticed that Phalsa fruit suppressed the proliferation of four human cancer cell lines from four different origins in the range of 72-80% as it exhibits 80% growth inhibition of A-498 (renal), 78% of MDA-MB-435(melanoma), 75% of A-549 (lung) and 72% of HCT-116 (colon).

Conclusion

From the foregoing discussion it can be inferred that bael can be propagated by seed but it’s not true to type plant thus it can be vegetatively propagated by patch budding in month of June. Foliar application of NAA @ 20 ppm gave higher fruit set and Application of 16 kg FYM with 2.4 kg mustard cake per plant gave higher fruit yield. It can be successfully grow in saline soil up to 10.3 ds m^{-1}. Bael leaves powder helps to reduce blood sugar level in human body.

Jamun can be propagated by seeds as it is polyembryonic in nature. However, vegetative propagation can be done by wedge grafting in month of June. Shelf life increase by fruit treated with $CaCl_2$ @ 1.5 %. Jamun seed powder helps to reduce blood sugar level in human body.

Phalsa can be propagated by hard wood cutting with 2000 ppm IBA in mist chamber. Application of urea 110 g + SSP 125 g + MOP 26 g along with 10 kg FYM per plant gave higher yield and Regular and heavy pruning done in last week of December enhance fruit production. Shelf life of fruit increased by fruit treated with sodium benzoate (0.1 %). Phalsa fruit extract inhibit the cancer cell lines growth in human body.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Patel Twinkle A.	**Course: FSC 591 (1+0)**
Reg. No. : 2020217025	**Date : 06/10/2018**
Major Guide : Dr. A. K. Pandey	**Time : 10:00 to 11:00 am**
Co-Guide : Dr. K. D. Desai	**Venue : Swami Vivekananda Hall**

Role of micro irrigation in fruit crops

Introduction

Micro irrigation is one of the latest innovations for applying water and it represents a definite advancement in irrigation technology**.** Water is applied to the root zone of the plant directly.In Gujarat around 58497 ha (PMSKY, 2017-18)of the total cultivated area is under micro irrigation.It can be adopted in undulated fields and also suitable for most of the soils. It provides precise quantity of water in and around root zone of plant with the help of emitters.

Drip irrigation is the most commonly used micro irrigation method in fruit crops. Drip irrigation in particular, is suitable for irrigation with water of poor quality (saline water). Irrigating daily pushes the salt away from the root zone of the crop. Fertilizers can be applied with drip irrigation termed asfertigation.

Plus points of drip irrigation and fertigation:-

High water use efficiency (30-60%), high quality &higher yields (10-60%), minimized fertilizer loss & soil erosion, can be laid out in undulating fields, efficient weed control (30-90%), saving the fertilizer by 25-30%, precise application and uniform distribution of fertilizer,major & micro nutrient can be applied in one solution with irrigation, saving in time, labour and energy, itnot only reduce the production cost but also lessens the ground water pollution, it allows to adapt the amount and concentration of the applied nutrients in order to meet the actual nutritional requirement of the crop throughout the growing season andconvenient use of compound and ready mix nutrient solutions.

Brief review of research work

Banana

Pramanik *et al*. (2014) studied the economic analysis of bananacv. Martaman under fertigation and conventional method**.** Theyfound thehighest yield (49.2 t/ha) and net return (1,84,618 Rs/ha) through combined application of irrigation at 60 per cent CPE(cumulative pan evaporation) and 80 per cent RDF.

Sharma and Kispotta (2016) studied the effect of drip irrigation in banana. They recorded maximum height of plant (163.3 cm), girth of plant (68 cm), average weight of bunch (163.3 kg) and yield (50 t/ha) under drip irrigation compared to flood irrigation.

Mango

Mattar (2007) studied the yield of mango under different irrigation systems and observed the highest averageyield (52.85 q/ha) under subsurface drip irrigationas compare to surface drip irrigation and flood irrigation.

Panigrahi*et al.* (2010) studied the effect of irrigation levels on yield and water use efficiency of mango. They noted thataverage fruit weight (163.65 g), yield (59.92 q/ha) and water use efficiency (3.21 q/ha.cm) were highestunder drip irrigation with 60% water + polythene mulch and the same characters were lowest under control (Basin irrigation with 100% water).

Maximum yield (19.3 t/ha) was obtained when subsurface drip irrigation was used at 50 cm below ground level in mango compared to surface irrigation method (Savani *et al*. 2010).

The highest yield (82.237 kg/tree) was obtained under drip irrigation with 1.0 pan evaporation fraction compared to surface irrigation in mango (Patel and Patel 2016).

Pomegranate

Ghosh *et al*. (2011) studied theeffect of irrigation and mulching on fruit yield of pomegranate. They recorded the highest fruit yield (16.8 kg/plant) and water use efficiency (299.2 kg/ha.cm) with drip irrigation for 3 hours compared to another treatments.

Nagpur mandarin

Goud *et a*l. (2017) studied the effect of fertigation on yield of nagpur mandarin and reported thehighest average number of fruits/plant(649.86), average weight of fruit (168.15 g) and fruit yield (107.98

kg/plant) in fertigation with 100% recommended dose of fertilizers which was at par withfertigation with 115% of recommended dose of fertilizers.

Sweet orange

Ghosh and Pal (2010) studied the effect of drip versus basin irrigation on fruit yield in sweet orange.They observed that maximum weightof fruit (166 g), diameter of fruit (7.0 cm) and numbers of fruits per plant (136)which received irrigation at 1.0Epan + black polythene mulch as compared to irrigation without mulching and basin irrigation treatments.

Papaya

Deshmukh *et al*. (2014) studied on yield of papaya as influenced by irrigation scheduling. Theynoted that fertigation with 100% cumulative pan evaporation and 100% recommended dose of fertilizersgave highest number of fruits per plant (35) and yield (112.55 kg/plant) as compared to conventional method of irrigation.

Sapota

Tiwari *et al*. (2014) studiedthe effect of plastic mulch and drip irrigation on growth and yield of sapota. Theyrevealed that drip irrigation with 100% of irrigation requirement with plastic mulch had highest plant height (4.82 m) and yield (16.10 t/ha) compared to drip irrigation without mulching and ring basin method.

Grapes

Hamied *et al*. (2017) studiedthe effect of water amounts and different drip irrigation systems on yield, weight and number of clusters in flame seedless grapevines. Theyfoundthe highest result in average weight of cluster (600.32 g), average number of clusters (36.44) and yield (21.68 kg/vine) under subsurface drip irrigation with 80% of water requirement than surface irrigation.

Conclusion

From the foregoing discussion, it can be concluded that drip irrigation system is an economic and very efficient system of irrigating for fruit crops. Fruit yield can increases in banana by fertigation with 80% RDF and 60% CPE. In mango drip irrigation at 1.0 PEF gives the highest yield and water use efficiency. Pomegranate yield is increases by drip irrigation whereas, in nagpur mandarin yield parameters are improved by fertigation with 100% and 115% RDF and in papaya it is by 100% CPE and 100% RDF. Irrigation through drip at 1.0 Epan + black polythene mulch increases the yield of sweet orange. In sapota 100% irrigation water with drip+plastic mulch gave better yield andyield attributes. In grapes subsurface drip with 80% irrigation water requirements gave highest yield.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Pradeepkumar M.	**Course : FSC 591 (1+0)**
Reg. No. : 2020217027	**Date : 29/09/2018**
Major Guide : Dr. D. K. Sharma	**Time : 10:00 to 11:00 am**
Co-Guide : Dr. Sudha Patil	**Venue : Swami Vivekananda Hall**

Advances in nanotechnology for fruit crops

Nanotechnology is a field of applied science and technology, covering wide range of branches which includes physics, chemisty, mechanical, computer science and biology. It is the manipulation of matter at a nano scale level ranging from 1 nm to 100 nm and self assembly of molecules into structures to create material devices with new or vastly different properties. Nano-scale science and nanotechnology have the potential to transform the agriculture and food production systems through which it interact with plants causing many morphological and physiological changes depending upon the efficacy of nano particles (NP's) by their size, surface covering, reactivity, chemical composition and dosage of application (Khodakovskaya *et al.,* 2012).

Nanotechnology has wide range of benefits in the field of horticulture by increasing the biological effects of nano particles on higher plants to attain self sufficient production. Nano fertilizers or nano-encapsulated nutrients have properties to release nutrients effectively when it is applied at lower amounts that regulate the plant growth and enhance target activity (Nair *et al.,* 2010). These nano fertilizers are more efficient, decreasing soil pollution and other environmental risks that occurs while using common fertilizers (Naderi *et al.,* 2011). Inorganic nano materials like silver NP's has a good antimicrobial properties and so widely used along with edible films and packaging materials to enhance the shelf life of fruits. In pest control, nano pheromones play significant role in control of pests with high efficiency, shelf life and eco friendly management. It has the potential to provide novel and improved solutions to many grand challenges face by Indian agriculture and the society today and in the future.

Review of research work

Nano particles for fruit yield:

Kumar *et al.* (2012) studied the effect of different concentrations of iron and zinc oxide nano particles for the yield characters of strawberry cv. Chandler and they noticed that treatment ZnO NP's 150 ppm + FeO NP's 150 ppm recorded significantly more number of fruits/plant (32.27), higher yield (478 g/plant) and total fruit yield (5.97 t/ha) compare to other treatments.

Nano fertilizers for fruit yield & quality:

Davarpanah *et al.* (2016) studied the response of foliar application of Zinc (Zn) and boron (B) nano-fertilizers on pomegranate (*Punica granatum* cv. Ardestani) and reported that maximum fruit yield (18.5 Kg/tree) and number of fruits (95.9 /tree) were observed in treatment Zn 60 + B 6.5 mg/Lit whereas maximum fruit diameter (78.8 mm), fruit length (91.6 mm), fruit weight (291.9 g), TSS (17.06 %), total sugar (14.93/100 g) and antioxidant activity (29.44 %) were recorded with treatment Zn 120 + B 6.5 mg/Lit.

Nano particles for shelf life of fruits:

Sardabi *et al.* (2013) studied the effect of 1-methylcyclopropene and potassium permanganate coated zeolite nanoparticles on Golden Delicious apples, which were stored for 5 months at 0^{o}C with 90 % RH and combination of 1-MCP and $KMnO_4$ sachets showed maximum firmeness, titrable acidity and maintains the pH.

Janhavi *et al.* (2013) reported that silver NP's prepared from *Ocimum sanctum* leaves extract mixed along with agar-agar was coated on surface of lime and apple fruits showed higher antibacterial activity and increased the shelf life of fruits.

Souza *et al*. (2014) stated that nano multilayer coating on fresh cut mangoes stored at 8^{o}C for 14 days recorded reduction in weight loss, pH, lower TSS and maintaining titrable acidity.

Nano packaging for fruit quality:

Li *et al*. (2009) studied the effect of nano packaging on preservation of Chinese jujube and they found that nano packaging showed minimum weight loss, fruit decay percentage, browning rate, increased firmness compared to normal packaging.

Zhou *et al.* (2011) studied the effect of PE/Ag_2O nano packaging on the quality of apple slices. They observed that nano packaging helps to maintain the freshness, delayed browning and reduce the weight loss of apple slices stored at 5°C compared to normal LDPE packaging.

Ren *et al.* (2012) investigated that 1% chitosan film along with 0.04% nano-silicon dioxide coating showed minimum occurrence of red index, decay incidence, weight loss and respiration rate of coated jujube under the ambient conditions.

Nano particles for antimicrobial effect:

Wang *et al*. (2010) studied the effect of hot air and nano packing in Chinese bayberries on fruit quality reported that combination hot air and nanopacking showed higher TSS (96.90 °Brix), TA (8.58 %), pH (3.31), fruit firmness (3.94 g/cm^2), antioxidant activity (49.14 %) and lower decay incidence than the other treatments.

Moussa *et al.* (2013) studied the botryticidal activity of nanosized silver chitosan on strawberry coated with nano Ag-Irradiated Chitosan solution observed that the treatment have the higher efficiency in prohibiting growth of gray mould and enhanced overall quality of strawberry fruits.

Nanogel pheromones for pest control:

Bhagat *et al.* (2012) reported that nanogel pheromones showed the better attaraction of fruit flies and long lasting shelf life compared to the methyl eugenol alone when tested in fruit flies of guava.

Nano clay coating for post harvest quality:

Motamedi *et al.* (2018) studied the effect of carnauba wax-nano clay emulsion coatings on Valencia orange fruits for improving the post harvest quality. The treatment with carnauba wax 1% nano-clay showed reduced weight loss and increased the sensory quality of fruits.

Conclusions:

From foregoing discussion, it can be concluded that nanotechnology plays a vital role in increasing yield attributes of fruits. Nano fertilizers improve fruit yield and quality more efficiently and decreases soil pollution. Nano coating and nano packaging improves the shelf life of fruits, delays ripening, maintains freshness with other quality parameters and silver NP's having antimicrobial properties too. Nanogel pheromone traps are good for fruit flies with ecofriendly pest management. Nano-clay coating contributes towards sustainable postharvest management by preserving sensory and nutritional quality of the commercial fruits.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Ahir Priya Jayantilal	**Course : FSC 591 (1+0)**
Reg. No. : 2020217002	**Date : 29/09/2018**
Major Guide : Dr. D. K. Sharma	**Time : 11:00 to 12:00 am**
Co-Guide : Dr. S.S.Masaye	**Venue : Swami Vivekananda Hall**

Role of bioferlizer in tropical fruit crops

India is the second largest producer of fruits in the world with annual production of 9,28,46,000 MT from 64,80,000ha (Anon.,2017).Now, farmers are facing difficulty in further increase in fruit production. Indiscriminate use of chemical fertilizer is one of the reasons behind it, as it causes disturbance in soil reaction, development of nutrient imbalances in plants, increased susceptibility to pests and diseases, reduction in legume root nodulation and plant mycorrhizal associations, decrease in soil life and environmental hazards such as water pollution and soil humus reduction. The realization of such detrimental effects of chemical fertilizers, when used continuously in large quantities in the absence of organic matter has triggered interest regarding the alternatives to supply the plant nutrients in an integrated manner giving rise to Integrated Plant Nutrient System in which, biofertilizer play a major role.

Biofertilizer are microbial preparations containing living cells of different microorganisms which have the ability to mobilize plant nutrients in soil from unusable to usable form through biological process. They help crop plants uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants.Certain biofertilizer have ability to absorb and convert atmospheric nitrogen to readily available form to the plants, while some other biofertilizer solubilize the bound phosphates of soil and thereby make them available to the plants.It also stimulates plant growth through synthesis of growth promoting substance (IAA and Gibberellins).

Review of Research Work:

Mango (*Mangifera indica* L.), Family: Anacardiaceae

Kundu *et al*. (2011) concluded that the soil application of 100 % NPK + 250 g/plant *Azotobacter* + 250 g/plant VAM were most effective to fruit weight (g), yield (kg/plant), TSS (°Brix), total sugar (%), acidity (%) and ascorbic acid (mg/100g) of mango cv. Amrapali.

Patel *et al*. (2014) studied that N 80% from neem cake + *Azatobacter* + PSB (50g each/tree) resulted in higher yield of quality fruits with maximum fruit retention. While, application of N 100 % from bio-compost gave maximum benefit cost ratio in mango cv.Kesar.

Dutta *et al*. (2016) revealed that the biofertilizer 150 g/plant *Azotobacter* + 100 g/plantPSM along with 50% inorganic fertilizer significantly increased the growth characters, fruit weight (g), yield (kg/plant) of mango cv. Himsagar.

Sapota (*Manilkara achrus* Mill. Forsberg), Family: Sapotaceae

Baviskar *et al.* (2011) reported that the soil application of 1125:750:375 g NPK + 15 kg vermicompost + 250 g *Azotobacter* + 250 g PSB/plant obtained significantly higher number of fruits/plant, fruit yield (kg/plant), fruit weight (g), pulp weight/fruit (g), peel weight/fruit (g), TSS (°Brix), total sugar (%) and lower acidity (%). They also found that the leaf macronutrients and micronutrient, nitrogen, phosphorus and potassium content in soil were maximum in treatment 1125:750:375 g NPK + 15 kg vermicornpost + 250 g *Azotobacter* + 250 g PSB/plant in sapota.

Patel *et al*. (2017) found that the maximum TSS (°Brix), ascorbic acid (%), shelf life (days), reducing sugar (%), non-reducing sugar, total sugars (%) and lower acidity with soil application of 75% NPK + vermicompost 15 kg + AAU Bio NPK 10 ml/tree in sapota cv. Kallipati.

Papaya (*Carica papaya* L.), Family: Caricaceae

Yadav *et al*. (2011) revealed that treatment combination of 10 kg vermicompost + 100% NPK+25g *Azatobactor* enhanced the plant height (cm), girth (cm), fruit setting (%), length and width (cm) in papaya cv. Pusa Dwarf.

Singh and Varu (2013) observed that ½ RDF (100:100:125 NPK g/plant) + *Azotobacter* @ 50 g/plant + PSB @ 2.5 g/m^2 gave maximum fruit length (cm), fruit girth (cm), fruit weight (g),seed weight/fruit (g), maximum number of fruit/plant, fruit yield (kg/plant), fruit yield (kg/plot), fruit yield (t/ha) and marketable fruit yield (kg/plot) in papaya cv. Madhubindu.

Srinu *et al*. (2017) studied theapplication of 75% RDF + 10 kg VC + 100g *Azotobacter* +100g PSB per plantgave higher values of growth characters *viz.*, plant height (cm), trunk girth (cm), petiole length (cm), number of leaves per plant, minimum days taken to first flowering and lowest days taken to fruit maturity in papaya cv. Red Lady.

Banana (*Musa paradisiaca* L.), Family: Musaceae

Lenka and Lenka (2014) concluded that significantly maximum number of hands per bunch, number of fingers per bunch, weight of bunch (kg), weight of finger (g), length of finger (cm) were observed in combination of RDF 100% + PSB @ 25 g/plant + *Azospirillum*@ 25 g/plant in banana var. Grand Naine Hussain *et al*.(2015) studied that the application of 80% RDF + 20% RDN through vermicompost + biofertilizers *viz*., 50 g *Azospirillum*, 50 g PSB and 25 g KMB/plant gave maximum number of hands/bunch, number of fruits/bunch,fruit length (cm), fruit girth (cm), bunch weight (kg) and fruit yield (t/ha) in banana var. Grand Naine.

Chhuria *et al*. (2016) concluded that the maximum bunch weight (g), number of hands per bunch and number of finger per bunch, pulp:peel ratio, ascorbic acid (mg/100 ml),weight of finger (g), length of finger (cm) and yield (t/ha) were observed in combination of 100% RDF +125 g *Azotobactor* + 125 g *Azospirillum* + 125 g PSB at 3rd , 5th , and 7th month after planting in banana cv. Grand Naine.

Guava (*Psidium guajava* L.), Family: Myrtaceae

Sharma *et al*.(2013) revealed that the application of *Azotobactor* @ 200g/plant+25 % of N/tree through FYM + 75 % of N/tree through inorganic fertilizer gave maximum fruit length, (cm), fruit weight (g), pulp weight (g), specific gravity, TSS (°Brix), total sugar (%), reducing sugar(%), non reducing sugar (%) in guava cv. Sardar.

Dutta *et al.* (2014) observed that the application of *Azospirillum*@ 50 g/plant +*Azotobacter* @ 50 g/plant +VAM@ 50 g/plant weremosteffective for improvingthefruitweight (g), fruit length (cm), TSS (°Brix), total sugar (%) , lower acidity and maximumcontentofleafminerals(N,PandK) in guava cv. L-49.

Jamval *et al.*(2018) recorded that the maximum number of fruits/tree, average fruit weight (g), fruit length (cm), fruit volume (cc), fruit yield/tree (kg), Fruit yield (q/ha) were observed in combination of *Azotobacter* @ 25 g/plant + 75% nitrogen through urea + 25 % vermicompost in guava cv. Allahabad Safeda.

Conclusion:

From the foregoing discussion it can be concluded that bio-fertilizers not only improve soil fertility but also increase the vegetative growth, yield as well as quality parameters in fruit crops, on sustainable basis.

- Soil application of 100 % NPK + 250 g/plant *Azotobacter* + 250 g/plant VAM, N 80% from neem cake + *Azatobacter* + PSB (50g each/tree) and 150 g/plant *Azotobacter* + 100 g/plantPSM along with 50% inorganic fertilizerwere increase yield, improve quality parameters and maximum fruit retantion in mango.

- Soil application of 1125:750:375 g NPK + 15 kg vermicompost + 250 g *Azotobacter* + 250 g PSB/plant and 75% NPK + vermicompost 15 kg + AAU Bio NPK 10 ml/tree was beneficial for growth, yield and increase nutrient uptake capacity in sapota.
- Application of 10 kg vermicompost + 100% NPK + 25g *Azatobactor,* ½ RDF (100:100:125 NPK g/plant) + *Azotobacter* @ 50 g/plant + PSB @ 2.5 g/m^2 and75% RDF + 10 kg VC + 100g *Azotobacter* +100g PSB gave higher values of growth characters, improve quality and increase yield in papaya.
- RDF 100% + PSB @ 25 g/plant + *Azospirillum@* 25 g/plant, 80% RDF + 20% RDN through vermicompost + biofertilizers viz., 50 g *Azospirillum*, 50 g PSB and 25 g KMB/plant and100% RDF +125 g *Azotobactor* + 125 g *Azospirillum* + 125 g/plantPSB increase the plant growth and yield in banana.
- Application of *Azotobactor* @ 200 g/plant+25 % of N/tree through FYM + 75 % of N/tree through inorganic fertilizer, *Azospirillum@* 50 g/plant +*Azotobacter* @50 g/plant+VAM@ 50 g/plant and*Azotobacter* @25 g/plant + 75% Nitrogen through urea + 25 % N throughvermicompost gavemore yield and quality parameters in guava.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Smita Kesurbhai Chaudhari	**Course : FSC 591 (1+0)**
Reg. No. : 2020217034	**Date : 20/10/2018**
Major Guide : Dr. B. R. Parmar	**Time : 09:00 to 10:00 am**
Co-Guide : Dr. N. B. Patel	**Venue : Swami Vivekananda Hall**

Induction of dwarfing in temperate fruit crops

Dwarfing is an alternation in the normal plant growth. It is smaller than normal size at full maturity and possesses other characteristics like precocity, canopy architecture, time of flowering and altered fruit size. Dwarfing of fruit trees play an important role in fruit growth, development and quality. The principle underlying dwarfing is to make the best use of vertical and horizontal space per unit time and to get maximum possible returns per unit of inputs and natural resources. Apart from that, it provides easy cultural operations like training, pruning, spraying and harvesting**.** (Dhillon and Bhatt, 2011)

Dwarfing in fruit crops can be achieved through various approaches like use of appropriate rootstock and interstock, growth retardants, pruning and girdling. These methods can be employed individually or in combination to obtain the maximum benefits of dwarf trees.

Brief review of research work

Rootstock

Apple

Jobir *et al.* (2017) reported that use of MM 106 rootstock for Golden Delicious gave minimum trunk circumference, tree height, number of branches and leaf area.

Shichiro (1979) studied that trunk girth, tree height and tree spread were found minimum by using M 9 rootstock for different apple cultivars.

Pear

Ozturk and Ozturk (2014) observed that minimum rootstock diameter, trunk diameter, tree height, tree width and canopy volume were found by using EMC rootstock for Deveci pear.

Plum

Webster (1980) reported that tree height, average spread, crown volume and trunk cross sectional area were found minimum by using Pixy rootstock in plum cv. Oullins Golden Gage.

Cherry

Pal *et al.* (2017) observed higher values for minimum tree height, shoot length, trunk cross sectional area and maximum yield with Gisela-5 rootstock for different cherry cultivars.

Monica and Gheorghe (2015) reported that by using Gisela- 5 rootstock for different cherry cultivar gave minimum trunk cross sectional area and total numbers of shoot.

Hrotko *et al.* (2009) reported that minimum TCSA, canopy volume with maximum fruit weight and yield were obtained with Gisela-5 rootstock in cherry cv. Vera.

Kumar and Gautam (2007) found significantly minimum plant height and spread in cherry cv. Stella when grafted on Colt rootstock.

Interstock

Apple

Bhat *et al.* (2011) found that M 9 an interstock (20 cm) gave minimum tree height, tree spread and trunk diameter in Ambri apple.

Vaio *et al.* (2008) reported that minimum rootstock and scion circumference, plant height, canopy volume and maximum fruit weight obtained with M 27 (20 cm) as an interstock in apple cv. Annurca Rosa Del Sud.

Peach

Hossain *et al.* (2005) observed that minimum shoot length and trunk circumference were obtained with Akatsuki interstock in peach.

Growth retardant

Apple

Lal *et al*. (2018) reported that minimum annual shoot extension, internodal length, leaf area and maximum fruit yield obtained with double spray of pro-hexadione Ca @ 200 ppm in Clapp's Favourite apple.

Peach

Arzani *et al.* (2009) studied that minimum TCSA and maximum yield were obtained with high dose of paclobutrazol in both peach cultivars J. H. Hale and Red Skin.

Chanana and Gill (2007) observed that minimum trunk girth, tree height, tree spread and no. of shoots obtained with soil drenching of paclobutrazol @ 8ml/tree in peach cv. Earli Grande.

Singh and Chanana (2007) reported that minimum tree height, spread and maximum fruit yield were obtained with soil drenching of paclobutrazol @ 15ml/tree in peach cv. Shan-e-Punjab.

Pruning

Peach

Ikinci (2014) noticed minimum average shoot length and TCSA when summer pruning were done in the month of July in peach cv. Maycrest.

Apple

Mitre *et al.* (2012) observed minimum average shoot length and TCSA were obtained with root pruned cultivar Topaz as compared to un-pruned cultivar in apple.

Girdling

Rufato *et al.* (2015) reported that minimum canopy volume, trunk diameter with maximum fruit weight and yield were obtained with double girdling in pear cv. Packham's Triumph.

Conlusion

Dwarfing in fruit crops can be achieved through various approaches like use of appropriate rootstock and interstock, growth retardant, pruning and girdling. These methods can be employed individually or in combination to obtain the maximum benefits of dwarf tree. In apple- M 9, MM 106, pear- EMC, plum- Pixy, cherry- Gisela 5 rootstocks were performed best for dwarfing effect. Dwarfing effect with use of interstock in apple like M 9, M 27, cherry- Northstar, peach- Akatsuki were found beneficial. Foliar spray of pro-hexadione Ca @ 200 ppm found beneficial in apple. Soil application of paclobutrazol @ 8ml and 15ml/tree was found effective as compared to foliar application in peach. Summer and winter pruning also contributes in dwarfing effect in peach. With respect to girdling, double girdling was found beneficial in pear.

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Speaker : Patel Zarna Kamleshbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020217026	**Date : 15/09/2018**
Major Guide : Dr. B. N. Patel	**Time : 10:00 to 11:00 am**
Co-Guide : Dr. S. N. Saravaiya	**Venue : Swami Vivekananda Hall**

Pre-harvest fruit bagging : a useful approach for plant protection and quality production of fruit crops

Good Agricultural Practices (GAP) are becoming popular throughout the world for the production of high quality fruit with less dependence on agro chemicals. Among such practices, pre-harvest fruit bagging emerged as an effective method. This practice is associated with organic farming as an alternative to pesticide. Climatic abbreviation such as sudden rise in temperature and humidity, abnormal rains are the main problems in some recent years. Such adverse climate not only affects the external apperearance of the fruit but also aggravate the pest and diseases incidence. Bagging provide physical barrier over such problems as it change the micro-environment for fruit development.

Fruit bagging is a technique of putting a bag over fruit for specific period of time to provide a physical protection against biotic and abiotic factor and quality production of fruits. It is known to originated in Japan and Korea. Countries such as Mexico, Chile and Argentina do not import fruits unless they are bagged. Bagging not only improves the visual quality of fruits but also improves the internal quality of fruits.

Review of research work

Mango

Dutta and Majumder (2012) observed that early bagging (35 days after fruit set) using polyethylene proved most effective in increasing fruit weight, length and diameter, but highest TSS of fruits was observed in those fruits which were bagged later (65 days after fruit set) in mango cv. Himsagar.

Haldankar *et al.* (2015) noticed that newspaper bag and brown paper bag increased fruit weight, fruit length, fruit diameter and pulp weight of fruits as comapared to other treatments. They also reported that TSS, reducing sugar and shelf life were highest in newspaper bag and there was 0 % of mealy bug infestation using newspaper bag, transparent PP bag and muslin cloth bag and 0 % spongy tissue infestation using NP bag and BP bag in mango cv. Alphonso.

Mingire *et al*. (2017) reported that newspaper bag increased fruit retention and fruit weight as compared to other treatments. While early harvesting of mango fruits were observed in transparent PP bag and black polythene bag.

Singh *et al.* (2017) observed lowest chlorophyll content in brown paper bag with Langra variety of mango. While brown paper bag with Kesar variety of mango recorded maximum carotenoids content at ripe stage.

Banana

Samantaray *et al.* (2015) recorded maximum TSS, total sugar and pulp : peel ratio in blue polypropylene sleeve with Champa variety of banana as compared to control.

Pathak *et al.* (2017) recorded maximum finger length, finger girth, finger volume, bunch weight, yield and harvest index when banana bunch covered with white non-woven polypropylene bag in banana cv. Jahaji.

Guava

Mondal *et al.* (2015) observed lowest percentage of fruit fly infestation in fruit wrapping with transparent poly-propylene bag (20 μ gauge) + paper within the poly-propylene bag as partial cover against sunlight. Maximum fruit weight was found in fruits wrapping with butter paper bag. Early harvesting and lowest yield loss were found in wrapping the fruits with transparent poly-propylene bag. Highest colour development and market price was found in fruits wrapping with transparent poly-propylene bag (20 μ gauge) + paper within the poly-propylene bag as partial cover against sunlight, fruits wrapping with non woven poly fabric bag of green colour (40 gsm) and fruits wrapping with non woven poly fabric bag of blue colour (40 gsm). Highest marketable price was found in fruits wrapping with non woven poly fabric bag of blue colour (40 gsm).

Rahman *et al.* (2017) observed maximum fruit length, fruit diameter, fruit weight, TSS and yield of fruits when bagged the fruit with white polythene in cv. BARI Peyara-2 of guava.

Litchi

Debnath and Mitra (2008) recorded moderate temperature, RH, LI, lowest GDD and early harvesting of fruits when bagged with semi- transparent CP bag. They also recorded maximum fruit retention per panicle, anthocynin content, TSS and TSS/acid ratio in fruits bagged with semi transparent CP bag, while maximum fruit weight and fruit yield was found in newspaper bag in litchi.

Purbey and Kumar (2015) recorded lowest fruit borer infestation, brown/black spotted fruits, cracked fruits and maximum healthy marketable fruits in bagging using WBPB at 40 DAFB. They also recorded maximum fruit weight in fruits bagged using WBPB at both 40 DAFB and 50 DAFB, while better colour development was found in fruits bagged using MCB and WBPB at both 40 DAFB and 50 DAFB.

Pineapple

Prabha *et al*. (2018) observed early harvesting of fruits when bagged with jute bag, while maximum fruit length and weight with crown, fruit circumference and fruit weight without crown was found in fruits bagged with paper bag. They also recorded maximum TSS, TSS-acidity ratio, reducing sugar, non-reducing sugar and total sugar in fruits bagged with same bag, while minimum acidity was found in fruits bagged with paper bag and jute bag as compared to other treatments.

Pomegranate

Samra *et al*. (2014) recorded lowest percentage of cracked fruit, sunburned fruits and highest percentage of marketable fruits and anthocynin content in paper bagged fruits in both the varieties as compared to other treatments.

Saad *et al*. (2017) recorded maximun fruit weight, fruit length, fruit diameter and fruit volume in fruits bagged with red colour paper bag in both the season in cv. Wonderful as compared to other treatments.

Date-palm

Kassem *et al*. (2011) recorded highest percentage of fruit set, bunch weight, yield and lowest percentage of fruit tip cracking in bagging of date-palm bunch with blue-polythene bag, harvested at partially-ripe (50-60 % fruits colouring) stage.

Omar *et al*. (2014) observed maximum SSC, reducing sugar and total sugar in date-palm bagged using grill cloth as compared to other treatments.

Apple

Bentley and Viveros (1990) recorded lowest codling moth as well as sunburned infestation and highest firmness, soluble solid and yield in combination of bagged in thinned fruits as compared to other treatments.

Conclusion

From the foregoing discussion, it can be concluded that pre-harvest fruit bagging respond beneficial effects on fruit development. Desirable effect of bagging dependent on type of bag, stage of fruit development, time of bag removal, and/or fruit and cultivar. In mango, newspaper as well as brown paper bag at 35 days after fruit set were effective in quality production fruits. In banana, white non-woven polypropylene bag as well as blue polypropylene sleeve both were effective in increasing physical and chemical properties as well as yield of bunches. In guava, wrapping individual fruit with transparent polypropylene bag (20 μ gauge) + paper bag as partial cover against sunlight was the best option for guava fruit fly management and reducing yield loss. White polyethylene bag also found beneficial for yield attributes and quality production of fruits. In litchi, improvement in peel colour and quality of fruits, when panicle was bagging with semi-transparent cellophane paper bag and also bagging of litchi bunches at 40 days after anthesis with white butter paper bag for quality fruits. Paper bag was best bagging material in pineapple. In pomegranate, bagging with red colour paper bag was effective to improve physical properties of fruits. In date palm, blue polythene bag and grill cloth were effective when bunches harvested at partially ripe stage of fruit development. In apple, brown paper bag was very effective against codling moth and sunburned infestation.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Ajay Kumar Sahu	**Course : FSC 591 (1+0)**
Reg. No. : 2020218001	**Date : 16/11/2019**
Major guide : Dr. B. N. Patel	**Time : 9.00 – 10.00 a.m.**
Co-guide : Dr. S. L. Chawla	**Venue : Swami Vivekananda Hall**

Foliar feeding in major fruit crops

Technique of feeding plants by applying liquid fertilizer directly to the leaves is known as foliar feeding. Plants are able to absorb essential elements through their leaves. The absorption takes place through their stomata as well as epidermis. Transport of nutrients is usually faster through the stomata, but total absorption may be as great through the epidermis. Foliar application overcomes soil fertilization limitations like leaching, insoluble fertilizer precipitation, antagonism between certain nutrients, heterogenic soils unsuitable for low dosages, and fixation/absorption reactions like in the case of phosphorus. A successful foliar feeding application is dependent on many factors and they are spray solution characters like solution pH, molecule type, solution water tension, droplet size, environmental factors like humidity, temperature, wind speed and rainfall and plant characters like leaf age, leaf surface, leaf orientation and plant species. In general, spraying during early morning or late afternoon is recommended when radiation and temperature are low (18-19 ℃, ideal 21 ℃), wind speed is low (less than 5 mph) and humidity is high (greater than 70 % relative humidity).

Brief review of research work

Mango

Amarcholi *et al.* (2016) observed that foliar application of KNO_3 (1.0 %) was found better for maximum flowering (26.12 %), fruit set (0.21 %) and fruit retention (20.45 %). This treatment was also found better with respect to highest number of fruits per panicle (2.10), number of fruits per tree (276.33) and fruit yield (11.30 t/ha) in mango cv. Kesar sprayed at flower bud differentiation followed by during the full bloom stage.

Momin *et al.* (2016) sprayed three times namely flowering, pea and marble stage with different chemicals in mango cv. Kesar and observed that tricontanol @ 750 mg/l enhance fruit set at pea stage per panicle (14.30) and marble stage per panicle (56.34), minimize fruit drop at harvest stage (83.62 %) and number of fruits per tree (201.15). While humic acid @ 1.5 % was found effective with respect to fruit yield (51.45 kg/tree) followed by tricontanol @ 750 mg/l.

Maximum number of flower shoot (17.89), fruit set at pea stage (8.18), fruit weight (317.14 g) and fruit yield (10.26 t/ha) was recorded in KNO_3 at 2 %. While maximum shelf life (9.56 days) in CCC at 1500 ppm in mango cv. Alphonso sprayed at 15th October and 15th November (Anon., 2019).

Sapota

Guvvali *et al*. (2017) applied micronutrients in sapota at 50 % flowering and at pea stage and observed that RDF + 0.5 % $ZnSO_4$ + 0.5 % $FeSO_4$ + 0.3 % B per tree had significant effect on increase in number of fruits per tree (189.50), and yield (23.44 t/ha) in HDP system of sapota cv. Kalipatti.

Barkule *et al*. (2017) observed that significantly higher fruit weight (88.83 g), fruit firmness (3.41 kg/cm^2), shelf life (9.45 days) was reported with foliar application of 6 ppm CPPU. However the pulp content (92.66 %) and pulp: peel ratio (12.63) were show higher with GA_3 at 100 ppm in the month of May. They also recorded the above characters in the month of February and observed that same treatment was found better in sapota cv. Kalipatti.

Banana

Kumar and Kumar (2007) studied the effect of foliar spray of SOP on yield and quality of banana cv. Neypoovan and revealed that the maximum number of leaves (10.2), higher chlorophyll content of leaf (1.769 mg/100g), early maturity (89.9 days), higher value of bunch traits and quality of banana was recorded with SOP 1.5 % applied after opening of the last hand (7th month after planting) and 30 days later.

Patil *et al.* (2018 [a]) recorded minimum days taken from flowering to harvesting (86.55 days), maximum length of bunch (84.43 cm), girth of bunch (107.27 cm), weight of third hand (3.43 kg), length of finger (23.98 cm), girth of finger (14.19 cm), weight of bunch (24.89 kg) and yield per hectare (86.41 ton/ha) with treatment of SOP 1.5 % in banana cv. Grand Naine sprayed immediately after complete emergence of bunch and 15 days after the first spray.

Patil *et al*. (2018 [b]) also recorded that total soluble solids (22.90 %) and total sugar (13.92 %) were maximum in SOP 1.5 %. While spraying of KNO_3 1.0 % exerted maximum score of organoleptic tests for colour (8.06), flavor (8.05), taste (8.07) and texture of fruit (8.09) in banana cv. Grand Naine.

Papaya

Shekhar *et al.* (2010) recorded that foliar application of $CuSO_4$ 0.25 % + $MnSO_4$ 0.25 % + borax 0.1 % was found better for maximum plant height (2.21 m) and plant girth (29.77 m), minimum fruiting height (87.33 m), maximum number of fruits per plant (30.67), fruit yield (40.40 kg/ plant), fruit length (25.00 cm) and fruit width (13.17 cm), TSS (9.60 %), total sugars (9.72 %) and ascorbic acid content (58.32 mg/100g). This treatment was also found better with respect to minimum days taken to first flowering (186.33) and acidity (0.053 %) in papaya cv. Washington sprayed at 60 and 90 days after planting.

Manjunath *et al.* (2014) recorded that the application of $ZnSO_4$ (0.25 %) + Borax (0.1 %) + $FeSO_4$ (0.5 %) gives maximum plant height (205.47 cm), stem diameter (113.59 mm), number of leaves (40.41), petiole length (71.71 cm), weight of fruit (1.73 kg), fruit length (21.17 cm), fruit diameter (17.47 cm), reproductive parameters (53.13 flowers and 22.30 fruits/plant) and fruit yield (119.04 t/plant) over control in papaya cv. Red Lady sprayed 4 times at 1 month interval after 3 months of planting.

Parmar Pinal *et al*. (2017 [a]) recorded that papaya cv. Red Lady plants fed with 100 % RDNK (200:250 g/plant) applied in 8 equal splits starting from 2nd month after planting at an interval of 30 days and foliar application of 1 % Grade-IV micronutrient gave maximum plant height (211.19 cm), plant girth (47.10 cm) and leaf area (1045.87 cm^2) and minimum days required for first flower initiation (101.64 days).

Parmar Pinal *et al*. (2017 [b]) recorded that papaya cv. Red Lady plants fed with 80 % RDNK (160:200 g/plant) and applied in 8 equal splits starting from 2nd month after planting in 30 days interval with foliar application of novel organic liquid fertilizer at 2nd, 4th, 6th and 8th month after planting gave minimum physiological loss in weight (12.47 %) and maximum TSS (12.03 ^{O}Brix), fruit firmness (7.80 kg/cm^2), total sugar (10.87 %), shelf life (7.61 days) and yield (106.57 t/ha).

Citrus

Mohammad *et al.* (2007) recorded that average fruit number and average fruit yield per tree were relatively higher with post bloom application of 500 ppm boron. However, there was apparent trend in increasing fruit weight with increasing boron application at prior to flowering and one month after flowering.

Sajid *et al*. (2010) recorded maximum fruit yield per plant (99.83 kg), minimum days to flowering (10.83 days), minimum fruit drop (22.24 %) was obtained when 0.05 % Zn with 0.04 % B applied to the plants whereas maximum number of flowers per twig (25.67) and fruit set (68.99 %) was obtained with the application of 0.05 % Zn with 0.02 % B and reduced dieback (13.77 %), chlorosis (9.66 %) and rosette (2.89 %).

Conclusion

From the foregoing discussion, it can be concluded that foliar feeding is a method of feeding plants when ground application is not efficient enough. In mango, KNO_3 at 1.5 % in Kesar and KNO_3 at 2 % in Alphonso cultivar of mango and tricontanol 750 mg / l and humic acid at 1.5 % in Kesar cultivar of mango give best flowering and physical and quality characteristics of fruit. In Sapota, 6.00 ppm CPPU and 100 ppm GA_3 and RDF + 0.5 % $ZnSO_4$ + 0.5 % $FeSO_4$ + 0.3 % B per tree in Kalipatti cultivar were better for flowering, fruiting and yield characters. In banana, Sulfate of potash at 1.5 % concentration gives highest leaves per plant, bunches per plants, fingers per bunch, bunch weight, finger weight and KNO_3 at 1.5 % was also found better for organoleptic characters. In papaya cultivar Red Lady, 100 % recommended dose of nitrogen and potassium into 8 equal spits along with 1 % Grade IV micronutrient (4 sprays), 100 % recommended dose of nitrogen and potassium into 8 equal spits along with 4 spray of 1 % Grade IV micronutrient along with 1 % Novel organic liquid fertilizers. In Washington cultivar, micronutrint spray like copper and manganese at 0.25 % and borax (0.1 %) and $ZnSO_4$ (0.25 %) + Borax (0.1 %) + $FeSO_4$ (0.5 %) gives highest number of fruit per plant, increased growth and yield. In citrus, boron at 500 ppm gives increased average fruit number and yield per tree and micronutrients like zinc (0.05 %) and boron (0.04 %) gives maximun yield and minimum infestation of dieback, chlorosis and rosette disorders.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Boricha Urvashi Kamleshkumar	**Course : FSC 591 (1+0)**
Reg. No. : 2020218006	**Date : 29/11/2019**
Major guide : Dr. B. R. Parmar	**Time : 4.00 – 05.00 p.m.**
Co-guide : Dr. N. B. Patel	**Venue : Swami Vivekananda Hall**

Fruit set and development: pre-requisites and enhancement in fruit crops

Fruit set is the transformation of ovary to a rapidly growing young fruit which is initiated after successful pollination and fertilization. The various pre-requisites for good fruit set are development of flower buds, certain temperature range for good pollination, pollen tube growth, fertilization and relatively high level of photosynthates for developing fruit. Three general categories of limited fruit set recognised may be attributed to limited pollination, limited nutrients and precocious abscission of flowers (Verma and Jindal, 1985). Pollination is an essential process for fruit set, fruit growth, fruit quality, and seed set of all fruits cultivars. Pollen source and temperature have a tremendous influence on the rate of pollen tube growth. In spite of adequate flowering, low fruit yields in orchards have been experienced because of low initial fruit set and subsequently higher fruit-let abscission. Initial fruit set is one of the serious problems of orcharding and it needs to be improved. Fruit set improvement can be increased by growth regulators, pollinators, by providing suitable climatic adaptability, reducing crop load *etc.* is essential to ensure good size fruits and high production.

Review of research work :

Effect of temperature

Patel *et al.* (2015) studied that *cv.* Alphonso induced the flower in phase-II (D2: 1-10th February-2012) at temperature above 12 ^{0}C and had maximum fruit at grain stage, pea stage, marble stage and harvesting stage.

De Long *et al.* (2016) observed that pollen tube growth increased with increasing temperature until 24 ^{0}C in Crabs Apple but pollen tube growth rate didn't increased further between 24^{0}C & 30^{0}C, indicated that maternal genotype also influences the pollen tube growth rate with highest being in Cripps Pink followed by Fuji at 24 ^{0}C.

Effect of stigmatic receptivity

Sanzol *et al.* (2003) recorded highest initial fruit set in pear flowers pollinated at anthesis and 2 days after anthesis. After 4 to 6 days, fruit set was significantly reduced.

Weiguang *et al.* (2006) found maximum pollen germination (15-20 %) and fruitfulness (35-70 %) in Padre cultivar of almond when compared with Non-pareil and Butte.

Pawar *et al.* (2017) studied that higher fruit set (86.66 %) was recorded when stigma of raspberry were pollinated on the day of anthesis which was at par with stigma pollinated one day after anthesis (60.10 %).

Effect of pollination

Freihat *et al*. (2008) found higher fruit set, seed number and seed weight of loquat under supplemental and open-pollination treatments than cover condition.

Rymbai *et al.* (2015) revealed that in mango highest number of fruit set was seen in cross Sonpari × Alphonso (88.91 %) than in cross Neelphonso × Alphonso (78.43 %) when Alphonso was used as a pollinizer in hybridization programme.

Pawar *et al.* (2017) revealed that the maximum fruit set (96.66 %) was recorded with self-pollination, followed by natural pollination in raspberry.

Effect of nutrient

Gurjar Tulsi *et al.* (2015) found that $ZnSO_4$ 1 % + $FeSO_4$ 1 % + borax 0.5 % significantly increased the number of fruit set at pea stage (14) marble stage (7.5), number of fruits per tree (1.73), and decreased the fruit drop (87.66 %) in mango.

Balaji *et al.* (2016) found that borax (0.1 %) and iron (0.2 %) gave highest flowering percentage and yield in banana.

Effect of PGRs

Ngullie *et al.* (2014) observed that foliar application of 2000 ppm salicylic acid was found better with respect to number of male and hermaphrodite flower/ panicle, hermaphrodite flower to male flower ratio (0.32), fruit retention per panicle (1.40), number of fruits per tree and quality parameters like TSS, titrable acidity and sugar of mango.

Anawal *et al.* (2016) observed that NAA 40 ppm was found effective in increasing number of fruit/tree (37.55), yield (kg/tree) and fruit quality among all other treatments in pomegranate cv. Bhagwa. Patel *et al.* (2018) studied that the foliar application of NAA 60 ppm increased the fruit retention (6.75 %) and yield (74.80 kg/tree) of mango cv. Kesar.

Dutta *et al.* (2018) noted that 0.5mM putrescine was most effective in improving fruit set, fruit retention and yield of mango cv. Himsagar.

Conclusion

It is inferred from the foregoing discussion that the effect of both internal as well as external factors seems to have greater impact on fruit set and development. Factors like pollination, temperature, stigmatic receptivity, micronutrients and PGRs have greater impact on fruit set percentage and yield of fruit crops. In mango, temperature above 12 ^{0}C gave maximum fruit setting at grain, pea, marble and harvesting stage. Pollens of Alphonso showed good compatibility with both Sonpari and Neelphonso which gave higher fruit set percent. Foliar application of 2000 ppm salicylic acid, 60 ppm NAA, 0.5mM putrescine and micronutrient $ZnSO_4$ 1 % + $FeSO_4$ 1 % + borax 0.5 % increased the fruit retention, fruit set and reduced fruit drop. NAA 40 ppm increased fruit set and yield in pomegranate cv. Bhagwa. In banana, borax (0.1 %) and iron (0.2 %) gave highest flowering percentage and yield. Flowers of pear pollinated at anthesis and 2 days after anthesis gave highest initial fruit set. In almond, maximum pollen germination (15–20 %) and fruitfulness was seen in cv. Padre than Butte. In loquat, supplemental and open-pollinated treatments increases fruit set. In apple, maternal genotype influences the pollen tube growth rate with highest being in Cripps Pink followed by Fuji at 24^{0}C. In raspberry, stigma pollinated at the day of anthesis and self pollination increased fruit setting percentage.

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POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Parmar Bhumikaben Maganbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020218026	**Date : 29/11/2019**
Major guide : Dr. BinayakChakraborty	**Time : 3.00 to 04.00 p.m.**
Co-guide : Dr. N. B. Patel	**Venue : Swami Vivekananda Hall**

Recent advances in physiological disorders of strawberry

Strawberry is one of the most important fruit crops of the world. Basically it is a fruit plant of temperate regions, but it grows profitably well in tropical and sub-tropical climates. Strawberry cultivation suffers from various physiological disorders like albinism, fruit malformation, fasciation and button berry. Among these, albinism is considered to be the most important. Physiological disorders of strawberry plants are caused by plant responses to non-biological factors, like adverse weather events, improper planting density, poor maintenance of transplants and interaction of fertilizers or pesticides. Loss of yield due to various physiological disorders in strawberries is reported to be 20-30 percent (Kirschbaum *et al.*, 2014).

Review of research work

Albinism

Lieten and Marcelle (1993) reported that shading plants delayed fruit development by about 1 week but increased albino from 5% to 56% compared with unshaded plants.

Sharma *et al.* (2006)observed that plants grown in shade produced higher percentage of albino fruits (37.6%) than those grown in open field (25.2%).

Singh *et al.* (2007) noted thatpre-harvest foliar application of either Ca (2.0 kg Ca/ha/spray)or Ca + B (2.0 kg Ca/ha/spray+ 150 g B/ha/spray) reduced the incidence of albinism by 6.7 and 6.5 %, respectively in cultivar Chandler.

Sharma *et al.* (2008) found that when strawberry plants raised under row covers produced higher percentage (17.1%) albino fruits than those which were left uncovered (15.2%) and plants under black polyethylene mulch produced higher percentage (18.4 %) albino fruits than those mulched either with white polyethylene (13.5%) or paddy straw (9.5%).

Singh *et al.* (2008) reported that plant receiving inorganic fertilizer produced significantly higher proportion of albino fruits (16.1%) and the incidence of albinism was decrease with increase in dose of vermicompost. They also found that vermicompost @ 10.0 t/ha had reduced the incidence of albino fruits upto 4.5%**.**

Wani *et al*. (2017) recorded that the incidence of albinism wasthe highest when plants were mulched with black polyethylene (38.68%) and least (22.65%) in the plants mulched with paddy straw.Among different cultivars, the incidence of albinism was the highest in Etna (50.60 %) and least in Sweet Charlie (22.50%).

Malformation

Singh *et al.* (2007) observed that pre harvest foliar application of either Ca (2.0 kg Ca/ha/spray)or Ca + B (2.0 kg Ca/ha/spray+ 150 g B/ha/spray) had reduced the incidence of malformed fruits by 3.4 and 3.1 %, respectively in cultivar Chandler.

Singh *et al.*(2008) noted that plant receiving inorganic fertilizer produced significantly higher proportion of malformed fruits (11.5%) and incidence of malformation was decrease with increase in dose of vermicompost. They also reported that vermicompost @ 10.0 t/ha had reduced the incidence (4.0 %) of malformed fruits.

Mochizuki *et al.* (2018) revealed that cultivation of strawberry in heated growing substrates (25 °C) decreased incidence of malformed fruit (9.0 %) in polyhouse condition.

Negi*et al.* (2018) reported that when flowers were selfed by bagging produced more than 50.0% malformed fruits while,hand pollination had reduced the incidence of malformed fruits.

Fasciation

Darrow and Borthwick (1954) found that fasciation in strawberry was influenced by short day condition and the varieties requiring short day length such as Redstar and Howard 17 were highly susceptible. They also reported that growing of strawberries in southern hemisphere increases the incidence of fasciation.

Button berry

Sharma and Singh (2008) observed that button berry contains lower amount of Ca and B than normal berryand thelipoxygenase (LOX) activity was higher in button berry than normal berry. They also reported that Etna variety of strawberry is highly susceptible to this disorder.

Conclusion

It can be inferred from the foregoing discussion that theuse of paddy straw mulch is beneficial for the management of albinism and the cultivar ‘Sweet Charlie’ should be selected in areas where the incidence of albinism is higher in strawberry. To reduce the albinism and malformed fruits in strawberry, vermicompost @ 10.0 t/ha is found to be effective and pre-harvest foliar application of either Ca (2.0 kg Ca/ha/spray)or Ca + B (2.0 kg Ca/ha/spray+ 150 g B/ha/spray) is also helpful.This disorder could also be minimized by raising of strawberry plants in unshaded open pollinated condition under uncovered row. Heating of growing substrate at 25 °C reduces the incidence of malformed fruits in protected culture. Strawberry varieties requiring short day length should be avoided to reduce the fasciation. Proper Ca and B nutrition in strawberry facilitates in reduction of button berry formation.

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POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Desai Devanshi Jayeshbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020218011	**Date : 05/10/2019**
Major Guide : Dr. R. V. Tank	**Time : 10.00 to 11.00 a.m.**
Minor Guide : Dr. K. D. Desai	**Venue : Swami Vivekananda Hall**

Effect of pre and post-harvest treatments on shelf life and quality of papaya fruits

Papaya (*Carica papaya* L.) has long been known as a wonder fruit of the tropics and grown primarily for its fruits. India ranks 4th in the world while Gujarat ranks 2nd in India inthe area, production and productivity (Anonymous, 2018). Being a climactericfruit, papaya is highly perishable and it becomes over ripe and spoiled within 4 to 6 days under normal conditions.High respiration rate, ethylene production and physiological loss in weight leads to deterioration in quality of fruits. The pre harvest and post-harvest loss is about 10-12% and 40-100%, respectively. So, it becomes necessary to find out suitable pre and post-harvest solutions to extend shelf life and quality of papaya.Various technologies have been developed to improve shelf life and quality of fruit. Pre harvest treatments such as a foliar spray of chemicals, proper method of harvesting and judging the stage of maturity and post-harvest treatments like dipping, wrapping, coating, storage and packaging are used for improving the shelf life and quality.

Review of research work:

Pre harvest treatments

Bhattacharya (2004) observed highest TSS (9.33° Brix), ascorbic acid(33.36 mg/100g), reducing sugar (8.20 %),total sugar (9.33 %) and non- reducing sugar (1.13 %) infruits ofMadhubindu cultivar treated with pre harvest spray of borex @ 0.2% at 4 month after transplanting.

Yadav *et al*. (2014) obtained highest TSS, ascorbic acid, total sugar and lowest acidity in fruits of Madhubindhu cultivar by spraying of carbendazim @ 0.05% ,15 days before harvesting.

Bhalerao and Patel (2015) found that spraying of calcium nitrate 1000 mg/l + borex 30 mg/l+ zinc sulphate 200 mg/l + ferrous sulphate 200 mg/l at 60, 90 and 120 days after planting gives the highest TSS (7.19° Brix), reducing sugar (5.27 %), total sugar (7.49 %) and shelf life (6.95 days) of papaya fruit cv. Red Lady.

Parmar *et al.*(2017) at NAU Navsarinoted that papaya cv. Red Lady when pre treated with 80% RDNK with 8 equal splits at monthly interval + spraying of 1% novel organic liquid fertilizer at 2nd,4th,6th and 8th month after planting recorded the highest TSS (12.03 ° Brix), reducing sugar (9.28%) and total sugar (10.87 %) with longer shelf life (7.61 days).

Dipping of 25 % mature fruits in spermine 2mM for 5 minuteswithshrink packaging found minimum physiological loss in weight andmaximumshelf life (16 days)of papaya fruit cv. Red Lady(Patil *et al.*2018).

Patel *et al* (2019) recorded the maximummarketable fruits percentage with longest shelf life and minimum physiological loss in weight with minimum spoilage of fruits cv.Red Lady by pre harvest spray of $CaCl_2$@ 1.0%at 20 days before harvesting and post-harvest dipping in $CaCl_2$@ 1.0 % for 5minutes.

Post-harvest treatments

Premlata (2009) revealed that papaya fruits cv. Red Lady dipped in GA_3 @ 100 ppm for 5 minutes, along with wrapped in butter paper and stored at 12±1˚C at 80 %RH recordedthe highest shelf life (19.99 days).

Ghadage (2011) found minimum physiological loss, respiration rate and maximum shelf life (10.33 days) and days taken to colour change (5. 67 days) of papaya fruit cv. Red Lady when dipped in $CaCl_2$ 3.5 % for 10 minutes and dipped in8% wax for 15 minutes.

Sai Lakshmi Marpudi*et al.* (2011) recorded maximum fruit firmness up to 15 days by dipping of fruits Local cultivarin Papaya Leaf Extract Aloe Gel (PLEAG) for 15 minutes.

Yadav *et al.* (2014) recorded the highest TSS, ascorbic acid, total sugar and lowest acidity in fruits of Madhubindhu cultivar by dipping them in GA_3 @ 15ppm for 5 minutes.

Rashid *et al.* (2015) investigated that irradiation (0.08 kGy) and hot water (50 ºC for 10 minutes) treatments recorded the minimum disease incidence and maximum shelf life (34.23 days) in mature green fruits of Frangi cutivars.

Srinu *et al.* (2017) at Hyderabad observed the highest shelf life (15.32 days), minimum physiological loss in weight and higher fruit firmness by dipping the fruits of Red Lady cultivarfor 5 minutes in $CaCl_2$@ 3.0 %.

Bhanushree *et al.* (2018) recorded lowest change in peel colour i.e. 21.5 Δ E(ambient condition) and 21.23 Δ E (cold storage) respectively, during 9 and 23 days of storage of Red Lady fruits coated with chitosan @ 3%.

Krishna *et al.* (2018) reported that dipping of Arka Prabhat fruits in $CaCl_2$ @ 2% + citric acid 5 % for 5 minutes improves TSS (15.29 %), total sugar (15. 32 %) and decreases spoilage (10 %).

Arundathi *et al.* (2019) concluded that the fruits of Red Lady wrapped in paddy straw, gave the maximum β-carotene content and shelf life (11.83 days).

Shabina *et al.* (2019) at Tamil Nadu explored that fruits of CO.8 variety packed in LDPE (Low Density Polyethylene) recorded minimum physiological loss in weight in both, ambient and refrigerated storage conditions.

Conclusion:

Pre and post-harvesttreatments increases the quality and shelf life of fruits. Pre harvest treatments like foliar sprayof borex (0.2%), $ZnSO_4$(200mg/l), $FeSO_4$(200mg/l),carbendazime (0.05 %), fertilizer application in combination with spraying ofnovel organic liquid nutrient (1 %)and harvesting at the colour break stage was found effective for better quality and prolonging the shelf life of papaya. Post-harvest treatment of hot water and irradiation (Cobalt -60), dipping of fruits in GA_3 (100 ppm), wax solution (8 %), $CaCl_2$ (2-3 %), wrapping with shrink wrap, butter paper, and paddy straw had positive effect on quality and shelf life. Packaging with LDPEand low temperature storage can enhance the shelf life and quality of papaya fruit as well as reduce physiological loss in weight and spoilage.Pre and post harvest application of calcium compounds also improved the quality and storage life.

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POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Lalitha K. R.	**Course : FSC 591 (1+0)**
Reg. No. : 2020218017	**Date : 18/10/2019**
Major Guide : Dr. R. V. Tank	**Time : 03.00 to 04.00 p.m.**
Minor Guide : Dr. S. L. Chawla	**Venue : Swami Vivekananda Hall**

Mutation studies in fruit crops

Mutation is sudden heritable changes in the DNA sequence that are not derived from genetic segregation or recombination. Perennial nature, long juvenile phase, heterozygosity, sexual incompatibilities *etc* in fruit crops limits their improvement through conventional breeding. Since, mutations bring about variation hence, they provide the ultimate basis for evolution of new forms, varieties or species. Spontaneous mutation occurs at a very low frequency *i.e.* 1 in 10 lakhs or 10^{-6}. In fruit crops, spontaneous bud mutations are more commonly called as bud sports. The occurrence of a large number of natural bud sports in citrus, mango, grapes *etc*. made the fruit breeders interested to breed through induced mutation. Mutations may result into deletion, inversion, translocation of chromosome and nucleotide base substitutions. Mutation can be induced artificially with the help of various physical and chemical agents which are called mutagens. Most commonly used physical and chemical mutagens are gamma rays and EMS (Ethyl Methane Sulphonate), respectively. Doses inducing 25 to 50 % lethality (LD_{25}-LD_{50}) among mutated plants will result in the highest mutation rates.

Brief Review of Research Work

Mandarin

Singh *et al.* (2019) observed that less bold seed number was observed in mutant-5 (30 Gy gamma irradiation) followed by mutant-1 whereas, the highest bold seed number per fruit was recorded in parent variety Kinnow. They also observed that maximum fruit weight was in mutant-4. One of the low seeded mutants (Mutant-1) was released as a new variety named PAU Kinnow-1.

Papaya

Ramesh *et al. (*2019) observed that although highest germination was seen in control but 250 Gy and 500 Gy gamma irradiation was superior with respect to all the morphological characteristics like plant height at fruiting (cm), trunk circumference (cm), canopy spread (cm), height to first flowering (cm), number of leaves at first flowering, number of nodes to first flowering and yield (kg/plant).

Yadav and Singh (2014) observed that physical mutagen gamma irradiation 10 kr showed positive response on fruit yield of papaya.

Grape

Munir *et al.* (2015) found that gamma irradiated mutants showed better response in terms of growth parameters as compared to chemical mutagens. Treatment with sodium azide gave better response at low concentrations but with an increase in sodium azide concentration resulted in browning of the explants.

Rayan *et al.* (2014) found that vegetative growth parameters (plant height, shoot thickness, number of leaves, root length, root thickness, number of roots) was highest at 4 Krad gamma rays. However, concerning survived plants percentage and acclimated plants percentage, the effect of gamma rays and sodium azide was lower than control.

Guava

Singh *et al.* (2018) found that the maximum sprouting occurred in control and minimum in 10 Gy treatment after 40 days of budding. The same trend of sprouting was noticed after 50, 60, 70, 80 and 90 days of budding. The buds treated at 40, 50, 60 and 70 Gy resulted in no sprouting even after 90 days. They also observed that there was a decrease in plant height with increase in gamma ray doses. Maximum number of branches and leaves were noticed in 20 Gy, maximum leaf size (length and breadth) and stomatal size (length and breadth) among treatments was observed in control.

Zamir *et al.* (2009) found that the germination percentage decreased with the increase in radiation. They also found the highest number of fruits/plant at dosage 0.15 KGy, maximum fruit circumference at 0.05 KGy, fruit weight at 0.2 KGy, less seeds/fruit and less seed weight at 0.30 KGy.

Banana

Saraswathi *et al.* (2016) identified 3 putative resistant mutants (NRCBRM- 7, 15 and 17) which are free from both the external and internal symptoms of fusarium wilt disease. They also observed that external scoring was uniformly 1 (healthy) in all the resistant mutants as against 4 (severe chlorosis, severe wilting, petiole buckling and dwarfing of newly emerged leaf) in the susceptible mutant.

Rayis and abdallah (2014) observed the frequency of variants was highest in 40 Gy follow/ed 30 Gy and 20 Gy, while it was very low in 60Gy expected for plants stature and bunch character.

Jamun

Barman *et al* (2015) observed that, the interaction between colchicine at 0.1 % concentration with coco-peat substrate resulted in less days taken for germination and higher germination percentage.

Conclusion

Mutation breeding plays a vital role in breeding programme for giving quick results than other methods. It is a suitable technique to improve both sexual and asexual propagated crops. It has great potential of improving fruit crops for changing the genetic structure of plant *viz.,* earliness, dwarfness, seedlessness, resistance or tolerance to biotic and abiotic stress and other quality parameters. It is one of the approaches to create variability through novel recombinations using both chemical and physical mutagens. Gamma irradiated mutants show better response in terms of growth parameters as compared to chemical mutagenesis. In many vegetatively propagated crops, mutation induction in combination with *in vitro* culture and other methods of plant biotechnology may be the only effective method for their improvement.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Patel Arpitaben Maheshbhai**	**Course :**	**FSC 591 (1+0)**
Reg. No.	**: 2020218028**	**Date**	**: 18/10/2019**
Major Guide	**: Dr. B. N. Patel**	**Time**	**: 04.00 to 05.00 p.m.**
Minor Guide	**: Dr. N. B. Patel**	**Venue**	**: Swami Vivekananda Hall**

A chronic problem of fruit cracking in fruit crops

Fruit cracking is a physiological disorder common in many fruit crops. This may be occurring due to wind, heavy irrigation or rain after long dry spell, varietal character, temperature, in appropriate level of moisture at maturity stage, and micro nutrient deficiency. The pericarp or skin of the fruit develops cracks mainly because the fruit contents absorb water faster than the expansion of the fruit wall. Fruit cracking is a serious problem in many fruits and the severity of damage varies with the cultivar. Fruit crops which have major loss due to fruit cracking are cherry, lemon, litchi, grapes and pomegranate (up to 75 %). All cracked fruits loose their value for fresh market and they are use for processing only if they are not affected by fungus.There is a specific difference between cracking and splitting *i.e.* cracking is expressed as fractures in the cuticle or peel while splitting is a type of cracking in which cracks penetrate deep into the fruit pulp. There are three types of cracking occurs in most of fruit crops 1. Peel cracking 2.Star cracking 3.Splitting. Different factors contributing fruit cracking are biotic factors, varietal factors, peel abnormalities, environmental factors, cultural factors and internal factors. Fruit cracking can be reduced by moisture management, foliar nutrient spray, fertilization and use of growth regulators.

Brief Review of Research Work

Pomegranate

Pravitha Sahu and Ankita Sahu (2018) recorded thatwhen plants grown under CBOC and given foliar application of CPPU at 5 ppm in mid-March and mid-May gave higher fruit set (24%) and reduced fruit cracking (2.8%) in pomegranate cv. Kandhari.

Ahmed *et al.* (2014) noticed that salicylic acid and all nutrient together gave minimum fruit splitting (4.3 and 4.2 %) and highest value of marketable yield/tree (121.4 and 129.6 kg) when four foliar applications at the 1st week of March (growth start setting), April, May and June was given during 2012 and 2013 seasons, respectively in pomegranate cv. Manfaulty at Horti. Research Institute, Egypt.

Sheikh and Manjula (2012) reported that pre-harvest spray of 0.2% boric acid resulted in the lowest percentage of cracked fruits (3.33%) and highest yield (34.05 kg/plant) in pomegranate cv. Ganesh.

Wafa (2014) concluded that significantlylowest fruit cracking (1and 1%) and sun burnt fruits (2and 2%) were recorded in fruits of pomegranate cv. Wonderful whenbagged with prgmen bag in both seasons, respectively as compare to control.

Litchi

Singh *et al.* (2017)found that minimum fruit cracking (4.50%) was recorded in the treatment T_7(urea 1% + borax 1%)which was applied in form of two spray, first in the month of April and second in month of May and maximum fruit cracking (7.2%)was found in control.

Kaur (2017) noticed that 0.4 % borax was most effective in increasing fruit setting (78.15%), fruit retention (60.17 %), fruit yield (158.73 kg/tree) and reducing fruit cracking (2.0 %) when sprayed on new growth flushes before initiation of inflorescence litchi cv. Dehradun.

Citrus

Bhatt *et al.* (2016) noticed that the maximum fruit set (3.12%) and minimum fruit drop (33.58 %) was obtained with the treatment GA_3 (20 ppm) and minimum fruit set (1.54 %) and maximum fruit drop (56.21 %) with control. The minimum fruit cracking (8.32 %) was observed under treatment NAA (50 ppm) in lemon (*Citrus limon*Burma.) cv. Pant Lemon-1 which was statistically at par with GA_3 20 ppm and maximum fruit cracking (13.24) was observed under control.

Khehra and Bal (2014) concluded that the spray of NAA (40 ppm) + K_2SO_4 (8%) and borax (1 %) proved to be most effective for minimizing the fruit cracking in lemon cv. Baramasi in two consecutive years of research trial, where it was recorded to be 13.84 % in first year and 11.64 % in second year.

Sandhu and Bal (2013) found that the T_6 (Irrigation at 20% ASMD and mulching) proved to be most effective treatment for lemon cv. Baramasi, by registering minimum fruit cracking (7.21 % and 8.28 %) during 2006 and 2007, respectively.They also studied the effect of organic and inorganic nutrient sources on the fruit cracking in same crop and observed that minimum percentage of fruit cracking was recorded in treatment T_7 [FYM (94 kg/tree) + Inorganic fertilizer (438 g/tree N) + Azotobacter (18 g/tree)]during two years of research study giving values 18.89 and 19.93 %, respectively while maximum extent of fruit cracking was evidenced in T_1(control) to the tune of 35.29 % during first trial year and 36.30 % in second year.

Mango

Rathore and Pal (2016) observed that, out of 100 fruits the minimum fruits(3) were found infested with disease in fruit of mango cv. Mallika when bagged with blue paper bag at the time of harvesting. Likewise, insect infested fruit (2) and cracked fruit (0) were also found minimum in the same treatment

Saran and Kumar (2011) screened different cultivars of mango with respect to fruit cracking and they noted that minimum fruit cracking percentagewas observed in chausa (0.20 %)while maximumfruit cracking percentage (4.12%)was observed inDashehari.They also studied effect of boron application on the incidence of fruit cracking in mango cv. Dashehari and revealed that minimum fruit cracking (0.47 %) observed with foliar spray of boron 0.10 % in mango cv. Dashehari.

Grape

Ramteke *et al.* (2018) revealed that minimum cracking (4.08 %) was observed when grape bunches were sprayed thrice at an interval of 10 days in veraison stage withSilixol(4ml/l) + Cagluconate (2g/l) + Boron (0.5 g).Whereas, Bunch spray with Silixol (4 ml/l) gave maximum yield (20.43 t/ha) in grapes cv. Fantasy Seedless.

Cherry

Yildirim and Koyuncu (2010)studied that the effect of GA_3 doses on fruit cracking rate in the '0900 Ziraat' sweet cherry cultivarat Turkey and they revealed that minimum cracking index (5.60 %) was observed with application of GA_3 20 ppm which when sprayed at straw-yellow stage

Conclusion

From the forgoing discussion, it can be concluded that fruit cracking severely affects the quality fruit production. In pomegranate, plants grown under CBOC with foliar application of CPPU (5 ppm), salicylic acid (100 ppm) and all nutrient, spray of 0.2 % boric acid and fruit bagged with prgmen bag reduced fruit cracking, improved fruit quality and increased yield. Foliar application of urea 1 % + borax 1 % gave minimum fruit cracking and application of 0.4 % borax was most effective in increasing fruit setting, fruit retention, fruit yield and reducing fruit cracking in litchi.In citrus, foliar application of GA_3 (20 ppm), NAA (50 ppm) and NAA (40 ppm) + K_2SO_4 (8 %) + borax (1 %), Irrigation at 20 % ASMD + mulching and application of FYM (94 kg/tree) + Inorganic fertilizer (438 g/tree N) + Azotobacter (18 g/tree) minimizing the fruit cracking as well as improve fruit quality and yield attributes. Foliar application boron 0.10 % and bagged with blue paper bag minimize fruit cracking in mango. The mango var. Chausa was less susceptible to fruity cracking as compare to Dashehari. In grape, bunch spray of Silixol (4ml/l) + Cagluconate (2g/l) + Boron (0.5 g) reduced fruit cracking and Silixol (4 ml/l) improve yield. The foliar application of GA_3 20 ppm gave minimum cracking index in cherry.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Patel Jollyben Jayeshbhai**	**Course :**	**FSC 591 (1+0)**
Reg. No.	**: 2020218030**	**Date**	**: 19/10/2019**
Major Guide	**: Dr. T. R. Ahlawat**	**Time**	**: 10.00 to 11.00 a.m.**
Minor Guide	**: Dr. Sanjeev Kumar**	**Venue :**	**Swami Vivekananda Hall**

Effect of seaweed extract on production and quality of fruit crops

Nowadays, application of biostimulants has become an alternative approach to minimize the use of chemical fertilizers.Seaweeds are marine macrophytic algae, a primitive type of plants lacking true roots, stems and leaves. Most of seaweeds belong to one of three divisions - Chlorophyta (Green algae), Phaeophyta (Brown algae) and Rhodophyta (Red algae). Seaweeds are used in the preparation of health food, medicines, pharmaceuticals, textiles, fertilizers, animal feed *etc.*in many countries. India is bestowed with a coastline of more than 17,000 km embracing 821 species of seaweeds. Seaweed extracts are marketed as liquid fertilizers and bio-stimulants because they contain multiple growth regulators such as cytokinins, auxins, gibberellins and various macro and micronutrients necessary for plant growth and development (Mahima Begum *et al*.,2018). Moreover, it helps in promoting the growth of beneficial soil microorganisms, developing tolerance to environmental stress and enhancing antioxidant properties. It was therefore felt worthwhile to review the application of seaweed extracts in the production of fruit crops.

Review of research work

Mango

Ahmed *et al.* (2013[a]) observed that application of 60 % inorganic N (1.8 kg ammonium nitrate/tree/year) + four sprays ofseaweed extract at 2 % increased no. of fruits/tree (302.0), yield/tree (67.5 kg), fruit weight (223.6 g),fruit length (10.66 cm) and fruit width (7.75 cm)as compared to other treatments. The same treatment resulted in maximum TSS (18.3 °Brix), total sugars (17.2 %), reducing sugars (9.1 %) and minimum total acidity (0.229 %).

Mohamed and El-Sehrawy (2013) recommended three sprays of seaweed extract at 0.2 % in mango cv. Hindy Bisinnara for higher yield/tree (211.0 kg), fruit weight (191 g), TSS(21.5 °Brix), total sugars (16.6 %), vitamin C content (57.0 mg/100 ml juice) and minimum total acidity (0.210 %).

Ahmed *et al.* (2015) noticed maximum fruit weight (277.0 g and 281.0 g), TSS (15.3 °Brix and 15.7 °Brix),total sugars (12.3 % and 12.3 %), reducing sugars (4.2 % and 4.3 %) and minimum total acidity (0.201 % and 0.183 %) during 2013 and 2014 seasons, respectivelywithfour sprays of seaweed extract (8%)only.

Banana

Roshdy (2014) recommended the use of potassium silicate in combination with seaweed extract both applied four times at0.05 % in Grand Naine variety of banana for higher bunch weight (29.7 kg), average hand weight (2.05 kg), finger weight (98.9 g), finger length (24.1 cm), finger diameter (10.7 cm), TSS (19.5 °Brix), total sugars (17.0 %) and minimum total acidity (0.095 %) over control treatment.

Papaya

Dharmishtha Patel (2019) recorded higher no. of fruits/plant (36.07), fruit weight (1.81 kg), fruit diameter (17.88 cm), fruit yield (161.48 t/ha) in papaya when sprayed with potassium silicate (0.4 %) along with seaweed extract at 4 %. However, maximum TSS (13.08 °Brix), total sugars (10.30 %), reducing sugars (8.86 %) and ascorbic acid (50.50 mg/100g) was recorded by the treatment combination comprising Ortho silicic acid 0.2 % + seaweed extract at 2 %.

Orange

Fornes *et al.* (2002) recorded highest yield (90.1 kg/tree) and no. of fruits/tree (416) with the application of seaweed extract at 0.30 % in Navelina orange, whereas, highest yield (86.1 kg/tree) and no. of fruits/tree (1013) were obtained by using seaweed extract 0.15 % and GA_3 6 mg/l in de Nules clementine.

Ahmed *et al.* (2013[b]) observed maximum no. of fruits/tree (209.0and 210.0), fruit weight (195.0 g and 199.0 g), yield/ tree (40.6 kg and 41.8 kg), TSS (14.6°Brix and 14.5°Brix),total sugars (9.4 % and 9.9 %), reducing sugars (5.3 % and 5.4 %) and minimum total acidity (1.202 % and 1.199 %) during 2011 and 2012 seasons, respectively with four times spray of three extracts namely roselle at 0.2 %, turmeric at 0.1 % and seaweed at 0.2 %.

Grape

Khan *et al.* (2012) identified that a combined application of 0.5 ml/l mixture of amino acids and seaweed extract at flowering + fruit setting + one month after fruit setting increased no. of bunches/cane (4.2), rachis length (17.94 cm), no. of berries/bunch (478), berry size (0.50 cm^2) and 100 berry weight (115.5 g) as compared to all other stages of application.

Gad El- Kareem and Abd El- Rahman (2013) recordedhighest average cluster weight (464.0 g and 475.0 g), average berry weight (2.87 g and 2.84 g) and lowest percentage of short berries (3.7 % and 3.5 %) with a mixture containingroselle extract at 0.2 %, salicylic acid at 100 ppm and seaweed extract at 0.2 % during 2011 and 2012 seasons. They also reported maximum TSS (21.4°Brix and 21.7 °Brix), total sugars (19.0 % and 19.5 %) and minimum total acidity (0.501 % and 0.511 %) in the same combination.

Strawberry

El-Miniawy *et al.* (2014) noticed thehighest average fruit weight (12.01 g) by the application of seaweed extract at 1.0 ml/l and fruit firmness (263.40 g/cm^2)at 2.0 ml/l when sprayed twice.Whereas, maximum total yield/ plant (464.75 g), SSC (10.00 °Brix)was recoreded with seaweed extract at 2.0 ml/l when sprayed thrice.

Mulberry

Pappachan *et al.* (2017) found that foliar application of seaweed extract from *Ascophyllum nodosum*(0.5 ml/l) at 21, 28 and 35 days after pruning enhanced protein content (76.04 mg/g) and plant height (76.04 cm) when compared to control.

Date-palm

Badran (2016) observed that maximum bunch weight (22.17 kg and 22.95 kg), fruit weight (22.95 g and 22.68 g), fruit length (5.57 cm and 5.63 cm), fruit diameter (2.72 cm and 2.78 cm), total yield/palm (176.00 kg and 176.58 kg) and quality parameters like TSS (28.20 °Brix and 28.57 °Brix), total sugars (26.63 % and 26.11 %), reducing sugars (20.26 % and 20.40 %), non-reducing sugars (6.37 % and 5.71 %) and minimum acidity (0.18 % and 0.19 %)during 2014 and 2015 seasons, respectively with three times sprays of Oligo-x seaweed extract (4 %)+ Silicon (0.5 %) in date palm cv. Zaghloul.

Omar *et al.* (2017) reported that highest bunch weight (17.27 kg), fruit weight (16.92 g), flesh weight (14.87), fruit yield (172.67 kg/tree) reducing sugars (37.40 %), total sugars (55.08 %) and fruit moisture (18.07 %)with foliar application of seaweed extract (2 %) in date palm cv. Sukary.

Kiwi fruit

Chouliaras *et al.* (1997) observed that increased fruit length and fruit weight with spraying (2 %) seaweed extract at 5 and 10 days after petal fall (DAPF) in kiwi fruit.

Conclusion

From the foregoing discussion, it can be concluded that seaweed extract improves yield attributesand quality parameters of fruit crops. In mango, application of60 % inorganic N (1.8 kg ammonium nitrate/tree/year) along with spraying SWE at 2 % improve yield, yield attributes as well as fruit quality. The application of SWE at 0.2 % and 8 % also found beneficial for improving the fruit quality in mango. Spraying of banana plants four times with a mixture of potassium silicate and SWE both at 0.05 % enhance the physical as well as chemical properties. In papaya, spraying 0.4 % potassium silicate and SWE 4 % improve yield and it's attributes as well as application of Ortho silicic acid 0.2 % and SWE 2 % also found to be beneficial for improving chemical properties. In orange, sole application of SWE at 0.3 % as well as combined application of SWE (0.15 %) and GA_3 (6 mg/l) help to enhance yield and yield attributes. The application of SWE at 0.2 % along with 0.2 % roselle and 0.1 % turmeric increase the yield and quality of orange fruits. The application of 0.5 ml/l mixture of amino acids and SWE at flowering + fruit setting + one month after fruit setting as well as a mixture containing roselle extract at 0.2 %, salicylic acid at 100 ppm and SWE at 0.2 % improve the berry quality of grape. In strawberry, application SWE at 1 ml/l twice increase the fruit weight, while application of SWE at 2 ml/l for thrice improve the yield and fruit quality. The application of SWE @ 0.5 ml/l at 21, 28 and 35 days after pruning in mulberry and 2 % SWE at 5 and 10 days after petal fall (DAPF) stage in kiwifruit was found beneficial.The combined application of Oligo-x seaweed extract at 4 % with Silicon at 0.5 % thrice as well as sole application of SWE at 2 % improve the yield, yield attributes and quality of date-palm fruit.

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NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Patel Khushbuben Ashokbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020218032	**Date : 05/10/2019**
Major Guide : Dr. A. K. Pandey	**Time : 11.00 to 12.00 a.m.**
Minor Guide : Dr. Sanjeev Kumar	**Venue : Swami Vivekananda Hall**

Use of hi-tech pre-shooting and post-shooting horticultural technologies in banana

Hi-tech horticulture is defined as "Any horticultural technology, which is modern, less environment dependent, capital intensive and has the capacity to improve the productivity and quality of crop". Hi-tech intervention of pre-shooting and post-shooting technologies like tissue culture, high density planting, bio-fertilizer, drip irrigation, fertigation, plant growth regulators, mulching, sleeving of banana bunch and bunch feeding. India is global leader in banana productionhowever, shrinking land holding capacity, less productivity and other quality characters need to addressed through hi-tech interventions. Since the export-import scenario is changing at a faster rate with the liberalization of global market under the WTO agreement, India needs to increase its production manifold. Therefore, intensive cultivation of banana with hi-techproduction inputs is the necessity of the day to achieve target result.

Brief review of research work

Tissue culture

Badgujar *et al.* (2005) revealed maximum pseudostem height (164.63 cm), pseudostem girth (63.90 cm), no. of leaves/plant (36.42), no. of hands/bunch (8.14), no. of fingers/bunch (137.11), length of fingers (20.17 cm), girth of fingers (11.29 cm), bunch weight (13.07 kg) and minimum days to flowering (339.06) and days to harvesting (430.68) in tissue culture plant.

Bhanusree *et al.* (2015) observed maximumpseudostemheight (219.76 cm), pseudostemgirth (73.95 cm), no. of leaves (23.37), leaf length (187.76 cm), leaf area (1.01m^2), bunch length (81.25 cm), bunch diameter (36.34 cm), bunch weight (25.38 kg), finger weight (330.88 g), fingers/bunch (156.13), yield (63.44 t/ha), benefit cost ratio (2.25) and minimum days to shooting (350.13 days), days taken from shooting to maturity (98.00 days) and crop duration (448.13 days) in tissue culture plant.

High density planting

Athani *et al.* (2009) recorded maximumyield (28.00 t/ha) and minimum no. of sucker production/plant (1.85) in plant spaced at 1.0 × 1.2 × 2.0 m while maximum bunch weight (6.72 kg/plant)in plant spaced at2.4 × 2.4 m.

Bio-fertilizer

That maximumno of hands/bunch (9.15), finger weight (156.02 g), bunch weight (20.87 kg) and yield (64.41 t/ha) in plant supplied with 200 g each N and K_2O in form of 10 kg FYM + 1.25 kg neem cake + 5 kg vermicompost + 1.75 kg wood ash and 50 g *Azospirillum*, 50 g PSB and 50 g*T. harzianum*as well as 25 g VAM in combination of triple green manuring as inter crop with sunhemp, cow pea and cow pea (Anonymous, 2016).

Chhuria *et al.* (2016) revealed maximum pseudostem height (185.24 cm), pseudostem girth (59.60 cm), total no. of leaves (38.73), days to harvest after shooting (100.91), weight of bunch (24.86 kg), no. of hands/bunch (9.45), no. of fingers/bunch (152.40), pulp:peel (4.2), ascorbic acid (12.33 µ g/ml), weight of finger (133.67 g), length of finger (22.31 cm), yield (76.72 t/ha) in 100 % RDF (300:100:300 g NPK/plant) +125 g *Azotobacter*+ 125 g*Azospirillum*+ 125 gPSB.

Drip irrigation

Ruchi Sharma and Kispotta (2016) recorded maximum plant height(163.3 cm),plantgirth (68 cm), average no. of leaves (35 per plant), averagebunch weight (35 kg), yield (50 t/ha) and minimum harvesting period (400 days) under drip irrigation compared to flood irrigation, while saved 38.82 % water.

Fertigation

That maximum pseudo stem height (2.16 m), pseudostem girth (72.57 cm), no. of leaf (26.56), no. of hands/bunch (9.85), no. of finger/bunch (161.29), bunch weight (23.23 kg) and yield (71.70 t/ha) and minimum flowering days (320.45) and maturity days(410.56) in100 % recommended dose of N (300 g/plant) and K_2O (200 g/plant) through drip (Anonymous, 2015).

Plant growth regulators

That maximum fingers/bunch 180.77 in 250:90:250 g NPK/plant and 178.53 in 2,4-D 10 ppm spray, bunch length 84.57 cm in 250:90:250 g NPK/plant and 83.00 cm in 2,4-D 10 ppm spray, bunch weight 23.52 kg in250:90:250 g NPK/plantand 23.92 kg in2,4-D 10ppm sprayand yield 72.58 t/ha in250:90:250 g NPK/plant and 73.82 t/ha in 2,4-D 10ppm spray (Anonymous, 2015).

Rajni Rajan *et al.* (2017) recordedmaximum bunch length (96.28 cm), bunch girth (128.53 cm), finger length (24.50 cm), finger girth (15.85 cm), finger weight (225.65 g), weight of third hand (4.01 kg), bunch weight (32.96 kg) and fruit yield (114.46 t/ha) in plant sprayed with brassinosteroid @ 2.0 mg/l.

Mulching

Eid and El-kholy (2018) observedmaximum bunch weight (23.22 kg and 22.22 kg) and yield (20.90 t/fed and 24.68 t/fed) in 2015 and 2016, respectively in black polyethylene mulch.

Sleeving

Sarkar *et al.* (2016) revealedmaximum bunch weight (16.97 kg), fruit weight (105.79 g), yield (43.50 t/ha), net profit (Rs.374543.21/ha) and minimum shooting-harvest interval (124.79 day) and no. of fruits infested by scarring beetle (1.50 %) in bunch cover than control.

Santosh *et al.* (2017) recorded maximum bunch weight (19.98 kg), finger girth (13.75 cm), yield (50.88 t/ha), TSS (23.25 ◦Brix), reducing sugar (12.58 %), and minimum days to harvesting (323.08 days), no. of fingers/hand (17.83) and fruit firmness (80.22 N) in bunch cover than without cover.

Bunch feeding

Garasangi *et al.* (2018) observed maximum bunch weight (13.20 kg), yield (14.66 t/ha), green life (12.67 days), shelf life (9.00 days) and minimum physiological loss in weight (15.34 %)through bunch feeding with cow dung slurry 500 ml + K_2SO_4@20 g.

Conclusions

It is inferred from the foregoing discussion thathi-tech pre-shooting and post-shooting technology*viz.*,use of tissue culture plant as planting material, high density planting, biofertilizer, drip irrigation, fertigation, plant growth regulators, mulching by black polythene mulch, sleeving of bunch by plastic bag and bunch feeding increase yield and quality of banana. Where, high density planting at spacing of 1.0 × 1.2 × 2.0 m as paired raw system, biofertilizer 200 g each N and K_2O (in form of 10 kg FYM + 1.25 kg neem cake + 5 kg vermicompost + 1.75 kg wood ash) + VAM (25g) + *Azospirillum*(50 g) + PSB (50 g) + *T. harzianum* (50 g) + triple green manuring- sunhemp + cow pea + cow pea as inter crop, 100% RDF (300:100:300 g NPK/plant) + 125 g *Azotobactor* + 125 g *Azospirillum* + 125 g PSB,fertigation with 100 % recommended dose of N (300 g/plant) and K_2O (200 g/plant) through drip, plant growth regulatorsbrassinosteroid @ 2.0 mg/l sprayed twice once at complete opening of inflorescence and other at 20 days of opening, 2,4-D 10 ppmspray five days after last hand opening, bunch feeding with cow dung slurry 500 ml + K_2SO_4@ 20 g hasincrease the yield and quality of banana.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Shailaja H. K.	**Course : FSC 591 (1+0)**
Reg. No. : 2020218045	**Date : 19/10/2019**
Major Guide : Dr. B. M. Tandel	**Time : 09.00 to 10.00 a.m.**
Minor Guide : Dr. S. T. Bhatt	**Venue : Swami Vivekananda Hall**

Effect of temperature on mango production

Drastic changes in climatic variables like temperature, rainfall, humidity, wind speed, hail, frost *etc*. have affected the fruit production. Among them temperature plays a very important role in determining yield and productivity of fruit crops. Adverse effect of change in temperature (lower and higher) can be noted during vegetative and reproductive growth stages in various fruit crops. Mango is one of the most widely cultivated and popular fruit crop among tropical and subtropical fruit crops, due to its high palatability, excellent taste, flavour and exemplary medicinal and nutritional values it is said to be the king of tropical fruits. Temperature is the most significant environmental factor that influences commercial mango production by affecting the frequency, intensity, duration at all stages of growth especially during flowering. These effects are either due to direct injuries or due to reduced activity of enzymes and disturbed metabolic processes. Rise in temperature above 35 ˚C during floral induction period progressively delays flowering and subsequently expose the emerging flower panicle to high temperature resulted in less number of perfect flowers, poor fruit set and decreased productivity of mango (Salvi *et al*., 2013)

Review of Research Work

Effect of temperature on vegetative growth

Whiley *et al*. (1989) observed rise in temperature increased the average growth of mango cultivars. Distribution of dry matter from new growth was mostly to the roots at the lowest temperature (95 % at 10/15 ˚C) and to the leaves (58 % at 30/25 ˚C). Temperature also affected the concentration of starch in the woody tissue of rootstock trunks at the end of 20 weeks.

Effect of temperature on flowering and yield

Shu and Sheen (1987) revealed that axillary flower induction was greatest on the mango trees subjected to the low temperature treatment of 19/13 ˚C for two or more weeks. The subsequent temperature following one week exposure at 19/13 ˚C also influenced the number of axillary buds to develop. A negative relationship existed as the number of axillary buds increased as the temperature decreased.

Shu (1999) conducted an experiment to study the effect of temperature on flowering and fertilization in mango and reported that warm temperature (31 ˚C/25 ˚C) hastened the growth rate of panicles and flowers, shortened flowering duration and life span of individual flower as compared to low temperature (25 ˚C/ 19 ˚C). Warm temperature decreased the number of hermaphrodite and male flowers but increased the rate and percentage of anther dehiscence and fertilization.

Sukhvibul *et al.* (2005) revealed that the exposure to low temperature (20/10 ˚C) for 3 to 4 days after hand pollination significantly increased the nubbin fruits, in which embryos aborted at some stage during early fruit development. Cultivars 'Nam Dok Mai' followed by 'Kensington' were the two most sensitive to embryo abortion while only few nubbin fruit were set in 'Irwin'.

Patel *et al*. (2015) suggested that low temperature during anthesis resulted to low fertility of pollen grain which produced seedless fruit. All the cultivars showed higher fruit setting at grain stage, pea stage, marble stage and harvesting stage when anthesis during minimum temperature above 12 ˚C *i.e.* phase- II (flower emergence after 31st Jan-2012 and anthesis before 19 to 25th Feb-2012), whereas flowers induced in phase-I (flower emergence before 31st Jan-2012 and anthesis during 5 to 11th Feb-2012) had shy fruit set.

Rajatiya (2018) studied the effect of weather parameters and revealed that fruit drop from grain to marble stage was negatively correlated with temperature (maximum, minimum, day and night) and sunshine hours whereas positive correlated with wind speed and relative humidity. Fruit yield per tree was positively correlated with temperature and sunshine hours and negatively correlated with wind speed and relative humidity.

An experiment was conducted at NAU, Navsari to study the effect of climatic variables on flowering mango Cv. Kesar. It is revealed from result that the panicle length, width and thickness were positively correlated with wind speed, evaporation, minimum temperature and humidity whereas negatively correlated with maximum temperature and humidity. Number of hermaphrodite flowers was positively correlated with maximum temperature and humidity also wind speed whereas negatively correlated with minimum temperature and humidity also evaporation. Number of male flowers was positively correlated with minimum temperature and humidity also evaporation and negatively correlated with maximum temperature and humidity also wind speed (Anon., 2019).

Effect of temperature on fruit quality

Rajput (2012) recorded early maturation (10 to 12 days) in all varieties of mango at Navsari in comparison to Paria due to availability of more mean daily heat units. Total heat units required for maturation was maximum in Neelphonso as compared to other varieties. The maximum fruit weight and volume was obtained at Paria location due to longer duration of maturity and less mean daily heat units.

Gill *et al.* (2017) revealed that fruit ripening changes was found to be slower at low temperature (20 ˚C and 25 ˚C) than room temperature (29.6 - 33.1 ˚C). The sensory qualities of mangoes were maintained for longer duration when ripened at lower temperature and they were more acceptable than fruits ripened at room temperature.

Effect of temperature on disorders

Katrodia and Sheth (1988) revealed that half an hour (12.30 to 13.00 hr) of Alphonso fruits to sun exposure treatment could not produce any external as well as internal symptoms of damage. But one hour (12.30 to 13.30 hr) sun exposure could produce 100 per cent occurrence and 75 per cent intensity of damage in fruits.

Vasanthaiah *et al*. (2008) studied artificial induction of internal breakdown in fruit by increasing temperature during ripening and reported that prolonged exposure at 43 ˚C for 18 to 114 hr increased spongy tissue occurrence from 27 to 90 per cent.

Effect of temperature on metabolic processes

Masahiko *et al*. (1996) observed that increasing temperature decreased net assimilation rate and stomatal conductance; and increased transpiration rate and internal CO_2 concentration in two year old seedlings of mango.

Remedies

Salvi *et al*. (2013) reported that fruit drop and spongy tissue were reduced up to 5.7 per cent by intercropping with various vegetables, tubers and other biennial crops and supplementary irrigation of 200 litres per plant at weekly interval.

Malshe *et al*. (2017) revealed that bagging of Alphonso fruits with PP non-woven fabric at marble stage which were retained up to 75 days or bagging at egg stage and retained up to harvest had lowest incidence of spongy tissue.

Conclusions

From the foregoing discussion, it is concluded that rise in temperature increased the rate of vegetative flush development, whereas the low temperature (19/13 ˚C for 2 or more weeks) favoured the floral induction in mango. The cultivars *viz.,* Carabao, Kensington and Dashehari did not grow at 20/15 ˚C as compared to other cultivars. Warm temperature also increased the growth rate of panicles and flowers, anther dehiscence and fertilization also shortens flowering duration and life span of individual flower. Fruit drop increased with increasing wind speed and relative humidity; and decreased with increase in temperature and sunshine hours. Fruit yield increased at higher temperature and sunshine hours; and decreased with increasing relative humidity and wind speed. Heat units can be used in estimating the maturity of mango fruits. Fruits ripened at 20 ˚C and 25 ˚C had better fruit qualities than those ripened at room temperature. The fruits exposure to higher temperature increased the occurrence and intensity of spongy tissue affected fruits in field and laboratory condition.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Thejaswini K	**Course : FSC 591 (1+0)**
Reg. No. : 2020218047	**Date : 16/11/2019**
Major Guide : Dr. S. J. Patil	**Time : 11.00 to 12.00 a.m.**
Minor Guide : Dr. M. A. Patel	**Venue : Swami Vivekananda Hall**

Biochar : it's role in fruit crops growth

Crop residue management is one of the emerging problems in agriculture sector. Crop residues in fields can cause considerable crop management problems as they accumulate in surplus. Conversion of crop residue biomass into biochar and using the biochar as a soil amendment is a nascent approach and suggested as an alternative to composting and crop residue burning. Biochar is a fine-grained, carbon-rich, porous product remaining after plant biomass has been subjected to thermo-chemical conversion process (pyrolysis) at temperature (350-700 ˚C) in an environment with little or no oxygen, used as a soil conditioner. (Lehmann and Joseph, 2009). The central quality of biochar that makes it attractive as a soil amendment, as it's highly porous structure, potentially responsible for improved water retention and increased soil surface area. Taking into account the benefits of biochar in improving the soil physical, chemical, biological properties and moreover in mitigating level and ill effects of greenhouse gases. Biochar appears to be very viable option for the growth of fruit crops.

Review of research work

Grape

Schmidt *et al*. (2014) studied on biochar and biochar compost as amendments to a vineyard soil: Influences on plant growth, nutrient uptake, plant health and grape quality and reported that shoot diameter (7.48 mm) was significantly higher in the biochar-compost (8 t ha^{-1}+55 t ha^{-1}) treatment compared to control.

Apple

Eyles *et al.* (2015) studied the impact of biochar amendment on growth, physiology and fruit of young commercial apple orchard and reported that trunk girth of trees was significantly greater in the biochar + compost (47 Mg ha^{-1}+10 Mg ha^{-1}) treatment than the trees in the control by 10 % during the first year, wheras the difference in trunk girth had increased to 15 % during fourth year. While, compost application of 10 Mg ha^{-1} had no effect in any year.

Poncirus trifoliata

Changxun *et al.* (2016) studied the effect of biochar on the growth of *Poncirus trifoliata* (L.) seedlings in acidic red soil and reported that plant height, shoot diameter and more lateral branches, thus increased in the root surface area were obtained highest in the red soil (RS) + 5 % biochar (BC) treatment. While, red soil (RS) + 3 % biochar (BC) treatment significantly increased the root tips of *Poncirus* seedlings.

Passion fruit

Barros *et al.* (2017) studied the effect of biochar of sawdust origin in passion fruit seedling production and reported that activated biochar at 75 % concentration combined with commercial substrate, composed by pine bark and vermiculite (4:1) showed increased growth parameters *viz.*, fresh total biomass (169.50 g), dry total biomass (3.11 g), fresh biomass of root (71.00 g), stem (39.00 g), leaf (62.50 g) and dry biomass of root (1.37 g), stem (0.94 g), plant height and stem diameter. Whereas, the number of leaves of passion fruit seedlings were higher than other treatments in all the doses of activated biochar.

Banana

Abo-Ogiala (2018[a]) studied the impact of biochar on vegetative parameters, leaf mineral content, yield and fruit quality of Grand Naine banana in saline-sodic soil and reported that pseudostem length (283.5 cm), pseudostem girth (91.77 cm), leaf area (2.15 m^2) and yield (82.51 t ha^{-1}) were greatly increased with the application of wood sawdust biochar (WB) at the rate of 20 Mg ha^{-1} as compared to control.

Siti *et al.* (2018) studied the effect of biochar amendment on growth, nutritional properties and biochemical changes of banana (*Musa acuminata*) cv. Berangan established in an ultisol soil at vegetative stage and reported that biochar mixed thoroughly with ultisol soil at the rate of 4.5 t ha^{-1} which was equivalent to 1.8 kg / polybag (size 16 × 16 inches) improved plant growth characteristics significantly including plant height (43.25 cm), leaf area (5516.8 cm^2) as well as maximum percent increase in total leaf number (22.73 %) and total root length (239.89 %) at 12 weeks after transplanting as compared to control.

Volkamer lemon

Abo-Ogiala (2018[b]) studied the impact of biochar on growth, biochemical parameters and nutrient content of volkamer lemon (*Citrus volkameriana,* Tenx pasq.) under saline condition and reported that plants showed significant increment in dry mass, fresh mass and dry/fresh mass ratio by the addition of biochar at 0.5 and 1 v/v to the sand:peat moss (4:2) mixtures under the salt levels (100 and 200 mM of NaCl) in comparison with control. The addition of biochar also significantly decreased the reduction of water content and inhibition of growth of shoot length, root length and shoot/root ratio due to salt exposure.

Mango

Jasmitha *et al.* (2018) studied the effect of enriched biochar on growth of mango seedlings in nursery and reported that maximum germination percentage (100 %), rate of germination (1.53), seedling vigour (3100) and minimum days for first germination were observed in potting mixture containing soil, sand and biochar organic (2:1:1). Maximum increment in growth attributes *viz.*, seedling height (45.63 cm), seedling girth (7.95 mm), number of leaves (24.00) and leaf area (159.51 cm^2) at 150 days after germination were also recorded by the same treatment.

Jamun

Rakesh (2018) studied the effect of biochar, vermicompost and azotobacter on growth and development of jamun (*Syzygium cuminii* L.) cv. Goma Priyanka and reported that maximum increase in percentage of shoot parameters *viz.,* rootstock girth, scion girth, plant height, number of shoots and number of leaves per plant were recorded with the application of vermicompost at the rate of 4 kg/plant. The biochar application at the rate of 750 g/plant also showed better results of shoot parameters over control.

Conclusions:

From foregoing discussion, it can be concluded that India being a primarily agricultural country and peasantry is farmer's most dominant occupation. With only one crop rice there is a production of 34 per cent of crop residue which can be easily converted into biochar. The uses of biochar has been well proven in improving the growth performance of apple, banana, grape, *Ponicirus trifoliata*, passion fruit, volkamer lemon, jamun, mango and also can be used for quality seedlings production under good nursery practices. Biochar application to the soil helps in improving the soil physical, chemical, biological properties and also addition of biochar alleviated the negative effects of salinity stress. It improves the absorption of nutrients resulting in increasing the fertilizer use efficiency and also provides climate benefits by transferring carbon from the atmosphere to highly stable soil carbon pools. Biochar is new to modern agriculture, but it has a long history of use in many cultures. This long history of use gives assurance that biochar will provide a net benefit when added to farm soils.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Desai Yashkumar G.	**Course : FSC 591 (1+0)**
Reg. No. : 2020218012	**Date : 10/01/2020**
Major Guide : Dr. D. K. Sharma	**Time : 05.00 to 06.00 p.m.**
Minor Guide : Dr. S. S. Masaye	**Venue : Swami Vivekananda Hall**

Induction of off season flowering and fruiting in fruit crops

In humans, fruit consumption is gaining importance day by day due to health benefits. People want to consume fruits not only in growing season but also in off season. To meet the requiremet of fruits round the year and to get a good income to farmers, off season production of fruit is a boon. The very early or late season fruit fetches better price in the market. As a result, the growers tend to produce off season fruits. Fruit production is seasonal in both tropical and temperate region. At the peak season oversupply of fruits happen and during off season there is no supply at all hence, farmers can get better prize of fruits during off season. This condition is not economically sustainable as it causes sharp fluctuation in the price of fruit.

Off season fruit growing is expressed as to take the harvest time early or late than that of the normal growing season. Off season production is preferred both to meet the fruit demand of off season and to sell the products with higher prices.

Brief review of research work:

Mango:

Yeshithela *et al.* (2004) used paclobutrazol to suppress vegetative growth and improve yield as well as fruit quality of Tommy Atkins mango in Ethiopia. They recorded that application of paclobutrazol at the rate of 5.50 and 8.25 g *a.i.* per tree both as a soil drench and foliar application were effective in suppressing vegetative growth and inducing early flowering compared with the control.

Tandel and Patel (2011) used three different chemicals *viz.*,paclobutrazol, ethrel and potassium nitrate for early flowering in mango. They revealed that, the application of ethrel and KNO_3 was found to be effective for induction of early flowering and also significantly increased fruit production compared to control in all the cultivar studied *i.e.*Alphonso, Kesar and Rajapuri in addition to effect of paclobutrazol.

Husen *et al.* (2012) conducted reaserch on induction of flowering and yield of mango hybrids using paclobutrazol. They recorded maximum flowering with 5 ml of paclobutrazol application.
Selvarajan *et al.* (2013) observed maximum yield (43.50 kg/ tree), fruit weight (299.13 g/ fruit) and TSS (24.16^o Brix) in mango *cv.* Neelum due to paclobutrazol application with pruning in off season.

Kumar *et al.* (2014) conducted research on influence of season on flowering characters in mango cultivars. They recorded maximum number of inflorescence/ m^2 (32.10 and 26.40), hermaphrodite flower percent (37.95 and 33.25), fruit set percent (0.67 and 0.63) in cv. Neelum During main season and off season respectively.

Kaviarasu *et al.* (2017) conducted experiment on environmental infunce under off season production on yield and quality attributes of mango. They recorded highest yield in Bangalora (520.80 kg/ ha). They also recorded maximum fruit length (22.60 cm), fruit girth (33.30 cm), fruit volume (469.50 ml), fruit weight (471.50 g) and number of fruits per tree (560.00) in Bangalora.

Gauva:

Bagchi *et al.* (2008) recorded maximum number of fruits retained per branch (12.99), fruits retained per plant (195.5), fruit weight (242 g) and yield per plant (48.6 kg) with bending of lateral branches and partial removal of old leaves.

Brar and Bal (2010) recorded maximum flowering and fruit set in paclobutrazol treated plants in both rainy and winter crops. They also recorded that paclobutrazol treated plants exhibited significantly higher fruit number, fruit yield, yield efficiency, fruiting density compared to ethephon treated and control plants.

Custard Apple:

Soler and Cuevas (2008) recorded maximum fruit number per tree (99) with minimum preharvest drop (7%) in trees which were pruned in January by removing in one year old shoots and cutting back the remaining shoots to two to three basal buds to encourage vigorous sprouting.

Vinay and Chithiraichelvan (2015) studied effect of various pruning levels and defoliants on reproductive growth and yield of custard apple. They recorded minimum days taken to first flower (22.6) and duration of flowering days (130.00) in plants treated with 50% pruning and 5% Urea. They also recorded maximum number of fruits per tree (41.33) and yield per tree (10.33) in treatment 25% pruning with Urea 5% and 25% pruning with potassium iodide 1%.

Conclusion:

Off season flowering and fruiting technique adopted successfully in various crop like mango, guava and custard apple by various cultural and chemical techniques like withholding of irrigation, flower and fruit thinning, shoot pruning and application of different chemicals like NAA, urea, Paclobutrazol *etc*. Off season production is more profitable for fruit growers. Success of off season fruit production depends upon experience of grower, orchard management practices and climatic conditions. In mango application of paclobutrazol is best method to induce early fruiting and flowering. In guava application of paclobutrazol, bending and pruning is helpful to induce early flowering and fruiting. In anonna pruning is best to induce early flowering and fruiting. More information and research on off season fruit production is required. Proper extension activities are required to disseminate the proven technology among the farmer for promoting off season cultivars of fruits.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Prajapati Dipti Rameshbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020218040	**Date : 18/01/2020**
Major Guide : Dr. B. M. Tandel	**Time : 10.00 to 11.00 a.m.**
Minor Guide : Dr. N. K. Patel	**Venue : Swami Vivekananda Hall**

Production technology of dragon fruit

Dragon fruit also called as “Noble Woman” or “Queen of the Night” is a recently introducedexotic super fruit in India and is considered as a promising and remunerative fruit crop.Dragon fruit is a perennial climbing cactus, belongs to the family Cactaceae. The origin is tropical and subtropical forest regions of Mexico and Central South America. It has received worldwide recognition not only as an ornamental plant but also as a fruit crop and industrial source of compounds hence, have high demand in national and international markets. It can be successfully cultivated on the neglected mine areas due to its potential to survive in dry areas and are adaptive to various marginal soil conditions. In India, it has been grown in some parts of Gujarat, Maharashtra, Kerala, Andhra Pradesh and Karnataka. The most successful tidings are from Gujarat where it is cultivated as monocrop.It is typically a long day plant with beautiful night blooming flower (Queen of the Night). It is a perennial, climbing cactus with triangular green stem growing to a height of about 6 to 10 m. Fruit is called as ‘pitaya’ meaning ‘the scaly fruit’due to the presence of the bracts or scales on the fruit skin. The fruit is non-climacteric fleshy berry, which is oblong and about 10-12 cm thick with red or yellow peel with scales. Fruit has high content of nutrients, medicinal and cancer preventing properties. The pulp may be white, red, yellow or magenta and juicy depending on the species.Fruit can be processed into various value added products like juice, sherbets, jam, jelly, ice cream, preserve, candy etc.

Review of research work

Varieties

Subandi *et al.* (2018) conducted experiment on the crossing effect of dragon fruit plant cultivars [*Hylocereus Sp*.] and concluded that crosses between the red flesh dragon fruit flower withwhite flesh dragon fruit flower gave maximum fruit diameter (10.38 cm), fruit length (9.81 cm), weight of fresh fruit (463.33 g)and sugar content of fruit (8.40 ºBrix) in red dragon fruit types at 40 DAC.

Mizrahi *et al.* (2003) studied metaxenia in the vine cacti *Hylocereuspolyrhizus*and *Selenicereus spp*. Theyobserved flowers of *Hylocereuspolyrhizus*was pollinating with *Selenicereusgrandiforus* pollen found maximum fruit weight (461.2 g) and pollen source has no influence on ripening parameterslike total soluble solids (TSS) and acidity.

Propagation

Ayesha *et al.* (2018) recorded that dragon fruit stem cutting treated with IBA 7000 ppm was found early initiationsprouting of root (14.54 days), shoot (7.34 days), maximum percentage of rooted cuttings (57.75 %), average number of roots per cutting (12.70) and length of the roots per cutting (12.41 cm).

Sudarjat *et al*. (2018) observed that dragon fruit cutting grown in soil+vermicompost (1:1)and soil+sand+compost (1:1:1) media gave best growth results with increased average number of shoots, length of the shoots and average number of roots in cutting in dragon fruit.

Elobeidy (2006) studied the effect of cutting size on rooting percentage, number and length of the dragon fruit and revealed that maximum rooting percentage (100 %), root number (37) and root length (8 cm) were found with stem cutting 25 cm.

Planting density

Hoe and Then (2017) conducted research on planting density of red dragon fruit (*Hylocereuspolyrhizus*) and reported that the cumulative yield over four years of harvesting produced 48.53 t/ha with planting density 1,815 trellis plant/ha (3.0×1.8 m^2).

Pruning

Hieu *et al.* (2017) revealed that pruning of unproductive and infected cladodes by 40% to 60% of the canopy were able to increase of shoots that transformed into flowering shoots as well as minimized canker disease infestation during off-season of pruning in dragon fruit.

Integrated Nutrient management

Chakma *et al.* (2014) recorded maximum number of fruits per pillar (60.33), average individual fruit weight (309.20g), fruit length (9.27cm), and fruit yield (37.48t/ha) inNPK 540:310:250 g/plant/year.

Then (2014) studied the effect of compost application to improve the red dragon fruit yield under various mixture fertilizer and reported that application of compost at 12 kg/pillar/yearwith mixture of fertilizer (9.6:4.8:17.6:2.4 N:P:K:Mg)application at 1.2 kg/pillar/year werefound maximum flower numbers (111.5 no/pillar/yr), fruit production (78.7 no./pillar/yr), yield (24.5 kg/pillar/yr) and fruit weight(311.0 g/fruit) in red dragon fruits.

Then (2013) studied the effects of foliar fertilizers on yield character of red dragon fruit (*Hyloceruspolyrhizus*) and reported that foliar fertilizer spray were not found any significant difference then untreated plants in total yield. The foliar application of box fruit (1%) produced maximum average weight of fruit (342.0 g) and fruit grade than all other treatment.

Plant growth regulator

Takata *et al.* (2016) studied the effects of season and GA_3 concentrations on *Hylocereusundatus* flowering and production. They concluded thatGA_3application did not promote flower and production of dragon fruit flowers. But it was possible to increase the percentage of fruit set and yield.

Pre harvest

Ghani *et al.* (2010) conducted experiment on disease occurrence and fruit quality of pre-harvest calcium application on red flesh dragon fruit (*Hylocereuspolyrhizus*) and observed that pre harvest application of $CaCl_2$ in fruit which increased firmness and Ca content in peel, it also reduce the disease severity in fruit of dragon fruits.

Postharvest

Tuan *et al.* (2017) conducted research oneffect of bagging time on fruit yield and quality of red dragon fruit (*Hylocereus spp.*) and reported that bagging of fruit at7 days after anthesis increases fruit weight and total soluble solid content (13.28 ºBrix) as well as lowest fruit cracking (5.55%), fruit blemished (5.55%), fruit sunburn (5.55%) and fruit damage from fruit flydamage (2.78%).

Freitas and Mitcham (2013) observed that dragon fruit stored at 5ºC followed by 7ºCmaintained better visual appearance, reduced decay incidence and severity of fruit after 20 days. Dragon fruit stored in perforated plastic bag had lower fruit weight loss during 20 days storage.

Conclusion:

From the foregoing discussion, it can be concluded that the quality character of red dragon fruit was improved by use of white flesh dragon fruit pollen. However, far *H. polyrhizus* when we use *S. grandiforus*as a pollen source gave maximum fruit weight, TSS and acidity. Twenty fivecm stem cutting treated with IBA 7000 ppm and grown in soil+vermicompost media gave maximum rooting and effective vegetative growth. Dragon fruit planted at 3.0× 1.8 m^2 was obtained maximum yield. Plant treated with RDF 540:310:250 g NPK/plant/year or mixture of N, P, K and Mg (9.6:4.8:17.6:2.4) applied at 1.2 kg along with 12 kg compost gave maximum fruit production. Foliar application of box-fruit (1%) nutrient was found effective to increase the fruit yield. Plant treated with GA_3at low concentration was found effective for increased fruit set and yield. Pre harvest spray of Ca with higher concentration helps to increase the Ca content in peel and firmness of fruit and also decreased the disease severity.Storage of fruits at 5ºC in perforated plastic bags helped to maintain better visual appearance of the fruit even after 20 days. Bagging of fruit at 7 days after anthesis greatly improved fresh fruit weight, fruit edible rate percentage as well as TSS (ºB).

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Jadhav Parth Janardhan	**Course : FSC 591 (1+0)**
Reg. No. : 2020219014	**Date : 19/12/2020**
Major Guide : Dr. A. K. Pandey	**Time : 09.30 to 10.30 a.m.**
Minor Guide : Dr. S. L. Chawla	**Venue : Online**

Ploidy manipulation in fruit crops

Ploidy manipulation includes scaling up and down chromosome numbers of a species within a polyploid series. It is useful to create novel genetic variations, to reduce time required by conventional methods and is an only way to get homozygous lines in woody species. Ploidy manipulation is also useful in breeding and genomic studies, being used in mutation research, genetic analysis, genome mapping and gene transfer. Ploidy manipulation can be carried out through haploid production, chromosome doubling, interploid hybridization, endosperm culture and protoplast fusion. Blakeslee and Nebel (1937) discovered chromosome doubling action of colchicine which is widely used alkaloid for doubling chromosome in plants. Ploidy manipulations can be utilized to develop varieties in fruit crops which have a narrow genetic base and tolerance to biotic and abiotic stresses.

Brief review of research work

Ber

Gu *et al*. (2005) studied the effect of different concentrations and durations of colchicine on induction of tetraploidy and obtained best results with the 0.05% colchicine (48 h, 72 h) and 0.1% colchicine (24 h, 48 h), in which over 3% of the treated shoot tips were induced to tetraploid level.

Wang *et al*. (2019**)** performedsystematic comparison on morphological, cytological and nutritional characteristics between autotetraploid cv.Riguang and diploid cv.Dongzao of Chinese jujube and observed that Riguang has bigger and darker green leaves, larger stomata, higher photosynthetic characteristics, higher yield per tree, bigger andbetterquality fruits than diploid Dongzao.

Kiwifruit

Wu *et al*. (2011) studied that effect of colchicine on shoot production and polyploidization in kiwifruit and observed that treatment 0.05% colchicine produced a significantly higher percentage of tetraploid shoots and polyploidization than 0.1% colchicine treatment.

Wu *et al*. (2013) observed that fruit flesh firmness and dry matter content was higher in diploid Hort16A as compared to induced tetraploid in kiwifruit. While soluble solid content and fruit skin thickness was found higher in tetraploid line Type B than diploid cv. Hort16A and tetraploid line Type A.

Banana

Assani *et al*. (2002) observed that highest embryo formation was obtained in genotype *Pisang klutuk wulung* (9.2%) as compared to other genotypes. While highest percentage of haploid formation was seen in genotype Tani of *Musa balbisiana* (BB) through anther culture.

Ganga and Chezhiyan (2002) recorded the highest rates of tetraploidy induced by colchicine @ 28.57% and 22.22% in Anaikomban and Sannachenkadali, respectively and by oryzalin@ 30.8% and 27.3% in Anaikomban and Sannachenkadali, respectively.

Citrus

Germana *et al*. (2005) observed that ploidy level of *Citrus clementina* regenerants developed through anther culture obtained in different years as determined by flow cytometry analysis showed that most regenerants were triploid (82%) as compared to other ploidy level.

Aleza *et al*. (2009) studied regeneration of colchicine and oryzalin treated micro-grafted shoot-tips and observed that the percentage of shoot-tips that developed with oryzalin (33.3%) was higher than with colchicine (15%). However, among regenerated plants the percentage of tetraploid plants was practically two times higher in colchicine treatments (33.3%) compared with oryzalin (15%) in mandarin genotypes.

Kundu *et al*. (2017) studied the optimum irradiation dose for induction of haploid plants through *in-situ* parthenogenesis and reported that pollination with irradiated pollen at 300–400 Gy followed by *in-vitro* ovule culture at 50 DAP can promote the development of parthenogenesis thus forming the haploid embryos through interruption of normal double fertilization.

Mango

Rezazadeh *et al.* (2011) carried outflow cytometry analysis of 242 PEMs lines and found 41 tetraploid lines. DNA fingerprinting of the regenerated embryos from the tetraploid lines showed that only four lines were somatic hybrids, all resulting from ‘Haden’ + ‘Kensington Pride’ protoplast fusions. By contrast, the tetraploid lines from ‘Keitt’ + ‘Kensington Pride’ and ‘Tommy Atkins’ + ‘Kensington Pride’ were autotetraploids.

Conclusion

Increasing or decreasing the ploidy level of plants is often beneficial in programmes of plant breeding and improvement.Ploidy Manipulations can be utilized to develop varieties in fruit crops which have a narrow genetic base.Ploidy manipulation can be used to restore fertility in sterile hybrid plants and enhanced tolerance to biotic and abiotic stress. Polyploid crops have greater vigor, biomass and good post-harvest quality. Since no direct genetic manipulation is involved the varieties developed may be acceptable and welcomed by the masses.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Jadav Hardipsinh Manojsinh	**Course : FSC 591 (1+0)**
Reg. No. : 2020219013	**Date : 07/11/2020**
Major Guide : Dr. Y. N. Tandel	**Time : 08.30 to 09.30 a.m.**
Minor Guide : Dr. K. D. Desai	**Venue : Online**

Recent advances in propagation of arid and semi-arid fruit crops

The arid and semi-arid region characterized by frequent droughts, wind erosion, covering of fertile land due to shifting of sand dunes. It receives annual rainfall between 100-500 mm with hot and extreme weather condition. In India, it isconfined to Rajasthan, Gujarat, Punjab, Andhra Pradesh, Haryana *etc*. by covering 3,17,090 sq km area. Arid and semi-arid fruit crops have some special features like deep tap root systems, leaf shedding in summer, water binding mechanism, wax coating, hairiness, sunken and covered stomata in leaves, tolerance capacity to salinity and alkalinity which offers scope in arid region e.g. aonla, ber, guava, bael*etc*. These fruits have great nutritional and medicinal value as they are rich in number of vitamins, antioxidants and minerals. They have commercial value for processed products such as jam, juice and ice cream.Sugars and sweeteners, starch, gums and resins, essential oils and fats, tannins, dyes and colours can be also extracted from them. Owing to the nutraceutical and medicinal importance of these fruits, the demand of quality planting material is increasing day by day.These fruit crops can be propagated by sexual and asexual methods*viz*., cutting, budding, grafting, layering, tissue culture.Efforts have been made on recent advances on propagation of arid and semi-arid fruits to meet the demand of planting materials are reviewed as under.

Review of Research Work:

Damar *et al.* (2014) observed minimum days taken to 50 per cent sprouting and maximum number of shoots per cutting, survival percent, number of roots per cutting and dry matter of roots with the dip treatment of PSB to cuttings of pomegranate in compare to Azotobacter and controls.

Singh *et al.* (2017) conducted an experiment to elucidate the effect of different spacing on regeneration of stool shoots in pomegranate. They recorded highest rooted shoots per plant, average root length and rooting in 1mx1m spacing whereas,maximum rooted shoot production per $m^2$was noted in 0.5mx0.5m spacing.

Kumar and Shukla (2012) observed that scion having 0.8cm thickness grafted on 29thMay showed earlier sprouting and longest shoot whereas, scion having 0.6cm thickness grafted on 29thMay showed highest graft success and collar diameter of sprout in custard apple cv. Balanagar.

Patel*et al.* (2019)stated that custard apple seeds showed maximum germination when scarified seed sown without any chemical treatment under *in vivo* conditionwhereas,under *in vitro* condition, highest number of seed germination was observed when scarified seed sownin ½ MS + 0.1 mg l^{-1} gibberellic acid.

Chiranjeevi *et al*. (2018) stated that higher seed germination per cent, seedling height, root length, seedling girth, number of leaves, fresh weight and dry weight of plants were found with the treatment combination of regular potting mixture (red earth, FYM, sand in 2:1:1 proportion) + cocopeat + VAM (20g perpolybag).

Singh (2020) revealed that the seed treatment of GA_3 400 ppm for 24 hr significantly improved allthe root and shoot growth parameters of aonla cv. NA-4 seedling over rest of the treatments.

Barman *et al.* (2015) stated that colchicine at 0.1% concentrationstimulated early seedling emergence and germination percentage of jamun in cocopeat.

Chavda *et al.* (2018) showedthat when defoliated scion stickand stored for one day used in softwood grafting of jamun var. Goma Priyanka individually found superior in scion growth and survival of softwood grafts.

Rani *et al.* (2015) registered highest percent of success and better growth parameters in patch budding performed during 15^{th}-21^{st} of September in guava.

Kadam *et al.* (2017) revealed thatmaximum rooting percentage, number of roots per shoot, maximum length of shootsand minimum days to root initiationfound with the treatment of full MS + 0.2 mg l^{-1} IBA in guava cv. Allahabad Safeda under *in vitro* condition.

Hashem *et al.*(2018) found thatmedium, supplemented with a half-strength of MS salts and the extract of cyanobacteria extracellular products (CEP) significantly increased the percentage response to rooting, number of primary and secondary roots, fresh and dry weight of roots.

Zayed *et al.* (2020) revealed thatthe addition of different concentrations of anextract of*Moringa oleifera* leaves with TDZ at 0.2 mg l^{-1} and 0.6 IBA mg l^{-1}in culture medium gave significantly the highest average percentage of callus formation, friable callus, germination of embryos and numbers of embryos in compare to other treatments.

Yashwanti *et al.* (2016) studied the effect on micro-budding in bael as influenced by foliar spray of NAA and BA on rootstock and scion 7 days before budding. They recorded significantly minimum number of days for bud sprouting and maximum bud sprouting and number of leaves in budded plants with 50 ppm BA in bael.

Pukhraj *et al.* (2020) noted early shoot bud initiation,highest shoot budinduction and 100 per cent morphogenetic response with WPM using BAP (2.0 mg l^{-1}) in nodal segment explants of bael.

Mewar and Naithani (2016) found that cuttings treated with 6000 ppm IBA during the month of July were superior in overall growth parameters and survival of cuttings of wild fig(*Ficuspalmata*FORSK.).

Sen and Patel (2018) stated that under *in vitro* condition, MSmedium supplemented with 1.0mgl^{-1} IBAgave maximum rooting, length of root, number of roots per shoot and minimum days taken for root initiation in Poona fig.

Singh *et al.*(2015) recorded highest survival percentage, number of leaves, rooting percentage and length of longest root in phalsa cuttings treated with 2000ppm IBA and planted in mist chamber.

Murlidhara*et al.*(2017) found that phalsa seeds treated with GA_3 100 ppm gave highest germination, survival percentage and minimum days taken for germination.

Kumar *et al.*(2020) studied the effect of pre-sowing seed treatments on root growth and survival inber and reported that GA_3 400 ppm for 24 hr, significantly improved all growth parametersand increased survival percentage of seedlings at 120days.

Conclusions:

From the foregoing discussion, it can be concluded that mound layering could be done at spacing of 1mx1m whereas PSB also increased rooting in stem cutting of pomegranate. In custard apple, scarified seed without any chemical treatment under *in vivo* condition and scarified seed in ½ MS + 0.1 mg l^{-1} gibberellic acid sown under *in vitro* condition showed better germination. Bench grafting in custard apple done in the month of May with scion thickness of about 0.6 to 0.8cm had higher success rate.The pre-sowing treatment of $GA_3$400ppm for 24 hrs and combination of regular potting mixture (red earth, FYM, sand @ 2:1:1) along with cocopeat and VAM (20g perpolybag) individually showed better germination of aonla. Defoliated scion stick stored for one day had highest success and growth of jamun grafts cv. Goma Priyanka. The seed germination and growth performance of jamun were found superior with pre-soaking treatment of 0.1% colchicines in comparison to other mutagens. Under *in vitro*condition, the treatment of full MS+0.2mgl^{-1}IBA gave better induction of rooting whereas patch budding done during 15^{th} – 21^{st} September had highest success rate in guava. For *in vitro* culturing of date palm, extract of *Moringa* *oleifera* leaves with TDZ at 0.2 mg $l^{-1}$and BA 0.6 $mgl^{-1}$and half strength of MS salts and the extract of CEP individually showed promising result. Foliar spray of BA 50 ppm on rootstock and scion resulted inhigher success in micro-budding of bael. Under *in vitro* condition, thebetter shoot induction of baelwas obtained in woody plant medium. In fig, half MS medium supplemented with 1.0 mgl^{-1} IBA gave better rooting under *in vitro* culturing whereasstem cutting done during the month of July and treated with 6000 ppm IBA gave highest success and better growth. Stem cuttings of phalsa treated with 2000 ppm IBA showed higher growth and survival under mist chamber whereas,seed treated with GA_3 100 ppm gave higher germination attributes. Ber seed treated with $GA_3$400 ppm gave maximum root growth and survival percentage of seedlings at 120 DAS.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Motilal	**Course : FSC 591 (1+0)**
Reg. No. : 2020219021	**Date : 05/12/2020**
Major Guide : Dr. B M. Tandel	**Time : 09.30 to 10.30 a.m.**
Minor Guide : Dr. N. K. Patel	**Venue : Online**

Breeding for seedlessness in fruit crops

Introduction

Seedlessness is appreciated by consumers both for fresh consumption (e.g., grape, citrus, and banana) as well as in conserved or processed form. This is of paramount importance in types that have strong, hard seed and impart off flavor and taste.Further, seeds can produce substances that accelerate the senescence.

The independence (whole or partial) of fruit development from pollination and subsequent fertilization is advantageous in horticulture crops in case where rate of fruit set is low. Pollen development, maturation and fertilization are affected by environmental factors such as light, temperature, relative humidity. Unfavorable environmental conditions can also drastically affect pollination and fruit development. These problems are occurring in crops/varieties where parthenocarpic fruit development is the norm. In horticulture, parthenocarpy can be exploited both for winter and timing the production regarding the ready availability of fruits for the fresh horticultural produce in all seasons.

Review of literatures:

Lemon

Kakade *et al.* (2017) conducted the study of flower and pollen structure, pollen viability, *in vitro* pollen germination of 'Kagzi Kalan' lemon (*Citrus limon* (L.) Osbeck) and *in vivo* pollen tube growth in self- and cross pollination to understand the mechanism of seedlessness. The results revealed that Kagzi Kalan had tetra-colporate spherical shaped pollen of uniform size. The results of Acetocarmine and FDA test and *in vitro* germination indicated normal pollen viability and germinability in Kagzi Kalan. *In vivo* pollen tube growth showed > 50% pollen germination on stigma in all treatments though a greater number of pollen tubes at the mid style, base of the style, and near the ovule were found in cross pollination. When the self pollination was done in 'Kagzi Kalan' lemon; there was no normal seed/fruits and shrunken seed/fruits were observed indicated the seedlessness in fruits.

Kiwifruit

Murakami (2020) conducted the study to confirmed that CPPU treatment inducesparthenocarpy in three kiwifruit cultivars. In all three varieties, when treatment (pistil removal +CPPU) was applied, seedlessness were observed. Furthermore, we found that'Kaimitsu' displayed fruit development without CPPU treatment or pollination.The role of seeds during fruit setting, maturation, and the process ofripening are not well understood in kiwifruit. Parthenocarpic fruits withoutCPPU treatment in 'Kaimitsu' are expected to be useful in future studies ofseed functions in kiwifruit.

Mandarin

Goldenberg *et al.* (2014) conducted experiment on irradiation treatment to budwood and found overall mutational breeding by gamma irradiation reduced the number of seeds per fruit in various varieties of mandarin by 70 to 90 %. Among all varieties, 0.5 seed per fruit was observed in Vardit irradiation.

Marian *et al.* (2018) reported that mutant plant derived from 20 Gy irradiation were obtained with less number of seeds and low pollen viability (7.7%) in malta.

Shereif *et al.* (2017) conducted the study to find out the effectiveness of repeated applications of GA3 and streptomycin (SM) to stimulate seedless fruit development or reducing seed number per fruit of mandarin cv. Balady.Results indicated that GA_3 at 25 ppm recorded the highest fruit weight and acidity in both seasons. SM 500 + 25 ppm GA_3 reduced seed number per fruit with an about 76.66 and 77.46 % in both seasons, respectively compared to the control. Meanwhile, high yield and fruit characteristics, firmness, vitamin C, brix and SSC/acid ratio, were maintained under this treatment.

Grape

Zhiquian *et al*. (2015) reported that GSLP1 is a potential marker to distinguish seeded, seedless and DR strains in grape breeding. Eight strains were found to have a 569-bp band found only in seedless parents; thus there were preliminarily identified as being seedless. The best sampling time for ovules of DR3 x Monukka and DR1 x Monukka found maximum percentage of embryos developed and plantlets.

Papaya

Rimberia *et al*. (2006) set up a study to investigate the morphological and fruiting characteristics of anther derived triploid papaya; a commercial diploid dwarf cultivar, 'Wonder blight' and 26 anther derived papaya strains were raised in the same green house. Parthenocarpic ability was variable among the strains. The dwarf and semi dwarf strains were fewer than the tall strains and they had good bearing and high yield of fruits. Two dwarf strains particularly EMD-D-28, EMD-D-4 and EMD-E-18 produced parthenocarpic fruits that weighed an average of 871.3, 670.0 and 888.0 g, respectively compared to the diploid cultivar, 'Wonder blight' whose fruits weighed 696.4 g. The combination of short stature with a high yield of large fruits means that these strains have a lot of potential for exploitation in both breeding and commercial fruit production.

Sun *et al.* (2010) studied triploid papaya plants were obtained by immature endosperm culture. This study present the first report of triploid plantlets of papaya from endosperm cultures. Endosperms with embryo at 10-13 DAP were successfully induced to develop callus with a maximum of 68.7 % of callus induction frequency and these in turn were capable of regenerating shoots.

Strawberry and Raspberry

The *DefH9-iaaM* gene fusion which is expressed specifically in placenta/ovules and promotes auxin-synthesis confers parthenocarpic fruit development to eggplant, tomato and tobacco.Mezzetii*et al.* (2004) incorporated *DefH9-iaaM* fusion gene instrawberry and raspberry plants and grown under standard cultivation conditions which show a significant increase in fruit number and size and fruit yield. In all three *Rosaceae* species tested, *Fragaria vesca*, *Fragaria x ananassa*and *Rubus idaeus*, *DefH9-iaaM* plants have an increased number of flowers per inflorescence and an increased number of inflorescences per plant.This results in an increased number of fruits per plant. Moreover, the weight and size of transgenic fruitswas also increased.

Conclusion:

Seedless fruits are a desirable commodity for consumers.Evidence that seedless forms of *Vitis vinifera* grapes have been prized for many centuries as dried fruit. Seedlessness is a boon to the processing industry and to a greater level to the consumers they can reduce the hardship regarding a crucial step in the fruit processing. Seedlessness fruit production is a age old practice, several technologies have been evolved but relevant one are discussed here, in that foremost is the plant growth regulator application among which gibberellin was found to be promising in certain major fruit crops. Further, technologies which have greatly improved seedless fruit production are, suicide gene and mutation. Nowadays trend is shifting, and urban culture is growing, and people are very busy and in this context, Seedless fruit: Fruits of future *i.e*. seedlessness is having great importance in the fruit production.

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GROUP : II

(Vegetable Science and Floriculture and Landscape Architecture)

ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Patel Krutikakumari Umeshrai	**Course : FSC 591 (1+0)**
Reg. No. : 2020218033	**Date : 24/01/2020**
Major Guide : Dr. C. R. Patel	**Time : 03.00 to 04.00 p.m.**
Minor Guide : Dr. V. K. Parmar	**Venue : Swami Vivekananda Hall**

Technologies in passionfruit cultivation

Passion fruit (*Passifloraspp.*, family Passifloraceace) is a vine fruit crop native to Tropical America. It is a high value export-oriented crop cultivated in countries like Australia,Brazil, Mexico, Kenya, Colombia,*etc*. In India, passion fruit cultivation is confined to Kerala, Tamil Nadu, Karnataka, Mizoram, Manipur and Sikkim. It has two cultivated edible types: yellow passion fruit (*Passiflora edulis var. flavicarpa*) and purple passion fruit (*Passifloraedulis*). The former grows best under tropical condition, while the latter prefers subtropical climate. Fruits are rich in vitamin A, C and minerals such as sodium, magnesium, sulphur,chlorides and pulp has very pleasant, sweet, characteristic flavour.Passion fruit is generally not consumed as a table fruit due to numerous small, hard, dark brown seedsin pulp and its commercial value lies in its processing for preparation of juice, concentrate, squash, ice-cream, confectionery,*etc*.Most of the people have not come across this fruit and its processed product which otherwise would have definitely captured their attention and boost the fruit crop basedindustry in the country.Research proven advanced technologies are available that can be used to extend the cultivation of passion fruit in tropical and sub-tropical regions of India.

Brief review of research work: -

Seed treatment

Joaquin *et al.* (2015) applied pre-sowing seed treatments to the seeds of purple passion fruit and found that treatment with 96 % sulphuric acid for 20 minutes improved the average germination speed (2.8 days) and decreased the average germination time (10.3 days)without negatively affecting seed germination percent and viability.

Mehta Sangita *et al.* (2016) treated the seeds of passion fruit with different pre-sowing treatments and found that the seeds treated with 2 % bleaching powder for 24 hours resulted in maximum germination percentage after 90 days (99.24 %), least time taken for 4 leaves emergence (75.05 days), maximum number of leaves (6.42) and plant height (8.32 cm) after 120 days.

Media

Joaquin *et al.* (2015) inoculated passion fruit seedlings with *Glomus fasciculatum* strain together with three levels of phosphorous and found that seedlings which received 0.02 mg L^{-1} phosphorous along with *Glomus fasciculatum*inoculation resulted in significant increase in stem diameter, plant height, dry biomass and leaf area.

Cavalcante *et al.* (2016) studied the effect of different organic substrates on growth parameters of passion fruit and observed that seedlings grown in substrate made up of goat compost + soil had better growth in terms of maximum ESI (1.52), EP (97.20 %), plant height (32.92 cm), stem diameter (5.30 mm), number of leaves (9.80) and root length (21.83 cm) of yellow passion fruit “Serra” seedlings.

Clonal Propagation

Kumar *et al*. (2008) treated the cuttings of passion fruit with different concentrations of IBA and NAA for 3-5 seconds (quick dip) and for 12 hours. They found that the cuttings treated with either NAA

800 ppm for 3-5 seconds or NAA 80 ppm for 12 hours gave maximum rooting,root length, fresh root weightand dry root weight.

Kishore *et al.* (2009) studied the effect of different period, scion length and grafting height in purple passion fruit at Mizoram and found that minimum days to callus formation (6.6), bud swell (8.6), bud burst (9.6), maximum graft success (81.6 %) and survival (84.6 %) were recorded when grafting was done in the month of June with 25 cm long scion at 10 cm height.

Santos *et al.* (2016) studied the growth of passion fruit plants grown from either seed or semi-hardwood cutting and found that seed-grown plants had maximum stem diameter and leaf area than those propagated by semi- hardwood cuttings at various intervals.

Irrigation

Solomon and Hamadina (2014) studied the effect of different intervals of water regimes on leaf characteristics and observed that leaf area (81.2 cm^2), leaf moisture (78 %), leaf dry matter content (8.15 g) and stem moisture (80 %) were maximum when watering at three days interval.

Integrated nutrient management

Mehta Sangita *et al.* (2016) studied the effect of different levels of nutrients on growth and fruit characters of passion fruit and observed better vine growth in terms of vine length, number of leaves, plant girth, number of secondary branches and fruit characters when the vines were fertilized with lower level of NPK (250:125:125g + 1.2g boron).

Training system

Sulladmath *et al.* (2012) studied the effect of different training system on fruit yield, photosynthetic rate and percent light interception and found that plants under 4 arms kniffin system had maximum percentage of light interception (84.81 %), cumulative fruit yield (67.22 t/ha), income and cost benefit ratio.

Fruit set and blooming behaviour

Kishore *et al.* (2010) studied stigma receptivity in terms of fruit set in four species of passion fruit and revealed that maximum fruit set was noted when flowers were pollinated on the day of anthesis in all the species.

They also studied different blooming periods, duration of blooms and duration of effective bloom of different passion fruit species. They revealed that in, *P. edulis***,** *P.quadrangularis*and *P.foetida* the major periods of bloom were March-April, July-August and September-October. The duration of bloom was maximum during March-April in *P. edulis*, *P.quadrangularis*and *P. foetida*while in *P. edulis var. flavicarpa* during May-June.The maximum days of effective bloom in*P. edulis*and *P. foetida*was during March-April,*P.edulis var. flavicarpa*during May-June and*P.quadrangularis* during September-October.

Post harvest

Singh *et al.*(2011) studied on effect of different post harvest storage treatments and observed that passion fruits coated with paraffin solid wax and padded with polyethylene had maximum juice percentage (29.77 %), higher TSS, lowest PLW (%) and decay loss (%)after 25 days of storage period.

Conclusions: -

From the foregoing discussion it can be concluded thatresearchbased technologies can be used for cultivation and better management of passion fruit crop.Pre-sowing seed treatment with H_2SO_4 (20 minutes) or 2 % bleaching powder (24 hours) were found effective in increasing the germination percentage and growth characters of seedling.Plants inoculated with *Glomusfasciculatum* together with phosphorus applied at 0.02 mg L^{-1} showed significant increase in growth parameters. Seedlings raised in substrate made up of goat compost mixed with soil had better growth. Semi-hardwood cuttings can be treated with either NAA 80 ppm for 12 hrs or 800 ppm for 3-5 minutesfor better rooting.Grafting should be done in month of June at 10 cm height using 25 cm long scion.Seed propagated plants grows better as compared to plants raised through cuttings.Watering the vines at three days interval after transplanting was found effective. Soil application of 250:125:125:1.2 g + NPKB vine[1] gave superior growth and better fruit quality. The vines trained in the four arms kniffintraining system had maximum fruit yield and economic returns. Stigmareceptivity of different species of passion fruit was maximum on the day of anthesis.The major periods of bloom were March-April, July-August and September-October. Themaximum duration of bloomwere during March-April (in purple and *P. foetida*) and during May-June (in yellow). Passion fruits stored after coatingwith paraffin solid wax and padded with polyethylene had better quality during storage.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Patel Sejalben Bharatbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020218035	**Date : 18/01/2020**
Major Guide : Dr. Y. N. Tandel	**Time : 09.00 to 10.00 a.m.**
Minor Guide : Dr. N. B. Patel	**Venue : Swami Vivekananda Hall**

Recent advances in fruit drop in mango, citrus and grape

Fruit drop is a premature shedding of fruits before harvesting. It is very much serious in some fruits like mango, citrus, grape, apple, peach *etc.* Fruit drop may occur at various stages of fruit growth, starting right from fruit setting till its harvesting. It may be natural, environmental or pest related. Losses due to fruit drop at various stages have long been a serious threat to the fruit growers. There are so many reasons for fruit drop like internal (hormonal, morphological and genetical) and external (biotic and abiotic) factors. After determining the actual causes of fruit drop, adaptation of a suitable control measure can bring relief to the growers. Among different drops, pre-harvest drop is of great economic importance which can cause serious crop loss to farmer.

Brief review of research work

Mango

Kumar *et al*. (2019) revealed that minimum percentage of fruit drop (95.22%), highest percentage of fruit retention (4.74%) and maximum fruit yield/ tree (61.69 kg) were found effective treated with drenching of 30 ml paclobutrazol/tree in mango cv. Dashehari.

The foliar spray of Putrescine (0.5mM) at 10-15 % flowering stage recorded the highest fruit retention (1.61%), maximum number of fruit/ tree (168 fruits/tree) and yield (42.04 kg/tree) in mango cv. Himsagar (Dutta *et al*.,2018).

Rajatiya (2018) studied the effect of weather parameters on mango and revealed that fruit drop from grain to marble stage was negatively correlated with temperature (maximum, minimum, day and night) and sunshine hours whereas positive correlated with wind speed and relative humidity. Fruit yield per tree was positively correlated with temperature and sunshine hours and negatively correlated with wind speed and relative humidity.

Dutta Piyali *et al.*(2017) revealed that Dashehari and Neelum mango recorded the lowest total fruit drop and highest fruit retention whereas Fazli variety of mango had highest total fruit drop and lowest fruit retention percentage as compared to rest of the varieties.

Momin *et al.* (2016) found that foliar application of Tricontanol (750 mg l^{-1}) enhanced fruit set at pea (14.30 %) and marble (56.34 %) stage per panicle, fruit retention at harvest (2.33 %) and fruit yield (49.44 kg/ tree) as well as minimized fruit drop at harvest (83.62 %) in mango cv. Kesar.

Bhamare *et al.*(2014) registered the lowest fruit drop (55.54, 81.82 and 91.97%, respectively) at pea, marble and mature stage with foliar spray of NAA@ 20mg/l in mango cv. Mallika.

Sankar *et al.*(2013) revealed that maximum fruit set at pea stage (0.66 %), fruit retention (2.23%), number of fruit (166.0) per tree and yield (44.6kg) per tree were obtained with the foliar spray of boric acid (0.02%) at 50 % flowering stage in mango cv. Alphonso.

Salvi *et al.* (2013) reported that fruit drop of Alphonso mango was reduced up to 5.7 per cent by intercropping with various vegetables, tubers and other biennial crops and 13.1 per cent by supplementary irrigation of 200 litresper plant at weekly interval in orchard.

Citrus

Pooja *et al.* (2019) revealed that foliar application of 2,4-D 20 ppm was found quite effective in reducing June drop (44.96 %) and pre-harvest fruit drop(12.69 %)in Kinnow mandarin as compared to rest of treatments and control.

Patel Neha *et al*. (2018) recorded minimum fruit drop percentage at pin head size (4.5 %), pea size (10.47 %) and pre harvest size (7.33 %) with foliar application of 20 ppm NAA which was followed by urea 2 percent at all the three stages of fruit drop (5.19,17.65 and 9.14 %,respectively). The maximum fruit yield per tree (33kg) was also noted with 20 ppm NAA followed 2 per cent urea (29.22 kg) in acid lime var. Kagzi.

Sweety *et al.* (2018) observed that minimum fruit drop was recorded with foliar application of NAA 20 ppm during May to October (3.33, 2.67, 2.00, 1.00, 1.00 and 0.67 fruits/tree, respectively) in sweet orange cv. Jaffa.

Ranganna *et al.* (2017) recorded the maximum percentage of fruit set (89.97) and minimum percentage of fruit drop (13.00) withthe spraying of 2,4–D @ 40 ppm during November + 20 ppm during February. The highest number of fruits per shoot (6.20) was recorded with application of paclobutrazol @ 5 ml per meter for four time starting from July to Decemberin acid lime cv. Balaji.

Somwanshi *et al*. (2017) revealed that minimum percent of fruit drop was obtained in spray of NAA 15 ppm (14.19 %) which was followed by NAA (20 ppm), GA_3(30 ppm) and GA_3(50 ppm), respectively. The maximum fruit set was observed in treatment urea (1%) + GA_3 (70 ppm) (66.67 %) in sweet orange var. Nucellar.

Arora *et al.* (2008) revealed that minimumfruit drop (15.20 %), maximum reductionin fruit drop over control (49.0 %) and maximum fruit yield (296 no./tree) wererecordedwith application ofZiram 27 SC (0.25%) + 2,4- D (10ppm) at second fortnight of April, July, August and September in Kinnow mandarin.

Grape

Abu –Zahra (2010)reported that GA_3 or GA_3 + Girdle berries resulted in heavier berries, hastened berry diameter and produced larger berries of Thompson Seedless grape, although the percentage of berry shattering was higher in all treatmentsin comparison to the control.

Sharma and Singh (2003) revealed that minimum percentage of preharvest berry drop (31.51 %) was recorded with the application of benzyl adenine @ 500 ppm in Beauty Seedless grape.

Conclusion:

From the foregoing discussion, it can be concluded thatsoil drenching of 30 ml paclobutrazol/tree reduced fruit drop and increased yieldof Dashehari mango. The foliar spray ofPutrescine (0.5mM) at 10-15 % flowering stage recorded the highest fruit retention and yield in mango cv. Himsagar.Fruit drop increased with increasing wind speed and relative humidity; decreased with increase in temperature and sunshine hours, Fruit yield increased at higher temperature and sunshine hours; decreased with increasing relative humidity and wind speed.Dashehari and Neelumshowedminimumfruit drop and maximum fruit retention as compared to other varieties. The foliar spray of Tricontanol 750 mg $l^{-1}$and NAA @ 20mg/l at pea and marble stage minimized fruit drop in mango cv. Kesar and Mallika, respectively. In Alphonso mango, the foliar spray of boric acid (0.02%) at 50 % flowering stage;intercropping with various vegetables, tubers and other biennial crops and by supplementary irrigation of 200 litres per plant at weekly interval increasedfruit retention and yield per tree. In Kinnow mandarin,the foliarapplication of 20 ppm NAA and Ziram 27 SC (0.25%) + 2,4- D (10ppm) were recorded minimum fruit drop at pin head size, pea size and pre harvest size and maximum fruit yield per treein acid lime var. Kagzi and sweet orange cv. Jaffa, respectively. The minimum percentage of fruit drop was also recorded with the spraying of 2,4–D @ 40 ppm during November + 20 ppm during February in acid lime cv. Balaji. NAA 15 ppm gave minimum percent of fruit drop in Sweet orange var. Nucellar. GA_3 was found an effective for improving Thompson Seedless grapevine berries compared with girdle treated bunches and control. BA 500 ppm gave minimum preharvest berry drop in Beauty Seedless grape.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Rathod Sheetal Devshibhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020218042	**Date : 03/01/2020**
Major Guide : Dr. C. R. Patel	**Time : 04.00 to 05.00 p.m.**
Minor Guide : Dr. N. B. Patel	**Venue : Swami Vivekananda Hall**

Pollen storage of fruit crops

Pollen storage is one of the valuable tools for increasing the yield through supplemental pollination in many crops like date palm, custard apple etc. Pollen storage is very useful in crossing with parents having non-synchronous flowering, germplam conservation as well as exchange. Pollen can be stored for short or long duration depending on purpose by manipulating temperature, relative humidity and other factors. Pollen can be stored by use of talc, organic solvents, refrigeration, freeze drying and cryopreservation depending on the cultivars, crops and storage duration.

Review of research work

Mango

Chaudhury Rekha *et al*. (2010) observed that viability of 4 year cryostored pollens of different mango cultivars (Amrapali, Bombay Green, Neelum, Bangalora and KishanBhog) were not differed considerably compared to fresh pollens.

They also studied on fruit set percentage of cultivars pollinated with pollens stored for 0, 1 or 4 years in cryopreservation and found that the pollen of Amrapali and Bombay Green gave higher fruit set even after 4 year of cryostorage. The pollen of Neelum gave higher fruit set when stored for 1 year whereas, the pollen of Banglora gave higher fruit set when fresh pollen used.

Banana

Karmacharya *et al.* (1986) stored the bracts of four clones (Elavazhai, BodlesAltafort, Wather and Sawai) of banana with or without desiccator at room temperature and refrigerator. They found the maximum pollen viability (24-38 days) in all clones when bracts were stored in refrigerator (4℃) conditions.

Uma and Arun (2016) stored the pollens of two wild species (*M. acuminatasub sp. burmannicoides* and *M.balbisiana*) of banana at 0℃, 4℃ and at room temperature and noted significantly the highest germination when fresh pollen stored at all three conditions under study. They also found that storage at 4℃ for 7 days resulted in significantly highest pollen germination percentage, while pollen loss viability after 30 days storage at 0, 4℃ or at room temperature.

Papaya

Ganeshan (1986) observed that papaya pollens cryopreserved in liquid nitrogen retained maximum germination percentage of (70.9 %) for 485 days.

Perveen *et al*. (2007) stored the papaya pollens for 48 weeks at 4, -20, -30 and -60℃ with different concentration of sucrose solutions andfound maximum germination of pollen when stored for 8 weeks at -30℃ in 30% solution concentration. They also found that papayapollen can be stored for 48 weeks at -60ºCin 40% sugar solution.

Citrus

Ahmed *et al*. (2017) studied the pollen germination in three cultivars (Mosambi, Jaffa and Itaboria) of Sweet Orange stored for 48 weeks at 4, -20 and -196℃ and observed maximum pollen germination in all cultivar stored at -196℃.

Date palm

Mortazavi *et al.* (2010) revealed that among the different storage conditions, pollen grains stored at-196 ℃ recorded significantly higher germination percentage in all the date palm cultivars studied, followed by storage at -20 ℃.

Anushma *et al*. (2018) reported that the pollens of date palm stored at -196℃ (cryopreservation) recorded higher germination percentage (90.29%) even after 1 year of storage.

Grape

Ganeshan (1985) stored the pollens of five grape cultivars at -196℃ for 64 weeks and revealed that pollen germination percentage of grape cultivars was increased as the duration of storage increased upto 64 weeks.

Dragon fruit

Macha *et al*. (2006) revealed that pollenof dragon fruit can be stored in a vial at 5℃ with higher germination percentage (about 25%) upto 8 days.

Kiwifruit

Bomben *et al*. (1999) stored the pollens of kiwifruit (*A. deliciosa*and *A. chinensis*) at 4, -18 and -80℃ for 160 weeks and noted that pollen germination of *A. chinensis* at 4℃ decreased rapidly after 24 week of storage while in *A. deliciosa* higher pollen germination (80-90%) upto 24 weeks and totally failed after 34 weeks of storage. Pollens of both species stored at -18℃ retained high germination rate (80-90%) for 32 weeks. Pollens of both species stored at -80℃ maintained higher germination of 80% upto 32 weeks while 60% upto 160 weeks of storage.

Apple

Imani *et al*. (2011) stored pollens of four apple cutivarsat 4, -20 and -80℃ for 3 and 7 months and found that higher germination percentage was maintained at -20 and -80℃ in all the four cultivars upto 7 month storage.

Almond

Gomez and Gradziel (2002) stored the pollens of four cultivars of almond at 0, 4, -20 and -80℃ for 12 months and noted higher germination percentage at 0ºC and -20℃ after 12 months of storage in all cultivars.

Walnut

Luza and Polito (1985) found the maximum germination percentage of walnut pollen after 8 and 12 month of storage at -196ºC in walnut cultivar Adams. Pollen germination was very less in cultivars Hartly and Tehama at -196ºC for 8 and 12 month storage period.

Pistachionut

Polito and Luza (1988) studied on germination of pollens of four pistachionut cultivars stored for 0, 4 and 12 months at -196℃and found higher germination with fresh pollens in all the cultivars, whereas higher germination after storage for 4 and 12 monthswas noted in cultivar Peters only.

Conclusion

From the foregoing discussion it can be concluded that, storage duration and storage condition differs with fruit crop and cultivar. Pollens can be successfully stored under cryopreservation (-196℃) in date palm (1 year), mango (4 year), citrus (48 weeks), grape (64 weeks), walnut (1 year), pistachionut (1 year) and papaya (485 days). Pollen of banana and dragon fruit can be stored upto 7-8 days in refrigerator at 5℃. Refrigerator storage is useful for storing pollen of banana (7 days), dragon fruit (8 days) and almond (1 year). For storage of kiwifruit (> 3 year) and apple (7 month), -80℃ temperature is required. Further research on pollen storage of commercial varieties of different fruit crops is required.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Patel Tanviben Ashokbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020218038	**Date : 04/01/2020**
Major Guide : Dr. A. K. Pandey	**Time : 09.00 to 10.00 a.m.**
Minor Guide : Dr. S. Y. Patel	**Venue : Swami Vivekananda Hall**

Crop regulation techniques in major fruit crops

India is rich in fruit diversity starting from tropical, subtropical to temperate region. Some of the fruit crops like guava, pomegranate, lemon, mandarin *etc*. if left without any treatment, gives several light harvests of the variable quantities and qualities from the various flowering and flushes throughout the year. It also bloom throughout the year without any resting period, but yield and quality remain poor. Hence, it is essential to adopt crop regulation techniques and regulate the crop in such a way to increase production with enhance fruit quality is followed which is known as crop regulation. Crop regulation is the basis for the regular and quality crop, which can be achieved through withholding irrigation water, root exposure, root and shoot pruning, deblossoming, girdling, spray of chemical or other plant growth regulators. There are three distinct flowering season *i.e.* February – March (*Ambebahar*), June – July (*Mrigbahar*) and October – November (*Hasthbahar*) with corresponding harvest period during rainy, winter and summer season. Crop regulation is a planning about identifying, selecting, implementing and monitoring methods to manage the yield and quality of fruit crops.

Review of research work:

Guava:

Agnihotri *et al.* (2016) found that the foliar spray of NAA @ 1000 ppm in April, significantly increase the TSS (13.80°B), ascorbic acid (193.75 mg/100g), total sugar (7.29 %) and reducing sugar (4.21 %) of guava fruits cv. Sardar.

Samant *et al.* (2016) observed that branch bending and pruning at higher intensity levels (50 and 70 %) had significant influence on summer flushing compared to control. The significantly higher yield (26.48 kg/tree) was noted in winter crop. Moreover, fruit quality (fruit weight, TSS, vitamin C) was also found significantly higher in branch bending in guava cv. Lucknow – 49.

Eko *et al.* (2016) recorded maximum TSS (14.23 °B) and reducing sugar (8.55 %) as well as significantly higher total sugar (12.24 %), ascorbic acid (618.50 mg/100 g) in single spray of urea at 15 % in guava cv. L – 49.

Sharma Arti *et al.* (2015) found that one leaf pair pruning resulting in maximum yield reduction in rainy season (9.73, 12.40 and 10 kg, respectively) with subsequent maximum yield (73.05, 72.40 and 76.40 kg, respectively) in winter season and GA_3 at all concentrations gave significantly higher yield in rainy season (51.23, 51.40 and 74.28 kg, respectively) in three year (2010, 2011 and 2012) experiment of guava cv. Allahabad Safeda.

Bagchi *et al*. (2008) noticed maximum mean no. of fruits retained per branch (12.99), mean no. of fruits retain per plant (195.5), mean fruit weight (242 g) and yield per plant (48.6 kg) was recorded in bending of lateral branches and partial removal of old leaves compared to control in guava.

Pomegranate:

Jhade *et al.* (2019) concluded that the spraying of ethrel at 1200 ppm was found to be more effective for quick defoliation followed by 1000 ppm and 800 ppm, respectively in pomegranate var. Bhagwa.

Phawa *et al.* (2017) revealed that application of GA_3 at 75 ppm showed maximum plant height (194.90 cm), spread of plant (194.20 cm), shoot length (15.57 cm), no. of flowers (29.01) and minimum days to flowers (23.67) in pomegranate cv. Kandhari.

Goswami *et al.* (2013) reported that application of NAA 50 ppm was found effective increasing number of fruits per plant (4767), average fruit weight (210 g), yield (10.08 kg/plant), number of stem per plant (2.89), at the time of pruning and minimum fruit drop per plant (7 %). As well as application of ethrel 200 ppm was superior for minimum days taken for first ripe fruits (152.33) in pomegranate cv. Sinduri.

Singh *et al.* (2011) noticed that maximum number of flower buds drop, flower drop, number of fruit per tree in control and minimum in deblossoming treatments, which wasstarted on 7th April and 15th April in pomegranate cv. Ganesh and Kandhari respectively.

Singh *et al.* (2006) recorded that the significantly highest thrum and pin flower drop and fruit number, was found in control as compared to other deblossoming treatment and flower buds removed and fruit set percent was found under deblossoming treatment at 7th April during 1995 and 1996, respectively in pomegranate cv. Ganesh.

Citrus:

Ranganna *et al.* (2017) concluded that minimum number of days for initiation of flowering (37.07) was recorded with treatment application of NAA @ 200 ppm during December, highest number of flowers per shoot (16.34) was recorded with drenching of paclobutrazol @ 5 ml per meter canopy for four times starting from July to December, highest percentage of flower retention (91.11) and fruit yield (13.61 kg/tree) was found in treatment GA_3 50 ppm during June + CCC @ 1000 ppm during September + KNO_3 2 % during October in acid lime cv. Balaji.

Deshmukh *et al.* (2016) found that minimum days taken to emergence of flower bud (39.57), duration of flowering (24.07), days taken to 50 % fruit set (6.54) in the application of 50 ppm GA_3 + 3.5 g *a.i*/tree paclobutrazol (soil application) + 0.2 % KNO_3 + 0.3 % Zn + 0.1 % Boron. whereas, increasing flowers per meter length of shoot (49.65) and fruit yield (32.29 kg/plant) were found in (GA_3 50 ppm + Cycocel 2000 ppm + KNO_3 0.2 % + Zn 0.3 % + Boron 0.1 %) in acid lime.

Thirugnanavel *et al.* (2007) revealed that application of 50 ppm GA_3 in June + 2000 ppm Cycocel + 2 % KNO_3 in October found effective in achieving maximum number of flower per shoot (7.01), initial fruit set (4.49 %), number of fruits per tree (224) and yield (11.15 kg/tree) in acid lime.

Conclusion:

From the foregoing discussion, it can be concluded that foliar application of NAA @ 1000 ppm in the month of April found effective to increase yield and quality in guava. Summer shoot pruning and branch bending has been reported an effective tools for crop regulation in guava. To get the maximum winter season crop guava trees are spray with aqueous solution of 15% urea for optimum regulating the crop. Rainy season crop of guava can be avoid by using one leaf pair pruning. Bending and pruning treatment in guava resulted in greater flowering and fruiting give rise to higher yield per plant. Spraying of ethrel @ 1200 ppm found effective for quick defoliation in pomegranate. Application of GA_3 at 75 ppm, NAA at 50 ppm increase the vegetative growth and flowering parameter, yield and quality in pomegranate. Early deblossoming gives the higher fruit set and yield in pomegranate. To get the good size and quality fruits, flower bud should be removed manually from 15th April and 22nd April in pomegranate. Foliar application of GA_3 @ 50 ppm during June + CCC @ 1000 ppm during Sep. + KNO_3 (2 %) in Oct. increase yield and quality of hasthbahar in acid lime. Application of GA_3 50 ppm + Cycocel 2000 ppm + KNO_3 0.2 % + Zn 0.3 % + Boron 0.1 % promise higher returns to the acid lime growers. GA_3 50 ppm in June + Cycocel 1000 ppm in September + KNO_3 2 % in October showed better performance on initiation of fruit set, fruit retention and yield in acid lime.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Patel Umang Ashvinbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020218039	**Date : 24/01/2020**
Major Guide : Dr. S. S. Gaikwad	**Time : 02.00 to 03.00 p.m.**
Minor Guide : Dr. S. S. Masaye	**Venue : Swami Vivekananda Hall**

Meadow orchard in fruit crops

In fruit crops before taking up actual planting, it is necessary to decide upon the ideal number of plant per hectare. Tree must be set at optimum planting distance to obtain the most efficient and profitable use of land. In other words, the primary objective is to develop maximum bearing surface in minimum time and space. Before adopting a definite spacing for a fruit, one should have proper knowledge about growth characteristics and tree morphology of the scion, kind of rootstock used, climate of area, depth and fertility of the soil and management practices to be followed in the orchard. A wider spacing for a given crop reduces the number of bearing units per hectare which ultimately results in reduction in yield. During the past 20-30 years lots of emphasis have been given on planting density and sustained research efforts have made it possible to grow tropical and subtropical fruit crops at a density of over 70,000 plants/ha. This density is very close to or even less than some of the field crops. With ever increasing land values, production costs, and the need of early returns on invested capitals, there is a worldwide tendency to use high density planting. Even in region where low cost land is available, growers are interested in high density planting for early returns. The fruit growers in tropical region can also adopt for high density planting, but the extent of increase in plant density should be decided very carefully.

Review of Research Work:

Guava:

Varieties

Singh (2011) reported maximum yield (8.60 kg/plant) in cv. Lalit. Besides he also found maximum flowering (90.5%) and fruit set (56.3%) in cultivar Sardar, while maximum number of shoots per plant (18.4) were recorded in Sweta cultivar of guava.

Canopy management

Pilania *et al.* (2010) reported the maximum number of flowers per shoot (50.93) in treatment I1 (pruning of 25% previous season growth). They also noticed maximum fruit set (45.40 %), fruit retention (44.45 %), fruit weight (127.79 g), pulp weight (123.84 g) as well as pulp:seed ratio (31.61) in treatment I3 (pruning of 75 % previous season growth). However, the maximum yield (5.13 kg/plant and 25.63 t/ha) as well as C:B ratio (4.32) was observed in treatment 50 % pruning of previous season growth.

Mehta *et al.* (2013) noticed that when guava tree pruned thrice in a year to 50% of its shoot length, resulted in maximum yield of summer and winter season crop and total yield per ha (34.88 t/ha and 37.24 t/ha during 2009-10 and 2010-11, respectively) in cultivar Sardar.

Spacing

Singh *et al.* (2007) recorded highest yield in rainy season (56.0 kg/tree), winter season (23.5 kg/tree) and total yield (79.5 kg/tree) from the tree planted at the distance of 3 m x 6 m in cultivar Allahabad Safeda.

In meadow system of planting at 2.0 x 1.0 m Singh (2008) revealed maximum yield (13.0, 25.0, 40.00, 50.0 and 60.0 t/ha) during 1st, 2nd, 3rd, 4th and 5th year, respectively.

Kumawat *et al.* (2014) recorded highest yield in treatment T5 (1.0 x 1.5 m). However, number of flowers/plant (88.40), fruits/plant (17.20) and fruit weight (77.50 g) were recorded in T1 (2.0 x 2.0 m). While, maximum fruit set (45.0) was noticed in T2 (2.0 x 1.5 m) in cultivar Sardar.

Mulching

Singh (2009) while working on impact of mulch in meadow orchard of guava, maximum number of new shoot (13.5 plant^{-1}) and fruit set (63.9 %) were recorded in paddy straw mulch, while highest flowering shoot per cent (78.0) and yield (63.5 t/ha) was noticed in black mulch from the tree planted at spacing of 2.0 x 1.0 m cv. Allahabad Safeda.

He also noticed maximum fruit weight (250 g), fruit length (7.9 cm), fruit diameter (7.20 cm) and ascorbic acid (177.7 mg/100 g pulp) with banana leaf mulch and maximum TSS (13.0 ^{o}brix) and total sugar (9.3%) was noticed in black mulch.

Integrated nutrient management

Pilania *et al.* (2010) studied that an application of 50:20:50 g NPK/tree + 5 kg vermicompost enriched with *Azotobacter* + *Aspergillus niger* gave significantly maximum number of flower/shoot (49.12), fruit set (45.79 %), yield (6.38 kg/tree) and total yield (31.91 t/ha) under ultra high density planting system.

Mango

Spacing

Nath *et al.* (2007) recorded highest yield (63.09 t/ha and 115.82 kg/tree, respectively) in 2.5 m x 2.5 m and 7.5m x 7.5m spacing from 1994-2002. However, in 2003 the highest yield/ha (13.9 t/ha) was observed in 5.0 m x 5.0 m spacing which was at par with 2.5 x 2.5 m in cultivar Amrapali.

Canopy management

Majid *et al.* (2018) found that 50 % pruning gave significantly higher yield per hectare (289.78 q). However, spacing of 2.5 m x 2.5 m + 50 % pruning recorded highest fruit yield/hectare (349.33 q) in Amrapali.

Gopu *et al.* (2014) recorded maximum number of fruits/tree (81.62), yield/tree (19.96 kg), hermaphrodite flower/panicle (16.53 %) and fruit set (0.276 %) in T5 (50 % remove past season growth) in cv. Alphonso

Conclusion

From the above discussion, it can be concluded that Meadow orchard planting system is going to revolutionized the fruit industry by enhancing productivity coupled with reduction of production cost. Guava planted at closer spacing (2.0 x 1.0 m or 1.0 x 1.5 m) with black mulching and pruning of branches 50 to 75 per cent for three times in a year gave higher yield. Application of nutrition and vermicompost enriched with *Azotobacter* and *Aspirgillus niger* gave higher yield as well as fruit weight of guava under ultra-high density planting. Mango cv. Amrapali planted at 2.5 x 2.5 m spacing with 50 % pruning of branches gave higher yield. The model scheme has been prepared keeping in mind what the farmers have been practically adoption in this field level. As such, credit inflow into this sub sector is mostly likely to help fruit growers in improving their economics by using appropriate cultural practices. Thus, it is clear that farmers should have to adopt this technology for improving its productivity.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Patel Yashkumar Narsinhbhai	**Course : FSC 591 (1+0)**
Reg. No. : 2020219035	**Date : 19/12/2020**
Major Guide : Dr. B. M. Tandel	**Time : 08.30 to 09.30 a.m.**
Minor Guide : Dr. N. K. Patel	**Venue : Online**

Potentiality of protected cultivation in fruit crops

With globalization of markets, shrinking land and climate change, the protected cultivation of high value crops has emerged as the single most important technology. India being a land of a marginal and small landholder, found it challenging to adopt the modern protected cultivation practices. Greenhouses were first introduced in India during 1960's for research purpose and commercial cultivation started in 1988.Currently around 2.15 lakh ha area in India is under protected cultivation. Through earlier crop production under protected condition, growers are able to capitalize on early markets and higher prices. Factors such as light, temperature, relative humidity, carbon dioxide concentration, wind speed and precipitation affects plant growth which can be control under protected cultivation ultimately improves photosynthetic efficiency. Protected cultivation can provide new alternatives and economic opportunities in crop production.

Review of literatures:

Strawberry

Kadir *et al.* (2006) found that the high tunnel (HT) protected strawberry fruits were produced 5 weeks earlier, larger in size, high soluble solids concentration (SSC), high marketable fruit plant^{-1} and high yield plant^{-1} than plants in field condition. Under high tunnel, maximum fruit weight, marketable fruitsplant^{-1} and yield recorded in cv. Chandler.

Pandey *et al.* (2015) revealed that strawberry (*Fragaria*x*ananassa* Duch.) grown in naturally ventilated polyhouse had higher crown height (26.46 cm), plant spread E-S (48.05 cm) and N-S (44.06 cm) as well as higher fruit yield (242.77 g plant^{-1}) with maximum number of fruits plant^{-1} (29.00).

Depardieu *et al.* (2017) found that plugged tray plants had a higher crown diameter growth rate, leaf dry massand marketable yield than bare-root plants. While bare-root plants under aged bark (AB) substrate resulted better quality parameters such as firmness and brix index in strawberry under greenhouse condition.

Kumar *et al.* (2018) observed that number of leaves (18.2), plant height (20.18 cm), fruit set (84.01 %), fruit weight (21.13 g), yield plant^{-1} (459.78 g) and ascorbic acid content (41.68 mg 100 g^{-1}) were significantly higher as well as minimumdays required from planting to flowering (32.88) in fruits harvested from plants mulched with black polyethylene than other mulches in strawberry cv. Winter Dawn under protected cultivation.

Panigrahi *et al.* (2020) revealed that maximum plant height, number of leaves and number of runners were found in strawberry cv. Nabila.While earliest flowering, fruiting and fruit maturity were recorded in strawberry cv. Sabrina under protected cultivation.

Banana

Gubbuk and Pekmenzci (2004) revealed that pseudostem circumference, pseudostemheight, number of leaves, number of hands, finger per bunch and bunch weight were found higher as well as minimum days required from shooting to harvest observed under protected cultivation in banana cv. Dwarf Cavendish.

Guven and Gubbuk (2014) noticed that highest pseudostem circumference (92.06 cm), pseudostem height (313.83 cm), leaves number (32.14), hand number (13.33) and minimum days from flowering to harvest (140.67) were observed in Williams variety of banana. While maximum bunch weight (57.42 kg) was observed in MA-13cultivar of banana.

Papaya

Reddy and Gowda (2014) found that 'Red Lady' papaya grown under greenhouse showed minimum days taken for flowering (84.69 days), higher fruit set (74.38%), fruit weight (962.70 g), fruit length (20.63 cm), fruit breadth (14.03 cm), yield (33.11 kg plant^{-1}) and pulp weight (813.46 g) as compared to open field. They also reported that fruit quality parameters *i.e.* carotene content (2.42 mg 100g^{-1}), firmness (2.82 kg cm^{-2}), shelf life (7.92 days), total soluble solids (13.92 ˚Brix), reducing sugar (9.53 %), non-reducing sugar (3.11 %) andtotal sugar (12.64 %) were found better in 'Red Lady' papaya under greenhouse.

Kaur and Kaur (2017) noticed that the plants under net house showed maximum plant height (214.05 cm), stem girth (35.67 cm), number of leaves (20.46), petiole length (72.26 cm), leaf area (876.5 cm^2), number of hermaphrodite flowers (51.32), pistillate flowers (15.58 %), fruits per plant (42.25), fruit set (63.12 %), yield (35.15 kg plant^{-1}) and minimum days taken for flowering (66.76) were recorded in papaya cv. Red Lady 786.

Grape

Sabir *et al.* (2019) revealed that under greenhouse condition, pulverization of zinc and *Bacillus subtilis*enhanced cluster weight and yield as well as lower decay rate as similar to chemical applications in 'Prima' grape. While soluble solid content was higher in calcite and *B. subtilis*treatments.

Pomegranate

Meena *et al.* (2016) recorded that shading with red shade net (50%) resulted in the significantly increased in the fruit weight (310 g),fruit length (83.39 mm), yield (6.70 kgtree-1) and enhanced fruit colour (46.38 L) as compared to the open field condition in pomegranate cv. Mridula.

Mango

Medany *et al.* (2009) revealed thatmango plant grown under white net recorded maximum height, number of leaves, number of branches and stem diameter per plant compared to open field orchard.

Juntamaneeet al. (2013) found that use of plastic roof in mango orchard reduced anthracnose at pre and post-harvest period, decreased severity of fruit rot and completely controlled thrips damage (%) compared to natural condition.

Sweet orange

Abd El-Naby *et al.* (2020) recorded that Washington Navel orange grown under shade net, especially covering the trees for certain period from the first of March until the end of June for every season was given maximum number of fruits (159 and 184), fruit diameter (8.73 and 8.85 cm) and yield (57.20 and 68.08 kg tree-1) during 2017 and 2018 seasons, respectively.

Dragon fruit

Chang *et al.* (2016) reported that 50 and 75 % black shade net maintained lower temperature, avoid sunburn problem and improved cladodes color by decreasing lightness (L*) and chroma (C*), but increasing hue angle (h˚) in 'Shih HuoChuan' dragon fruit. They also reported that maximum fresh weight with higher TSS/acid ratio and the lowest fruit splitting percentage were found in 50 % black shading net.

Conclusion

From the ongoing discussion, it can be concluded that fruit production and quality could be improved under protected cultivation as compared to open condition. Strawberry exerted early flowering, fruiting, maturity, maximum plant growth, yield and quality grown under protected condition with black polythene mulch. Banana grown under polyhouse produce excellent growth, flowering, yield parameters and early harvesting.Papaya cv. Red Lady 786 under net house and greenhouse shows better growth, flowering, fruiting, yield and quality parameters. Under protected cultivation of 'Prima' grape, zinc and Bacillus subtilis enhances cluster weight, yield and reduce decay rate. In pomegranate cv. Mridula, red shade net (50%) have shown to escalate yield and yield attributing characters. In mango, growth increases under white net and plastic roof reduced anthracnose, fruit rot and avoidthrips damage. Covering the trees with shade net from Marchto end of June gives maximum yield and yield attributing characters in Washington Navel orange. In dragon fruit, 50 and 75 % black shade net maintained temperature, avoid sunburn and improved cladode colour as well as improve quality.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker	**: Chaudhari Lavbhai Bhagubhai**	**Course**	**: PSMA 591 (1+0)**
Reg. No.	**: 2020215009**	**Date**	**: 31/12/2016**
Major Guide	**: Dr. M. M. Patel**	**Time**	**: 04.00 to 05.00 p.m.**
Minor Guide	**: Dr. T. R. Ahlawat**	**Venue**	**: Swami Vivekananda Hall**

Advances in production technology of turmeric

Turmeric (*Curcuma longa* L.) belonging to the family Zingiberaceae is one of the most valuable and important spices of the world. India is the largest producer and exporter of turmeric. India has nearly 1.95 lakh hectares under turmeric cultivation with a total production of 9.92 lakh tonnes. In India it is grown mainly in the states of Andhra Pradesh, Tamil Nadu, Uttar Pradesh, Bihar, Kerala, Odisha, Maharashtra and Gujarat. However, Andhra Pradesh and Tamil Nadu contribute nearly 50% of the production. Turmeric has characteristic flavour and yellow colour. It is cultivated for its underground rhizomes which are used as spice, dye, drug, in cosmetic industry and in religious ceremonies. The turmeric rhizomes contain a variety of pigments in which 'curcumin' is the major pigment responsible for colour. Apart from curcumin and the volatile oil 'turmerol' it also contains appreciable quantities of protein (6.3 %), lipids (5.1 %), carbohydrates (69.7 %) and fibers (2.6 %). With this, new advance practices and technology are shown below to enhance the production in turmeric.

Brief Review of Research Work

Varietal performance

Chaudhary *et al.* (2006) studied varietal performance of turmeric varieties on yield attributes and they found that among the different varieties of turmeric the variety Krishna gave highest rhizome per plant, length of the rhizome, gross yield of green turmeric, cured turmeric and dry weight of shoot.

Microrhizome production

Naz *et al.* (2009) observed that the highest percentage of shoot induction was found in application of MS media + BAP 3.0 mg/l in Faisalabad and Kasur variety and application of BAP + NAA 2 mg/l + 1mg/l in Banun variety. They also studied effect of different concentrations of cytokinin and auxins on shoot and root length and found that application of MS media + BAP 1.0 mg/l resulted in highest shoot and root length in all three varieties.

Chougule *et al.* (2011) studied the influence of growth regulators on microrhizome production in turmeric and they observed that the days taken for initiation of microrhizome, number of microrhizome per shoot, weight of microrhizome and number of nodes per microrhizome was found good in MS media containing 1 mg/l BAP.

Soil and climate

Garg (2011) studied the fresh yield of turmeric grown at different levels of soil ESP and he found that up to 10 ESP level cv. Rajendra Sonia variety gave highest yield, whereas the ESP level increased, cv. Meducar showed highest yield.

Propagation

Dhatt *et al*. (2008) studied the effect of planting material on growth characteristics of turmeric and they observed that plant height, number of tiller, number of leaves and leaf length was found to be highest when mother rhizome and primary rhizome was used as planting material.

Kumar and Gill (2010) studied the effect of planting materials on fresh, dry and processed yield of turmeric and they found that mother rhizome was better over primary and secondary finger for all the parameters. Among spacing, 60 x 10 cm was found best for all growth parameters.

Intercropping

Kumar and Roybarman (2012) reported that the plant height, number of leaves, clump weight, yield and dry yield was highest in cv. Sudarsana, hence it was better suited for intercropping with coconut.

Fertilizer

Banwasi and Singh (2010) found that the application of 150 and 100 kg/ha phosphorus resulted in better vegetative growth as well as higher yield in turmeric.

Sathish and Paramaguru (2010) studied the response of bioregulants on nutrient uptake of turmeric cv. BSR 2 and they found that highest leaf nitrogen content and nitrogen uptake was recorded with humic acid 0.05% foliar spray.

Syed *et al*. (2010) studied the effect of fertigation on growth and yield characters in turmeric cv. Mydukur and they observed that 75 % recommended dose of N and K through drip was best for all growth parameters and B:C ratio.

Dhanoji (2011) studied the effect of foliar spray of micro nutrients and plant growth regulators on yield and yield traits in turmeric and stated that the treatment Lihosin 0.05 % spray was best for main finger length, width, number of main fingers and yield.

Inter cultivation

Verma and Sarnaik (2006) stated that paddy straw as mulch proved best for all growth and yield parameters of turmeric cv. 'Shillong'.

Harvesting and Yield

Rao *et al.* (2006) observed that the short duration genotype PCT-13 and PCT-14 recorded higher curcumin content over medium and long duration genotypes.

Plant protection

Saravaiya *et al.* (2011) studied the different growth and quality parameters of different genotypes and found the highest values for growth parameters like plant height, number of leaves, number of tillers, number of fingers, length of rhizome, days to maturity, green and dry weight of rhizome, powder yield and quality parameters like curcumin (%), oleoresin (%), leaf colour and powder colour found in NVST-37.

Rao *et al.* (2012) stated that the least disease incidence and disease control efficiency was observed in rhizome treatment + foliar application of propiconazole at 45 and 90 DAP and rhizome treatment + foliar application of carbendazim + mancozeb at 45 and 90 DAP which were on par with each other in relation of PDI and PEDC.

Conclusion

From the foregoing discussion, it can be concluded that the efforts to increase production of turmeric have been made by exploring and selecting superior cultivars, optimizing fertilizers, intercropping with compatible crops, Sustainable Turmeric Initiative (STI) methods, mechanized farming and drip irrigation. NVST-37 possessed compact rhizome with more length, width and fiberless rhizome with higher number of fingers per rhizome which is suitable for South Gujarat conditions. The demand in world market for turmeric is consistently increasing, so there is more scope for inventing new production technologies to increase the quality and yield.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker	**: Patel Urvi Thakorbhai**	**Course**	**: PSMA - 591**
Reg. No.	**: 2020215046**	**Date**	**: 31/12/2016**
Major Guide	**: Dr. M. M. Patel**	**Time**	**: 11.00 – 12.00 hrs**
Co – Guide	**: Dr. T. R. Ahlawat**	**Venue**	**: Swami Vivekananda Hall**

Integrated nutrient management in medicinal crops

Medicinal plants are rich in secondary metabolites and are potential sources of drugs. Among ancient civilizations, India has been known to be rich repository of medicinal plants. Ayurveda, *Unani*, *Siddha*, Homeopathy and Folk systems are traditional system of medicine in India, popular for make extensive use of herbs in therapeutic treatments. India is very rich in medicinal plant flora. More than 750 medicinal plant species are reported from Gujarat alone. India exported herbal products worth about 500 crores in 2001and Rs. 9,000 crores in 2012 (Asha, *et al*., 2014).

Integrated nutrient management is required for producing quality of economic produce of medicinal plants. Integrated nutrient management is a concept which aims at maintenance of adjustment of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of benefit from all possible sources of plant nutrient in an integrated manner (Roy and Ange, 1991).

Brief review of literature:

Safed Musli (B.N.:-*Chlorophytum borivillianum*, Family:- Liliaceae)

Gaikwad *et al.* (2011) conducted experiment on loamy sand soil during *kharif* season to study the effect of organic manures and bio-fertilizer on soil fertility, yield and quality of safed musli under semi-arid hot region at Anand. They observed that maximum yield, sapogenine content, organic carbon, available N_2, P_2O_5 and K_2O were recorded in application of 2 t vermicompost/ha + *Azotobacter*.

Kalmegh (B.N.:- *Andrographis paniculata* Wall. Ex. Nees., Family:- Acanthaceae)

Tiwari *et al.* (2012) carried out a field experiment to study the effect of different sources of nitrogen on physiological parameters of kalmegh. Leaf area, leaf area index, chlorophyll a and b content in leaves, herbage yield were found highest in 100% RDN through FYM followed by 100% RDN through vermicompost and 100% RDN through poultry manure.

Mishra and Jain (2014) evaluated the effect of integrated nutrient management on vegetative growth, flowering and fruiting of kalmegh. The results indicated that maximum growth *i.e.* plant height, number of branches, number of leaves, leaf length and leaf breadth, leaf area, land area occupied by per plant and leaf area index were recorded by application of 50% NPK + 5 t/ha vermicompost + 250 g bio-fertilizer (125g *Azotobacter* + 125 g PSB).

Chauhan Hemalatha *et al.* (2015) revealed that application of microbial consortia with 50% NPK performed best with respect to growth, yield, quality and nutrient uptake in kalmegh as compared to other treatments.

Patel and Patel (2016) carried out a field experiment to assess the effect of INM on growth, yield and economics of kalmegh and found that 100% RDN through neem cake gave maximum growth and yield whereas, maximum BC ratio was found in 100% RDN through biocompost.

Isabgol (B. N.:- *Plantago ovata* Forsk, Family:- Plantaginaceae)

Raissi *et al.* (2012) studied the effects of phosphate bio-fertilizer, organic manure and chemical fertilizer on yield, yield components and seed capabilities of isabgol. Result showed that effect of vermicompost on spike length, number of grains per spike, 1000 seed weight, crop yield and seed yield per hectare was stronger than other treatments. Maximum number of shoot length, root length and germination rate were recorded for the phosphate bio-fertilizer.

Glory lily (B.N.:-*Gloriosa superba*, Family:- Liliaceae)

Gupta *et al.* (2013) conducted a field experiment to study the influence of organic and inorganic fertilizers on its growth and yield. Vermicompost @ 4 t/ha + ⅓ NPK was found more effective than other treatments.

Ashwagandha (B.N.:- *Withania somnifera* Dunal, Family:- Solanaceae)

Boudh *et al.* (2013) carried out a field experiment to evaluate the effect of organic and inorganic sources of nutrients on physiological and biochemical parameters of ashwagandha var. Jawahar-20. Among the organic sources of nutrients, triple bio-fertilizers (*Azospirillum*, *Azotobacter* and PSB) brought about significantly higher chlorophyll content ('a' and 'b'), carotene content, photosynthetic and respiration rates as well as total alkaloid content over the remaining organic sources. However, FYM 5 t/ha produced maximum root yield and thereby alkaloid yield. Amongst the inorganic sources of nutrients, 100% RDF (20:40:20 NPK kg/ha) recorded significantly higher values of all these physiological and biochemical parameters including root yield and alkaloid yield.

Raja and Veerakumari (2013) studied the impact of cowdung vermicompost, leaf ash vermicompost and poultry feather vermicompost on yield and alkaloid content in ashwagandha. The plant growth, yield and alkaloid content were significantly increased in the plants cultivated in the soil amended with poultry feather vermicompost.

Periwinkle (B.N.:- *Catharanthus roseus* G. Don, Family:- Apocynaceae)

Chaurasia and Singh (2015) conducted an experiment to study the effect of integrated nutrient management on growth and productivity of periwinkle. Application of 10 t FYM/ha + 80:30:50 kg/ha NPK followed by application of 250 kg/ha bone meal + 250 kg/ha neemcake + 80:30:50 kg/ha NPK were found more effective for increasing plant growth and productivity of periwinkle.

Conclusions:-

From the foregoing discussion it can be concluded that application of chemical fertilizers along with organic manures and biofertilzers improve physiological and biological parameters of medicinal crops as well as soil physical, chemical and biological properties. Application of 4 t/ha vermicompost along with 40: 17: 25 NPK kg/ha in glory lily, while 10 t/ha FYM along with 80: 30: 50 kg/ha NPK in periwinkle is superior over application of manures or fertilizers alone. Application of 2 t/ha vermicompost along with *Azotobacter* improved yield, sapogenine content as well as organic carbon content, available nitrogen and phosphorous in soil. In case of isabgol biological fertilizing systems have ability to produce more reliable seeds with more storability potential compared to conventional system. Application of chemical fertilizer along with biofertilizer and vermicompost was effective to increase percentage andrographolide content and improving yield and growth of kalmegh and ashwagandha.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker	**: Patel Zina Ashokbhai**	**Course**	**: PSMA - 591**
Reg. No.	**: 2020215049**	**Date**	**: 16/12/2016**
Major Guide	**: Dr. P. P. Bhalerao**	**Time**	**: 02.00 – 03.00 pm**
Co – Guide	**: Dr. S. S. Gaikwad**	**Venue**	**: Swami Vivekananda Hall**

Integrated nutrient management in coconut

Coconut is botanically known as *Cocos nucifera* L. belongs to the family Arecaceae and also known as '*Kalpavriksha*'. It shares about 91.47 % production as compared to other plantation crops in India. India is the largest producer of coconut in the world with 149.11 Lakh tonne production. Kerala, Karnataka, Tamil Nadu and Andhra Pradesh are leading coconut producing states in India. In Gujarat, the area under coconut is 31.63 thousand hectare and production is 295.03 million nuts (Anonymous, 2015a). Coconut requires well managed fertilizer programme for good production. Integrated nutrient management means combined application of different sources of plant nutrients like organics, inorganic and bio fertilizers for sustainable crop production without degrading the natural resources on long term basis. The aim of integrated nutrient management is to integrate the use of natural and man-made soil nutrients to increase crop productivity and preserve soil fertility for future generations.

Brief review of literature:

Kalpana *et al.* (2008) studied the effect of different INM treatments on growth, yield, quality and economics and found that 50% CCP (25 kg) + 50% chemical fertilizers (0.5 kg Urea + 1.0 kg SSP + 1.2 kg MOP) gave maximum growth, yield, quality with highest BC ratio in coconut.

Karunasinghe *et al.* (2009) studied the effect of PL (Poultary manure) and IFM (Inorganic fertilizer mixture) on root colonization, arbuscular, yield and soil physico-chemical parameters. They found maximum percentage of root colonization and arbuscular in NT (non-treated) whereas, maximum nut yield as well as pH, EC and OC were found in treatment of PL in coconut.

Suresh (2010) studied the effect of fertilization and root feeding of coconut tonic on leaf nutrient composition and nut yield of coconut. He found that recommended dose of NPK (1.3 kg Urea + 2.0 kg SSP 2.0 kg SSP) + root feeding of TNAU coconut tonic (200 ml/palm/year) gave maximum yield but there was no significant effect on leaf nutrient composition in coconut.

Nistane *et al.* (2011) studied the effect of micronutrients on flowering, yield as well as quality characters and leaf nutrient status of coconut cv. D×T. They found that foliar application of $FeSO_4$ 1% + $ZnSO_4$ 1% + Borex 0.5% not only enhance flowering and yield but also gave quality nuts.

Solangi and Iqbal (2012) reported maximum number of leaves and petiol length was found in NSP GSL. Maximum height of seedling, maximum ranches length and maximum number of roots was found in combination treatment of NPK + NSP + GSL in coconut seedling.

Masheswarppa *et al.* (2013) studied the effect of different INM treatments on yield, copra content and oil content of coconut in coconut based HDMSC. They found that there was no significant result among applied treatments even though there were highest nut yield, copra and oil content was in the treatment of fully organic with recycling biomass (VC) + biofertilizer + green manuring + vermiwash + husk burial + mulching.

Maheshwarappa *et al.* (2014) found that nut yield was increased over the years than pre-treatment yield due to the application of 50% N in form of VC + 50% NPK. They also found that significant change of pH and OC in soil was due the application of 75% and 100% N through VC. There was no significant change in EC of soil, number of leaves in crown and leaf production in coconut.

Experiment was conducted on effect of different levels of fertigation on growth of coconut var. 'Sakhi Gopal Tall'. She observed that maximum plant height, collar girth, no. of functional leaves and annual leaf production in coconut when they were fed with 100% RDF NPK (900:300:1200 g/palm) as fertigation. (Anonymous, 2015b)

Experiment was conducted on influence of nutrients on growth, yield and quality of dwarf tender coconut var. COD and found that the treatments were non significant in response due to the application of different treatments even though growth, yield and quality were found to be highest in treatment of combine application of organic and inorganic fertilizers. (Anonymous, 2015c)

Experiment was conducted on influence of integrated nutrient management practices on growth, yield and economics of coconut based integrated cropping system. He found that 50% recommended fertilizer NPK (750:375:750 NPK) + 40 kg VC/plant + 100 ml *Azatobactor*/plant + 20 kg green manure/plant + 10 ml vermiwash/plant not only gave maximum growth and yield but also gave highest BC ratio in coconut cv. 'D×T'. (Anonymous, 2015d)

Senjaliya *et al.* (2015) studied the effect of INM treatments on yield of coconut cv. 'West Coast Tall'. They found that 50% RDF + 50% N from castor cake gave maximum nut yield/plam/year, maximum weight of nut and maximum weight of kernel.

Conclusion:-

From the foregoing discussion, it can be concluded that in coconut to ensure maximum growth, yield and quality, nutrients should be applied through organic as well as inorganic sources. Application of NPK @ 1500:750:1500 g/palm/year along with VC (40 kg/palm), green manure (20 kg/palm), biofertilizers (100 ml/palm), vermiwash (10 lit/palm) as well as 50% CCP + 50% chemical fertilizers (0.5:1.0:1.2 kg NPK) also gave maximum growth, yield and highest BC ratio. Foliar spray of micronutrients like $FeSO_4$ 1% + $ZnSO_4$ 1% + Borex 0.5% showed good results in terms of flowering, yield, quality and leaf nutrient status. Application of poultry manures (30 kg/palm) gave maximum nut yield as well as maximum soil pH, EC and OC. Coconut palm fed with 100% RDF (900:300:1200 g NPK/palm) as fertigation shows maximum growth. Root feeding of TNAU tonic (200 ml/palm/year) along with recommonded dose of NPK (1.3:2.0:2.0 kg) as well as 50% RDF (400:320:1500 g/palm/year) + 50% N in form of castor cake showed significantly higher yield in coconut.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker	**: Dhoti Sachinbhai Dilipkumar**	**Course**	**: PSMA – 591 (1+0)**
Reg. No.	**: 2020217005**	**Date**	**: 01/09/2018**
Major Guide	**: Dr. M. M. Patel**	**Time**	**: 10.00 – 11.00 a.m.**
Co – Guide	**: Dr. B. M. Tandel**	**Venue**	**: Swami Vivekananda Hall**

Organic farming in medicinal crops

Medicinal plants rich in secondary metabolites and are the most important source of life saving drugs have been used for cure of various diseases and physiological abnormalities in ancient traditional system such as *Ayurveda*, *Unani* and *Siddha*. Medicinal plants are mainly used as nutraceuticals, food supplements and folk medicines. According to the report of World Health Organization (WHO) more than 80 % of the world's population relies on traditional medicine mainly of plant base in their primary healthcare. Continuous use of synthetic fertilizers and pesticides chemical cause ill effect on soil, crops as well as human and animal health. Medicinal plants are source of drugs so there is need of production of medicinal cropss without any chemical treatments. Organic farming is reliable way to chemical residue free production of medicinal crop. Organic farming is a system which avoids or largely excludes the use of synthetic inputs such as fertilizers, pesticides, hormones and feed additives. It rely upon crop rotations, crop residues, animal manures, off-farm organic waste and biological system of nutrient mobilization and plant protection. No chemical or pesticide is used in crop production, there is no chance of pesticide residues in product. Organic products are healthier and have better product quality.

Review of research work

Kalmegh (B. N. : *Andrographis paniculata* L., Family: Acanthaceae)

Makawana *et al.* (2010) recorded maximum plant height, plant breadth and leaf:stem ratio, highest fresh and dry yield of kalmegh with application of FYM 10 t/ha.

Khan *et al.* (2015) recorded significantly highest stem:leaf ratio, fresh herb yield and andrographoloide yield with application of vermicompost 5 t/ha + *Azotobacter chrococcum.*

Ram *et al.* (2008) obtained maximum plant height, plant spread, number of primary branches per plant, number of secondary branches per plant, number of leaves per plant, fresh herbage yield and dry herbage yield in treatment of FYM 10 t/ha.

Stevia (B. N. : *Stevia rebaudiana* Bertoni, Family: Asteraceae)

Zaman *et al*. (2017) recorded significantly maximum plant height, number of primary branches per plant, number of leaves per plant, leaf area per plant, leaf dry weight per plant with application of cow dung 10 t/ha.

Charankumar (2009) studied the effect of organic manure and bio fertilizers on yield and quality of stevia. He noticed that maximum fresh leaves per plant, dry leaves per plant and stevioside content were obtained with 50 % RDN through vermicompost + 50% through neem cake + biofertilizer.

Isabgol (B. N. : *Plantago ovata* Forsk, Family: Plantaginaceae)

Raissi *et al.* (2012) studied the effects of phosphate bio-fertilizer, organic manure and chemical fertilizers on yield, yield attributes of isabgol. They noticed that maximum spike length, grain per spike, seed yield per plant and yield per hectare obtained with application of vermicompost 10 t/ha.

Ashwagandha (B. N. : *Withania somnifera* Dunal., Family: Solanaceae)

Guruprasad *et al.* (2014) recorded minimum days for 100% flowering, maximum root length, root diameter, root yield and seed yield with application of FYM 5 t/ha + vermicompost 0.5 t/ha.

Meena Kumari and Upadhyay (2012) noticed maximum root diameter, root length, seed yield per plant and root yield per plant with the application of vermicompost 10 t/ha and transplanted at spacing 60 x 60 cm^2 during panchang time.

Kumar *et al.* (2009) recorded maximum plant height, number of offshoots per plant, root yield and seed yield with application of FYM 20 t/ha + *A. chroococcum* + *P. putida.*

Coleus (B. N. : *Coleus forskohlli* Briq., Family : Lamiaceae)

Saraswati *et al.* (2016) recorded that the maximum number of tuber per plant, length of roots, diameters of roots, fresh weight of tuber per plant, fresh weight of tuber per hectare, dry weight of tuber per plant and dry weight of tuber per hectare with application of 100% RDN through FYM. They also recorded maximum forskolin content and forskolin yield in treatment 100% RDN through poultry manure.

Padmadevi *et al.* (2016) recorded significantly maximum plant height, stem girth, lamina length, lamina breadth, tuber length, fresh weight, carbohydrate content in tuber and protein content in tuber with application of composted coir pith @15 t/ha.

Shakila and Gunasekaran (2014) recorded lowest weed density, weed dry weight and highest weed control indexes with black polythene mulch. They also recorded maximum number of tuber per plant, tuber length, tuber girth, fresh weight of tuber per plant, per plot and per hectare were observed in black polythene mulch and organic mulches also found best over control so, organic point of view organic mulches were best.

Senna (B. N. : *Cassia angustifolia* Vahl., Family: Leguminosae)

Prabha and Vasantha (2010) recorded significantly maximum shoot length, root length, number of branches per plant, number of pods per plant, fresh weight per plant, dry weight per plant and chlorophyll content with application of FYM + Spraying of *panchagavya* (2%).

Conclusion

From the foregoing discussion, it can be concluded that medicinal crops respond positively to organic cultivation practices. Mulching, green manuring and different organic manure either alone or in combination with bio fertilizers are being used for organic production of medicinal crops. In kalmegh, application of FYM 10 t/ha increase growth and yield and application of vermicompost 5 t/ha + *Azotobacter chrococcum* maximize the growth, yield and andrographolide yield. In stevia, application of cow dung 10 t/ha increase growth and yield. The application of 50% RDN through vermicompost + 50% through neem cake + bio fertilizer increase the growth, yield and quality. In isabgol, application of vermicompost 10 t/ha maximize the yield. In ashwagandha, application of FYM 5 t/ha + vermicompost 0.5 t/ha minimize the days for flowering and increase the yield. The application of vermicompost 10 t/ha and transplanted during *panchang* time with spacing 60 × 60 cm^2 maximize the yield. The application of FYM 20t/ha + *A. chrococcum* + *P. putida* increase the growth and yield. In coleus, application of 100% RDN through FYM increase the yield and 100% RDN through poultry manure increase the forskolin content and forskolin yield. The Application of composted coir pith at 15 t/ha increase the growth, yield and quality. The application of organic mulch control the weed and increase the yield. In senna, application of FYM + spraying of *panchagavya* (2%) increase the growth, yield and quality.

Constrains in organic cultivation of medicinal crop

Organic manure contain fewer amount of nutrient, lack of awareness, marketing problems of organic product, poorly supporting infrastructure, high input cost, lack of financial support, low yields during conversion period, complex certification procedure and lack of organic input responsive variety (Meena *et al*., 2013).

Future thrust

The area of medicinal crop under organic farming needs to be increase at a faster space. Precision farming with organic inputs needs to be standardized. Development of package of practices for organic production of medicinal crops. Provide linkage between growers and pharmaceutical companies to ensure marketability of raw drugs. Building brand name for encouraging export of medicinal plants and their products.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker	**: Kalpesh Makwana**	**Course**	**: PSMA – 591 (1+0)**
Reg. No.	**: 2020216016**	**Date**	**: 08/01/2018**
Major Guide	**: Dr. M. M. Patel**	**Time**	**: 2.30 – 03.30 p.m.**
Co – Guide	**: Dr. D. R. Bhanderi**	**Venue**	**: Swami Vivekananda Hall**

Recent practices for raising coconut seedlings

Introduction

The coconut palm, *Cocos nucifera* L., belongs to family Palmae with its tall, slender and uniformly thick stem, massive crown, large number of leaves and bearing bunches of nuts in their axils is one of the most beautiful and useful palm in the world. At global scale, coconut is grown in about 12.9 M/ha in over 90 countries, India is the third largest coconut producing country in the world. The four Southern states; Kerala, Karnataka, Tamil Nadu and Andhra Pradesh are the main growing areas in the country. In the North East, it is mostly grown in Assam and Tripura. Every part of the tree is useful to human life for some purpose or the other. Hence, the coconut palm is called *'kalpavriksha*' meaning tree of heaven which provides all the necessities of life. It is a perennial oil yielding crop that plays an important role in the socio-economic life of large number people in the country. It is exhibits considerable genetic variation and is propagated mainly through seeds. Raising and selection of healthy coconut seedlings in nursery alone ensures 10 % improvement in yield (Liyanage,1953). Coconut is propagated through seed hence, selection and use of planting material of higher value assumes much importants. The fact that the coconut is a cross-fertilized palm and that it does not breed true, makes the selection of seed nuts and then of seedlings in the nursery more difficult and important also.

Review of research work

Selection of nut

Chattopadhyay and Hore (2012) reported that seedlings raised from heaviest seed nut (1001-1100 g) group exhibited the maximum seedling height (98.38 cm), collar girth (11.95 cm), number of leaves (6.74) and length of leaves (91.45 cm) as compared to 82.16 cm, 9.70, 5.24,and 82.72 cm in minimum nut weigltt group (601-700 g).

Raja and Sivasubramaniam (2015) found that the seed nut size grade 901-1000 g registered speedy germination (1.75 %), collar girth (6.0 cm) and number of leaves (3.3) in var. East Coast Tall.

Nursery site

Raja and Sivasubramaniam (2015) reported that the nursery bed with mist chamber grown coconut var. East Coast Tall registered higher growth rate (2.20) and plant height (82.6 cm).

Media

Karthikeyan *et al.* (2009) revealed that coconut seed nut showed beter response by the water soaked nuts sown in sand (3) and vermicompost (1) media which significantly influenced seed germination and subsequent growth of plant.

Pre-sowing treatment

Nagar *et al.* (2013) showed that fifteen days rest after harvesting (R2) was better with respect to earliness in germination with higher percentage of germination and growth with maximum height of seedling and number of leaves. Whereas in per-sowing treatment, seed nut soaked in water for 15 days with punching was superior in early germination and growth of seedling**.**

Weed control

Senarathane and Perera (2010) found significantly tallest seedling (125 cm) and maximum collar girth (14.83 cm) in seed nuts treated with glyphosate 1.08 kg a.i/ha.

Planting method

Chattopadhyay and Hore (2012) found significantly maximum germination percentage (86.80%), height (93.42 cm), collar girth (11.14), number of leaves (6.50) and length of leaves (87.26 cm) in horizontal sowing of coconut seedling.

Raja and Sivasubramaniam (2015) reported significantly maximum growth rate (2.12), germination percentage (90%), plant height (78.6 cm), collar girth (8.1 cm) and number of leaves (3.8) in vertical planted coconut seed nut var. East Coast Tall.

Fertilizer

Perera *et al*. (1996) revealed that the substitution of topsoil in the polybag mixtures with river sand had no significant effet on the development of coconut seedlings and they also found that application of fertilizer improved the seedling height and girth, but this effect was significant only five months after seed nut laying.

Conclusion

From the foregoing discussion, it can be concluded that recent practices for raising coconut seedlings, for the selection of nut must have age of 11-12 months and weight of 901 – 1100 g. Use mist chamber for nursery structure with using media of sand and vermicompost (3:1). Seed nut soaked in water for two weeks before sowing as pre-sowing treatment. For the weed control in nursery stage use glyphosate 1.08 kg a.i./ha. Use horizontal method of planting to raise the seedling. Above different practices were found better in all case of growth rate, germination percent, plant height, number of leaves, collar girth, length of leaves.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker	**: Prajapati Vishalkumar R.**	**Course**	**: PSMA – 591 (1+0)**
Reg. No.	**: 2020216027**	**Date**	**: 06/01/2018**
Major Guide	**: Dr. M. M. Patel**	**Time**	**: 10.00 – 11.00 a.m.**
Co – Guide	**: Dr. Sanjeev Kumar**	**Venue**	**: Swami Vivekananda Hall**

Recent advances in micro-propagation in medicinal plants

Medicinal plants are the most important source of life saving drugs and have been used for cure of various diseases and physiological abnormalities in ancient traditional system such as Ayurveda, Unani and Siddha. Medicinal plants are mainly used as nutraceuticals, food supplements and folk medicines. Due to excess demand of herbal medicine and less effort on systematic propagation, the over-utilization from wild resulted in to loss of genetic biodiversity and forced many of medicinal plants to become vulnerable, threatened or endangered. As per the record of International Union for Conservation of Nature and Natural Resources(Anju Rani and Kumar., 2017) 44 medicinal plant species are critically endangered, 113 endangered and 87 vulnerable in India. Hence, there is an urgent need to conserve the plant resources for the benefit of human beings. Micro-propagation is one of the most important tools for conservation and multiplication of these rare and endangered species of medicinal plants. Through micro-propagation, it is possible to produce a large number of plantlets from single explants within a short time.

Review of Research Work

Kalmegh (*Androgrphispaniculata* L.)

Al-Mamun *et al.* (2015) reported maximum culture responded (80.09±1.9 %), number of shoots per explant (6.8±0.2) and length of longest shoot (4.0±0.3 cm) in application of 0.5 mg/l BAP. They also recorded that 0.2 mg/l IBA gave significantly higher root induction (100 ±0.9 %), number of roots per explant (12.4±0.5) and length of longest shoot (3.7±.0.2 cm) and minimum days to root initiation (8-10 days).

Sarpagandha (*Rauwolfiaserpentina*Benth)

Susila *et al*. (2013) reported highest number of shoots/culture (5.8), average number of useful shoots (5.6), average length of shoot (6.8 cm) and shooting percentage (92 %) in the treatment 1 mg/l NAA + 2.5 mg/l BA. They also reported that 0.4 mg/l NAA + 0.1 mg/l IBA gave maximum rooting percentage (91 %), root length (6.5 cm) and number of roots per culture (16) and minimum days for root formation (27-35 days).

Nirbrahmi (*Bacopamonnieri*L.)

Jain *et al*. (2013) found maximum number of shoot (87 %), shoots per plant (3.4 ± 0.16) and shoot length (2.6 ± 0.31 cm) in the treatment 0.50 BAP mg/l. They also reported that 0.25 mg/l IBA gave highest rooting (86 %) and number of roots /culture (3.5 ± 0.76).

Bahera (*Terminaliabellerica*Roxb.)

Jaya *et al.* (2013) noticed that 3.5 mg/l BAP + 0.5 mg/l Kin gave significantly higher number of shoots/ culture (5.02 ± 0.76) and shoot response (90 %). Whereas the maximum shoot length (3.87 ± 0.39 cm) was found in 2.0 mg/l BAP + 0.5 mg/l Kin treatment. They also reported that 0.1 mg/l IBA gave maximum number of roots/explants (3.60 ± 0.51), root length (1.68 ± 0.32 cm) and rooting response (90 %).

Ashwagandha (*Withaniasomnifera*Dunal)

Rishikesh *et al*. (2016) reported that MS medium + 2.0 mg/l BAP gave highest number of shoot (2 ±0.37), shoot length (2.8 ± 0.15 cm), maximumnumber of roots (12 ± 0.20) and root length (9.8 ± 0.26 cm) was found in MS medium +2.0 mg/l compared to other treatments.

***Stevia* (*Stevia rebaudiana*Bertoni)**

Alhady (2011) noticed that 0.5 mg/l BA +0.5 mg/l Kin gave highest survival percent (90 %) and growth survival (100 %), while the highest shoot length (4.2 cm) was found in 0.0 mg/l Kin + BA 0.5 mg/l Kin. They also noticed that 2.0 mg/l gave highest rooted shoot (100%), number of roots/explant (8.4) and root length (9.0 cm).

Velvet bean (*Mucunapruriens*L.)

Sathyanarayana *et al*. (2008) noticed highest number of shoots per explant (16.33 ± 0.58) in the treatment of 3.55 µM BAP, while 0.44 µM BAP gave maximum shoot length (1.67 ± 0.58 cm). They also reported that 16.2 µM NAA gave highest rooting response (100%), number of root/explant (16.67 ± 2.89) and root length (4.61 ± 1.14).

Monk fruit (*Siraitiagrosvenorii*Swingle)

Yan *et al*. (2010) noticed that temporary immersion system(TIS) treatment gave the highest shoot proliferation rate (8.75 ± 0.38) and shoot length (18.36 ± 1.07 cm). In rooting, significantly higher rooting response (100.0 ± 0 %), root proliferation rate (7.68 ± 0.19) and root length (15.11 ± 1.91 cm) was found in TIS.

Conclusion

From the foregoing discussion, it can be concluded that technique of micro propagation for propagation of medicinal plant species has been getting importance, as the herbal medicines are still in mainstay of about 75-80% of the world population for primary health care because of the better acceptability with the human body and less side effects. Use of different plant growth regulators either alone or in combination are being used at present, for micro propagation of medicinal plants. Plant growth regulators such as BA,BAP, NAA, IBA, kinetin at different concentrations with MS media can be used for better results in micro propagation of medicinal plants.Recent modification in micro propagation like TIS is extremely useful to increase multiplication rate which is yet to be explored for Indian endangered medicinal plants. Hence, more comprehensive research attempts are needed for better exploration of advance techniques.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
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POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Architha M. V.**	**Course**	**: PSMA 591 (1+0)**
Reg. No.	**: 2020218003**	**Date**	**: 30/11/2019**
Major Guide	**: Dr. M. M. Patel**	**Time**	**: 11.00 – 12.00 a.m.**
Co – Guide	**: Dr. B. M. Tandel**	**Venue**	**: Swami Vivekananda Hall**

Secondary metabolite synthesis in medicinal and aromatic crops

According to WHO, 70 percent of the world's population depends upon herbal medicine and 60 – 70 percent of the population in developing countries depends almost entirely on traditional medicine practices and herbal medicines for their primary health care needs (Mafuva and Marima, 2018). This is due to the presence of vast diversity of compounds in medicinal and aromatic plants, basically the secondary metabolites, which keeps functioning in plants and serves to cure various diseases in humans. Secondary metabolites are metabolic intermediates or products which are not essential to growth and life of the producing plants but rather required for the interaction of plants with their environment. It can be divided into 3 major classes: terpenes, phenolics and nitrogen containing compounds mainly alkaloids. The presence, yield and composition of secondary metabolites in plants can be affected in a number of ways, from their formation in the plant to their final isolation.

Review of research work

Environment and stress conditions

Chatterjee (2002) observed that increase in active principle content of *Digitalis purpurea*, *D. lanata* and *Solanum khasianum* with additional light hours of 4 and 8 for 20 days. Highest increase in active principle content was found at 8 hours of additional light.

Marchese *et al.* (2010) studied on effect of water deficit on accumulation of artemisinin in *Artemisia annua*. Results showed that treatment of 38 hours water deficit prior to the harvesting not only reduces the time and cost in drying the crop but also increases the accumulation of artemisinin content (28 %).

Plant factors

Genetic factors

Ravi *et al.* (2013) evaluated 17 genotypes of *Solanum nigrum* for growth, yield and quality. Results showed that there was highest plant height (155.10 cm), number of leaves/plant (1190.50), leaf area (18026.19 cm^2/plant), fresh herbage yield (1586.33 g/plant) and dry herbage yield (209.07 g/plant) in MG-1, whereas highest alkaloid content (0.23 %) in MG-13 and alkaloid yield in MG-14 (12.26 kg/ha).

Developmental stages of plant

Chatterjee (2002) observed that maximum active principle content during reproductive phase of *Rauvoflia serpentina* (2.81 % - total alkaloid and 0.18 % - reserpine), *Digitalis lanata* (1.24 %) and *D. purpurea* (0.88%) over vegetative and post-reproductive phase.

Satyabrata (2010) reported highest fresh leaf weight (491.78 g), fresh gel weight (378.10 g) and fresh rind weight (113.67 g) in *Aloe barbadensis* at 10^{th} leaf stage, whereas highest dry leaf exudates weight (460.8 mg) at 7^{th} leaf stage and Aloin-A content (20.12 %) at 2^{nd} leaf stage.

Agronomic factors

Season of planting/harvesting

Kubsad *et al*. (2008) reported maximum dry root yield, total withanolide content, total withanolide yield in ashwagandha sown on 15^{th} September (1323 kg/ha, 0.53 % and 7.23 kg/ha, respectively) and also with late harvested crop (1461 kg/ha, 0.56 % and 8.18 kg/ha, respectively).

Cultural practices

Archna *et al.* (2009) observed maximum essential oil content (0.64 %) and essential oil yield (60.67 l/ha) in *Ocimum basilicum* when planted as a sole crop at 50 cm x 50 cm spacing over intercropping with *Cajanus cajan*.

Kebede (2013) reported that highest essential oil content (0.44 %) in rose scented geranium was obtained when plants were planted at spacing of 30 cm x 40 cm and harvested at 90 DATP.

Post harvest practices

Asma *et al.* (2017) reported maximum alkaloid content (1.07 %) and alkaloid yield (85.63 %) in black night shade (*Solanum nigrum*) when harvested at mature green berry stage and dried under shade.

Biotechnological approaches

Putalun *et al.* (2006) observed medium containing 5 % sucrose concentration stimulates the growth of hairy roots and increases the sennoside content (169 µg/g) in *Senna alata.*

Nurcahyani *et al.* (2008) reported that there was increase in production of reserpine content in sarpagandha with respect to the addition of Cu^{+2} but higher content (0.87 mg/g) was found at 5 µM Cu^{+2} concentration.

Vanda *et al.* (2019) observed increase in production of total phenolic compounds and rosmarinic acid in shoot cultures of *Melissa officinalis* when treated with chitosan. Total phenolic compound (2500 µg/gfw) and rosmarinic acid (0.11 mmol/gfw) was found highest when treated with 100 mg/l chitosan concentration

Conclusions

From the foregoing discussion, it can be concluded that stress conditions, results in higher accumulation of artemisinin content in *Artemisia annua* L. Day length have been found to influence on production of secondary metabolites in *Digitalis purpurea*, *D. lanata* and *Solanum nigrum*. Alkaloid content varies among genotypes in *S. nigrum* which is due to genetic makeup of plants. Season of planting and harvesting alters withanolide content in ashwagandha. Sole crop of *Ocimum basilicum* gives highest esssential oil content than intercropping with *Cajanus cajan*. Maximum essential oil content was obtained when planted at 30 cm x 40 cm spacing and harvested at 90 DATP. *S. nigrum* gives higher alkaloid content when harvested at mature green berry stage and dried under shade. Medium containing 5% sucrose concentration stimulates the growth of hairy roots and increases the sennoside content in *Senna alata*. Treating sarpagandha explants with Cu^{+2} and *Melissa officinalis* with chitosan gives highest secondary metabolites content. Hence, all the factors are to be taken into consideration in increasing the production of these chemicals and multiple factors either individual or in combination have synergistic effects on biosynthesis as well as accumulation of plant secondary metabolites.

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NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Jadav Jayti A.**	**Course**	**: PSMA 591 (1+0)**
Reg. No.	**: 2020218015**	**Date**	**: 27/12/2019**
Major Guide	**: Dr. M. M. Patel**	**Time**	**: 03.00 – 04.00 p.m.**
Co – Guide	**: Dr. Sanjeev Kumar**	**Venue**	**: Swami Vivekananda Hall**

Phytoremediation potential of medicinal and aromatic plants

Metals are naturally present in soils, the concentration of some metals, such as lead (Pb), copper (Cu), cadmium (Cd) and zinc (Zn) is particularly high in polluted soil as compared to concentration of these metals in unpolluted soil. Besides the natural activities, all human activities have potential contribution to produce heavy metals as a side effect. There are many methods being used to clean up the environment from these kinds of contaminants but most of them are costly and performing low whereas, phytoremediation uses plants to clean up contaminated soil and ground water, taking advantage of plants natural abilities to take up, accumulate and/ or degrade contaminants from their soil and water environments (Miller, 1996).

Medicinal and aromatic plants such as *Ocimumspp*.L., *Menthapiperita* Wild., *Lavandulaangustifolia* L., *Orthosiphonstamineus*and*Centellaasiatica* have capacity to absorb heavy metals from soil and reclaim it.Aromatic species would appear to be a good choice for phytoremediation as these plants are grown primarily for essential oils. Oil extraction by distillation or solvents would generally leave heavy metals in the plant residue making essential oil free of heavy metals without yield reduction even if extracted from species growing on metal contaminated soil (Gupta *et al*.,2013).

Brief review of research work:

Jeliazkovaand Craker (2008) studiedseed germination of anise, caraway and fennel in a heavy metal environment. They reported maximum germination percentage (118.2% and 130.9 %) with 6 mg/l cadmium and 100 mg/l lead respectively. Moreover root growth (122.3 mmand 105.2 mm)found best when treated with 6 mg/l cadmium and 100 mg/l lead respectively.

Jeliazkova *et al.* (2008) studied effect of cadmium and lead on seed germination and root growth of anise, caraway and fennel. They reported maximum germination percentage (103.6%) and root growth (92.9 mm)in caraway when treated with 6 mg/l cadmium and 100 mg/l lead.

Zheljazkov *et al.* (2008)investigated soil samples in the vicinities of the Non- Ferrous Metal Combine (Pb- Zn smelter) from plots at 0.5 km (soil 1), 3 km (soil 2), 6 km (soil 3) and 9 km (control soil) from the smelter with three different medicinal plants. They recorded highoil percentage 0.13 in 1st yearand 0.15 in 2ndyear 0.5 km away from smelter in*Melissa officinalis*.

Amirmoradi *et al.* (2012) observed thatlow concentration of Cd (10 ppm) performed better with respect to essential oil percentage (1.29) and fresh weight (39.10g) in 2ndharvest of *Menthapiperita* L.

Angelova (2013) recorded maximum Pb and Cd content in roots of *Salvia sclarea* L.(471.0 ± 1.8 mg/kg and 17.5 ± 0.4 mg/kg respectively) moreover in shoots of *Salvia sclarea* L. (1978 ± 10 and 57.2 ± 1.9 mg/kg respectively). She also reported maximum Pb (328.4 ± 6.1) and Cd (6.7 ± 0.09) content in stems of *Lavandulaspica* L.

Ziarati *et al.* (2014) recordedlowconcentration of cadmium 1.63 mg/ kg in tea leaves added soil after 60 days by *Lavandulaangustifolia*. They also recorded that heavy metals uptake by *Lavandulaangustifolia*wassignificantly affected by the age of plant.

Manan *et al.* (2015) carried out experiment for evaluation of the phytoremediation potential of *Centellaasiatica*and *Orthosiphonstamineus*. They recorded significant positivecorrelations between Zn and Cu accumulation in *C.asiatica* leaves (0.84) whereas in the leaves (0.99) and stem (0.81) of *O.stamineus.*

Ashwini (2016) recorded maximum accumulation of Cd in the roots of *Ocimumgratissimum*(307.20 mg/kg) followed by *O. basilicum*(205.10 mg/kg) when treated with 100 mg/kg of Cd solution.

Lydakis *et al.* (2016) recorded roots of sage as hyper accumulator of Cd (51.7 ppm) and Pb (177.0 ppm) whereas roots of chamomile for Ni (288.0 ppm).

Conclusion:

Caraway could be used for phytoremediation of soil contaminated with Cd or Pb if concentration does not exceed 10 mg/l Cd and 100 mg/l Pb.*Salvia sclarea*L. was identified as metal hyperaccumulator while *Lavandulaspica*L. and *Centranthusruber*L. as a Pb accumulators and *Lavandulaspica*L. and *Salvia sclares*L. as Cd accumulators.The roots of *Orthosiphonstamineus*accumulated high concentration of Zn, Cu and Pb while leaves of *Centellaasiatica*were more concentrated with Zn and Pb.Heavy metal accumulation become more easy and rapid when soil is added with any organic matter.Quality and content of essential oil were not altered when they were grown in heavy metal contaminated soil.*Ocimumgratissimum*and *O. basilicum*showed higher tolerant to cadmium and considerable amount of accumulation. Hence, it can be considered for phytoremediation of cadmium polluted soil.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker	**: Parikh Riddhesh Prafulbhai**	**Course**	**: PSMA 591 (1+0)**
Reg. No.	**: 2020218025**	**Date**	**: 03/01/2020**
Major Guide	**: Dr. P. P. Bhalerao**	**Time**	**: 03.00 – 04.00 p.m.**
Co – Guide	**: Dr. S. J. Patil**	**Venue**	**: Swami Vivekananda Hall**

Effect of light intensity on performance of rhizomatic spice crops

Light is an important factor in the facilitation of plant growth. Intensity refers to the total amount of light that plant receives and it is measured by LUX meter or FOOT CANDLES. Most of the plants respond well to 12 to 14 hours against its growth and development. Rapidly growing tips of plants detected light and caused plants to grow in a certain direction (Darwin, 1880). One foot candle means the degree of illumination 1 foot away from a lightened standardized wax candle whereas, 100 foot candles is 1 foot away from 100 candles that are lightened simultaneously. Lux is the unit of illumination that a surface receives one meter away from a light source (1 Foot candle = 10.76391 Lux; 1 Lux = 0.093 foot candle). Runkle and Heins (2006) reported the better unit of light intensity for studies involving plant responses is the µmol $m^{-2}s^{-1}$. Deficient or minimum light intensities are tends to reduce plant growth, development and yield of particular crop. Moreover, the excessive light intensity should be avoided because it can scorch the leaves and reduce crop yield, chlorophyll content with rapid transpiration and water loss.

In rhizomatic crops, the rhizome is a horizontal stem growing either underground or along the surface of ground. It is main axis of the plant, producing roots on its lower surface and leaves, flowering shoots above the ground. Generally ginger, turmeric and mango ginger are mostly cultivated and comes under the rhizomatic spices crops.

Review of research work:

Effect of light intensity/shade on growth and yield parameters:

Bhalerao and Maheshwarappa (2019) reported maximum yield of turmeric cv. Sugandham (20.16 t/ha) was recorded in fully organic treatment under coconut based cropping system.

Babu *et al*. (2017) reported the Suprabha cultivar gave maximum plant height (89.83cm), number of tiller/plant (28.56) and number of leaves per plant (245.16) under shade condition at 180 days after planting in ginger.

Pandey *et al.* (2017) noted maximum plant height (42.28 cm) under jatropha crop while, the highest yield (60.61 q/ha) of ginger variety Udaipur Local under sapota + jatropha shade condition.

Srikrishnah and Sutharsan (2015) recorded highest leaf area (4200 cm^2) at 6 month after planting and maximum yield (9000 kg/ha) of turmeric under 50 % shade level as compare to other shade levels.

Bhuiyan *et al.* (2012) noted that maximum no. of mother rhizomes of turmeric (4.23), weight of mother rhizome (255.82 g), no. of primary fingers (12.32), weight of primary fingers (190.78 g), no. of secondary fingers (25.65), weight of secondary fingers (150.46 g), yield of fresh rhizome/clump (582.13 g) and yield (40.25 t/ha) recorded under coconut + guava + spices based agro-forestry system. Moreover in ginger, maximum weight of primary fingers (127.15 g), weight of secondary fingers (144.28 g), fresh weight of rhizome per hill (362.92 g) and yield (32.88 t/ha) also found under same agro-forestry system with 70-80% PAR.

Amin *et al.* (2010) reported maximum plant height (31.47 cm) when the ginger crop grown under shade of guava tree (70±5% shade). Moreover, the highest number of rhizome (1.64), fingers (19.2 per plant), fresh and dry weight of rhizome (39.46 g/plant) and (33.08 g/plant) with fresh & dry weight of finger (101.54 g/plant and 82.75 g/plant) was recorded under shade of mango trees (50±5% shade).

Padmapriya *et al.* (2007) recorded highest yield (19.20 kg/plot) under 100% NPK + 50% FYM + coir compost (10 t/h)+*Azospirillum* (10 kg/ha) + *Phosphobacteria* (10 kg/ha) + 3% panchagavya under coconut shade condition.

Hegde *et al*. (2006) noted that the Humnabad genotype was gave higher plant height of 31.75 cm, 39.85 cm, 45.20 cm under coconut shade level at 90, 120 and 150 days after planting, respectively.
Vastrad *et al*. (2006) found higher fresh rhizome yield (12.64 t/ha) of ginger under normal light with RDF 100:50:50 kg NPK/ha.

Ajithkumar and Jayachandran (2003) reported that the dry ginger yield (92.38 g/plant and 88.00 g/plant) was found maximum under 20% and 40% shade level respectively, at 240 days to after planting.
Sreekala (1999) stated that the maximum dry yield of ginger (57.57 g/plant) recorded under 20 per cent of shade as compared to rest of shade conditions.

Jayachandran and Nair (1998) noted that the number of tiller per plant (3.8) and rhizome yield (7.65 kg/plot) was observed under 0% shade while, the plant height recorded maximum (105.7 cm) under 50 % shade level at 150 days after planting of mango ginger.

Effect of light intensity/shade on quality parameters:

Padmapriya *et al.* (2007) recorded highest curcumin (5.57%) and essential oil (5.68%) at 50% FYM (15 t/ha)+coir compost (10t/ha) +*Azospirillum* (10 kg/h)+ phosphobacteria (10kg/ha)+3% panchagavya under shade condition.

Hegde *et al.* (2006) noted Humnabad genotype contain highest oleoresin (8.70%) and fresh rhizome yield (24.4 t/ha) while, essential oil (2.40%) found highest in Rio-de-janeiro genotype under open condition cultivation as compare to coconut shade.

Vastrad *et al.* (2006) recorded highest non volatile ether extract (9.13%) in ginger at 25% RDF + 75% vermicompost under reduced light.

Ajithkumar and Jayachandran (2003) reported that volatile oil content of ginger rhizome were (3.53% and 3.93%) observed maximum under the 60% and 80% of shade level, respectively at 150 DAP. Moreover, the non volatile ether extract (NVEE) contain (9.75%) of ginger rhizome on dry weight basis found maximum under the 20% shade level at 180 DAP. They also reported that crude fiber content of ginger gradually reduced as the intensity of shade is increased.

Sreekala (1999) revealed that the volatile oil contain of ginger was observed in maximum under shade level of 80% at 150 DAP.

Effect of light intensity/shade on disease incidence:

Singh *et al.* (2004) noted lowest *phyllosticta* leaf spot disease severity (2.0%) of ginger grown under the shade of pigeon pea and highest yield (12.4 kg/plot) of ginger grown the shade of maize crop.
Singh and Edison (2003) noted lowest *colletotrichum* leaf spot disease severity (1.8%) of turmeric grown under the shade of pigeon-pea and highest yield (7.8 kg/plot) of turmeric grown in open sun (no shade) condition.

Nizam and Jayachandran (1997) observed 15 g size of Kuruppampady variety rhizome showed minimum *Phyllosticta* leaf spot incidence under intercrop with coconut as compared to open condition.

Conclusions

From the foregoing discussion, it can be concluded that higher yield and good quality of ginger can be obtained under optimum level of light intensity depending on the agroclimate. Higher yield as well as quality of turmeric can be obtained by growing under shade condition. Rhizomatic spices grown under shade are less susceptible to leaf spot diseases. However, both ginger and turmeric are suitable associated intercrops with many plantation crops and getting the benefit for additional income to the farmers.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker	**: Sowmya K.**	**Course**	**: PSMA 591 (1+0)**
Reg. No.	**: 2020219044**	**Date**	**: 19/12/2020**
Major Guide	**: Dr. P. P. Bhalerao**	**Time**	**: 10.30 to 11.30 a.m.**
Co – Guide	**: Dr. S. J. Patil**	**Venue**	**: Online**

Conservation of spices germplasm through cryopreservation

In many spices, conventional seed storage can satisfy most of the conservation requirements. But, in crops with recalcitrant seeds and those having conservation needs cannot be satisfied by seed storage, have to be stored *in vitro*. Most field gene banks are prone to high labour cost, vulnerable to hazards like natural disasters, pests and pathogens attack (especially viruses and systemic pathogens), to which they are continuously exposed and require larger area and space. This supports *in vitro* and cryo- conservation. Cryopreservation is an attractive option for long term storage of germplasm. Liquid nitrogen (–196°C) is routinely used for cryogenic storage, since it is relatively cheap and safe, which requires little maintenance and is widely available. Plant germplasm stored in liquid nitrogen (-196°C) does not undergo cellular divisions. In addition, metabolic and most physical processes are stopped at this temperature. As such, plants can be stored for very long time periods and both the problem of genetic instability and the risk of losing accessions due to contamination or human error during sub culturing are overcome.

Review of research work

Black Pepper (*Piper nigrum* L.)

Decruse *et al.* (2003) studied on seed cryopreservation was a suitable storage procedure for a range of *Piper* species. They stated that wild species of *Piper* have 26.1 to 36% moisture content and after desiccation to 10.2 to 13.9% moisture, they exhibited 60-87.3% germination which was unaffected by one week storage in LN. Seeds of three *Piper nigrum* cultivars desiccated to 13% moisture content showed 60-73.3% germination rate. Thus, they proved seed cryopreservation was a suitable storage procedure for a range of *Piper* species.

Ginger (*Zingiber officinale* L.)

Yamuna *et al.* (2007) studied the cryopreservation of *in vitro* grown shoots of ginger. They found that shoots cryoprotected with a mixture of 5% DMSO and 5% glycerol gave the highest regrowth of 80% after vitrification.

Vanilla (*Vanilla planifolia* L.)

Arnao *et al.* (2009) conducted an experiment on multiplication and cryopreservation of vanilla. They found that regeneration of new shoots from cryopreserved samples has been obtained only with apices derived from *in vitro* plantlets frozen using the droplet vitrification technique under the experimental condition of 1 day pre growth of apices on solid medium with 0.3 M sucrose, loading with 0.4 M sucrose + 2 M glycerol solution for 20–30 min. and exposure to PVS3 for 30 min. at room temperature before immersion in LN.

Dolce *et al.* (2019) conducted an experiment on cryopreservation of vanilla (*Vanilla planifolia*) root tips: a new alternative for *in vitro* long term storage of its germplasm. They found that control explants displayed high level of survival (>90%) and shoot regeneration (80-83%). The preconditioning and loading treatment did not affect the survival (≥90%) and regrowth (83- 77%) of non-cryostored root-tips. Likewise, the PVS3 exposure over 30 to 45 min proved not to be cytotoxic, since explants survival (90-83%) and regrowth (73-67%) remained without significant changes. However, a longer exposure period to PVS3 significantly decreased the root-tip survival. On the other hand, recovery after cryostorage was strongly affected by the PVS3 and its exposure duration.

Garlic *(Allium sativum* L.)

Kim *et al.* (2004) conducted an experiment on cryopreservation of garlic shoot tips by vitrification. They found that PVS3 was the most effective of the seven vitrification solutions compared. Treating shoot tips with PVS3 for 150-180 min ensured 92% regeneration after freezing.

Kim *et al.* (2006) conducted an experiment on cryopreservation of garlic bulbil primordia by the droplet vitrification procedure. The highest survival and regeneration percentages of cryopreserved primordial (93.5-95.0 % and 83- 84.0%, respectively) were achieved after preculture for 2 to 4 days at 10°C on solid medium with 0.1 to 0.3 M sucrose. Dehydration with PVS2 variant 2 or PVS3 induced higher regeneration percentages than with the original PVS2 or PVS2 variant 1. Thus, a higher total concentration of cryoprotectants and especially a higher glycerol concentration in the vitrification solution effective in increasing the recovery of cryopreserved garlic bulbil primordia.

Celery (*Apium graveolens* L.)

Benito *et al.* (2002) studied the cryopreservation of *Apium graveolens* (celery) seeds. They observed that seed storage in LN did not reduced germination percentage of any of the cultivar. Moreover cryopreservation did not have negative effect on germination of pelleted seeds whereas, the non pelleted seeds of variety Utah showed best response after storage in LN for 30 days.

Coriander (*Coriandrum sativum* L.)

Popova *et al.* (2010) studied the cryopreservation of coriander (*Coriandrum sativum*) somatic embryos using sucrose pre culture and air desiccation. They found that preliminary incubation on sucrose-enriched medium (100 g/L) improved both desiccation and cryo-tolerance of ECs compared to medium with normal sucrose content (30 g/L). The regrowth after cryopreservation and average number of new embryos developed from cryopreserved ECs were retained at the level of the untreated control (98% and 13 embryos per clump, respectively).

Conclusion

From the foregoing discussion, it can be concluded that cryopreservation is an attractive option for long term storage of germplasm especially those which are difficult to store due to high moisture content and high desiccation and freezing sensitivity. It can be achieved by different techniques like direct freezing, encapsulation dehydration, encapsulation vitrification, droplet vitrification and vitrification. The highest survival and regeneration percentages of cryopreserved garlic primordia can be achieved by preculturing for 2 to 4 days at 10°C on solid medium with 0.1- 0.3 M sucrose and dehydration with PVS3 vitrification solution for 90 to 150 min. The feasibility of cryopreservation on celery was compatible with other treatments such as priming and pelleting make it an interesting tool for celery germplasm storage. In coriander, preliminary incubation on sucrose enriched medium (100 g/L) improves both desiccation and cryo tolerance of embryo clumps. Seed cryopreservation was a suitable storage procedure for a range of *Piper* species. In vanilla, recovery after cryostorage was strongly affected by the PVS3 and its exposure duration. In Ginger, shoots cryoprotected with a mixture of 5% DMSO and 5% glycerol gave the highest regrowth of 80% after vitrification.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker	**: Ashuqullah**	**Course**	**: PHT - 591**
Reg. No.	**: 2020215004**	**Date**	**: 16/12/2016**
Major Guide	**: Dr. Dev Raj**	**Time**	**: 04.00 – 05.00 pm**
Co – Guide	**: Dr. K. D. Desai**	**Venue**	**: Swami Vivekananda Hall**

Dehydration of sweet potatoes for value addition

Introduction:

Sweet potato {*Ipomoea batatas* (L.) Lam} is an important root crop grown all over the world and consumed as a vegetable, boiled, baked or often fermented into food and beverages. Food and Agriculture Organization (FAO) also reported that sweet potato {*Ipomoea batatas* (L.) Lam} is a very important traditional crop in the developing world. According to FAO, sweet potato is one of the seventh important crop in the world produce over 105 hundred million metric tonnes of edible food products in the world annually Anonymous (2011). China alone produced 80 to 85% of the total sweet potato production in the world while the remaining countries in Asia have the next highest production and then, followed by Africa and Latin America (Oke and Workneh, 2013). Tuber crops are known to be rich in starch content only. However, sweet potato is such a tuber crop which contains several important nutritional ingredients beside starch. Sweet potatoes are known to be rich in carbohydrates, fibres, carotenes, thiamine, riboflavin, niacin, potassium, zinc, calcium, iron, vitamins A and C and high quality protein Anonymous (2009). Thus, it could be a very good vehicle for addressing some health related problems and also serve as food security. Sweet potato roots are bulky and perishable unless cured. This limits the distance over which sweet potato can be transported economically. So, handling and marketing pose a greater problem during the glut season and fetches low price to the farmers. On the other hand the consumer has to pay a heavy price during off season due to constant demand of vegetables throughout the year. The "dehydration of Sweet potato" can become one of the economical and feasible methods of preservation of surplus produce, for use in season of short fall, thereby minimizing the fluctuation in the market price and preventing post harvest losses. Dehydration is the process of removal of water from the commodity to an alarm level at which micro-organism cannot survive.

Review of Research Work

Effect of Cultivars:

Ali *et al.* (2012) conducted an experiment to study the effect of cultivars on quality attributes of sweet potato tubers and starch. They reported that tubers of sweet potato cultivar "Lovers Name" having spindle oval shape possess significantly higher proteins, ash, maltose and sucrose content. They also reported higher starch viscosity and swelling power for starch of cv "Lovers Name". The colour of the flesh and starch was also reported better for sweet potato cv. "Lovers Name".

Sinha *et al*. (2015) studied the effect of two sweet potato cultivars namely ST-14 and ST-13 on retention of quality in dehydrated sweet potato flour and reported higher pigment retention (79.67%) in ST-14 than ST-13 cultivar ST-13 (78.53%).

Effect of dehydration parameters:

Yadav *et al*. (2006) studied the effect of hot air drying and drum drying on the quality characteristics of sweet potatoes. They reported that hot air drying lowered the total amylose and water binding capacity/viscosity and increased the digestibility compared to those of drum dried flour and fresh sweet potato. They also reported that the solubility and swelling power of the flours increased with increase in processing temperature.

Hatamipour *et al*. (2007) conducted a study to investigate the effect of blanching and different dryers (oven without air circulation, forced air convection tray dryer and fluidized bed dryer) on drying rate of sweet potatoes having cut into cylindrical size of 11-13mm x 45-65mm. Results revealed that increasing blanching time decreased drying time in the absence of air circulation whereas it has no significant effect on drying time in dryers with air circulation. They also reported that drying time of a forced convection tray dryer was ½ of the drying time in a free convection dryer while that of fluidized bed dryer is about 1/4th of the drying time in a free convection dryer.

Shih *et al.* (2009) conducted an experiment to study the effect of drying techniques on quality characteristics of dried chips of two sweet potato cultivars. They reported that air drying gave higher water solubility index and total dietary fibre content while freeze drying gave higher colour score, phenols, β-carotene and anthocyanin content in dried chips of different cultivars. Among cultivars orange colour sweet potato possessed higher water solubility index, total dietary fibre content, phenols, β-carotene and anthocyanin.

Ahmed *et al*. (2010) studied the effect of peeling, drying temperatures and pretreatments on the physico-chemical quality of sweet potato flour and reported significant differences in browning index between flours from peeled and unpeeled sweet potatoes without sulphite-treatment (PF and UF). On the other hand, flours from peeled and unpeeled sweet potatoes with sulphite (0.5%) treatment (PSF and USF) had higher L*, a*, and b* values, swelling capacity, ascorbic acid and total phenolics than PF and UF. However, USF and UF had higher β-carotene content than PSF and PF. β-Carotene and ascorbic acid contents decreased with increasing drying temperature for all flours, whereas total phenolics increased for PSF and USF. The best quality product was obtained when samples were pretreated with sulphite before drying at any temperature.

Singh *et al.* (2014) conducted an experiment to know the effect of sugar concentration and different drying temperatures on the quality of osmotically dehydrated sweet potato. Sweet potato cubes were osmotically dehydrated in sugar syrup concentrations of 50, 60 and 70˚Brix for 48 hours and thereafter samples were dried using tray drier at temperatures of 55, 65 and 75ºC. Results depicted that water loss was maximum for the sample of 50˚Brix sugar concentration.

The drying rate decreased with increase in drying time and became uniform for 55, 65 and 75ºC drying temperature irrespective of concentration of sugar solutions, whereas at initial stage higher decrease in drying rate was found in 75°C at 50 °Brix. The L value was least *i.e*. 49.6 in dehydrated sweet potato having 70°Brix sugar concentration and 75°C drying temperature, whereas maximum value of 60.2 was observed for dehydrated samples of 70 °Brix and temperature of 55°C**.**

Wijewardane *et al.* (2015) conducted an experiment to study the effect of different dehydration techniques viz. sun drying, solar drying, freezing & drying (Freeze one hour followed by mechanical drying at 55°C), vacuum drying and oven drying on quality characteristics of the sweet potato flour. They reported maximum retention of the anthocyanin and ash content when dehydrated by using vacuum drying technique and found vacuum drying as the most effective drying method to protect chemical properties and retention of antioxidants in dehydrated sweet potato flour having particle size of 150µm.

Storage Stability:

Chukwu *et al.* (2015) compared the storage stability of sweet potato (*Ipomoea batatas*) and yam (*Dioscorea alata*) flours. They reported that the moisture, ash, crude fibre and fat contents of yam flour at the end of two weeks storage period were relatively higher than that of sweet potato flour. The protein and carbohydrate contents of yam flour were slightly lower than those of sweet potato flour. Results also showed that the bacterial count of sweet potato flour ranged between 72 × 103 cfu/g and 81 × 103 cfu/g while that of yam flour ranged between 61 × 103 cfu/g and 141 × 103 cfu/g after two weeks of storage. The fungal count of sweet potato flour was relatively higher than that of yam flour after two weeks of storage.

Value addition:

Malomo *et al.* (2013) reported that the effect of blanching and un-blanching on physico-chemical properties of wheat flour and sweet-potato flour based bread prepared using 10%, 20% and 30% sweet potato flour. The flour prepared by blanching treatment possessed higher swelling power and lower water absorption and solubility than prepared without blanching. Further, result showed that the substitution of sweet-potato flour into wheat flour affected the rheological and textural properties of wheat flour. The rate of water absorption of the wheat flour increased as sweet-potato substitution levels increased. This was due to high starch content of sweet potato.

Kamal *et al.* (2013) conducted an experiment to study the effect of substitution of wheat flour with sweet potato flour of two local varieties (Local Sada and Local Lal) on the quality of bread. Results showed that sweet potato flour of Local Sada and Local Lal cultivars contained 5.25 and 5.32% moisture; 4.12 and 4.17% Ash; 0.75 and 0.81% fat; 9.80 and 9.21% protein; 80.08 and 80.49% carbohydrate; 2.45

and 2.31 mg/100g vitamin-C, respectively. The results obtained on sensory evaluation showed higher overall acceptability score on 9 point Hedonic scale for breads containing sweet potato flour (Local Lal) up to 10% than control.

Conclusion:

From above forgoing review it can be concluded that sweet potatoes can be dehydrated to prevent glut during peak season and to fetch high price to the farmers. Sweet potatoes can be dehydrated following selection of the suitable cultivars. Sweet potatoes cultivars namely Lovers Name, ST-14 (orange flesh) and Local Lal can be used for dehydration for processing into flour. Sweet potatoes after selection, washing, peeling and slicing must be at 85°C blanched for 2 min. following pre-treatment with sulphitation (0.5%) to increase the colour value and decrease the microbial counts during storage of the dehydrated products. The pre-treated slices can be dehydrated in forced air convective dryer at 70°C for maintaining the quality characteristics of dehydrated sweet potato. Sweet potato flour (10%) can be used along with wheat flour for the preparation of breads. Osmotic dehydration of the sweet potatoes also possesses a great potential for maintaining the nutritional qualities of the dehydrated product. Thus, "Dehydration of Sweet potato" can become one of the economical and feasible methods of preservation of surplus produce for minimizing the fluctuation in the market price and preventing post harvest losses.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
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POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker	**: Kothariya Bhavesh Harjeebhai**	**Course**	**: PHT - 591**
Reg. No.	**: 2020215027**	**Date**	**: 30/12/2016**
Major Guide	**: Dr. Shakti S. Arbat**	**Time**	**: 10.00 – 11.00 am**
Co – Guide	**: Dr. D. K. Sharma**	**Venue**	**: Swami Vivekananda Hall**

Residual effect of pesticides in fresh and processed horticultural produce

Pesticides are the chemicals used for the control of pest infestation and diseases of crops. Contamination of food commodities with trace amounts of pesticides has become a growing source of concern for the general population. However, the extensive use of pesticides may result into their accumulation in the agricultural produce. The debate on pesticide residues in food in India has raised awareness over contamination of our food commodities with toxic pesticide residues. Unfortunately the debate became restricted to the quality standards and norms pertaining to drinking water and foods at the point of consumption. The more fundamental problem of contamination of all natural resources with chemical pesticide residues, because of faulty and hazardous agricultural technologies at the farming level is often ignored. Moreover, good agricultural practices and processing leads to large reductions in residue level in the prepared food. Particularly washing, peeling, cooking, drying and processing methods are the important and effective tools in minimizing pesticide residues in food commodities.

Review of Research Work

Washing

Chandra *et al*. (2014) studied the effect of washing on chlorpyrifos residue in capsicum and cauliflower and concluded that the 15 min. hot water washing was found to be most effective in reducing pesticide residues.

Peeling

Randhawa *et al.* (2007) studied the removal of endosulfan residues from vegetable by household processing. They took house hold processing like washing, peeling and cooking in different vegetables. Peeling had a significant effect on residues removal in the skin of potato (72%) and brinjal (64%).

Sheikh *et al.* (2015) studied the processing of onion with traditional processing methods it the removal of pesticide residues below MRL levels. The peeled sun drying and peeled dehydration was found to be most effective in reducing the pesticide residues.

Cooking

Joshi *et al.* (2012 a) studied the effect of processing on pesticide residues in cauliflower and they concluded that cooking was reduced the pesticide residue up to 85.30 %.

Harinathareddy *et al.* (2014) studied the effect of household processing methods on the removal of pesticide residues in tomato and reported that cooking was best methods to reduce the pesticide residue.

Joshi *et al.* (2015) studied the effect of processing on pesticide residues in tomato**.** It was found that cooking process minimized the pesticide residues up to 90.15 %.

Roasting

Joshi *et al.* (2012 b) studied the effect of household processing on reduction of pesticide residues in brinjal. It was found that roasting was more effective than cooking.

Frying

Sheikh *et al.* (2012) studied the reduction of pesticide residues in okra by using different processing method. It was observed that maximum reduction of profenofos and endosulfan pesticides residues through detergent washed fried okra.

Boiling

Chandra *et al.* (2015) studied the reduction of pesticide residues in okra through household processing. It can be concluded that maximum residues were reduced by boiling (99.7%). Boiling was found comparatively more effective than other household processing.

Drying

Sheikh *et al.* (2012) studied the removal of pesticide residues from okra through traditional processing. It was observed that maximum reduction of bifenthrin pesticides residues through detergent washed sun-dried okra.

Storage

Bhattacherjee and Pandey (2010) studied the dissipation of carbendazim residues in mango fruit after post-harvest treatments. After harvesting, mango was dip in 0.05 % and 0.1 % of carbendazim solution and they reported the residue level of carbendazim was dissipate below its MRL value during 10 days after storage.

Processed product

Panhwar *et al.* (2014) studied the removal of pesticides residue from brinjal by making different product. It was concluded that detergent washed peeled burta was found to be effective in reduction of pesticides residues.

Ryad and Mahmoud (2016) studied the effect of household processing on pesticide residues in olive fruits. They reported the minimum pesticide residue was found in pickles of olive fruits.

Conclusions

Pesticide residues in food have a significant health effect on human and animals. The usage of pesticide is necessary but dissemination of information regarding food safety, pesticide handling and good agricultural practices (GAP) among farmers is also a dire need. Post harvest technology leads to large reductions of pesticides residue levels in the prepared food particularly through washing, peeling, drying, storage and cooking operations. Washing with water and various chemical solutions for domestic and commercial use are necessary to decrease the intake of pesticide residues. Peeling is necessary to remove the pesticide residues in the skins of fruits and vegetables. Cooking of food products helps to eliminate most of the pesticide residues and also reduction of residues by different cooking method likes roasting, frying and boiling. Drying decrease the pesticides residues and specially sun drying is good for reduction of pesticide residues as compare to other drying method. Processed product is also found beneficial to reduce the pesticide residue as compare to fresh and raw.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
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POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker	**: Dholiya Dhavalkumar R.**	**Course**	**: PHT – 591 (1+0)**
Reg. No.	**: 2020215018**	**Date**	**: 26/11/2016**
Major Guide	**: Dr. C. S. Desai**	**Time**	**: 11.00 – 12.00 am**
Co – Guide	**: Dr. S. J. Patil**	**Venue**	**: Swami Vivekananda Hall**

Fortification of fruit and vegetable products

The spectrum of life in terms of income, life style and spending is changing rapidly with economic development. Diet related diseases such as obesity, diabetes, cardiovascular disease, hypertension, stroke and cancer are escalating both in developed and developing countries, in part due to imbalanced food consumption patterns.Food fortification has been defined as the addition of one or more essential nutrients to a food,whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiencies of one or more nutrients in the population (FAO, 1994).Fortification of foods with vitamins and minerals can be an effective way to combat micronutrient deficiencies in developing countries.For increasing the nutritionalvalue of processed foods from commercial point of view, it is the safest strategy of providing measured amount of nutrients in the diet in low concentration.Food fortification not only increase nutritional value (CHO, protein, fat, vitamin and minerals) of the food but also decrease microbial load and increase the sensory quality of processed food products.Current status of fortification utilize for preparation in powder, softdrinks, noodles, pasta, snacks, biscuits, breads, milk products, probiotics, wines, tea, coffee etc.

Why food fortification is necessary? (1)Replace nutrients (2) Act as a public health intervention (3) Ensure the nutritional equivalence (4) Ensure the appropriate vitamin and minerals.

Review of Literature

Fruit Products:

Nectar

Karanjalker *et al.* (2013) investigatedeffect of soymilk in guava nectar andreveled that there wasdecreased in ascorbic acid (mg/100 gm) &significantly higher protein in 50 % guava nectar and 50 % soymilk for both fresh and store PEN.They also found higher sensory scores in blendof 70% guava nectar and 30 % soymilk and this treatment also gave betterresult in protein (2.62 %) and ascorbic acid (118.9 mg/100g).

Fruit Leather

Thakur *et al.* (2008) evaluated the effect of soy slurry in apricot soy leather and recordedhighest protein and fat percentage at 70 % apricot + 30 % soy slurry. They also found highersensory score, blend of 85 % apricot + 15 % soya slurry, which also recorded gave better protein (6.71%), fat (1.77%) and ascorbic acid (18.72mg/100g).

Anju *et al.* (2014) studied the effect of different blends and storage (0, 2 and 4 month)for quality evaluation of peach soy fruit leather and recorded highest crude protein (3.22%), fat (1.64%) and ascorbic acid (19.70 mg/100g) in treatment 70% peach + 30% soy slurry.

Fruit Bar

Sarojini *et al.* (2009) studied the effect of guava carrot puree enriched fruit bar and observed that guava bar fortified with 20% carrot puree gave maximum beta carotene (3058 µg/100g). However, 10% carrot puree gave highest ascorbic acid (12.4 mg/100g). They also studied thephysico-chemical characteristics of calcium fortified mango bars and observed that mango bar fortified with calcium fumarate had maximum (589 mg) calcium content followed by calcium carbonate (462 mg). They also observed higher sensory score in same treatment. Further they alsoevaluated the physico-chemical characteristics of protein enriched mango bar and recorded highest protein concentration (5.2%) in pea protein treatment.

Take *et al.* (2012) conducted an experiment to studied the preparation of fortified sapota-papaya fruit bar with skim milk powderand observed that highest protein (1.85%), ash (2.9%), total ash (2.47%), crude fibre (12.08%), carbohydrate (78.14%), ascorbic acid (205 mg/100g) and total energy (346.06 Kcal) were found in 6% SMP. They noticedhigher sensory score in 60 g sapota pulp + 40 g papaya pulp + 1.80 g pectin + 6 % SMP.

Parimita and Arora (2015a) investigated the development of whey protein fortified fruit bar from bael and observed highash (1.23%),protein (7.24%), and carbohydrate (79.01%) in treatment 100% bael : 30% sugar : 7.5% whey protein, while ash (%) was at par with all treatment and protein (%) was at par with T_2 and T_6 treatment. They also found higher sensory score in fortified fruit bar of 100 % bael :20 % sugar : 5 % whey protein and no microbial load found among the all treatment, which also have protein (5.48%) and ash (1.13%).

Parimita and Arora (2015b) evaluated thedevelopment of fruit bar by using apple and banana pulp supplemented with omega-3 fatty acid and observedhighest protein (1.42%), fat (8.65%) and antioxidant (35.95%) in treatment 97 % fruit pulp + 3 % omega-3 fatty acid, while protein (%) and fat (%) was at par with 98 % fruit pulp + 2 % omega-3 fatty acid.

Fruit RTS

Pawar *et al.* (2012) studied the development of soymilk based mango RTS beverages and observed that the RTS beverages prepared by blending the soymilk and mango pulp in the proportion (80:20) was found high in protein (4.04%) and fat (0.81%), while fat (%) was at par with T_2 and T_3 treatment. They also recordedhighash (0.67%) and ascorbic acid (9.77 mg/100g) in blending of soymilk and mango pulp in the proportion (50:50), while which was at par with T_3 treatment, they also observed that maximum sensory score with same treatment.

Nandan *et al.* (2016) studied the development of protein rich RTS beverages incorporating whey in carambola juice and observed that RTS beverages prepared by incorporating whey incarambola juice in the proportion (40:60) was gave higher protein (0.43 %) and ash (0.49%) content. Further, observed maximum ascorbic acid (23.40mg/100g) in the RTS beverages prepared by the whey and carambola juice in the proportion (00:100).

Fruit Jam

Effect of central core blending for preparing jam from mango and found that, higher proportion of central core in the mango pulp leads to increase in fibre content of jam. However from the sensory qualities of blended jam, up to 50 % blending of central core gave good quality jam with higher content of fibre (0.28 %). (Anon., 2015)

Vegetable Products:

Tomato ketchup

Amruthesh *et al*. (2012) conducted an experiment to study the protein enrichment of tomato ketchup using soy protein isolate and whey protein isolate and observed that significantly highest sensory score at 2% soy protein isolate which wasat par with 2% whey protein isolate. They also reported that significantly highest protein (2.41%) and ascorbic acid (26.32 mg/100g) at 2 % soy protein isolate which wasat par with 2 % whey protein isolate, while 2% soy protein isolate gave best result.

Tomato leather

Madhavand Parimita(2015) studied the development of tomato leather prepared for calcium carbonate powder and observed the significantly highest ash (1.72%) and calcium (0.92%) and lowest microbial load in 98.5% tomato puree and 1.5% calcium carbonate powder.They also found that higher crude fat in 100% tomato puree.

Sweet potato cookies

Herawati *et al.* (2015) studied the effect of fortified sweet potato cookies composition and observed that higher ash (2.80g/100g),crude fat (14.91g/100g),protein (5.15g/100g),carbohydrate (74.97g/100g),Vit-C (814.28 mg/100g),Vit-B_{12}(2.73 µg/100g),Vit-A (10530.35µg/100g), folic acid (248.38µg/100g) and Fe (94.90 mg/100g) in fortified cookies.

Conclusion:

For increasing nutritional value of processed foods from commercial point of view, it is the safest strategy of providing measured amount of nutrients in the diet in low concentration.Food fortification is not only increase nutritional value (CHO, protein, fat, vitamin and minerals) of the food but also decrease microbial load and increase sensory quality of processed food products.It is most cost effective approach to prevent stated deficiencies and can reach target populations across geographies, which can be implemented through existing distribution system, does not require change of food habits or practices. Modern world consumes are also well aware of nutritional facts of products, which leads to brighter future of fortified food industry.

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POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker	**: Bharai Rambhai Boghabhai**	**Course**	**: PHT – 591 (1+0)**
Reg. No.	**: 2020215007**	**Date**	**: 30/12/2016**
Major Guide	**: Dr. Shakti S. Arbat**	**Time**	**: 09.00 – 10.00 am**
Co – Guide	**: Dr. D. K. Sharma**	**Venue**	**: Swami Vivekananda Hall**

Beverage preparation through blending

India is the second largest producer of fruits in the world after china. In our country, especially in horticulture, the fruit crops are grown under temperate, tropical, subtropical and arid region, having 6,405 thousand ha. area and 91,443 thousand MT production. Gujarat, having 384.42 thousand ha. area and 8,300.60 thousand MT production. (Anonymous 2015). Mostly fruits are utilized as table purpose but due to the short shelf life it is needed to process in to varieties of product, which provide the nutrition in human diet. Great attention is being paid now a days to the usage of natural colors in view of hazards that the synthetic colours create problems to human health. Now a days, there is a banned on many synthetic colors. Therefore, blending with high anthocyanin and carotenoids contain fruits which are helpful to improve color as well as nutritional status of the product. The two or more fruits blended in various proportions in product development are helpful to increasing the sensory as well as nutritional quality of the product. Product developed from mixed fruit or blending are more nutritional, attractive and tasteful than those made from sole fruit.

Review of Research Work:

Cold beverages

Blended juice

Kothari and Bhatnagar (2010) observed significantly higher organoleptic score for color, flavour, taste, appeareance, overall acceptability and total mean score (8.0, 8.4, 8.8, 8.6, 8.6, and 8.68, respectively) were found in blend aonla:pineapple (15:85) + black salt (0.35%) in blended juice of aonla and pineapple.

Blended RTS beverage

Tondon *et al.* (2007) revealed that the anthocyanin and total carotenoids decreased during storage. However, they found higher anthocyanin (0.108 to 0.090 mg/100ml) in only bael RTS (100:0) while, significantly higher total carotenoids (120 to 100 mg/100ml) recorded in only papaya RTS during storage at ambient temperature.

Blended nectar

Singh *et al.* (2007) recorded higher acidity, reducing sugar, total sugar and TSS (3.139 %, 16.24 %, 25.48 % and 24.78^0 brix, respectively) during 120 days storage, whereas significantly higher ascorbic acid (7.34 mg/100ml) found in 0 days storage. However, reducing sugar, total sugar and TSS increased while the ascorbic acid decreased at 120 days storage (at ambient temperature) in guava pineapple blended nectar prepared from standardized blend (70:30) and recipe (20 % pulp, 17 % TSS, 0.2 % acidity).

Concentrated beverages

Blended squash

Gajanana *et al.* (2007 a) revealed that higher score for color (3.88) was recorded in 25 % aonla juice + TSS 40^0 brix whereas, for taste and overall acceptability significantly higher score (3.67 and 3.69, respectively) were recorded in blend of 30 % aonla juice + 5 % lime juice + 2 % ginger juice + TSS 40^0 brix. Significantly higher acidity and ascorbic acid (0.55 % and 64.10 mg/100g, respectively) were recorded in blend of 30 % aonla juice + 7 % lime juice + 2.5 % ginger juice + TSS 40^0 brix whereas, higher score for flavor, total sugar and sugar:acid ratio (3.81, 15.66% and 44.05, respectively) found in blend of 30 % aonla juice + 7 % lime juice + 2.5 % ginger juice + TSS 50^0 brix, in aonla:lime:ginger blended squash.

Blended syrup

Gajanana *et al.* (2007 b) noticed higher score for color, taste, flavor, overall acceptability, acidity and ascorbic acid (4.04, 3.59, 3.59, 3.61, 0.86 % and 141.12 mg/100 g, respectively) in blend of aonla juice (55 %) + lime juice (10 %) + ginger juice (4 %) + TSS 68^0 brix however, highest total sugar (27.28 %) was recorded in blend of aonla juice (50 %) + lime juice (5 %) + ginger juice (2 %) + TSS 68^0 brix whereas, significantly highest sugar:acid ratio (85.15) was recorded in blend of aonla juice (50 %) + TSS 68^0 brix, in aonla:lime:ginger blended syrup.

Fermented beverages

Blended cider

Kruma *et al.* (2013) studied the effect of blending on sensory characteristics of apple cider. They concluded that the sensory properties showed that ciders from the variety 'Remo' blending Auksis : Remo : Kerr 1:1:1apples had high clarity and more intensive apple aroma.

Blended wine

Chaudhary *et al.* (2014) observed that acceptable red wine can be prepared by mixing of grape and jamun juice but acceptability of red wine was more when juices were blended in 75:25 (grape:jamun) ratios.

Carbonated beverages

Kaur *et al.* (2015) studied on sensory evaluation of low-alcoholic self blended carbonated beverages produced from grape, kinnow and pomegranate juice. They concluded that the grape:pomegranate (1:1) blending overall acceptability is more.

Hot beverages

Blended coffee

Fiore *et al.* (2008) conducted that the Blending of 25% *arabica* + 75% *robusta* coffee is best combination. The *arabica* gave qualities of aroma, delicate flavour and the right degree of acidity. While *robusta* gave qualities of full flavour, body, chocolatiness and creaminess in the cup. So, the blending of this two types of coffee which obtains a delicate and skilful balance in various characteristics.

Blended tea

Selvan and Sivasamy (2009) studied the effect of blending seedling leaves with quality cultivar TTL-2 leaves in various proportion for one cycle. They reported that the seeding leaves:TTL-2 (2:1) ratio is increase the Polyphenol (%), Catechin (%) and Soluble sugars (%).

Conclusion:

From the discussion, it can be fulfilled that instead of sole fruit products, medicinal fruits or berries and spices with single as well as two or more fruits. Process into innovative value added blended products *viz.* RTS beverages like juice, nectar and RTS Concentrated beverage like squash, cordial, and syrup, fermented beverages like cider, wine, fenny, carbonated beverages and hot beverages like coffee and tea. All are definitely increase the qualitative, sensory and nutritional value of the product. This will be helpful to increase the economical status of the country by exporting them. Moreover, it improves the health of the consumers and get the higher prizes to processors as well as indirectly benefited to growers**.**

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker : Pooja R. Naik	**Course : PHT-591 (1+0)**
Reg. No. : 2020216020	**Date : 30/12/2017**
Major Guide : Dr. N. V. Patel	**Time : 11:00 to 12:00 am**
Co-Guide : Dr. D. R. Bhanderi	**Venue : Swami Vivekananda Hall**

Application of osmosis in food industries

Introduction:

Fruits and vegetables are vital sources of essential minerals, vitamins, dietary fibers, carbohydrates and proteins. India is the second largest producer of fruits and vegetables in the world. They are highly perishable in nature and possess very short shelf life. Post harvest losses have been attributed in part to lack of marketing outlets, inappropriate storage techniques and absence of alternative uses. The development of value-added products would help to overcome problems associated with the limited storage life and high post-harvest losses.

What is Osmosis….?

Osmosis is spontaneous movement of a solvent (such as water) from a lower concentration to a higher-concentration solution, through a semi-permeable membrane separating the two solutions. The flow of solvent stops when both solutions become equal in concentration. In nature, osmosis is an essential process by means of which nutrients are delivered to the cells.

What is Osmotic Dehydration…?

Osmotic dehydration is a process that entails the partial removal of water from food items such as fruits and vegetables. The process is based on a tendency to reach equilibrium between osmotic pressure inside the biological cells and the surrounding osmotic solution, which has an increased osmotic pressure caused by high concentration of soluble osmotic agent. Molecular diffusion of water through semi-permeable cell membranes takes place and product losses its water.

Review of research work:

Kishore *et al*. (2016) found that the maximum content of ascorbic acid and total soluble solids in candies prepared from guava var. Allahabad Safeda for a cooking time of 90 minutes. While, the maximum carbohydrates content was found in the candies prepared from var. Lucknow-49 for a cooking time of 150 minutes. The guava candy prepared from var. Allahabad Safeda by cooking for 120 minutes gave the maximum consumer acceptance.

Nazaneen *et al.* (2015) found that the osmo-dehydrated pineapple cubes with 60^{o} B TSS at 60^{o}C gave the highest consumer preference by means of overall acceptability and retention of vitamin. C.

Sidhu *et al.* (2015) reported that the kinnow peel candy packed in HDPE bag was microbiological stable as compared to other packaging materials and also can be store for 60 days under ambient as well as refrigerated conditions till 60 days of storage.

Hasanuzzaman *et al.* (2014) investigated that the moisture(%), acidity(%), ash(%), protein(%) and ascorbic acid (mg/100g) content of candy prepared by using 40% sugar solution was higher whereas, the total sugar(%), carbohydrate content and energy(K Cal) were higher in candy prepared by using 60% sugar solution. They also noticed that the colour, texture, flavour, softness, taste and overall acceptance of candy prepared by using 40% sugar solution was most preferred.

Patil *et al.* (2014) reviewed that the treatment combination T_1D_1 (Fruit pieces impregnated in cane sugar syrup (TSS 60 ^{0}Brix)+0.5% citric acid + cabinet drying) recorded the maximum score for all the organoleptic parameters up to 120 days of storage. It is also most economic method for the preparation of karonda candy.

Totad (2014) found that the maximum acidity was recorded in treatment T_4 (50°-70° Brix + 1% citric acid) during storage. While, the maximum ascorbic acid (mg/100g) was recorded in treatment T_3 (40°-70°Brix+1% citric acid) and the maximum total sugars of sapota candy in treatment T_1 (40°-70°Brix) during 120 days storage. Whereas, the maximum overall acceptability scores of sapota candy was recorded in treatment T_2 (50°-70°Brix).

Chaturvedi *et al.* (2013) observed that the bacterial as well as mould count were found lower in IRR (Infrared dried and radiated). So, it has been found that a reduction of microbial load by infrared drier and hurdle technology of radiation processing for IM carrot shreds.

Fasogbon *et al.* (2013) investigated that the amount of water loss increased with increase in immersion time. Pineapple slices immersed in sugar:salt solution (47:3) exhibited a significantly greater water loss compared to those samples immersed in sugar solution.

Nath *et al.* (2012) found that the maximum TSS and acidity were observed at slice thickness of 7.93 mm and blanching time duration of 20 min. Whereas, the maximum taste score was observed at slice thickness of 10 mm and blanching time duration of 25 min for instant ginger candy.

Nayak *et al.* (2012) concluded that TSS (°B) acidity(%) and total sugars were found maximum in aonla candy prepared form var. Krishna and flavoured by cardamom during 180 days of storage.

Khan *et al*. (2010) investigated that the moisture loss and solid gain were maximum in 60% sugar syrup treated apple pieces and also increased with duration of osmosis at all osmotic solution concentrations.

Zita *et al.* (2009) found that the increase in moisture loss (%) during osmotic dehydration with increasing osmotic solution concentration. The moisture loss was found higher in osmotic dehydration by sucrose solution. The non significant effect was observed in sugar type and temperature in osmotic dehydrated mango.

Sharma *et al*. (2006) concluded that the lye treated samples of apricot wholes as well as halves obtained significantly lower contents in moisture(%), titrable acidity(%) and ascorbic acid(%),while the higher contents of total sugars(%) and higher values for brix:acid ratios after 90 days of storage.

Conclusion:

From the research results of various researchers on this aspect, it can be concluded that the best guava candies can be prepared by cooking for 120 min from var. Allahabad Safeda. The osmo-dehydrated pineapple cubes prepared by using osmotic solution having 60^{o} B TSS strength at 60^{o}C for highest retention of vit. C with better sensory quality. Osmotically dehydrated kinnow peel candy can be packed and store safely in HDPE under ambient as well as refrigerated conditions till 60 days. Raw tomato candy can be prepared by using 40% sugar solution. For preparation of karonda candy, fruit pieces impregnated in cane sugar syrup (TSS 60 ^{0}Brix)+0.5% citric acid followed by cabinet drying. Which gave higher profit for the processor. Sapota candy can be prepared by using sugar syrup T_2 (50°-70°Brix) with can be stored for 120 days within higher acceptability. The shelf stable intermediate moisture carrot shreds using IRR (Infrared dried and radiated) as hurdle technology reduce the microbial attack during storage. The use of sugar:salt solution (47:3)as osmotic solution to increase the solid gain and water loss from pineapple slices during osmotic dehydration .The best ginger candy can be prepared by keeping slice thickness 10 mm and blanching for 25 min. Candy prepared form aonla var. Krishna and flavored by cardamom can be store up to180 days with better quality parameters. 60% sugar syrup increase the moisture loss and solid gain which is useful for quicker preparation of osmotic dehydrated slices of apple. Sucrose solution (50°Brix at 45°C) can be used for better and quicker dehydration of Mango slices by osmotic dehydration. The best apricot candy can be prepared by lye treating of apricots and also can be stored up to 90 days.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
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POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Bhatt Zalak Kartikkumar	**Course : PHT-591 (1+0)**
Reg. No. : 2020217004	**Date : 20/10/2018**
Major Guide : Dr. N. V. Patel	**Time : 11:00 to 12:00 am**
Co-Guide : Dr. N. B. Patel	**Venue : Swami Vivekananda Hall**

Application of stabilizers in food industry

Meeting consumer demands for variety of taste, appearance and convenience with food products that are at the same time wholesome, safe and affordable can be achieved using modern food technologies including variety of food additives proven useful and safe through long use and rigorous testing. Food additive is any substance which is not normally consumed as food but used as a typical ingredient of food whether or not it has nutritive value, the intentional addition of which to food for technological reasons including organoleptic purpose during manufacturing, processing, preparation, treatment, packaging, transport and storage.

Stabilizer is an additive to food which helps to improve texture of foods, inhibits crystallization of sugar, formation of ice, stabilize emulsions and foams. These are used to keep products in set state, such as jellies, jams and baby foods. They are also used to keep ice cream creamy. They generally improve consistency and will affect appearance and texture of foods. Jellies, jams, ice creams, puddings, pie fillings, soups, ketchups and salad dressings are some foods which contain stabilizers (Raj *et al.*, 2016).

Review of research work

Abdul *et al.* (2007) observed that 0.4% guar gum gave higher sensory quality to the tomato paste in terms of color, taste, texture, appearance and overall acceptability and also observed minimum changes in sensory quality of tomato paste incorporated with the same treatments during 180 days of storage.

Broomes and Badrie (2010) noticed significant difference in texture of reduced calorie sorrel jam prepared by using different pectin concentrations and revealed that sorrel jam prepared by using 1.5% pectin got highest scores in texture with an overall acceptance.

Mircea and Gheorge (2010) studied that addition of 4% potato starch gave good consistency to tomato ketchup.

Mudgil *et al.* (2011) observed that stabilizers either sole or in combination resulted in reducing in serum loss and increasing in viscosity of ketchup but in term of sensory quality ketchup with 0.5% guar gum showed higher sensory scores.

Shivkumar (2011) found that bread baked with incorporation of 1.0% guar gum gave higher sensory quality in terms of crumb color, texture and overall acceptability.

Nima *et al.* (2012) reaveled that xanthan gum and carrageenan increased viscosity and decreased syneresis of yoghurt, 0.01% xanthan gum gave highest viscosity and lower syneresis to yoghurt at room and refrigerated storage temperature.

Chaudhari and Nikam (2013) noticed that beet root jelly prepared with using 2% pectin showed higher sensory attributes in terms of color, appearance, flavor, taste, texture and overall acceptability.

Sohini *et al.* (2015) showed that 0.5% xanthan gum gave highest overall acceptability to the chocolate fortified barley oat fermented product.

Sangle *et al.* (2015) reported that ice cream prepared with 0.2% guar gum got the highest hedonic sensory scores by the panel members for appearance, texture, flavor, taste and overall acceptability.

Kabirian *et al.* (2015) found that carrageenan and carboxymethyl cellulose improved the viscosity and consistency of chocolate drink powder. They also observed that level of 1% carrageenan and 2% carboxymethyl cellulose gave highest viscosity to chocolate drink powder but the level of 0.5% carrangeenan and 1% CMC were found more acceptable.

Akkarachaneeyakorn and Tinrat (2015) revealed that 0.5% xanthan gum stabilizer gave higher viscosity to cloudy mulberry juice with higher acceptance among sensory panelists. They also noticed that 0.5% xanthan gum produced no precipitate during storage.

Patil *et al.* (2017) found that 1% pectin and carboxymethyl cellulose gave higher sensory quality to date - mango leather in terms of color, flavor, taste, texture and overall acceptability.

Anju *et al.* (2017) studied that corn based starch in instant soup mix from dehydrated pumpkin powder had higher nutritional composition than rice and potato starch sources based instant soup mix.

Conclusion

From the research results of various researchers on this aspect, it can be concluded that 0.20% and 0.40% guar gum gives higher overall acceptability to ice cream and tomato paste, respectively, whereas 1.00% guar gum gives higher sensory qualities to bread and 0.50% guar gum increases viscosity of ketchup and reduces serum loss which gives higher overall acceptability. Sensory properties and textural quality of date- mango leather can be improved by using 1.00% pectin and CMC while, 1.50% and 2.00% pectin gives higher sensory score to sorrel jam and beet root jelly respectively in terms of color, taste, texture, flavor and overall acceptability. Xanthan gum at 0.01% increases the viscosity of yoghurt and decreases syneresis whereas, 0.50% xanthan gum gives higher viscosity to the cloudy mulberry juice as well as gives higher overall acceptability to chocolate fortified barley oat fermented product. Desirable viscosity of tomato ketchup was found when 4% potato starch added. Corn based starch source provides higher nutritional quality to instant soup mix. Chocolate drink prepared by using 0.50% carrageenan and 1.00% CMC gives higher overall acceptability and increases the viscosity.

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NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Patel Gauravkumar Dalpatbhai	**Course : PHT-591 (1+0)**
Reg. No. : 2020217020	**Date : 20/10/2018**
Major Guide : Dr. N. V. Patel	**Time : 10:00 to 11:00 am**
Co-Guide : Dr. N. B. Patel	**Venue : Swami Vivekananda Hall**

Application of antioxidants in food industry

Introduction

Food additives are substances added to food to preserve their freshness, improve their visual appeal and enhance their taste and flavour. Humans have been using food additives since long time for preserving food by adding vinegar, oil, sugar and salt. Food additives are classified into six groups: preservatives, antioxidants, colouring and flavouring agents, stabilizers, anti-caking agents, acidity regulators and antibiotics. Among these, antioxidants plays an important role in food industry.

Antioxidants are a substance which prolongs the shelf life of foodstuffs by protecting them against deterioration caused by oxidation, such as fat rancidity and colour change. Foods that contain vegetable or animal fat go rancid when exposed to oxygen, heat, moisture or the action of enzymes. The speed at which this takes place depends on a number of factors including the source of the oil or fat and how it is stored. Antioxidants, both natural and synthetic, are used by the food industry as food additives to help prolong the shelf life and appearance of many foodstuffs.

Review of research work

Effect of synthetic antioxidants in food

Raj (2004) studied the effect of frying media and antioxidant (TBHQ) on peroxide value of potato products and found that potato chips and french fries fried in refined sunflower oil along with 100 ppm TBHQ resulted minimum increase in peroxide value during storage. It was also noted minimum enzymatic browning when potato products were dipped in 0.05% ascorbic acid along with 3% NaCl solution during preparation.

Bala (2002) studied the effect of EDTA and ascorbic acid dip treatment on thiobarbituric acid (TBA) value and microbial count of catla fish stored at refrigerated temperature and reported that combined effect of EDTA and ascorbic acid in 1:1 proportion resulted minimum TBA value, *Pseudomonas* count and yeast and mould count.

Effects of natural and synthetic antioxidants in food

Prasad *et al.* (2018) investigated the free radical scavenging activity of burfi samples using different essential oils (EOs) and found that combined effect of EOs had higher antioxidant activity as compared to single effect but, the samples treated with butylated hydroxyanisole (BHA) recorded highest antioxidant activity.

Zbikowska *et al.* (2017) observed the minimum increase in peroxide as well as anisidine values of cakes prepared by using BHA 200 ppm and green tea extract 1% after 28 days of storage.

Abdulla *et al.* (2016) studied the antioxidant and antimicrobial effects of ziziphus leaves extract in sausage during cold storage and revealed that sausage prepared with the addition of 1% ziziphus leaves extract showed lower thiobarbituric acid (TBA) values as well as total microbial growth as compared to control and TBHQ added samples.

Konak *et al.* (2015) studied the effect of different levels of cherry laurel fruit on total phenolic compounds and antioxidant capacity of cakes and cookies and found significant effect on the total phenolic content, antioxidant capacity and sensory characteristics. Moreover, these values were found to be increased with increasing fruit levels.

Ling *et al.* (2015) reported that sunflower oil containing 200 ppm extract of unripe banana peel showed significantly lower PV compared to BHA and α-tocopherol. Furthermore, sunflower oil containing 200 ppm of unripe banana peel extract exhibited comparable inhibitory effects with BHA.

Saatchi *et al.* (2014) studied the effect of some antifungal and antioxidant compounds extracted from some herbs on thiobarbituric acid (TBA) values of cakes stored at room temperature and found absence of rancidity in samples within the first week, while no change was observed in the samples containing the natural antioxidants up to second week. After a passage of six weeks, they noted that ajwain and camel thorn oils bear the most antioxidant activity and possess better performance than BHT.

Ibrahium *et al.* (2013) concluded that Peroxide Value (PV) and TBA value increased continuously in all cake samples during storage. The rate of increment in the PV value decreased with increasing of clove essential oil (CEO) concentration from 400 to 800 ppm. TBA value of cake samples containing CEO at levels 600 and 800 ppm were lower than the control and BHT samples, while the sample containing 400 ppm was almost in equal with BHT sample.

Conclusion:

It is inferred from the foregoing discussion that antioxidants have received greater attention in recent years for protecting food from rancidity and browning due to oxidation. Potato chips and french fries fried in refined sunflower oil along with 100 ppm TBHQ resulted minimum increase in peroxide value with higher sensory score. Furthermore, pre-treatment by sodium chloride (3.0%) with ascorbic acid (0.05%) given to slices and sticks for preparation of potato products resulted negligible enzymatic browning. The shelf life and quality of catla fish can be maintained by improving odour and inhibiting the microbial growth and TBA values when they are treated with EDTA + ascorbic acid and stored at low temperature. Ziziphus leaves extract (1%) led to retardation of lipid oxidation and lowering the total microbial count in beef sausage at low temperature. Sensory quality of cakes and cookies can be increased with increasing cherry laurel fruit level having antioxidant property. Moreover, ajwain and clove essential oils as well as green tea extract can result increase in shelf-life and quality with decreased PV and TBA value in cakes due to their antifungal and antioxidant properties. Unripe banana peel extract at 200 ppm having strong protection effects can be used against lipid peroxidation of sunflower oil during storage.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Raghavendra H R	**Course : PHT-591 (1+0)**
Reg. No. : 2020217028	**Date : 01/09/2018**
Major Guide : Dr. C. S. Desai	**Time : 11:00 to 12:00 am**
Co-Guide : Dr. S.J. Patil	**Venue : Swami Vivekananda Hall**

Role of 1-MCP on post harvest physiology and shelf life of fruits

Ethylene is an natural plant harmone helps for the ripening of fruits which makes desirable qualities in terms of texture, palatability, colour, nutrition etc., but alsoethylene can cause spoilage of F&V due to its over action. Hence there is a need of right technology to minimize the loss and increase storability of F&V by controlling of ripening process.

There are many strategies for controlling ethylene production and thus ripening and senescence can be prevented like 1-MCP, AVG (1-Aminoethoxyvinylglicine), Nitric oxide, MAP (Modified Atmosphere Packaging) and so on. Among these 1-MCP (1-methylcyclopropene) exhibit synthetic plant regulatory mechanism by inhibiting the action of ethylene by blocking the ethylene receptors in the cell. Compare to others 1-MCP exhibits non toxic mode of action which activates at very lower concentration with negligible residual effect. (Blackenship and Dole,2003)

Review of research work

Effect of 1-MCP on respiration and ethylene rate:

Claire *et al*. (2002) reported that apple fruits which were treated with 1μl/L 1-MCP showed reduced ethylene production during ripening period at 20^0C where ascontrol and 0.01μl/L 1-MCP treated fruit increases from 5μl/kg/hr on 1^{st} day to maximum 260μl on 7^{th} day of storage.

Zisheng Luo (2005) showed that 'Qiandaowuhe' persimmon treated with 1-MCP not only delayed the onset of respiratory climacteric peak but also effectively suppressed the respiratory production and greatly inhibited ethylene production during the first 8 days of ripening.

Penchaiya *et al*. (2006)observed that 'Nam Dokmai' mangoes were treatedwith higher concentrations of 1-MCP (500 and 1000 ppb) for 24 hours at 25ºC showed lower respiration rate and ethylene production than the250 ppb treatment fruits and control.

Ashariya *et al.* (2006) reported thatpapaya fruits at colour break stage (<10% yellowing) treated with 1-MCP at 100 nl/L for 12 hrs showed reduced respiratory climacteric, reduced ethylene production upto 20 days during ripening.

Effect of 1-MCP onphysico-chemical parameters:

Alejandra *et al*. (2004) showed that persimmonfruits treated with 1-MCP significantly maintained firmnessupto 8 days during normal condition even after 50 days of cold storage by sharply reduced the softening. The effect of 1-MCP was similar wether it is applied before or after cold storage.

Ashariya *et al*. (2006) reported that firmness of non treated papaya fruit when fully ripe was approximately 15.1N where as the 1-MCP treated fruit was firmer at 162.9 N on day 10 which is declined to 41.4N on day 20.

Harb and Hasan (2012) found that guava fruits which were treated with combination of 1-MCP and MAP maintainsgood fruit firmness for almost 2 weeks at 12^0C than the control and MAP alone.

Alejandra *et al*. (2004) reported thatpersimmon fruits treated with 1-MCP either beforeor after cold storage maintains colour (orange-yellow) upto 8 days during normal condition even after 50 days of cold storage.

Feygenberg *et al*. (2012) found that mature green banana fruits treated with 50 ppb 1-MCP showed progressive development of yellow colour after short ethylene treatment than 100 ppb treated fruits which showednon reversible ripening inhibition effect.

Zisheng Luo (2005) revealed that persimmon fruits treated with 3μl/L 1-MCP reduced the activity of PG & PME which leads firmer upto 8-10 days.

Singh and Dwivedi (2008) observed that mango fruits with 1-MCP can strengthen the antioxidant system by increasing the activity of catalase activity and decreasing of Reactive Oxygen Species (ROS) like H_20_2.

Effect of 1-MCP on Decay:

Yueming *et al*. (2001) found thatstrawberry fruits responds to 1-MCP at lower concentration of 100-250nl/L to reduced the incidence of disease and increases post harvest life.

Singh and Pal (2007) reported that guava fruits which were treated with 1-MCP at 300nl/L for 24hrs or 600nl/L for 12 and 24hrs reduced the decay after 25 days at 10^0C followed by 5 days of storage at 25-29^0C.

Effect of 1-MCP on Chilling injury:

Singh and Pal (2007) observed that guava fruits treated with 1-MCP at 600nl/L for 24 hrs showed reduced chilling injury index followed by 600 nl/L for 12 or 300nl/L for 24hrsafter 25 days at 10^0C followedby 5 days of storage at 25-29^0C.

Selvarajah *et* al. (2001) revealed that pineapple treated with 1-MCP (0.1ppm for 18hrs at 20^0C) completely eliminated internal browning upto 3 weeks of storage at 10^0C and exhibit only 15-20% after 3 weeks at 20°C.

Effect of 1-MCP on Sensory quality:

Harb and Hasan (2012) reported that guava fruits were treated with combination of 1-MCP and MAP were considered as best sensory qualified fruits compared to control and MAP alone.

Conclusions:

1-MCP provides potential to maintain fruits quality after harvest in respect to reduction in respiration, ethylene production, volatile production, chlorophyll degradation, softening, disorders and diseases.1-MCP is an effective tool in reducing the chilling injury by reducing softening, internal colour discolouration, skin pitting indirectly by retarding the ripening process.Application of 1-MCP can increase the antioxidant system in fruits by reducing ROS (Reactive Oxygen Species) like H_2O_2 (Hydrogen peroxide) and lipid peroxidation.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Gohil Mehulbhai Maganbhai	**Course : PHT-591 (1+0)**
Reg. No. : 2020218014	**Date : 19/10/2019**
Major Guide : Dr. Dev Raj	**Time : 11:00 to 12:00 am**
Co-Guide : Dr. A. K. Pandey	**Venue : Swami Vivekananda Hall**

Advances in waste utilization technology for pectin extraction from fruit and vegetable

Pectin is a structural hetero polysaccharide present in the primary cell walls and middle lamella of terrestrial plants and it is extensively employed as a gelling agent, thickener, stabilizer and emulsifier in food industry. It is structurally composed mainly of galacturonic acid. There are two types of pectin depending on their degree of methylation (DM) viz. high methoxy pectin and low methoxy pectin. Recovery of pectin is a crucial component for determining the success of food industry in order to provide adequate supply of the growing demand. Pectin is extracted at high temperature by hydrolyzing proto-pectin into pectin by conventional method. However, conventional method have several draw backs, due to that, novel methods such asacid extraction method, microwave assisted extraction, enzymatic extraction and ultra sound extraction have become more popular. Acids are the strongest extracting agents of pectin as they facilitate extraction of insoluble pectin that is tightly bound to the cell matrix of the plant material and result in higher yields. Microwave assisted extraction exhibits large handling capacity, short processing time and good purity. Ultra sound extraction exhibits shortening of extraction time, reduction of reagent consumption. Enzymatic extraction exhibits mild conditions, low energy consumption and no pollution. The extracted pectin possess great potential for its utilization in food processing industry for preparation of value added products *viz*. jam, jelly, marmalades, beverages, etc.

Review of research work

Acid extraction method

Sudhakar and Maini (1999) observed optimum yield of pectin from mango peels when extracted two times for 90 minutes duration employing a peel: extractant ratio of 1:4.

Rehman *et al*. (2004) reported highest an hydrouronic acid (72.80%), methoxyl content (9.77%) and equivalent weight (943) when pectin was extracted at pH 2.5 for heating duration of 120 minutes.

Dennapa *et al.* (2005) observed optimum yield of pectin when pectin was extracted by using 0.06 M concentration of HCland precipitated with $AlCl_3$ for 3 hours.

Woo *et al.* (2010) studied on effect of pH and extraction time on the degree of esterification of pectin from red dragon fruit peel. They found highest degree of esterification (71) of pectin which was extracted at pH 4 for 120 minutes heating.

Chaitra (2014) reported that treatment of banana peel with citric acid and heating for 90 minutes resultrdhigher amounts of pectin in three varieties of banana peel.

Mohamed (2015) reported highest value of methoxyl content (8.875%), degree of esterification (55.05) and lowest value of ash (1.800%), acetyl content (0.455%) of pectin from red grapefruit peel and at par value of anhydrouronic acid (60.95%), Intrinsic viscosity (1.500 dl/g), molecular weight (31620) of pectin from red and white grape fruit peel.

Leong *et al.* (2016) reported that the citric acid-extracted pectin solution has lowest brightness and highest redness (colour parameter a) and yellowness (colour parameter b) compared to solution made from nitric acid- and sulfuric acid-extracted pectin.

Nurul and Dayang (2017) reported highest yield of pectin from sweet potato peel when pectin was extracted at temperature of 90 ^{0}C for extraction time of 60 minutes.

Microwave-assisted extraction method

Kratchanova *et al*. (1994) observed that dried materials treated by microwave heating gives higher yield (27.3g/1 kg), degree of esterification (74.8%) and gel strength (237 ^{0}TB) compared to another initial material for pectin extraction.

Koh *et al.* (2014) revealed that MAE at 450 W was the most effective extraction condition among the different power levels for extracting pectin from jackfruit rinds due to its efficiency to extract pectin with similar yield and quality relative to a conventional extraction.

Hartati and Endah (2015) recorded highest pectin yield (11.25%) from water melon rind when microwave treatment was given for 15 minutes.

Quoc *et al*. (2015) reported the highest yield (20.41%) and degree of esterification (92.75%) of pectin from pomalo peel when treated with 660W microwave power.

Zarei *et al*. (2017) reported that fresh lemon peel pectin exhibited the highest galacturonic content (74.5%) when samples were pretreated with microwave as compared to dried lemon peel, while apple pomace pectin indicated the higher galacturonic acid content in dried pomace irrespective of microwave treatment.

Ultrasound-assisted extraction method

Bagherian *et al*.(2011) reported highest yield (17.92%) of pectin when treated with ultrasound for 25 minutes at constant temperatureof 70^{o}C.

Grassino *et al*. (2015) reported the UAE for 30 minutes at 80 °C resulted highest yield (20.1%) of pectin from tomato waste.

Shabana *et al.* (2015) observed highest DE (73.81%) and GalA content (70.87%) at 20 minutes with ultrasound procedures and maximum pectin yield (16.59%) with conventional procedure at 90 minutes which is almost similar pecin yield (15.8%) at 20 min by ultrasound procedures.

Cibele *et al.* (2016) observed the highest yield of pectin when treated with ultrasound power intensity of 644 W/cm^{2} and temperature of 85 ^{0}C. Under these conditions, the yield, the galacturonic acid content and the esterification degree were 12.67 %, 66.65 % and 60.36 %, respectively.

Bruna *et al.* (2018) revealed that the ultrasound having 75% intensity resulted lowest brightness (94.5), lowest greenness (colour parameter a:-0.36) and highest yellowness (colour parameter b:4.9) in the extracted pectin compared to control and conventional extracted pectin.

Enzymatic-assisted extraction method

Olga *et al.* (1997) studied on effect of different enzymes on yield and polygalacturonic acid of pectin from pumpkin peel and found highest yield (21.5%) and polygalacturonic acid (38%) of pectin with cellulase enzyme.

Ptichkinaa *et al*. (2008) reported highest recovery of pectin (14.0%) having high polygalacturonate (64%), molecular mass (45 kD) and lowest value of ash (2.9%) in pectin extracted from pumpkin peel by using*Aspergillusawamori*.

Vinay *et al*. (2019) observedthat treatment of apple pomace with cellulase (12µg for 2 hr) for pectin extraction resulted highest pectinyield (20.42%). The extracted pectin contains high equivalent weight (1710.32), methoxylcontent (5.94 %), degree of esterification (76.62%) and a jelly grade (80).

Conclusion:

The application of microwave assisted extraction can lead to increased pectin yield, decreased extraction time and reduce thermal degradation of pectin compared to the other method. Pectin extraction by acid need a long period of heating, so thermal degradation of the pectin may occur resulting in changes in quality of the pectin. Ultrasound assisted extraction help to decrease extraction time and temperature compared to the conventional extraction method. The use of enzyme- assisted extraction improved pectin yield compared to the control sample but require more time for pectin extraction. Besides different pectin extraction methods; non-specific extraction parameters *viz*. extraction time, temperature, pH, origin of extracted material, material to solvent ratio and number of extractions etc. are very also essential to predict the quality of the extracted pectin.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Karangiya Arjun Bhikhabhai	**Course: PHT-591 (1+0)**
Reg. No. : 2020218016	**Date : 30/11/2019**
Major Guide : Dr. C. S. Desai	**Time : 09:00 to 10:00 am**
Co-Guide : Dr. S. J. Patil	**Venue : Swami Vivekananda Hall**

Calcium: an indispensable element affecting postharvest life of fruits and vegetables

Fruits and vegetables have an important role in the human diet and their consumption helps to lower the risk of chronic diseases and to maintain a healthy weight. The continuous increase in population would also increase the global demand for food but on the other hand the growing competition for land, water and energy coupled with overexploitation of natural resources will affect our ability to produce food. Prevention of post harvest losses is increasingly cited as a means to effectively contribute to available food supplies making it a prime goal to develop technology. It is commonly cited that one third of the world's agricultural produce is lost before reaching to consumers in which fruits and vegetables are comparatively more perishable. The magnitude of losses in fruits and vegetables due to pathological or physiological factors is estimated at about 25–30 %.The shelf life extension of any fruits and vegetables prerequisite for minimizing the postharvest losses. However, the calcium application has a significant impact on the shelf life of fruits and vegetables. Different benefits of calcium application like delay ripening reduced post harvest loss and increasing the nutrional value *etc.*

Review of research work:

Papaya

Mahmud *et al*. (2008) observed that postharvest infiltration of calcium at 2.5 % has potential to prolong the storage life (25.93 days), maintain firmness (5.37 Kg. cm^{-2}) and minimum weight loss (2.78, 4.51 and 6.87 % at 7, 14 and 21 days respectively) in papaya.

Apple

Elham *et al.* (2011) studied effect of post harvest treatment on physiological loss in weight, firmness, and ethylene and found 2 % calcium chlorides gave minimum weight loss and improve firmness and minimum ethylene production found in 4 % calcium chloride.

Sapota

Tandel (2009) studied the effect of calcium hydroxide on days taken on ripening of sapota cv. Kalipatti and found that maximum days taken for ripening (6.98 and 6.93 days in the year of 2007 and 2008, respectively) when dipping in 1% calcium hydroxide solution for 5 minute and wet rubbing after drying.

Berries

Tamar *et al.* (2016) observed that application of calcium did not significantly effect on total soluble solid but minimum loss (5.3 %) was observed in raspberry fruits which were treated with 2% calcium chloride. Similarly, strawberry fruits found minimum weight loss (4.1%) with 2% calcium chloride.

Jamum

Dalvadi *et al.* (2017) observed minimum spoilage loss (3.85, 6.34, 24.65 and 34.65 % at 1,2,3 and 4 days respectively) and maximum marketable fruit (94.25, 90.00, 70.25 and 63.25 % at 1, 2, 3 and 4 day respectively) when fruits were treated with 1.5 % calcium chloride.

Tomato

Dhruba and Durga (2012) studied physiological weight loss of tomato fruits at various days after storage as affected by calcium chloride treatment at ambient condition and found that 1 % calcium chloride application gave maximum storage life of tomato fruit.

Mango

Monica *et al*. (2017) observed effect of postharvest treatments on shelf life and quality of mango and found that shelf life of the mango fruits affected by various postharvest treatments among them maximum shelf life (20.33 days) of fruits was observed and the minimum spoilage incidence (19.83 %) was recorded in fruits treated with 2 % calcium nitrate.

Cashew apple

Kumar Anjan (2011) studied that the effect of postharvest application of calcium on physiological loss in weight of cashew apple cv. Ullal-2 with nut and without nut during storage and found that application of 1 % calcium chloride gave minimum physiological weight loss.

Pear

Mahajan (2004) observed that postharvest application of calcium chloride on physiological loss in weight and core browning of pear fruits during storage and observed on various days in which minimum post harvest loss (0.52, 1.10, 2.00, and 3.00 on 30, 45, 60 and 75 days during storage respectively) and minimum core browning (5 %) at 75 days during storage with application of 4 % calcium chloride.

Conclusion:

From above discussion we can conclude that, calcium plays wide and important role in post harvest life of fruits and vegetables. The importance of calcium in the nutrition of plants has been long recognized and application of calcium before harvest is important, but direct calcium application to harvested fruit is more significant than the former. Postharvest factors like shelf life extension, quality improvement and control of decay *etc*, are clearly influenced by the effect of calcium. In papaya, infiltration of calcium at 2.5 % has potential to prolong the storage life, maintain firmness and minimum weight loss. In apple, 2 % calcium chlorides gave minimum weight loss and improve firmness and minimum ethylene production found in 4 % calcium chloride. In sapota, fruit treated with 1 % calcium hydroxide solution for 5 minute and wet rubbing after drying achieved delay ripening. Postharvest applications of 2 % calcium chloride improve the shelf life of beery fruit. Improve the shelf life and maximum marketable quality achieved through 1.5 % calcium chloride application in jamun. In tomato, 1 % calcium chloride gave maximum storage life. In mango, of 2 % calcium nitrate reduced the risk of spoilage incidence in mango. Postharvest treatment of 1% calcium chloride gave minimum physiological weight loss in cashew apple. In pear, applications of 4 % calcium chloride improve storage life and reduced the risk of core browning.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Muhammad Rokai Muhammadi	**Course : PHT-591 (1+0)**
Reg. No. : 2020218021	**Date : 30/11/2019**
Major Guide : Dr. C. S. Desai	**Time : 10:00 to 11:00 am**
Co-Guide : Dr. S. J. Patil	**Venue : Swami Vivekananda Hall**

Drying and dehydration of fruits and vegetables

Fruits and vegetables occupy an important place among the food crops as these provide adequate amount of vitamins and minerals for humans. Vegetables serve as rich sources of β carotene, ascorbic acid, iron, zinc and dietary fiber (Negi and Roy 2000). Ripe fruits are sub acidic, exert cooling effect and are used for making excellent juice, squash, jams, pies and chutneys as well as consumed as table fruit by the people of all age group during hot summers (Kumar *et al.* 2014). Drying is an ancient technique of food preservation and for extension of shelf-life of foods and it also minimizes the transportation cost as well as the storage cost per unit product weight. Sun drying is the most common method to preserve the foods in rural area where as in industries mechanical drying is in practice. Preservation of fruits and vegetables by drying in the sun or in the naturally dry air of the deserts and mountains has been practiced and is still a vital operation in the life of many rural communities. For the faster drying and more versatility in commercial scale mechanical drying is the common technique to preserve the food stuffs. Drying or dehydration is a heat and mass transfer process for removal of water by application of heat from a solid or liquid food with the purpose of obtaining a solid product sufficiently low in water content. Where removal of water takes place by virtue of a difference in osmotic pressure and not by evaporation. The main objectives of food dehydration are preservation as a result of lowering of water activity, low transport and storage cost as a reduction in weight and volume and transformation of a food to a form more convenient to store, package, transport and use.

Review of Research works

Freeze drying

Mahendran (2008) observed that colour (8.4), sweetness (7.6), aroma (8.0), flavour (8.6), consistency (7.8) and total acceptability (40.4) was recorded maximum in freeze dried as compare to vacuum and spray dried.

Mishra *et al.* (2009) revealed that freeze dried samples showed maximum calcium (79.6 mg/100g), phosphorus (12.38 mg/100g), iron (88.03 mg/100g) and ascorbic acid (5432.75 mg/100g) content compared to other dried methods.

Kumar *et al.* (2012) observed that colour (4.3), taste (4.4), flavour (4.1), texture (4.5) and overall acceptance (4.6) were recorded maximum in freeze dried as compared to oven dried or hot drying.

Drying temperature

Artnaseaw *et al*. (2009) reported that minimum shrinkage (18.18 %) and highest rehydration ratio (1.38 %) observed at 60 ^{0}C with 10 kPa pressure and lowest colour change (1.2) observed at 50 ^{0}C with 15 kPa pressure.

Moreno and Diaz-Moreno (2017) revealed that maximum total phenol (76.53mg/100g), antioxidant activity (0.16 mmol/100g) and carotenoids (46.65 mg/100g) were found at 50, 60 and 70 ^{0}C respectively.

The conducted study showed the effect of dehydration temperatures on color, test and flavour of dehydrated cauliflower and results revealed that colour ratio (9.00) and flavour ratio (9.00) of dehydrated cauliflower was recorded maximum at temperature 75,70,65 and 60 °C meanwhile taste ratio was found maximum (8.54) at 65 ^{0}C (Anon., 2017).

Osmotic drying

Nazaneen *et al*. (2017) reported that osmo-dehydrated pineapple have more total sugar contents (65.64 %) as compared to raw pineapple (13.76 %).

Solar drying

Agoreyo *et al.* (2011) reported that carbohydrate level was found highest (83.08 %) in the solar drying sample and lowest (80.19 %) in the oven dried sample although ash content (5.50 %) was also recorded highest in the solar drying sample as compared to sun and oven drying.

Spray drying

Caparino *et al*. (2012) observed that spray drying required less time (1-3 sec) to reduce water content of mango puree compared to other drying method.

Cabinet drying

Satewase *et al.* (2013) reported that cabinet dried sample were better than other drying methods and it had highest nutrient contents *viz.*, protein (32.60 %), fat (9.85 %) and less moisture (5.3 %) followed by shadow, sun drying and oven dried sample.

Vacuum drying

Wijewardane *et al.* (2015) observed that vacuum dried pumpkin powder retained higher level of β-Carotene (38.7 mg/100g), fat content (2.20 %), protein (2.92%), total ash (4.35 %), fiber (8.88 %), moisture (12.24 %) and TPC (0.06 mgGAE /g) compared to other drying method.

Sun drying

Çoklar and Akbulut (2017) reported that phenolic compounds caffeic acid (4.78), 2, 5-dihydroxybenzoic acid (17.56 mg/g DW), isorhamnetin-3-O-glucoside (20.97 mg/g DW) and gallic acid (7.41 mg/g DW) were recorded maxim in sun drying as compared to oven dried and freeze dried.

Pre treatments effect on moisture content and drying time

Dermesonlouoglou *et al.* (2008) reported that colour (7.0), texture (7.5), taste (7.0) and overall acceptance (7.3) was recorded maximum at 0 month for -15 °C temperature in the treatment (HDM) .

Yaswant (2010) conducted a study to assess the effect of drying methods, chemical preservative (0.1 % KMS and 0.2 % KMS) and storage temperature (16 ^{0}C and 27 ^{0}C) on quality of banana fig and found that total soluble solid (60.33) and acidity (1.760) were recorded more in oven drying as compare to sun drying.

An experiment was conducted for the development of technology for dehydration of onion rings and results revealed that minimum moisture (4.70 %) and maximum TSS (68.75 ^{0}Brix) and acid content (3.48 %) were recorded in the treatment T_{12} (K2500+C1000) (Anon., 2017).

An experiment was conducted for dehydration of okra slices and results showed that maximum drying rate (12.07 g/min) and minimum drying time (12.29 hrs.) were recorded in treatment T_{12} (K2500+C1000) as compare to control (Anon., 2017).

Conclusion

The study shows the suitable and cheap techniques for drying the fruit and vegetables. The major quality problems faced during fruit and vegetable drying are loss of flavor, discoloration and poor rehydration characteristics of the dried products. Osmo-dehydrated pineapple pieces using 60 ° Brix sugar syrup concentration with 60°C drying temperature produced better quality product with respect to physico-chemical as well as sensory quality. Oven drying and cabinet dryings are the most frequently methods used for food dehydration. Although sun drying is still the most common method used to preserve agricultural products in most tropical and subtropical countries. Meanwhile Freeze drying produced the best quality mango powder in terms of colour, flavor and ascorbic acid retention. Freeze-drying treatment is the most suitable procedure to preserves maximum ascorbic acid content and colour quality of some fruit (guava), but it is quite expensive technique as compared to convection and microwave oven methods. However, solar drying is most cost effective than other drying methods and it also give lower moisture content, a higher capacity to prevent microbial growth and decay in the dried products which is important for dried products shelf life. Consequently, solar drying may be the best techniques for preserving the food crops.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Sushmitha M. B.	**Course : PHT-591 (1+0)**
Reg. No. : 2020218046	**Date : 16/11/2019**
Major Guide : Dr. C. S. Desai	**Time : 10:00 to 11:00 am**
Co-Guide : Dr. S. J. Patil	**Venue : Swami Vivekananda Hall**

Applications of spray drying in microencapsulation of fruit powders

India is the second largest producer of fruits, grown over an area of 6.5 million hectares with production of 97.3 million tonnes (Anon., 2018[a]). As per the ICMR, the Recommended Dietary Allowance of fruits per person is 100 g/day. Even though the production of fruits is more but the consumption is very low. Around 1.7 million deaths are attributed to inadequate fruits and vegetables consumption (Anon., 2018[b]). This is mainly due to lack of suitable processing technologies for proper utilization of our production. Hence, microencapsulation of fruit powders by spray drying can be used as an efficient technology to overcome these problems. Microencapsulation is a process in which tiny particles are surrounded by a coating material to give small capsules. This plays an important role in reducing the loss of bioactive compounds and increase their shelf life by transforming them into microencapsulated powder. Around 80-90 % of microencapsules in food industry are produced mainly by spray drying method due to its advantages over other methods of microencapsulation. Wall materials are mainly film forming materials that can be selected from a wide variety of natural or synthetic polymers. This influences the encapsulation efficiency and stability of the microcapsule.

Review of literature

Noni (*Morinda citrifolia* L.)

Krishnaiah *et al*. (2012) observed better encapsulation yield (31.56 %) and DPPH scavenging activity (24.91 %) with high total phenolic content (36 mg TAE/g) and total flavonoid content (30 mg CE/g) using carrageenan as wall material while, better encapsulation yield (27.64 %) with relatively high DPPH scavenging activity (28.36 %), total phenolic content (54 mg TAE/g) and total flavonoid content (45 mg CE/g) was observed when maltodextrin as wall material used at 1: 2 ratio of Mcore:Mwall with 90 ^{0}C inlet air temperature.

Mango (*Mangifera indica* L.)

Caparino *et al.* (2012) observed that spray drying required less time (1-3 sec) to reduce water content of mango puree compared to other drying methods.

Passion fruit (*Passiflora edulis* L.)

Borrmann *et al*. (2013) stored microencapsulated passion fruit powder at 7 and 25 ^{0}C for 77 days and observed that storage temperature had no significant effect on Vitamin C degradation during storage.

Andes berry (*Rubus glaucus* L.)

Villacrez *et al*. (2014) observed relatively low water activity (0.331 aw) and moisture content (4.61 %) with better anthocyanin content (0.54 mg/g), along with good sensory properties when maltodextrin is used as wall material with 2 mm nozzle diameter and comparatively more stable when stored at low relative humidity of 75 % during 6 days of storage.

Jaboticaba (*Myrciaria jaboticaba* L.)

Silva *et al*. (2016) observed that 30 % maltodextrin as a carrier agent with 160 ^{0}C inlet air temperature gave better anthocyanin retention (99.02 %) with low hygroscopicity (0.138 %) in jaboticaba microcapsule.

Jamun (*Syzygium cumini* L.)

Sneha (2016) observed relatively low moisture content (7.52 %) with better solubility (96.23 %), with high anthocyanin content (0.55 mg/g) and high ascorbic acid (66.66 mg/100g) retention in microencapsulated jamun fruit powder prepared at 170 ^{0}C inlet air temperature with 5 ml/min feed flow and 30 % Maltodextrin and stored for three months.

Jussara (*Euterpe edulis* L.)

Paim *et al*. (2016) observed more than 10 log CFU/g of viable cell count in all the formulations, while high phenolics (1697.5 mg/100g), anthocyanins (739.2 mg/100g) and low hygroscopicity (0.171 %) in formulation of maltodextrin : inulin (50:50) used to prepare jussara probiotics.

Chinese plum (***Prunus salicina* L.**)

Yibin *et al.* (2017) observed 182.8 mg/g of total phenol in non encapsulated and 57.8 mgGAE/g in microencapsulated plum phenolics powder. However, storage studies showed that more than 85 % retention of total phenol in microencapsulated and more than 35 % loss of total phenol in non encapsulated powder during 60 days of storage at 25 ^{0}C.

Pineapple (*Ananas comosus* L.)

Raghuwanshi *et al.* (2019) studied on changes in physiochemical and organoleptic properties of spray dried pine apple powder with different maltodextrin concentration and inlet air temperature. Results showed that 150 ^{0}C inlet air temperature with 20 % maltodextrin gives powder with better yield, low moisture content and good sensory properties.

Conclusions:

From the foregoing discussion, it can be concluded that Mcore:Mwall of 1: 2 using maltodextrin at 90^{0}C inlet air temperature is preferred over carrageenan to prepare noni microcapsules rich in bioactive compounds. 2 mm nozzle diameter with maltodextrin as coating material is best to prepare andes berry microcapsules. Inlet air temperature of 160 ^{0}C using 30 % maltodextrin as coating material will give stable jaboticaba microcapsules with high anthocyanin retention. Inlet air temperature of 170 ^{0}C with 5ml/min feed flow and 30 % maltodextrin operating parameters will give stable jamun microencapsulated powder. Probiotic jussara powder prepared with wall material of maltodextrin:inulin (50:50) gives high viable cell count with more anthocyanins and phenolics retention. Microencapsulated plum phenolics powders are more stable during storage than the non encapsulated phenolics powder. Inlet air temperature of 150 ^{0}C with 20 % maltodextrin gives pine apple powder with better yield, low moisture content and good sensory properties. Storage temperature will have a least influence on microcapsules during storage and low relative humidity (75 %) is better for storage of dehydrated products. Microencapsulation is an important approach to meet all the demands to hold and deliver bioactive compounds of fruits for long time. Spray drying requires less time than other drying methods. Powders are best way of preserving the bioactive compounds for long term.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Brunda N B	**Course : PHT-591 (1+0)**
Reg. No. : 2020219006	**Date : 27/11/2020**
Major Guide : Dr. C. S. Desai	**Time : 03:00 to 04:00 pm**
Co-Guide : Dr. B. M. Tandel	**Venue : Online**

Peracetic acid: a potential disinfectant for fruits and vegetables

Post harvest cleaning and disinfection are a critical unit operation for preserving the quality of fresh produce by controlling microbial contamination related to spoilage and food safety (Davidson *etal*., 2017). For disinfection chlorine is used widely now-a-days. Excess use of chlorine reduces its efficacy and results in the generation of by-products with residues and harmful to employees. The peracetic acid or peroxyacetic acid (PAA) is gaining increased interest as an alternative to chlorine disinfectants because it does not produce harmful by-products. Further PAA is more potent than chlorine. Consideration to increasing food waste and outbreaks of foodborne illness related to fresh and fresh-cut fruits and vegetables motivates continued innovation in postharvest handling and disinfection practices, especially around the use of other harmful chemical disinfectants (Feliziani *et al*., 2016).

Review of research work

Silveira *et al*., (2011) studied theeffect of hot water treatment and peracetic acid to maintain fresh-cut Galia melon quality during storage. They observed that hot water dipping for longer duration (90 and 120 s) followed by peracetic acid dip, provided the lowest metabolic activity and helped to control microbial load without affecting the sensorial quality of cut Galia melon. In addition, it also increased the polyamine content helping to maintain the cell membranes integrity.

Neo *et al*., (2013) stuied the efficacy of chlorine and peroxyacetic acid on reduction of natural microflora, *Escherichia coli* O157:H7,*Listeria monocyotgenes* and *Salmonella spp*. on mung bean sprouts.Theyreported that peracetic acid treatment at 70 ppm resulted in greater reductions for non-adapted *E. coli* O157:H7, *L.monocytogenes*, *Salmonellaspp*., and natural microflora in sprouted mung bean. The results revealed that the efficacy of peracetic acid was significantly better than that of chlorine.

Bang *et al*., (2017) conducted experiment on synergistic effects of combined ultra sound (US) and peroxyacetic acid treatments against *Cronobacter sakazakii* biofilms on fresh cucumber. They stated that peracetic acid (200 ppm) significantly reduced biofilm formation on cucumber (1.88 log reduction). Furthermore, the combination of 60 min US and 200 ppm peracetic acid resulted in an additional reduction of *C. sakazakii* biofilms.

Ling *et al*., (2018) studied the effect of ultrasonic treatment (UT) combined with peracetic acid treatment reduces decay and maintains quality in loquat fruit. They observed thatperacetic acid (PAA) significantly reduced both decay and browning index in loquat fruit compared to the control. The combined treatment UT (400 watts) and PAA (0.4%) was more effective in decreasing decay, browning index and maintaining higher quality parameters. It also resulted insignificant increase in fruit extractable juice, total soluble solid (TSS) and ascorbic acid content in loquat fruit.

Shen *et al*., (2019) conducted experiment on enhanced efficacy of peroxyacetic acid against *Listeria monocytogenes* on fresh apples at elevated temperature. They stated that peracetic acid (80 ppm) treatment for 30 second and 2 minutes exposure, reduced *Listeriamonocytogenes* on fresh apples. The anti-*Listeria* efficacy of PAA was not affected by the water hardness and pH of the solvent, while the effect was improved dramatically when applied at elevated temperature. Exposure of PAA (80 ppm) at

43°C and 46°C for 2 minutessignificantly enhanced its bactericidal effects, and reduced*Listeria monocytogenes,* total plate count and yeast and mould count on fresh apples.

Conclusion

From the foregoing discussion it can be concluded that, peracetic acid is a strong disinfectant with a wide spectrum of antimicrobial activity and it is used in many industries including food processing, beverage, medical, pharmaceutical and textile due to bactericidal, fungicidal and sporicidal effect of peracetic acid (Kitis, 2013). Peracetic acid mixtures is environmentally friendly,because its composition that does not produce harmful by-products or leave behind residues that alter the organoleptic properties,and it is useful alternative to sodium hypochlorite for washing vegetables and fruits without the health drawbacks of trihalomethanes.The mechanism of oxidation, its composition as acetic acid and hydrogen peroxide, and efficacy of the biocide against pathogenic bacteria and spoilage microorganisms in fresh produce were reviewed. Newer developments in disinfecting technology have combined two or more oxidants or implemented physical and chemical treatments together to improve disinfectant delivery. Particularly, peracetic acid mixtures used in combination with physical treatment methods, such as ultrasound have shown synergistic effects at reducing microbial levels on fresh produce.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Mayursinh Jitendrasinh Dabhi	**Course : PHT-591 (1+0)**
Reg. No. : 2020219019	**Date : 05/12/2020**
Major Guide : Dr. N. V. Patel	**Time : 11:30 to 12:30 pm**
Co-Guide : Dr. A. K. Pandey	**Venue : Online**

Application of vacuum frying technology in food industry

Fruits and vegetables are highly perishable and have very short shelf life. One of the alternative to maintain quality and shelf life is by frying them into chips or slices. Fried products possess more shelf life than fresh fruits and vegetables because of low water activity. Atmospheric/traditional deep fat frying is one method to develop such product with lower moisture content/water activity within 360 seconds (Yamsaengsung*et al.*, 2008).Deep fat frying is a complex operation which is basically the immersion of food pieces in hot oil, at a temperature above the boiling point of water. This condition causes high rates of heat transfer, so that water evaporates from the immersed product. Frying temperature can range between 130-190 ℃. Higher heat treatment causes adverse effects on surface darkening, formation of toxic compounds such as acrylamide, loss offlavour, colour and nutrients. Besides that, fruits and vegetables containing higher sugar content cannot be fried by this method as caramelization will occur. Vacuum frying can be employed to prevent such adverse effects. In vacuum frying, food is deep fried under reduced pressure that lowered boiling point of water in food. Vacuum frying such as nutrient preservation, oil quality protection, reduced oil uptake and reduction in formation of toxic compounds are due to lower temperatures and minimal exposure to oxygen. Due to lower temperatures employed vacuum frying can be used to fry high sugar containing fruits and vegetables. Pre-treatments of the raw material before frying possess significant effect on product quality (Ayustaningwarno*et al.*, 2018). Vacuum frying can be successfully used for frying of important horticultural crops (Diamante *et al.*, 2015). Within last two decades several studies have been conducted to standardize vacuum frying technology for frying of different fruits and vegetables.

Review of research work:

Granda *et al.* (2004) compared the effect of traditional frying and vacuum frying on acrylamide formation in chips of different potato cultivars and revealed thatvacuum fried chips had lower acrylamide content as compared to traditional fried chips. Potato cv.NDTX 4930-5W had lowest acrylamide content in both traditional and vacuum frying. They also studied effect of frying time and temperature on acrylamide content and reported that chips of potato cv. Atlantic vacuum fried at 118 ℃ for 600 sec had lowest acrylamide content.

Shyu *et al.* (2005) carried out work on vacuum frying of carrot chips and observed that oil uptake, moisture loss and colour change increased with increase in frying time and temperature. They concluded that vacuum frying at 100 ℃ for 20 min can produce carrot chips with lower moisture and oil contents as well as good colour and crispy texture.

Perez *et al.* (2008) conducted an experiment on vacuum frying of pineapple slices with varying frying time (6.3-7.7 min) and temperature (106.3-117.7 ℃) and studied the effect on major physico-chemical and nutritional quality of fried slices. They observed that moisture content, water activity, color parameters L^*, C^* and H^* and total Vitamin C content decreased while total phenolic content and dehydroascorbic acid content increased with increasing frying time and temperature.By superimposing iso-response curves of all quality parameters, it was determined that processing conditionsof 6.9min frying time and 112 ℃ frying temperature produced pineapple chips of best quality.

Da Silva and Moreira (2008) reported that vacuum fried slices of blue potato, green bean, mango and sweet potato retained higher amount of pigments (total carotenoids and anthocyanins) as compared to traditional frying.

Dueik *et al.* (2010) studied effect of frying pressure and equivalent thermal driving force on trans α and β-carotene retention in vacuum fried carrot chips. They observed that 89.5 % α-carotene and 86.4 % β-carotene retention by frying at 1.92 inchHg pressure and 60 ℃ thermal driving force.

Maity *et al.* (2014) studied the effect of frying temperatures and durations on quality of vacuum fried jackfruit chips. They noted that oil content increased with increase in temperature and time whereas, color values (L^*, $a^*$and b^*) deteriorated with increase in temperature and time. Sensory evaluation showed maximum acceptability for jackfruit chips fried at 90 ℃ for 25 min. They also reported that degradation of total phenols, total flavonoids and total carotenoids increased with increase in time and temperature.

Basuny and Oatibi (2016) observed that moisture content, oil uptake and acrylamide content in vacuum fried potato chips were significantly lower than traditionally fried potato chips. They also reported significantly higher changes in chemical properties (oleic acid, peroxide value, polar value, polar content, polymer content and oxidized fatty acids) of oil extracted from traditionally fried potato chips as compared to vacuum fried potato chips.

Mariotti *et al.* (2017) revealed that vacuum frying of potato chips significantly reduced formation of furan and acrylamide as compared to traditional frying. They reported that potato chips vacuum fried at thermal driving force of 50 ℃ produced lowest furan and acrylamide.

Zambre *et al.* (2019) carried out work on vacuum frying of guava chips and concluded that guava chips fried at 85 ℃ for 55 min retained maximum ascorbic acid, crude fiber and total phenolic content as compared to other treatments whereas there was no significance difference in moisture content and oil uptake levels.

Conclusion

From the foregoing discussion, it can be concluded that vacuum frying can be used for reduction in formation of toxic compounds, reduced oil uptake, oil quality protection, and preservation of nutrients, colours and flavours. Vacuum fried potato chips had lower acrylamide content as compared to traditional fried chips and potato cv. NDTX 4930-5W had lowest acrylamide content. Chips of potato cv. Atlantic vacuum fried at 118 ℃ for 600 sec had lowest acrylamide content. Vacuum frying at 100 ℃ for 20 min can produce carrot chips with lower moisture and oil contents as well as good colour and crispy texture. Processing conditions of 6.9 min frying time and 112 ℃ frying temperature produced pineapple slices with best physicochemical and nutritional quality. Vacuum fried slices of blue potato, green bean, mango and sweet potato retained higher amount of pigments as compared to traditional frying. In carrot chips, 89.5 % α-carotene and 86.4 % β-carotene was preserved by frying at 1.92 inchHg pressure and 60 ℃ thermal driving force. Jackfruit chips vacuum fried at 90 ℃ for 25 min had maximum sensory acceptability. Deterioration in chemical properties of oil extracted from traditionally fried potato chips were significantly higher compared to vacuum fried potato chips. Potato chips vacuum fried at thermal driving force of 50 ℃ produced lowest furan and acrylamide. Guava chips fried at 85 ℃ for 55 min retained maximum ascorbic acid, crude fibre and total phenolic content.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Ram Bhavinkumar Bachubhai	**Course : PHT-591 (1+0)**
Reg. No. : 2020218041	**Date : 10/01/2020**
Major Guide : Dr. N. V. Patel	**Time : 04:00 to 05:00 pm**
Co-Guide : Dr. A. K. Pandey	**Venue : Swami Vivekananda Hall**

Application of sweeteners in food industry

Sweeteners are used to add the basic taste of sweetness to a food provides texture, bulking properties, aroma and color. Sweetener is a food additive that can be used to sweeten the product. They may also be used to improve the palatability and shelf life of food products. Sweetness balances bitterness, sourness and saltiness so, most humans prefer sweet tastes. The osmolarity (the solute concentration) of sweeteners means that they usually inhibit bacterial and mould growth. Two types of sweeteners are available: natural sweeteners from plant origin and artificial or synthetic sweeteners. Sweetening agents either evoke sweet taste or enhance the perception of sweet taste. Natural sweetening agents are preferred over synthetic sweetening agents since they do not have any adverse impact on health. Non-saccharine natural sweetening agents are low in calorific value, nontoxic and super sweet (100 to 10,000 times sweeter than sugar) in nature. Natural sweeteners are useful sugar substitutes for diabetic patients used as tabletop sweeteners and in both hot and cold beverages (Watson, 2014).

Brief review of research work

Effect of sweeteners on quality of beverages

Cardoso and Bolini (2008) revealed that sucralose based peach nectar showed higher score for sensory attributes *viz*., brightness (8.07), visual viscosity (8.14), sweetness (7.13) and body (7.48) on the basis of 9 point hedonic scale.

Patel (2009) concluded that low calorie beverage based on sapota sweetened with sucralose along with fruits and spices blend was found to be the most stable and most acceptable low calorie product in terms of physico-chemical and sensory attributes up to three months storage.

Lakhanpal and Vaidya (2013) observed that preparation of mango nectar with mustard honey was found highly acceptable with minimum changes in physico-chemical parameters like TSS (˚Brix), ascorbic acid (mg/100ml), total sugar (%), reducing sugar (%) and carotenoids (mg/100ml) under refrigerated condition up to 6 months storage.

Dutra and Bolini (2013) studied physico-chemical properties and sensory analysis of acerola nectar sweetened with different sweetners and reported that highest TSS (10.03˚Brix) was observed when they used sucrose as sweeteners while titrable acidity (0.268 %) and ascorbic acid (550 mg/100 ml) were found highest in neotame whereas, L, a, and b values along with sensory attributes *viz*., aroma (6.04), flavour (6.42), texture (6.45) and global impression (6.60) were noted highest with sucralose.

Sharma *et al.* (2016) studied the effect of storage on total phenol content, antioxidant activity and sensory quality of honey and sugar based lemon RTS up to six months storage and revealed that highest phenol content (9.87 mg/100g), antioxidant activity (26 %) and sensory quality parameters in honey based lemon RTS under refrigerated storage conditions.

Panda Bhawna *et al.* (2018) observed that maximum mean score regarding ascorbic acid (12.11 mg/100g), non reducing sugar (10.57 %), color and appearance, taste and overall acceptability was found with 50% aspartame + 50% sugar while highest acidity (0.78 %), reducing sugar (3.91 %) and total sugar

(13.89 %) was found in jamun RTS sweetened by stevia (100 %) at the time of preparation and 90 days after of storage.

Effect of sweeteners on quality of other processed products

Patil Swapna *et al*. (2014) studied on dose response of sweeteners on sensory attributes of *Shankarpoli* and revealed that sucrose with 32% concentration scored best regarding to sweetness, viscosity and lingering sweetness.

Balaji *et al*. (2014) studied changes in chemical composition in non-coated and honey coated aonla candy during storage in four varieties and reported that honey coated candy prepared from all the four varieties were acceptable. However, aonla candy prepared from *var*. NA-6 was found best up to 90 days of storage.

Stamatovska *et al*. (2017) conducted an experiment on effect of different sweeteners on peach and plum jam and found that both jam prepared by using sorbitol were highly acceptable with maximum total points for sensory attributes *viz*., color, smell, taste and texture.

Yaseen *et al.* (2018) studied effect of different treatments on physico-chemical and sensory analysis of mango jaggery jam and observed that highest TSS was recorded when they treated mango jaggery with 50% pulp + 30% sugar + 20% jaggery and acidity with 50% pulp + 25% sugar + 25% jaggery, pH with 50% pulp + 50% jaggery however the highest ascorbic acid and overall acceptability was observed in jam prepared with 50% pulp + 50% sugar.

Conclusion

From the foregoing discussion it can be concluded that sweeteners improve the quality and storage life of the products. Sucralose was found best for the preparation of acerola nectar and peach nectar with highest sensory score and consumer acceptance. It was also found best for the preparation of low-calories beverages based on sapota. Honey was found to be highly acceptable for the preparation of mango nectar and lemon RTS with minimal physico-chemical changes up to 6 months storage under refrigerated conditions. Whereas, 50% aspartame + 50% sugar gave best results at the time of preparation and 90 days after storage in preparation of jamun RTS. In case of snack food named *Shankarpoli* was more acceptable while prepared by using sucrose. Honey coated aonla candy prepared from NA-6 variety was found best as compared to other varieties. In case of sensory analysis of peach and plum jam, sorbitol was found best among different sweeteners. Mango jam prepared with 50% pulp + 50% sugar was found best due to minimum changes in nutritional quality up to 30 days storage.

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NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker	**: Thakor Dilip C.**	**Course**	**: HENT – 591**
Reg. No.	**: 2020215058**	**Date**	**: 30/12/2016**
Major Guide	**: Dr. Snehal M. Patel**	**Time**	**: 03.00 – 04.00 pm**
Co – Guide	**: Dr. P. R. Patel**	**Venue**	**: Swami Vivekananda Hall**

Integrated pest management against major insect-pest of cabbage

Cabbage (*Brassica oleracea* var. *capitata* L.) belongs to family Brassicaceae. It includes about 100 species, majorities of which are native to the Mediterranean region. India is the second largest producer of cabbage in the world with production of 8597 thousand tonne after China. In India it is mainly grown in the states like Uttar Pradesh, Odisha, Bihar, Assam, West Bengal, Maharashtra, Gujarat, Haryana, Andhra Pradesh, Arunachal Pradesh and Karnataka in an area of 379 thousand hectare.

The cabbage production in India is severely constrained by the regular outbreaks of major insect pests like Dimond back moth (DBM), cabbage looper, aphid, cabbage caterpillar, tobacco caterpillar, cabbage borer and leaf webber. Management of insect pest is difficult and is mainly based on intensive insecticide treatments that are used to control pest populations. However, this method is harmful to the environment, so management of cabbage pest through different integrated pest management methods is an appropriate approach for the management of insect pest in cabbage.

What is IPM?

“Integrated pest control is a pest management system that in the context of associated environment and population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible manner as possible and maintain pest populations at levels below those causing economic injury”.

Review of Research Work

Cultural method

Shukla and Kumar (2004) reported lowest population of *P. xylostella* and highest yield in variety Madhvi followed by Krishna and Stonchea whereas highest population and lowest yield recorded in Quiesto followed by NS-25.

Kumar *et al*. (2009) revealed that the cabbage grown with garlic (1:2) had the lowest larval population of *P. xylostella* followed by coriander (1:2), fenugreek (1:2) and tomato (1:1).

Mochiah *et al*. (2011) recorded the highest aphid population in the sole cabbage (20.14) while the least population was found on 2RC1RT (10.78). For both the cutworm and DBM, the highest populations were recorded on sole cabbage while the least was found on the two rows of cabbage to one row of tomato. Similarly, highest yield was recorded on 2RC1RT (1336 g) while the least was found on the sole cabbage (961g).

Vanlaldiki *et al.* (2013) observed that the lowest population of *P. xylostella* (0.06 larvae/plant) and highest yield (20.80 t/ha) was recorded in the early planted crop of 15th November followed by 30th November, 15th December and 30th December and highest population and lowest yield was recorded in the late transplanted crop of 14th January.

Thonger *et al.* (2015) reported minimum population of *P. xylostella* was recorded on Rare Ball varieties followed by BC-76, Millennium- 111, Pride of India and G-8 variety whereas maximum population was recorded on the Rare Ball.

Physical Methods

Prasannakumar *et al*. (2009) observed maximum catches of *P. xylostella* in red (13.23 ± 11.10 moths/trap/week) and followed by the pink with 9.66 ± 8.75 moths /trap / week.

Biological Methods

Vanlaldiki *et al.* (2013) recorded lowest larval population (0.21 larvae/plant) in *Bt* (dipel) treatment which proved to be the most effective treatment, followed by *Bt* (delfin) as compared to untreated control (8.88 larvae/plant).

Sunanda *et al*. (2014) noted maximum 90 % mortality at an inoculums level of 1000 IJs/ Petri plate which was at par with 85.39 % at 750 IJs/Petri plate at 72 hrs.

Botanical Methods

Bhat and Dhoj (2005) found that the 1:5 concentrated solution of Bakaino (*Melia azedarach* L.) extract at five days interval was most effective in lowering aphid population and scale of leaf damage as compared to the other treatments.

Thakur and Sharma (2014) recorded that neem oil (0.3 %) and melia extract 10 % gave *P. xylostella* emergence from pupae, respectively under laboratory condition.

Begna and Damtew (2015) observed the lowest number of DBM larvae per plant recorded from cabbage treated with neem as compared to other botanicals and control.

Degri and Zakaria (2015) observed that lowest diamondback moth population recorded in both years after spraying with *A. sativum* extract followed by *A. indica.*

Chemical Methods

Umeda and MacNeil (2000) found Aphistar at 0.1 lb AI/A the most consistently efficacious treatment that had the fewest aphids in the cabbage for up to 14 DAT.

Bhure (2013) recorded the lowest population of *P. xylostella* on crop treated with novaluron 10 EC which was followed by emamectin benzoate 5 WSG.

Satish (2013) observed that Indoxacarb 15.8 EC having highest mortality against third instar larvae of *S. litura* which was followed by Flubendiamide 48 SC.

Reddy *et al*. (2014) studied the bio-efficacy against *P. xylostella* and found that profenophos at 1000 g a.i./ha followed by bifenthrin at 100 g a.i./ha were recorded high per cent reduction of *P. xylostella* population compared to other insecticides

Chowdary *et al.* (2015) revealed that Rynaxypyr @30 g. a.i./ha was found to be effective in suppressing the larval population of the pest though it was at par with Rynaxypyr @ 20 g. a.i./ha.

Vidhyadhari *et al.* (2016) recorded Spinosad + metalaxyl MZ 88.90 % and 84.22 % reduction of aphid population respectively and it was at par with spinosad + copper oxychloride in both the seasons. The highest yield was recorded in Spinosad + metalaxyl MZ.

Sharma *et al.* (2016) found that all the modules were significantly superior to untreated control in protecting cabbage crop from lepidopterous insect pests. The module M3 was the most effective IPM strategy against lepidopteron insect pests resulting in hundred per cent reduction in larval population.

Conclusion

Incidence of insect pest results in severe yield losses in cabbage. So, integrated pest management is the best way to reduce pest damage in cabbage. At present IPM strategy is found more suitable for managing the cabbage pests for sustainable production. Various IPM components *viz.* cultural practices, mechanical method, use of effective bio-agents, bio pesticides, resistance varieties, eco-friendly pesticides etc. have been found very effective in IPM strategy for cabbage pests and their use need to be encouraged in order to reduce the harmful chemical pesticides for sustainable agriculture as well as increasing the quality and productivity of cabbage.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker	**: Patel Prashant P.**	**Course**	**: HENT 591 (1+0)**
Reg. No.	**: 2020215044**	**Date**	**: 19/11/2016**
Major Guide	**: Dr. Snehal M. Patel**	**Time**	**: 11 to 12 a.m.**
Co-Guide	**: Dr. P. R. Patel**	**Venue**	**: Swami Vivekananda Hall**

Compatibility of microbial insecticides with pesticides

Introduction

Now a day, an important approach that could be taken in integrated pest management (IPM) programs is the use of biological pesticides together with a rational use of chemical pesticides. In fact, when a range of pests is present or only one method is not efficient, there may often be economic and environmental advantages in combining two or more control methods. Such methods need to be compatible with each other, as incompatibility can lead to loss in effectiveness, increased toxicity to humans and other non-target organisms, the development of pesticide resistance, major product loss and crop injury. Some information on the selectivity of most pesticides to natural enemies of pests is already known, but data on the compatibility of chemical and specific bio-pesticides are often limited and are sometimes conflicting. Biopesticides have high compatibility with other pest management techniques such as natural enemies, resistant varieties *etc*. So integrating biopesticides with pesticides could enhanced performance of IPM strategies.

Compatibility of Bacterial Entomopathogens

Desai and Kapadia (2007) stated that compatibility of *Bacillus thuringiensis* var. *kurstaki*.@ 1.0 kg/ha with endosulfan@ 0.035 per cent and fenvalerate @ 0.0075 per cent gave 100 per cent mortality of *Earias vittella* after 2, 3 and 4 days.

Jethwa and Kapadia (2007) noted lowest number of *Spodoptera* larvae/10 plant in the treatment of compatibility of *Btk*.@ 1.0kg/ha+chlorpyriphos@ 0.025 % and *Btk*.@1.0kg/ha+endosulfan@ 0.035 % and also increase in yield.

Lucas *et al*. (2014) observed the relationship between vegetative growth and CFU/ml indicated that spiromesifen (maximum and minimum recommended concentration) was compatible with both concentration i.e. (0.75L/haand0.50L/ha)of *Btk*.

Amizadeh *et al*. (2015) reported that *Bt.* showed maximum compatibility with chlorantraniliprole which was formed highest number of *Bt.* colonies.

Compatibility of Viral Entomopathogens

Trang and Chaudhari (2002) noted that the preliminary studies with sublethal dosages with thiamethoxam 25WG, diflubenzuron 25 WP and imidacloprid 17.8% EC produced negligible mortality. So, these sublethal dosages were selected for the combination studies. From the lowest up to highest concentration of thiamethoxam, the mortality increased from 65 to 83.3 percent as compared to 48.5 percent of virus alone. In case of combination of NPV and diflubenzuron was also found to increase the mortality from 43.3 up to 93.3 percent at the lowest to highest concentration as compared to 43.3 percent mortality due to virus alone. Whereas, combination of NPV and imidacloprid, the mortality increases the concentration from 1 to 7 ppm (73.3 % to 88.3 %) and decrease when applied at the higher concentration 10 and 20 ppm (48.3 % and 45.0 %).

Kumari and Singh (2009) observed that application of NPV–S (500 LE/ ha) + endosulfan (625 ml/ ha) and NPV- S (250 LE/ ha) + endosulfan (625 ml/ha) recorded better insect control than with NPV-S (500 LE/ ha), NPV-S (250LE/ha) and endosulfan (1250ml/ha) alone.

Shaurub *et al*. (2014) reported that the maximum larval mortality (79.20%) obtained from combined treatment with the LC25 of SpliMNPV and azadirachtin as compared to LC50 of the virus alone (50.23 %).

Compatibility of Fungal Entomopathogens

Oliveira *et al.* (2003) observed thiamethoxam at different field recommended dose and cyfluthrin at half field recommended dose compatible with *Beauveria bassiana.*

Armarkar and Chikte (2008) studied compatibility of *Verticilium lecanii* with different chemical pesticides and observed highest mycellial growth and lowest growth inhibition (%) in treatment of streptocyclin and it was at par with dimethoate, methyl-dematon and thiometon after 20 days.

Ambethgar *et al*. (2009) reported that chlorpyriphos, dimethoate, monocrotophos and NSKE were slightly harmful to *Beauveria bassiana* with 27.33, 32.60, 34.07 and 22.22 percent inhibition, respectively at sub normal dose.

Thilagam *et al*. (2010) observed significant inhibition on the growth at all dose of flubendiamide tested. Whereas, spinosad recorded a growth of 1.53 cm and 1.64 cm at 5 and 10 DAI respectively.

Asi *et al*. (2010) found that spinosad was safe to the fungus growth by inhibiting only 6.84percent growth.

Amutha *et al.* (2010) studied the effect of insecticides on the growth of *B. bassiana*and observed chlorpyriphos@ 20 EC least toxic to *B. bassiana* which could be considered compatible with *B. bassiana* for control of insect-pest.

Monga *et al*. (2011) observed that imidachloprid 17.8 SL (0.5 g/ml^{-1}) was least toxic to *Fusarium pallidoroseum* with 17.9 percent inhibition which could be considered compatible with *F. pallidoroseum*.

Raj *et al*. (2011) noted maximum germination (82.7 %) and colony growth (19.6 %) of *B. bassiana*reported in the treatment of dimethoate 30EC.

Akbar *et al.* (2012) reported that spinosad was compatibile with *M. anisopliae*which gave maximum radial growth of *M. anisopliae* on the 10th day than other treatment.

Compatibility of Nematode Entomopathogens

Radova (2010) reported that insecticide piperonyl-butoxide showed the highest vitality (18.68%) after 72 hours of incubation. Whereas, in acaricides fenpyroximate showed the highest vitality (20.18%) which could be compatible with *Steinernema feltiae* entomopathogenic nematode.

Conclusion

Effectiveness of insect-pests control can be enhanced with combined use of compatible bio-agents with chemical pesticides. Most of bio-agents have either positive synergistic or additive effect with pesticides indicating their selective use in IPM. Bacterial pathogens are more compatible with pesticides than fungal and viral entomopathogens. These features of microbial agents help us in their exploration for ecofriendly and less harmful strategies in modern agriculture and also for reducing pesticide load going to our agro-ecosystem.

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POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker : Tandel Roma Ramniklal	**Course : Hort. Ento 591 (1+0)**
Reg. No. : 2020216030	**Date : 18/11/2017**
Major Guide : Dr. Snehal M. Patel	**Time : 10:00 to 11:00 am**
Co-Guide : Dr. P. R. Patel	**Venue : Swami Vivekananda Hall**

Role of insect vectors in transmission of plant viral diseases in important vegetable crops

Any organism that carries disease causing organisms such as virus, fungi, bacteria and phytoplasma are called vectors. Among all vectors more than 80% vectors of plant viruses belong to the order hemiptera (Tripathi 2004). Aphid, hopper, thrips, whitefly, psyllid, beetle, mealybug *etc.* are act as vector of many plant viral diseases. Three steps to transmit virus through vector to a healthy plant are acquisition, inoculation and transmission. Different vector transmitted virus based on retention time are persistent, semipersistent and non persistent. Acquisition time in non persistent transmission is <1 min, semipersistent transmission is >30 min and persistent transmission is hours or days. Aphids transmit more number of viral diseases compared to other hemipteron insects. Aphids transmit a wide range of viruses in 16 genera. Aphid and whiteflies transmit viruses in persistent, semipersistent and non persistent manner, whereas, hoppers transmit viruses in persistent and semipersistent manner. Thrips transmit viruses in persistent manner only. Aphids transmitted viruses like Caulimovirus, Fabavirus, Potyvirus *etc*. Whiteflies transmit viruses such as Ipomovirus, Begomovirus, Crinivirus *etc*.

Review of literature:

Tomato

Paul (2014) recorded that disease transmission percentage by whiteflies was highest with less incubation period in January- February as compared to October- November months. Curling and rolling symptoms occur highest during January- February in ToLCV infected field.

Idris and Mandal (2014) found that whitefly population and thereby, tomato yellow vein mosaic virus was found lowest when crops were spread with imidacloprid 70 WS @10g a.i./ha and it was at par with acetamiprid 20 SP @40g a.i./ha

Naik (2001) studied the effect of inoculation access period on transmission of ToLCV by *Bemisia tabaci* ranging from 5 min to 24 hr. Highest percent of transmission was found between 12 hr to 24 hr.

Naik (2001) reported 1,2,3,4,5 and 10 number of whiteflies population on transmission of ToLCV in tomato cv. Rashmi per plant. The results showed that 100 percent transmission was occurred when five whiteflies per plant were present.

Chilli

Pandey *et al*. (2010) observed the effect of plant seed extracts on the incidence of chilli leaf curl disease. Results indicate that disease incidence was lowest in the treatment of neem seed kernel extract (27.78%) followed by Tumba seed extract (33.33%) and Karanj seed extract (36.11%).

Pandey *et al*. (2010) conducted an experiment on effect of different insecticides at different concentration to control chilli leaf curl disease. Result showed that minimum disease incidence was observed 14.81% with the use of imidacloprid at (0.003%) followed by acephate at 0.1% (25.92%) disease incidence and spinosad at 0.02% (33.33%) disease incidence.

Shitole (2010) found that 15 thrips per plant took only 6 days to produce symptoms with 80% leaf curling intensity.

Potato

Gundannavar and Giraddi (2014) studied the transmission of Potyvirus by insect species, *A. gossypii, M. persicae* and reported them as major insect vectors for transmission of potyvirus.

Okra

Jambhulkar *et al*. (2013) studied the effect of bioagents on reduction of disease incidence of YVMV in okra. Among the bioagents, two sprays with azardirachtin, 25 days after sowing and later at 15 days interval was the most effective treatment in lowering the whitefly population.

Gowdar *et al*. (2007) studied the effect of insecticides against whitefly and yellow vein mosaic virus on okra. The mean disease incidence in insecticide treated plot varied from 6.4 to 36.2%. The mean incidence of YVMV after 75 DAS was recorded up to 6.4% in acetamiprid 20SP @ 40g a.i./ha. Which was at par with acetamiprid 20SP @ 30g a.i./ha and imidacloprid 70WS @ 10g a.i./ha.

Onion

Kumar *et al.* (2009) found that the transmission of OYDV by nymph of three aphid species was lower compared to mechanical transmission. Highest transmission of OYDV was by mechanical way but among the aphid species it was highest by *M. persicae* (62.5%).

Dolichos bean

Renuka (2014) observed highest percent transmission (70%) and maximum number of infected plant were found at 30 min acquisition feeding period of *Myzus persicae*.

Renuka (2014) studied transmission of dolichos mosaic virus of field bean by two different aphid species. Result showed that highest transmission of dolichos mosaic virus was by *Myzus persicae* (72%) as compared to *Aphis craccivora* (38.46%).

Cucumber

Borollosy (2015) studied the rate of transmission of CMV using winged and wingless forms of 5 different aphid species. Result found that highest percent transmission occured in wingless forms compared to the winged form of aphid species. Wingless form of *Aphis gossypii* gave highest 95% transmission with 19 infected plants.

Conclusions

From ongoing discussion it can be concluded that insect play key role in transmission of plant viral diseases from infected host to healthy host. Most of the viral diseases are transmitted by sucking pests. Botanical insecticides like neem seed kernel extract, tumba seed extract, karanj seed extract, tulsi seed extract *etc*. are found effective for controlling sucking pests. Among conventional chemical insecticides imidacloprid, acetamprid, dimethoate, acephate etc., has found effective for controlling sucking pests and thereby in preventing viral diseases like tomato leaf curl, chilli leaf curl, cucumber mosaic virus, YVMV, Bean common mosaic virus *etc*. In nutshell, insect vectors need to be managed either at seeding time or in the early stage of the crop so as to prevent transmission of diseases by insect vectors.

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POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker : Surela Vipul A.	**Course : Hort. Ento 591 (1+0)**
Reg. No. : 2020216029	**Date : 30/12/2017**
Major Guide : Dr. H. V. Pandya	**Time : 10:00 to 11:00 am**
Co-Guide : Dr. P. R. Patel	**Venue : Swami Vivekananda Hall**

Eco-friendly management of insect pests in tomato

Any insect pests of crops are managed below ETL without using of health hazards chemical treatment to protect soil, water, environment and plants called eco-friendly management. Tomato (*Solanum lycopersicum* L.) is one of the most important "Protective Foods”. It is the world's largest vegetable crop after potato and sweet potato, but it tops the list of canned vegetables. A wide variety of insect pests attack tomato including: Tomato fruit borer, serpentine leaf miner, red spider mite, aphids, whiteflies *etc.* These pests are managed by different eco-friendly strategies like cultural, biological, mechanical, botanical and physical. Different cultural practices use for controlling insect pests such as time of planting, crop rotation, crop sanitation, ploughing, traps crops and host plant resistance *etc.* (Dhalival, 2002) Host plant resistance has different three mechanisms antixenosis, antibiosis and tolerance. Hand picking, clipping, pruning, crushing, pheromone trap and sticky traps are used for insect pest controlling in mechanical manner. Natural enemies of insect like predators, parasites and pathogens used by man to manage pest population below economic injury level are called biological control. Hot, cold treatment, burning, moisture and light traps are used to control insect pest in physical manner. Different plant products and extracts are used to control insect pests in botanical manner.

Review of literature:

Cultural method:

Waluniba and Nego (2015) reported that the treatment of 19th December planting date recorded least aphid population. They also found least leaf miner infestation at 19th November.

Hussain *et al.* (2010) observed economics of marigold as a trap crop for control *Helicoverpa armigera* on fruit yield of tomato. They noticed that 3:1 combination was found superior in terms of tomato equivalent yield (28399.99 kg/ha) and retrievable loss (63.38 %) which was at par with 6:1 for tomato equivalent.

Rashid *et al.* (2007) studied the effect of planting time on the incidence of whitefly, yield and yield contributing characters of tomato. The lowest weight incidence was (32) observed in 15th November treatment which was at par with 15th October, 15th December,2000, 15th January, 15th February and 15th September. The highest no. of fruit per plant (46.33) was under 15th January, 2001, while the highest single fruit weight (40.67) and yield (4.23 t/ha) was under 15th November, 2000 planting (4.23 kg plant^{-1}) which was at par with 15th December, 2000 for yield and 15th February, 2001 for single fruit weight.

Biological method:

Debnath *et al*. (2016) recorded lowest fruit damaged percent after 7 and 10 days, with the treatment of *Beauveria bassiana* AS @500 ml/ha (5.65%, 7.32%) which was at par with *B. bassiana* WP @1250 g/ha (6.97%, 9.05%) at 7 days.

Rahman *et al.* (2014) studied the effect of different microbial treatments on management of *H. armigera* during *rabi* season and the results revealed that the lowest fruit infestation in number (11.78 %) and weight (9.64 %) and the highest % reduction of infestation for no. and weight (35.70 and 43.43, respectively), yield (16.92 t/ha) and yield increase over control (58.28 %) was under treatment HaNPV and *Bt* alternate spraying.

Cabello *et al*. (2009) reported that number of larvae and damaged leaves were significantly lower where parasitoid had been released and the number of damaged fruits was also lower under this treatment. The number of larvae of *Tuta absoluta* was 12 times lower on lots where *T. achaeae* was released compared with the control.

Kumar *et al.* (2004) observed that all the treatments gave significantly higher yield than control. Highest yield (261 .07q/ha) was obtained in plots where *T. chilonis* eggs were released @ 1 lakh/ha with the lowest mean fruit damage (8.01) which was on at par with releases of *T. chilonis* at 75,000/ha.

Physical method:

Nazakat *et al.* (2016) studied the biological efficacy of pheromones capsules for controlling *T. absoluta* adults. Pheromone capsules applied at a density of 5 pheromone capsules/ha appeared to have higher rates of monitoring ability (50.0%-62.1%) compared with the efficiency of capsules used at a rate of 1 or 7 capsules/ha.

Uthamasamy and Loganathan (1997) studied an effect of trap heights on moth catches of *H. armigera.* Result showed that highest numbers of moths were noticed when trap height was 90 cm above the ground level which was at par with 30 cm trap height.

Botanical method:

Mandloi (2013) found the least number of whitefly population when plant treated with NSKE 5%, (2.11 flies/ 10 cm twig). He also found that aphid population was minimum when plant treated with NSKE 5% (2.84/6 leaves).

Devraj and Nandihalli (2002) studied efficacy of Neem Seed Kernel Dusts on pupae of *H. armigera.* Among different treatment highest pupal mortality was noted in Talc based NSK 60% dust (63.33%) with lowest adult emergence (36.67%).

Conclusion:

From the foregoing discussion it can be concluded that chemical pesticides were effective for the control of the pests, but their indiscriminate use has resulted in several problems like insecticide resistance, resurgence, outbreak of secondary pests, reduction of biodiversity and natural enemies. In the tomato cultural method like, early transplanting, late transplanting and trap crop can be used for minimizing the insect pest population. Biological methods including spray of HaNPV, released parasitoid were significantly reducing the damaged caused by *T. absoluta and H. armigera.* In physical methods, use of different traps is effective for control the *T. absoluta* and *H. armigera.* Botanical insecticides like NSKE and NSKD were also effective for control of whitefly, aphid and *H. armigera.*

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Anjali G. P.	**Course : HENT-591 (1+0)**
Reg. No. : 2020217003	**Date : 17/11/2018**
Major Guide : Dr. H. V. Pandya	**Time : 10:00 to 11:00 am**
Co-Guide : Dr. P. R. Patel	**Venue : Swami Vivekananda Hall**

Insect parasitoids in pest management of horticultural crops

The use of chemicals in pest control has caused the rapid development of resistance in insects and mites, subsequent out breaks of pests due to annihilation of their natural enemies. These factors evoked considerable interest in the adoption of biological control in the recent years.Biological control is the action of parasites, predators or pathogen in maintaining another organism's population density at a longer average than would occur in their absence. Insect pest management of horticulture crops by integrating parasitoids, a biocontrol agent, in IPM drastically reduced the pest population in efficient way without relying on chemicals alone.

Review of Literature

Jalali *et al*. (2005) at Bangalore, suggested that the new method of release of *Trichogramma* spp. by mixing with vermiculite resulted in highest parasitization of 76.7 per cent which was on par with loose eggs mixed in agar solution (55.3%).

Jalali *et al*. (2007) at Bangalore, reported that the vacuum packaging of Corcyra eggs enhanced the storability to 42 days as compared to 7 days in non-vacuum packaged eggs for parasitization by *Trichogrammachilonis*.

Vegetables

Tomato

Kumar *et al*. (2004) at Ludhiana, recorded highest egg parasitism of *T. chilonis* @ 100000/ha which resulted in least larval population of *Helicoverpaarmigera*, lowest fruit damage and highest yield in tomato,on par with *T. chilonis* @ 75000/ha.

Singh and Sood (2018) at Himachal Pradesh, found out the highest parasitization of *Encarsiaformosa*on *Trialeurodesvaporariorum* when soil application of imidacloprid (0.009%) along with foliar application of azadirachtin (0.00045%) was carried out in tomato under protected environment.

Brinjal

Niranjana *et al*. (2015) at Srilanka, observed the preference of *T. pretiosum* on freshly laid eggs of *Leucinodesorbonalis* than older eggs and the weather conditions prevailing in Kharif and Rabi promoted the parasitism efficiency and emergence rate but drastically reduced in Summer.

Nath *et al*. (2018) at Tinsukia, observed that integration of different control measures along with release of *T. chilonis* @ 50000/ha were best in reducing the infestation of *L. orbonalis*when compared to farmer's practice.

Okra

Thanavendan and Jeyarani (2012) at Coimbatore, reported parasitization of cent percent by *Braconbrevicornis* and 97.5 per cent by *B. hebetor* on all instars and fourth instar of *Eariasvittella* respectively at parasitoid-host ratio of 5:10, whereas highest cocoon formation and parasitoid emergence was observed at 4:10 ratio on third and fourth instar for both the parasitoids.

Thanavendan and Jeyarani (2012) at Coimbatore, observed highest parasitization of *Chelonusblackburni* against *E.vittella* and *Helicoverpaarmigera* at a parasitoid host ratio of 5 : 100 and the highest number of adult parasitoid emergence at 3 : 100.

Crucifers

Singh *et al*. (2004) at Bangalore suggested that 100:5 is a suitable host parasitoidratio of *T. bactrae* on *Plutellaxylostella* eggs as it recorded highest per cent parasitization of eggs and least larval hatch.

Palande and Pokharkar (2005) at Pune, proved that five releases of *T. bactrae* @ 50000 adults/ha/release at weekly interval with two intermittent sprays of *Bacillusthuringiensis* @1kg/ha at 10 days interval resulted in highest (84.16) per cent reduction in DBM larval population and maximum marketable yield of 380.2 q/ha cabbage heads.

Seenivasagan (2010) at New Delhi,recorded the highest parasitization of diamondback moth by *Cotesiaplutellae*on cauliflower(56.3%) and was on par with cabbage(53.3%) and mustard(44.9%).

Potato

Chandish*et al*. (1989) at IIHR, Bangalore, observed maximum parasitising efficiency of *Chelonusblackburni* against potato tuber moth when released singly and in combination with *Copidosomakoehleri*.

Fruit Crops

Krishnamoorthy (1987) at Bangalore, observed decrease in developmental period of *Apantelespapilionis* larva from 14.1 to 7.2 days on four instars of *Papiliodemoleus* with increasing host age.

Okolle *et al*. (2008) at Malaysia, concluded that *Ooencyrtuserionotae*,*Cotesiaerionotae* and *Brachymeriaalbotibialis*prefer 3rd stage egg, third instar larva and pupa of banana skipper, respectively.

Rasheed *et al*. (2017) at Tirupati**,** reported that introduced parasitoid, *Acerophaguspapayae* is effective in reducing the population of Papaya mealybug on papaya.

Coconut

Lyla *et al*. (2006) recommended to adopt trunk release of *Goniozusnephantidis* against coconut black headed caterpillar at 1.2-1.5m height of palm after field evaluation of different release techniques in Kerala.

Naganna *et al*. (2017) at Navsari, observed the highest per cent of parasitism of coconut black headed caterpillar by *G.nephantidis* (17.69%) and *Habrobraconhebetor* (15.65%) during 2nd fortnight of May followed by 1st fortnight.

Conclusion

From ongoing discussions it can be concluded that parasitoids play an indispensable role in pest management of horticultural crops. Trichogrammatidae are egg parasitoids parasitizing the eggs of several insects, mass produced using *Corcyra* eggs.Vacuum packaging of *Corcyra* eggs enhanced its shelf life when compared to non-vacuum packaging.The highest per cent egg parasitism of *H. armigera*and highest yield of tomato was recorded when *T. chilonis*was released @one lakh/ha.*T. pretiosum*preferred freshly laid eggs of *L. orbonalis*for parasitism and Kharif and Rabi seasons promote the parasitism efficiency. Parasitising efficiency of *T. bactrae*on *P. xylostella*eggs was highest at host- parasitoid ratio of 100: 5.*Braconspp*and*C.blackburni*showed highest percentage parasitisationagainst last instar larvae of *E. vittella*and *H. armigera*at parasitoid: host ratio of 5:10onokra.*C.blackburni*showed highest percentage parasitizationagainst *E. vittella*and *H. armigera*on okra at parasitoid: host ratio of 5:10.*C. blackburni*is more efficient in reducing host survival of potato tuber moth and does not seem to be affectedby combination with *C. koehleri*.The parasitization of diamondback moth larvae by *C. plutellae*was highest on cauliflower, cabbage and mustard compared to other hostplants. In coconut, the farmers could easily and effectively adopt the trunk release of *G.nephantidis*in reducing the population of *O. arenosella*.The highest per cent of parasitism by *G. nephantidis*and *H. hebetor*on *O. arenosella*was recorded during 2nd fortnight of May under South Gujarat conditions and*G. nephantidis* was the dominant species.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Patel Niyati Pradipbhai	**Course : Hort. Ento. 591 (1+0)**
Reg. No. : 2020217023	**Date : 06/10/2018**
Major Guide : Dr. Snehal Patel	**Time : 11:00 to 12:00 am**
Co-Guide : Dr. P. R. Patel	**Venue : Swami Vivekananda Hall**

Role of neem products for the management of insect pests in important vegetable crops

Vegetables are important protective food and share 59.3% of production among various horticultural crops in India (Anon., 2017). According to Rai (2017), the crop loss to the tune of 30 to 40% have been reported in vegetable crops due to insect-pests. The problem of insect-pests can be solved by chemical pesticides but it leads to number of problems such as resistance, resurgence, residual toxicity, adverse effect on environment and human health, biomagnification, *etc*. That's why botanicals like neem has become better alternative to control these pests.

Neem has been identified as a natural pesticide because it is eco friendly and non toxic. Various neem products are suitable for IPM because of their different properties like low toxicity, antifeedent action, repellent action and deterrent effects on insects. Neem seed kernel, neem leaf, neem oil, neem powder, neem cake and neem based pesticides play a vital role for pest management. They are mostly used in the form of dust, extract and oil to control various pests.

Brief review of research work

Brinjal

Rahman *et al*. (2009) reported highest reduction of brinjal shoot and fruit borer infested fruit (69.44% in number and 68.86% in weight) with lowest fruit infestation (30.28% in number and 31.29% in weight) after both application @ 15 days interval inneemoil+neem cake @ 4%+250 kg/ha treatment followed by neem oil @ 4%.

Karkar *et al*. (2014) concluded that brinjal aphid could be effectively controlled by neem seed kernel extract @ 5%, followed by neem oil @ 0.3%and neem leaf extract @ 10%.

Dhilooet *al*. (2016) studied effect of different neem oil concentrations on jassid population at different days interval and observed highest reduction in jassid population (81.4%) on day 7 using neem oil @ 3%. Overall, neem oil @ 3% gave highest reduction in jassid population (52.09%).

Tomato

Devraj and Nandihalli (2002) found highest pupal mortality (63.33%) with lowest adult emergence (36.67%) of *Helicoverpaarmigera* in talc based NSK @ 60% dust among various concentrations.

Mandloi (2013) tested some phytoextracts against *Bemisiatabaci* in tomato and observed least population of whitefly (2.11/10 cm twig) in NSKE @ 5% after all three sprays compared to other extracts.

Chilli

Mallik (2008) observed lowest fruit borer (3.88%/plant), red mites on leaves (24.30%/plant) and aphids on leaves (4.06%/plant) in neem oil treated plot among various botanical and chemical pesticides treated plots.

Barot (2012) noticed least number of thrips when plants were treated with neem oil @ 0.5% recording lower population3 days after spray (4.38thrips/twig), 5 days after spray (4.70thrips/twig) and 7 days after spray (5.31thrips/twig) in comparison with other botanical oils.

Okra

Sakthivel *et al*. (2007) found neem oil @ 3% had least jassid population (0.25) and highest reduction of jassid population (95.54%) with less population of whitefly (0.38) indicating highest reduction of whitefly (86.90%) compared to other botanicals.

Kavitha *et al.* (2009) proved that neem oil had maximum insecticidal effects on okra fruit borer indicating maximum larval mortality (79.16%) in neem oil @ 2% followed by neem cake extract @ 5%.

Cucurbits

Renuka (2009) studied fruit damage due to fruit fly in cucumber under field condition indicating lowest fruit damage after first spray (7.33%), second spray (2.67%) and third spray (2.00%) in Nimbex treated plot.

According to Tandon and Anita (2009) *Azadirachtaindica* extract at @ 5% concentration was found most effective in terms ofrepellency of red pumpkin beetles. It repelled minimum 41% of beetles in 1 hour and maximum 88% of beetles in 48 hours.

Pigeon pea

Babu *et al.* (2015) found neemsoap+indoxacarb had lower pod damage (4.07%) by *Helicoverpa*whereas lower pod damage (0.48%) by *Maruca* was observed in NSKE+indoxacarb treatment.

Rahman *et al*. (2017) reported lowest number of pod fly eggs after first spray (2.20), second spray (1.20) and third spray (0.87) in NSKE @ 4% treatment.

Cabbage

Mari (2012) found neem extract the most effective treatment with highest diamond back moth larval mortality at 72 hours among all botanical extracts.

Potato

Manendra (2016) noticed lowest foliar damage due to cutworm (0.40%) with lowest tuber damage by number (0.30%) and by weight (0.35%) when treated with neembicide.

Sweet potato

Danquah and Osei **(**2013) studied mean population of *cylas* spp. and showed that mixture of neem leaf amended and neem leaf extract had least population (3.50) after 4th week, (4.80) after 7th week and (5.30) after 10thweek.

Onion

Patel (2016) studied different oil against onion thrips. After all sprays lowest population of thrips (4.08/plant) was noted in neem oil @ 0.5% treatment among different botanical oils.

Conclusion

From the forgoing discussion, it can be concludedthat health and environmental concerns have influenced public option in recent years for use of safe and non hazardous pest control measures. Thus, demand for organic products is rising. Neem has emerged as the best environmental friendly botanical pesticide for its unique pest control properties, safe to mammals and low toxicity to bio control agents. Azadirachtin is the major active ingredient and its growth regulatory effect on harmful pests ensures decrease in pest incidence. Unlike synthetic pesticides, insect develop resistance and resurgence against neem has not been reported so far. Neem products are very effective against lepidopteran, coleopteran, hemipteran, and dipteran pests. Neem products can effectively manage insect vectors which cause diseases in plants. Neem oil @ 0.3% to 0.5% found effective against thrips while @ 2% to 4 % found effective against lepidopteran and homopteran insects. NSKE @ 4% to 5 % effectively control pigeon pea podfly and other sucking pests. Dust of NSK @ 60 % found effective against *Helicoverpa*. Neem leaf extract @ 5% to 10 % has been effective against coleopteran pests like red pumpkin beetle and sweet potato weevil and @ 2 % effectively managed diamond back moth. Azadirachtin based pesticides nimbex @ 0.15% and neembicide @ 0.03% found effective against cucumber fruit fly and potato cutworm.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Vaishnav Avinash Hiralal	**Course : HENT 591 (1+0)**
Reg. No. : 2020219048	**Date : 27/11/2020**
Major Guide : Dr. H. V. Pandya	**Time : 04:15 to 05:15 p.m.**
Co-Guide : Dr. V. P. Prajapati	**Venue : Online**

Integrated management of Anar butterfly, *Virachola isocrates* (Fab.)

Pomegranate belongs to the family punicaceae is one of the most adoptable subtropical fruit crops of the world. In India, it is cultivated in Gujarat, Maharashtra, Karnataka, Uttar Pradesh, Andhra Pradesh and Tamil Nadu. During recent years, anar butterfly, *Virachola isocrates* (Fab.) has become a major constraint in the production of quality fruits of pomegranate for domestic and export markets. It is the most widespread, polyphagous and destructive pest with a wide range of host plants. Full grown larvae are flattened, dark brown in colour with small dark brown head. The fore wings of both sex, covered with brownish scale while, hind wings had long tail like structures which was about 4-5 mm on its anal margin. Females are violet-brown while, males are deep violet-blue. The freshly laid eggs were shiny white in colour and more or less round in shape.

Review of Research Work

Cultural control

Bagle (2009) studied that minimum average incidence (%) of anar butterfly were observed in Jalore Seedless.

Anitha kumari *et al*. (2011) recorded maximum infestation of anar butterfly in Mridula (60%) followed by Araktha, G-137 and Ganesh and lowest in Bhagawa (30%).

Bhat (2019) recorded lowest incidence of anar butterfly in Dholka (15.00%) and Bedana (15.27%) cultivars.

Mechanical control

Bagle (2009) evaluated the effect of bagging on the incidence of anar butterfly and found that minimum incidence (4.44%) was recorded in 4^{th}, 6^{th} and 8^{th} row in cultivar Ganesh.

Bhut (2012) reported that minimum percent fruit damage was recorded in fruits covered with muslin cloth bag alone and clipping off calyx + muslin cloth bag.

Biological control

Bhut *et al.* (2013) reported that neem oil @ 0.5%, neem seed kernel extract @ 5% and *Bacillus thuringiensis* @ 0.15 % were found most effective against *V. isocrates.*

Chemical control

Khan *et al*. (2015) reported that lambda-cyhalothrin 5 SC and methomyl found most effective against *V. isocrates*.

Nadef (2017) reported that minimum fruit damage (%) Chlorantraniliprole 18.5 SC.

Integrated management

Khan (2016) recorded lowest infestation of fruit borer in both the IPM modules *viz.*, field sanitation + collection of infested fruits + application of (chlorpyriphos + cypermethrin 505 EC) @ 1 ml/ l water and field sanitation + collection of infested fruits + bagging of fruits with polythene bag.

Vanitha (2017) found that minimum fruit borer damage was recorded in IPM module *viz.*, collection and destruction of infested fruits + release of *T. chilonis* @ 2.5 lakh/ha + cyantraniliprole

10.26% OD + Spinosad 45 SC. However. She also revealed that minimum incidence of anar butterfly was recorded in adoptable IPM module (1.00%) and chemi-intensive IPM module (1.07%).

Conclusion

Anar butterfly is a polyphagous and destructive pest. It can be effectively managed by integrating various pest management strategies *viz.,* cultural methods (field sanitation, collection of infested fruits, resistant varieties *viz.,* Dholka and Bedana), mechanical methods (clipping of calyx and bagging with muslin cloth or muslin cloth alone), biological methods, (release of egg parasitoid *T. chilonis*), use bio-pesticide (*B. thuringiensis*), botanical insecticides (neem oil and NSKE). Among chemical insecticides, lambda-cyhalothrin 5 SC, chlorantraniliprole 18.5 SC, spinosad 45 SC are most effective for managing anar butterfly.

Future thrusts

- Need to explore effective natural enemies associated with anar butterfly in pomegranate growing regions.
- Need to develop of semio-chemical based trapping technology for monitoring of anar butterfly incidence.
- Need to standardize of repellent and oviposition deterrents for managing anar butterfly at an early stage of infestation.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Kasad Urvaksh Zarir	**Course : HENT 591 (1+0)**
Reg. No. : 2020219015	**Date : 05/12/2020**
Major Guide : Dr. Snehal Patel	**Time : 10:30 to 11:30 a.m.**
Co-Guide : Dr. V. P. Prajapati	**Venue : Online**

Non chemical methods of insect pest management in important solanaceous vegetable crops

Introduction

The botanical family Solanaceae includes several economically important vegetable crops *viz;* tomato, potato, brinjal and chilli which are extensively cultivated in India. India is the second largest producer of vegetables in the world followed by China. These crops are grown in about 6 million hectares contributing 3 per cent of the total cropped area (Director of Horticulture, 2018). They are rich source of minerals, vitamins, fibre and contain a fair amount of protein as well as carbohydrates. These crops are attacked by number of insect pests like shoot and fruit borer, thrips, yellow mite, fruit borers, green peach aphid, cut worm and potato tuber moth. Among them, fruit borer is highly polyphagous and reported as major pests in tomato and chilli.

Brief Outline of Npm Research Work done on Important Solanaceous Crops

Pest Scouting

Surveys across tomato fields indicated gregarious occurrence and feeding of nymphs and adults of painted bug *Bagrada hilaris* on foliage and fruits from first week of April to third week of May which considerably reduced market value of the produce. The influx of *B. hilaris* adults started from first week of April at almost 45 days of crop growth during both the seasons. Considering that *B. hilaris* was not a regular recorded pest of tomato however, there has been increasing population of the pest over the last two years (Anon., 2011)**.**

Cultural Practices

Hussain and Sheikh (2007) observed minimum percent fruit damage by fruit borer when marigold used as a trap crop in ratio of (3:1) (Tomato: Marigold) compared to sole crop of tomato.

Rai *et al.* (2009)[a] revealed that in early planting of chilli (July) at early growth phase exhibited significantly lower mite population (0.22-0.33mites/leaves) where, the thrips population lower (0.11-0.18thrips/leaves) in early planting consequent gave higher yield (154.40 q/ha), whereas late planting period result in maximum infestation of mites (5.85) and thrips (0.21) consequently reducing the yield to 32.15 q/ha.

Degri (2014) concluded that closed spaced (60 × 20 cm) brinjal plants had significantly higher shoot and fruit borer infestation both in shoot and fruit, whereas it was minimum in wider spaced (60 × 40 cm) plants.

Sujay and Giraddi (2015) carried out an experiment on different intercropping combinations and observed that chilli intercropped with coriander and onion recorded lowest population of aphids (0.20 and 0.21 aphids/leaf), thrips (0.80 and 0.76 thrips/leaf), mites (0.56 and 0.58 mites/leaf) and leaf curl index (0.54 and 0.46) respectively.

Host Plant Resistance

Rai *et al.* (2009)[b] recorded significantly lower mites (32.12 mites/plant), thrips (0.90 thrips/plant) and highest yield (64.98 q/ha) in VNS -4, EC-391075 and VNS-4-1 cultivars of green chilli, respectively are considered as best. However cultivar NEC (2.50) indicated maximum tolerance index.

Shaikh *et al.* (2013) revealed that brinjal genotypes AB-09-1 (1.67 jassid/leaf) and JBGR 1 (1.72 jassid/leaf) were at par with each other in terms of minimum jassid population. Significantly minimum whitefly population was recorded in AB-09-1 (1.75 whitefly/leaf) which was at par with NDB 18 (1.78 whitefly/leaf). Genotype AB-09-01 also indicated significantly higher fruit yield (296.64 q/ha).

Mechanical and Physical Control

Onekutu *et al.* (2014) observed that integration of nylon net and weekly cutting of infested shoots in brinjal significantly reduced shoot and fruit borer infestation (19.58 and 26.02 %) during both the years as compared to control.

Anandagopal *et al.* (2010) observed that Wota-T trap with water + kerosene caught significantly higher male moths (21.49/3 nights/trap) of *Leucinodes orbonalis* as compared to other traps in brinjal field and at period P_{10} with 12.73 mean catch.

Seyed (2015) conducted an experiment on trap colour and height from ground level. He recorded moth wise data indicated that green traps captured significantly higher males (120.11 to 418.11/trap) of *Phthorimaea operculella.* Water-pan traps placed at 0.6 m above ground captured significantly highest moths (53.22 to 357.21/trap) and maximum numbers of moths were captured in month of September.

Biological Control

Usman *et al.* (2012) recorded lowest number (0.68/plant) of *Helicoverpa armigera* larvae in T_4 (300 *Trichogramma* eggs+ 45 *Chrysoperla* 2nd instar larvae and neem extract 5%) in tomato.

Release of *Brumus suturalis* @ 1500/ha recorded significantly less population of mealy bug (9.4 and 7.6/plant after 1st and 2nd releases) in brinjal over control (17.2 and 18.6/plant) and gave higher (68.1 kg/ha) yield, (Anon., 2013).

Karkar *et al.* (2014)[a] indicated that brinjal plots treated with higher dose (40g/10 litres water) of *Verticilium lecanii* and *Metarhizium anisopliae* showed significantly lower aphid (0.99 aphids/leaf), leafhopper (2.34 leafhopper/leaf) and whitefly (2.20 whitefly/leaf) as compared to the other treated brinjal plots.

Zeleke *et al.* (2015) reported that higher concentration (1×10^8 Spore/ml) of *Metarhizium anisopliae* treated potato plots had significantly lower number of larvae of Potato tuber moth (0.3 larvae), damage tuber (20.7%), galleries per tuber (0.5 galleries) and gave higher egg mortality (83.3%) followed by *Beaveria bassiana* and *V. lecani*.

Botanical Control

Malik (2008) observed that aphid (41.89 aphids/plant) and whitefly (4.73 whitefly/plant) as well as per cent aphid on leaves (4.06 %) and per cent infestation of whitefly per plant (0.46 %) were lowest on chilli when treated with neem oil @15ml/l

Singh and Raju (2011) observed significantly lower fruit infestation (19.42%), (26.39%) and (13.29%) of tomato fruit borer after 1st, 2nd and 3rd spray of Nimbecidine whereas, Achook was found least effective.

Karkar *et al.* (2014)[b] reported that sucking pests such as aphid (1.38 aphids/leaf), leafhopper (2.11 leafhopper/leaf) and whitefly (2.06 whitefly/leaf) as well as per cent fruit damage (18.78 and 20.88 %) incidence were lower in brinjal crop and consequently recorded higher yield (25000 and 21019 kg/ha) when treated with cow urine @ 50 per cent concentration.

Conclusion

Non-chemical pest management is an eco-friendly approach based on sustainability of the environment. Continuous use of NPM technology results in improving soil as well as plant health. NPM technology protects the natural enemies of the pest as well as pollinators and may not be toxic to the productive insects. Most of these crops are harvested or picked at a short interval. So, there is a strong need to protect these crops from pests using eco-friendly NPM technologies which do not result in accumulation of toxic pesticides in human being after consumption. In case of cultural control, use of marigold as trap crop for management of tomato fruit borer, intercrop such as onion and coriander for suppression of sucking pest in chilli, use of higher concentration of *M. anisopli* for management of PTM in potato, cow urine and vermiwash @ 50 per cent concentration are used for suppression of sucking pest of brinjal. Use of green pan trap at 0.6 m height, would allow for a greater efficacy with respect to capture of PTM. They are mainly cultivated by small and marginal farmers so, use of NPM technology which offer reduction in input cost lead to increased profit and farm income.

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POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Patel Saurabh Vitthalbhai	**Course : HENT 591 (1+0)**
Reg. No. : 2020218034	**Date : 17/01/2020**
Major Guide : Dr. H.V. Pandya	**Time : 03:00 to 04:00 p.m.**
Co-Guide : Dr. P. R. Patel	**Venue : Swami Vivekanand Hall**

Tomato pinworm [*Tuta absoluta* (Meyrick)] a devastating pest of tomato

Introduction:

Tuta absoluta (Meyrick) (Lepidoptera: Gelechiidae) is also known as tomato pinworm, tomato leaf miner, tomato borer and American tomato moth. It is recently noticed as invasive pest from most part of the world's tomato growing regions. It is the native to South America (Cabello *et al*., 2012) and has been recorded from Argentina, Bolivia, Brazil, Chile, Colombia, Paraguay, Peru, Uruguay and Venezuela. Outside its native areas, the pest has been reported for the first time from Spain in 2006, from where it spread to other European, African, Asian and Middle East countries (CABI, 2017). In India, it was first reported from Pune, Maharashtra in 2014, later it was detected from Andhra Pradesh, Tamil Nadu, Karnataka, and Gujarat. Now-a-days, the pest is found so devastating in many countries and has been responsible for losses of 80-100 per cent in tomato plantations in both protected and open field cultivation (Korycinska and Moran, 2009) and 40 per cent of world's tomato crop was infested with this pest (EPPO, 2014).

Economic impact:

Tomato yield and fruit quality significantly reduced by the direct feeding of the pest and the secondary pathogen which may enter through the wounds made by the pest. In 2011, the *T. absoluta* infested 4,04,000 acres of cultivated tomato, representing 40 per cent of the world's crop (EPPO, 2014).

Biology and Ecology:

Egg: A female laid average 260 eggs singly on the under surface of the leaves (73%), stems (21%) and calyx (5%) of young fruits. (1%) Eclosion of eggs (at 26-30°C and 60-75% RH) occurred at about 5-7 days. **Larva:** The larvae pass through four instars and completed larval period in around 8-9 days at 26-30°C and 60-75% RH. **Pupa:** It pupated in the soil (1-2 cm deep) and larvae build a cocoon and pupate on the leaf surface or inside mines (Uchoa- Fernandes *et al*., 1995). Pupation lasted about 10-11 days for females and 11-13 days for males. **Adult:** It lived for 7-8 days. Adult were Nocturnal and usually hide during the day time between leaves.

Nayana and Kalleshwaraswamy (2015) reported that total 24.50±2.15 days for pre-adult period, 1.75±0.49 days for adult pre-oviposition period, 9.5±1.04 days for oviposition period, 4.35±1.43 days for adult post-oviposition period and fecundity was 137.2±13.86 eggs/female.

Sridhar *et al*. (2015) reported that the tomato was the most preferred host then potato and egg plant.

Seasonal activity:

Nitin and Sridhar (2017) found that *T. absoluta* adults trapped in pheromone traps showed that the activity of adults increased in summer season and it decreased in *kharif* and *rabi* season.

Management:

Cultural control: Control weeds to prevent multiplication in alternative weed host (especially *Solanum, Datura, Nicotiana*) (IRAC, 2016). Destroy crop residues and adopt soil solarization (Arno and Gabbara, 2010).

Behavioral control: Qlure-TUA was ideal for mass trapping of *T. absoluta* particularly in protected tomato cultivation (Anon., 2016).

Monitoring: Pheromone trap based Qlure-TUA gave early warning of infestation and also exhibited the density of the insect accurately in low population to medium level infestation (Anon., 2016).

Biological control:

El-Arnaouty *et al*. (2014) found that the parasitoid *Trichogramma achaeae* and *Trichogramma euproctidis* were effective for the management for *Tuta absoluta*.

Cabello *et al*. (2009) reported that the *Trichogramma achaeae* (30 adults/plant) in greenhouse reduced 75-80 per cent damage when released at every 3 to 4 days.

Chemical control:

Braham and Hajji (2012) reported that indoxacarb 150 EC (50 cc/hl) was found effective and gave 96.87 per cent reduction of *T. absoluta*.

Gacemi and Guenaoui (2012) reported that three applications of emamectin-benzoate 5 EC (0.6 g/l) gave 86.7 per cent of mortality of *T. absoluta*.

Snehata *et al*. (2012) observed that treatment of profenofos 72 EC (750 ml/ha), lufenuron 5 EC (20 ml/ha), indoxacarb 15SC (53.6 ml/ha), cyfluthrin 10 EC (250 ml/ha) and chlorpyriphos-methyl 50 EC (1 l/ha) were effective and reduced 61.4, 52.0, 51.0, 50.8 and 49.6 per cent fruit damage.

Moussa *et al*. (2013) found that chlorantraniliprole 20 SC (20 ml/100 l water), chlorfenapyr 36 SC (50 ml/100 l water), indoxcarb 15 EC (50 ml/100 l water), chlorfenapyr (36%) mixed with indoxcarb 15 EC (25 ml+25 ml/100 l water), spinosad 24 SC (50 ml/100 l water) and spinosad (24%) mixed with abamectin (1.8%) (25 ml+25 ml/100 l water), emamectin benzoate 5 SG (30g/100 l water), emamectin benzoate 5 EC (150 ml/100 l water) caused (99.2-91.6) per cent mortality of *T. absoluta*.

Samir *et al*. (2015) reported that spinosad (30 ml/100 l water) was found most effective insecticide with 98.6 per cent reduction on *T. absoluta* infestation.

Conclusion

Tuta absoluta is considerably spreading very fast across the continent and getting status of globally invasive pest in tomato growing regions of world including India. Tomato is also invaded by this invasive pest and it shows its presence in tomato growing areas of Gujarat. Mostly, it entered in various regions by invading tomato plant and later it has expanded its host range. The use of alternate strategies *i.e*., cultural, behavioral, biological control are more effective to manage it. The pest can be effectively managed by the insecticides *viz*., spinosad 24 SC (30 ml/100 l water), indoxacarb15 EC (50 ml/100 l water) and emamectin benzoate 5 EC (150 ml/100 l water).

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Alkesh Kumar Rathva	**Course : Horti. Path. 591 (1+0)**
Reg. No. : 2020215003	**Date : 17/12/2016**
Major Guide : Dr. B. P. Mehta	**Time : 03:00 to 04:00 p.m.**
Co-Guide : Dr. H. V. Pandya	**Venue : Swami Vivekanand Hall**

Eco-friendly management of important diseases of cucurbits

Crops belonging to the family Cucurbitaceae are generally known as cucurbits or gourds. The family Cucurbitaceae comprises of about 118 genera and 825 species in tropical countries. As a group, cucurbits occupy the largest area of the vegetable crops in India and in other tropical countries. It includes crops like cucumber, squashes, pumpkin, melon and watermelon, out of this more than 15 cucurbit crops, grown and consumed within the tropical region. India having highest area of 1,03,000 ha and highest production 1.8 MT), while watermelon having highest productivity 24.13 MT/ha (Anonymous, 2014). In south Gujarat region Navsari having highest estimated area of 8,962 ha and production 1,57,193 MT, while Valsad having highest productivity 17.60 MT/ha (Anonymous, 2015). In North-East India, many species of cucurbits are found as vegetables and fruits. In Gujarat, many species of cucurbits are grown like cucumber, muskmelon, bottle gourd, pumpkin, little gourd, pointed gourd etc.

The cultivation and production of cucurbitaceous vegetable is threatened by many diseases, which covers common cucurbit diseases caused by fungi, bacteria and viruses. Cucurbitaceous vegetable is prone to various diseases, *viz.*, downy mildew, powdery mildew, anthracnose, alternaria leaf spot, bacterial wilt and viral disease, *viz*., cucumber mosaic virus. The cultivation and production of cucurbitaceous vegetable is hampered due to disease infection. So management of the disease is important for better cultivation and production of cucurbitaceous vegetables. Farmers used to control these diseases after the occurrence found in the fields with chemicals. These chemicals are toxic and their residues are injurious for human health. Therefore, eco-friendly management of diseases is an appropriate approach for the management of diseases of cucurbitaceous vegetables.

Different important diseases of cucurbits in Gujarat:

Downy mildew (*Pseudoperonospora cubensis*), Powdery mildew (*Sphaerotheca fuliginea*), Anthracnose (*Colletotrichum orbiculare*), Fusarium wilt (*Fusarium oxysporum*), leaf spot (*Alternaria alternata*) are major diseases reported from Gujarat.

Brief review of literature:

Ahmed (2004) observed that the spraying of clove extract at 10 %, garlic extract at 20 % and withania extract at 50 % concentration showed the least powdery mildew incidence in cucumber cv. Primo under green house condition.

Awasthi *et al*. (2005) recorded maximum reduction of mosaic (72.3 %) and minimum disease incidence (27.6 %) in maximum number of sprays (6) of root extract of *Boerhaavia diffusa* at weekly interval in the field against cucumber mosaic virus.

Pandya (2006) reported that GMM-3 cultivar of muskmelon having less number of wilted plants and average wilted plants in field condition which showed moderately resistant reaction against wilt. He observed that *Trichoderma viride* having minimum average colony diameter (11.33 mm) and maximum growth inhibition (74.04 %) under *in vitro* condition against muskmelon wilt. He also found that farm yard manure showed minimum average colony diameter (41.50 mm) and maximum growth inhibition (53.03 %) under *in vitro* condition in muskmelon wilt caused by *Fusarium solani*.

Patel (2008[a]) recorded that *Trichoderma longibrachyatum* showed minimum average colony diameter (10.47 mm) and maximum growth inhibition (73.69 %) under *in vitro* (dual culture technique) condition in *Alternaria alternata* causing leaf spot in bitter gourd. He also found that turmeric showed minimum average colony diameter (33.50 mm) and maximum growth inhibition (58.64 %) having least sporulation under *in vitro* condition.

Patel (2008[b]) observed that *Trichoderma viride* having minimum average colony diameter (7.67 mm) and maximum growth inhibition (75.79 %) under *in vitro* condition against *Alternaria alternata* causing leaf spot in bottle gourd.

Parasiya (2008) reported that *Trichoderma viride* having minimum average colony diameter (13.33 mm) and maximum growth inhibition (69.92 %) under *in vitro* (dual culture technique) condition against *Fusarium solani* in cucumber causing wilt. He also observed that garlic extract showed minimum average colony diameter (41.67 mm) and maximum growth inhibition (53.18 %) under *in vitro* condition.

Negishi *et al.* (2011) reported that spraying of diseased cucumber leaf extract having 1×10^6 concentration on anthracnose of cucumber recorded minimum number of lesions (25) over healthy cucumber leaf extract (134) and control (377) in green house condition.

Relevante and Cumagun (2013) observed that *in vitro* assay of mustard slurry (1 ml/g tissue) resulted in 100 % suppression of the mycelial growth of *Fusarium oxysporum* on bitter gourd and bottle gourd after exposure to 5, 10 and 15 g of mustard slurry.

Bhat *et al.* (2013) revealed that mean disease severity of downy mildew was 38.61 % and 22.93 % recorded on cucumber cultivar Punjab Naveen and Poinsette, respectively when the crop was sown on 15th December under low plastic tunnels. The disease severity increased with delay in date of sowing. He also reported that disease severity was less (30.41 % and 19.75 %) when daily four hour side ventilation was given in cucumber grown under low plastic tunnels and it considerably increased when no side ventilation was given in both the cultivars, respectively.

Pawar *et al.* (2014) observed minimum mean colony diameter and maximum growth inhibition of *Trichoderma hamatum* seven days after treatment and 10 days after treatment under *in vitro* condition in *Alternaria alternata* causing fruit rot of bottle gourd.

Amer *et al.* (2015) reported maximum disease resistance (76.90 %) and minimum disease severity (18.5 %) of cucumber downy mildew in *Trichoderma harzianum* (10^9 CFU/ml) treatment in the field condition.

Conclusion

From the present study it can be concluded that the eco-friendly management of fungal, bacterial and viral diseases is very important, because it is environment friendly, without any hazardous effect on human health, animal health as well as soil. For managing downy mildew in cucumber, sowing on or before 15th December and four hours of ventilation/day is effective in greenhouse and *Trichoderma harzianum* of 4 mm disc (10^9 CFU/ml) were effectively control *Pseudoperanospora cubensis* pathogen causing downy mildew *in vitro*. For controlling powdery mildew in cucumber, spraying of clove, garlic and withania extract @ 10, 20 and 50 % concentrations, respectively were effectively control the disease. For managing anthracnose in cucumber, spraying of 1 ml diseased leaf extract having 1×10^6 conidia/ml control the disease. For controlling leaf spot of bitter gourd pathogen *Alternaria alternata* , *Trichoderma longibrachyatum* of 5 mm disc and turmeric leaf extract @ 5 % concentration, and in bottle gourd, *Trichoderma viride* of 5 mm disc were effective *in vitro*. For controlling *Fusarium solani* in muskmelon wilt, moderately resistant cultivar GMM-3 was found effective in green house. For managing muskmelon wilt pathogen *Fusarium solani*, *Trichoderma viride* of 5 mm disc and FYM @ 10 % concentration, in cucumber *Trichoderma viride* of 5 mm disc and garlic extract @ 10 % concentration *in vitro*, and in bottle gourd and bitter gourd, mustard slurry @ 5, 10 and 15 gm (1 ml/g tissue) were effectively control the disease in green house. For controlling fruit rot pathogen *Alternaria alternata* of bottle gourd *in vitro*, *Trichoderma hamatum* of 5 mm disc was found effective. For managing mosaic in cucumber, six sprays of root extract having 1 % concentration of *Boerhaavia diffusa* at weekly interval was found effective.

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NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker	**: Chauhan Rinkal Tulsidas**	**Course**	**: Horti. Path.- 591 (1+0)**
Reg. No.	**: 2020215016**	**Date**	**: 16/12/2016**
Major Guide	**: Dr. P. R. Patel**	**Time**	**: 11:00 to 12:00 a.m.**
Co-Guide	**: Dr. H. V. Pandya**	**Venue**	**: Swami Vivekananda Hall**

Seed bio-priming: a biological method of seed treatment for plant disease management

Seed borne diseases refers to the particular plant diseases that are transmitted by seeds and soil borne diseases are caused by microorganisms that survive and move in the soil. Seed borne pathogen may be present on seeds either externally or internally cause infection during or prior to germination. They are responsible for considerable loss of yield in various crops particularly vegetables. Common seed and soil borne diseases are: pre- and post- emergence damping off and seedling blight, root rot, wilt, etc.

Biological treatment or control may be referred as a total or partial inhibition or destruction of pathogen populations by other organisms. Biological treatment typically offers longer term management of plant disease and also cost effective than chemical method, in these contacts, biological control with seed bio-priming coming up as an alternative strategy for disease management which is also ecology conscious and environment friendly. Several organisms have been successfully used as a bio control agents (seed bio-priming) such as *Trichoderma* sp., *Bacillus* sp., *Pseudomonas* sp. Very little work has been done in vegetable crops to reduce diseases by seed bio-priming.

Bio-priming is an advance tool in the system of biological control of seed and soil borne diseases. Simply, it is an approach to treat the seed with beneficial microorganisms with suitable priming agents and with suitable priming time. It may serve as an important means to manage the seed and soil borne pathogens (fungal, bacterial and other organisms), as well as increases the shelf life of seed, enhances yield and may be useful under adverse soil conditions also.

Brief Review of Research Work

Tomato (*Solanum lycopersicum,* Family: Solanaceae)

Thakur and Tripathi (2015) reported that application of FYM @ 200q/ha + *Azospirillum* + PSB + *Trichoderma harzianum* @ 1.0 % and vermicompost @ 50q/ha + *Azospirillum* + PSB + *Trichoderma harzianum* @ 1.o % reduced diseases incidence of pre and post damping off, fusarium wilt and buck eye rot of tomato cv. Solan Lalima.

Chilli (*Capsicum frutescens*, Family: Solanaceae)

Sathya *et al.* (2016) observed that seeds bio-primed with *Pseudomonas fluorescens* + yellow polymer coating showed very low disease incidence of damping off in chilli cv. K 2 and a very high range of damping off incidence was observed in control when compared to other treatments.

Cucumber (*Cucumis sativa* L., Family: Cucurbitaceae)

Devi and Shivprakash (2013) observed that cucumber seeds were bio-primed with *Azotobactore brasilences* + *Bacillus megaterium* + *Pseudomonas fluorescens* + *Trichoderma harzianum* shows the highest activity of enzyme PO to reduced *Pythium* sp. followed by *Azotobacter chroococcum* + *Bacillus megaterium* + *Pseudomonas fluorescens* + *Trichoderma harzianum.*

Onion (*Allium cepa*, Family: Amaryllidaceae)

Gupta *et al.* (2012) found that seed treatment with different bio agents such as *Trichoderma viride* followed by *Trichoderma pseudokoningii* was found to be most effective against seed borne *Aspergillus niger* in improving seed germination and seed index by reducing pre- and post- emergence mortality of onion.

Pea (*Pisum sativum,* Family: Fabaceae)

According to Mohamedy and Baky (2008), bio-priming, seed coating with bio-control agents *Trichoderma harzianum, Bacillus subtilis* and *Pseudomonas fluorescens* reduced the root rot disease incidence caused by *Fusarium solani, Rhizoctonia solani* and *Sclerotium rolfsi* at pre and post emergence stage of plant in greenhouse as well as field conditions.

Faba bean (*Vicia faba,* Family: Fabaceae)

Under greenhouse conditions, Mougy and Abdel-Kader (2008) found that *Trichoderma viride, Trichoderma harzianum, Trichoderma hamatum, Bacillus subtilis, Bacillus cereus* and *Pseudomonas fluorescens* these all bio agents tested fresh and two month old bio-primed treated seeds showed a highly significant effect causing a complete reduction in root rot incidence at both pre- and post- emergence stage of faba bean plant growth compared with the control treatment.

Cowpea (*Vigna unguiculata*, Family: Fabaceae)

Mohamedy *et al*. (2006) proved that in greenhouse trails, soil amendment and bio-primed seeds with *Trichoderma harzianum* formulated on sugarcane bagasse @ 10 % of soil showed a highly effect in reducing root rot incidence of cowpea caused by *Fusarium solani, Macrophomina phaseolina* and *Rhizoctonia solani.*

Green bean (*Phaseulas vulgaris* L., Family: Fabaceae)

Mohamedy *et al*. (2015) found that seed bio-priming with *Trichoderma harzianum* combined with seed soaking in potassium salt or potassium sorbet @ 5% level was superior to fungicidal seed treatment in controlling root rot disease causing by *Fusarium solani* and *Rhizoctonia solani* of green bean cv. Giza 3 under green house conditions.

Okra (*Abelmoschus esculantus* L., Family: Malvaceae)

Rafi and Dawar (2015) proved that okra seeds were bio-primed with *Trichoderma harzianum* @100% pure conidal suspension was found to be most effective for suppression of root infecting pathogenic fungi *Macrophomina phaseolina, Rhizoctonia solani* and *Fusarium* sp.

Conclusions

It can be concluded that bio-priming of seeds play an important for the management of soil and seed borne diseases. It can be used as a one of the component of biological management of plant diseases. *Trichoderma harzianum* found more effective in checking the post emergence damping off, fusarium wilt and buck eye rot diseases of tomato. Bio-primed seeds with *Trichoderma harzianum, Bacillus subtilis* and *Pseudomonas fluorescens* are the most effective seed treatments in reducing root rot disease in pea, faba bean, green bean and okra, damping off in chilli and cucumber and pre- and post- emergence mortality of onion, likewise cowpea seeds treated by Bagasse + *Trichoderma harzianum* 10% of bio-primed were effectively reduced root rot disease incidence. *Trichoderma viride, Trichoderma harzianum, Pseudomonas fluorescens* and *Bacillus subtilis* are found to be potential bio-agents used as a bio-priming for plant disease management.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2018-2019

Speaker	**: Disha Devang Desai**	**Course**	**: Horti. Path.- 591 (1+0)**
Reg. No.	**: 2020217006**	**Date**	**: 15/09/2018**
Major Guide	**: Dr. P. R. Patel**	**Time**	**: 09:00 to 10:00 a.m.**
Co-Guide	**: Dr. H. V. Pandya**	**Venue**	**: Swami Vivekananda Hall**

Eco-friendly management of post harvest diseases of fruits

Introduction

India ranks second in fruits and vegetables production in the world, after China. Fruit crops are grown on 63.73 lakh hectare area with the production of 9.29 crores MT in India. Gujarat occupies an area of 4.15 lakhs hectare with the production of 90.27 lakhs MT (Anon., 2016). Fruits are perishable in nature and are affected by some important post harvest diseases like anthracnose, stem end rot, blue & green mould, gray mould, *Rhizopus* rot, soft rots and *Alternaria* rots occuring in major fruit crops. Over 30 to 35 per cent loss of fruits are caused by post-harvest fungi in transit and storage, (Gadgile, 2017).

Increasing concern for human health and environment, it has become mandatory to seek for eco-friendly management of post harvest diseases. It uses environment-friendly methods like physical, cultural, botanical and biological to control diseases without the use of hazardous chemicals to protect the ecosystem and living beings. Chemicals pose a serious threat to human health and environment. Hence, we need to be eco-friendly to preserve and sustain the natural resources for generation to come.

Brief review of research work

Mango

Chaudhari (2013) reported that least disease incidence was observed at a temperature 55±1˚C for 20 minutes (6.67 and 13.33%) at 5th and 10th days after inoculation against mango anthracnose. He also found that least per cent disease intensity (13.33 and 20.00%) at 5th and 10th day after inoculation was recorded in neem leaf extract with highest decay reduction index (68.97%). Further, he observed that lowest disease severity was observed in fruits treated with *Trichoderma viride* (8.89% and 15.55%) followed by *T. harzianum* (13.33% and 17.78%).

Banana

Raut (2011) reported that Basrai variety showed resistance against anthracnose (*Colletotrichum gloeosporioides*) while Poovan showed 68.50% disease index which was highly susceptible to the infection of anthracnose (*C. gloeosporioides*). He observed that mycelial growth of *C. gleosporioides* was significantly inhibited by *T. viride* (67.76%) followed by *T. harzianum* (61.98%). Also among phytoextracts screened *in vitro* by poisoned food technique against *C. gloeosporioides*, the garlic extract proved superior in inhibiting the mycelial growth (73.17%).

Citrus

Solaimani *et al.* (2009) recorded that highest prevention effect of *Penicillium digitatum* (17%) on the orange fruit was observed at 200 µl of shiraz thyme oil for 10 minutes by dipping method.

Prem chand (2014) proved that extract from *Emblica officinalis* was highly effective to reduce the mycelial growth (61.64%) of *Penicillium digitatum* (green mould rot) *in vitro.* Also he found that mustard oil was most effective and significantly superior among all treatments with 78.71 % inhibition in mycelial growth of *P. digitatum.*

Grapes

Senthil *et al.* (2011) observed that *Bacillus subtilis* strain (EPC-8) was the most effective to suppress 88.7% of *Aspergillus carbonarius*. Also for *P. expansum, Bacillus subtilis* strain (EPCO-16) showed highest mycelial growth inhibition (88.1%).

Shinde *et al.* (2016) observed that treating grape berries with garlic extract 1% showed berries in good condition upto 8, 10 and 8 days against *A. niger*, *A. alternata,* and *P. digitatum* respectively. For 5% yeast solution grape berries remained in good condition for 12 days for all 3 pathogens.

Guava

Ismail *et al.* (2010) recorded the antifungal activity of crude lemon grass oil and noted that it completely inhibited fungal growth *in vitro* at 100 ppm with direct added method to PDA medium and also at 6 ppm concentration with head space technique.

Nabakishor (2016) tested efficacy of neem oil against 6 pathogens and concluded that 50% concentration of neem oil significantly reduced the pathogen growth.

Papaya

According to Patel (2013), wrapping fruits with news paper has showed the least per cent disease incidence (8.33%) against fruit rot. Further he evaluated 6 different oils against fruit rot and castor oil recorded minimum per cent disease incidence (10.33%) significantly over the rest. He also observed that hot water treatment at 50˚C for 5 minutes effectively controlled fruit rot.

Sapota

Anjana (2016) reported that maximum per cent growth inhibition of *A. niger* was achieved by *T. viride* at 91.39% and for *P. digitatum* and *Rhizopus stolonifer* were achieved by *T. harzianum* at 91.39% and 92.22%, respectively using dual culture technique.

Apple

Temur and Tiryaki (2014) reported that gamma radiation at 3.5 kGy recorded least diameter of 7.85 mm at 40^{th} day after treatment against *Penicillium* decay. He also found that at 40^{th} day of sodium carbonate + 3.0 kGy gamma radiation treatment lesion diameter was 19.18 mm against 49 mm of control sample.

Abd-El-Latif (2016) concluded that thyme oil (0.8%) obtained maximum disease reduction for gray mould (86%) and blue mould (84.5%) followed by eucalyptus oil (0.8%) at 83.3% and 82.7%, respectively.

Conclusion

Emerging results on the use of natural products to control postharvest fungal rotting indicate that we should be able to use natural fungicides that would be as effective as synthetic fungicides and presumably safer for man and environment. Biological methods including application of *T. viride* and strains of *B. subtilis* effectively control the post harvest pathogens like *Aspergillus* spp. and *Penicillium* spp. of mango, banana, grapes and sapota. In physical methods, hot water treatment at 55±1 ºC for 20 minutes and 50 ºC for 5 minutes controlled the anthracnose and fruit rot occurring in mango and papaya, respectively. In apple treatment with gamma rays at 3.5 kGy effectively controlled the *Penicillium* decay. Plant extracts and essential oils obtained from neem, tulsi, garlic, mustard etc. controls various post harvest diseases of fruits. Packaging is another important concern to prevent cuts and bruises during postharvest handling and transit. Hence, development and implementation of these new technologies will require greatly accelerated research to develop safe, effective and profitable measures to control postharvest diseases of fruits.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2020-2021

Speaker	**: Kunvar Hetalben Ramanbhai**	**Course**	**: Horti. Path.- 591 (1+0)**
Reg. No.	**: 2020219016**	**Date**	**: 07/11/2020**
Major Guide	**: Dr. V. P. Prajapati**	**Time**	**: 11:00 to 12:00 a.m.**
Co-Guide	**: Dr. H. V. Pandya**	**Venue**	**: Online**

Eco- friendly approaches for sustainable management of vegetable diseases

Vegetables play a major role in Indian agriculture as they ensure the food and nutritional security of the country apart from enhancing per capita income of the farmers. Diseases caused by fungi, bacteria and viruses are prime causal organisms which restrict the crop quality and quantity produce in our country. Enormous losses have been caused every year due to the pre-and post-harvest diseases of crops in India. Farmers use pesticides as first line of defense and frequently resort to indiscriminate and non-judicious use of pesticides.Howeverthese measures lead to several problems such as environmental pollution, pesticide residue in the harvested products, development of resistance in disease, emergence of new disease, destruction of natural enemies and pollinators, and increase cost of production.Eco-friendly approach for sustainable management of vegetable diseases involves biological control including deployment of host resistance, best cultural practices and need based use of chemical pesticides. Such plant protection measures are also in harmony with international food safety and environmental protection protocols.Eco-friendly approach which involves minimum off-farm input for the sustainable and profitable production of crop by enhancing soil fertility, promoting biological diversity and minimizing risk to health and natural resources. The system efficiently utilized biological cycle and enhance biological activities.In the resent seminar we will be discussing over view of the eco- friendly approaches for sustainable management of vegetable diseases.

Review of Research Work

Physical method:

Shiomi (1992) observed inhibitory effects of hot-air treatment on survival of the pathogenof black rot of cabbage seed (naturally infested seeds) and recorded that survival rate of black rot pathogen was zero at 75°C up to 7 days. However, Akhtar *et al*. (2012) revealed that solarized plots for eight weeks + FYM @ 0.2 kg/m^2 amended soil could effectively reduce pre-emergence and post-emergence damping-off of tomato, chili and brinjal seedlings (17 and 2.00, 11.33 and 3.00 and 18.67 and 4.67 %), respectively. Whereas, Prem *et al.* (2017) recorded lowest stem rot (*Sclerosiumrolfsii*) disease incidence in chili crop as plot treated with solarizedat 8.18 per cent and 9.20 per cent in the year 2010 and 2011, respectively

Cultural methods:

Kumar and Sugha (2000) noted that inter cropping of tomato and maize (2:2) found significantly superior to less Septoria leaf spot disease incidence (16.10%) after three weeks.However, Zewain*et al.* (2005) observedeffect of intercropping with onion, garlic, marigold for the management of stalk rot of cauliflower caused by *Sclerotinia sclerotiorum* and recorded that minimum incidence of stalk rot in cauliflower plants was found after intercropping with one (43%) and two rows (41.7%) of garlic during 1999-2000 , During 2000-2001, the lowest disease incidence was recorded with one and two row of onion (15.3, 16.7%). Whereas, Shahin. (2017) noted that the percentages of tomato yellow leaf curl disease incidence and severity in five treatments of two different varieties (BARI Tomato-14 and BARI Tomato-16) are presented that lowest incidence was recorded in treatment T3 (Blue polyethylene) of both of BARI Tomato-14 & 16 (8.33%). While lowest disease average disease severity was found in BARI Tomato-16 (52.32%) in T3 (Blue polyethylene) followed by BARI Tomato16 (56.06%) inT2 (Rice straw). The minimum mean powdery mildew disease severity of cucumber was recorded in crop sowing on I fortnight of July (7.96 %)Naik *et al.* (2018).

Biological methods:

Ramakrishna (2006) evaluated three bio-control agent culture filtrate extract on *Alternaria solani*inoculated potato plants andrecorded that maximum disease control (89.14%) was observed in culture filtrate extract of *Trichoderma harzianum* followed by *Trichoderma viridae* (65.39%). Whereas, Sangani. (2014) studied six bio-agents against *Leveillulataurica* causing powdery mildew of cluster bean among them *Pseudomonas fluorescens* recorded minimum disease intensity 37.77 per cent and maximum disease control 29.03 followed by *Trichoderma harzianum isolate*-I*in vivo* condition during kharif season, 2013. Whereas, VandnaJogani (2014) recorded minimum disease incidence (25.75%) with maximum disease control (67.55%) of tomato wilt by application of *Trichoderma harzianum* as seedling dip @ 5g spore suspension (1 × a10^{6}cfu/l) for one hour + soil application @ 75g/kg. However, Meena. (2017)studied the effect of bioagents usedalone and in combination as seed treatment (ST), soil application (SA) and both ST + SA against dry root rot of clusterbean in green house. Among them *Trichoderma viride* (Tv-BKN) + *Pseudomonas fluorescens* (Pf-18) recorded maximum disease control (65.66%, 69.43%, 81.20%) as seed treatment, soil treatment and both ST+SA, respectively.

Prajapati and Patil (2017) evaluated six *Trichoderma spp.* against black mould rot of onion (*A. niger) in vivo* after 7thand 14thday in pre and post-inoculation treatment and recorded that *Trichoderma asperellum* was significantly superior in reducing the onion black mould rot severity on 7thand 14thday after pre-inoculation and post- inoculation followed by *T. harzianum*.

Use of Botanicals:

Jha *et al*. (2014) found that higher concentration of eucalyptus oil (4%) was more effective against leaf spot of brinjal which was at par with eucalyptus oil (2 and 3%). However, Rahmatzai*et al*. (2017)screened five botanical oils as foliar application against early blight of tomato plant under field condition. Among them garlic oil recorded minimum disease incidence (38.2%) and severity (34.2%) compared to control. Whereas, Gondaliya*et al*. (2020) evaluated thirteen phytoextracts at 10 and 20 percentconcentration against combined growth of *A. porri*and *S. vesicarium*causing leaf blight complex of onion. Among them Ginger rhizome extract recorded 86.85 and 83.70 per cent growth inhibition of at 20 and 10 per cent concentrations, respectively.

Organic Matter Amendments:

Islam *et al.* (2013) studied inhibitory effects of different organic management approaches on the incidence and severity of late blight of potato and tomato. Among them minimum late blight incidence, per cent late blight infected leaves per plant and per cent leaf area diseased per potato plant were recorded in T3 (compost tea applied as foliar spray) followed by T2 (Foliar spray of Ridomil). In tomato minimum late blight incidence and severity were noticed in the plot received T4 (Compost tea applied as soil drenching) and T9 (BAU-Biofungicide as foliar spray) as compared to control and other treatments. However, Kumar and Kumar (2018) evaluated six organic amendments againstblack scurf disease of potato caused by *Rhizoctoniasolani* under screen house conditions. Among them vermicompost recorded minimum disease incidence (40.00%, 33.33%) and maximum control disease (40.00%, 50.01%) at a dose of 10 and 20 g/kg soil/pot respectively. Whereas, Pooja and Simon (2019) tested inhibitory effect of organic amendments and *Pseudomonas fluorescens* on disease intensity of *Colletotrichum capsici* on chilli plant at 45, 60, 75 days after transplanting in field condition. Among them Minimum disease intensity was recorded in T1 (NPK+carbendazim -26.13%) followed by T5 (FYM + Pseudomonas fluorescens-26.40%) at 75 DAT.

Soil Biofumigation:

Anita (2012) observed that out of different crucifer vegetable leaf residues @ 1 kg / 5 kg soil against root knot disease of celery caused by *Meloidogyne hapla.* Among themfresh radish leaf residue recorded lowest nematode population 142.9 per 100g soiland lowest root gall index (2) compared tocontrol. However, Rubayet*et al*. (2017) studied the effect of single component or combined application of soil solarization and biofumigation on incidence and severity of stem rot disease of potato in the field condition. Among them lowest disease incidence(26.67%) and severity (29.86 %) was significantly recorded in T5. Whereas,Aparna and Girija (2018) evaluated ten plant fumigants against *Rhizoctonia solani* causing collar rot of cowpea. Among them cabbage, cassava, garlic creeper and mustard recorded cent per cent mycelial growth inhibition *in vitro* condition.

Biorationals:

Kumar *et al*. (2010) tested inhibitory effect of MPG in integration with antagonists and neem products against damping off of tomato. Among the various integrated treatments, MPG + neem leaf extract and MPG+ neem cake gave significantly cent per cent disease control and zero seedling mortality as compared to rest of the treatments. However, Nidhika Mehta. (2014) screened four biorational and two combinations of biorationals at 5 per cent concentrations against *Sclerotium rolfsii*caused stem rot in chilli*in vitro* condition. Among them maximum per cent growth inhibition of pathogen was noticed in buttermilk (87.71%). Whereas, Katediya*et al*. (2019) tested antifungal effect of sterilized cow urine at 5, 10, 20 percent and 5, 10 and 15days fermented against *Colletotrichum capsici* caused chilli anthracnose *in vitro* condition. Among them highest growth inhibition (91.67%) was observed in 20 per cent 15 days fermented cow urine.

Conclusion:

From the forgoing discussion, it can be concluded that aneco- friendly approaches for sustainable management of vegetable diseases is largely based on physical methods (soil solarization), use of resistant variety, traditional organic input (farm yard manure and oil cake), cultural methods (intercropping, wide spacing, time of sowing, mulching, weeding), use of botanical extract (Eucalyptusoil, garlic and neem), soil biofumigation, use of biorational (cow urine) and use of fungal bio-agents like *Trichoderma viride*, *Trichoderma harzianum*and bacterial bio-agents like *Pseudomonas fluorscencs*and *Bacillus subtillis*by either soil treatment, seed treatment or along with organic amendments will help in reduction of pathogensand increasing yield without effecting soil health.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES:- 2015-16

Speaker	: Patel Krishna D. (1020214011)	**Course** :	VSC 691
Major guide	: Dr.A.I.Patel	**Date** :	02-04-2016
Co-guide	: Dr.T.R.Ahlawat	**Time** :	2.30 p.m.-3.30 p.m

NEW PLANT BREEDING TECHNIQUES AND THEIR APPLICATION FOR CROP IMPROVEMENTS

The improvement of crop species has been a basic pursuit since cultivation began thousands of years ago. To feed an ever increasing world population will requires a great increase in food production. Wheat, corn, rice, potato and few others are expected to lead as the most important crops in the world. Enormous efforts are made all over the world to document as well as use these resources. Everybody knows that the introgression of genes in wheat provided the foundation for the "Green Revolution". Later also demonstrated the great impact that genetic resources have on production. Several factors are contributing to high plant performance under different environmental conditions, therefore on effective and complementary use of all available technological tools and resources is needed to meet the challenges.

The development in biotechnology, genomics research and molecular marker applications has brought to the forefront an interdisciplinary science that is revolutionary 21st century crop improvement. But innovation in plant breeding is necessary, to meet the challenges of global change such as population growth and climate change, therefore plant breeder search for new plant breeding techniques which provides nutritional security to the world. (New plant breeding techniques. Wani and Malik, 2014).

Research work:-

a) Site Specific Mutagenesis

Carroll (2011) reported instances of successful site specific mutagenesis-induced gene targeting by using different method *viz*., agrobactarium, viral delivery, cell culture and protoplast etc., specially in plants and concluded that the prospects for continuing developments seem bright.

b) Cisgenesis and Intragenesis

Rommens *et al*. (2004) were produced marker-free P-DNAs, transferred to plant cell nuclei together with conventional T-DNAs carrying a selectable marker gene and displaying reduced expression of a tuber-specific polyphenol oxidase gene in potato.

Rommens *et al*. (2008) studied the heat induced formation of acrylamide can be decreased by reducing the asparagine content in potato tubers. Silencing of two asparagine synthetase genes (*StAs1* and *StAs2*) through 'all-native DNA' transformation and produced the intragenic plants. Intragenic lines contained up to 20-fold reduced levels of free asparagines and also acrylamide content in French fries and chips.

Rekha *et al*. (2012) were assessing the effects of silencing *StAs*1 and *StAs*2 for reduce the acrylamide-forming potential of potatoes grown in the field without affecting tuber shape and yield. Silencing of *StAs*1 had a greater impact on tuber ASN levels but not yield trait and also determined over expression of *StAs*2 caused ASN to accumulate in leaves but not tubers.

c) Grafting

Barry *et al*. (1994) studied expression of the prosystemin gene by using transgenic rootstock with wild type scion and wild type rootstock with wild type scion and observed that the transgenic root stock systemically induced high levels of proteinase compared to wild type rootstock with wild type scion.

Haroldsen *et al*. (2012) conducted an experiment for mobility of transgenic nucleic acids and proteins within grafted rootstocks for agricultural improvement when wild type scions were grafted on GE rootstocks, in transgrafted plants the disease incidence was observed lower compared to control.

Avramidou *et al*. (2015) studied DNA methylation changes in scions of cucumber, melon and watermelon heterografted onto pumpkin rootstocks using MSAP analysis and observed that significant increase of DNA methylation in cucumber and melon scions pointing to an epigenetic effect in *cucurbitaceae* heterografting.

d) Agroinfiltration

Munusamy *et al*., (2013a) screened out transformed progenies by using agrobacterium-mediated transformation through floral dip method, to screening out transformed progenies and observed that transform AGL1 containing p5b5, p5d9 and p5f7 produced more than 95% of seed productivity which was better than the non-transformed plant. The transformation efficiency of approximately 1% to 2% was determined for p5b5, p5d9 and p5f7, respectively.

Munusamy *et al*. (2013b) induced the production of α-tocotrienol by the co-suppression of tocopherol cyclase gene. The *Amaranthus sp.* and *Allium porrum* leaves infiltrated with p4a1, p4c9 showed significant reduction in the concentration of α- tocopherol and induced the production of α-tocotrienol.

Conclusions:- New Plant Breeding Techniques offer a promising and sustainable way for crop improvement because of its high potential, economic advantage and lack of foreign genes to the species. Though these techniques are at its primary stage of development, they are racing forward at an unprecedented speed. In crops like potato, tomato, leafy vegetables (*Amaranthus sp., Allium porrum*) and cucurbits etc. these techniques are utilized and it would in commercialization very shortly.

Future perspective:- Further research and development of different new plant breeding techniques is required in different aspects. Uncertainties regarding the regulatory status worldwide, possible high regulatory costs and low efficiency of the techniques are major constraining factors for the adoption of the new techniques. The fate of the new plant breeding techniques will be decided by the regulatory status-whether they are classified as GMOs or non-GMOs.

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Navsari Agricultural University
ASPEE College of Horticulture and Forestry, Navsari
Post-Graduate Seminar Series: 2016-17

Speaker	**: Vashi J. M. (1020214017)**	**Course**	**: VSC 691 (1+0)**
Major Guide	**: Dr. S. N. Saravaiya**	**Date**	**: 03-09-2016**
Co-Guide	**: Dr. B. N. Patel**	**Time**	**: 9.00 to 10.00 a.m.**
Venue	**: Swami Vivekananda Hall**		

Silicon : The most under-appreciated element for vegetable production

Silicon (Si) an element abundantly available in earth's crust, is second only to oxygen (Ehrlich, 1981). It is the eighth most abundant elements in universe. It's content in soils vary greatly and ranges from <1 to 45% by dry weight (Sommer *et al.,* 2006). Silica (SiO_2) content of soils varies from less than 10 % to almost 100 %. Silicon dioxide (SiO_2/silica) comprises 50-70 % of the soil mass. As a consequence all plants rooting in soil contain some Si in their tissues. Si role for vegetable production was overlooked or under-appreciated but the beneficial effects of this element on growth, yield, quality and disease resistance have been observed in wide range of research on vegetables.

Major functions of Silicon:

- To promote morphological, physiological and metabolic performance of vegetable crops.
- Reduces metal toxicity.
- Regulates nutrient uptake.
- Increases growth, development and yield of vegetable crops.
- Resistance against biotic & abiotic stresses.

Review of research work:

Growth and yield:

The effect of silicate minerals on the head weight of Six Cabbage cultivars was checked out and revealed that silicate mineral treatment recorded significantly higher head weight in two cultivars. (Balint *et al.*, 2010).

Ghasemi *et al.* (2013) recorded significantly higher number of flower (128/plant), maximum average pod weight (14.33 g), maximum average seed number (2.7 per pod) and the lowest number of days (84.0) requires for flowering in Broad bean with different level of Silicon.

Application of K-silicate at 1.5 kg/Fed resulted in higher stem diameter and maximum RGR, NAR and LWC in Capsicum during both season. (Kamal, 2013).

Jaywardana *et al*. (2014) noticed that Capsicum recorded significantly higher shoot length, number of leaves, average leaf area, fruit length, fresh weight of fruit and yield per plant with rice hull leachate+AL and rice hull leachate+NF treatment over control.

Jing-Kai *et al*. (2014) measured significantly higher plant fresh weight (60.04 g), pseudostem length (12.90 cm), pseudostem diameter (14.87 mm) and maximum plant height (58.33 cm) in Garlic with Si-1.5 (mmol/l) treatment. Furthermore, they found significantly higher Chlorophyll a, b and carotenoid content (0.71 mg/g, 0.19 mg/g and 0.20 mg/g, respectively), stomatal conductance (878.34 mmol/m^2/s) with Si-1.5 (mmol/l) treatment. Transpiration rate (5.14 mmol/m^2/s) was also found significantly lower in this treatment.

Olle (2014) studied the effect of silicon on cucumber and found that silicic acid treatment recorded significantly 35 per cent higher plant height (cm) and significantly 27 per cent higher stem diameter (cm) than control. He also noticed significantly higher nitrogen and phosphorus content in dry matter of cucumber plant.

Gowda *et al*. (2015) recorded the maximum plant height (104.13 cm and 103.20 cm) as well as no.of branches/plant (24.85 and 23.20) in both *kharif* and *rabi* seasons in tomato with OSV-5 (T_9). OPV-3

(T_4) recorded significantly higher Chlorophyll-a content (1.53 mg/g and 1.59 mg/g) and maximum total chlorophyll content (2.66 mg/g and 2.55 mg/g) in both *kharif* and *rabi* seasons. In case of chlorophyll-b maximum content (1.57 mg/g and 1.51 mg/g) recorded with OSV-1 (T_5).They also noticed maximum number of fruits per plant (94.24 and 79.85), maximum fruit yield per plant (3.90 kg and 3.47 kg), maximum fruit yield per plot (66.08kg and 53.74kg) in both *kharif* and *rabi* seasons with OSV-5 (T_9).

Maria *et al.* (2016) observed significantly higher plant height (59.3 cm), fresh weight of root , stems and leaves (6.2, 38.1 and 25.7 g/plant, respectively) and also dry weight of root, stems and leaves (2.1, 7.5 and 5.7 g/plant, respectively) of tomato cv. Magilsas found maximum with nano silica treatment. The minimum day required for anthesis (16) was recorded with micro silica. They also found significantly higher fruit yield (143.9 g/plant), higher fruit weight (13.8 g) and number of fruits per plant (10.2) with nano silica treatment.

Biotic and abiotic stress

Murillo *et al*.(2007) investigated the effect of calcium silicate to the nutrient solution under salt stress on two legumes (Cowpea and Kidney bean) and noticed that in both the crops, salinity reduced growth variables but silicate supplementation partly overcome this growth reduction.

Carlos *et al*. (2009) noticed the effect of silicon application and water deficit on potato and found higher Si concentration on potato leaves (0.47 %), reduction of stem lodging (36.8 %), increased mean tuber weight (36.0g) and tuber yield (1014.6 g/plant).

Sharifa (2015) observed that silicon at different level (1 mM, 2mM and 3mM) alleviated the harmful effect of Cd and Pb supplemented with different concentrations (0, 5, 50 and 100 mM/l for Cd and 50, 500 and 1000 mM/l for Pb) on germination and growth of faba bean.

Torlon *et al.* (2016) found that the percent of leaf area covered by powdery mildew in Pumpkin tended to be lowest at 63 DAS (4 %) and at 71 DAS (55 %) with Wollastonite. However, among from other amendments, Montana Grow also recorded the lower leaf area by powdery mildew at 68 DAS (40 %).Both these amendments also recorded the lowest percent of powdery mildew at 65 DAS, 67 DAS and 70 DAS (17, 32, and 40 %, respectively).

Conclusions:

From the foregoing discussion it can be concluded that silicon can be considered as beneficial element for the vegetable crop production. The supplementation of silicon with nutrient element to the vegetable crops play a vital role for significant increase in growth, yield and quality. Silicon application also resulted in increase the productivity by act as defense system and thereby neutralizing the extremities of various biotic and abiotic stresses.

Future thrust:

Silicon nutrition in crop production remains largely unexplored till to date for vegetable crop production. So, identifying and implementation of Si nutrition management for vegetable crops should be planned and included in integrated plant nutrient management system. There is an urgent need for applied research to quantifying monosilicic and polysilicic acid contents in soil to elaborate optimum Si rate and the best time as well as methods of its application under various condition**.**

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker: Panchal Bhakti Bharatkumar (Reg. No.: 1020215007) Major Guide: Dr. D. R. Bhanderi Co - Guide: Dr. R.V.Tank	Course: VSC 691 (1 + 0) Date: 3/9/2016 Time: 10 to 11 a.m. (Venue: Swami Vivekanand Hall)

: Physiology of PSB and VAM in Vegetables:

Vegetables are potential crops for improving nutrition, food security and also generate employment in the country. They are loaded with vitamins and minerals that contribute to growth and the maintenance of good health. It also acts as a cheapest source of natural protective foods and grown easily in different farming systems (Rai and Yadav, 2005).

In vegetables, biofertilizers are used to improve the status of soil fertility using biological wastes, do not contain any chemical which are detrimental to the living soil. Some microorganisms play an important role in improving soil fertility and crop productivity due to their capability to fix atmospheric nitrogen, solubilizing insoluble phosphate and decompose farm wastes resulting in the release of plant nutrients. Biofertilizers have become an accepted strategy to bring about improvement in soil fertility and protecting the environment. The galaxy of biofertilizers is many like, Phospho, *Rhizobacteria*, *Azotobacter*, Composter, Vermicompost and Biocompost (Singh and Purohit, 2008). Therefore, biofertilizers have for long witnessed shifting fortunes in horticulture.

Review of research work:

Brinjal (*Solanum melongena* L., Family: Solanaceae):

Solanki *et al*. (2010) an experiment conducted to study on the effect of biofertilizers on brinjal (Surati Ravaiya). They found maximum plant height (81.93 cm) at harvest, number of fruits per plant (45.40), fruit yield per plant (2.64 kg per plant) and TSS (7.80 %) in brinjal plants treated with 100 % RDF + *Azotobacter* + *Azospirillum* + PSB.

From the investigation, in brinjal it was observed that application of chemical fertilizers with biofertilizers reduce the requirement of chemicals as well as pesticides. The result revealed that significantly improvement in growth characters such as height of plant (11.03 % to 37.54 %), stem diameter (6.38 % to 23.79 %), length of root (5.56 % to 36.93 %), number of functional leaves (5.67 % to 51.51 %), weight of fresh shoot (7.90 % to 35.91 %) and weight of dry shoot (7.14 % to 46.94 %) over control. Similarly, number of fruits picked per plant (11.30 % to 52.81 %) and yield of fruits (11.89 % to 54.61 %) was more in inoculated crop, (Doifode and Nandkar, 2014).

Latha *et al.* (2014) noticed maximum plant height (94 cm), number of flowers (36 per plant), maximum number of fruits (28 per plant) and highest number of branches per plant (12) in T_{10} containing urea, super phosphate, muriate of potash, *Azospirillum*, Phosphobacteria and potassium mobilizer (each 5 g per pot). Highest fruit weight (1133.3 mg) and total number of leaves (33) also observed in T_{10}.

Potato (*Solanum tuberosum* L., Family: Solanaceae):

Dash and Jena (2015) studied the effect of seed soaking and biofertilizers treatment in potato. Different treatment caused significant variations in plant growth characters, *viz*., maximum plant height (55.3 cm), number of leaves per plant (69.2), number of tuber per plant (10.4), tuber weight (352 g) and tuber yield (29.05 t per ha) with application of 100 % NP + tuber soaking with urea and $NaHCO_3$ + tuber treatment with biofertilizers (*Azotobacte*r + PSB) which were statistically at par with the treatment T_8, T_7 and T_6 indicating that biofertilizers with all levels of fertilizers and only 75 % NP + tuber soaking with urea and $NaHCO_3$ had very positive effect on growth of potato plants.

Tomato (*Solanum lycopersicum* Mill., Family: Solanaceae):

While working on tomato, Walpola and Yoon (2013) studied the PSB effect on growth and phosphorus uptake of tomato plant. In which, they used two strains of phosphate solubilizing bacteria (PSB), *Pantoea agglomerans* and *Burkholderia anthina,* both strains showed positive respond for all the tested plant growth promoting traits. IAA production was 10 and 7.5 µg per ml, respectively for *P. agglomerans* and *B. anthina*. Both strains produced > 80 % siderophore and they were considered as efficient siderophore producers.

Cowpea [*Vigna unguiculata* (L.) Walp., Family: Leguminosae]:

Singh *et al.* (2005) found that application of different biofertilizers inoculants significantly affected on yield containing traits. The maximum pod yield (87.70 quintal per ha) was recorded in B_3 (*Rhizobium* + VAM) followed by individual inoculation B_2 (VAM) and B_1 (*Rhizobium*).

Prasad *et al.* (2008) reported that application of VAM *(Cigaspora calospora), Rhizobium* culture and 80 kg P_2O_5 per ha significantly increased the yield contributing characters *i.e.* number of pods per plant, length of pod, fresh weight of pod and pod yield of cowpea [*Vigna unguiculata* (L.) Walp.]. Besides this, 10 % and 50 % flowering was significantly influenced by *VA-Mycorrhiza* and *Rhizobium* culture.

Prasad *et al.* (2013) observed the *Rhizobium* and PSB inoculation significantly increased the number of leaves per plant after 30 days of sowing. Maximum number of branches per plant was found to be 31.80 due to phosphorus and *Rhizobium* at 45 days of sowing. It was also concluded that to have optimum growth and nodulation of cowpea, application of *Rhizobium* and PSB along with phosphorus @ 80 kg per ha was very useful.

Meena *et al.* (2014) indicated that seed inoculation with *Rhizobium* and PSB were significantly increased the number of pods per plant (9.51), number of seeds per pod (9.21), test weight (76.99 g), straw yield (25.40 q per ha) and biological yield (16.29 q per ha) over other treatments.

Cluster bean [*Cyamopsis tetragonoloba* L. (Taub.), Family: Leguminosae]:

Singh *et al.* (2014) conducted an experiment to study the effect of bio-inoculants on growth and productivity in cluster bean. They found that application of 75 % RDF + PSB recorded the maximum plant height (125.9 cm), nodules per plant (21.5), pods per plant (35.9), seed yield (1062), harvest index (26.79 %) and with B: C ratio 1.11, over the other treatments and control. It remained statistically at par with 75 % RDF + *Rhizobium*.

Cauliflower (*Brassica oleracea* var. *botrytis,* Family: Brassicaceae):

Sharma *et al.* (2009) studied the bio-inoculants effect on growth, yield and nutrient uptake in cauliflower and found that higher curd yield (304.05 q per ha), curd diameter (10.53 cm) and curd weight (0.747 g) was recorded under the treatment of *Azotobatcer* + PSB in cauliflower.

Conclusions:

From the research result of various experts, it can be concluded that application of bio-inoculants with the application of other fertilizers, reduce requirement of chemicals as well as pesticides. In brinjal, application of 100 % RDF along with *Azotobacter*, PSB, *Azospirilum* and potassium mobilizing bacteria increase the yield contributing traits like, height of plant, fruit weight, root length, number of fruits per plant and yield. In potato, tuber was soaked in urea + $NaHCo_3$ and treated with PSB and *Azotobacter* along with 100 % NP it was increased the emergence (%), number of leaves per plant, number of tuber per plant, tuber weight and tuber yield. In tomato, soil was treated with PSB-1 and PSB-2 strain with application of Tri Calcium Phosphate increase the availability of phosphate. Also increase the plant height, root length, shoot and root dry matter, IAA production in root and siderophore production in tomato. In cowpea, application of biofertilizers like, PSB, VAM, *Azotobacter, Azospirilum* along with 100 % RDF increase the root nodules, phosphorus availability, number of leaves, pod weight, test weight and pod yield. In cluster bean, for increasing the yield of plant apply 75 % RDF with PSB. It was improving the phosphorus availability, number of leaves, pod weight, harvest index and B: C ratio. In cauliflower, for improving the curd diameter, curd weight and B: C 100 % RDF along with PSB and *Azotobacter* inoculation was found beneficial**.**

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker : Mr. Hitesh V. Vasava	**Course : VSC -692**
Reg. No. : 1020214016	**Date : 3-12-2016**
Major Guide : Dr. K. N. Chaudhari	**Time : 4:00 to 5:00 pm**
Co- Guide : Dr. R. V. Tank	**Venue : Swami Vivekananda Hall**

Precision farming in papaya

Papaya (*Carica papaya* L.) is an important fruit crop of tropical and sub tropical regions of the country belong to the family of Caricaceae. India accounted for about 10 per cent of the global production of the fruits and is supposed to be highest producer of papaya in the world. It is cultivated on an estimated area of 1.33 Lakh ha with 56.39 Lakh MT production and 42.40 MT/ha productivity (Anon., 2016). In Gujarat, it is cultivated 19,590 ha area with production of 11,850 MT and 60.50 MT/ha productivity (Anon., 2015).

Precision farming is about doing the right thing, in the right place, in the right way, at the right time. Managing crop production inputs such as water, seed, fertilizer etc. to increase yield, quality, profit, reduce waste and becomes eco-friendly. The intent of precision farming is to match agricultural input and practices as per crop and agro-climatic conditions to improve the accuracy of their applications.

BRIEF REVIEW OF RESEARCH WORK

Growing media for seedling

Patel (2015) reported that media M3 (Red laterite soil + vermicopost + cocopeat) and seed treatment chemical C2 (GA3 200mg/l for 12 hr) were significantly influenced growth parameters of papaya seedlings.

Drip irrigation and Fertigation

Tank *et al.* (2011) reported that treatment T9 (drip irrigation @ 0.8 PEF + N and K2O @ 100 per cent RD) gave maximum yield and better quality of papaya fruits. However, maximum cost: benefit ratio was observed with treatment T8 (drip irrigation @ 0.8 PEF + N and K2O @ 80 per cent RD).

Deshmukh and Hardaha (2014) revealed that significantly highest plant height (140cm) was observed in treatment T5 (80% CPE and 80 % RDF) and T6 (80% CPE and 100 % RDF). Whereas, significantly maximum yield and yield attributing parameters were observed in treatment T9 (100% CPE and 100% RDF).

Thakor *et al.* (2014) reported that GIS map shown good quality soil of Anand district area as compare to other South Gujarat area.

Mulching

Solia *et al.* (2010) observed that growth and yield attributes were significantly higher with treatment drip irrigation @ 0.6 PEF + BPM @ 20% coverage (50 micron) in papaya.

Precise space utilization

Kumar *et al.* (2012) found that maximum no. fruit/plant, fruit weight and yield were recorded in treatment nitrogen (N 200 g/pit), potassium (K 300 g/pit) and spacing (S2: 1.5 x 1.5 m) in papaya.

Intercropping

Singh *et al.* (2010) reported that intercropping of summer ground nut (cv. Dh-86) in papaya cv. S-1 displayed the better compnionship for yield of both crops.

Integrated nutrient management (INM)

Singh and Varu (2013) revealed that yield and physico-chemical parameters were significantly influenced and noted higher with treatment T8 (½ RDF + Azotobacter 50 g/plant + PSB 2.5 g/m2) in papaya cv. Madhu bindu.

Srivastava *et al.* (2014) manifested that maximum yield and better quality fruits were found with the treatment T10 (FYM + 100% NPK + *Azotobacter* 20 g/pit + PSB 20 g/pit) in papaya.

Micronutrients

Bhalerao and Patel (2015) revealed that among the different micronutrients treatments, treatment T10 (calcium nitrate 1000 mg/l + borax 30 mg/l + zinc sulphate 200 mg/l + ferrous sulphate 200 mg/l) was found significantly higher in yield and quality parameters of papaya cv. Red Lady. 4 **Plant growth regulators**

Pusdekar and Pusdekar (2009) reported that spraying of MH @ 600 ppm gave maximum fruit weight, fruit volume and yield of papaya. However, maximum TSS, ascorbic acid and minimum acidity were noted due to application of MH @ 400 ppm, CCC @ 500 ppm and etherel @ 250 ppm, respectively.

Varietal performance

Das and Dinesh (2014) noted maximum plant height (237.77 cm) of papaya cv. Sunrise Solo. Whereas, Pusa Dwarf was found better with respect to fruit volume (1367.00 ml) and fruit breath (15.23 cm). Maximum pulp thickness (3.27 cm), TSS (14.83 0B) and the carotenoids (3.27 mg/100g) were found in papaya cv. H-39.

Micro Propagation

Patel *et al.* (2013) reported that MS medium with 1.0 mg/l IBA resulted in maximum rooting under micropropagation in papaya.

Economics

Solia *et al.* (2010) revealed that maximum net realization found with drip irrigation @ 0.6 PEF + Black plastic mulch @ 20% coverage (50 micron) as compared to drip alone.

Conclusion:

Papaya seed treated with GA3 200mg/l for 12 hr and shown in media of red laterite soil + vermicopost + cocopeat was found better seedling growth. Fertigation in papaya @ 0.8 PEF + N and K2O @ 80 per cent RD, saved 20 % N and K2O and gave maximum cost benefit ratio with better yield and quality of papaya. GIS map shown good quality soil of Anand district area as compare to other South Gujarat area. Drip @ 0.6 PEF+BPM (50 micron) 20% coverage was fond economically viable technology with increased yield of papaya. Under precise space utilization, papaya planted at distance of 1.5 x 1.5 m and fed with nitrogen (200 g/pit) and potassium (300 g/pit) resulted in higher yield and yield attributing parameters. Inter cropping of summer groundnut cv. Dh 86 in papaya cv. S-1 was found beneficial with respect to yield of both the crops. Application of INM ½ RDF + Azotobacter 50 g/plant + PSB 2.5 g/m2 increased the yield and quality of papaya cv. Madhu bindu. Yield and quality of papaya also can be increased with the application of FYM 20 kg/plant + 100% NPK + Azotobacter 20 g/pit + PSB 20 g/pit. Foliar spray of micronutrient like calcium nitrate 1000 mg/l + borax 30 mg/l + zinc sulphate 200 mg/l + ferrous sulphate 200 mg/l increased the yield and quality of papaya cv. Red Lady. Spraying of plant growth regulators like MH @ 600 ppm increased the growth and yield of papaya. Under the varietal performance cultivar Pusa Dwarf and H-39 was found better in terms of physico-chemical parameters of papaya. Use of MS medium with 1.0 mg/l IBA was found better for rooting in papaya under micro propagation.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2016-2017

Speaker: Patel Himani Biharilal (Reg. No.: 1020215011)	**Course: VSC 692 (1+0)**
Major Guide: Dr. S. N. Saravaiya	**Date: 18 / 3 / 2017**
Co- Guide: Dr. S. J. Patil	**Time: 9 to 10 a.m.**

Genetic diversity and potential role of underutilized fruit crops in food security

Underutilized fruit crops are known to provide higher economic returns per unit area and to generate large employment opportunities uplifting the rural economy along with ensuring nutritional security to the people. There is a need to diversify and include underutilized species in the cropping systems. The neglected and underutilized species common in the ecologically deprived regions inhabited by poor people are nutritionally rich. These fruits provide food security to the people in their native regions of diversity during the famine and scarcity periods in different parts of the world (Pareek and Sharma, 2009).

Review of Research Work

Genetic Diversity:

Wangchu *et al.* (2013) studied different variability characters of 44 genotypes of jackfruit and showed that these genotypes have wide range of variability, high heritabity and high genetic advance; therefore, selection may be effective. They also observed that the genotypes collected from the same location did not necessarily belong to the same cluster (Group), which indicates that genetic drift, natural selection, cross pollination and seedling origin of the plant were responsible for this diversity rather than geographical distance.

Meghwal *et al.* (2014[b]) analyzed genetic diversity of *Carissa carandas* accessions by dendrogram and revealed that CZK 2011 accession was most diverse among the rest of all accessions.

Anuragi *et al.* (2016) analyzed molecular diversity of *Annona* genotypes by dendrogram with combined RAPD and SSR data and revealed that significant genetic diversity was present among the genotypes and *A. muricata* was most diverse genotypes among the rest of all *Annona* genotypes.

Priadi *et al.* (2016) analyzed the relationship between eight varieties of carambola and genetic diversity were observed with RAPD markers. They revealed from dendrogram that only one variety (Dewimurni) was the most genetically diverse variety than others.

Nutritional Composition:

Swami *et al.* (2012) studied epidemiological studies on antioxidants in human from jackfruit and found that jackfruit contains many useful antioxidants, which prevents many human diseases.

Meghwal *et al.* (2014[b]) conducted an experiment on yield and physico-chemical characteristics of fruits of karonda accessions and found that the germplasm lines showed great variation in fruit yield. Most of the accessions gave fruit yield equal to or greater than the check variety *i.e.* Pant Manohar. The germplasm also exhibited significant diversity in physico-chemical characteristics of fruits of karonda accessions.

Zehra *et al.* (2015) studied the comparative nutritional contents of leaves, seed and fruit pulp of bael and found that parts of bael contains good amount of moisture, crude fat, ash, crude protein, crude fiber, total carbohydrate, energy, brix and pH, thus it is a new and good source of superior quality food.

Nutritional composition of minor fruits were analyzed at NAU, Navsari and revealed that in comparison to major fruits (Sapota and Banana), underutilized fruits were rich in many nutritional parameters. Tamarind was rich source of total carbohydrate, vitamin C, acidity and brix, whereas, Star gooseberry was high in protein and β – carotene. (Anonymous, 2017).

Value Addition:

Nandal, Urvashi and Bhardwaj (2015) studied frequency of awareness about processed/value added products of underutilized fruits in tribal women and found that the maximum tribal women (85%) knew about preservation of the fruit by dehydration method. Whereas 60 % women were also familiar about pickling of fruit and 45 % have good knowledge about preparation of fruit chutney.

Genotypes/Varieties and Yield:

Growth and fruiting characters of jackfruit genotypes were studied by Rai *et al.* (2003) and found that different jackfruit genotypes had different diversity in fruit shape, fruit attractiveness, pulp aroma and good amount of yield per tree (kg) among which HPJS-5/8 genotype recorded high yield per tree.

Obeed *et al.* (2008) conducted an experiment on fruit properties of five ber cultivars during 2006 and revealed that these five ber cultivars recorded good amount of quality parameters and had different fruit morphology, in which Komethry had high pulp content and fruit length; Pakstany had high TSS, TSS/Acid, non reducing sugar and total sugar; Um- sulaem had high pulp, acidity and vitamin C content; Toffahy had high fruit diameter, while Peyuan had high fruit weight and reducing sugar.

Meghwal *et al*. (2014[a]) evaluated pattern of flowering, fruiting and yield variation in gonda accessions and revealed that different gonda accessions had good amount of yield range which showed diversity of these accessions, among which G 2025 genotype had high average fruit yield.

Pests and Diseases Tolerance/Resistance:

Meshram and Soni (2011) carried out screening of certain varieties of aonla against key insect pests and diseases in clonal seed orchard and found that the NA-10 followed by Kanchan variety of aonla showed more resistant in terms of larval population of *B. stylophora, G. acidula*, number of holes made by *I. quadrinotata*, number of fruits damaged by *Alternaria spp*. when compared with other varieties. Out of eight varieties of aonla, Hatizola-Local (2.50 %) followed by Francis (2.75 %) were least infected by wilt disease in grafted seedlings at nursery stage.

Korlapati (2014) studied resistant/tolerant varieties of ber and found that many varieties were resistant to powdery mildew, fruit borer and tolerant to fruit fly.

Economics:

Gondalia and Patel (2007) conducted an experiment on cost and returns from aonla orchard on different farm groups (Rs./ha/year) and revealed that annual net return was highest (Rs. 68,660/ha) in large farms. Thus, farmers of large-size farm group were found more efficient in utilizing their resources in aonla production compared to other farm-size groups.

Thorat and Shelke (2012) carried out study for per hectare costs and returns from ber cultivation and found that per hectare net profit Rs. 21,628 was obtained with output-input ratio of 1.57.

Nandal, Urvashi and Bhardwaj (2015) studied economics of plantation of underutilized fruits in tribal areas of district Sirohi and observed that jamun have high expected total income.

Conclusions:

Underutilized fruits are in a reasonable position to capitalize as a source of addressing rural food and income security. Jackfruit genotypes had wide range of variability, high heritabity and high genetic advance; therefore, selection may be effective. There were different genetic diversity observed in underutilized fruit crops like karonda, *Annona* and carambola. Jackfruit had many antioxidant properties against many diseases. Karonda accessions showed great variation in fruit yield and significant diversity in physico-chemical characteristics of fruits. Bael is a new and good source of superior quality food. Tamarind is rich source of total carbohydrate, vitamin C, acidity and brix, whereas, Star gooseberry is high in protein and β – carotene. There was different frequency of awareness about processed/value added products of underutilized fruits in tribal women. Underutilized fruits like jackfruit, ber and gonda showed diversity in their accessions and high yield potential. Aonla and ber like underutilized fruits have shown pests and diseases tolerance/resistance. Underutilized fruits provide high benefit from production and provide opportunity in income security.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker : Kalariya Vijaysinh Dhanjibhai	**Course : VSC-692**
Reg. No. : 1020215004	**Date : 16/12/2017**
Major Guide : Dr. D.R. Bhanderi	**Time : 10.00 to 11.00 a.m.**
Co-Guide : Dr. R. V. Tank	**Venue : Swami Vivekananda Hall**

Dehydrin, a scavenger against abiotic stress in fruit crops

Introduction:

Stress in terms of biology is an adverse force or a condition, which inhibits the normal functioning and growth of a biological system of plants. Stress can be broadly classified as biotic and abiotic. Abiotic stress includes temperature, salinity, water, radiation, chemical, etc. Among which cold, salinity and drought are the major stresses, which adversely affects plants growth and productivity. Water availability for plant is highly affected by three environmental stresses which include salinity, low temperature (freezing) and drought (Mahajan and Tuteja, 2005).

Dehydrin

Dehydrin belongs to group II of late embryogenesis abundance (LEA) protein. These proteins are most commonly found in higher plants, algae, yeast and cynobacteria. Currently, dehydrins are considered all the proteins which have at least one copy of the lysine rich amino acids sequence known as K segment. Apart from K segment dehydrins also contain S segment, Y segment and $— segment. Molecular weight of dehydrins ranges from 9 to 200 kDa. They are water soluble and thermo stable. Dehydrins are classified according to the combinations of highly conserved segments (K, Y and S segments). There are mainly 5 types of dehydrins *viz.*, YpSKp9 Kp9 SKn› KnS and Y K, (Close, 1996). Dehydrin found in cell cytoplasm and nucleus (Houde *et al.*, 1995), near to plasma membrane (Danyluk *et al.*, 1994), also found in cell organelles, such as mitochondria (Borovskii *et al.*, 2000) and vacuoles (Heyen *et al.*, 2002).

Mode of action of dehydrin

K segment of dehydrins imparts structural modification when translocated to the plasma membrane and it forms o—helix which is amphipathic in nature. It combines with water molecules at hydrophilic side and lipid molecules at the other side. Thus the liquid crystalline state is maintained during cold stress and at the same time water loss due to disturbed osmotic potential can be prevented. By this means prevention of hexagonal II phase transition from liquid crystalline state can be greatly achieved (Allagulova *et al.* 2003).

Review of research work:

Salt and Drought Stress

Hanana *et al.* (2014) identified and isolate genes related to abiotic stress (salinity and drought) tolerance in grapevine, a candidate gene approach led to the isolation from Cabernet Sauvignon cultivar of a full-length cDNA of dehydrin gene. The expression study of VvDhn was carried out within plant organs and tissues as well as under drought and salt stresses. VvDhn was not detected in vegetative tissue, whereas it was only expressed during seed development (during late embryogenesis) at extremely high levels and was induced by salt stress.

Cold Stress

Xu *et al.* (2014) reported that the role of EjDHNs in freezing resistance in loquat fruitlets. Two cultivars of loquat, the freezing-sensitive 'Ninghaibai' (FS-NHB) and the freezing-tolerant 'Jiajiao (FT-JJ) were analysed under induced freezing stress. Freezing stress led to obvious accumulation of reactive oxygen species, they also found seven DHNs, showing four different structure types from loquat fruitlets and used to study the characteristics of different EjDHN proteins.

Parmentier-Line *et al.* (2002) monitored two dehydrins of 65 and 30 kDa were detected with a polyclonal antibody raised against the 65 kDa dehydrin of blueberry. Using a full-length cDNA clone of blueberry dehydrin 1 as a probe, one mRNA of 0.75 kb, an appropriate size to encode the 30 kDa dehydrin, was detected on RNA blots.

Yang *et al.* (2012) identified the *DHN* gene family in *V. vinifera* and the corresponding homologues were isolated from *V. yeshanensis*. The four grapevine *DHN* genes shared a low sequence identity, and exhibited clear differences in physicochemical properties and expression profiles, which indicates functional 10 diversification within the grapevine *DHN* family. *DHN-1* appeared to be the principal stress-responsive gene in grapevine species, and was induced not only by various abiotic stresses.

Hara *et al.* (2001) identified CuCOR19 mRNA or protein by Northern or Western hybridization, respectively. A small amount of CuCOR19 mRNA was present in leaf when it was detached and the mRNA level decreased during the control experiment.

Monica *et al.* (2009) identified a DHN of the class Y2SK4 with a deduced amino acid sequence with 79– 98% identity among the cultivars "Royal Gala", "Goldrush" and the M9 rootstock that showed high identity to our DHN from "Golden Delicious" (92–98%).

Houde *et al.* (2004) The WCOR410 protein was expressed in transgenic strawberry at a level comparable with that in cold-acclimated wheat. Freezing tests showed that cold-acclimated transgenic strawberry leaves had a 5 °C improvement of FT over wild-type or transformed leaves not expressing the WCOR410 protein.

Conclusion:

From forgoing discussion it can be concluded that the genes which encode these proteins are expressed during late embryogenesis, as well as in vegetative tissues subjected to drought, low temperature and high salt conditions. Fascinating, over-expression of DHN genes in transgenic plants has been found to enhance resistance of the transgenic lines to various adverse environments, such as cold, drought, salinity and osmotic stress, which has raised significant interest in their putative application for crop improvement. While it is generally accepted that DHNs function to protect cells from damage caused by stress-induced dehydration, their precise mechanism remains elusive.

Future thrust

➢ To understand the underlying molecular mechanism of how a plant cell modulates its protein expression network to cope with the stress, an in-depth study of the organelle proteome is of great contribution toward development of stress tolerant crop varieties to meet the increasing demand of food supply worldwide

➢ Attempts should be made to design suitable vectors for stacking relevant genes of one pathway or complementary pathways to develop durable tolerance

➢ It is desirable that appropriate stress inducible promoters should drive the stress genes as well as transcription factors, which will minimize their expression under a non-stressed condition thereby reducing yield penalty

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2017-18

Speaker	Ganta Koteswara Rao	**Course**	VSC-691
Reg. No.	1020216003	**Date**	06-01-2018
Major Guide	Dr. N. B. Patel	**Time**	3 to 4 p.m.
Minor Guide	Dr. T. R. Ahlawat	**Venue**	Swami Vivekananda Hall

Influence of Antitranspirants (ATs) in Vegetable crops

Water is the most abundant compound found in nature and is the most limiting factor in agricultural production. More than 98% of water is lost in the form of transpiration and evaporation. Transpiration is the loss of water from aerial parts of plants in the form of vapor, which is also known as 'Necessary Evil'. It takes place through lenticels, cuticle and stomata. Transpiration is affected by both external and internal factors. Water is a scarce commodity and with the expansion of agriculture, water conservation measures are becoming more important particularly chemical manipulation of transpiration with antitranspirants. Antitranspirants are chemicals sprayed on transpiring plant surfaces with an attempt to reduce water use by reducing transpiration. A wide range of materials have been tried as antitranspirants (Solarova *et al.*, 1981). Depending upon their mode of action, they are stomatal closing type, film forming type, reflectance type and growth retardants. Antitranspirants should have some of the ideal properties like non toxic, cheap, stable, long lasting in their effectiveness and they should have some of the assured benefits. Several researchers reported that antitranspirants not only reduce the water loss but also they improve the physiological, disease resistance, quality and yield aspects in many vegetable crops.

Review of Research work

Brinjal

Prakash and Ramachandran (2000) studied the effect of chemical ameliorants on stomatal frequency and water relations in brinjal under moisture stress conditions. They reported that potassium chloride performed best in terms of stomatal behaviour and leaf water potential, whereas Cycocel proved best in the case of relative water content.

Kuruppaiah *et al*. (2003) conducted an experiment on effect of antitranspirants on growth, photosynthetic rate and yield characters of brinjal. They found that Kaoline (7.5%) spray was found to be the best which improved the number of flowers, number of fruits per plant, yield per hectare, maximum net photosynthetic rate, RWC and minimum transpiration rate followed by salicylic acid (1000 ppm).

Cowpea

Farouk and Ramadan (2012) reported that foliar application of chitosan @ 250 mg/l, increased plant growth, yield and its quality as well as physiological constituents in plant under stressed or non stressed conditions as compared to untreated plants in cowpea.

Cucumber

Wafaa (2002) revealed that among different film forming compounds, Kaolin and Nu-film @ 1% were more effective in reducing spores counts germination, infected area and lesions number of downy mildew. Scanning electron microscope examination showed that Kaolin antitranspirant inhibited spores germination and made the sporangia becoming collapsed and lost its turgidity when applied either pre or post inoculation. Under protected cultivation Kaolin strongly protected cucumber against downy mildew and increased vine height and yield.

Sweet potato

Moussa (2012) reported that foliar application of folicote @ 15% resulted in significant increases in water use efficiency, yield and yield attributing characters of sweet potato under low water areas.

Summer squash

Ibrahim and Selim (2010) envisaged that foliar application of Kaolin @ 6% significantly increased the water use efficiency, foliage weight, leaves weight, mean fruit weight, total yield per hectare and TSS in summer squash during summer 2008 and 2009 seasons.

Okra

Pateliya *et al*. (2008) found that foliar application of growth retardant CCC @ 300 ppm increased the fruit length, fruit diameter, number of green fruits per plant and fresh weight of fruit. However, highest net return with higher cost benefit ratio was also produced under the treatment of CCC 300 ppm as compared to rest treatments in okra.

Bell pepper

Kamal (2013) reported that foliar application of Kaolin @ 4% and Potassium silicate @ 1.5% significantly increases the stem diameter, relative growth rate, net assimilation rate, leaf relative water content, number of fruits per plant, average fruit weight, yield and water use efficiency in bell pepper.

Potato

Kyaw *et al*. (1991) observed that application of antitranspirant folicote formulation @ 6% on field grown potato, significantly reduced the extent of necrosis and necrotic tubers percentage in small sized potato, thus enhancing crop quality without significantly reducing yield.

Conclusion

From the foregoing discussion, it can be concluded that, Antitranspirants not only reduce the transpiration loss but also useful for improving physiological, growth, disease resistance, quality, yield and yield attributing characters in vegetable crops. Foliar application of antitranspirants like stomatal closing (Potassium chloride 1%), film forming (Chitosan 250 ppm, Nu-film 1%, Folicote 15% and Potassium silicate 1.5%), reflectance type (Kaolin 4 and 6%) and growth retardant (CCC 300 ppm) have been found to increases the growth, physiological, disease control, quality, yield and yield attributing characters with highest net return in brinjal, cowpea, cucumber, sweet potato, summer squash, okra, bell pepper and potato respectively.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2017-2018

Speaker : Ganta Koteswara Rao	**Course : VSC-692**
Reg. No. : 1020216003	**Date : 05/05/2018**
Major Guide : Dr. N. B. Patel	**Time : 09.30 to 10.30 a.m.**
Co-Guide : Dr. T. R. Ahlawat	**Venue : Swami Vivekananda Hall**

Fruit based agroforestry systems in drylands

Crop production on drylands in particular results in low, unstable and often uneconomic yields because of aberrant monsoon behavior. These marginal lands are not able to sustain arable crops particularly during the drought conditions. Tree component in dryland agriculture increases production and income, besides imparting stability to the farming system. Among the alternate land use system developed, fruit based agroforestry systems are readily picked up by the fruit growers due to cash benefits derived from these system. The fruit based agroforestry system can be defined as a planting system comprising combinations of plants with various morpho-phenological features to maximize the natural resource use efficiency and enhanced total factor productivity. Fruit based cropping system is now considered to be the most ideal strategy to provide food, nutrition and income security to the people (Chundawat, 1993). Integration of annual crops with fruit trees yields multiple outputs that ensure production and income generation in a sustainable manner (Randhawa, 1990). The main components of fruit based agroforestry systems are main crop, filler crop and inter crop. There are different kinds of fruit based systems using across the country *viz,* mango, guava, ber, aonla, sapota etc. Several researchers reported that fruit based agroforestry systems were useful for improving economic returns of the farmers, generating employment, higher production, soil fertility status and quality characters of fruits under drylands.

Review of Research work

Growth, Yield, Quality and Soil fertility status

Ahmad *et al.* (2018) conducted an experiment on forage grass/legume mixtures as a means of orchard floor management and for augmenting forage resource availability in apple based agroforestry systems. The results revealed that growth and soil nutrient parameters were high under red clover + apple followed by white clover + apple combinations than control.

Shweta *et al.* (2015) studied the effect of different types of leguminous intercrops on guava growth under guava based agri-horti system at research farm of CCS Haryana Agriculture University, Hisar. Results showed that intercropping with mung bean increased guava tree height as compared to other crops (cowpea and guar) as well as mono cropping.

Swain (2014) conducted an experiment to assess the effect of various intercrops on the performance of mango in the rainfed uplands of Odisha. The results of the study revealed that the mango + guava +cowpea intercropping system exhibited better performance which has been reflected in the form of plant height, fruit weight and fruit yield of mango closely followed by mango + guava + french bean system.

Rathore *et al.* (2013) conducted an experiment on performance of mango based agri-horticultural models under rainfed situation of Western Himalaya in two phases. In the first phase, mango + cowpea + toria system, in the second phase mango + turmeric system significantly improved the fruit quality and soil properties as compared to initial values.

Das *et al.* (2011) studied the effect of different intercrops on aonla based agri-horticultural systems. Among different treatments, the treatment aonla + turmeric significantly increased the growth, fruit characters of aonla and soil properties.

Mutanal *et al.* (2007) conducted an experiment to assess the mixed cropping of trees with tamarind at Forest Research Station, Prabhunagar (Dharwad) during 1985. At the end of 20th year of experimentation it was found that tamarind growth (ht and dbh) was higher with *C. equisetifolia* (10.46 m and 20.85 cm respectively) and *E. tereticornis* (10.63 m and 19.32 cm respectively) as compared to other tree species. Among tree species, height and dbh were higher in *C. equisetifolia* (21.60 m and 23.70 cm respectively) and *E. tereticornis* (18.34 m and 18.21 cm respectively) as compared to *D. sissoo* (8.46 m and 11.36 cm respectively).

Singh and Singh (1999) studied the influence of horti-pasture systems on soil quality. Among different pastures, available nitrogen was high under stylo compared to no pasture. 18.

Economics

Meena *et al.* (2017) reported that the cropping sequence fenugreek- okra inter cropped with ber exhibited highest net return (Rs. 8,09,215 ha-1) and BCR (4.68) followed by intercropping of ajwain-tinda cropping sequence with ber which resulted a net return of Rs.7,22,075 ha-1. Thus, it is inferred that intercropping of fenugreek- okra cropping sequence with ber is recommended for realizing higher system productivity, net returns and BCR.

Mutanal *et al.* (2016) reported that among the different treatments, higher net returns and B:C ratio were recorded in the V-2 tamarind clone + curry leaf (Rs. 9,764.5 ha-1 and 2.16) followed by the clone PKM-2 + curry leaf (Rs. 8,561.8 ha-1 and 1.85) as compared to other clones.

Arya *et al.* (2011) observed that the maximum benefit: cost ratio of 3.48:1 when crops were grown under combination of aonla + ber + karonda + moth bean + mustard. They also noticed higher benefit: cost ratio of 2.22:1 for ber alone among the perennial components.

Solanki and Ramnewaj (1999) studied the performance of *Zyziphus* based agri-horticultural systems on yield of *Zyziphus* at AICRPDA, Dantiwada. They reported that the yield and gross income of ber was more under *Ziziphus* + mung bean and *Ziziphus* + sorghum systems.

Conclusion

Mounting pressure on our natural resources due to rocketing population rise has ushered in large scale degradation of our environment and ecosystem thus calling for immediate attention for seeking newer approaches in cropping system to meet the food, fibre, fire wood and timber requirement of the 21st century. For sustainable management of dry lands and for enhancing the economic viability of the cropping system, partial shift from the existing high input requiring rotation to low input requiring system is the need of time. The fruit based agroforestry systems have potential in generating income, employment, soil improvement, higher production and waste land reclamation.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post Graduate Seminar Series 2019-20

P.G. Student	: Velamala Sravani	Course	: VSC 692 (1+0)
Reg. No.	: 1020217013	Date	: 05-10-2019
Major Guide	: Dr. S. N. Saravaiya	Time	: 9.00-10.00 a.m.
Co-Guide	: Dr. B. N. Patel	Venue	: Swami Vivekananda Hall

Effect of climate change on major tropical and sub tropical fruit crops

The climate of earth, although relatively stable for the past 10,000 years or so, has always been changing, mainly due to natural cause such as volcanic activity. But since the 1900s more rapid changes have taken place and these are thought to be mainly man-made. Climate change refers to a change in the state of the climate that can be identified by changes in the mean and variability of its properties and that persist for an extended period, typically decades (Anonymous, 2007). Climate change is becoming an observed reality, very likely due to the increase of anthropogenic greenhouse gas concentration. Since a few decades, several research teams around the world carried out a huge work to model the future climatic change during the 21st century, based on several scenarios of greenhouse gas emission (Meehl *et al.*, 2007). We have to expect rise in average temperatures, atmospheric CO_2 concentration, soil salinity in some areas and receiving erratic rainfall. The climate variability and the frequency of extreme events like scorching heat, heavy rainfall, drought, hurricane are also expected to rise.

Review of Research Work

Mango (*Mangifera indica* L., Family: Anacardiaceae)

Shu (1999) conducted an experiment to study the effect of temperature on flowering biology and fertilization of mangoes of four cultivars Haden, Irwin, Keitt and Local. Warm temperature (31 ^{0}C/25 ^{0}C) hastened growth rate of panicles and flowers, shortened flowering duration and life span of individual flower as compared to 25 ^{0}C/ 19 ^{0}C. It also decreased number of hermaphrodite and male flowers. But warm temperature increased the rates and percentages of anther dehiscence and fertilization.

Parmar *et al.* (2012) reported that temperature below 17 ^{0}C was considered optimum for flower induction, night temperature more than 17 ^{0}C prevailing during flower induction period in December seems to have detrimental effect leading to poor flowering and ultimately affecting crop yiled in mango.

Kumar *et al.* (2014) studied the correlation between weather and yield attributes of mango. They revealed that maximum temperature (32 ^{0}C), minimum temperature (20.3 ^{0}C), relative humidity (84.50%) and rainfall (130.00 mm) had highly significant and positive correlation with all flowering and fruiting parameters of both main and off season in Kanyakumari location.

Normand *et al.* (2015) assessed climate change and its probable effects on mango production and cultivation. They predicted climate for the end of the 21st century, with respect to mean climate of last 20 years of the 20th century was warmer and wetter in South Asia conditions and drier and moderately warmer in Carribbean islands probably lead to lower floral induction.

Geetha *et al.* (2016) studied varietal variations in temperature responses for hermaphrodite flower production and fruit set in mango. They reported that Langra and Amrapalli varieties showed higher proportion of hermaphrodite flowers. Fruit set was recorded highest during the month of March followed by February and was lowest in January, eventhough the hermaphrodite flower proportion was lowest in February indicating that the fruit set was influenced by both sex ratio as well as the temperature during flower anthesis.

Banana (*Musa paradisiaca* L., Family: Musaceae)

Patil *et al.* (2015) assessed growth, variability in weather parameter, correlation in area, production and productivity of fruit crops. They reported that CGR was significant in case of productivity of banana and mango. There was negatively correlated in case of rainfall and minimum temperature with area, production and productivity. The positive correlation between production and maximum temperature with banana as well as mango and negative correlation with grape was noticed.

Badgujar (2016) did correlation study on weather and growth parameters in banana. The study indicated that the rainfall, relative humidity and wind velocity had positive correlation with the bunch weight but negative correlation with temperature, evaporation and sunshine hours in banana.

Salau *et al.* (2016) suggested that excessive rainfall and extremely high temperature reduced banana productivity, while production was less when rainfall and temperature were very low with poor humidity. The mean temperature of about 26 ^{0}C and average rainfall around 1891 mm with relative humidity of 77 % was lead to good annual banana production above 61,000 tonne in Ondo state, Nigeria.

Swati *et al.* (2019) revealed that production and productivity of 4 major fruits (banana, mango, sapota and papaya) had moderate negative correlation with mean annual temperature *i.e.* > - 50 percent except the productivity of banana whereas, it showed negative and non-significant correlation with total annual rainfall.

Pomegranate (*Punica granatum* L., Family: Punicaceae)

Hanim and Yildiz (2009) examined the change of proline content in pomegranate cultivars namely Hicaz, Oguzeli and Devedisi in year 2007 and 2008. In year 2007, proline content of three cultivars were 30 mg l^{-1} while it was 93 mg l^{-1} in year 2008, indicating that climatic change affects proline accumulation in pomegranate fruits. In hot and dry areas, proline accumulation in fruits were increased.

Borochev *et al.* (2011) reported that anthocyanin accumulation change was inversely proportional to season's temperature. Total anthocyanin content was higher in winter fruit compared to summer fruit. Fruit that ripened in early summer and during the winter were significantly smaller than late summer and autumn. Early summer fruit contained higher juice content and TA whereas, mid winter fruit contained highest level of total phenolics.

Pineapple (*Ananas comosus* L., Family: Bromeliaceae)

Williams *et al.* (2017) analyzed correlation studies on pineapple production in Ghana. The results showed that minimum temperature during all growth stages had significant correlation with pineapple yield in Nsawam and Gomoa districts. Maximum temperature had significant correlation with vegetative, flowering stage and yield for Akatsi and Gomoa districts.

Litchi (*Litchi chinensis* L., Sapindaceae)

Menzel and Simpson (1991) reported that high temperature increased the number of male flowers in as well as, decline in the proportion of female flowers in Tai So and Bengal cultivars of litchi. In cultivars, Kwai May Pink and Wai Chee, the proportion of female flowers was reduced only at 30/25 ^{0}C.

Sapota (*Manilkara achras* (Mill.) Fosberg, Family: Sapotaceae)

Arun and Azeez (2004) conducted an experiment on declining yield in sapota in Dahanu areas of Maharashtra. They reported that the orchards have experienced around 50 % reduction in their annual yields during the past five years due to climate change.

Conclusions

From the foregoing discussion, it is concluded that warm temperature increased the rate and percentages of anther dehiscence and fertilization in mango compared to cool temperatures. Night temperature more than 17 ^{0}C during flower induction period in December showed detrimental effect leading to poor flowering and ultimately affecting the crop yield in mango. Temperature, humidity and rainfall showed significant and positive correlation with all flowering and fruiting parameters of main and off season mango in Kanyakumari. Fruit set percent was greater during the month of March followed by

February in mango. The rainfall, relative humidity and wind velocity had positive correlation with the bunch weight in banana but negative correlation with temperature, evaporation and sunshine hours. The positive correlation was noticed between production and maximum temperature banana and mango and negatively correlated with grape. The production and productivity banana, mango, sapota and papaya has negative correlation with mean annual temperature *i.e.* > 50 percent except productivity of banana whereas, non significant and negative correlation with annual rainfall. Proline accumulation increases with increasing temperature in pomegranate. Anthocyanin content was higher in winter fruit as compared to summer fruit in pomegranate. The maximum and minimum temperature had significant correlation with yield and flowering in pineapple production in Ghana districts. High temperature increased the number of male flowers as well as decrease of female flowers in Tai So and Bengal cultivars in litchi. There was a 50 percent reduction in annual yield of sapota during the last 5 years in Dahanu areas due to climate change.

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NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI, GUJARAT
ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
POST GRADUATE SEMINAR SERIES: 2020-21

Speaker	Patel Hardikkumar S.	**Course**	VSC 692 (1+0)
Reg. No.	1020218010	**Date**	06/11/2020
Major Guide	Dr. N. B. Patel	**Time**	9.00 to 10.00 AM.
Minor Guide	Dr. S. L. Chawla	**Mode of presentation**	Online

Advances in soilless cultivation of flower crops

Soilless culture system has been used widely in protected cultivation to improve the growing environment, provide optimal water and nutrient supply for cultivated crops. Soilless culture can potentially improve cropping systems by optimizing the use of inputs (nutrient, pesticides and water), controlling diseases more efficiently and make it possible to increase crop production regardless of the climatic conditions. Soil is the natural growing media for cultivation of majority crops in the world. However, it has few problems such as soil born diseases, undesirable microbial activities, nematodes, changing acidity levels, salinity, poor drainage, poor nutrient levels and undesirable soil characters (Dayananda and Kadhim., 2014). To overcome these problems, soilless cultivation system emerged as a better alternative. It is a technology for growing plants in nutrient solutions (water and fertilizers) with or without the use of an artificial holding medium like cocopeat, sand, gravel, vermiculite, rock wool, peat moss and saw dust for mechanical support. A variety of flower crops *viz*., rose, gerbera, anthurium, gypsophila, tulip, orchid and gladiolus can be grown by using soilless media.

Review of research work

Rose

Hazarika (2009) studied the effect of potting media of rose cv. Naranga grown under green house condition. Significantly higher plant height (67.40 cm), shoot lenght (25.37 cm), stalk lenght (cm), no. of leaves per stalk and diameter of flower (cm) were recorded with treatment of cocopeat + leaf mould (1:1).

Das *et al.* (2012) studied three commercial cultivars of rose grown successfully in a low cost device of hydroponics for 165 days. They found that number of shoot branches and length of the shoot branches per plant were higher in the cv. Calcutta than the other two cultivars. Whereas, the plant height and plant weight of the cultivar Tajmahal increased significantly higher than other two cultivars during the entire period of study.

Gerbera

Sindhu *et al.* (2010) revealed the effect of different amendments in gerbera under greenhouse condition using available materials *viz*., soil, farm yard manure (FYM), vermicompost, *samridhi* (a soil conditioner) and sawdust. They found that cocopeat : vermiculite : perlite (4:1:1) significantly increased number of leaves (9.07) at appearance of first flower, fresh weight (107.14 g plant^{-1}) and dry weight (27.21 g plant^{-1}), CVP + *Samridhi* (8:1) was best with respect to total no. of leaves plant^{-1} (31.1).

Khalaj *et al.* (2011) studied different growing media on the growth and yield of gerbera and found that perlite + peat + expanded clay mix (25% + 70% + 5%) produced significantly maximum number of flowers (10.33) plant^{-1}, flower disc diameter (12.4 cm), flower height (54.5 cm plant^{-1}) and stem diameter (0.79 cm) among different media.

Anthurium

Tatte *et al.* (2016) conducted an experiment on the effect of various growing media and foliar spray of primary nutrients on anthurium var. Tropical under fan and pad type greenhouse. Coconut husk + charcoal (3:1) as a growing media significantly improved all the vegetative and flowering parameters.

Weekly foliar spray of 30:10:10 (NPK) @ 0.2 % recorded maximum plant height, number of leaves, leaf petiole and plant spread. Whereas, early flower bud emergence, early unfurling of spathe and maximum stalk length, stalk diameter, spathe length, spathe width and flower yield was recorded in plants sprayed with 12:61:40 (NPK).

Chandrappa (2016) conducted experiment on influence of growing media on flower charecteristics in anthurium var. Lady Jane. Coir pith as a growing media significantly improved the vegetative parameters like stalk length (35.62 cm) and spathe size (0.43 cm^2).

Gladiolus

Nosir (2011) studied the effect of commercial fertilizers nutrient film technique on flowering characters of gladiolus corms. Maximum spike length (102 cm), spike fresh weight (42.35 g $plant^{-1}$), spike dry weight (5.79 g $plant^{-1}$) was recorded in Nutrafin fertilizer whereas maximum number of florets $spike^{-1}$ (13.52) in singral solution NFT of hydroponics.

Tulip

Lee and Suh (2005) revealed the effect of nutrient solution composition on growth and flowering in hydroponically-grown in 'Ile de France' and 'Golden Apperdoorn' tulip. They found minimum days to flowering (38.3), minimum length of internode (6.2 cm) and minimum days to flower (41.3 days) with minimum length of internode (18.2 cm) in nutrient solution composition of 17.9 : 3.9 (N:K meq l^{-1}) with respective varieties. In 'Ile de France', the maximum stem length (33.7 cm $plant^{-1}$) was found in 12.1:5.1 solution composition whereas, maximum stem length (37.1 cm $plant^{-1}$). Internode diameter and tepal length was found non significant in both varieties.

Gypsophila

Paul *et al.* (2011) studied effect of different hydroponics systems and growing media on the growth and yield of gypsophila. They observed that maximum number of shoots $plant^{-1}$ (14.4) and number of branches $flower^{-1}$ (36.1) in bag culture along with vermiculite treatment whereas maximum cut flower stem length (67.0 cm) in bag culture along with sawdust.

Orchid

Muna *et al.* (2016) studied the different media combination for hardening of Orchid *Dendrobium* cv. Sonia 17. They found that cocopeat along with 2 pieces of cocohusk media combination was beneficial regarding plant growth and survival.

Hsu and Lin (2011) studied the effect of cultural medium and hydroponic culture on growth and flower quality of *Oncidium*. They found maximum total soluble solids, starch content and maximum root activity in rock wool media in hydroponic system.

CONCLUSION

From the forgoing discussion in roses for better growth and quality flower production, cocopeat + leaf mould (1:1) should be used as a media while, under the hydroponics system cv. Calcutta or Tajmahal should be preferred. Gerbera grown on cocopeat : vermiculite : perlite (4:1:1) or perlite + peat + expanded clay mix (25% + 70% + 5%) should be used as a media for better growth, quality and flower yield under green house condition. Coconut husk + charcoal (3:1) or coir pith as a growing media and weekly foliar application of 12:61:40 (NPK) @ 0.2 % was best for superior growth and quality spathe production in anthurium. Under nutrient film technique of hydroponics in gladiolus, commercial grade Nutrafin or singral fertilizers gave best quality gladiolus spikes and yield. Tulip cv. 'Ile de France' and 'Golden Apperdoorn' produces best quality flowers when supplied with the nutrient solution composition of 17.9 : 3.9 (N:K meq/l). Hydroponics systems in bag culture along with vermiculite or sawdust as a growing media was suggested for superior growth and yield of gypsophila. For hardening of *Dendrobium* Orchid cv. Sonia 17 cocopeat along with 3 pieces of coconut husk media combination was beneficial for better plant growth and survival. A rock wool media in hydroponic system for superior growth and flower quality of *Oncidium*.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2020-2021

Speaker : **Jayanth S.**	**Course** : VSC 692 (1+0)
Reg. No. : 1 0 2 0 2 1 8005	**Date** : 30/01/2021
Major Guide : Dr. D. R. Bhanderi	**Time** : 16:30 to 17:30 hrs
Minor Guide : D r. S. L. Chawla	**Mode** : Online

DOUBLE HAPLOIDS IN BREEDING OF FLOWER CROPS

Haploid plants can be produced either spontaneously in nature or by *in vitro* or *in vivo* induction techniques and further by doubling chromosome number of haploids either spontaneously or artificially, double haploids (DH) could be produced (Thaneshwari *et al*., 2018). In general, the genetic upgradation of crops through conventional breeding approaches require longer time. Using DH production system, homozygosity is achieved in one generation, eliminating the need for several generations of self-pollination. DH lines can be used as a new variety (self-pollinated crop) or used as inbred lines to produce hybrids (cross pollinated crops), fixation of heterosis, recovery of recessive mutants, cytological and evolutionary studies, genome mapping, *etc*.

Currently, constant research is being made on establishment of protocols to produce DH in various species. However, this technique has a significant impact on the improvement program of several floricultural crops like anemone, anthurium, calla lily, chrysanthemum, carnation, narcissus, gerbera, iris, marigold, lily, phlox, *etc*.

Brief review of research work

Anemone

Copetta *et al*. (2018) studied the effect of thermal shock in the development of androgenic plants of anemone and observed that the treatment of anthers at 33°C for 5 days increased the percentage of reactive anthers and regenerants as compared to thermal shock at 5°C for 5 days.

Anthurium

Winarto *et al*. (2010) tested different methods to assess the ploidy level of anthurium anther cultures to find the most reliable and convenient method. They noted that counting of chloroplast number in stomatal guard cells was the most convenient and reliable indirect method to determine ploidy level as it was highly correlated with anthurium ploidy level.

Calla lily

Zhang *et al.* (2011) studied the effect of various parameters on callus induction in anther culture of calla lily. The results showed that the frequency of anthers producing calli increased with increase in concentration of sucrose from 4 to 8 per cent. The anthers collected from winter season gave the best response (5.1%). Media containing 1.0 mg/l BA along with 0.1 mg/l NAA gave the highest frequency of shoot producing calli.

Carnation

Dolcet *et al.* (2001) summarized the protocol to produce double haploid lines and incorporate them in a breeding program for resistance to *F. oxysporum*. Only 3 out of 24 double haploid lines had more than 20 descendants. The progeny of these 3 double haploid lines (D220, D504 and D524) pollinated with ‘Persa’ were evaluated and found to be homozygous for the three genes involved in resistance.

Chinese narcissus

Chen *et al*. (2005) conducted an experiment to study efficient callus induction and plant regeneration from anthers of Chinese narcissus. They observed that the highest callus induction efficiency occurred with anthers cultured at early to mid-uninucleate microspore stage on the medium supplemented with 1 mg/l 2,4-D and 0.5 mg/l BA. The profiles of amplified RAPD markers showed that the donor plants and regenerated plants had identical banding patterns.

Chrysanthemum

Gao *et al.* (2010) conducted a study on the production of haploid chrysanthemum plants for a breeding program by using anther culture. Significant differences were observed for various morphological traits among regenerated haploid plants and the pollen donor plants. They also suggested that counting of chloroplasts could be an efficient alternative to determine the ploidy of regenerated plants in early stage.

Khandakar *et al*. (2014) investigated the effect of media and cold pre-treatments on anther culture of Chrysanthemum cv. 'Yes Morning'. They noted that the highest callus and shoot induction rate was observed with anthers pre-treated at 40C for 48 hours and later cultured on basal MS media supplemented with 2mg/l BA, 0.1mg/l NAA, 45 g/l sucrose and 250 mg/l casein hydrolysate.

Gerbera

Miyoshi and Asakura (1996) investigated the gynogenetic formation of plants from unpollinated ovules in gerbera. Among 17 genotypes tested, the highest frequency (17.5%) was observed with genotype '0-8M-A'on medium that contained 0.1 mg/l IAA and 0.2 mg/l BA. Ploidy determined by flow cytometry recorded that 80.4% regenerants were haploid, 15.2% were diploid, and 4.3% were mixoploid.

Iris

Grouh *et al*. (2015) studied the effect of irradiation dose on haploid induction using *I. spuria* as a pollen donor and *I. pseudacorus* as a female parent. They reported that irradiation dose of 100 and 200 Gy was insufficient to cause pollen sterility thereby producing diploids. Hence, the best dose for haploid production in *I. pseudacorus* was found to be 300 or 400 Gy of X-ray.

Lilum

Niimi *et al*. (2001) investigated the production of virus-free plantlets by anther culture of *Lilium*×'Enchantment'. They observed that the anthers of greenhouse grown plants (collected in March) with/without cold pretreatment had a significantly higher capability to regenerate. Also, 41% of plants regenerated were completely free from LSV, CMV and/or TBV.

Han and Niimi (2004) observed the ploidy level variation in maintained anther-derived callus lines of *Lilium formosanum.* They reported that T1 and T3 lines generally remained at the haploid level, the T2 and T4 lines mostly changed into diploid, and the T5 line was mixoploid. Further, they concluded that the plantlets of haploid, diploid and mixoploid consisting of haploid and triploid cells could be regenerated from these callus lines maintained for long term.

Marigold

Kumar *et al*. (2019) reported the *in-vitro* androgenic response in different African and French marigold cultivars. The results depicted that direct shoot bud induction was significantly higher in French marigold (Pusan Arpita) as compared to the African marigold lines. The cold treatment of 40C for 10 days recorded the highest direct differentiation of shoot buds in cv. Pusa Arpita.

Phlox

Anupama *et al*. (2008) developed an efficient protocol for *in vitro* production of androgenic haploids of phlox and found that anther-derived callus showed the greatest shoot differentiation at 13 weeks after culture initiation which was maintained on MS medium supplemented with 9% sucrose.

Conclusion

From the foregoing discussion, it can be concluded that DH is an efficient tool to produce homozygous lines in a single step and can also be used in genetic and cytological studies. In anemone, heat shock treatment (330C) for 5 days increases the number and survival of embryos. In anthurium, counting chloroplast number is the most convenient and reliable indirect method to determine ploidy level in regenerants. In cally lily, high concentration of sucrose, inflorescence from winter, high temperature stress (320C) for 2 days and 1.0 mg/l BA along with 0.1 mg/l NAA gives the highest frequency of shoot producing calli. DH lines from standard carnation clones resistant to *F. oxysporum* could be used to accelerate breeding for new resistant varieties. In Chinese narcissus, anther colour and length are good indicators to select appropriate anther stage for explants. In chrysanthemum, counting of chloroplasts could be a valid alternative to determine ploidy level and also cold pre-treatment and media composition greatly influence the callus induction rate. In gerbera, genotypic variation is found in the ovules forming callus and analysis of flow cytometry confirms haploidy in regenerants. In iris, the best dose for haploid production is found to be 300-400 Gy of X-ray. In *Lilium* × 'Enchantment', anthers from green house plants has higher capability to form callus and anther culture could be an alternative to obtain virus free plants. In *Lilium formosanum,* anther derived callus can be maintained at haploid level for long term and spontaneous ploidy variation may occur during subculture. In marigold, higher shoot bud differentiation can be observed in French marigold as compared to African marigold. In phlox, age of anther derived calli and sucrose concentration in medium influences induction and development of haploids.

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POST GRADUATE SEMINAR SERIES: 2015-2016

Speaker	**:**	**Kapadiya Dhruv B. (1020214009)**	**Course**	**:**	**FLA – 691**
Major Guide	**:**	**Dr. (Mrs.) Alka Singh**	**Date**	**:**	**21st May 2016**
Co-Guide	**:**	**Dr. T.R. Ahlawat**	**Time**	**:**	**09.00 to 10.00 Hrs.**

GENOMICS – EXPLORING GENOME HORIZONS IN FLORICULTURE

Life as we all know it is specified by the genomes of the myriad organisms with which we share the planet. Every organism possesses a genome that contains the biological information needed to construct and maintain a living example of that organism. The field of plant genomics can provide both the genetic knowledge and new tools for plant breeders to improve their breeding methods and to develop better breeding germplasm and advantageous cultivars. Genome biology provides a scientific framework that helps to analyze entire DNA sequence of an organism in the context of fine scale genetic mapping and functional interaction network among the genes and genetic entities. Now-a-day genomics discoveries provides a new set of tools and techniques *viz.* structural, functional and comparative genomics that lead to greater understanding of genetic knowledge and biological systems (Brown, 2003).

Brief Review of Research Work

Structural Genomics

Kim *et al.* (2014) elucidated the genome structure and composition of rice variety 'Tongil' by SEG-Map analysis. The whole genome of 'Tongil' consisted of 91.8 % contribution from *indica* and 7.9 % contribution from *japonica* while remaining 0.3 % was unknown.

Functional Genomics

Shahin *et al.* (2012) made assemblies for gene annotation for the representation of Gene Ontology (GO). GO assignments of Lily-All and Tulip-All contigs were divided into: 42 % & 19 % in molecular function; 31 % & 42 % in biological process and 27 % & 39 % in cellular components contigs, respectively.

Su *et al.* (2013) constructed and expanded Orchidstra database for studies on complex genomic information by functional and comparative genomics. Total 3,81,918 non-redundant TSAs of contigs > 200 bp were stored in Orchidstra database and divided into 1,14,933 protein-coding and 2,66,985 non-coding TSAs from various tissues of five species and one hybrid. They also plotted Venn diagram for comparing homologous TSA sequence. Homologs make up commonly shared among *P. aphrodite*, *E. pusilla* and *Oncidium* Gower Ramsey (2,496 Arabidopsis and 2,422 for rice homologs) approximately 20% of the total coding TSAs.

Comparative Genomics

Debener and Linde (2009) compared the diploid genotypes of *Rosa* with other Rosaceae model species. Genome size of *Rosa* is relatively smaller compared to *Malus x domestica* but larger than *Fragaria vesca*. The availability of linkage maps with low juvenile period facilitated genetic analysis among Rosaceae family.

Gar *et al.* (2011) constructed the linkage map of rose using the genome sequence of strawberry. They prepared linear order to compare common markers of two different genotypes of rose *viz.* 'Golden Gate and 'Fragrant Cloud' and constructed the linkage map of chromosome number five and seven. They observed that more than 95 % of these markers appeared in the same linkage group in both genotypes indicated the similarities of gene number as well as gene sequences in both the parents.

Conting sequences of the lily and tulip genotypes were translated using ESTscan2 to compare with rice proteins using OrthoMCL and represented by Venn diagram. A total of 10,110 of rice, 15,751 of lily and 16,585 of tulip orthologous groups were generated. Overall, 6,900 (31 %) orthologous groups were contained common sequences from all three monocot species. Moreover, lily and rice specific groups (817); tulip & rice specific groups (489) and lily & tulip specific groups (5,117) were identified by Shahin *et al.* (2012).

Genetic Mapping

Yagi (2015) constructed the genome map of carnation using 178 SSR markers in 16 LGs covering 843.6 cM. Comparative analysis of CBW resistance loci between LG 85P_4 (*Cbw4*) and LG NP_4 (*Cbw1*) using SSR markers revealed nearly identical positions in both LGs. STS-WG44, which has been tightly linked to *Cbw1* using (STS) markers was mapped onto LG 85P_4. He also identified QTL governing anthocyanin content in flower petals: carnation anthocyanin pigmentation loci *Cap1* on LGs NP_4. *Cbw1* was located on the same LG as *Cap1*, at a distance of 15.4 cM. In another genetic maps he located D_{85} locus for flower type (double or single) on LG 85P_15-2 and identified four co-segregating SSR markers. Among the four markers, CES1982 and CES0212 were tightly linked to the D_{85} locus.

Marker

Gar *et al.* (2011) screened the sequence-characterized markers (RFLP and CAPS) using AFLP, SSR and morphological markers to increase marker density. They analyzed total 449 polymorphic markers in GGFC population. Among them 86 AFLP and 86 CAPS markers shows simplex (1:1) heterozygosity in single parent, whereas 36 CAPS markers segregated as duplex (1:5) ratio. In FC population 4 phenotypic qualitative traits were identified. They also observed 28 AFLP, 6 RFLP, 9 SSR and 3 CAPS double simplex heterozygosity (1:3) in both the parents. Moreover, total 55 codominant markers were identified in GGFC population.

Shahin *et al.* (2012) developed SNP markers and SSRs from the mapping population in lily ('Connecticut King' and 'White Fox') and tulip ('Cantata' and 'Kees Nelis') from the orthologous groups. As a result, 'Connecticut King' was found to have 30 and 38 common SNP markers; 65 and 116 common SSRs in common with 'Kees Nelis' and 'Cantata', respectively. Similarly, 'White Fox' has 22 and 23 common SNP markers; 55 and 56 common SSRs with 'Kees Nelis' and 'Cantata', respectively.

FISH

Zhang *et al.* (2005) examined the heterochromatin region of three bivalent chromosomes of *Antirrhinum majus* using FISH. They detected the FISH signals from 36D21 clone at the poleward positions on the bivalent chromosome. They also detected the strongest FISH signals which contains centromeric sequences using BAC 5E10 clone from the three bivalent chromosomes. They isolated two tandem repetitive sequences (CentA1 and CentA2) from the 36D21 and 5E10 clones, respectively. A standard karyotype established by anchoring this centromeric repeats on meiotic pachytene chromosome by using FISH.

The FISH analysis using rRNA genes and TAC clones was performed by Sato *et al.* (2008). They stained mitotic prometaphase chromosome and meiotic pachytene chromosomes with DAPI. TAC clone (LjT30P03) was detected on the long arm of chromosome 5 and 45S rDNA was detected on the short arms of chromosomes 2, 5 and 6. Further, they confirmed the positions of centromeres by FISH analysis using the pericentromere-specific retroelement LjRE2 as a probe. TAC clones (LjRE1) were located on the telomeric regions of all the chromosomes with the exception of the bottom of chromosome 4 and the top of chromosome 6.

EST

Shahin *et al.* (2012) successfully developed the first set of 81,791 contigs with an average length of 514 bp for tulip, and enriched the very limited number of 3,329 available ESTs (Expressed Sequence Tags) for lily with 52,172 contigs with an average length of 555 bp.

Whole-genome shotgun sequencing

Whole-genome shotgun sequencing of the cv. 'Francesco' was performed to understand the genetic system of carnation by Yagi *et al.* (2014). The total length of the non-redundant sequences was 56,88,87,315 bp, consisting of 45,088 scaffolds, which covered 91% of the 622 Mb carnation genome estimated by k-mer analysis. The N50 values of contigs and scaffolds were 16,644 bp and 60,737 bp, respectively and the longest scaffold was 1,287 bp. The average GC content of the contig sequences was 36%.

Next Generation Sequencing (NGS) / High Throughput Sequencing

Su *et al.* (2011) integrated sequence output of moth orchids from two NGS platform technologies, Roche 454 and Illumina/Solexa. They assembled 88.7% of the 42,590 annotated genes and 43.7 % of the 1,91,233 non-annotated genes by sequences derived from both Roche 454 and Solexa platforms. De novo assembly of the remaining Solexa reads contributed to 11.1% of the contigs and 55.9 %, whereas contigs identified solely by Roche 454 reads were only 0.2% and 0.4 % respectively, with annotated and non-annotated genes.

Bartoszewski and Malepszy (2012) revealed that Illumina is the most popular sequencing platform used with less error rate and minimum cost per 1 Mb (US$) as compared to Sanger, Roche 454 + GS FLX or SOLiD^{TM}. Third-generation sequencing platforms such as single-molecule real-time DNA sequencing or SMRT (*e.g.*, PacBio HRS and Ion Torrent) are emerging platforms, which will make genome sequencing even more precise and less costly.

Conclusions

Genomic discoveries are shedding new light on the dynamics, complexity and evaluation of plant genomes, leading to greater understanding of how plant biological system works. Structural genomics determine the origins of specific genome segments of species which is applicable to structural genomes. Functional genomics ultimately integrates the molecular function, biological process and cellular compound involved in various developmental process of organisms. Exchanging genetic information between two related species by linking their genetic maps would be of great interest. Identification of polymorphisms in orthologous sequence that allow marker development in different species provides a set of common genetic loci for comparative mapping, which may improve our understanding of the evolutionary history (gene duplication, conversion and rearrangement) of the crops. The advent of NGS technologies has made whole genome shotgun sequencing affordable and accessible for biological research. EST represents an efficient method of genome sequencing yielding information of the most expressed parts of the genes at a lower cost. However, implementation of genomic knowledge and tools into the different areas is still limited and challenging, so there is strong need to push the development of plant genomics for the benefit of plant breeding.

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NAVSARI AGRICULTURAL UNIVERSITY
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NAVSARI POST-GRADUATE SEMINAR SERIES: 2015-2016

Speaker	: Mr S.K.Chavan	Course : FLA-691 (1+0)
Reg. NO	: 1020214004	Date : 21-05-2016
Major Guide	: Dr. Alka Singh	Time : 3.00 P.M. to 4:00 P.M.
Minor Guide	: Dr. T.R.Ahlawat	Venue: Swami Vivekananda Hall.

Genetic Improvement of Potted Ornamentals

Floriculture is most important commercial segment of Agriculture. Now this industry is saturatedwith cut flowers, which needs diversification. Potted ornamentals are becoming sustainable alternative for diversification. Demand for potplants isincreasing for architectural aesthetics,pleasant environment and positive psychosomatic effects. Kalanchoe, Petunia, Geranium, Poinsettiaare the important pot plants of global as well as domestic commerce of floriculture. World flora market is estimated to the tune of USD25billion, out of whichpot plant contributes for USD10 billion(Anonymous,2016). Indian export share inglobal flora market is only 455crore(Anonymous, 2014). Environmental conditions and low cost of production are the strength of Indian Territoryfor production and export of pot plants.

Ample genetic resources are available for breeding of pot plants for newer flower colours and various traits. Breeding of new varieties which will cater the demand of world as well as local markets is the need of time. Systematic efforts are required to breed new varieties.

BRIEF REVIEW OF RESEARCH WORK:

Chen *et al.*(1998) studied morphological and genetic variations in somaclones of Phalaneopsis orchid cv.'True Lady b 79-19'.RAPD and Isozyme analysisindicated that normal and variant somaclones were not genetically identical. With respect toisozymeAAT,three distinct banding patterns were found in normal somaclonesand only two banded phenotypes were detected in varying somaclones.

Endo *et al.*(2004)observed large extent of variationin aneuploidyplants(2n=44, 45 and 46)of segregating progeniesof chrysanthemum,derived from crossbetween'YS xMibuvase' and 'YS xArmorikii'.Average inflorescence diameter was higher(5.6 cm) in plants from cross ‘YS xKimorikii’, while lowest flower diameter and highest pollen fertility was observed in plants derived fromcross'YS Polyploid xYuzawagiku'*i.e*2.00 cm and 87.40 % respectively.

Hennyet al. (2006) bred hybrid of Dieffenbachia named ‘Sterling’ through crossing two heterozygous varieties namely ‘Tropic Marine’ and ‘Victory’. New cultivar ‘Sterling’ was patented in USA wide patent no.14762.

Kudo *et al*. (2008) developed interspecific hybrid of hydrangea by crossing*H. scandens*ssp. chinensis and *H. macrophylla* followed by ovule culture. The hybridity was confirmed by RAPD analysis. The hybrid plant had flower and leaf morphologies intermediate between the two parental species. The hybrid showed more vigorous growth than both parents with evergreen foliage and was flowered in winter.

Ashwath*et al.*(2009) developed two hybrids of Crrosandranamely IIHR2005-1 and IIHR2005-2. Hybrid IIHR 2005-01 recorded maximumflower diameter (1.30 cm) andstalk length (4.16 cm). IIHR 2005-02 yielded maximum flowers (325.1 flowers/100 g.) over rest of theexperimentalgenotypes.

Jadrená *et al*. (2009) studied induction of polyploidy in the black leaved cultivar of *Pelargonium hortorum*‘Black Velvet Scarlet F1’. Tetraploidy was induced in seedlings in the cotyledon stage using various concentrations (from 0.1 to 2.5%) of aqueous solution of colchicine. The treatments were repeated daily for 2, 3, 5 and 7 successive days.17.4% of treated‘Black Velvet Scarlet F1’ plants and 23.7% of treated ‘Gizela F1’ plants (control) were tetraploid. Other ploidy levels were also detected as a result of colchicine treatment.

Lee *et al.*(2009) bred new poinsettia cultivar 'Noel' by crossing cv. ‘GutbierV-10 Amy' and cv. 'Ichiban. 'Noel' had smooth waving red elliptic bracts. Leaf blades were dark green and ovate. Developed cultivar recorded high plant height, bract length, bract width and petiole length *i.e*39.8cm, 11.4cm, 5.7cm and 7.0 cm,respectively over commercial check ‘Red Velvet’.

Winarto*etal.*(2011) formulated aprotocol for callus inductionand plant regeneration fromanther culture of*Anthurium andreanum* cv. Tropical. Winarto and Teixeira-1an original basal medium containing 0.01 mg/1 NAA, 0.5 mg/l Thidiazuron and 1.0 mg/1 BAPwas foundto besuitable for callus formation while,New Winarto-Teixeira-3 supplemented with 0.25 mg/1 2-4-D(2-4-Dichlorophenoxy Acetic Acid),0.02 mg/1 NAA, 1.5 mg/1 Thidiazuron and 0.75 mg/1BAPwas foundto besuitable for callus formation from the tissues of anthers.

Hassan et al. (2012) in petunia breeding programme observed highest positive values of heterosis in hybrid combination of Line 5 and Line 2 over its parental mean (37.3 %) and to the better parent (33.9 %).

Chin (2012) identified a double flowered periwinkle *Catharanthus roseus*mutant ‘TYV1’ and the morphology and inheritance of the double-flowered phenotype were studied. Self-pollinated ‘TYV1’ produced all double-flowered progeny compared with self-pollinated single-floweredcultivars ‘Little Pinkie’ and ‘Titan Burgundy’. F1 plants between ‘TYV1’ and ‘Little Pinkie’ or ‘Titan Burgundy’ were all single. Three F2 populations segregated into 3 single: 1 double ratio. Backcrossing F1 to seed parents also indicated that a double flowered form was controlled by a recessive allele.

Jung *et al.*(2012) developeda new cultivar of pot chrysanthemum ‘MySong' .It had single type flowers with purple petals. The diameter of flower was 24.4 mm. Numbers of flowers per stem and petals per flower were 49.8 and 23.5, respectively. It’s leaf color was green (Green Group 137B) and plant height was 13.8cm.

Verma *et al*. (2012) studied isolation of solid mutants through petal regenerated callus of chrysanthemum. Maximum survival of cultures were found when the ray florets were pre-treated with Mancozeb (0.2%) + Carbendazim (0.2%) + 8-HQC (200 mg/l) for 3 h followed by surface sterilization with Mercury chloride(0.1%) for a duration of four minutes. The callus induction was maximum on MSmedium supplemented with BAP (4.0 mg/l) and NAA (1.0 mg/l). The maximum regeneration of micro shoots (95.56%) from the ray floret induced callus was recorded on MS medium fortified with BAP (4.0 mg/l) and NAA (0.1 mg/l). The isolated mutant produced flowers that were true to type to the original red mutant.

Razdan*etal.*(2014) developed triploid plants of ornamental *Phloxdrummondii* through callus culture ofendosperm. Five weekold callus sub cultured onMS medium with 10 uM BAP + 2.5 uM IAA, gave maximum percentage of green nodular shoot buds. Shoot elongation occurred on medium supplemented withlow concentration of IAA (0.5 uM) in presence of 10 uM BAP.

Wang *et al*.(2014) developed haploids and doubled haploids in chrysanthemum through ovule culture. They observed distinct changes in the morphology and anatomy of haploids,dihaploids and heterozygote. Inbredline was developed in one generation through ovule culture followed by doubling of chromosomes.Stomatalength of heterozygote, haploid and doubled haploid was 43.71, 33.60 and 38.90 micrometre,respectively.

Ha *et al.*(2015) developed hybrid hibiscuscultivar 'Daewangchun', withvigorous growth, uniform plant habit, upright, compact branchesand a long red eyethrough interspecific crosses between *H.syriacus*'Samchully' and *H. sinosyriacus*'Seobong' **.** Hybridhad violet pink flowers (RHS N80C) with a long red eye spot, medium size and fan petals. The size of flower was 12.0 cm and size of the red eye was 3.0 cm. Leaves were 8.7 cm long and 4.7 cm wide.

CONCLUSION: Conventional as well as modern approaches of plant breeding holds immense scope for crop improvement of ornamental plants.Useof embryo, ovuleand anther is of paramount importance for interspecific hybridization, triploiddevelopment and reducingtime ofbreeding cycle. Clonal multiplication by advanced techniques isvery much useful to fix heterosis and various traits of horticultural merit. Development of inbred lines is at all not necessary to render the breeding programme, which otherwise are important in vegetable and field crops. Marker assisted breeding helps to preserve identity of newly bred varieties, whichis useful in IPR regime.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post Graduate Seminar Series: 2017-18

Speaker	**: Patel Henaxiben Babubhai**	**Course**	**: FLA 691**
Reg. No.	**: 1020216008**	**Date**	**: 16/12/2017**
Major Guide	**: Dr. Alka singh**	**Time**	**: 4:00 to 5:00 p.m.**
Co- Guide	**: Dr. N. B. Patel**	**Venue**	**: Swami Vivekanand Hall**

Hibiscus- A Versatile Ornamental Plant

Flowers being the part of human life from birth to death have been associated with man's history from a long time. Flowers are entwined in our day to day activities like religious and social ceremonies, weddings, birthday celebrations, interior decoration as well as for self-adornment. Floriculture has emerged as a major diversified substitute for agribusiness in recent years. Many kinds of flowers are grown for domestic and foreign trade in developed and developing countries. In India, flowers are grown in around 3,28,000 ha land, with the production of 58,200 lakh numbers of cut flowers and the loose flowers around 16,95,000 MT (Anon., 2016-17). However, regarding pot plants or nursery industry, floriculture data in India does not reflect any information about production and sale of ornamental plants but only of loose and cut flowers although ornamental plant nursery is spread on a large scale and is a big commercial today.

What is an ornamental plant: Ornamental plant is a plant that is grown for decorative purpose in garden and landscape design project, as houseplants, for cut flowers or specimen display.

Hibiscus

Hibiscus rosa-sinensis belongs to Malvaceae family. Conventionally, it is cultivated by stem cutting. This plant is native to tropical and southeastern Asia (China) and is commonly found throughout the tropics and as a house plant throughout the world. *Hibiscus rosa-sinensis* plants is a member of the Mallow Family that has more than 200 species. There are main types of Hibiscus: tropical, hardy perennial and annual. It is highly popular in landscaping as well as also gaining impetus not only as flowering pot plant but also for medicinal and nutritional properties.

<u>Brief review of research work:</u>

Pekamwar *et al.* (2013) have reported phytochemical as pharmacological activity in all parts of Hibiscus *rosa sinensis*.

Sonia (2009) studied many different uses of red Hibiscus flowers in different countries.

Use as an ornamental plant for landscaping:

Bhandari *et al*. (2015) reported that hard wood cutting of *Hibiscus rosa sinensis* treated with IBA @ 750 mg/l proved best with respect to number of minimum days to new sprout (8.83), number of shoots (5.50), number of roots (13.60), fresh and dry weight of roots and survival percentage (90.50) of cuttings.

Shadparvar *et al*. (2011) studied propagation in difficult to rooting variety of "yellow double hybrid" in *Hibiscus rosa sinensis* and found that treatment of 4000 mg/1 IBA increased the percentage of rooting and other affecting factors on the quality of cuttings in peat perlite bed.

Soniya Kasliwal and Srinivasamurthy (2016) reported that inoculation of *Hibiscus rosa sinensis* with Arbuscular Mycorrhizae (*Glomus mosseae)* resulted in to 60 % increase in shoot length and 33 % increase in number of leaves as compared to uninoculated.

Use for pot plant:

Soad (2016) showed that Hibiscus pot plants treated with either STS (1:4 mM) or sachets of potassium permanganate and stored at 5 °C for 15 days during shipment gave the least values of bud abscission percentage and anthocyanins in the flowers.

Fiber purpose:

Hossain *et al.* (2011) showed that variety HC2 of *Hibiscus cannabinus* was most suitable for growing on sandy bris soil and showed higher total nutrient content in plant (45.40 g/plant) while HC95 had the lowest total nutrient content in plant (37.51 g/plant).

Pigment purpose:

Escalante *et al*. (2012) evaluated the effect of diet supplemented with anthocyanin from roselle (*Hibiscus sabdariffa*) in goldfish and found that highest dose of 160 mg anthocyanin from roselle calyx/ kg diet increased the growth rate, specific growth rate, weight grain and feed conservation rate of *Carassius auratus*.

Medicinal uses of Hibiscus:

Ogunwole and Otusanya (2013) reported that aqueous extract of *Tithonia diversifolia* and *Chromolaena odorata* and kinetin (TKN and CKN) geometrically promoted the growth and chlorophyll accumulation in *Hibiscus sabdariffa* plants.

Diane *et al*. (2009) reported that compared with baseline, 6 week treatment of Hibiscus tea lowered mean SBP (- 7.2 ± 11.4), DBP (- 3.1 ± 7.0) and MAP (- 4.5 ± 7.7), whereas the placebo beverage did not affect these variables.

Remella *et al.* (2015) reported that hydro alcoholic extract of the leaves of *Hibiscus cannabis* extract showed higher antioxidant activity when compared to ethanolic and water extracts.

Ghaffar and Ibrahim (2012) showed free radical scavenging activity of *Hibiscus rosa* extract increased with increasing concentration at 500 μg/ml of it concentration nearly reached to the standard Butylated Hydroxyanisole for super oxide and nitric oxide.

Ganeriwala *et al*. (2015) revealed in the phytochemical study of the (*Hibiscus rosa sinensis*), presence of organic components like alkaloids, tannins, amino acid, glucosides, flavonoids, reducing sugar, hexose sugar and steroid in both the water and alcoholic extracts except saponin which was present only in water extract.

Conclusions:

From the foregoing discussion it can be concluded that Hibiscus is a versatile plant which is not only important for landscaping and ornamental pot plant but also for pigments, pharmaceutical and nutriciated for human as well as animals. For rooting in hardwood cutting of H*ibiscus rosa sinensis*, treatment at 750 mg/l IBA in sand media has been found to be best for variety red double while, 4000 mg/l in peat perlite bed for variety yellow double hybrid. Inoculation of Hibiscus with Arbuscular Mycorrhizae (*Glomus mosseae*) improves overall plant growth. Treatments of Hibiscus potted plants with silver thiosulphate (1.4 mM) or potassium permenganate (KMnO4) and 5°C temperature can be adopted for shipment up to 15 days. Variety HC2 of *Hibiscus cannabis* which is cultivated for fiber use showed better performance for cultivation in sandy bris soil. inclusion of 160 mg anthocyanins from roselle calyx/ kg diet increased the growth rate of gold fish and chromatophores. Application of aqueous extract of *Chromolaena odorata* and *Tithonia diversifolia* increased the growth and chlorophyll contents of *Hibiscus sabdariffa* plants. *Hibiscus cannabis* and *Hibiscus rosa sinensis* are highly rich in antioxidant activity. Daily consumption of Hibiscus tea in amount to the diet lowers blood pressure pre and mildly hypertensive adults.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
POST GRADUATE SEMINAR SERIES: 2017-2018

Speaker : Gurjar Rashmikant Anantray	**Course: FLA-691**
Major advisor : Dr. S. L. Chawla	**Date: 16/12/2017**
Minor advisor : Dr. Dev Raj	**Time: 2:00 – 3:00 pm**

ADVANCES IN SOILLESS CULTIVATION OF FLOWER CROPS

INTRODUCTION

Soil is the natural growing media for cultivation of majority crops in the world. However, it has few problems such as soil born diseases, undesirable microbial activities, nematodes, changing acidity levels, salinity, poor drainage, poor nutrient levels and undesirable soil characters (Dayananda *et al.,* 2014). To overcome these problems, soil-less cultivation system emerged as a better alternative. It is a technology for growing plants in nutrient solutions (water and fertilizers) with or without the use of an artificial holding medium like coco peat, sand, gravel, vermiculite, rock wool, peat moss and saw dust for mechanical support. A variety of flower crops *viz*., rose, carnation, gerbera, chrysanthemum, gypsophila, tulip, *Oncidium, Dendrobium* and gladiolus can be grown by using soilless media.

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BRIEF REVIEW OF RESEARCH WORK

Rose

Das *et al.* (2012) studied three commercial cultivars of rose were grown successfully in a low cost device of hydroponics for 165 days. They found number of shoot branches and length of the shoot branches per plant were higher in the cv. Calcutta than the other two cultivars. Whereas, the plant height and plant weight of the cultivar Tajmahal increased significantly higher than other two cultivars during the entire period of study. Hydroponics device and procedure are recommended for the rose gardening in soil stress area for both urban and city growers.

Fascella and Zizzo (2005) studied the influence of two growing media *viz.*, perlite and perlite/coir dust on quantitative and qualitative parameters of rose grown in plastic bags. The maximum flowers (18.7 stems/plant), longest stem (70.1 cm) and maximum petals/bud (44.7) were recorded with application of perlite and perlite/coir dust (1:1, v/v).

Naomi Chelimo Ketter (2015) evaluated cocopeat based hydroponic system for production of roses. The cumulative produced fresh weight of stems was significantly greater in cocopeat system compared to the soil system ($P<0.01$). By the end of the 12 month period, the cocopeat system had 9.2 kg/sq. m. weight of flower stem and 242 stems sq. m. compared to 5 kg/ sq. m. weight of flower stem and 157 stems/sq. m. for soil system respectively, which represented 82% more weight of stems with 53% more stems.

Samartzidis *et al.* (2005) studied different substrates for soil-less culture in rose and revealed that cumulative production of rose plants did not differ among substrate mixtures. Coarse zeolite and perlite in soil-less culture simply acts as an inert materials and does not exert any significant positive effect on productivity of rose stems..

Gerbera

Sindhu *et al.* (2010) revealed the effect of different amendments in gerbera under greenhouse condition using available materials *viz.,* soil, farm yard manure (FYM), vermicompost, samridhi (a soil conditioner) and sawdust. They found that coco peat : vermiculite : perlite (CVP) (4:1:1) significantly increased number of leaves (9.07) at appearance of first flower, fresh weight (107.14 g/plant), suckers produced (1.4 /plant) and dry weight (27.21 g/plant), CVP + Samridhi (8:1) was best with respect to total no. of leaves /plant (31.1).

Khalaj *et al.* (2011) studied different growing media on the growth and yield of gerbera and found that, perlite + peat + expanded clay mix (25% + 70% + 5%) produced significantly maximum number of flowers (10.33) per plant, flower disc diameter (12.4 cm /plant) and flower height (54.5 cm/plant) among different media.

Anthurium

Tatte Sumathi (2016) conducted experiment on the effect of various growing media and foliar spray of primary nutrients on anthurium var. Tropical under fan and pad type greenhouse. Coconut husk + charcoal (3:1) as a growing media significantly improved all the vegetative and flowering parameters. Weekly once foliar application of 30:10:10 (NPK) @ 0.2 % recorded maximum plant height, number of leaves, leaf petiole and plant spread. Whereas, early flower bud emergence, early unfurling of spathe and maximum stalk length, stalk diameter, spathe length, spathe width and flower yield was recorded in plants sprayed with 12:61:40 (NPK) @ 0.2 % once in a week.

Gladiolus

Walid (2011) studied effect of commercial fertilizers nutrient film technique on flowering characters of gladiolus corms.Maximum spike length (102 cm/plant), spike fresh weight (42.35 g/plant), spike dry weight (5.79 g/plant) was recorded in Nutrafin fertilizer where as maximum number of florets/spike (13.52) in singral solution NFT of hydroponics.

Tulip

Lee and Suh (2005) revealed the effect of nutrient solution composition on growth and flowering in hydroponically-grown. In ‘Ile de France’ and ‘Golden Apperdoorn’ tulip. They found minimum days to flowering (38.3) minimum length of internode (6.2 cm) and Minimum days to flower (41.3 days) with minimum length of internode (18.2) in nutrient solution composition of 17.9 : 3.9 (N:K, meq/l) with respective varieties. In ‘Ile de France’, the maximum stem length (33.7 cm) was found in in 12.1:5.1 solution composition whereas maximum stem length (37.1 cm / plant). Internode diameter and tepale length was found non significant in both varieties.

Gypsophila

Paul *et al.* (2011) studied effect of different hydroponics systems and growing media on the growth and yield of gypsophila. They observed that maximum number of shoots/plant (14.4) and number of branches/flower (36.1) in bag culture along with vermiculite treatment whereas maximum cut flower stem length (67.0 cm) in bag culture along with sawdust.

Orchid

Muna *et al.* (2010) studied the different media combination for hardening of Orchid *Dendrobium* cv. Sonia 17 plants and found that cocopeat alongwith 2 pieces of cocohusk media combination was beneficial regarding plant growth and survival.

Hsu and Lin (2011) studied the effect of cultural medium and hydroponic culture on growth and flower quality of *Oncidium*. They found maximum total soluble solids, starch content and maximum root activity in rock wool media in hydroponic system.

CONCLUSION

Soilless culture is not only a solution for problematic soils but it also helps to improve the quality and quantity of floriculture produce. The application of a soilless culture system using artificial substrate would result in efficient and effective use of water and fertilizers. Minimizing the use of chemical for pest and disease control, because medias don’t carry disease and pest. Atomization of irrigation and fertigation is easily possible in soilless culture as mentioned in hydroponics. Most of the medias such as, cocopeat, perlite, rock wool, charcoal etc. have shown great responses against yield, quality and quantity indices. It can be argued that soilless cultivation is “The next logical step” after traditional agriculture. We can confidently say that application of soilless cultivation has a great scope in Indian floriculture industry.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post Graduate Seminar Series: 2017-18

Speaker	**: Patel Henaxiben Babubhai**	**Course**	**: FLA 692 (1+0)**
Reg. No.	**: 1020216008**	**Date**	**: 21/04/2018**
Major Guide	**: Dr. Alka Singh**	**Time**	**: 3:00 to 4:00 p.m.**
Co- Guide	**: Dr. N. B. Patel**	**Venue**	**: Swami Vivekananda Hall**

Organic farming in cucurbitaceous vegetable

Vegetable constitute an important segment of our agricultural system from economical as well as nutritional point of view. Fresh vegetables are rich sources of essential vitamins, minerals, dietary fibers and contain fair amount of carbohydrates and proteins.The constitutes of vegetables have both the nutritional and therapeutic values due to anticarcinogenic and antioxidant properties.In India vegetables are cultivated in an area of 10.10 million ha, with an annual production of 169.06 million MT (Anonymous,2017).

What is organic farming?

Organic farming is a production system which avoids or largely excludes the use of synthetic compounds like fertilizers, pesticides, weedicides and livestock feed additives. It is based on crop rotations, legumes, green manures, farm organic wastes and biofertilizers, biological method of pest control which result into the maintenance of soil health, supply of plant nutrients and controls insects and weeds.

Brief review of research work:

Cucumber (B.N.: *Cucumis sativus* L.)

Ikeh *et al*. (2012) reported that application of 8 t/ha goat dung and poultry dropping performed best for vine length, number of leaves per plant, number of fruits per plant, length of fruits and fresh fruit yield at 9 weeks after sowing in cucumber variety Ashley.

Yeole (2013) recorded that plots treated with 30 t/ha vermicompost shows significantly quantitative increased fruit number (38.66) and number of leaves (47.33) per plant at 90 days in cucumber variety NS-46.

Khan *et al.* (2017) found that the application of 20 t/ha poultry manure to S. Green cultivar induced high growth and yield in cucumber.

Eifediyi *et al*. (2010) reported that at 8 weeks after sowing, application of farmyard manure 10 t/ha increased vine length (287.50 cm), number of leaves per plant (55.97) and number of branches per plant (19.04) in cucumber variety Palmetto.

Agu *et al*. (2015) reported significantly higher values for vine length (68.9 cm), number of leaves per plant (254) and minimum days to 50 % flowering (30 days) with the application of 40 t/ha poultry manure at 60 days after sowing in cucumber variety Poinsett.

Watermelon (B.N.: *Citrullus lanatus* Thumb)

Enujeke (2013) showed that plants that received highest rate of poultry manure i.e. 20 t/ha were superior in the parameters tested with vine length (177.5 cm), number of leaves per plant (37.1) and number of branches per plant (5.77) at 8 weeks after sowing in watermelon cultivar Sugar Baby.

Dauda *et al*. (2008) showed that application of 9.9 t/ha poultry manure significantly enhanced vine length (86.68 cm), number of leaves per plant (18.54), number of branches per plant (3.36), number of fruits per plant (14.05) and average weight of fruit (3.91 kg) in watermelon cultivar Sugar Baby.

Muskmelon (B.N.: *Cucumis melo* L.)

Tittarelli *et al*. (2014) noticed that the green manure treatment recorded highest total and marketable yield followed by fallow (FA), while roller crimper (RC) was characterized by a significant lower yield in muskmelon.

Ghanbarian *et al*. (2008) reported that application of broiler litter 10 t/ha showed significantly maximum plant height (89.12 cm), total yield (39.97 t/ha) and marketable yield (32.10 t/ha), while variety Shahabadishowed highest plant height (73.42 cm), total yield (38.40 t/ha) and marketable yield (28.92 t/ha) as compared to variety Semsouri.

Bottle gourd (B.N.: *Lagenaria siceraria* L.)

Sundararasu (2017) found that vermicompost and vermiwash treated soil showed increased plant growth (242.5 cm), number of leaves (105.7), flowers (32.6) and fruits (26.2)at 90 days as compared to control in bottle gourd.

Pumpkin (B.N.: *Cucurbita moschata* L.)

Oroka (2015) reported that liquid organic manures made from animal manure with water hyacinth significantly increased the vine length (215.2 cm), branch number (9.2), leaf number (54.3) and fresh marketable yield (589.8 kg/ha) in pumpkin.

Bitter gourd (B.N.: *Momordica charantia* L.)

Anuja and Archana (2011) revealed that the application of FYM @ 25t/ha and vermicompost @ 5t/ha along with panchagavya 3 % foliar spray improved the fruit set percentage (81.02 %) and took minimum days for fruit maturity (13.21 days) in bitter gourd cv. Long Green.

Pointed gourd (B.N.: *Trichosanthes dioica* Roxb.)

Ram *et al.* (2013) found that paddy straw mulch and single stake system of training showed significant response and gave maximum yield in parwal.

Conclusions:

From the foregoing discussion it can be concluded thatthe modern form of organic farming is a new concept. Organic farming system is an alternative and appropriate management system that helps to improve soil health and environment and thus increases the productive levels and improves quality of vegetable crops.In cucumber and watermelon application of poultry manure at the rate of 5- 30 t/ha increased vegetative and yield parameters because poultry manure is an excellent organic fertilizer contains high photosynthetic activities and thus promotes root and vegetable growth. In muskmelon application of green manure at 30 t/ha showed highest total and marketable yield. In bottle gourd plants treated with 50 % vermicompost and vermiwash showed better growth of plants. For pumpkin mixture of animal manure with water hyacinth significantly increased qualitative and quantitative parameters and in bitter gourd application of farm yard manure @ 25 t/ha and vermicompost @ 5 t/ha along with panchagavya 3 percent foliar spray improved flowering and fruit set. In pointed gourd, paddy straw mulch and single stake system of training gave maximum yield.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY,NAVSARI
Post Graduate Seminar Series 2018-2019

Speaker	**: Ahir Tejas R.**	**Course**	**: FLA 691 (1+0)**
Reg. No.	**: 1020216001**	**Date**	**: 01.12.2018**
Major Guide	**: Dr. S. L. Chawla**	**Time**	**: 11.00 to 12.00 AM**
Co-Guide	**: Dr. R. V. Tank**	**Venue**	**: Swami Vivekanand Hall**

Advances in China aster

China aster (*Callistephus chinensis*) is one of the important commercial flower crop belongs to the family Asteraceae and native of China. The genus *Callistephus* is derived from two greek words, *Kalistos* meaning 'most beautiful' and *Stephus*, 'a crown' referring to the flower head. Flowers are solitary with wide range of colours. It is a self-pollinated crop. Among annual flowers, it ranks next to chrysanthemum and marigold. China aster can easily be grown in open field as well as in net house for production of flowers. This shallow rooted annual crop prefers winter season for better growth and development. Its popularity is increasing day by day in urban areas where it is used for loose flowers, cut flower, landscape, floral decorations and making garlands. It is very good crop for increasing income of small as well as marginal farmers of the country. The productivity and flower quality of China aster can be increased by the adoption of advanced technologies developed.

Brief Review of Research:

Crop improvement

Bhargav *et al.* (2018) recorded maximum flower stalk (36.84 cm) in cv. Phule Ganesh Violet, whereas maximum flower diameter (6.24 cm) was in Hybrid 24. Maximum flowers/plant (43.59) was noted in cv. Hybrid 30. Phule Ganesh Purple recorded maximum weight of flowers/plant (126.83 g) and flower yield (106.54 q/ha), while Hybrid 26 recorded maximum vase life (8.67 days) in China aster.

Pratiksha Kumari *et al.* (2018) studied that cross ability in China aster was found significant for no. of seeds/flower head, weight of seeds/flower head. While the early seed maturity was shown in Arka Archana x Local Pink. The total no. of seeds/cross and seed weight/cross were maximum in Arka Poornima x Local Pink and maximum 100 seeds weight was in Arka Shashank.

Savitha *et al.* (2016) studied the flower yield and quality parameters in different cultivars of China aster and recorded significantly highest flower yield (308.68 g/plant), seed yield (8.70 g/plant), fresh weight of flower (5.70 g), flower diameter (6.80 cm), stalk length (46.90 cm) and dry weight of flower (0.81 g) in cv. Phule Ganesh White.

Seed priming

Badek *et al.* (2014) studied the rapid evaluation of germinability of primed China aster seeds and recorded that the germination percentage of seeds moistened up to 30% and 37.5% and incubated for 1 and 8 days was higher compared to control batch. But minimum time for germination was recorded in seeds having 37.5% moisture when soaked in limited amount of water for 8 days.

Gornik and Grzesik (2005) evaluated the effects of Asahi SL (Sodium ortho and Para nitro Phenolate, Sodium 5 nitro guaiacolate) with different concentration showed a wide range of possibilities for improving seed yield. However, foliar application of Asahi SL resulted highest seed yield on secondary capitula by 134% and on tertiary capitula by 38% during flowering of the majority of flowers on tertiary capitula in China aster.

Planting date

Kaushal *et al.* (2014) studied that the Kamini variety of China aster planted on 6th April recorded significantly highest plant height (97.38 cm), plant spread (56.08 cm), no. of flowering stems/plant (9.23) and yield of cut flower stems/plot (184.70), while the maximum vase life (11.23 days) was observed in Violet Cushion variety planted on 5th June.

Spacing

Bhargav *et al.* (2016) observed that spacing of 30x15 cm took minimum days to 50% flowering (124.13), higher flower yield (1946.51 g/m^2) and seed yield (186.77 g/m^2). Whereas spacing of 30x30 cm gave maximum no. of flowers/plant(32.63), flower diameter (6.58 cm) and fresh weight of individual flower (5.79 g). In response of different cultivars maximum no. of flowers/plant (33.41) observed in cv. Kamini. While cv. Poornima gave higher flower diameter (7.15 cm) and fresh weight of individual flower (7.24 g). The maximum flower yield/plot (2011.84 g/m^2) and seed yield (229.04 g/m^2) was produced in cv. Violet Cushion.

Pinching

Sailaja *et al.* (2014) studied that the flowering parameters in terms of days to first flower bud initiation, full opening of flower from bud initiation, and days to 50 per cent flowering were found earlier in Phule Ganesh White under the control treatment of pinching i.e. no pinching. Whereas, maximum flowering span was found in Phule Ganesh White as well as the treatment double pinching at 30 and 45 days after transplanting. The yield characters like number of flowers per plant and flower yield per hectare were recorded maximum in Phule Ganesh White as well as under single pinching at 30 days after transplanting.

Nutrient management

Verma *et al.* (2018) found maximum plant height (63.00 cm), diameter of main stem (3.00 cm), leaves/plant (125.40), plant spread (38.34 cm), green weight of plant canopy at final (401.25 g), days of visibility of flower bud (131.30), days of colour break (139.29), days of harvesting of floral heads (162.18), maximum fresh weight of floral heads (4.96 g) and length of floral stalk (21.67 cm) in foliar application of Ferrus Sulphate @ 0.2%.

Kumar and Kumar (2014) found that the application of 300 kg N and 200 kg P/ha recorded maximum plant height, no. of leaves/plant, flower weight, flower diameter and flower yield. Interaction of both also produced the superior results regarding growth, flowering and yield characters in China aster.

(P.T.O.)

Thamara *et al.* (2010) noted that the 120 % RDF (WSF) through fertigation resulted significantly maximum flowers/plant (51.50), flower yield (174.32 g/plant and 12.70 t/ha), flower diameter (6.37 cm), stalk (28.70 cm) and vase life (9.00 days) in China aster cv. Kamini.

Chaitra and Patil (2007) revealed that application of *Azo* + PSB + VC + 50% RDF gave maximum plant height (60.88 cm), no. of leaves/plant (103.81), no. of branches/plant (25.08), minimum days to first flowering (74.93) and higher flower yield (11.71 t/ha) in China aster.

Plant growth regulators

Vinutha *et al.* (2017) revealed that highest plant height (65.07 cm), leaves/plant (115.67), stem girth (12.71 mm), secondary branches (13.00), minimum days taken for first flowering (59.00), days to 50% flowering (73.00), maximum stalk length (27.50 cm) and flower weight (2.40 g) were obtained with the foliar spray of GA_3 @200 ppm at 45, 60, 75 and 90 DAT, while maximum duration of flowering (70.33 days) was observed in application of Humicil @1%. Maximum vase life of cut flowers (8.17 days) was found in spray of Biovita @1%.

Kumar *et al.* (2015) studied role of different PGR on growth, flowering and quality of China aster cv. Kamini and found that the foliar application of 200 mg/l GA_3 produced highest plant height (60.10 cm), no. of secondary branches (61.45), flowers/plant (84.96), flower yield (109.66 g/plant and 16.58 t/ha) and seed yield (1509.31 kg/ha).

Seed production

Mathad *et al.* (2009) found that harvesting of flowers at 42 DAF recorded maximum capitulum diameter (4.40 cm) and thousand seed weight (1.71 g) in China aster.

Post harvest management

Chander *et al.* (2018) revealed that pulsing of cut flowers with sucrose (10%) + 8-HQC (400 ppm) for 12 hours exhibited maximum water uptake (36.16 ml/stem), flower diameter (7.47 cm) and vase life (12.83 days) in China aster cv. Kamini.

Ranchana *et al.* (2017) standardized the tinting techniques in China aster cv. Local White and revealed that food dyes *viz.,* Apple green, lemon yellow and orange red at 4 % concentration expressed full bright coloured flowers with quick uptake of dyes in a short period of two hours duration.

Meman *et al.* (2006) studied the effect of drying on per cent weight loss in the flower of China aster and observed that flowers dried under sun drying using silicagel as embedding media resulted significantly highest per cent weight loss from first day to fourth day.

Conclusion:

From the foregoing discussion, it can be concluded that among different varieties of China aster, PG White and Kamini found best for commercial cultivation. Seed treatment with 37.5 per cent moisture and soaked in limited amount of water for 8 days gives higher germination with lesser time. Planting distance of 30x15 cm found best for flower and seed yield but wider spacing (30x30 cm) gives quality flowers. Pinching is important crop specific practice for increasing quality and yield of flowers which should be followed at 30 DAT. Soil application of 300:200 kg N and P ha^{-1}gives superior results. Fertigation of 120 % RDF (WSF) produces maximum yield of flowers. Moreover, *Azo.* + PSB + VC + 50% RDF application give better quality and yield of flowers. Foliar application of 200 mg/l GA_3 also beneficial for enhancing growth and yield of China aster. Pulsing of cut flowers with sucrose (10%) + 8-HQC (400 ppm) for 12 hours is best treatment for enhancing vase life. Tinting of white colour flowers with food dyes *viz.,* Apple green, lemon yellow and orange red at 4 % concentration increases brightness of flowers. China aster flowers dried under sun drying using silicagel as embedding media is found best for drying.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post Graduation Seminar Series 2018-2019

Speaker	**:**	**Mamilla Sindhuja**	**Course**	**:**	**FLA 691(1+0)**
Reg. No.	**:**	**1020217006**	**Date**	**:**	**20.04.2019**
Major Guide	**:**	**Dr. Alka Singh**	**Time**	**:**	**3.00 to 4.00pm**
Co-Guide	**:**	**Dr. B. N. Patel**	**Venue**	**:**	**Swami Vivekananda Hall**

Nutraceuticals in Flower Crops

Nutraceuticals are food or part of food that provides medicinal or health benefits including the prevention and/or treatment of a disease. Nutraceutical has advantage over the medicines because they avoid side effects. Some major nutraceutical ingredients include amino acids, peptide, proteins, minerals, carotenoids, polyphenols, prebiotics, carbohydrates, fibers, fatty acids, vitamins and sterols. It is known that antioxidants when present in the daily food could prevent chronic diseases such as diabetes, cancer, cardiovascular and neurodegenerative disorders. Nutritional value of flowers is also important and represents a sufficient reason for their consumption. The flowers reveal as nutraceutical resource possessing phytochemicals that can serve as anti-anxiety, anti-cancer, anti-diabetic, anti-inflammatory, anti-oxidant, diuretic, anthelmintic, immune-modulatory and anti-microbial properties. Marigold, Bougainvillea, Cassia, Crossandra, *Jasminum*, Lantana, Tuberose, Stenolobium, Bauhinia, Calendula, Calotropis, Canna, Celosia, *Couroupita*, Gulmohar, Ervatamia, Gerbera, Hibiscus, Ixora, Nerium, Plumeria, Rose, Tabebuia *etc*. are flowers for human nutrition.

Brief Review of Research Work:

Kumar *et al*. (2011) investigated the free radical scavenging capacities in different flower extracts of *Michelia champaca* Linn. through DPPH method and concluded that the anti-oxidant activity increases with increase in concentration of all extracts namely, methanol, ethanol, aqueous solution and methanol was found highest free radical scavenging capacity with standard gallic acid.

Jeeva *et al.* (2012) examined the phyto-constituents such as alkaloids, phenolic compounds, flavonoids, saponins glycosides, terpenoids, steroids, coumarins, quinines, phytosterols, proteins and carbohydrates in the extracts of some ornamental flowers of the family Apocyanaceae. They reported that the presence and absence of phyto-constituents were dependent upon the solvent medium used for the extraction and physiological property of the flowers. The finding of this study revealed that even ornamental flowers have potential antimicrobial compounds that may be used for developing plant based drugs.

Mlcek *et al.* (2012) analysed the content of mineral elements in 12 flower species, which was higher than in most fruit or vegetable species. The highest levels of mineral elements were observed in the flowers of species *Dianthus, Tagetes* and *Viola*. The most abundant element was potassium, the content of which ranged from 1,842.61 to 3,964.84 mg/kg of FM found in viola and *Dianthus caryophyllus* showed highest total phenolic content, total antioxidant capacity and total flavonoid content.

Bhat *et al.* (2013) studied antioxidant compounds and antioxidant activities of *Hibiscus rosa-sinensis* L. and *Senna bicapsularis* L. flower extracts. Ethanolic extracts of Cassia had high total phenolic, total flavonoid and total flavonol content and showed highest activity for inhibition of DPPH, while aqueous extract of *Hibiscus rosa-sinensis* L. had high tannin and anthocyanin contents.

Ebrahim *et al.* (2013) reported that *Adenium obesum* extracts are a rich source of anthocyanins and possess a significant antioxidant activity and revealed correlations between anthocyanins content and antioxidant activity were dependent on the extraction solvent with the best determination coefficients in water/methanol systems.

Bhuvaneswari *et al.* (2014) studied percent inhibition of free radicals in different flowers. The flowers of *Couroupita guianensis* and *Gerbera sp.* recorded highest inhibition of free radicals at the EC_{50} value of <200 μg/ml whereas, the flower of *Gomphrena globosa* did not record any value even at the concentration of 1000 μg/ml. *Bauhinia purpurea*, *Canna indica*, *Crossandra infundibuliformis*, *Delonix regia*, *Ixora coccines*, *Lantana camara*, *Nerium oleander*, *Plumeria obtuse*, *P. rubra*, *Rosa sp.* and *Stenolobium stans* recorded the EC_{50} value for inhibition of free radicals at the range of 401-800 μg/ml; *Bougainvillea spectabilis*, *Cassia alata*, *Hibiscus rosa-sinensis*, *Jasminum officinale*, *Polianthus tuberosa*, *Tabebuia rosea* and *Celosia argentea* at the value of 801 – 1000 μg/ml. *Calendula officinals*, *Calotropis gigantean*, and *Ervatamia coronaria* flowers recorded their EC_{50} value at the range of 201 – 400 μg/ml.

Setty *et al.* (2014) revealed that ethyl acetate, n-butanol, and ethanol extracts could scavenge DPPH radical effectively *i.e.*50–70% at the concentration of 320 *μ*g/mL in *N. arbortristis* flowers. The highest amount of flavonoids and total phenolic content was observed maximum in ethanolic extract of *N. arbortristis* flowers.

Husain and Kumar (2015) studied the presence of certain phytochemical compounds in flowers like *Wedelia trilobata, Achyranthes aspera* and Chrysanthemum. The flowers of *Chrysanthemum* were found to be good source of phytochemical constituents whereas, the inflorescence of *Achyranthes aspera* was comparatively reported for less source of phytochemicals. The methanolic flower extracts of *Wedelia trilobata, Achyranthes aspera* and Chrysanthemum showed rich presence of phytochemicals as compared to the chloroformic extracts.

Ivanov *et al.* (2016) evaluated five flowers for different nutraceutical properties. Highest content of total chlorophyll and total carotenoid was recorded in Geranium and Pot marigold. Betacyanins content from *Bougainvillea*
flowers gave highest value in the water solvent. The highest antioxidant activity was found in 95 % ethanol extract from *Geranium macrorrhizum* L. - 242.9 mM TE/g fw for DPPH assay and 106.3 mM TE/g fw for FRAP assay. Geranium and
Jerusalem Artichoke showed remarkably highest total phenolic content, whereas African marigold and Jerusalem Artichoke showed highest flavonoid content in all the investigated extracts.

Afify and Hassan *et al.* (2016) evaluated three flowers of *Hibiscus rosa-sinensis*, *Quisqualis indica* and *Senna surattensis* and revealed that the Senna flower extracts in 80% ethanol showed good scavenging activity with 500 mg/l while pigments like total chlorophyll, carotenoids and anthocyanins were observed maximum in *Hibiscus rosa-sinensis* flowers.

John *et al.* (2017) observed the total carotenoid content in different varieties of *Calendula officinalis* and reported highest carotenoid content (276.0 mg/100 g) in fresh flowers of Double Esterel Orange followed by Radio Extra Selected (111.8 g carotenoid/ 100 g).

Kumari (2017) evaluated 50 rose varieties wherein rose variety Pusa Priya recorded highest anthocyanin content (242.53mg/100g), phenolic content (134.32±1.20 mgGAE/100g) followed by Pusa Ajay (170.36±2.32 mg/100g and 73.38±0.52 mgGAE/100g) and total chlorophyll content was highest in Shabnam (1.45±0.01 mg/g) followed by Iceberg (1.35±0.00 mg/g). Further in rose variety Ashwini, enhanced induction of anthocyanin pigment accumulation was observed in *invitro* condition in petal derived rose calli in response to EM+sucrose @ 80g/l.

Landi *et al.* (2018) observed the highest total phenols, total anthocyanins in *Tropaeolum majus* L. *i.e* 194.33±16.50 mg GAE g-1FW, 10.10±3.34 (ABSb 100 mg-1 FW) and total flavonoids 41.79±13.87 (mg RE g-1 FW) highest in *Begonia semperflorens* L., pink. The highest DPPH scavenging capacity was found in *Tropaeolum majus* L. *i.e* 142.13±22.16(mmol TE g-1 DW).

Huang *et al.* (2018) investigated the antioxidant activities in different parts of three different hybrids of *Phalaenopsis* orchids. The highest levels of total chlorophyll were respectively obtained in leaf extracts of white and yellow orchids, whereas carotenoid showed the highest content in the flower extract of the yellow orchid. Among all the tested extracts, flavonoids and anthocyanin demonstrated the highest levels in the flower extract of the purple orchid, whereas the highest level of polyphenols was observed in the flower extract of the yellow orchid. The leaf extract of the white orchid was the most effective extract with a 50% inhibitory concentration in the DPPH-scavenging activity assay.

Conclusion: Flowers have been known to possess phytochemicals which can be exploited as nutraceutical and aid for human nutrition. *Michelia champaca* flowers showed highest DPPH scavenging capacity in methanolic extract. The maximum levels of mineral elements like P, K, Ca, Mg, Na, Fe, Mn, Cu, Zn and Mo were observed in the flowers of *Dianthus, Tagetes* and *Viola*. The most abundant element potassium was found in viola. *Dianthus caryophyllus* showed highest total phenolic content, total antioxidant capacity and total flavonoid content. Ethanolic extract of *Senna bicapsularis* and aqueous extract of *Hibiscus rosa-sinensis* flowers showed considerable amount of total phenolic, total flavonoid and total flavonol content. Ethanolic extract showed highest free radical scavenging capacity in *Adenium obesum* and *Senna surattensis*. Ethanol can be used for extraction of phytochemicals in *N. Arbortristis. Couroupita guianensis* and *Gerbera sp.* recorded highest inhibition of free radicals. Methanolic extract was most suitable for extraction of phytochemicals from *Wedelia trilobata*, *Achyranthes aspera* and Chrysanthemum. Calendula and Geranium showed highest source of carotenoids and chlorophyll. Water was good source for extraction of betacyanins in Bougainvillea. Rose variety Pusa Priya is good source of phytochemicals and Em+sucrose @ 80g/l showed *in vitro* induction of anthocyanins in rose variety Ashwini through petal derived calli. *Tropaeolum majus* showed highest amount of phytochemicals. Thus, flowers are found to be rich sources of antioxidants that it can be utilized as effective nutraceuticals.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
Post Graduate Seminar Series 2019-2020

Speaker	**: Ahir Tejas R.**	**Course**	**: FLA 691 (1+0)**
Reg. No.	**: 1020216001**	**Date**	**: 15/11/2019**
Major Guide	**: Dr. S. L. Chawla**	**Time**	**: 3.00 to 4.00 PM**
Co-Guide	**: Dr. R. V. Tank**	**Venue**	**: Swami Vivekanand Hall**

Role of biostimulants in fruit crops

Biostimulants are substances or microorganisms applied to plants with the aim to enhance nutritional efficiency, abiotic stress tolerance and crop quality traits, regardless of its nutrient content. Biostimulants may either directly interact with plant signaling cascades or act through stimulation of endophytic and non-endophytic bacteria, yeast and fungi to produce molecules of benefit to the plant. The benefit of the biostimulant is derived from the reduction in assimilated that are diverted to non productive stress response metabolism. Biostimulants foster plant growth and development throughout the crop life cycle from seed germination to plant maturity. These are available in humic substance, hormonal containing products and amino acid containing products for commercial utilization.

Brief Review of Research

Mango

Damodhar and Shinde (2010) revealed that six foliar sprays (at pea stage, marble stage and egg stage of fruit development each stage two spray at 15 days interval) of 55 % cow urine resulted maximum fruit weight (255.16 g), number of fruits/tree (351.68) and yield (90.28 kg/tree and 9.02 t/ha) in mango cv. Alphonso.

Ahmed *et al*. (2013) revealed that the significantly higher fruit weight (223.6 g), fruit length (10.66 cm), fruit width (7.75 cm), fruit thickness (5.97 cm), number of fruits/tree (302.00) and yield (67.5 kg/tree) were recorded with combined application of 60 % inorganic N (1.8 kg ammonium nitrate/tree/year) + spraying seaweed extract at 2% (at growth start, just after fruit setting and 1 month interval) on mango cv. Ewaise.

Ahmed and El-Sehrawy (2013) reported that highest fruit yield (213.00 kg/tree) of mango cv. Hindy Bisinnara were obtained with foliar spray of 0.4% seaweed extract four times (at growth start, just after fruit setting and after 21 days) under Egypt condition.

Ngullie *et al*. (2014) reported that foliar application 0.1 % humic acid at flower bud initiation stage gave higher yield of mango cv. Kesar. Whereas, application of 2000 ppm salicylic acid was found better for quality of mango fruits.

Sathe and Patil (2014) noted that five times (October to February) foliar spray of 1 % vermiwash to mango, increased fruit production from 1.00 (control) to 8.5 (treated) and 1.00 (control) to 2.5 (treated) fruits/fruiting body in Indigenous and Hapus varieties, respectively. Percentage of flowering was also increased from 62.00 % (control) to 95 % (treated) in Indigenous variety and 70 % (control) to 100 % (treated) in Hapus variety of mango in Kolhapur region.

Sau *et al*. (2017) observed that soil application of *Azotobacter chorococcum* @ 250 g + *Azospirillum brasilense* @ 250 g + AM @ 250 g in month of October along with foliar application of *panchagavya* 3% immediately after fruit set significantly increased plant growth, yield and quality of mango cv. Himsagar.

Patel *et al*. (2018) revealed significantly maximum organoleptic evaluation score, TSS (20.44 ^{0}B), total sugars (13.73 %), reducing sugars (5.38 %), ascorbic acid (52.86 mg/100g), shelf life (18.24 days) and lower acidity (0.23 %) in mango cv. Kesar with foliar application of 2 % Novel organic liquid fertilizer at induction of flowering and full bloom stage.

Banana

Hussain *et al*. (2015) revealed that maximum number of hands/bunch (10.75), numbe of fruits/bunch (156.50), fruit girth (14.37 cm), bunch weight (24.53 kg/plant) and yield (68.02 t/ha) were obtained with an application of 80 % RDF + 20 % RDN through FYM + 50 g *Azospirillum* + 50 g PSB + 25 g KMB in banana cv. Grand Naine.

Chhuria *et al*. (2016) recorded higher number of hands/bunch (9.45), number of fingers/bunch (152.40), weight of finger (133.67 g), length of finger (22.31 cm), bunch weight (24.86 kg) and yield (76.72 t/ha) in the plants treated with 100 % RDF (300:100:300 g N:P:K/plant) + 125 g *Azotobacter* + 125 g *Azospirillum* + 125 g PSB on ratoon crop of banana cv. Grand Naine.

Kumar and Nair (2016) reported maximum shelf life (8.25 days) in fruits obtained from banana cv. Nendran with bunch application of *jeevamrut* 3 % at 15 and 30 days after emergence + bunch cover.

Patil *et al*. (2017) noted that foliar application of Novel organic liquid fertilizer @ 1 % at 3rd, 5th and 7th month after planting of banana cv. Grand Naine obtained maximum number of fingers/bunch (171.08), number of hands/bunch (9.63), bunch weight (31.09 kg/plant) and yield (107.85 t/ha).

Papaya

Parmar *et al*. (2017) noted that papaya cv. Red Lady plants treated with 80 % RDNK (160:200 g/plant) applied in 8 equal splits at monthly interval + spraying of 1 % Novel organic fertilizer at 2nd, 4th, 6th and 8th month after planting resulted significantly highest yield (106.57 t/ha), TSS (12.03 ^{0}B), reducing sugar (9.28 %) and total sugar (10.87 %) with longer shelf life (7.61 days).

Patel Dharmishtha (2019) stated that the foliar application of potassium silicate 0.4 % + seaweed extract 4 % resulted significantly maximum fruit diameter (17.88 cm), fruit weight (1.81 kg/plant), number of fruits/plant (36.07) and yield (161.48 t/ha) in papaya cv. Red Lady.

Acid lime

Patel *et al*. (2019) revealed that the maximum height of seedlings (47.32 cm), number of leaves (36.31), stem diameter (3.12 mm), fresh weight of seedling (17.97 g), dry weight of seedling (10.02 g), survival percentage (75.20) and minimum mortality percentage (24.82) were noted at 180 DAS with the foliar spray of *panchagavya* 3 % at 60 and 90 days after seed sowing of acid lime.

Custard apple

Sindha *et al*. (2018) stated that the foliar application of humic acid @ 1% at marble stage and 15 days after first spray resulted maximum fruit yield (23.25 kg/plant), shelf life (6.57 days) and TSS (25.35 ^{0}B) on custard apple cv. Local.

Sapota

Baviskar *et al*. (2011) noted that soil application of 1125:750:375 g NPK/tree + 15 kg vermicompost + 250 g *Azotobacter* + 250 g PSB increased number of fruits per tree (1569.33), fruit yield (197.53 kg/tree), fruit weight (125.87 g) and TSS (23.16 ^{0}B) in sapota.

Conclusion

From the foregoing discussion, it can be concluded that biostimulants enhance the nutrient efficiency, growth, yield and quality of fruit crops. In mango, six foliar sprays of 55% cow urine at different flowering stages maximize yield. Application of 60 % inorganic N along with 2 % seaweed extract give higher yield and quality. Humic acid @ 0.1 % and salicylic acid 2000 ppm at bud initiation stage can also be used for better yield and quality. Flowering and fruiting can also be improved by spraying of 1% vermiwash five times. The combine application of biofertilizer + *panchgavya* 3 % is better for yield and quality. Novel organic liquid fertilizer @ 2 % at induction of flowering and full bloom stage increase quality of fruits. In banana, the application of 80 % RDF + 20 % RDN through FYM + 50 g *Azospirillum* + 50 g PSB + 25 g KMB increase yield. Moreover, spraying of Novel liquid fertilizer @ 1 % and *jeevamrut* 3 % can be used for higher yield and shelf life, respectively. Yield and quality of papaya can be improved through split application of fertilizer along with 1 % Novel organic fertilizer. Potassium silicate (0.4 %) + seaweed extract (4 %) also maximize yield of papaya. *Panchgavya* 3 % at 60 and 90 days after sowing increases growth of acid lime seedlings. Higher yield and quality of custard apple can be achived through spraying of humic acid @ 1 % at marble stage and 15 days after 1st spray. Soil application of 1125:750:375 g NPK/tree + 15 kg vermicompost + 250 g *Azotobacter* + 250 g PSB is beneficial for sapota yield.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST – GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Mamilla Sindhuja	**Course : FLA 692 (1+0)**
Reg. No. : 1020217006	**Date : 06/12/2019**
Major Guide : Dr. Alka Singh	**Time : 04:00 to 05:00 pm**
Co-Guide : Dr. B. N. Patel	**Venue : Swami Vivekananda Hall**

Mechanization and robotics in fruit crops

Mechanization is a crucial input for horticultural crop production and one that historically has been neglected in the context of developing countries. Factors that reduce the availability of farm power compromise the ability to cultivate sufficient land and long been recognized as a source of poverty. Robotics in horticulture is undoubtedly in an immature stage right now. The use of robotics or automated machines in orchard operations is associated primarily with insufficient labour availability and rapidly increasing labour costs in fruit production and is critical for improving yield of high-quality fruit minimal dependence on seasonal human labour. Primarily, mechanized or robotic orchard management operations include weeding, pruning, thinning, spraying, harvesting, *etc.* Applying new technologies that are environment friendly enables farmers to produce crops more efficiently by using less power.

Review of research work

Mechanization

Razeto *et al.* (2005) studied hand and machine pollination of kiwifruit and revealed that higher fruit set (77.5 %), fruit weight (87.1 %), fruit length/width ratio (1.13) was obtained in dusting machine compared to hand pollination.

Schupp *et al.* (2011) investigated on Golden Delicious, York and Pink Lady cvs. of apple demonstrated increase in efficiency ofvaccum assist harvest system per acre by 10 to 49 per cent. The fruit quality of machine-harvested fruit was better than hand harvested fruit in the cv. York, whereas, quality of machine-harvested was equal to hand harvested fruit in the cv. Golden Delicious and Pink Lady.

Kurtural *et al.* (2012) reported that traits *viz.,* count shoots, count clusters, total shoots,total cluster, clusters harvested (no./vines), cluster weight, berry weight and yield weight were recorded maximum in mechanical box-pruning with mechanical shoot thinning (MP+MT) in grape cv. Cabernet Sauvignon during 2009 and 2010compared to hand pruning (HP). There were no effect on treatments applied on TSS, pH, titrableacidty, total phenolics, anthocyanin and tannins. The MP+MT method reduced the labour operationcost and time per acre compare to MP+HT and HP management methods.

Pflanz *et al.* (2016) reported significantly higher fruit weight by 14 g and 12 g in apple cvs. Pinova and Elstar at the optimum rotational speed of 280 rpm when compared to 200 rpm and alsosignificantly increased in fruit flesh firmness (9.05 kg cm-2), SSC (14.96 0B) and streif index (0.13) with the same rotational speed, whereas, starch index (6.74) was significantly maximum at 240 rpm in cv. Pinova. Fruit flesh firmness (8.14 kg cm-2), SSC (13.610B), starch (3.83) and streif index (0.24) were significantly maximum at 320, 200, 280 and 240 rpm respectively, in the cv. Elstar.

Robotics

Bulanon and Kataoka (2010) studied performance of fruit recognition system and found 100 per cent accuracy in single fruit detection in apple cv. Fuzi. For each image processing step,309 ms execution time was required with 100 per centrelative percentage. End effector showed more than 90 per cent success rate in detaching the fruit.

Oberti *et al.* (2014) observed 84 per cent reduction in pesticide use by robotic system as compared to a conventional homogeneous spraying of canopy, where it sprayed 25 spots which actually covered all the disease foci in grape.

Yamamoto *et al.* (2014) confirmed that the harvesting success rate for mature fruit was 67.1 per cent, detection 89 per cent, maturity assessment 83.4 per cent and picking 90.3 per cent withstationary robotic strawberry harvester in strawberry. 22

Amatya *et al.* (2017) reported that maximum fruit removal efficiency of 92.9 per cent and 86.6 per cent was achieved using up to five shaking and four shaking events per branch in Y-trellis system and vertical trellis system respectively in cherry.

Duke *et al.* (2017) studied the automated pollination of kiwifruit flowers and reported that the robotic pollination system detected 89.3 per cent of flowers, correct localized 71.9 per cent of flowers and hit an estimated 80.1 per cent whilst driving at a speed of 0.36 m/s through kiwi orchard rows.

Mu *et al.* (2019) studied the design and simulation of an integrated end-effector for picking kiwifruit and reported that in the experiment, with total 240 kiwifruit samples picked in total, the average success rate was 94.2 per cent. This success rate was calculated as the number of fruits successfully picked divided by the number of attempted picks.

Conclusions

A number of benefits have been foreseen through mechanization and robotics application in fruit crops. Higher fruit set, fruit weight and fruit length/width ratio were obtained in dusting machine as compared to hand pollination in kiwi fruit. The fruit quality of machine-harvested fruit was better than hand harvested fruit in the cv. York. Count shoots, count clusters, total shoots,total cluster, clusters harvested (no./vines), cluster weight, berry weight and yield weight were recorded maximum in mechanical box-pruning with mechanical shoot thinning (MP+MT) as well as reduced the labour operation cost and time per acre compared to MP+MT and HP management methods in grape.Fruit weight,fruit flesh firmness, SSC and streif index was significantly maximum in apple cvs. Pinova and Elstar at the optimum rotational speed of 280 rpm.Apple cv. Fuzitooks 309 ms execution time for each image processing step with 100 per cent relative percentage and detected single fruit with 100 per cent accuracy with no false detection.84 per cent reduction in pesticide use by robotic system as compared to a conventional homogeneous spraying of canopy, where it sprayed 25 spots which actually covered all the disease foci. Success rate for mature fruit was 67.1 per cent, detection 89 per cent, maturity assessment 83.4 per cent and picking 90.3 per cent with stationary robotic strawberry harvester.Maximum fruit removal efficiencywas achieved by five shaking and four shaking per branch in Y-trellis system and vertical trellis system respectivelyin cherry.Automated pollination detected 89.3 per cent of flowers, 71.9 per cent correct localized of flowers and 80.1 per centhit an estimated of kiwifruit flowers. 94.2 per cent success rate was reported by end-effector for picking kiwifruit. Thus, application of mechanization and robotics appears to be highly efficient and precise technology with regard to inputs reduction and time saving, specially for commercial cultivation of fruit crops on large scale.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2019-20

Speaker : Pawar Ravindra Dadabhau	**Course** : FLA 691 (1+0)
Reg. No. : 1 0 2 0 218012	**Date** : 17/07/2020
Major Guide : Dr. S. L. Chawla	**Time** : 2.00 to 3.00 pm
Co-Guide : Dr. S. J. Patil	**Venue** : Online / Swami Vivekananda Hall

Advances in crop improvement in chrysanthemum

Chrysanthemum (*Dendranthema grandiflora* Tzvelev) is the second most popular ornamental plant in the global flower industry owing to its wide variations in form, colour, growth habit and utility for loose as well as cut flowers, landscaping and as a pot plant. There is still a need for novelty due to rapidly changing demands from chrysanthemum consumers, which forces breeders to search new sources of variation and to continuously create new cultivars. The natural as well as enforced mutations and intermating between a large genetic base, varying ploidy levels, self incompatibility and anemophily mechanisms leading to cross pollination have resulted in the developement of vide variations in the forms and colours of modern chrysanthemum. The methods of intergeneric and interspecific hybridization, polyploidy breeding, mutations and selections are the most common and conventional methods used in chrysanthemum improvement. In recent years, the advanced breeding techniques such as somaclonal variations, somatic hybridization, gene transformation, protoplast fusion, embryo rescue, *etc*. have resulted in developement of novel chrysanthemum types thus improving its genetic base.

Brief review of research work

Somaclonal variation

Miler and Zalewska (2014) performed an *in vitro* regeneration of adventitious shoots from two explant types, leaves and internodes, in eight chrysanthemum cultivars representing three groups consisted of original cultivars and their radiomutants. Under glass house cultivation, the phenotypes at anthesis were observed. Three new attractive variants with changed inflorescence colours were obtained from two cultivars (‘Albugo’ and ‘Alchimist Tubular’) from leaf explants which retained their phenotypes during subsequent vegetative propagations. The analysis of pigment content in ligulate florets revealed the presence of carotenoids in somaclones, while in control plants they were lacking. The genetic distinctiveness of new somaclones was corroborated with the estimation of the genetic similarity coefficients based on RAPD-PCR technique.

Somatic hybrids

Furuta *et al*. (2004) produced intergeneric somatic hybrids between chrysanthemum [*Dendranthema* × *grandiflorum* (Ramat.) Kitamura] and wormwood (*Artemisia sieversiana* J. F. Ehrh. ex. Willd) by electrofusion of mesophyll protoplasts. Out of 1,342 somatic hybrid plantlets with chromosome numbers 64–72 grown in pots in a greenhouse, only 23 plants flowered. These 23 somatic hybrid plants were examined for rust (*Puccinia horiana*) resistance and abnormal morphology in comparison with the parent plants. The somatic hybrid plants were male sterile and more resistant to rust than chrysanthemum with flower shapes and colors different from those of the parent plants.

Genetic transformation

Shinoyama *et al*. (2012) transformed chrysanthemum cv. Yamate Shiro using a disarmed strain of *Agrobacterium tumefaciens*, EHA105, carrying the binary vector pBIK102H69A and introduced the ethylene receptor gene from melon (CmETR1/H69A) into chrysanthemums to induce male sterility and prevent transgene flow via pollen. The results indicated that the mutated ethylene receptor was able to reduce both male and female fertility significantly in the genotypes with more significant results in three of the lines (Nos. 91, 191 and 324). In these lines, mature lines were formed only at 150C. Shinoyama *et al*. (2015) developed genetically modified chrysanthemums by introducing a modified *cry1Ab* gene of *Bacillus thuringiensis* var. Kurstaki HD-1 (*mcbt*) for resistance to lepidopteran pests and a modified *sarcotoxin IA* gene of *Sarcophaga peregrina* (*msar*) for rust resistance with or without the 5'-untranslated region of the *alcohol dehydrogenase* gene of *Arabidopsis thaliana* (*AtADH*-5'UTR, as *ADH*) through the leaf discs using a disarmed strain of *Agrobacterium tumefaciens*, EHA105, carrying the binary vectors pBIK201BPS or pBIK201ABPS which contain the *mcbt* and *msar* genes. The GM chrysanthemums accumulated more than 1.31 μg of *Cry1Ab* per mg of total soluble protein and showed a strong resistance against 4 species of lepidopteran larvae (*Helicoverpa armigera* and others) where all larvae died during the first instar stage. A strong resistance against white rust by *Puccinia horiana* was observed especially in the *ADH::msar*-transgenic chrysanthemum in which the expression level of sarcotoxin IA peptide was more than 19.5 μg per g fresh weight of leaves.

Hybridization

Aida *et al.* (2018) investigated artificial cross-pollination between colour-modified bluish transgenic chrysanthemums and the wild species *Chrysanthemum japonense* var. Japonense. They achieved relatively high seed set rates of 28.8%-53.5% with a wide variation in the size and shape of the flowerheads and leaves of the progenies and the parent plant. Most of the seedlings were assumed to be hybrids. Polymerase chain reaction applied to amplify the *Campanula F3'5'H* gene fragment confirmed the segregation and inheritance of the transgenes into the progeny cross. Some transgenic progeny exhibited a modified flower colour similar to that of the parent. The progeny were also demonstrated to have accumulated anthocyanins specific to the parent plant. The results confirmed the transmission of the transgenes to the interspecific progeny. Ohtsuka and Inaba (2008) carried out the intergeneric hybridization to diversify flower colour and growth habit of marguerite (*Argyranthemum frutescens*) using marguerite as the seed parent and annual chrysanthemum (*Glebionis carinatum*) or crown daisy (*G.coronaria*) as the pollen parent. The cross-pollination was followed by application of ovule culture to successfully obtain the seedlings. The ovule culture-derived plants showed novel characteristics in flower shape and colour (orange, reddish brown, or wisteria pink) that are not observed in marguerite with novel perpetual flowering habits in some types.

Mutation

Kim *et al.* (2015) irradiated the stem explants of standard-type chrysanthemum 'Migok' and spray-type 'Argus' cultivars by 40 Gy of gamma-ray, respectively to induce flower-colour variation and produced 7 stable and solid mutants from Migok and 4 from Argus with novel flower colours.

Setia (2016) treated the rooted terminal cuttings of two chrysanthemum cvs. Thai Chen Queen and Purnima with 0, 5, 10, 15 and 20 Gy dose of gamma rays for inducing novel traits in chrysanthemum at PAU, Ludhiana. LD50 dose was determined as 20 Gy dose for cv. Thai Chen Queen and 15 Gy for cv. Purnima. In both the cultivars, plant survival, vegetative growth parameters, flower diameter and number of ray florets were found to decrease with increasing dose of gamma irradiation. They reported 7 flower colour

variants in cv. Thai Chen Queen (three at 10 Gy, three at 15 Gy and one at 20 Gy) and two flower colour variants in cv. Purnima, one at 10 Gy and the other at 15 Gy.

Palai and Rout (2011) obtained three bud sports of chrysanthemum through spontaneous sporting with different flower colours as compared to the parent spray type varieties Yellow Regan and White Regan. All the three variants recorded significant morphological differences.

Chakrabarty *et al*. (2000) reported a bud sport in a large flowering cultivar ‘Kasturba Gandhi’ at NBRI, Lucknow as a sectoral chimera with a yellow flower colour against the origial white and rest morphological parameters as per the parent variety. They carried out the *in vitro* organogenesis and shoot regeneration from petals as explant.

Selfing

Nakano *et al*. (2019) isolated a natural self-compatible mutant of *Chrysanthemum seticuspe* and established a pure line through repeated selfing and resultant homogeneous strain was named Gojo-0 which was favorable for genetic analyses and compatible for interspecific hybridization with other chrysanthemum species. This diploid model strain of *C. seticuspe* was also having the flowering property and morphology similar to *C. morifolium*.

Wang *et al.* (2014) investigated the pistil receptivity, seed set and compatible index of 24 chrysanthemum cultivars to solve the argument over self-incompatibility in chrysanthemum of which only 10 produced self-pollinated seeds with the cultivar “Q10-33- 1” recording the highest seed set (56.50%) and compatible index (87.50). Ten of its progeny had a wide range of separation in seed set (0–37.23%) and compatible index (0–68.65). The results indicated that most of chrysanthemum cultivars were self-incompatible, while a small proportion of cultivars were self-compatible. In addition, there is a comprehensive separation of self-incompatibility among progeny from the same self-pollinated self-compatible chrysanthemum cultivar.

Wang *et al.* (2018) further studied the four selfed progenies of cultivar “Q10-33-1” and found a significant variation in fertility and seed set on self-pollination mainly attributable to differences in pollen germination percentage and pistil receptivity. They reported that the failure of the seed set in “Q10-33-1(10)” was possibly due to self-incompatibility.

Conclusion

From the ongoing discussion, it can be concluded that in the production of new and novel cultivars the advanced biotechnological methods should be commonly applied along with the conventional breeding methods. Somaclonal variations can be induced to create mutations for creating novelty in presesnt cultivars. Somatic hybridzation and elctrofusion of proptoplasts is a best method for crossing the genetically distant species while genetic transformation should be used for inducing genes for disease and pest resistance, novel colours which may be lacking in the chrysanthemum germplasm. These transgenic plants may further be utilized for further improvement through hybridization. But, in some cases the male as well as female sterility should also be introduced in the transgenic varieties to avoid the unnecessary genetic pollution. The sponataneous mutations such as bud sports can further be progressed by the organogenesis followed by shoot regeneration. It is also concluded that the conventional methods of breeding are still important at the starting phases of breeding programs, although cross-breeding in chrysanthemum is hindered for many reasons. The intergeneric crosses if successful can be progressed through ovule culture to get the progeny as they fail to develope mature embryos and seed naturally. The self compatible species and genotypes thereof should be identified and made to develope the pure lines for breeding programs.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES 2019-20

Speaker : Naik Bhoomi Parimal	Course : FLA- 691 (1+0)
Reg. No. : 1020218007	Date : 14-8-2020
Major Guide : Dr. Alka Singh	Time : 2:00 p.m. to 3:00 p.m.
Co. Guide : Dr. R. V. Tank	Venue : Swami Vivekananda Hall

Essential Oils in Ornamental Plants: Versatile Utility

Floriculture is gaining importance throughout the world and considered as one of the country's sunrise industry both in case of cut flowers as well as loose flowers. The area under flower crops in India has increased and reached up to 3,24,000 ha with a production of 19,62,000 MT of loose flowers and 82,3000 MT of cut flowers (Anon., 2018). An interweaving industry based on value addition in flowers is thriving, where in essential oil has its own importance. India is the 3rd largest producer of natural essential oils next to USA and Brazil. Essential oil is a concentrated hydrophobic liquid containing volatile aroma compounds from different parts of plant *viz.*, roots, flowers, leaves, seeds and bark. Essential oils are obtained either by hydro distillation or solvent extraction. Further, the increase in demand of the perfumery raw materials is very fast in the world trade and that has been exerting demand for essential oils also. Essential oils are used in the fragrance, food and pharmaceutical industries. It is also used in paint, pesticide, mining, petroleum industries and Aromatherapy.

Brief Review of ResearchWork

Cultivar

Adnan *et al*. (2009) evaluated different rose cultivars from four different species and found that the *Rosa damascena* cv. Gulqandi produced maximum (27.25 g) essential oil from 20 kg petals in Pakistan conditions.

Maximum essential oil (0.99%) was recorded in chamomile cv. Germiana at 120C temperature in Iranian conditions (Ebrahimi *et al.*, 2011).

Extraction Methods and Harvesting

Punjee *et al*. (2009) assessed extraction of scents and essential oils from *Michelia alba* with three different methods and reported that maximum oil (0.2250%) was extracted through water distillation method.

Adnan *et al.* (2009) obtained higher absolute (17.09 g) and concrete (25.09 g) of essential oil from 20 kg rose petals which were harvested during early morning (5.00 h.) as compared to harvesting during evening hours under Pakistan conditions.

Medicinal properties and Aromatherapy

Batchu *et al*. (2017) studied antibacterial activity of *(Michelia champaka* essential oil) (MCMO) against gram positive and gram negative strains of bacteria and reported that mean zone of inhibition was found to be high against *S. mutans* (30.33±1.04 mm) at a concentration of 200 mg/ml with MIC of 25 mg/ml. Thaweboon *et al*. (2018) studied inhibitory effect of jasmine oil against various oral microorganisms and reported that jasmine oil showed antimicrobial activities against *S. mutans*, *L. casei*, *E. coli* and all strains of Candida species with the zones of inhibition ranging from 9 to 26 mm.

Hongratanaworakit (2009) studied the relaxing effect of rose oil on humans and reported that rose oil significantly decreased autonomic parameters like systolic blood pressure (113.8±1.9), breathing rate (15.5±0.8), blood oxygen saturation (97.0±0.2) and increasing skin temperature (34.9±0.3); whereas, emotional parameters like alertness (30.5±4.7), calmness (20.2±4.1) and relaxation (29.0±4.1) are significantly increased.
Hongratanaworakit (2010) studied the stimulating effect of aromatherapy massage with jasmine oil and found that jasmine oil significantly increases autonomic parameters like systolic blood pressure (121.7±3.6), diastolic blood pressure (72.1±1.6), breathing rate (18.4±1.1), blood oxygen saturation (98.2±0.1); whereas, alertness (18.7±2.6), vigour (30.7±3.9) emotional parameters decreased.
Kurniawansyah *et al*. (2018) stated response of time evaporation of different three oils aromatherapy with concentration variation on number of bacterial colonies that ungrowth after evaporation and reported that minimum inhibitory concentration at 5% v/v with effective duration in 60th minute with lavender aromatherapy, whereas, 7.5% v/v with effective duration in 90th minute with rosemary and 5% v/v with effective duration in 60th minute with ylangylang aromatherapy.

Vase life

Shanan (2012) studied the application of essential oils to prolong the vase life of rose (*Rosa hybrida* L.) cv. "Grand" and revealed that maximum vase life (7.80 days), water uptake (0.84 ml/g), minimum bacteria counts (5.30 CFU/ml) and fungi counts (2.0 CFU/ml) were observed with the lavender essential oil; whereas, highest transpiration (0.35ml/g) was observed with geranium oil treatment.
Zarchini *et al*. (2013) studied the effect of artemisia oil on post-harvest parameters of cut chrysanthemum cv. white and reported maximum vase life (10 days), fresh weight (44.50 g) and dry weight (8.96) with 30% artemisisa oil as vase solution.
Bazaz *et al.* (2015) reported maximum vase life (14.71 days) and relative fresh weight (74.21 g/stem) chrysanthemum cut flowers with thyme essential oil at 100 mg/l concentration.

Conclusions:

From foregoing discussion it can be concluded that essential oils are noble alternative, increasingly being used for improvement of the quality of life. Essential oils are natural, safe and biodegradable compounds that have strong antimicrobial properties against various microorganisms. Essential oils can be effectively used as antibacterial agent against pathogenic strains like *E. coli*, *Listeria monocytogenes, L. innocua, Salmonella typhimurium.* They have aroma as well as antimicrobial properties. Rose oil and jasmine oil have been found to have relaxing effects on humans. Rose oil decreases autonomic parameters like systolic blood pressure, breathing rate, blood oxygen saturation and increasing skin temperature; whereas, emotional parameters like alertness, calmness and relaxation are significantly increased. Application of different essential oils have been found to increase vase life of various cut flowers like chrysanthemum and rose. Geranium, lavender, artemisia oils suppressed the blockage of xylem vessels by reducing the number of bacteria and fungi in vase solution and were very effective as antimicrobial agents in inhibiting the growth of microorganisms. Thus, essential oil possess effective antimicrobial properties along with aroma that positively influence on human psychology and has versatile application in life.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2020-21

Speaker : Pawar Ravindra Dadabhau	Course : FLA 692 (1+0)
Reg. No. : 1 0 2 0 218012	Date : 06/11/2020
Major Guide : Dr. S. L. Chawla	Time : 15.00 to 16.00 hrs
Co-Guide : Dr. S. J. Patil	Venue : Online / Swami Vivekananda Hall

Advances in production technology of pomegranate

India is the world's largest producer of pomegranates produced over 2.34 lakh ha area with an annual production of 28.45 lakh tonnes and productivity of 12.15 t/ha (Anon., 2018). In spite of this, India exports only 2.55 % of its total production. There is a tremendous potential for exports of pomegranate from India. Pomegranate has several salient features unique to its credit. It's ability to withstand heat, drought and moisture deficit, versatile adaptability, hardy nature, low maintenance cost, steady but high yields, better keeping quality, fine table and therapeutic values and possibilities to throw the plant into rest period when irrigation potential is generally low, indicate the avenues for increasing the area under pomegranate in India. It has immense medicinal and nutritional value. Pomegranate is one of the richest sources of antioxidants. It observed decreasing trend in area, production and productivity since 2009-10 owing to mainly the oily spot infestation and various other reasons. Since 2012-13, an increasing trend is witnessed. In the quality fruit production of pomegranate, varieties, propagation methods, training and pruning, mulching, water and nutrient management, mulching, use of plant growth regulators, fruit bagging, etc. play a very important role.

Brief review of research work
Propagation

Ahire et al. (2016) assessed eleven genotypes (rootstocks) and two propagation methods viz., wedge grafting and patch budding for cv. Phule Bhagwa Super and observed that wedge grafting was superior over patch budding in all aspects whereas among rootstocks, Bedana Suri and Alandi took the minimum time for bud sprout. The highest bud sprout at 30 day after grafting/budding, per cent survival of grafts/buds at 60 and 90 DAG/DAB, longest shoot length, maximum number of internodes, maximum girth at graft/bud union, highest fresh shoot and root weight were registered in Bedana Suri while, highest number of shoots and shoot: root weight ratio recorded in Ganesh and Kandhari, respectively.
Panjavarnam (2019) approved that plants raised through tissue culture improves the production and productivity of pomegranate and offers the possibility to obtain high quality fruits as it performed best in terms of maximum plant height, canopy volume, number of flowers and fruits/plant, fruit yield/plant, average fruit weight, fruit length and girth, rind weight, aril weight, rind to aril ratio, minimum days to first ripe fruit and quality attributes viz., total soluble solids, and anthocyanin content while, lowest titrable acidity over plants raised through grafts and air layers.

Training & Pruning

Hiremath (2017) studied the influence of pruning intensities in cv. Phule Bhagwa Super under organic conditions during Hasta bahar treatment and reported that pruning the shoot tips by 30 cm after one month rest period but before withholding of irrigation water; produced maximum number of secondary branches and length of fruit and recorded significantly maximum shoot length at 150 DAP, individual fruit weight, diameter and fruit yield per plant and per ha, whereas, unprunned control treatment possessed maximum number of flowers per shoot, significantly earlier flowering and fruit set with maximum number of fruits per plant registering maximum primary branches.
Sharma and Singh (2018) recorded the maximum shoot extension, fruit size (diameter, length, fruit weight), fruit volume, superior fruit qualities and reduction in fruit drop and fruit diseases in the treatment of retention of 15 cm fruiting shoot length + thinning. Whereas, control treatment recorded maximum values for plant height, tree volume, plant spread, fruit set percentage, number of fruits and yield per plant and marketable yield. All pruning treatments also proved beneficial in controlling fruit cracking, bacterial blight on fruit and leaf surface to some extent.

Irrigation

Haneef et al. (2014) conducted an experiment on four-year-old pomegranate orchard of cv. Bhagwa planted under HDP system at 2 m x 2 m spacing with four fertigation levels viz., 50, 75, 100 and 125 % RDF and three drip irrigation levels viz., 50, 75 and 100 % on pan evaporation basis and inferred that treatment combination 100 % RDF and 100 % drip irrigation at alternate day resulted in higher marketable yield and maximum net returns per ha with quality fruits having high juice content and organoleptic rating. Treatment combination 125 % RDF and 75 % drip irrigation gave maximum vegetative growth parameters.
Meshram et al. (2019) studied the effect of various micro-irrigation treatments on pomegranate cv. Bhagwa. Maximum number of flowers, number of fruits, average fruit weight, yield per plant, juice content, minimum fruit losses due to sun burn and cracking and maximum water use efficiency was recorded in subsurface drip irrigation system with 2-inline laterals (30 cm x 30 cm).

Nutrition

Thanari and Suma (2018) studied the effect of different fertigation levels of major nutrients on the fruit quality and yield of pomegranate during Hasta bahar season on Bhagwa variety and observed maximum number of hermaphrodite flowers, number of fruits per plant, fruit length and yield per plant and per ha in 75 % fertigation with schedule-2, while, 100 % fertigation treatment recorded maximum individual fruit weight and diameter. Thanari et al. (2019) recorded the superior fruit quality parameters with 100 % fertigation treatment in terms of higher values of titrable acidity, ascorbic acid content, phenol contents and antioxidant activities in peel and juice and juice mineral content (N, P, K, Ca, Mg, S). Kurer et al. (2017) investigated the efficacy of organics on growth behaviour and fruit yield of pomegranate cv. Super Bhagwa during Hasta bahar season in which RDN was applied through the different organic sources. Results revealed that 100 % RDN through vermicompost recorded significantly maximum vegetative growth (number of shoots/plant, shoot length, plant height and plant canopy spread in N-S and E-W directions) whereas 100 % RDN through poultry manure recorded significantly highest number of productive flowers, fruit set and yield.

Mulching

Sharma et al. (2017) applied five orchard floor management treatments in pomegranate cv. Kandhari Kabuli of which black polythene mulch proved to be most effective in increasing fruit set, yield (number and weight basis) of superior quality fruits with reduction in fruit drop and cracking percentage. Grass mulch was better in terms of fruit size and average fruit weight over other treatments.

Yograj et al. (2017) evaluated the effect of seven organic and inorganic mulch materials and reported that black polythene mulch (100 micron) was effective to improve the all aspects of fruit growth and yield of pomegranate cv. Bhagwa.

Plant growth regulators Anawal et al. (2016) studied the beneficial effects of ethrel, GA3 and NAA on induction of flowering in pomegranate cv. Bhagwa and revealed that application of ethrel at 250 ppm gave significantly maximum number of hermaphrodite flowers, minimum days taken for 50 and 100 % flowering and minimum losses due to intermediate and hermaphrodite flower drop whereas, NAA at 100 ppm resulted in maximum length and diameter of the flowers as against control. Jhade et al. (2019) sprayed ethephon at different concentrations (600, 800, 1000 and 1200 ppm) on pomegranate cv. Bhagwa plants during stress period for Ambia crop (Jan-Feb) and reported significant defoliation to a tune of 81.63 % to 96.53 % after 7 days of spraying in all treatments over untreated control and advised ethephon spraying @ 1200 or 1000 ppm for quick defoliation.

Fruit bagging

El-Wafa (2014) applied 7 bagging treatments 21 days after fruit set and sustained till harvest time and observed that bagging fruits with prgmen bag increased fruit weight, total and marketable yield/tree, fruit firmness while reduced the percentage of cracked fruits and sunburn fruits/tree as compared to the other treatments. Increased in TSS, total soluble sugars, vitamin C content and total anthocyanin content and reduction in acidity in fruit juice were also recorded over other bagging treatments. Sarkomi et al.(2019) evaluated two bagging types and different months of bagging and reported that white and brown bag effectively reduced fruit sunburn and cracking and decreased the total damaged fruits, particularly when fruits were bagged in the month of August and increased juice volume and weight when fruits bagged from July as compared with non-bagged control.

Conclusion:

The quality planting material raised through tissue culture should be preferred for improved growth, fruit quality and productivity of pomegranate whereas, among budding and grafting methods, wedge grafting on rootstocks Bedana Suri and Alandi is advocated. Pruning the shoot tips by 30 cm produced better growth, quality fruits and higher yields while retention of 15 cm fruiting shoot length followed by thinning in rejuvenation pruning reduced fruit drop and fruit diseases along with superior fruit qualities. The micro-irrigation through subsurface drip irrigation system with 2-inline laterals should be followed at 100 % of PE at alternate day and fertigation of major nutrients with 100 % fertigation for quality fruit production. For organic pomegranate production, 100 % RDN through poultry manure was best for superior yield and quality. For better orchard floor management, black polythene mulch (100 micron) was effective to improve the all aspects of fruit growth, quality and yield. Spray application of ethrel at 250 ppm during induction of stress produced significantly early and maximum number of hermaphrodite flowers and reduced flower drop, NAA at 100 ppm produced larger flowers, ethephon at 1200 ppm for quick defoliation during bahar regulation. Pre harvest fruit bagging at 21 days after fruit set with prgmen bag produced larger and nutritionally superior fruits with higher marketable fruits and reduced yield losses due to abiotic and biotic stresses.

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NAVSARI AGRICULTURAL UNIVERSITY
ASPEE COLLEGE OF HORTICULTURE AND FORESTRY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2020-21

Speaker : Naik Bhoomi Parimal	**Course : FLA 692 (1+0)**
Reg. No. : 1020218007	**Date : 5-12-2020**
Major Guide : Dr. Alka Singh	**Time : 8.30 to 9.30 a.m.**
Co. Guide : Dr. R. V. Tank	**Mode of presentation : Online**

Advances in fruit packaging techniques

India is a country with wide agro-climatic conditions with different climatic condition in differentparts of the country throughout the year. India ranks 2nd in fruit production in world after china. Packaging is one of the important considerations in fruit market to reduce post-harvest losses. The use of properly designed container for transporting and marketing of fruits can maintain their freshness succulence and quality for longer period. Packaging is required not only for preservation but also for safe transportation of product during handling and storage. Packaging is the system by which a fresh produce or processed product reaches from the production centre to ultimate consumer in safe and sound condition at an affordable price. Changes in consumer preference for safe food have led to innovations in packaging technologies. Different materials like LDPE, HDPE, CFB boxes, cling film, cellophane paper film, newspapers, teff straw, dried banana leaf, wooden boxes, plastic bags are used for packaging of fruits. Further, various smart packaging systems including sensors and specific indicators are also been reported. Modified atmosphere packaging and edible coatings are effective way of internal packaging that prolong shelf life and quality of fruits. There is need to adopt complete packaging technology to ensure good post-harvest quality of fruits at the consumer end at an affordable price.

Review of research work

Polyfilm Packaging

Kardile *et al*. (2014) studied the effect of packaging material and storage conditions on storage behaviour of sapota fruits. They found that minimum ripening and spoilage (%) were recorded when sapota fruits kept in LDPE bag + CFB and cold stored at 120 C temperature.
Ankalagi *et al*. (2017) studied the effect of packaging material on organoleptic evaluation of sapota var. Cricket Ball during storage. They reported that highest organoleptic score (7.313) was recorded in treatment 75 micron LDPE which was followed by 100 micron LDPE (7.057); whereas, lowest score (5.954) was observed in control. Pratap *et al*. (2017) studied the impact of different packaging materials on the shelf life of sapota fruits. They reported that minimum physiological loss in weight and decay loss were observed when fruits packed in shrink material. Whereas, maximum fruit pulp and peel ratio was observed with shrink and maximum specific gravity with cling film (23μ). Suchismita *et al*. (2019) studied the effect of different packaging films on shelf life and qualitative attributes of pomegranate fruit cv. Mridula under ambient environment and reported that among all the packaging materials, the pomegranate fruits packed in LDPE 25 micron film had the least reduction in physiological loss in weight at 3rd, 6th, 9th, 12th days of storage (0.38, 1.36, 4.19, 5.17%, respectively) and minimum decay loss 3.71 and 10.51% on 9th and 12th days of storage, respectively. Avesh *et al*. (2019) studied the effect of

different packaging materials on organoleptic rating during storage of transported guava cv. Hisar Safeda. They revealed that guava fruits packed in corrugated fibre board box lined with newspaper cutting had maximum organoleptic rating (7.94). Avesh *et al*. (2019) studied the effect of different packaging materials on change in colour during storage of transported guava cv. Hisar Safeda and reported that guava fruits packed in perforated poly bags, wooden box lined with paddy straw and corrugated fibre board box line with newspaper cuttings maintained fruits colour in acceptable limit at the end of the storage. Martha and Daniel (2019) studied the effect of different packaging materials on shelf life of banana (*Musa paradisiaca* L.) and found that highest moisture content (93.39, 96.86 and 98.28%) were observed in banana packed with polythene bag at 4th, 8th and 12th days of storage, respectively.

Modified Atmosphere Packaging

Antala *et al*. (2014) studied the effect of MAP on shelf life of sapota fruits. They observed that maximum overall acceptability and marketable fruits of sapota was found when fruits were packed in 25 micron LDPE bags with 5% O2 + 10% CO2 concentration on 49 days of storage. Sahel *et al*. (2018) studied the effect of modified atmosphere packaging on biochemical properties of pomegranate (*Punica granatum* L.) fruits. They reported that maximum ascorbic acid content and total antioxidant activity of pomegranate fruits was noted when fruits were packed in silver nano bag during all the days after storage.

Edible Coatings

Hazarika *et al*. (2017) studied the influence of edible coatings on physico chemical characteristics and shelf life of papaya (*Carica papaya* L.) fruits during ambient storage. They reported that minimum physiological loss in weight (7.83%) and maximum fruit firmness (3.84%) were recorded when papaya fruits coated with liquid paraffin wax at 16th days of storage.

Active Packaging

Mir *et al*. (2018) studied the effect of active packaging on quality and shelf life of peach fruits and they found significantly highest retention of ascorbic acid (9.73mg/100g) and maximum mean score of overall acceptability (7.50) were observed with ethylene absorber + 4 perforations in peach fruits.

Conclusion

On the basis of above findings it can be concluded that adaptation of proper packaging techniques by the industry can be useful for extending the shelf lie, improve quality and safety of different fruits for marketing and consumption. Fruits packed in LDPE 25 micron film had least reduction in physiological loss in weight and minimum decay loss. Corrugated fibre board boxes had significantly overall positive influence on different parameters. Banana fruits packed with plastic bag showed better result for moisture content. 75 micron is the advisable packaging material for sapota fruits because of their higher organoleptic score during storage. Sapota fruits kept in LDPE bag + CFB and cold stored at 120 C temperature recorded significantly minimum ripening and spoilage percent. Shelf life of sapota fruits could be increased up to 49 days by packaging in 25 micron LDPE bags at concentration 5% O2 + 10% CO2 and stored at 60 C with maximum sensory score. Pomegranate fruits packed with different MAP bags and stored in low temperature prolonged the storage and shelf life.

Paraffin wax was the most efficient edible coatings for extending the shelf-life and delaying the ripening of papaya fruit. Highest retention of ascorbic acid and highest mean score of overall acceptability were observed with ethylene absorber + 4 perforations in peach fruits.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATION SEMINAR SERIES 2020-21

Speaker : Jadhav Sheetalben Kirtikumar	Course : FLA 691 (1 + 0)
Reg. No. : 1020218004	**Date : 05/12/2020**
Major Guide : Dr. Alka Singh	**Time : 2:30 to 3:30 pm**
Co-Guide : Dr. R. V. Tank	Mode : Online

MANAGEMENT OF SALINITY STRESS IN FLOWER CROPS

Commercial floriculture has been emerging as a potential money-spinner and an economically viable agri-business in our country. About 3.24 lakh ha area in India is under floriculture with total production of 27.85 lakh MT out of which loose and cut flowers contributes to 19.62 lakh MT and 8.23 lakh MT respectively (Anon., 2018). The major problem in flower crops' cultivation is that they are frequently subjected to the environmental stress such as water deficit, freezing, heat and salt stress factors. Salinity is one of the most common environmental stress factors. It is a complex phenomenon and involves not just an osmotic effect but also toxic ion effects and nutritional imbalance. It is estimated that 8.9 % total world's land and 19.5% of the world's irrigated areas are affected by salinity (Shinde *et al*., 2015). Whereas, the vast majority of water on the earth's surface is saline water in the form of oceans having only about 1 % of fresh water (Gleick, 1993). Salinity problem is further aggravated by irrigation and is more in hot regions where there is excessive water loss through transpiration. Flowers should be irrigated with high quality of water having desirable amount of mineral (Cassaniti *et al*., 2012). Major management approaches have been adapted to avoid salinity problems *i.e.* natural salt tolerant plants, crop improvement techniques, seed priming, biological management, use of exogenous phyto-hormones and soil-water management.

Brief review of research work

Rose (B.N.: *Rosa spp.* Family: Rosaceae)

Safi *et al*. (2005) found that the soil planting gave maximum flower length, flower diameter, flower stalk length, flower stalk diameter and number of nodes per stalk in Natal Briar rootstock of rose combined with three saline irrigation (salinity range 2.5-3.0 dSm-1) frequencies than tuff planting.

Reezi *et al.* (2009) revealed that application of Si50 and Si100 without any saline water treatment showed maximum growth of rose var. Hot Lady. The same concentrations of silicon were also found effective to alleviate salinity stress than control in all growth parameters *i.e.* peduncle diameter, bud diameter, bud length, shoot length, flower number, leaf area index and chlorophyll content.

Ali *et al.* (2014) reported that foliar application of GA3 treatments (50 and 100 ppm) alleviate the negative effects of salinity on the growth, biochemical and anti oxidative activities of rose as compared to control. The most pronounced promotion was observed with the highest GA3 level. However significant decrease was observed with increased salinity level in all parameters.

Rehman *et al.* (2014) revealed that canal water excelled rest of treatments by producing maximum plant height, number of leaves per plant, number of branches per plant, leaf area, number of flowers per plant, flower diameter, flower quality, fresh and dry weight of flower and fresh-dry weight ratio followed by saline water level (2.5 dSm-1) in rose cv. Kardinal. Significant drop was observed with maximum salinity level (15.0 dSm-1) in all the morphological parameters.

Goldenrod (B.N.: *Solidago candensis*, Family: Asteraceae)

Jayakumari *et al*. (2017) studied the effect of saline irrigation water and GA3 on flowering parameters of goldenrod and reported that water with 1.23 dSm-1 of EC showed improved flowering growth followed by 3.00 dSm-1 of EC with significant decrease in growth. No plant survival was observed above 6 dSm-1 of saline water level at the end of experiment.

Tuberose (B.N.: *Polianthes tuberosa*, Family: Amaryllidaceae)

Ahir *et al.* (2017) concluded that all growth and flowering parameters of tuberose cv. Prajwal were significantly influenced by various salinity levels of irrigation water. However, all parameters were reduced drastically after irrigation treatment of 4.0 dSm-1 and above.

Rahman and Hoque (2018) reported that tuberose plants produced without salinity performed positively best in number of florets per rachis, vase life length of spikes and diameter of spike. Whereas days taken to spike initiation, number of spikes per plant found best in 2.00 dSm-1 of EC. The maximum weight of underground bulb was found with 4.00 dSm-1 of EC. Interaction effect of Mexican Single cultivar and controlled level of water positively affected above all flowering parameters whereas tolerated up to 4 dSm-1 of salinity level.

Spider lily (B.N.: *Hymenocallis littoralis*, Family: Amaryllidaceae)

Ahir and Singh (2018) investigated the effect of different levels of salinity of irrigation water on plant growth

and flowering of spider lily cv. Local. It was revealed that all growth, flowering and biochemical parameters were significantly influenced by various salinity levels of irrigation water. However, above 10.0 and 8.0 dSm-1 salinity level of irrigation water significantly reduced growth and flower production, respectively.

Gladiolus (B.N.: *Gladiolus grandiflorus*, Family: Iridaceae)

Ahir and Singh (2017) found that the gladiolus cv. American Beauty treated with best available water performed best in growth and flowering parameters. Whereas above 2.0 dSm-1 of saline water prominently decreased growth and flowering of gladiolus. No plant survival was observed in 12.0 dSm-1 of saline water treatment whereas no flower production was recorded in irrigation treatment 10.0 dSm-1 and above.

Carnation (B.N.: *Dianthus caryophyllus*, Family: Caryophyllaceae)

Safi *et al*. (2005) found that flowers with large size (length and diameter) and longer flower stalks were produced by the three carnation cultivars *i.e.* Voyore, Diana and Chad grown in soil than in tuff using treated saline water (2.5-3.0 dSm-1).

Freesia (B.N.: *Freesia spp.*, Family: Iridaceae)

Aydinsakir *et al.* (2010) reported that increased saline irrigation water levels decreased the corm, cormel and flower yield, flower stem length and diameter, flower numbers and flower spike length in all freesia varieties *i.e.* Oberon, Athena and Cordula under soilless condition. The Athena and Cordula varieties were found tolerant up to 3.0 dSm-1 of salinity stress whereas Oberon found sensitive.

Safflower (B.N.: *Carthamus tinctorius*, Family: Asteraceae)

Elouaer and Hannachi (2012) reported that the increase in salt stress level (0, 5, 10, 15 and 20 g/l) caused a significant decrease in safflower's seed germination and growth parameters in control as well as primed seeds but the decrease was more significant for non primed seeds than

NaCl and KCl seed priming. The most pronounced increase was observed with the NaCl priming in all parameters.

Shaki *et al.* (2017) studied the effect of salicylic acid (1 mM) on enzyme activities under salt stressed condition (0, 100 and 200 mM) in safflower at nursery stage. They found that application of SA significantly increased enzymatic activities *i.e.* SOD, PPO, POX, APX at 200 mM salinity level as compared to control.

Conclusion

It has become more important to manage salinity stress in flower crops to acquire higher quality of production. Rose rootstock Natal Briar performs best in soil with three frequencies of saline water (2.5-3.0 dSm-1) than soilless media. Application of silicon (50 and 100 ppm) increases growth and alleviate salt stress (3.8 dSm-1) effect in rose cv. Hot Lady. Foliar application of GA3 (50 and 100 ppm) is useful to promote rose growth, antioxidant and biochemical activities under salt stress. Rose cultivar Kardinal performs best with canal water application and it can tolerate up to 2.5 dSm-1 of salinity stress. Goldenrod shows best growth under less than 1.23 dSm-1 of salinity level whereas it can tolerate up to 3.0 dSm-1 of salinity level with 16 percent of reduced growth. Plant growth and flowering of tuberose shows prominent decrease with above 4 dSm-1 of salinity stress. Spider lily cv. Local gives good flower production up to 8.0 dSm-1 of saline level with overall good plant growth and flower quality. Gladiolus cv. American Beauty is a salt sensitive plant as above 2.0 dSm-1 of saline water level decreases the growth and flowering. Carnation cultivars Voyore, Diana and Chad can tolerate saline water (2.5-3.0 dSm-1) in soil better than soilless and produce good flower quality. The freesia varieties Athena and Cordula shows tolerance up to 3.0 dSm-1 of salinity stress whereas Oberon is a sensitive in comparison. Seed priming of safflower with NaCl and KCl increases germination and growth parameters than non primed seed. NaCl seed priming gives most pronounce increase in seed germination and growth parameters. Application of salicylic acid (1 mM) increases anti oxidative enzyme activity in safflower. Thus, different management techniques are very useful to alleviate negative effect of salinity stress in flower crops.

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NAVSARI AGRICULTURAL UNIVERSITY
ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
POST GRADUATE SEMINAR SERIES: 2015-16

Speaker	**: Mr. Sachin Sheth**	**Course : VSC-591**
Major guide	**: Dr. K.D.Desai**	**Date : 16-4-2016**
Co-guide	**: Dr. S.J.Patil**	**Time : 10:00 to 11:00 a.m.**
Reg. No.	**: 2020215057**	**Venue : Swami Vivekananda Hall**

Integrated weed management in tuber crops

A weed is a plant growing where it is not desired", Jethro Tull, a Great Britain farmer was the first to use this definition of weeds in 1731. Weeds are responsible for causing substantial losses in all field crops. The losses caused by weeds are much more alarming than the one caused by insect-pests, diseases, nematodes, birds or the rodents. Having diversified agro-climatic conditions in our country, wide ranges of weed spp. are observed. Many reasons could be attributed to low productivity of all crops, but among various biotic stress, weeds contribute significantly. Weeds cause enormous losses to crops by one or the other way so, they are a major concern for farmers and need effective management. Weeds can be managed by using different methods like chemical, cultural, mechanical and biological. Hence, integrated approaches to manage weeds are in great demand around the world particularly those that are cost effective and less harmful to the environment.

Weeds are ubiquitous and continue to be an important constrain in the production of crops. A conservative estimate of about 10% loss in the tropics would amount to a total loss of about 25 MT of food grains, currently valued at approximately Rs. 65000 crore (Yaduraju, 2012). The total economic losses will be much higher if indirect effect of weeds on health, loss of biodiversity, nutrient depletion, grain quality etc. is taken into consideration. Losses of similar magnitude would occur in root and tuber crops. IWM is more needed in root and tuber crops than in any other type of food crops as they have long growing season (Akobundu, 1987).

Integrated weed management (IWM) can be defined as a holistic approach to weed management that integrates different methods of weed control to provide the crop with an advantage over weeds (Neil, 2013). The concept of integrated weed management (IWM) has been around for a long time but has not been taken very seriously. Traditionally, tillage and other cultural methods have been practiced as a means of weed control. Growers adopting reduced or zero tillage systems can no longer depend on these practices as components of an IWM system. The ultimate goal of an IWM system should be to reduce the movement of weed seeds into the soil and to reduce the impact of weeds on crops to an economically acceptable level. The emphasis should be given on management rather than eradication.

There are two major approaches for weed control

- Preventive weed control
- Control techniques - pre and post crop planting

BRIEF REVIEW OF RESEARCH WORK

Potato (**B.N.:** *Solanum tuberosum* L.), (**Family:** Solanaceae)

Manorama (2004) assessed the effect of different weed management practices and found highest WCE (80.9 %), tuber yield (24.7 t ha-1) and net return in T8 (Alachlor 2.0 kg ha-1 as PE) treatment.

Effect of different integrated weed management treatments on six different weed species, yield and economics were evaluated by Khan *et al.* (2008) at Munshigunj, Bangladesh. They found 100 % control of all weed species in T3, T4, T6 and T7 treatments, over non weeding treatment and got maximum tuber yield (29.58 t ha-1) in T6 [Mulching + Herbicide (Ronstar 25 EC @ 1 ml/lit.

water) spray at 7 DAP + weed uprooting at 25 DAP] treatment which was statistically remained at par with all other treatments except T1 (untreated control). They got higher BCR in T6 treatment.

Biswajit *et al.* (2012) studied an integration of weed management practices under alluvial soil of Durgapur, West Bengal and revealed that total weed density at different growth stages was found lowest at 30, 60 and at harvest (6.03, 5.95 and 17.56 m-2, respectively) in T3 (Hand weeding @ 20 DAP + Mulching) treatment. Lowest weed biomass was recorded in same treatment at 30 and 60 DAP (2.11 and 4.84 g m-2, respectively) but at harvest it was recorded lowest (11.05 g m-2) in T7 treatment. Treatment T3 showed highest WCE (%) at 30 and 60 DAP (74.55 and 74.91 per cent, respectively). Whereas, it was found highest (61.05 per cent) in T7 treatment at harvest. The highest tuber yield (29.32 t ha-1) and B:C ratio was recorded in T3 treatment.

Sweet potato (**B.N.:** *Ipomoea batatas* (L.) Lam.), (**Family:** Convolvulaceae)

Lewthwaite and Triggs (2000) tested a set of treatment having single application of different herbicides and hand weeding. They recorded minimum weed count (25 m-2) and minimum weed dry weight (29.4 g m-2) in T2 (Acetochlor 2.4 a.i. kg ha-1, Incorporated in soil before T.P.) treatment. They obtained highest total and marketable yield (27.5 and 26.7 t ha-1, respectively) in the treatment of hand weeding done twice (T1) and both yields were remained at par with T2 treatment. The highest (31.6 %) root dry matter was obtained with the application of clomazone applied once (T10).

Momanyi *et al.* (2016) trialled out integrated weed management practices at two different sites (Muguga and Siaya) and with two different varieties in Kenya. At Muguga both the varieties *viz.*, SPK-004 and Kemb-10 yielded the highest (29.54 and 21.72 t ha-1, respectively) when weeded twice. At Siaya both the varieties *viz.*, Cuny-Kibuonjo and Bungoma yielded the highest (33.28 and 30.68 t ha-1, respectively) in mulched plots.

Colocasia (**B.N.:** *Colocasia esculenta* (L.) Schott), (**Family:** Araceae)

Ademiluyi (2013) evaluated different methods of weed control in colocasia and found minimum average weed density and biomass in T6 (Diuron + Hand weeding) treatment. Same treatment recorded higher no. of green leaves (5.7), no. of cormels (8) and weight of cormels (2.61 kg) per plant.

Tannia (**B.N.:** *Xanthosoma sagittifolium* (L.) Schott), (**Family:** Araceae)

Abasi and Onwueme (1981) assessed the effect of hand weeding and herbicide application in tannia and found maximum corm and cormel yield (352.3 and 356.3 g, respectively) per plant with 7721.4 kg ha-1 total yield in the treatment of herbicide (ametryne and paraquat) application. They found minimum cost of weed control in same treatment *i.e.* herbicidal application.

Elephant foot yam (**B.N.:** *Amorphophallus paeoniifolius* (Dennst.) Nicolson), (**Family:** Araceae)

Bhaumik *et al.* (1988) studied the herbicidal effect and methods of planting on dry weight of total weeds, growth and corm yield of EFY. They observed lowest weed dry matter (66.3 g m-2), highest shoot length (79.2 cm), girth of shoot (18.1 cm), canopy spread (102.7) and corm yield (65.1 t ha-1) of elephant foot yam in M2H6 (planting followed by complete earthing up + hand weeding) treatment.

Different integrated weed management practices on growth and yield of EFY at Kovvur, under Andhra Pradesh conditions were tested and found significantly highest plant height (78.20 cm), stem girth (14.10 cm), canopy spread (116.46 cm) in T8 (straw mulch at the time of planting) treatment. Highest corm yield (47.44 t ha-1) was also noted in same treatment but remained at par with T3 treatment. Lowest monocot weed population (10.5 m-2) was recorded in T9 treatment whereas dicot weed population and weed dry weight were recorded minimum in T10 treatment with 1 m-2 and 12.1 kg ha-1, respectively (Anon., 2006 a). Another experiment with same set of treatment was evaluated at Kalyani, under West Bengal conditions and found that treatment of polythene mulch recorded significantly highest corm weight (3.98 kg) per plant and corm yield (71.07 t) per hectare. Whereas, higher BCR (2.78) was obtain in the treatment of straw mulch (Anon., 2006 b).

Cassava (**B.N.:** *Manihot esculenta* Crentz.), **Family:** (Euphorbiaceae)

Chikoye *et al.* (2007) evaluated the effect of integrated management practices on tuber yield and economics of cassava. They recorded higher tuber yield (14,589 kg ha-1), crop value (77,478 N ha-1), yield per cent increased (61) over FP (Farmers practices) and B:C ratio (3.94) with minimum cost (19680 N) of weed control in application of Glyphosate only.

The experiment was conducted to study the effect of different weed management practices on no. of tubers per plant and yield (t ha-1) for two years at Yethapur, under Tamil Nadu conditions. Based on pooled analysis they concluded that treatment of black polythene mulch recorded higher no. of tuber per plant (8.15). Same treatment recorded higher tuber yield (32.82 t ha-1) which remain at par with T3 (four hand weeding: 1, 2, 3 & 4 MAP) treatment (Anon., 2013 a). Similarly, same set of treatments was tested at Jagdalpur, under Chhattisgarh conditions and the maximum tuber yield (23.85 t ha-1) was obtained in T3 treatment which was remained at par with T10 treatment. Further, they recorded that minimum weed index and highest B:C ratio was also obtained in same treatment. Whereas minimum weed population (9.25 m-2) and maximum WCE (97.65 %) was obtained in T10 treatment (Anon., 2013 b).

Conclusions:

Weeds are the major constraints in root and tuber crop production. No single method of weed control is effective in controlling weeds as the weed flora and their growth habits vary widely. With the labour shortage looming large and cattle population dwindling rapidly, use of power weeder, mulch, herbicides, *etc.* becomes inevitable for proper weed management. Due to increased use of herbicides, the issues such as herbicide residues in the soil, water and food, resistance to herbicides in weeds etc. would come into prominence and such issues warrants attention. Best results are therefore obtained when a number of practices are simultaneously followed which are economically affordable and chemically less hazardous. In potato and sweet potato, herbicidal application in combination with hand weeding and mulching were found best. In Colocasia and Tannia application of herbicide followed by hand weeding was found better in controlling weed. EFY and cassava gave better results when mulched with black polythene.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post Graduate Seminar Series 2016-2017

Speaker : Ms. Navya. K	**Course** : VSC 591 (1+0)
Reg. No. : 2020215030	**Date** : 20/08/2016
Major Guide : Dr. K. D. Desai	**Time** : 8:30 to 9:30 a.m.
Co-Guide : Dr. Y. N. Tandel	**Venue** : Swami Vivekanand Hall

Importance of molecular markers in root and tuber crops

Root and tuber crops are the third important group of food crops, after cereals and grain legumes that constitute either staple or subsidiary food for about one fifth of the world population and have utmost importance for the world food security. They have very high productivity with less inputs. They can also be used as animal feed and raw material for processing industries. They are the major sources of energy in developing countries with fast population growth and high urbanization rates. They are the staple food for hundreds of millions of poor people and contribute significantly to generate extra income and nutritional well-being of people especially in the tropics.

A molecular markers is basically a DNA sequence that is readily detected and whose inheritance can be easily monitored. The development and use of molecular markers for the detection and exploitation of DNA polymorphism is one of the most significant developments in the field of molecular genetics. During the one and half decades, molecular markers have been entered the scene of genetic improvement in a wide range of vegetable crops including root and tuber crops. Among the major traits targeted for improvement in root and tuber crops breeding programs are germplasm characterization, varietal identification, biotic and abiotic stress resistance, yield and quality. Molecular markers are tags that can be used to identify specific genes and locate them in relation to other genes. Genetic mapping of disease resistance genes will help to improve the efficiency of plant breeding program, and it will lead to better understanding of the molecular basis of resistance.

Brief review of reasearch work

Cassava

Okogbenin *et al*. (2012) conducted experiment on molecular marker analysis and validation of resistance to CMD in elite cassava genotypes of Nigeria. Resistance to CMD of two Nigerian cassava cultivars (TMS 97/2205 AND TMS 98/0505) was analyzed with markers (SSR and SCAR) and in the field for four years. Molecular data indicated that CMD resistance in the two Nigerian cultivars was mediated by the *CMD2* gene. Results showed TMS 97/2205 to be highly resistant.

Akinbo *et al*. (2007) detected RAPD markers linked to resistance to cassava anthracnose disease. F1 progenies were produced from a cross between resistant genotype TME 117, and susceptible genotype TMS 92/0326 and screened with two hundred decamer primers. Bulk segregant analysis was used to search for RAPDs linked to anthracnose resistance in F1. The gene was linked on both the sides by the primers OPAF2 and OPFO06 at 13.1 and 22.2 cM. This is the first report of molecular markers used as tag to CAD resistance.

Potato

Barone *et al*. (2004) studied the application of MAS for the introgression of genes from one genotype to another through a backcross breeding scheme. *Gro1* gene, resistant to the *pathotype* Ro1 of the nematode *G. rostochinensis* was located on the mp by Positive assisted selection. Of the 58 RFLP markers tested, 10 mapped to chromosome VII showed linkage with *Gro1* gene. Likewise *Rp1l* and *Ns* genes for resistant to *p. infestance* & PVS localized on chromosome VII & VIII respectively. Negetive assited selection, for reducing the wild genome content and linkage drag around the introgressed gene. Species specific molecular markers are excellent tools to select against the donar genome thus speeding up the recovery of recurrent genome.

Rosa *et al*. (2010) evaluated a set of microsatellite markers for varietal identification and characterization of most widespread potato cultivars in Brazil. The DNA from 14 cultivars were genotyped and the alleles were scored. Twenty-four microsatellite markers evaluated, and only one locus was monomorphic. Based on band patterns, set of two that were able to identify and differentiate all examined cultivars was obtained.

Sweet potato

Douglas *et al*. (2010) conducted a study to establish the genotypes identified as resistant or susceptible to SPVD in Kenya could be distinguished using molecular markers. A set of thirty genotypes consisting of 15 resistant and 15 susceptible were used to develop classification models. AFLP marker profiles were generated for each individual and used in association studies to identify markers suitable for classifying the two predefined phenotypic groups. Four markers which gave 100% correct classification of the two groups were selected.

Tannia and Taro

Schnell *et al*. (1999) evaluated eighteen cultivars of cocoyam and two cultivars of taro for the genetic relatedness using RAPD data. Seven random primers generated 40 RAPD loci. The molecular data indicated that very little genetic variation exists within the accessions of cocoyam and large variation between cocoyam and taro.

Arrowroot

Asha *et al*. (2015) studied the molecular characterization of seven arrowrrot accessions using 12 ISSR primers and to estimate the extent of diversity. These 12 primers were successful in differentiating all the accessions with no duplicates. The results also indicated that primers selected will be useful for the future genetic studies andprovide genetic base for selection of diverse parents for crop improvement in arrowroot.

CONCLUSION

With the help of molecular markers the breeding efficiency can be effectively increased by reducing the breeding cycle where majority of the root and tuber crops have a long production cycle which also can aid in reducing the input costs. Marker technology can integrate the conventional breeding by easy identification of desirable traits and increasing the selection intensity. Markers are the powerful tool in biological research and plays an increasingly important role in the evolution of newer ways of plant breeding.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2016-2017

Speaker	**: Lathiya Jasmin Bharatbhai (Reg. No.: 2020215028)**	**Course**	**: VSC-591**
Major Guide	**: Dr. Sanjeev Kumar**	**Date**	**: 20-08-2016**
Co- Guic	**Dr. T. R. Ahlawat**	**Time**	**: 11 to12 a.m.**

Microgreens: A Homestead Vegetable Production Option for Food and Nutritional Security

The spectrum of life in terms of income, life style and spending is changing rapidly with economic development. Diet related diseases such as obesity, diabetes, cardiovascular disease, hypertension, stroke and cancer are escalating both in developed and developing countries, in part due to imbalanced food consumption patterns.In developing countries like India, 13.5% people are chronically undernourished with Western-Asia and Sub-Saharan Africa, the most severely affected regions(Anonymous, 2015). Microgreens: a new class of edible vegetables with lots of potential in term of nutritional ability to cure various deficiencies (Pinto *et al.*, 2015).

There are more than 25 microgreenscommercially grown all over the world. Phytonutrient levels differ according to growth stages of the plant and often decrease from the seedling to the fully developed stage(Ebert *et al*., 2014).Microgreens are 4-6 times more nutrient dense than their mature counterparts (Xiao *et al.,* 2012). So, microgreens can be termed as 'Functional Foods', which have health promoting or disease preventing properties. In recent years, consumption of microgreens has increased along with consumer awareness and appreciation for their tender texture, distinctive fresh flavours, vivid coloursand concentrated bio-active compounds such as vitamins, minerals, antioxidants *etc.*

Review of Literature:

Nutritional Importance:

Dagmar*et al.* (2010) carried out DPPH assay to estimate antioxidant activity as gallic acid equivalent in common and tartary buckwheat microgreens and observed higher antioxidant activity in tartary buckwheat than those of common buckwheat microgreens.Sudtirol-3was the only common buckwheat variety having higher antioxidant activity than cv. 01Z5100001 of tartary buckwheat.

Xiao *et al.* (2012) assessed commercially grown microgreens for different nutritional components and observed higher levels of TAA in cabbage, phylloquinone and violaxanthin in garnet amaranths, β-carotene and lutein in red sorrel, therebyhighlightingthe relevance of individual microgreen for different nutritionally important compounds.

Ebert *et al.* (2014) evaluated four cultivars of amaranth separately as microgreen and mature greens for various nutritional parameters and found higher levels of neoxenthin, lutein, α-carotene and β-carotene in microgreens of cv. VI04470 compared to its fully grown stage. Likewise, cv. VI047164 emerged as single cultivardisplaying higher level of chlorogenic acid compared to other microgreens as well as fully grown amaranths. The organoleptic study revealed high appreciation for appearance in cv. 047764, whereas'VI044470' and 'Hung-Shing-Tsai' received the highest rating for texture, taste and general acceptability.

Pinto *et al.* (2015) carried out comparative analysis of mineral profiles in microgreens andmaturegreens of lettuce and observed significantly higher content of minerals like Ca, Mg, Fe, Mn, Zn, Cu, Mo and Se in microgreens compared to mature greens. The presence of lower level of nitrate content in microgreens than mature greens signifies their importance as safer food item in human diet particularly for children.

Xiao *et al*. (2016) analyzed mineral composition of popularly grown microgreens of Brassicaceae family and found variable potential of these microgreens with highest Ca, Mg in cauliflower, P in broccoli, K in arugula and Fe in kohlrabi purple. All the microgreensanalyzed under study for the presence of heavy metal Cd were found free from this toxic element.

Germination:

Lee *et al*. (2004) studied the effect of different seed treatments on seed germination of beet and chard and observed higher final germination percentage (FGT) of 99% and 91% in beet and chard, respectively through matric priming treatment. However, seed treatment with H_2O_2 registered earliest germination in both the types of *Beta vulgaris*.They further studied that horizontal vermiculite orientation resulted in a higher germination percentage along with longer radicles than vertical vermiculite orientation. Shoot fresh weight was little affected by vermiculite orientation in beet but was reduced slightly within the vertical orientation when seeds came from the bottom rather than top. Whereas, horizontal vermiculite orientation gave greater shoot fresh weight in chard than the vertical orientation.

Fertilizer:

Kou*et al.* (2014) studied the effect of different sources of calcium on hypocotyl length of broccoli microgreens and observed significantly higher hypocotyl length with 10 mM $CaCl_2$ application. They further compared fresh weight, dry weight and calcium content in broccoli microgreens raised with water and best treatment (10 mM $CaCl_2$) and reported significantly higher value ofthese componentsin microgreens sprayed with $CaCl_2$.

Light:

Brazaityte *et al*. (2015) carried out an experiment to determine the effect of UV-A on antioxidant content of beet microgreens under different lighting regimes with different degree of UV-A supplementation. The study revealed that supplemental UV-A resulted in increased DPPH radical scavenging activity. The lower UV-A irradiance level have no effect on phenol content but it increased significantly at +402 nm supplementation and anthocyanin content was also greatest under UV-A supplementation of +390 nm. Ascorbic acid significantly increased at +366 nm UV-A radiance which was further higher in +402 nm irradiance in EXP-2. At higher irradiance level, all supplemental UV-A had a positive effect on α-tocopherol content of microgreens with highest level in +366 nm. They also noticed greater effect of supplemental +366 nm irradiance on flavonol index. UV-A exposer increased nitrate content in microgreens,however maintained below the limit not affecting human health.

PTO

Viktorijaand Akvile(2015) studied the effect of different light treatments on growth and nutritional parameters of mustard microgreens and observed no gain in hypocotyl length, plant heightand leaf areain LED compared to control(HPS). However, artificial light treatment affected nutritional parameters significantly with highest impact of LED 250 treatment on ascorbic acid and total phenol content with at par response in LED 150. Whereas, total anthocyanin content was significantly higher in microgreens grown under LED 150 treatment. Artificial lighting also increasedflavonoland $ABTS^+$significantlyover control irrespective of LED lighting.

Disease Management:

Pill*et al.* (2011) studied the response of beet to damping off upon treatment with*Trichodermaharzianum*(Th)+*Trichodermavirens*(Tv) and observed lowest degree of damping off in seeds treated with *ThTv* at the rate of 1 mg per seed ball under 0.5 and 1.0 (*Pythium aphanidermatum*) levels of inoculum. However, seed treated with 0.25 mg recorded early germination.

Post Harvest:

Chandra *et al*. (2012) studied the changes in off-odour of chinese cabbage treated with different sanitizers and packaging films during storage and observed minimum undesirable off-odour development in microgreens sprayed with citric acid followed by ethanol,when stored in polyethylene during storage time.

Kou *et al*.(2013) studied the effect of storage temperature on changes in aerobic mesophilic count and tissue electrolyte leakage of buckwheat microgreens and observedsignificantly higher bacterial count(1-2 log CFU/g) in microgreens stored at 15 and 20 ^{o}C than those stored at 10, 5, and 1 ^{o}C after 10 days of storage. Microgreens stored at 10^{o}C showed minimum activity of bacteriaeven after 14 days of storage. Similarly, microgreens stored at lower temperatures revealed minimum electrolyte leakage and remained constant during all the period of storage. TheOTR level of 16.6 (m^2 s Pa) turned out to be best storage atmosphere for minimum electrolyte leakage, which was at par with the level of 29.5 (m^2 s Pa).

Conclusion:

A new class of edible vegetablespopularly termedas 'Microgreens', are concentrated with various bio-active compounds like vitamins, minerals, antioxidants*etc*. for health promotion and disease prevention.So, it can be inferred that higher level of antioxidant in tartary buckwheat microgreens may be helpful to deal with oxidative stress. Microgreens of amaranths possessed higher amount of bio-active compounds in contrast to full greens but showed specificity with respect to cultivar. Similarly, higher level of TAA in cabbage, phylloquinone and violaxanthin in garnet amaranths,*β*-carotene and lutein in red sorrel highlighted the importance of individual microgreen for various phytonutrient compounds. The higher level of minerals in most of the microgreens can be used as health promoting strategy to meet the requirementsforelementarydietary intake. Matric priming could be important for better germination in *Beta vulgaris*. Broccoli microgreens raised with the application of $CaCl_2$ showed higher fresh-dry weight and calcium content. UV-A irradiation supplemental at +360 was important to improve antioxidant property of microgreens. However, microgreens exposed to various UV lights supplementation responded variably for various phytochemical compounds. Similarly, cultivation of mustard microgreens under LED 250 increased ascorbic acid and phenol content, whereas total anthocyanin content was found to be higher under LED 150. Susceptibility of microgreens to damping off can be minimizedthrough seed treatment with *ThTv.*Spraying chinese cabbage microgreens with citric acid followed by ethanol was observed as best treatment to avoid undesirable off-odour, when stored in polyethylene. Buckwheat microgreens showed minimum activity of mesophilic bacteria even after 14 days of storage at 10^{o}C. Modified atmosphere of 16.6 (m^2 s pa) OTR was observed to maintain lowest electrolyte leakage for freshness retention in microgreens.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2016-2017

Speaker	:	**Nikki Bharti (Reg. No.: 2020215031)**	**Course**	:	**VSC- 591**
Major Guide	:	**Dr. Sanjeev Kumar**	**Date**	:	**20-08-2016**
Co- Guide	:	**Dr. R.V. Tank**	**Time**	:	**3 to 4 p.m.**

Genetic and Physiological Aspects of Grafting in Vegetable Production

Vegetables are nutritionally rich, often referred as ‘Protective Food’. These are high value crops and remunerative enough to replace subsistence farming. However, Vegetable crops are very sensitive to climatic vagaries and sudden rise in temperature as well as irregular precipitation at any phase of crop growth can affect the normal growth, flowering, fruit development and subsequently the yield (Afroza *et al*., 2010). Grafting in vegetable has emerged as a promising and an alternative tool to the relatively slow conventional breeding methods aimed at increasing tolerance to biotic and abiotic stresses (Bahadur *et al*., 2015). Grafting is considered as a surgical alternative over plant breeding. Production of grafted plants was first started in Japan and Korea in late 1920s with commercial applicability in Japan during 1960s (Davis *et al*., 2008).

Review of Research Work:

Genetic Aspects:

Genetic Potential:

Bletsos (2006) undertook a study of comparative analysis of chemical sterilants and grafting against *Verticillium* wilt of eggplant and found that plants grafted on *Solanum torvum* exhibited significantly lowest leaf symptom index (LSI) and disease index (DI) against *Verticillium* wilt statistically at par with ones that grown in soil treated with calcium cyanamide and methyl bromide during 1st year of study. Although, grafted eggplant exhibited low LSI with at par results as observed in soil treated with calcium cyanamide but grafted plants recorded significantly lower DI compared to calcium cyanamide in 2nd year of his study.

Saccardo *et al*. (2006) studied the response of commercial rootstocks of pepper to soil borne pathogens mainly *Phytophthora capsici* and root knot nematode and categorised Snooker as a potential rootstock governing resistance through CaRGA gene for *P. capsici* . They further identified DRO8801, ES 98-1, ES 00-40 and RX 600 rootstocks carrying *Mi, Ma, Mj* genes of resistance for root knot nematode.

Gilardi *et al*. (2011) studied the disease reaction of different tomato rootstocks to soil borne pathogens mainly *Fusarium oxysporum, Ralstonia solani* and *Verticillium dahliae* and identified He-Man, Maxifort and Natalya as potential rootstocks governing resistance through I-1 and I-2 genes for *F. oxysporum*. Simultaneously, they also categorized all the rootstocks as resistance to *R. Solani* at 15 and 30 DAP except Natalya. Whereas all the rootstocks under investigation showed resistant to *F. oxysporum* f.sp. *radicis-lycopersici* and *V. dahlia* at all the stages of artificial inoculation.

Johnson *et al*. (2014) compared *Verticillium* severity of grafted and ungrafted eggplant in naturally infested field at Eltopia and greenhouse condition at Mount Vernon during 2010 and 2011 and observed that eggplant grafted on ‘Beaufort’ had lowest *Verticillium* wilt severity at both the conditions in different years.

Mechanism of Resistance:

Wu *et al.* (2013) demonstrated alteration through DNA methylation in inter-specific grafting in solanaceous vegetables by MSAP and compared three kinds of methylation levels (CG, CHG and total methylation) in hetero-grafted and self-grafted plants. However, they observed alternation in DNA methylation level only in specific case of grafting tomato on eggplant thereby causing dynamic changes in steady state transcript abundance of gene encoding for a set of enzymes functionally relevant to DNA methylation.

Physiological Aspects:

Salinity:

Colla *et al*. (2012) exposed cucumber plant grafted on PS1313 rootstock to different salt stresses such as NaCl and Na_2SO_4 and observed that grafted plants are more capable of maintaining higher stomatal conductance (g_s), chlorophyll content (SPAD index) and membrane selectivity (electrolyte leakage) under such condition for better performance.

Drought:

Agele and Cohen (2009) studied the inter-relationship of scion, rootstock and graft types on leaf water potential (lwp) in melon using Arava (AR) as a rootstock for two genotypes (RS 57 and RS 82) through side and V method of grafting and observed highest lwp in self-grafted plants of melon. However, genotype RS 57 showed higher lwp upon grafting on AR rootstock following V method of grafting. They also studied effect of genotypes and graft types on hydraulic conductance in grafted melon and recorded high hydraulic conductance in genotypes RS 82 when grafted on AR rootstock through side grafting.

Flooding:

Bahadur *et al*. (2015) studied the performance of grafted tomato onto eggplant and ungrafted tomato by exposing to waterlogging stress for 72 and 96 hours during vegetative and reproductive stages, respectively and found that tomato plant grafted on rootstock IC-354557 did not show any wilting symptoms during all the stages under observation.

Thermal Stress:

Low Temperature:

Lee *et al*. (2005) investigated the lipoxygenase enzymes activity in the roots of cucumber and figleaf gourd- a potential rootstock of cucurbits in response to low temperature stress and concluded that chilling stress induces significantly higher lipoxygenase activity in figleaf gourd thereby performing better under low temperature stress.

Li *et al*. (2015) studied the effect of low temperature on change in electrolytic leakage rate in ungrafted and grafted cucumber cv. Xintaimici by using three rootstocks Kilameki, Tielizhen and Figleaf gourd and observed varied response of these rootstocks to electrolytic leakage with lowest in cucumber grafted onto figleaf gourd compared to other grafted plants.

High Temperature:

Abdelmageed *et al.* (2004) carried out a study on electrolyte leakage in grafted tomato under high temperature stress by using heat tolerant cultivars ‘Summer Set and Black Beauty’ as rootstocks and noticed lowest electrolyte leakage in tomato cv. UC 82-B grafted onto the rootstock of Black Beauty.

Heavy Metal:

Kumar *et al*. (2015) studied the role of grafting and Arbuscular Mycorrhiza (AM) on heavy metal tolerance in tomato by using two graft combinations (self-grafted ‘Ikram’ and Ikram grafted onto ‘Maxifort’) with and without AM with an exposure of to 0 and 25 μM Cd levels. The study revealed that Ikram/Maxifort combination induced higher antioxidant enzymes and proline synthesis in the absence of AM and had a high ROS scavenging activity than self-grafted plants to reduce the effect of this heavy metal.

Conclusion:

Grafting has emerged as one of the promising tools to enhance plant performance of various vegetable crops with a capacity to deal with biotic and abiotic stresses. Grafting provides opportunities to transfer some genetic variations of specific traits of rootstocks to influence the phenotype of scion. Genetic potential of commercial rootstocks like Snooker and DRO8801, ES 98-1, ES 00-40, RX 600 can successfully be exploited against *Phytophthora* and root knot nematode, respectively in pepper. Grafting eggplant onto *Solanum torvum* has been found to express effective control for *Verticillium* wilt and emerged as better alternative to chemical sterilants. Analysis of DNA methylation levels through MSAP marker has established that grafting can produce extensive and heritable alteration to transfer traits from stock to scion. PS1313 rootstock has shown inherent capacity against salt stress in cucumber by maintaining higher stomatal conductance, chlorophyll content (SPAD index) and membrane selectivity. Grafting melon with different graft types induces modifications in root-shoot relationships and thus, affects hydraulic characteristics of the sap pathway and water relations in grafted melon. IC-354557 is a potential tomato rootstock, which may improve waterlogging tolerance during vegetative as well as reproductive stages. The higher activity of lipoxygenase and low electrolyte leakage in figleaf gourd has proven better response to low temperature stress and may provide broad insight into stress response mechanisms. Similarly, exhibition of low electrolyte leakage in tomato cultivar grafted on rootstock Black Beauty reflect its tolerance to high temperature. Grafting tomato involving vigorous rootstock such as Maxifort could effectively mitigate the adverse effects of Cd stress by increasing the capacity of antioxidant enzymes and proline. Therefore, it is envisaged that various conventional and modern approaches of science should be collaborated to identify mechanism and pathway of rootstock-scion relationships for better understanding and execution of this technique.

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Navsari Agricultural University
ASPEE College of Horticulture and Forestry, Navsari
Post-Graduate Seminar Series 2016-17

Speaker	: Chaudhary Lalabhai Rajabhai (2020215014)	Course	: VSC 591 (1+0)
Major Guide	: Dr. S. S. Masaye	Date	: 20-08-2016
Co-Guide	: Dr. S. S. Gaikwad	Time	: 04:00 to 05:00 p.m.
Venue	: Swami Vivekananda hall		

Abiotic stress management in vegetable crops

India is the second largest producer of vegetables. In India total area under vegetable 9.39 million ha with annual production 162.89 million tonnes and productivity 17.3 t/ha (Anonymous, 2014). Vegetable crop plants are herbaceous succulents hence much prone to abiotic stresses. Most of them are grown in different agro-climatic situations than their evolutionary regions which make the vegetables more vulnerable to adverse climatic factors and associated losses. The severity of environmental stress imposed on vegetable crops varies with their genotypes and other crop factors.

What is abiotic stress?

The stress caused by non-living factors, like deficiency or excess of nutrition, moisture, temperature, and light, presence of hormonal gases or toxicants & abnormal soil conditions such as salinity, alkalinity and acidity is referred as abiotic stress.

As per the annual report of NISAM (2014), only 9% area of world is conducive for crop production while net 91% is under one or more stresses. Under stress condition, all the function of plant suffers badly and a huge loss is caused to the production (Anonymous, 2014). Basically abiotic stress can be managed by two approaches *i.e.* breeding (resistant varieties) and horticultural approach (cultural & chemical method).

Types of abiotic stress

Temperature stress, Water stress, Light stress, Nutrient stress and Chemical stress.

Research work

➢ **Temperature stress**

Orabi *et al.* (2010) reported that highest plant height, leaves fresh weight, leaves dry weight, stem dry weight, stem fresh weight, leaf area and fruit weight per plant of 45 day after transplanting in treatment of 4mM salicylic acid. They recorded maximum chlorophyll ‘a’ in 25 mg/L paclobutrazol treatment and they revealed significantly higher chlorophyll ‘b’ and carotenoid content in treatment of 4 mM SA as par 25 mg/L PBZ on cucumber under low temperature.

Saha *et al*. (2010) evaluated the effect of maximum and minimum temperature on various genotypes of sweet pepper and concluded that 24/18 ˚C and 29/23 ˚C were ideal to temperature condition for SP002 & SP009.

Water stress

Effect of water stress on dry matter production and yield of tomato over all cultivars was evaluated by Nahar *et al.* (1998) at Dhaka, Bangladesh. They observed maximum dry matter and yield in 70% F.C.

Pervez *et al*. (2009) studied the effect of drought on tomato and found minimum plant height (73.2 cm), and number of leaves per plant (16.5) in early stress. They also found minimum number of fruits per plant (12.5) and fruit weight per plant (613 g) in middle stress.

Bideshki *et al*. (2010) observed that drought reduced all growth, yield and quality traits compared to control. Drought reduced shoot height (20%), root fresh weight (47%), root dry weight (60%), leaf area (29%), leaf fresh weight (34%), leaf dry weight (33%), whole plant fresh weight (37%), bulb length (21%), clove number (6%), clove length (10%), clove diameter (20%), clove weight (24%), bulb yield (28%) and harvest index (12%). They also found maximum root fresh weight (11.22 g), root dry weight (1.33 g), bulb length (4.88 cm), number of clove (12.56), clove length (2.86 cm), clove brix (30.08%), harvest index (55.29) and allicin (5.61%) in treatment of 0.5 mM salicylic acid (SA).

Shinde *et al.* (2013) opined that among all the six genotypes of chickpea, Dahod Yellow gave the highest seed yield under drought stresses and thus proved to be the best drought tolerant variety.
Shamim *et al.* (2014) evaluated different type of tomato genotypes under different moisture stress level. They found that 40% field capacity had maximum leaf area index and number of total fruit in *L. pennellii*. They recorded 80% and 60% F.C. perform best in total number of fruit and leaf area index, respectively in CLN1767 and Ailsa Craig. They also observed 40%, 60% and 80% F.C. had maximum plant height and single fruit weight, respectively in 10584/G and Roma.

- **Light stress**

Haque *et al. (*2009) studied the effect of light intensity on the morpho-physiology and yield of bottle gourd (*Lagenaria vulgaris*) and revealed that 75% PAR light level has fruit number per plant (9.15), individual fruit weight (1894g), fruit yield per plant (17.20Kg) and fruit yield per ha (41.53 t) where as 50% PAR light level has highest fruit length (48.57cm) and fruit diameter (23.70cm) than other light levels.

- **Salinity stress**

Kumari Madhana and Sekar (2008) assessed the effect of plant growth regulators on chlorophyll and carotenoid content in okra under salt stress and found highest chlorophyll and carotenoid content in T_3 (40 mM NaCl + 3mg/L triadimefon) treatment.
Rady (2011) evaluated effect of 24-epibrassinolide on growth traits and leaf photosynthetic pigment, chlorophyll and proline content under Cd stress. He originate maximum growth trait in 5 μM EBL (24-epibrassinolide) at 15 Day After Treatment and found $CdCl_2$+ EBL best in Chlorophyll 'a', Chlorophyll 'b', Total Chlorophyll and Carotenoid, He also reveled treatment $CdCl_2$ best in Root proline and Leaf proline.
Amuthavalli and Sivashankaramoorthy (2012) assessed effect of salinity on Proline content of Pigeon pea and found maximum amount of proline content in treatment 100 mM NA_2SO_4.

Conclusion

From the above foregoing discussion it can be concluded that optimum temperature required for proper growth of the crops, Also salicylic acid play an important role in maximum chlorophyll and carotenoid content under temperature stress. In case of water stress, plant growth parameters, yield and dry matter content maximum at 40% to 80% field capacity, while drought reduced all growth, yield and quality traits compare to normal condition. Light intensity effect on the morpho-physiology and yield of attribute of the vegetables. Salinity stress significantly effect on chlorophyll, carotenoids and proline content in vegetables.
Resistance to abiotic stresses like water, temperature and salinity stress in vegetable crops are governed by important physiological, biochemical and yield contributing factors (photosynthetic rate, relative water content, membrane injury index, plant height, flower drop, root : shoot ratio, specific leaf area, chlorophyll content, drought tolerant efficiency, total grain yield, harvest index, proline, etc.). Therefore, studying these characters in vegetable crops will help in developing resistance mechanism against such abiotic stresses. Wild species, germplasm collection, land races etc. will provide a large genetic variability for development of abiotic stress tolerance variety in vegetable crops.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2016-2017

Speaker : Chaudhary Kamleshkumar Vaktabhai	**Course : VSC-591**
(Reg. No.: 2020215013)	**Date : 03-09-2016**
Major Guide : Dr. Sanjeev Kumar	**Time : 2 to 3 p.m.**
Co- Guide : Dr. S. J. Patil	**Venue: Swami Vivekananda Hall**

Alleviation of Salt Stress in Solanaceous Vegetable Crops through Halo Priming

Potato, tomato, brinjal, chilli and capsicum are important vegetable crops of Solanaceae family, cultivated extensively in an area of 3.7 m ha area with annual production of 75.7 m t across the country (Anonymous, 2014). Among various environmental stresses, soil salinity has become a critical problem worldwide due to its dramatic effects on plant physiology and performance of various crops. This is owing to inappropriate management of irrigation and drainage, low precipitation, high evaporation and irrigation with saline waters (Munns and Tester, 2008). It has been estimated that Gujarat alone accounts for 2.2 m ha of salt affected soils constituting 32.94% of the country as a whole (Anonymous, 2012). Germination is an important stage of seedling establishment and therefore it plays a key role in crop production. However, crop establishment depends on the interaction between environment and seed quality, where salinity has been identified as one of the major limiting factors influencing establishment. Halo priming is a low cost, simplest and powerful technique of pre-sowing seed treatment with inorganic salts aimed at uniform and rapid emergence of seeds and better tolerance to adverse conditions like salinity (Heydecker *et al*., 1973, 1975; Harris *et al*., 1999). Priming is also believed to increase activity of various antioxidants enzymes (catalase, superoxide dismutase), synthesis of organic solutes (proline), accumulation of potassium and calcium, gene expression *etc*., which act as major defense system in seeds under salt stress (Mahdi and Idris, 2013; Lara *et al.,* 2013).

Review of Research Work:

Germination and seedling establishment:

Pill *et al.* (1991) exposed seeds of tomato cv. ACE 55 to -0.8 MPa polyethylene glycol 8000 (PEG), instant ocean, $NaNO_3$ and then transferred to growing media moistened with saline (-0.6 MPa) solution for germination in dark at 10, 20 and 30 ^oC temperatures. The results showed superiority of $NaNO_3$ over PEG or Instant Ocean for final germination percentage under salinity conditions. Days to 50% germination was also reduced in seeds primed with $NaNO_3$. They further carried out 2nd experiment having different seed moisture and planting methods in $NaNO_3$ priming and recorded significantly minimum number of days to germination in primed fluid drilled seeds.

Amjad *et al.* (2007) carried out a comparative study of halo and hydro primed seeds of pepper under different salinity regimes and found higher emergence rate of pepper seedlings raised from KNO_3 pre-treated seeds under all the salinity levels. Halo primed seeds also induced maximum seedling vigour at all the salinity levels.

Ziaf *et al.* (2007) evaluated hydro and halo primed seeds (1% NaCl pre-treated) of chilli at different salinity levels (1.17, 3.0, 5.0 and 7.0 dS m^{-1}) and observed maximum emergence rate in halo primed seeds at all the salinity levels. Halo primed seeds showed more final emergence percentage than unprimed as well as hydro primed seeds at all salinity levels above the threshold level. Maximum number of roots per plant was observed in seedlings raised from halo primed seeds at 1.17 dS m^{-1}, statistically at par with those from halo primed seeds at 3 dS m^{-1} and hydro primed seeds at 1.17 dS m^{-1}. Vigour induced in seeds by halo priming at 7 dS m^{-1} was statistically similar to vigour induced by hydro priming at 5 dS m^{-1} and that of unprimed seeds at 3 dS m^{-1} *i.e.* 936.00, 936.40 and 916.67, respectively.

The results of study carried out by Khan *et al.* (2009) revealed significantly higher final emergence (%), emergence index and vigour index in hot pepper seedlings raised through NaCl primed seeds (1 mM) at salinity levels of 0, 3, 6 and 9 dS m^{-1}.

Aloui *et al.* (2014) primed seeds of three cultivars of pepper namely Beldi, Baklouti and Anaheim Chilli with KCl, $CaCl_2$ and NaCl solution, respectively for 24 hrs and subjected primed seeds to seven different NaCl concentrations for 14 days. The results indicated higher germination in primed seeds compared to control at all salinity levels. However, germination decreased with increased salinity stress showing reduction on total germination due to an increase in salinity from 0 g/l to 12 g/l and it was 22%, 87% and 37%, respectively for Beldi, Baklouti and Anaheim Chilli in primed seeds. It was further observed that plants derived from primed seeds developed longer radical and stem in all the cultivars at various salinity levels.

Ebrahimi *et al.* (2014) studied the performance of tomato cultivars primed with $CaCl_2$ and KNO_3 at different salinity levels of 50, 100 and 150 mM. The highest coefficient of velocity of germination was observed in all priming treatments and levels of salinity conditions, except under primed with KNO_3 and $CaCl_2$ in 150 mM level of salinity conditions. Similar results have also been observed in terms of median germination time and final germination percentage. The maximum germination and growth rate index (GRI) were observed for Orient F_1 under all priming conditions in 50 mM level of salinity, beside for Rebelion F_1 under primed with KNO_3 in 50 mM level of salinity.

Nutrient accumulation:

Demirkaya (2014) studied the effect of 0, 100 and 200 mM NaCl salinity treatments on potassium and calcium uptake in halo and water primed tomato cv. Rio Grande and observed significantly higher potassium content in NaCl primed plants at 45 days of planting compared to hydro priming. However, potassium accumulation was significantly higher in hydro primed seeds after 60 days of planting, whereas calcium accumulation remains unaffected by either of the priming techniques at different salinity levels.

Protein and Soluble Sugar:

Mahdi and Idris (2013) studied the effect of NaCl pre-treatment on salt tolerance of tomato callus grown under elevated salinity levels and found higher content of soluble protein in salt tolerant tomato (*Lycopersicon pimpinellifolium*) compared to pre-treatment/untreated species of tomato (*Lycopersicon esculentum*). They also analyzed that pre-salt treatment (NaCl) produced almost similar amount of soluble protein in sensitive tomato as in tolerant one at 70 mM NaCl salinity level.

Demirkaya (2014) compared sugar accumulation in the leaves of salt and water primed seeds of tomato cv. Rio Grande at three levels of salinity (0, 100 and 200 mM NaCl) and observed maximum accumulation in seedlings subjected to hydro primed seed compared to halo primed at all the levels of salinity, thus signifying the importance of hydro priming over salt priming. They further stressed upon that halo priming alone cannot serve to alleviate salt stress, but there is a need to identify potential priming technique for each crop.

Enzymatic Activity:

Mahdi and Idris (2013) observed increased activity of superoxide dismutase (SOD) enzyme in untreated, pre-treated and wild species in response to salinity levels upto 35 mM (NaCl). The SOD activity in salt pre-treated seeds showed similar trend of increase as that of wild species. On the other hand, catalase (CAT) activity decreased with increasing levels of salinity, but the decrease was more pronounced in untreated tomato than salt pre-treated and tolerant tomato.

Lara *et al.* (2013) analyzed the activities of defense system in tomato against salt stress upon priming and observed higher nitrate reductase (NR) activity in seeds primed by KNO_3 compared to PEG + KNO_3 and PEG alone. Likewise, a significant increase in antioxidant activity of SOD and CAT was observed in seeds primed with KNO_3.

Proline accumulation:

Mahdi and Idris (2013) evaluated proline accumulation in the callus tissues of untreated, salt pre-treated (*Lycopersicon esculentum*) and *Lycopersicon pimpinellifolium* at varying levels of salinity. Although, salt tolerance species showed good amount of proline accumulation but pre-treated tomato also showed synthesis of good amount of the content upto 105 mM NaCl level of salinity.
Aloui *et al.* (2014) studied the accumulation of organic solute-proline in seedlings of pepper raised from halo priming at different salinity levels and observed progressive and significant increase in proline content in all the cultivars with increased levels of salinity.

Molecular mechanism:

Nakaune *et al.* (2012) studied the expression of gene encoding GA biosynthesis enzyme in tomato upon halo priming with NaCl (300 mM) and observed higher relative expression levels of GA biosynthesis genes namely *SIGA20ox1*, *SIGA3ox1* and *SIGA3ox2* during 48 hrs of sowing under salt stress, thereby suggesting better tolerance under salinity conditions.

Conclusion:

Gujarat accounts for 32.94% of total salt affected soils in India. Pre-sowing treatment with inorganic salts commonly termed as halo priming, is a simple, low cost technology to alleviate adverse affect of salt stress. Halo priming tomato seeds with $NaNO_3$, KNO_3 has shown better germination, GRI *etc*. under salt stress. Pre-seed treatment in capsicum species with KNO_3, NaCl, KCl and $CaCl_2$ was observed to enhance seedling vigour, number of roots per plant, emergence index *etc*. under salinity conditions. Halo priming in tomato with NaCl resulted in higher potassium accumulation after 45 days of sowing, hence play an important role in balancing membrane potential and turgor, thereby imparting tolerance against salinity. Pre-treatment with NaCl has also been found to elevate the level of soluble protein and sugar with implication in the stored reserves mobilization. The increased activity of many enzymes like superoxide dismutase, nitrate reductase, catalase as a result of priming seed with NaCl and KNO_3 imparted tolerance against salinity in tomato. The synthesis of higher level of proline in chilli and tomato through halo priming under salt stress is an indicator of osmotic adjustment under such situation. The increased expression level of genes like *SIGA20ox1*, *SIGA3ox1* and *SIGA3ox2* encoding GA biosynthesis pathway signifies the importance of halo priming in activation of specific genes of tolerance. Since, little or no useful information exists for a great number of Solanaceous vegetables, further research is needed to study the suitable material with precise concentration that can make sure the successful seed germination and seedling growth of crops under salinity conditions. In addition, future research should focus on molecular, physiological and metabolic changes induced by priming agents under salt stress.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post Graduate Seminar Series 2016-2017

Speaker	: Basavaraj B. Athani	**Course**	: VSC 591 (1+0)
Reg. No.	: 2020215006	**Date**	: 17/09/2016
Major Guide	: Dr. D. R. Bhanderi	**Time**	: 9:00 to 10:00 a.m.
Co-Guide	: Dr. R. V. Tank	**Venue**	: Swami Vivekananda

GRAFTING TECHNIQUES IN VEGETABLE CROPS

Grafting is an art of connecting two pieces of living plant tissue together in such a manner that they will unite and subsequently grow and develop as a single successful plant, by means of tissue regeneration in which the resulting combination of parts achieve good physical union and grows as a single plant (Singh and Bahadur, 2014).Vegetable grafting has been recently popularised in agriculture system because of ost of damage caused by soil borne diseases and nematode, so there is a need of vegetable grafting to develop resistant to several biotic and abiotic stress and to improve of yield and quality without reducing their juvenility.

REVIEW OF RESEARCH WORK

Tomato

Marsic and Osvald (2007) studied the effect of grafting and the positive effect of grafting was obtained when 'Monroe' was used as scion, and 'Beaufort' as rootstock. In that grafted combination, the total fruit yield per plant increased significantly in comparison with that of the non-grafted plants or when ' PG-3' was used as rootstock. A negative effect of grafting was shown when 'Belle' was used as scion.

Turhan *et al*. (2011) reported that the fruit index (diameter/length), number of fruits/truss and fruit weight were significantly influenced by grafting. The highest fruit yield 6.77 kg/plant was found in the Yeni Talya/Beaufort grafted combination and the lowest fruit yield 4.46 kg/plant was recorded in the Beril cultivar. However, fruit yield of Yeni Talya and Beril was significantly affected by grafting onto Beaufort or Arnold rootstock. The use of Beaufort rootstock caused a significant increase in yield per plant of Yeni Talya and Beril.

Wahballah (2014) studied the effect of grafting in salt and water stress conditions. It is revealed that the grafted plants showed superior result in leaf area, average fruit weight, total yield and water use efficiency in all the treatments in comparison with the non-grafted plants, both in water and salt stress condition and gave the significant superior result because when Faridah used as scion on grafted to Unifort rootstock, showed tolerance to water and salt stress condition as the rootstock possess stronger and deeper root system and also improve the quality parameters of fruits such as Vitamin-C and TSS.

Capsicum

Jang *et al*. (2012) obtained the highest germination % under the Konesianhot rootstock compared with the other rootstocks and lowest germination % was obtained in PR901 rootstock. Significant superior graft take was obtained in PR928 and PR929 in 12 days after grafting but it is decreased as the number of days increased due to drying of scions because of poor compatibility. Graft take after 30 days, Konesianhot showed the highest graft take percentage. They also observed the Nokkwang/Konesianhot grafted combination, the marketable yield and gross yield/plant increased significantly in comparison with that of the non-grafted plants.

Rodriquez and Bosland (2010) observed the grafting of *Capsicum annuum* seedlings onto 'Celebrity' tomato seedlings in that the apical wedge and tube graft were both successful. The success of grafting was not significantly affected by the size of the grafting tube clips. However, the apical wedge graft had the highest percentage of success, with a survival rate of 100%. They also observed the percentage and number of successful grafts with *Capsicum annuum* cultivar scion grafted onto the same cultivar using 1.5mm tube clips. There appeared to be a cultivar difference with 'NuMex Joe E. Parker' (76%) with the success rates that were higher than 'Early Jalapeno' (50%) for healing response.

Brinjal

Fruit quality of brinjal was improved by grafting on tomato rootstock compared with non-grafted treatment (Liu *et al*., 2009).

Cucumber

Sakata *et al*. (2006) evaluated the powdery mildew resistances of the rootstock cultivars revealed that Tokiwa Power Z, White Power and PI 197088-1 tested by detached cotyledon incubated at 20^0C, were the most resistant. The symptoms on the leaf surfaces of these cultivars was nearly undetectable, because they exhibited very few sporulations under microscope. Hikari Power Gold, Agura, All Star, Shishigadani, Shin-tosa and Encore-10 were severely infected and thus regarded as susceptible. Nearly identical results were obtained when the cultivars incubated at 20 ^{0}C or 26 ^{0}C.

Fung-chao and Fu-yen (2013) observed that grafting onto *Cucurbita* rootstock showed the positive effect on cucumber in increases main stem length and number of leaves. They could not detect any negative effect on cucumber fruit quality using *Cucurbita* rootstock. In addition, there was no significant difference between the two rootstocks in grafting in terms of fruit length, fruit width and fruit weight. Moreover, grafting resulted in significantly higher soluble solid content and total yield on both the rootstocks due to various factors such as increase in uptake of water and nutrients with the widespread root-system of the rootstock and due to improved tolerance to soil-borne diseases.

Watermelon

Alan *et al*. (2007) revealed that number of fruits per plant, fruit weight, fruit yield were significantly higher in grafted plants compared with the non-grafted control plants, due to enhanced vigorous root system, root length, main stem length, number of lateral vine and root dry weight resulting in growth and yield promotion.

Dolichos bean

Kim and Okubo (2010) revealed that the control of growth habit by grafting between determinate and indeterminate Lablab bean plants. The experiment was conducted at 20^0C, 25^0C and 30^0C. Indeterminate stock slightly increased the plant height and increases the number of nodes of determinate scion at any temperature of 20^0C, 25^0C and 30^0C, but differences were not significant. Under determinate plants, the plant height does not affected by grafting, however increases the number of nodes. These results may indicate that factors controlling stem elongation and development of nodes are transmissible across graft union.

CONCLUSIONS

Though grafting has been practiced since thousands of year in fruit trees, vegetable grafting has been recently adopted on a commercial scale for production. Grafting provides a site specific management tool for soil borne diseases. It fits well into the organic and integrated crop production system. It reduces the need for soil disinfectants and there by environmental pollution. Grafting is also a rapid alternative tool to the relatively slow breeding methodology aimed at increasing biotic and abiotic stress tolerance of fruit bearing vegetables and increases the number of nodes in Dolichos bean. Since grafting gives increased disease tolerance and vigor to crops and it will be useful in the low input sustainable horticulture of the future.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2016-2017

Speaker : Pankaj Dharva	**Course : VSC- 591**
(Reg. No.: 2020215034)	**Date : 17-9-2016**
Major Guide : Dr. A. I. Patel	**Time : 10 to 11 a.m.**
Co- Guide : Dr. B. M. Tandel	

Breeding for leaf curl virus resistance in tomato

Tomato leaf curl virus disease is one of the most devastating viral disease in tomato plants across the globe (Hanseen *et al*., 2010). In Southest and East Asia as well as in many countries of old world, these viruses have been termed as tomato yellow leaf curl virus (TYLCV) or tomato leaf curl virus (ToLCV). The disease is transmitted by the insect vector whitefly (*Bemisia tabaci*). From the early 1960s, it has spread to Middle East and is presently wide spread in many region of Africa, America and Asia. ToLCV causes yield losses in tomato world-wide. In many tomato growing areas, ToLCV has become a major limiting factor in tomato production. Tomato production in India is severely constrained by the regular outbreaks of tomato leaf curl virus disease. This disease can reach up to 100% incidence with yield losses often exceeding 90% (Saikia and Muniyappa, 1989).

Controlling ToLCV is difficult and is mainly based on intensive insecticide treatments that are used to control vector populations (Palumbo *et al*., 2001). However, this method is harmful to the environment (Navot *et al*., 1991) and has limited success because it selects for insecticide-resistant populations in *B. tabaci* (Cahill *et al*., 1996). Although the use of virus resistant cultivars is currently the best alternative for controlling ToLCV, limited sources of useful resistance are available at the commercial level, which greatly limits the possibility of crop breeding. Therefore, breeding tomato cultivars possessing in built resistance either for virus or vector or both is an appropriate approach for the management of leaf curl virus disease in tomato.

Review of Research Work:

Kasrawi (1989) analyzed F1, F2 and backcross population developed from crosses of *L. pimpinellifolium* with the susceptible cultivar Special Back and found that the resistance was controlled by a single dominant gene.

Kalloo and Banerjee (1990) found that the line H-2 derived from crosses between *L. hirsutum f. glabratum* and HS 101 had the highest resistance by showing the least disease incidence and CI value.

Lapidot *et al*. (1997) found that the breeding lines, TY172 and TY197 were exhibited the highest level of resistance to TLCV along with the yield and its attributes characters.

Maruthi *et al*. (2003a) observed that the wild species *Lycopersicon peruvianum* INRA sel., *L. chilense* LA 1969 and *L. hirsutum* LA 1777 were resistant to ToLCBV-[Ban4]. Among the *L. esculentum* genotypes, H-24, FL 744-6-9, FL 699 and FL 699 sp+ were tolerant to ToLCBV-[Ban4].

Maruthi *et al*. (2003b) observed that the genotype CMV Sel. INRA, LA 1777 and PI 390659 was resistant to ToLCV-[Ban4] were as 901-1, 902, 906-7 and 910 was resistant to TYLCV-Is.

Dharmatti *et al*. (2004) revealed that the maximum fruit yield /plant and lower incidence of ToLCV was recorded by 20/6 Alcobasa x L-58 followed by 20/4 Alcobasa x L-58 and 20/5 Alcobasa x N-229-8MF6.

Shankarappa *et al*. (2008) carried out an experiment on production of tomato hybrids and their reaction to TLCV. They evaluated twenty hybrids out of them, eleven hybrids were found resistant due to their one of the resistant parent (Shankranthi, Nandi and Vybhav).

Singh *et al*. (2008) studied on inheritance of resistance to ToLCV in tomato and found that the resistance in Punjab Chhuhara x H-88-78-4 (F1) and Punjab Chhuhara x H-24 (F1) appeared to be incompletely dominant whereas resistance in Punjab Chhuhara x H-88-78-4 (F2) and Punjab Chhuhara x H-24 (F2) are controlled by single completely dominant gene.

Chattopadhyay *et al*. (2011) conducted an experiment on line x tester in tomato, in which CLN2777 G, CLN2777 A and BCT-82P were identified as good combiners for yield and yield contributing characters. They also found two promising hybrids CLN2777G x BCT-59 and CLN2777A x BCT-82P could be exploited commercially because of high yield coupled with low Percent Disease Index (PDI) values for tomato leaf curl disease.

Osei *et al*. (2012) recorded fewer number of plant infected 30 DAT in accession FLA 456-4, FLA 96-11-6-1-0, WSP2F7 (3) pt.3, 2641A, Local Roma and Tomato Red Cloud. They also found that at 30 days after transplanting, Local Roma, Tomato Slumac and Petomech-gh/Fr. were the only accessions with no symptoms. However, some accessions (FLA 505, TLB111, H24, CLN 2026D, WSP2F1pt.3, WSP2F7 (3) pt.3, WSP27F7 (3) pt.3 and 2641A) showed mild symptoms.

Mahmoud (2014) conducted an experiment on grafting to improve TYLCV tolerance in tomato and found that grafting increased TYLCV tolerance in susceptible plants, expressed as delay in the appearance of TYLCV symptoms and an increase of yield components compared to non-grafted plants. The related species *S. pimpinellfolium* was considered a suitable tolerant rootstock for tomato grafting to improve TYLCV-tolerance, fruit yield and quality.

Singh (2014) conducted an experiment on screening of tomato genotypes and its reaction against ToLCV and found that H-88-78-1 showed immune reaction against ToLCV without producing any symptoms of leaf curl disease whereas Hisar Lalima, TLBRH-6 and NS-515 showed resistant reaction to ToLCV.

Kaushik *et al*. (2015) conducted an experiment on screening of tomato hybrids and found that out of fifty-five cross combinations, seventeen crosses were completely free from TLCV and twenty-three cross combinations showed mild infection.

Pandiarana *et al*. (2015) revealed that CLN 2777E x CLN 2777F had the lowest PDI value followed by CLN 2777 F × CLN 2768 A, CLN 2777 F × H-24, CLN 2777 A × CLN 2777 F up to 120 DAT so these cross combination may be recommended for commercial exploitation.

Yadav *et al*. (2015) revealed that the inheritance of resistance to ToLCV in IIHR-2195 was controlled by a single dominant gene.

Conclusion:

ToLCV infection causes severe yield losses in tomato. So, the best way to reduce ToLCV-induced damage is by breeding tomatoes resistant to the virus. Grafting on resistant rootstocks improved ToLCV tolerance in susceptible tomato scion as delayed appearance of ToLCV symptoms. Screening of genotypes helps in identification of ToLCV resistance plant. Also the lines showing minimum or no symptoms of TLCV disease under natural field conditions could be used to breed true breeding lines or commercial F1 hybrids tolerant to TLCV.

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NAVSARI AGRICULTURAL UNIVERSITY
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P.G. SEMINAR SERIES: 2016-17

Speaker	**: Habibullah**	**Course: VSC 591**	
Major Guide	**: Dr. S.N. Saravaiya**	**Time : 11.00 a.m.**	
Co- Guide	**: Dr. Y. N. Tandel**	**Date : 17/09/2016**	
Reg. No.	**: 2020215022**	**Venue**	**: Swami Vivekananda Hall**

EFFECT OF FOLIAR APPLICATION OF MICRONUTRIENTS ON TOMATO

India has raised the vegetable production over the years and occupied second position in the world next only to China in order to meet the dietary requirement of predominantly vegetarian population for the basic constituents of food.

Tomato (*Solanum lycopersicum* L.) belongs to Solanaceae family having chromosome number 2n = 24. It is one of the most popular and nutritious fruit vegetable, widely grown around the world and ranked second after potato. The major tomato growing countries are China, India, USA, Turkey, Egypt and Italy. It is a leading vegetable grown across the country in an area of 0.88 million hectare with an annual production of 18.74 million tonne. Gujarat occupies 0.45 lakh ha. area with an annual production of 12.59 lakh metric tonne (Anon., 2014).

Micronutrients like Zinc, Iron, Manganese, Copper, Boron and Magnesium have an important role in the physiology of tomato crop and are required for plant activities such as respiration, meristematic development, chlorophyll formation, photosynthesis, tannin and phenolic compounds development thereby harnessing the higher yield potential, hence supplementation of micronutrients is essential (Azeem and Ahmed (2011). Micronutrients are not only essential for better growth, yield and quality but also play an important role in various physiological activities of plant. They also help in uptake of major nutrients and play a vital role to the growth of plants as catalyst in promoting various organic reactions from cell development to respiration, photosynthesis, chlorophyll formation, enzymatic activity, hormonal synthesis, nitrogen fixation etc.

Review of research work:

Growth:

Patil *et al.* (2008) studied the effect of foliar application of micronutrients on growth of tomato cv. Megha. They take nine different treatments of different micronutrients and found significantly the best treatment was boric acid 100 ppm in individual year as well as in pooled analysis for growth parameters.

Naga *et al.* (2013[b]) conducted an experiment to find out the response of foliar application of micronutrients. Among all treatments in studied the significantly best treatments were boron 100 ppm or mixture of all micronutrients 100 ppm for plant height and no. of compound leaves per plant in higher growth stages of two varieties of tomato *viz*., Utkal Kumari and Utkal Raja.

Saravaiya *et al*. (2014) studied the influence of foliar application of micronutrients on tomato cv. Gujarat Tomato 2 involving eight different treatments. They revealed from the study that T_7 (T_1 + Mixture of all micronutrients) had significantly superior effect on plant height (132.77 cm), number of branches per plant (5.96), fresh weight of plants (25.70 t ha^{-1}), over rest of the treatment.

According to research results of Ali *et al*. (2015), it is apparent that combination of foliar application of micronutrients *viz.,* boron and zinc enhanced plant growth characteristics in BARI hybrid tomato 4.

Yield:

Patil *et al.* (2008) studied the effect of foliar application of micronutrients on growth of tomato cv. Megha. They take nine different treatments of different micronutrients and found significantly the best treatment was boric acid 100 ppm in individual year as well as in pooled analysis for yield parameters.

Kumar *et al.* (2012*)* conducted an experiment on effect of foliar application of micronutrients solution and proved to be superior with respect to useful in case of mean values of transverse length, polar length, pericarp thickness of tomato Var. Rupali. Three foliar applications of mixture of B, Zn, Cu, Fe and Mn each @ 100 ppm and Mo @ 50 ppm at 10 days interval starting from 40 DAT of tomato but all the treatments were non-significant.

Naga *et al.* (2013[a]) studied the effect of foliar application of micronutrients on seed yield of tomato. Both the tomato varieties under investigation showed significant variations among treatments with respect to seed yield per plant and per hectare. Application of micro-nutrients mixture 100 ppm gave maximum seed yield (181.05 kg/ha, 205.70 kg/ha) of Utkal Kumari and Utkal Raja followed by control.

Naga *et al*. (2013[b]) found that in the cv. of Utkal Kumari, the fruit yield per plant 37.40 t/ha and in Utkal Raja, it was 35.50 t/ha. In both the tomato varieties, combined application of micronutrients produced the maximum fruit yield followed by application of boron and zinc.

Saravaiya *et al*. (2014) studied the influence of foliar application of micronutrients on tomato cv. Gujarat Tomato 2 involving eight different treatments. They revealed from the study that T_7 had significantly superior effect on plant height (131.73 cm), number of fruits per plant (34.26), number of branches per plant (5.81), dry matter yield of plants (7669.04 kg. ha^{-1}), fruit weight (49.20 g), fruit weight $plant^{-1}$ (1.68 kg), fruit yield per ha (46.78 t) and marketable fruit yield per ha (45.62 t) over rest of the treatment.

Combination of foliar application of 12.5-ppm $ZnSO_4$ + 12.5-ppm H_3BO_3 gave highest yield (58.3 t/ha) in BARI hybrid tomato 4 (Ali *et al*., 2015).

Quality:

Salam *et al.* (2010) studied the effect of boron and zinc on fruit quality of tomato. The higher values for TSS (4.26 ^{0}brix), acidity (0.41) and lycopene content (97.66 ug/100 g) were found in treatment T_3.

Santosh Kumari (2012) studied the effect of foliar application of micronutrients on fruit quality. The higher values for TSS (4.46 ^{0}brix) and lycopene content (3.48 mg/100 g) were found in the treatment of manganese (100 ppm).

Saravaiya *et al.* (2014) studied the influence of foliar application of micronutrients on tomato cv. Gujarat Tomato 2 involving eight different treatments. The data clearly showed that higher TSS (4.87 ^{0} Brix) was recorded in the treatment T_7 as compared to other treatments.

Economics:

Saravaiya *et al*. (2014) studied the influence of foliar application of micronutrients on tomato cv. Gujarat Tomato 2 involving eight different treatments. The data clearly showed that higher net return and C:B ratio (1:2.71) was recorded in the treatment T_7 as compared to other treatments.

Conclusions:

The research results inferred that the foliar spray of micronutrients along with soil application favorably influenced plant growth attributes. In general, efficacy of the inorganic fertilizers was pronounced when they are applied with micronutrients *viz*., B, Zn, Cu, Fe and Mn and that may leads higher fruit yield and superior quality produce hence, get a remunerative return to tomato growers. Moreover, micronutrients are not only important for better crop productivity but also essential for sustaining human and animal health.

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NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
POST GRADUATE SEMINAR SERIES : 2016 - 2017

Speaker	:	**Patel Atish N. (2020215040)**	**Course**	: :	**VSC - 591 (1+0)**
Major Guide	: :	**Dr. V. K. Parmar**	**Date**	: :	**15/10/2016**
Co- Guide	: :	**Dr. Y. N. Tandel**	**Time**	: :	**4.00 pm to 5.00 pm**
Venue	: :	**Swami Vivekananda Hall**			

EFFECT OF TEMPERATURE ON PHOTOSYNTHESIS, FLOWERING AND FRUIT SET OF SOLANACEOUS VEGETABLE CROPS

'Temperature is the degree of hotness or coldness of a substance/environment'. Temperature varies with the succession of seasons and over any 24-h period low night temperature alternate with higher daylight temperatures. Confronted to changes in temperatures, plants readjust their biochemical makeup to adapt and survive. The fact that temperature changes can induce cellular responses indicates that temperature is sensed without no internal thermometer as such. However, alterations in cellular equilibrium triggered by temperature change acts as a networked thermostat to sense heat and cold. Among this temperature sensitivity has been identified by membrane fluidity, protein conformation, cytoskeleton depolymerization and metabolic reactions in plants.

Solanaceous vegetables crops *i.e.* tomato, pepper, brinjal and potato cultivated for the daily consumption and processing products. The vegetative and reproductive response of solanaceous crops are strongly modified by temperature alone or in conjunction with other environmental factors *viz.*, light, moisture and nutrition. Photosynthesis is known to be one of the most temperature sensitive process and it can be completely inhibited by high or low temperature. High temperature stress cause severe damage to the photosynthetic apparatus and alter the activity of enzyme and sucrose metabolism in leaves. Sexual reproduction phase in solanaceous crops is more sensitive to temperature variation than the vegetative growth. Plant's reproductive organs are more vulnerable to changes in temperature prior to and during the early stage of flowering (Reddy and Kakani, 2007). Temperature is a key factor for fruit set in tomato, pepper and brinjal.

Review of research work :

Photosynthesis

Camejo *et al*. (2005) investigated the functional activities of the photosynthetic apparatus of 'Campbell-28' and 'Nagcarlang' tomato cultivars at different thermotolerance after a short period of high temperature treatment. The heat shock treatment caused important reductions of the net photosynthetic rate (P_n) due to non-stomatal components of cv. 'Campbell-28' plants.

Jie *et al*. (2012) recorded the changes in the production and metabolism of photosynthesis in tomato leavesafter treated with moderately high temperature stress for 8 hour. The changes in stomatal conductance (G_s) was significantly higher than the control, when plants were exposed to 35°C temperature.

Flowering

Adams *et al.* (2001) studied the effect of different temperature (14, 18, 22 and 26°C) on tomato flowering. The maximum rate of truss production (0.198) and highest rate of flower opening (1.13) were achieved at 22°C temperature and maximum number of flowers (16.3) was recorded at 14°C temperature.

Pressman *et al*. (2002) exposed tomato plants to high temperature continuously to study the pollen characteristics of flower. Flowers developed at 32/26°C had only half the numbers of pollen grains than flowers developing at 28/22°C .The number of viable pollen grains decreased by two-thirds and the number of non-viable grains increased by almost a factor of four in high temperature.

Adil *et al.* (2003) studied the effect of high temperature and heat shock on pollens of tomato genotypes. Pollen production was reduced in all cultivars at HS condition. 'Kervic F_1' and 'Drd85

F_1' cultivars seem to be some tolerant to HS condition and produced a higer number of pollen grains than the less tolerant cv. 'UC 82-B'.

Sato *et al.* (2004) studied the effect of high temperature treatment on flowering percentage of tomato cultivars. High temperature (HT) increased the formation of undeveloped flowers and aborted flowers significantly in all nine cultivars

Firon *et al.*(2012) conducted an experiment on effect of heat stress on pollen number and qual **(P. T. O)** of cv. 'Pearson' and cv. 'Nr' mutant of tomato plant. Heat stress affects the pollen quality cv. 'Pearson' and 'Nr'. Plants of 'Nr' cultivar exposed to mild chronic heat stress (MCHS) showed significant lower number of viable pollen grains (28.3) as compared to 'Pearson'.

Fruit set

Saha *et al.* (2010) evaluated 12 sweet pepper genotypes under two different temperature regimes of 24/18°C and 29/23°C in the phytotron. Per cent fruit set varied from 14.63 to 56.17 at 24/18°C being the lowest in SP011 genotype and the highest in SP002 genotype. It could be observed that the percent fruit set of all the genotype were lower at higher temperature and higher at comparatively low temperature.

Sato *et al.* (2000) observed the percentage of fruit set of five cultivars under the 28/22°C and 32/26°C temperature treatments. All cultivars had highest percentage of fruit set under the 28/22°C treatment. For the 32/26°C treatment, only cv. 'FLA 7156' was able to produce fruit.

Adams *et al.* (2001) studied the effect of different temperature (14, 18, 22 and 26°C) on tomato fruit set. The maximum fruit set per truss was found at 40°C temperature.

Sato *et al.* (2004) studied the high temperature treatment on fruit setting percentage of tomato cultivars. High temperature (HT) decreased the percentage of seeded fruit significantly in all nine cultivars. Whereas percentage of parthenocarpic fruits was significantly increased.

Gunawardene and De Silva (2014) studied the impact of temperature and water stress on fruit setting of chilli. Maximum fruit setting (56%) was achieved at ambient temperature and no water stress, whereas minimum fruit set (12%) was recorded with 34°C temperature and 50% water stress treatment.

Conclusion

Heat lead to a sun-type adaption response of the photosynthetic apparatus for the 'Nagcarlang' genotype. Rising temperature in changing climate will affect the rate of photosynthesis and stomatal conductance in tomato. Tomato plants exposed to moderately high temperature stress of 35°C for 8 h provoked important changes in photosynthesis activity in plants. Low-high temperature regimes shows a tendency towards small parthenocarpic fruits which combined with maximum flower numbers and poor fruit set at 14°C in tomato. Reproductive processes in tomato were more sensitive to high temperature and affect the pollen viability and germination rate. However, healthy pollen grains produced by heat tolerant genotype compared to heat sensitive genotypes. Elevated temperature affects seed percentage, undeveloped flowers, aborted flowers which helps the selection of high temperature tolerant cultivars. Per cent fruit set in sweet pepper plants raised at 24/18°C temperature. Temperature and water stress also affect the fruit setting in chilli flower.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST - GRADUATE SEMINAR SERIES: 2016-2017

Speaker	:	**Chaudhari Vishvas J.**	**Course**	:	**VSC- 591**
Reg. No.	:	**2020215011**	**Date**	:	**17/12/2016**
Major Guide	:	**Dr. N. K. Patel**	**Time**	:	**02:00 to 03:00 p.m.**
Minor guide	:	**Dr. B. M. Tandel**	**Venue**	:	**Swami Vivekananda Hall**

USE OF BIOFERTILIZERS IN VEGETABLE CROPS

A biofertilizer is a substance that contains living microorganisms, when applied to seed, soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply of primary nutrients to the host plant.

Biofertilizers works in several ways like nitrogen fixation in the soil, conversion of insoluble phosphate and potash into soluble form. They maintain soil pH and improve the physical, chemical and biological properties of soil which enhance the availability of nutrients for plants. They are cost effective and less expensive source of plant nutrients, eco-friendly and pollution free.

Bio fertilizers are beneficial in many ways like improve the quality of fruits and their shelf life, saving inorganic fertilizers, increase fertilizer use efficiency. It is safe to handle and easy to apply; leave no harmful residues in plants & soil. They are compatible with organic manures, inorganic fertilizers and agro-chemicals. Biofertilizers may also produce growth promoting substances.

Biofertilizers require special care for long-term storage because they are alive. They must be used before their expiration date. The soil must contain adequate nutrients for biofertilizer organisms to thrive and work. They complement other fertilizers, but cannot totally replace them. They lose their effectiveness if the soil is too hot or dry.

REVIEW OF RESEARCH WORK

TOMATO (B.N: *Lycopersicon esculentum* Mill, Family: Solanaceae)

Ramkrishnan and Selvakumar (2012) found that the *Azotobacter* + *Azosprillum* treatment gives significantly better growth and yield of tomato plant.

Premshekhar and Rajashree (2009) recorded significantly maximum plant height (72.6 cm), number of branches per plant (8.80), number of fruits per plant (33.7), fruit weight per plant (35.63 g) and highest yield (43.85 t/ha) with *Azosprillum* + 75% N + 100% P and K, in tomato cv. CO-3.

CHILLI (B.N: *Capsicum annuum* L., Family: Solanaceae)

Kumar *et al*. (2011) noticed that combination of *Azotobacter* + PSB + 40 ppm NAA recorded maximum length of fruits (9.65cm), girth of fruits (3.41 cm), no. of fruits/ plant (68.53), yield/ plant (81.46 gm) and yield/ ha (30.13 q).

Bharathi *et al*. (2011) studied the effect of organics and inorganics inputs on yield and yield attributes of chilli and they proved that application of green manure (sunnhemp) + neem cake @ 2 t/ha + *Azospirillum* @ 2kg/ha + burnt ash (crop residue) + phosphobacteria + 100% of recommended dose of nitrogen obtained significantly maximum plant height (cm), plant spread (cm), no. of fruits/plant and yield (kg/ha).

Jadhav *et al*. (2014) recorded significantly maximum plant height and number of branches per plant with *Azospirillum* + 100% N + 100% PK and maximum number of fruits per plant, fruit length and fruit yield with *Azospirillum* + 80% N + 100% PK.

BRINJAL (B.N: *Solanum melongena* L., Family: Solanaceae)

Latha *et al.* (2014) found that maximum morphological character of brinjal plant in T_{10} (Urea + Super phosphate + MOP + Azospirillum + PSB + PMB).

OKRA *(*B.N: *Abelmoschus esculantus* Moench, Family: Malvaceae*)*

Mal *et al*. (2014) conducted field experiment to assess the effect of diazotrophs (biofertilizers- *Azotobacter*, *Azosprillum* and PSB) and chemical fertilizers along with vermicompost on okra cv. Mahyco-10 in terms of growth and yield. They found maximum plant height, leaf area, fruit length fruit girth, single fruit weight and highest yield received with the treatment FYM @ 10 t/ha + 100% NPK + vermicompost @ 5 t/ha + biofertilizers.

Choudhary Kirti *et al*. (2015) noted that application of *Azospirillum* 5 kg/ha + RD of NPK obtained significantly higher growth attributes, yield attributes and yield.

GARLIC *(*B.N: *Allium sativum* L., Family: Alliaceae*)*

Chattoo *et al.* (2007) reported that *Azotobacter* + Phosphobacteria (Clove dip method @ 2.0 kg/ha & Soil inoculation @ 2.5 kg/ha) applied with 75 kg N + 45 kg P_2O_5 /ha resulted in significantly superior over other treatments in garlic.

Nainwal *et al.* (2015) worked on effect of phosphate solubilizing bacteria, Trichoderma, FYM and NPK on growth and yield of garlic They found significantly higher growth attributes, yield attributes and yield under treatment combination 100% NPK + FYM@ 20 t/ha + Trichoderma + PSB**.**

ONION *(*B.N: *Allium cepa* L., Family: Alliaceae*)*

Shedeed *et al*. (2014) reported that O.M 20% + Bio-fertilizer (soaking seedling in nitrobeine for 15 minute before transplanting) resulted in significantly higher growth attributes and yield attributes of onion.

LETTUCE *(*B.N: *Lactuca sativa* L., Family: Asteraceae*)*

Borthakur *et al.* (2012) reported that maximum Lettuce head diameter (cm), Lettuce fresh weight (g) and Lettuce dry mass (g) in treatment T_5 (With green manuring, with mulching, with normal dose of *Azospirillum*).

CONCLUSION

From the foregoing discussion it can be concluded that Biofertilizers like *Rhizobium*, *Azotobacter*, *Azospirillum* and Phosphate Solubilizing Bacteria improves growth, yield and quality of the vegetable crops. Application of biofertilizers along with chemical fertilizers enhance their effectiveness. The overall results suggests that biofertilizer inoculations improves plant mineral concentration through nitrogen fixation and there by alerts production in tomato, chilli, brinjal, okra, lettuce etc. by using strains of different phosphate soluble microorganisms, *Azotobacter* and *Azospirillum* in chilli obtain better growth and higher green chilli yield. *Azospirillum*, *Azotobacter* and PSB in combination with chemical fertilizers resulted in all over growth as well as yield attributes in garlic and onion crops with decreasing in quantity of costly chemical fertilizers and also improve soil health by live preparation of several microorganisms.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY,
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES 2016-17

Name of Speaker	:	**Patel Bhumi Sanjay**	**Course**	:	**VSC 591 (1+0)**
Reg. No.	:	**2020216023**	**Date**	:	**18-02-16**
Major Advisor	:	**Dr. N. K. Patel**	**Time**	:	**10 am -11 am**
Co-Guide	:	**Dr. B. M. Tandel**	**Venue**	:	**Swami Vivekanand Hall**

Topic: Influence of Sea weed extract on vegetable crops

Introduction:

Nowadays, application of biostimulants has become an alternative approach to minimize the use of chemical fertilizers. The sea weeds are marine macrophytic algae, which form an important component of inshore, marine ecosystems as they provide shelter and food to numerous marine biota. Most of seaweeds belong to one of three divisions - Chlorophyta (Green algae), Phaeophyta (Brown algae) and Rhodophyta (Red algae). The uses of sea weed as health food, medicines, pharmaceuticals, textiles, fertilizers, animal feed *etc.* are well known in many countries. India is bestowed with a coastline of more than 17,000 km embracing 821 species of seaweeds. There are two methods widely adapted for sea weed cultivation, *i.e.*, the raft method and the mono line culture. Sea weed extracts are reported to promote faster germination of seeds, increase number of leaves, number of flowers, fruit length, fruit diameter, and yield of various vegetable crops. The effect of sea weed extract is due to macro elements, micro elements and plant growth regulators present in it. Therefore, the sea weed extracts is gaining a major importance in olericulture.

Review of research work:

Tomato

Zodape *et al.* (2011) concluded that foliar application of *Kappaphycus alverizzhi* sap @ 5% can increase the plant height (121.8 cm), root length (13.2 cm), chlorophyll content (1.12 mg/100g), number of fruits per plant (23.78), yield(38.09 t/ha), polar (5.86 cm) and equatorial diameter of fruit (3.8 cm).

Dobromilska and Mikiciuk (2014) revealed that highest total yield (9.56 kg/m^2), marketable (8.81 kg/m^2), early yield (2.67 kg/m^2), length of clusters (11.3 cm) and fruit number in clusters (6.1) were obtained under the treatment of foliar spray of Acadian @ 0.5%.

Brinjal

Bozorgi (2012) noticed that fruit yield, number of fruits per plant, number of branches per plant, fruit length and fruit yield were highest when the plants were applied with *Ascophyllum nodosum* @ 1g/litre.

Okra

Zodape *et al.*(2008) carried out investigations on the effect of sea weed extract *Kappaphycus alverizzhi* on growth and yield of okra and revealed that foliar application of 2.5% sea weed extract gave the best results for growth and yield parameters like plant height, fresh weight and dry weight of fruits, fresh and dry weight of plants, number of fruits, length of fruits, diameter of fruits and fruit yield.

Chilli

Manna *et al.* (2012) found that soil application of RDF + seedling treatment of Biozyme seed plus + Biozyme vegetable granules (soil application) + Biozyme mirchi liquid (as foliar spray) recorded maximum plant height (61.21 cm) number of branches per plant (26.12), flowers per plant (101.5), fruits per plant(88.18), fruit setting (86.89 %), fruit length (11.19 cm), fruit diameter(10.38 mm), average fruit weight(2.78 g), fruit yield (9.77 t/ha) and ascorbic acid (121.28 mg/100g).

Mohammed (2013) disclosed that foliar application of sea amino extract supplemented with ascorbic acid resulted gave the best results with respect to fruit diameter, fruit length, no of fruits per plant, fruit weight, yield per plant, yield per hectare.

Cucumber:

Sarhan *et al* noticed that cucumber plants that received 6 g/l bread yeast and sprayed with a mixture of 0.33ml/l Alga 600 +2.5 ml/l Sea force 2 were characterized by the highest values of all growth and yield characteristics in cucumber.

Onion

Soil application of seaweed extract (prepared from *Ascophyllum nodosum*) significantly increased the growth and yield parameters and reduced downy mildew incidence in onion cv. N-53 (Dogra and Mandradia, 2012).

Foliar application of seaweed extracts @ 1 g/l significantly increased the bulb diameter, fruit weight, total bulb yield per m^2 and total bulb yield per hectare (Shafeek *et al*, 2015)

Potato

Sarhan (2011) reported that foliar application of 3ml humic acid + 0.33 g/l Alga600 + 3 ml/l Seaforce 2 gave the best results for vegetative and yield characters.

Cluster bean

Ramya *et al*. (2011) assessed the influence of liquid extract of *Stoechospermum marginatum* on yield characteristics of cluster bean and found that the maximum number of flowers, number of clusters, pod length and pod weight were obtained when plants were applied with 1.5% sea weed liquid fertilizer.

Sweet Potato

Doss *et al*. (2015) stated that maximum no. of branches, leaves, no. of tubers, marketable tubers and yield were obtained when the plants were treated with 75% RDF and 0.75% sea weed extract.

Conclusions:

From the foregoing discussion it can be concluded that sea weed extract improves growth, yield and quality of the vegetable crops. Foliar spray of sea weed extract at low concentration is highly effective in increasing the yield attributes of tomato, brinjal and okra. Combination treatments of chemical fertilizer, seedling treatment and foliar spray of Biozyme is effective in increasing the growth and yield parameters of chilli. Sea weed in combination with ascorbic acid gives best results for growth and yield parameters of chilli. Bread yeast in combination with sea weed extract can give better results for early , total yields and chlorophyll content in cucumber. Inspite of increasing the growth and yield parameters in onion sea weed extract foliar application also reduced the incidence of downy mildew in onion. Humic acid in combination with sea weed extract gave the best results for tuber yield in potato. Sea weed extracts at low concentration gives the highest results for growth and yield characters of cluster bean. 75% RDF and 0.75% Sea weed extract gave the best results for marketable tubers.

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Navsari Agricultural University
ASPEE College of Horticulture and Forestry, Navsari
Post-Graduate Seminar Series: 2016-17

Speaker	**: Golakiya Prayagbhai Dineshbhai (2020215021)**	**Course : VSC 591 (1+0)**
Major Guide	**: Dr. S. N. Saravaiya**	**Date : 20-08-2017**
Co-Guide	**: Dr. C. R. Patel**	**Time : 10 to 11 a.m.**
Venue	**: Swami Vivekananda Hall**	

Evaluation of GA_3 on performance of cowpea

Vegetables are the integral part of the balanced diet of human being since time immemorial. Cowpea (*Vigna unguiculata* (L.) Walp, Family: Fabaceae, Origin: Africa, 2n=2x=22) is grown throughout India in both summer and rainy season. Cowpea when grows for the immature green pod as vegetable is variously known as Asparagus bean, Snake bean and Yard long bean. Cowpea if grows for dry seed is known as Black-eyed pea, Kaffir pea, China pea and Southern pea. Dry seeds are rich in protein (23.09-28.75 %) so it is also known as Vegetable Meat.

In India cowpea is cultivated as one of the leading legume vegetable crop, covering an area of 1.5 million ha, with an annual production of 0.7 million tonne and having productivity of 4.6 t/ha. Gujarat state occupies an area of 26,883 ha, with an annual production of 2.85 LT and having productivity of 10.61 t/ha. (Anonymous, 2014).

Plant Growth Regulators:

Are either synthetic or organic compound other than plant nutrients or plant hormone that modify or regulate or inhibit plant physiological processes when used in very low concentration.

Role of GA_3 :

- Improve physiological efficiency
- Enhance the source–sink relationship and stimulate the translocation of photo-assimilates
- Foliar application of GA_3 enhances plant growth and development by encouraging cell elongation and division resulting in larger produce, extended shelf-life, increased plant vigour and better pod set. (Richards *et al.*, 2001).

Review of Research Work

Growth:

While working on cowpea, Mukhtar and Singh (2006) revealed that application of 50 ppm GA_3 with 14 hrs/day photoperiod were gave higher values for longer branches (116.8 cm), longer peduncle (76.6 cm), no. of internode (15.6 cm), no. of primary branches (9.70), length of primary branches (54.8 cm), no. of leaves(73.6) and total plant weight (41.4 g). However, higher values for plant height (98.2 cm) and length of internode (6.30 cm) were noticed with 50 ppm GA_3 and >12.5 hrs/day photoperiod.

Patel *et al. (*2011) noticed maximum plant height (64.60 cm), no. of branches per plant (7.81), no. of seeds per green pod (12.78), total green pod yield/plant (403 g) and green pod per ha (152.44 q) when seeds were soaked in GA_3 25 mg/l for 6 hrs. They also noticed that foliar application of GA_3 @50 mg/l increased plant height (64.79 cm), no. of branches per plant (7.81), no. of seeds per green pod (13.16), total green pod yield/plant (414.75 g) and green pod per ha (157.56 q).

Nabi *et al.* (2014) conducted an experiment to study the effect of GA_3 at 30, 60 and 90 DAS and found that plant height (61.07 cm), no. of branches per plant (19.73) and no. of leaves per plant (28.50) were higher under the treatment of foliar spray of GA_3 @33.3 ppm.

Yield & yield attributes:

An experiment was carried out at University of Agricultural Science, Dharwad. The results showed that significantly the maximum seed yield (1801 kg/ha) was recorded under the treatment

of GA_3 @50 ppm. Whereas, maximum values for no. of pods per plant at 80 DAS (9.50), at harvest (19.33), no. of seeds per pod (10.14) and 100 seed weight (13.24 g) were recorded under the treatment of GA_3 @25 ppm. (Ganiger *et al*., 2003).
Emongor and Ndambole (2008) studied the effect of GA_3 on performance of cowpea and found that treatment GA_3 @202.51 ppm recorded significantly higher seed yield than control. They also noticed that foliar application of GA_3 increased plant height, pod length, leaf area, nodulation, pods per plant, no. of seeds per pod, harvest index and 100 seed weight (test weight).
At Barisal conditions, Nabi *et al.* (2014) conducted an experiment on cowpea and noticed higher values for no. of pods per plant (11.50), 100 seed weight (12.25 g), seed yield (2986.72 kg/ha) and harvest index (22.45 %) with the treatment of GA_3 @33.3ppm.

Quality:
Ganiger *et al. (*2002) at RRS, Raichur, UAS, Dharwad observed that GA_3 @25 ppm concentration recorded higher total dry matter content (3.13, 9.77, 16.76, 25.58 g/plant) followed by GA_3 @50 ppm (2.98, 9.70, 16.13, 23.50 g/plant) after 25, 50, 75 DAS and at harvest, respectively.
Ganiger *et al.* (2003) at RRS, Raichur, UAS, Dharwad reported that GA_3 @25 ppm concentration recorded higher chlorophyll content (3.10 mg/g) after 25 DAS followed by control (2.74 mg/g) at harvest. Moreover, they also reported that GA_3 @50 ppm concentration recorded higher chlorophyll content (3.11 mg/g) after 50 DAS followed by control (2.11 mg/g).
Application of 50 ppm $GA_{3,}$ with 14 hrs/day photoperiod were gave higher DMC of petiole (2.0 g), DMC of leaves (6.8 g), followed by cowpea grown in short day lengths (P=10 and P>12.5 hd^{-1}) photoperiod. Flower bud initiation (25^{th} day) and first open flower (37^{th} day), were excellent with 50 ppm GA_3 and (P=10 and P>12.5 hd^{-1}) photoperiod. (Mukhtar and Singh, 2006).

Growth Analysis:
Ganiger *et al.* (2002) at UAS, Dharwad reported that GA_3 @25 ppm concentration gave higher total leaf area (10.08 cm^2/plant) followed by TIBA 50 ppm (8.99 cm^2/plant) at harvest.
Nabi *et al.* (2014) conducted an experiment to study the effect of GA_3 at different DAS and found that leaf area index (0.71, 1.10 and 1.13) were higher under the treatment of foliar spray of GA_3 @33.3 ppm at 30, 60 and 90 DAS, respectively.

Conclusions:
From the research results of various scientist, it can be concluded that foliar application of GA_3 enhances plant growth and development by encouraging cell elongation and division resulting in larger produce, increased plant vigour and better pod set. Seed soaking in GA_3 25 ppm solution increased plant height (64.60 cm), No. of primary branches (7.81), No. of seeds/pod (12.78), total green pod yield per plant (403.00 g), 100 seed weight (13.24 g), total dry matter content (25.58 g), leaf area (10.08 cm^2/plant). Foliar application of GA_3 @33.3 ppm enhanced plant height (61.07 cm), No. of primary branches (19.73), No. of leaves (28.50), seed yield (2986.72 kg), harvest index (22.45 %) and leaf area index (1.13). GA_3 @50 ppm enhanced plant height (64.79 cm), No. of internodes (15.6), No. of primary branches (7.81), No. of leaves (73.6), total plant weight (41.4 g), chlorophyll content (3.11 mg/g), No. of seeds/pod (13.16), total green pod yield/plant (414.75 g) and seed yield (1801 kg/ha). GA_3 50 ppm also increased DMC of leaves (2.0 g), DMC of petiole (6.8 g), early flower bud initiation (25^{th} day) and first flower open (37^{th} day).

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post Graduate Seminar Series: 2017-18

Speaker	: Punna Samatha Sree	**Course**	: VSC-591 (1+0)
Reg. No.	: 2020216028	**Date**	: 30/12/2017
Major Guide	: Dr. K.D. Desai	**Time**	: 2 to 3 pm.
Co-Guide	: Dr. B.M. Tandel	**Venue**	: Swami Vivekananda Hall

Root and Tuber Crops: Better Option for Nutritional Security

Food and nutritional security exists when all people, at all times have physical, social and economic access to food which is consumed in sufficient quantity and quality to meet their dietary needs and food preferences which must be supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life. Nutritional security is an integral component of food security and should be embedded within all four of its dimensions *i.e.* availability, access, utilization and stability. Root and tuber crops are second only in importance to cereals as global sources of carbohydrates. They provide a substantial part of the world's food supply and are also an important source of animal feed and processed products for human consumption and industrial use. Root and Tubers are plants which store edible starch material in subterranean stems, roots, rhizomes, corms, and tubers. Due to the high starch content and caloric value, these crops have a major role in meeting the food security of marginal farmers and ethnic people in the humid tropics (Peter, 2008). Root and tubers are important diet component for humans and add variety to it. In addition to the main role as an energy contributor, they provide a number of desirable nutritional and health benefits such as anti oxidative, hypoglycaemic, hypocholesterolemic, anti microbial, and immunomodulatory activities. Tubers may serve as functional foods and nutraceutical ingredients to attenuate non communicable chronic diseases and to maintain wellness.

Brief review of literature

Tuber crops:

Chandrasekara and Joseph kumar (2016) analysed raw tubers of potato (white and red flesh), sweet potato, cassava and yam and found highest energy and carbohydrate in cassava, protein in red flesh potato, total dietary fibre in yam, total sugars in sweet potato and also gives content of minerals and vitamins of above tubers.

F.M. Ugwu. (2009) studied requirement of quantity of different amino acids for the normal growth of different age groups of human being and its content in different tuber crops.

Aroids:

Sarma *et al*. (2016) studied the variability in nutritional content of some under utilized edible aroids found in hilly terrain of Assam. Out of eight different members of aroids, highest carbohydrate (25.0%), fat (0.95%), crude protein (4.39%), ascorbic acid (114.2 mg/100g) and flavonoid content (9.04%) were found in *Colocasia esculenta* (dasheen type-Tekela kochu).

Elephant foot yam:

Basu *et al*. (2014) analysed complete nutritional profile of *Amorphophallus campanulatus* tuber cultivated in Howrah district of West Bengal. They stated that tuber of *Amorphophallus* contain carbohydrates, protein, fat, fibre, ash and vitamins *i.e.* ascorbic acid, alpha tocopherol, β-carotene and lycopene in reasonable amount.

Harshavardhan *et al*. (2012) analysed elephant foot yam extracts and found three different total phenols and flavonoids. Out of these different extracts they investigated the effect of acetone extract on body weight of diabetic and non diabetic (control) rats and revealed severe loss in body weight of STZ induced diabetes. Further they also investigated the effect of acetone extract on urine sugar of the same group and after 24 hours recorded decrease in urine sugar excretion by about 35 and 55% in AEFD0.1 and AEFD0.25 groups, respectively. They also examine the effect of acetone extract on fasting blood sugar and recorded that of AEFD0.1 and AEFD0.25 groups showed 23 and 37% reduction, respectively. Whereas, AFD group showed 45% reduction in comparison to SFD group.

Sweet potato:

Nutritional information of sweet potato given in "Foods high in" shows that tuber of sweet potato contains reasonably high amount of protein (6.65g), fat (0.21g), carbohydrate (85.21g) etc. with different minerals and wide range of vitamins.

Performance of sweet potato entries at Navsari (Anonymous, 2012) and revealed that ST-14 entry recorded significantly the highest (13.48 mg/100g) beta carotene content.

Colocasia:

Agriculture department of United States analysed tubers of colocasia and recorded composition like carbohydrates (26.46 g/100 g), protein (1.5 g/100 g), fat (0.20 g/100 g), cholesterol (0 mg/100 g), dietary fibre (4.1 g/100 g), vitamins, electrolytes and minerals.

Champagne *et al*. (2009) studied the variation of major compounds in 66 parents and 45 hybrids of Taro. They found that the average starch and protein content was higher in the group of cultivars (79.34% and 5.40 per cent, respectively) than the hybrids. Total sugar (6.58%), minerals (4.15%) and cellulose (3.51%) content were higher in the hybrids than the cultivars.

Cassava:

USDA recorded composition of cassava root tubers with total carbohydrates (38.06 g/100g), protein (1.36 g/100g), lipids (0.28 g/100g), dietary fibre (1.8 g/100g) and also find five different vitamins and nine different minerals.

Potato:

FAO document recorded range of different constituent of potato tubers *viz.* protein (1.0-2.4 mg/100g), fat (1.8-6.4 mg/100g), starch (8.0-29 mg/100g), ascorbic acid (25 mg/100g) etc.

Conclusion

From the foregoing discussion, it can be concluded that root and tuber crops are analogous substitution of cereals and research on their chemical composition are an important contribution in the field of indigenous traditional system of food consumption. Therefore, most of these underutilized edibles can be used to mitigate micro and macro nutrient deficiency and improve food security. It is manifestly clear from our vision that the root and tuber crops will remain a vital component of the global system in the era beyond 2020. It also is clear that these commodities, the farming systems in which they are produced and the people who produce, process and consume them will value and depend on roots and tubers in the decades ahead. This is particularly true for many of the world's poorest and most food insecure households.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
POST GRADUATE SEMINAR SERIES: 2018-2019

Speaker : Manani Nishant Prafulkumar	**Course : VSC 591 (1+0)**
Reg. No. : 2020217015	**Date : 01/09/2018**
Major Guide : Dr. V. K. Parmar	**Time : 2:00 to 3:00 pm**
Co-Guide : Dr. Y. N. Tandel	**Venue : Swami Vivekananda Hall**

Synthetic Seeds in Vegetable Crops

Introduction

Synthetic seed is a novel concept in seed bio-technology. During the last few years, there is a progress in biotechnology research and has opened up unprecedented opportunities in synthetic seed industry. The successful demonstration of encapsulation of tissue culture derived propagule in a nutrient gel has initiated a new line of research on synthetic seed. It is an encapsulated plant tissue or somatic embryo in a suitable matrix to grow into a complete plantlet. The encapsulated matrix has the ability to incorporate nutrients, bio fertilizers, pesticides, nitrogen-fixing bacteria, antibiotics or other essential additives. These encapsulated embryo or synthetic seed behave like a true seed can resist unfavorable field conditions without desiccation. They can also be sown directly in the green house or in fields. (Kumar, 2011)

It is a potential technique for plant multiplication and preservation, especially it has been considered to be promising for propagation of non seed producing plant, transgenic plants and other plants that need to keep superior traits by means of asexual propagation. This technology may be value in breeding programs and allow the propagation of many elite genotype- derived plants in short time. Synthetic seed technology is an alternative to traditional micropropagation for the production and delivery of cloned plantlets.

Brief review of research work

Cassava (B.N: *Manihot esculenta* L., Family: Euphorbiaceae)

Hegde *et al*. (2016) observed that the combination of 3 % sodium alginate with 100 mM calcium chloride produced the best overall performance; producing optimally uniform, isodiametric capsules, with good results in terms of germination percentage (93.33%) and days to germinate (8.11 days).

Brinjal (B.N: *Solanum melongena* L., Family: Solanaceae)

Huda and Bari (2007) revealed that 1% sucrose showed the best result for germination of synthetic seed made of nodal segment among different sucrose levels treated in MS medium. In this sucrose level, 95% seeds of Loda variety and 90% of China variety were germinated on artificial medium.

Huda and Bari (2007) recorded that 81% synthetic seed of Loda variety within 4-5 days and 70% synthetic seed of China variety within 15-16 days were germinated in treatment of 1.0 mg l^{-1} BAP with 0.1 mg l^{-1} GA_3 used in seed bead.

Beet root (B.N: *Beta vulgaris* L., Family: Chenopodiaceae)

Rizkalla *et al.* (2012) reported that sucrose @ 30 g l^{-1} added in MS medium to form alginate capsules significantly improve germination of beet root synthetic seed after six week of storage.

Pointed gourd (B.N: *Trichosanthes dioica* Roxb., Family: Cucurbitaceae)

Malek (2009) found that 4% alginate gave best result with 95% of seed germination. They also observed the highest percentage of shoot proliferation in MS medium containing 1.0 mg l^{-1} BAP in both genotypes AM-8 and AM-15 with 85% and 90% shoot proliferation, respectively.

Potato (B.N: *Solanum tuberosum* L., Family: Solanaceae)

Ghanbarali *et al.* (2016) concluded that excise 2-3 mm buds of potato with full strength of MS medium gave the best conditions to optimize bud regrowth. They also found that encapsulated bud stored at 4°C was able to retain the highest viability rate for up to 120 days in '*Santeh'* and 90 days in '*Agria'* variety.

Sharma *et al.* (2007) revealed that there was no difference in mean tuber weight and tuber yield per plant derived with embling and micro tuber, while tuber skin colour was uniform in both treatments.

Spine gourd (B.N: *Momordica diocia* L., Family: Cucurbitaceae)

Muthu *et al.* (2012) found that the maximum response (100%) for conversion of encapsulated shoot tip explants into plantlets was obtained on solidified full-strength MS medium containing 0.5 µM BAP. They also observed that encapsulated shoot tips was stored at low temperature (4°C) up to 10 weeks with a survival frequency of 50%.

Cauliflower (B.N: *Brassica oleracea L. var. botrytis*, Family: Brassicaceae)

Rihan *et al.* (2011) found that encapsulated microshoots at the age of 13-14 days had highest number of converted artificial seed and weight of plantlets produced.

Siong *et al.* (2012) reported that isolated micro shoots encapsulated in MS supplemented with 0.3 mg l^{-1} NAA and 3.0mg l^{-1} BAP gave high germination percentage (70% and 63.33%) after 7 and 30 days of pre-germination storage period, respectively.

Garlic (B.N: *Allium satium* L., Family: Alliaceae)

Shawky (2006) revealed that the highest number of proliferated shoots and their growth parameters (shoot length and fresh mass) were obtained by using MS medium containing 2 mg l^{-1} BA +2 mg l^{-1} naphthaleneacetic acid (NAA).

Conclusion

From the research results of various researchers on synthetic seed concept, it can be concluded that the encapsulation of apical and axillary buds with 3% sodium alginate and 100 mM calcium chloride improve germination in cassava. The encapsulation of shoot tip with 4% sodium alginate with MS medium and 1.0 mg l^{-1} BAP improve germination and shoot proliferation in pointed gourd. Phytohormone like 0.3 mg l^{-1} NAA and 3.0 mg l^{-1} BAP used for getting high germination of cauliflower synseed. There was no yield reduction found in plant derived with synthetic seed in potato. Synthetic seed stored at 4°C able to retain the highest viability rate up to 120 days in potato and 60 days in spine gourd. Use of MS-medium supplemented with 2 mg l^{-1} BA+2 mg l^{-1} NAA increased number of proliferated shoots and their growth in Garlic.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY NAVSARI
POST GRADUATE SEMINAR SERIES: 2018-2019

Speaker	:	Goswami Mayurgiri J.	**Course**	:	VSC 591 (1+0)
Reg. No.	:	2020217011	**Date**	:	01/09/2018
Guide	:	Dr.V. K. Parmar	**Time**	:	4.00 to 5.00 P.M.
Co-Guide	:	Dr. Y. N. Tandel	**Venue**	:	Swami Vivekanand Hall

ROLE OF HONEYBEE (GREATER POLLINATORS) IN POLLINATION OF VEGETABLECROPS

Introduction

India is second largest producer of vegetables in the world. But, its productivity per unit area compared with other developed countries is quite low.There are many factors responsible for lowering the vegetables productivity *viz*.,quality of planting materials, lack of knowledge about soil health, biotic and abiotic stresses, specific chronic problems and pollination and pollinators problems are also a great concern. Pollination is one of the most critical, complex and less understood subject in vegetables production.Almost all agricultural crops depend upon pollinating insects for commercial seed/fruit production (Deodikar, G. B. and Suryanaryana, M. C., 1977).

Honeybees are considered the effective and cheapest pollinators for triggering the crop yield.Honeybees not only provide honey a food of high nutritive and medicinal value, but also help in the qualitative and quantitative improvement of crop production through pollination. Evidently, for increased crop production and sustainable agriculture, it is essential to explore the possibility of planned bees pollination or any insect pollination.

Factor affecting the honeybees pollination

A mainly three factors such as biotic,abiotic and cultural factors appears to influence on honeybees pollination.

High or Low Air temperature and high humidity had negative influence on honey bees visits (Puskdija*et al*., 2007).

Effect of improper pollination

Adequate pollination usually assures uniform and perfectly formed fruits with even maturity, while incomplete pollination results in flower drop,poor fruit setting,misshapen and stunted fruit, thus leading to low yield of marketable fruits.

The high percentages of misshapen fruits (20%) and less healthy fruits (79.64%) in cucumber werenoted in open, in compare to pollination by honeybee’s pollination(Meena and Rana, 2008).

Brief review of research work

Cole crops

The maximum pod/panicle (55.10), seed/pod (16.70), 1000 seed weight (3.36 g) and seed yield (620.50 kg/ha) in broccoli var. PusaSamridhi were found in planned honeybees pollination as compared to natural pollination(Shushil*et al*., 2013).

Shushil*et al*. (2013) reported that the maximum pod/panicle (45.80), seed/pod (19.10), 1000 seed weight (1.11 g) and seed yield (212.85 kg/ha) in cabbage var. open type were obtained in planned honeybees pollination.

Shushil*et al*. (2013) observed that planned honeybees pollination had given maximum pod/panicle (45.60), seed/pod (17.25), 1000 seed weight (4.19 g) and seed yield (187.00 kg/ha) in knol-khol var. White vinnea as compared to natural pollination.

Rouf*et al*. (2016) reported that the maximum seed per siliqua (11.08),1000 seed weight (3.57g) and seed yield (455.88 kg/ha) in cauliflower seed production were obtained byusing bee pollination insidethe net.

Cucurbits

The maximum yield (1037.9 g/plant and 11.417 ton/faddan) in muskmelon was noted in treatment of cage with bee compare to other treatments (Nagi and Mohammad, 2016).

Rahile*et al*. (2016) found that theminimum flower drop (7.65 %) and the maximumfruit set (92.35 %),fruit weight (24.78±1.85g),fruit length (6.31±0.19 cm), diameter (3.27±0.13cm) and yield/ acre (4500kg) inbitter gourd were noted intreatment of pollination by*Apisceranaindica* in compare to natural pollination.

The highest per cent fruit set (87.14 and 84.14) in bitter gourdand cucumber, respectively was observed in honeybee pollinationover control or self-pollination(Dorjay*et al.*, 2017).

Rai *et al*. (2008) reported the maximum fruits/plant (75.75), fruit length (15.85 cm),average fruit weight (147.35 g), yield (236.25 q/ha) in treatment of polyhouse with bee hive incompare to other treatments in cucumber.

Fruit vegetables

Rahile*et al*. (2016) found that minimum flower drop (8.33 %) and maximum fruit set (91.67 %), fruit weight (84.32±2.95g), fruit length (7.42±0.31cm), diameter (5.14±0.14cm) and yield/ acre (5000 kg) in brinjal were noted in treatment of pollination by*Apisceranaindica*in compare to natural pollination.

The maximum fruit production per plant (22±3.5 kg/plant), average fruit weight (12.55±4.17 g) and fruit size (25.16±9.99 cm) were reported in treatment of *Apiscerana* incompare to other treatment in *Capsicum annum*. L. (Putra *et al*., 2014).

Onion

Munawar *et al*. (2011) reported that maximum seed sets percentage was noted in hybrid seed production of onion caged with honey bee follow by blowflies and control (no pollinators).

Conclusion

Crops	Conclusion
Cole crops	• Planned honeybee pollination increased the overall performance of the plants in terms of se production and seed vigour of cole crops.
Cucurbits	• Honey bees pollination increased the fruit setting, fruit weight, fruit size, fruit yield and reduc the flower drops and misshapen fruits in the cucurbits vegetables crops.
Fruits vegetable crops	• *Apisceranaindica*found the better pollinators than other pollinators in capsicum and brinjal. Th increase thefruit sets, fruit weight, fruit size, fruit yield and reduced theflower dropsin capsicu and brinjal.
Onion	• Honey bees increased the seed sets in hybrid seed production of onion as compare blowflies a no pollinators.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2018-19

Speaker Adarsh Guddadamath	**Course** VSC-591
Reg. No. 2020217001	**Date**15-09-2018
Major Guide Dr. D. R. Bhanderi	**Time**2:00 to 3:00 p.m.
Co- Guide Dr. R. V. Tank	**Venue** Swami Vivekananda Hall

Development of nutraceutical rich vegetable varieties through conventional and molecular approaches

Vegetables and fruits are fundamental components of human diet. They not only important sources of essential vitamins and minerals, but also contain wide variety of secondary metabolites important to human health. Coloured vegetables and fruits have gained an increasing interest as functional foods, owing to their high levels of plant pigments with potent nutritional and health-promoting effects. But, these vegetables are lacking in some of the important nutrients which can greatly affect on the growth and development of the humans. One example for such nutrients is vitamin-A, its deficiency is one of the most prevalent nutrient deficiencies in many underdeveloped regions of the world. Where it affects an approximately 250 million children under 5 years of age, between 2,50,000 and 5,00,000 of these children become blind each year and about two-thirds of those losing vision and die within a year (Zhu *et al,* 2007).

Breeding of the staple vegetable crops through conventional and molecular approaches will improve the availability of important nutrients like beta-carotene, anthocyanins, proteins, vitamins, flavonoids, glucosinolates, thiosulfates and antioxidants. These nutrients not only help to overcome the nutritional disorders but also improves the growth and development of humans, especially the children. As the potato is the staple food for many European countries, developing of protein rich potato i.e. 'protato' through transgenic breeding helps in accumulation of 60% more protein content compared to normal potato (Chakraborty *et al,* 2000). So evidently to overcome the different problems of nutrition, breeding of the vegetables with high nutritive content is essential.

Review of research work

Conventional approaches

Dey *et al*. (2006) studied on the six different genotypes of bitter gourd for the ascorbic acid content in fruits, the range of ascorbic acid content was 60.20 mg to 122.07 mg/100 g of fresh weight of fruit. The highest amount of ascorbic acid was found in genotype DBTG-3 (122.07 mg) followed by DBTG-8 (120.53 mg).

Dey *et al*. (2006) observed that total carotenoid content in the six genotypes of bitter gourd ranging from 0.205 mg to 3.2 mg/100 g fresh weight of fruit. The highest number of carotenoids were noticed in genotype DBTG-8 (3.2 mg) followed by line DBTG-9 (3 mg).

Cuevas *et al*. (2010) noticed that the hybridization between 'Addis' (*Cucumis sativus cv. Sativus*) and XIS (*C. sativus cv. Xishuangbannanesis*) which resulted progenies with different mesocarp and endocarp colored fruits, in that orange (ORG) shows highest accumulation of beta-carotene both in meso and endocarp 2.72 ± 1.15 and 7.54 ± 0.68, respectively when compared to other lines.

Hazra *et al*. (2012) studied on the nutritive characters of tomato mutants. They revealed that the hybrid progenies from cross of Alisa Craig *ogc* and BCT-53 showed highest accumulation of beta-carotene (0.47 mg/100 mg) and anthocyanins (1.56 mg/100 mg) which was at par with the progenies of Alisa Craig *ogc* and Patharkutchi.

Davis *et al*. (2013) found that higher ploidy in watermelon showed higher amount of lycopene accumulation. From the six family lines they observed family line 18 showed highest accumulation of lycopene in 2X (10.9 mg/g), 3X (10.7 mg/g) and 4X (11.1 mg/g).

Davis *et al*. (2013) revealed that auto-triploid family lines showing high content of glutathione. This may because of positive co-relation of glutathione with larger fruits, line 20 showed highest accumulation of glutathione compared to other lines 2X (51.1 mg/g), 3X (117.7 mg/g) and 4X (60.1 mg/g

Thayyil *et al.* (2016) revealed that seedless triploids obtained by crossing common tetraploid KAU-CL-TETRA-1 with CL-4 (RED fleshed diploid) and CL-5 (yellow fleshed diploid) and got 'Shonima' and 'Swarna' triploids, respectively. The 'Swarna' was showed highest beta- carotene accumulation (1.51 mg/g) compared to 'Shonima' (1.15 mg/g).

Molecular approaches

Chakraborty *et al. (*2000) reported that the transgenic breeding in potato using gene *AmA1* which was responsible for protein synthesis from *Amaranthus hypocondriacus* L. on three lines of potato. The line pSB8G showed highest accumulation of protein (16.5 mg/g) in potato compared to other two lines.

Apel and Bock (2006) observed that the transplastomics in tomato, genes from *Erwinia uredovora* and *Narcissus spp.* responsible for converting lycopene to beta-carotene. The line *S.l.-pNLyc* showed highest accumulation of total beta-carotene (95 ng/mg) dry weight compared to other two.

Chiu *et al.* (2010) studied on transgenic improvement of cauliflower by inserting a *Pr-D* gene from the wild mutant. Under uncontrolled CaMV conditions BoDFR showed high relative accumulation of anthocyanins and under controlled condition for CaMV BoMYB2 showed highest relative accumulation of anthocyanins.

Li *et al.* (2012) found that *Or* transgene induced in three lines of potato from cauliflower orange. The highest carotenoids accumulation in line L93 (95 μg/g) of dry weight after five months at cold storage followed by L29 (60 μg/g).

Conclusion

Evaluation of genotypes for higher ascorbic acid and carotenoid content may utilized for quality improvement in bitter gourd. Hybridizing the wild types with cultivated ones to improve the beta-carotene content in cucumber. Utilizing mutants in crop improvement to acquire higher amounts of anthocyanins and carotenoids in tomato. The triploid and tetraploid accumulate higher glutathione and lycopene, respectively in watermelon.

Transgenic breeding of potato with gene from amaranthus enhanced the protein production (60% higher) in tubers of potato. The transplastomics enhanced the total carotenoids production by conversion of lycopene to carotenoids in tomato. Increased anthocyanins leading purple curds in cauliflower by transgenics from mutant cauliflower. Storing of *Or* transgene potato tubers-maintained carotenoids in yellow colour fleshed potato tubers along with increased carotenoids at longer cold storage conditions.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2018-2019

Speaker	:	Parmar Manishkumar N.	**Course**	:	VSC 591 (1 + 0)
Reg. No.	:	2020217018	**Date**	:	15-09-2018
Major Guide	:	Dr. S. Y. Patel	**Time**	:	3:00 to 4:00 pm
Co- Guide	:	Dr. A. K. Pandey	**Venue**	:	Swami Vivekananda Hall

Special horticultural practices for vegetable crops under protected cultivation

The concept of modern horticultural technologies has widened the horizon of vegetable industry in India. Now-a-days, it is not only a question of providing enough vegetables for a balanced diet, but also to produce quality vegetables throughout the year. The present per capita availability of vegetable in India is only 210 g as against the requirement of 300 g/capita/day. The crops grown in open field conditions are often exposed to varying levels of temperature, humidity, wind flow *etc*., which ultimately influence extensively on the productivity as well as quality of crops. Further, with globalization of markets and global climate change, protected cultivation along with special horticultural practices emerged as the single most important technology for ensuring high productivity, improved quality and lucrative return.

Review of Research Work

Training

Patel *et al.* (2016) found that the significantly maximum plant height at 90 and 120 DAP (163.11 and 216.69 cm, respectively), no. of flowers per cluster (8.78), no. of fruits per cluster (6.19), no. of fruits per plant (31.83), fruit weight (92.86 g), yield per plant (2.71 kg), and yield per m^2 (6.76 kg) in tomato were obtained in single stem training system.

Thakur *et al.* (2018) found that the significantly maximum number of leaves per plant at 30, 60, 90 and 120 DAP (50.01, 85.37, 111.60, 119.61, respectively), maximum number of flowers per plant at 60, 90, 120, 150 and 180 DAP (10.19, 11.41, 9.44, 7.54, 3.62, respectively), number of fruits per plant (20.31), fruits yield per plant (3.20 kg) and total yield (95.01 t/ha) in capsicum were noted with four shoot system of training as compare to two & three shoot system. While, significant higher fruit weight (175.91 g) was found into two shoot system of training than the rest treatments.

Pruning

Shetty and Manohar (2008) found that the minimum days to first flowering (27.81 and 25.25 DAT, respectively), fifty per cent flowering (34.18 and 32.63 DAT, respectively), maximum number of flowers per plant (34.34 and 39.41, respectively), fruit set (52.37 and 63.51 %, respectively), yield per plant (1.97 and 2.39 kg, respectively), yield per plot (19.70 and 23.90 kg, respectively) and yield per hectare (118.20 and 143.40 tonnes, respectively) of capsicum in winter and summer season were noted in pruned upto four branches per plant + NAA 10 ppm as compared to other treatments.

Ahirwar and Hedau (2015) studied the effect of shoot pruning on growth, yield and quality attribute in a winter capsicum (*Capsicum annum* L.) in protected condition and found that significant number of fruits per plant (110.67) and fruits yield (10.68 kg) obtained in the control system while, significant highest polar diameter (100.94 mm) and radial diameter (111.84 mm) cited in fourth leader system.

Plant growth regulators

Bharti *et al.* (2017) reported that the significant highest number of fruits per plant (26.0), average fruit weight (185.0 g), fruits yield per plant (3.0 kg), marketable yield per m^2 (10.75 kg) and total yield per m^2 (11.44 kg) of bell paper were came out with 20 ppm NAA as compare to rest of the treatments under the experiment.

Pollination

Al- Attal et al. (2003) reported that significantly the maximum average yield per plant (5132.20 g), average fruit weight (100.3 g), average fruit specific gravity (1.03 g/cm3) and average fruits set (99.1 %) in tomato were found by bumbles bee use for pollination whereas, PGB and vibration treatment followed to them.

Rai *et al.* (2008) found that the significantly higher number of fruits per plant (75.75), average fruit weight (147.35 g) and yield (236.25 q/ha) in cucumber under poly house with bee hive than without bee hive under polyhouse and open field condition.

Mulching

Singh *et al.* (2017) found that significantly higher fruits per plant (40.4), fruit weight (60.2 g), yield (10.9 kg/m^2) and harvest duration (85.6 days) in tomato were found in double shaded plastic mulch than others coloured plastic mulch use in the experiment.

Rolaniya *et al*. (2018) revealed that the minimum days to first flowering (35.24), days to first fruiting (41.71), days to first harvest (44.11), maximum fruit length (13.16 cm), fruit girth (3.55 cm), fruit weight (110.83 g), number of fruits per vine (11.91), fruits yield per vine (1.37 kg) and fruits yield (561.31 q ha^{-1}) in cucumber found in black polythene mulch than straw mulch and control.

Shade net

Desai *et al.* (2016) reported that the maximum plant height (25.25, 20.39 and 28.50 cm, respectively), no. of leaves per plant (28.13, 29.23 and 4.70, respectively) in fenugreek, coriander, garlic crop and fresh biomass yield (128.33 and 59.0 kg/100 m^2, respectively) in fenugreek and coriander were found into red shade net. Whereas, fresh biomass yield (54.33 kg/100 m^2) in garlic found into green shade net as compare to rest of the treatments.

Conclusion

- Various horticultural practices such as training, pruning, pollination, PGRs, mulching and shade net in protected cultivation found significant for achieving higher yield of various vegetable crops.
- In tomato, single stem training results better vegetative and reproductive character of plant. While, in case of capsicum four leader system found higher yield and its attributes.
- In capsicum, four shoot pruning system with NAA @ 10 ppm had significantly improve the yield characters.
- In case of PGRs, NAA @ 20 ppm significantly improve the marketable yield of bell papper.
- In case of pollination, bumble bee found best for fruit set and higher yield under poly house conditions.
- Use of black polythene mulch and double shaded polythene mulch gave higher yield with good quality fruits.
- Use of the red shed net in fenugreek, coriander and garlic, significantly improve vegetative and reproductive growth of the crops.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2018-2019

Speaker	**:**	**Modi Shivani Rajendra (Reg. No.: 2020217016)**	**Course**	**:**	**VSC- 591**
Major Guide	**:**	**Dr. Sanjeev Kumar**	**Date**	**:**	**15-09-2018**
Co- Guide	**:**	**Dr. Dev Raj**	**Time**	**:**	**4 to 5 p.m.**
			Venue: Swami Vivekananda Hall		

Agrivoltaic: A Novel Prototype of Energizing Olericulture

The world is facing dire circumstances of ever growing world population thereby intensifying the severe need for enough food production and sustainable and renewable energy production. Three major changes helped to feed growing world population during last century, mechanization and fossil fuels; food imports and increased land for agriculture and green revolution (Suay *et al*., 2017). Biomass fuel and solar energy assure resource sustainability and environment friendliness after exploitation of fossil fuels up to verge of depletion. Renewable energy production is one of the corner stones in mitigating global warming. Energy from photovoltaic (PV) system seems to have the largest potential in near future. However, implementation requires large amount of land @2 ha/MW (Priyabrata *et al*., 2017). Moreover, increase in population exacerbates new land availability. The concept of combining food and renewable energy production by PV systems promises to provide congenial environment for crop with added benefit of solar energy. Agrivoltaic systems consist of field scale arrays of solar PV modules mounted directly either on ground or on elevated structure under which crops are grown. Agrivoltaic systems can refine growing demand for carbon free electricity while preserving and protecting productive agricultural land.

Review of research work:

Mounted on ground systems:

Beena *et al.* (2015) conducted an experiment on "agro-electric model" and listed various economic, social and environmental impacts. The results showed income of average 15,45,209 INR/ha/year from solar panels. Moreover, ~250 tonnes/year CO_2 was sequestered from 6 ha plantation leading to CO_2 fixation back in soil. Considering average 0.346 tonnes/ha productions in turmeric and ginger, total 28,486 and 30,144 INR/ha/tonnes of net profit was gained respectively. Similarly, in bottle gourd cultivation, 2020 INR/ha/tonnes; in lady finger, 20,361 and in ivy gourd, 14,260 INR/ha/tonnes net profit was obtained.

Mounted on elevation:

a) Open Structure:

Marrou *et al.* (2013a) studied changes in microclimate under agrivoltaic systems and observed average proportion of daily radiation transmitted below full density (FD) and half density (HD) photovoltaic panels (PVPs) ranging around 32% and 48%, respectively compared to full sun (FS) treatment during 117-143 Day of Year (DOY). They advocated the use of mobile panels set in a direction of maximum light penetration during plant growth to mitigate effect of light reduction under agrivoltaic systems.

Marrou *et al.* (2013b) evaluated different varieties of lettuce under PVPs during 124 to 144 DOY and cucumber during 175 to 241 DOY. Out of all varieties of lettuce, "Kiribati" and "Emocion" performed excellent in shade in terms of relative yield as well as water use efficiency (WUE) in all FS, FD and HD systems. In average, when pooling all varieties together, WUE between DOY 124 and 144 was reduced by 5% in FD and increased by 12% in HD. In case of actual evapotranspiration (AET), FD and HD systems showed significant reduction compared to FS.

However, cucumbers were most sensitive to shade which affected dry matter accumulation and WUE negatively.

Marrou *et al.* (2013c) studied the response of lettuce grown under partial shade of PVPs for two consecutive seasons and found significant reduction in number of leaves in shade for every treatment during first season and only in HD treatment during second season. On the contrary, total leaf area was found higher in FD during second season.

The results of study carried out by Marrou *et al.* (2013d) revealed significant yield reduction is observed in FD compared to full sun (A0). In case of spring lettuce, biomass production tended to be higher in HD with increase in biomass production efficiency in shade. Considering actual prices for electricity, vegetable and PVPs, it was found that A0, FD and HD systems generated nearly the same revenue in the case of lettuce monocropping. In the case of the diversified rotation, A0 was more profitable, but a slight increase of electricity price would be enough to equal FD and A0 profitabilities. They also recommended HD system for minimum 70% availability of light fulfilling the requirement of plants.

Valle *et al.* (2017) demonstrated cohering of mobile solar panels and food production on same land. The results showed that the mean daily transmission of radiation substantially reduced under all PVP systems compared to FS. However, controlled tracking (CT) showed higher fraction of transmitted radiation compared to solar tracking (ST) and stationary HD systems. In case of crop production, both the varieties of lettuce (Kiribati and Madelona) showed higher no. of leaves per plant under full sun and increased specific leaf area under agrivoltaic systems. Irrespective of season, ST increased total electricity production per land unit area compared to stationary HD system.

Chauhan (2018) studied the effect of solar panels on various environmental parameters and crop performance and found that light intensity and relative humidity are significantly lower under solar photovoltaic (SPV) plant compared to open field. Cumulative electricity production during crop production was 3026.1 kWh. Total tomato fruit production under agrivoltaic structure and open field condition was obtained to be 200.11 kg and 183.92 kg respectively in eight pickings from an area of 152m^2.

b) Mounted on greenhouse type structure:

Kadowaki *et al.* (2012) investigated the effects of PV-array shading on Welsh onion growth. The results showed that the PVs (straight-line arrangement) shaded more than 50% of Photosynthetic Photon Flux Density (PPFD) at the northern plant positions which was related to decrease in plant growth. However, more than 50% of the control greenhouse PPFD was exposed to the entire PVc (checkerboard arrangement) greenhouse plants which improved plant growth accordingly. Unlike PVc greenhouse, the crop yield in PVs greenhouse was found to be significantly less than control treatment. PVs and PVc arrays generated electrical power output of more than 30W/m^2 with electrical power/solar irradiance conversion efficiency of 5%. They concluded that PVc array is preferred to the PVs array in terms of crop yields while providing a comparable amount of electrical energy generation.

Raul *et al.* (2012) undertook greenhouse tomato production and energy generation by roof mounted greenhouse solar panels and found that mean daily radiation for the T_0 (control) was greater than in T_1 (12 flexible solar panels) or T_2 (six solar panels) for the entire study period. The solar panel arrangements did not negatively affect the marketable production of tomato. However, mean fruit mass and fruit diameter of fruits of T_0 were higher than T_1 and T_2. The energy production of the solar panels was 2766 kW h/crop-cycle in both T_1 and T_2. Moreover, the savings made by the consumption of self-produced energy during the growth cycle was 7,680 INR. The rest of the energy produced over the growth cycle provided an income of 51,120 INR.

Roberta *et al.* (2015) carried out a comparative study of tomato production under PV and traditional greenhouses and found that PV greenhouse recorded lowest incoming solar radiation (<35%). The height of tomato remained unaffected in both systems, however number of flowers was found to be significantly higher in traditional greenhouses. Similarly higher amount of lycopene and β-carotene contents of tomatoes were recorded in traditional greenhouse resulting in significant differences in yield as well as quality of tomatoes.

c) Greenhouse with photovoltaic roof:

Cossu *et al.* (2014) in their study demonstrated income deriving from the energy production is considerably higher than that resulting from the crops. At the end of first cycle, PPFD in GH was averagely 72% lower than potential value, while in second cycle, it was 63% lower. They also found that total and marketable yields were affected by the decrease of PPFD along to the North–South gradient. The 'Earliness Index' values were significantly higher in the rows under the plastic roofs compared to the rows under the PV roofs. The annual electricity production was 1,07,885 kWh generating an additional revenue estimated around 16,08,669 INR as an indirect income.

Conclusion:

In a context where renewable energy production vie for food and arable land, agrivoltaic systems act as possible solution that can combine and coexist with agriculture. "Agro-electric model" using ground mounted solar panels can generate employment in rural people, increases water use efficiency by reuse of panel washing water as irrigation water along with its major aim of energy and food production. Although, economic incentives are required to sustain HD system, to maintain balance between electricity generation and food production, HD system should be preferred over FD system. However, very high productivity per unit area can be reached using dynamic PV systems. With electricity generation, ST system favors higher yield representing real economic gain regarding food production. Geometrical arrangements of PV arrays drastically affect the growth of plants cultivated below the PV arrays inside greenhouse. The arrangement of photovoltaic arrays in checkerboard formations instead of straight line reduces shading on the crop and generates higher electricity. Flexible solar panels affording 9.8 % blacking in different arrangements can be installed on tomato greenhouses as a means of generating electricity/extra income. The fruit quality in context to physical as well as physiological parameters is negatively affected when more than 50% of greenhouse roof is covered with PV modules. However, the lower income from the cultivated crops can be fairly compensated by the huge income generation of PV energy. The concept of agrivoltaic is at early stage of development and performance needs to be monitored closely and comprehensively in context of sustainability. Simultaneously, there is urgent need to optimize agrivoltaic systems by plant breeding, selection of crop, adaptation in cropping practices and by specific arrangement of PVPs panels to find the best compromise between food production and electricity production on same piece of land.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2018-2019

Speaker	: Gadhiya Dhara Pravinbhai	**Course**	: VSC 591 (1+0)
Reg. No.	: 2020217008	**Date**	: 29/09/2018
Major Guide	: Dr. N. K. Patel	**Time**	: 2:00 to 3:00 pm
Co-Guide	: Dr. B. M. Tandel	**Venue**	: Swami Vivekananda Hall

EFFECT OF HUMIC ACID ON VEGETABLE CROPS

India is a second largest vegetable producing country after China. Humic acid is derived from humus. Humus is a dark coloured organic matter found in soil; made of decayed plants and animals. Humus can be divided into humic and non humic substances. Humic substances can be subdivided into three major fractions *viz*., HAs, FAs and Humin. Humic acid (HA) is a mixture of weak aliphatic and aromatic organic acids, which are not soluble in water under acid condition but are soluble in water under alkaline conditions. It is a natural bio-stimulant that is derived from leonardite. HA contains many elements which improve the soil fertility and increasing the availability of nutrient elements and consequently affected plant growth and yield. It also reduces other fertilizer requirements, increases yield in crops, improves drainage, increase aeration of the soil and establishes a desirable environment for micro-organism development. In vegetable crops, HA increases growth, yield and quality parameters.

Brief review of research work

Family: Solanaceae

Potato (B.N.: *Solanum tuberosum*L.)

Selladurai and Purakaystha (2016) observed that maximum fresh tuber yield was obtained with GF 45 H and 100 % RD, whereas maximum dry tuber yield obtained with Chemical fertilizer (100 % RD) + Supa humus 26 which was significantly at par with GF 45 H- 100 % RD.

Tomato (B. N.: *Solanum lycopersicum* L.)

Abdellatif *et al.* (2017) revealed that soil application of HA @ 9.6 and 14.4 kg ha^{-1} gave early yield and total yield of tomato under hot climatic condition.

Suman *et al.* (2017) reported that maximum plant height, leaf area index, no. of fruits/plant, fruit weight, total yield, ascorbic acid and titratable acidity were obtained with fertigation with RDF + HA compared to fertigation with RDF.

Kazemi (2014) observed that foliar application of 30 ppm HA + 15 mM Ca gave maximum plant height, no. of branches, flowers & fruits per cluster, fruits per plant, fruit weight and fruit yield. It also increased quality parameters of fruit *viz.,* TSS, vitamin- C, fruit firmness, lycopene content and lowest percentage of BER compared to control.

Brinjal (B. N.: *Solanum melongena* L.)

Paramasivan *et al.* (2015) reported that significantly maximum plant height, branches/plant, fruits/plant, fruit weight, fruit yield, total nutrient uptake and minimum days to 50 % flowering were obtained with 75 % RDF+10 kg HA (SA)+0.2 % HA ha^{-1} (FA) compared to all treatments.

Suchitra and Manivannan (2012) opined that significantly maximum plant height, no. of leaves per plant, no. of primary branches per plant, no. of fruits per plant, weight of fruit, yield per plant and yield per ha were obtained with soil application of Vermicompost + HA compared to remaining treatments.

Chilli (B. N.: *Capsicum annum* L.)

Manas *et al.* (2014) observed that foliar application of HA+Zn+B (0.05%+0.05%+0.02%) gave maximum plant height, no. of leaves, no. of branches, no. of fruits per plant, length of fruit and average weight of 20 fresh fruit.

Fatima and Denesh (2013) noted that maximum no. of branches per plant and no. of fruits per plant and dry chilli yield were obtained with HA spray @ 4 ml L^{-1} at 35 DAP + @ 4 ml L^{-1} at 50 DAP. While, HA spray @ 6 ml L^{-1} at 35 and 50 DAP recorded maximum plant.

Capsicum (B. N.: *Capsicum frutescens* L.)

Singh *et al.* (2017) revealed that highest plant height, no. of branches, leaf area, no. of fruits, fruit weight and yield per plant were obtained with RDF + HA10 kg/ha (SA)+HA 0.1% (FA)+MN mixture (FA). Maximum fruit length was obtained in treatment RDF + HA10 kg/ha (SA) + MN mixture.

Family: Malvaceae

Okra (B. N.: *Abelmoschus esculentus* L.)

Kumar *et al.* (2015) observed that HA @ 150 ml as foliar spray gave maximum plant height, no. of leaves/plant, no. of fruits/plant, total yield and minimum days taken for full germination and first flowering compared to all treatment.

Butani (2004) concluded that maximum nitrogen and phosphorus uptake by plant were obtained with soil application of HA @ 20 kg ha^{-1}. While, soil applied HA @ 40 kg ha^{-1} recorded maximum uptake of potassium.

Family: Fabaceae

French bean (B. N.: *Phaseolus vulgaris* L.)

Sharma *et al.* (2017) reported that maximum plant height and leaf area were obtained with 30 ml HA foliar spray whereas, maximum no. of pods/plant, pod yield per plot and pod yield per ha were obtained @ 50 ml HA + Kinetin 100 ml foliar application.

Family: Brassicaceae

Cabbage (B. N.: *Brassica oleracea* var. Capitata*)*

Verma *et al.* (2014) opined that significantly maximum head height, head diameter, fresh weight of head, head yield, vitamin-C, carbohydrate and protein were obtained with treatment 100 % RDF + seedling treatment with *P. fluorescens* + HA over treatment @ 100 % RDF.

Family: Amaryllidaceae

Onion (B. N.: *Allium cepa* L.)

Sangeetha and Singaram (2007) revealed that maximum plant height, no. of leaves, no. of bulbs per plant, bulb girth and bulb yield were obtained with soil application of 100 % NPK + 20 kg HA ha^{-1} compared to control.

Family: Amaranthaceae

Amranthus (B. N.: *Amaranthus spp.*)

Sathiyabama and Selvakumari (2001) reported that maximum plant height, root length, green matter yield and total chlorophyll were obtained with soil application of 75 % NPK + HA @ 10 kg ha^{-1}.

Conclusion

From the foregoing discussion it can be concluded that humic acid increase the vegetative growth, yield as well as quality parameters of vegetable crop. Soil application of GF 45H -100 % RD increased tuber yield in potato, fertigation with RDF + HA and soil application of HA @ 9.6 and 14.4 kg $ha^{-1}$was beneficial for growth and yield in tomato, application of 100 % RDF + 20 kg ha^{-1} HA increased bulb yield in onion, HA @ 20 kg/ha increased nutrient uptake capacity in okra and similarly in amaranthus, 75 % RDF + HA @ 10 kg/ha maximize growth and yield.

Foliar spray of HA @ 30 ppm + 15 mM Ca increased growth and yield as well as improve quality parameters in tomato, while foliar application of HA @ 150 ml and 50 ml + Kinetin @ 100 ml gave higher growth and yield in okra and french bean, respectively. As far as both soil and foliar application is concerned, the combined application of HA with RDF and Vermicompost increased the growth and yield of brinjal. Soil application and foliar spray of HA with micronutrient increased growth as well as yield of chilli and capsicum. In cabbage, seedling treated with *P. fluorescens* + HA and 100 % RDF (SA) increased yield and quality traits.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
Post Graduate Seminar Series: 2018-19

Speaker	:	Vasava Chetanaben Kanubhai	**Course**	:	VSC-591 (1+0)
Reg. No.	:	2020217037	**Date**	:	29/09/2018
Major Guide	:	Dr. N.K. Patel	**Time**	:	3.00 to 4.00 p.m.
Co-Guide	:	Dr. B.M. Tandel	**Venue**	:	Swami Vivekananda Hall

EFFECT OF ZINC AND IRON ON LEGUMINOUS VEGETABLE CROPS

The word legume is derived from the Latin word *legere* which means together because seed pods are collected, unlike grasses which are cut by a sickle. They belongs to the family Leguminoceae now known as fabaceae. It fixes atmospheric nitrogen about 40 to 200 kg/ha and contain 15-50 % protein. Legume vegetables are rich in folate, potassium, iron and magnesium. They also contain beneficial fats, soluble and insoluble fibers. Legume vegetables are consumed as Green pods which are cheap source of plant protein commonly called as poor man's meat.

The essential elements which are required in small amount (less than 100 mg/kg of dry matter) or trace by the plants which cannot be replaced by any other nutrients are called as trace elements. In the absence of these trace elements, the plants are known to suffer from physiological disorders which eventually lead to imbalanced growth and low yield. Zn and Fe are involved in all metabolic and cellular function. These elements are active that makes them essential as catalytically active co-factors of enzyme, other have enzyme-activating functions and yet fulfill a structural role in stabilizing proteins. Now-a-days, micronutrients especially Zn and Fe are gradually gaining momentum among the vegetable growers because of scarcity in soil as well as their beneficial nutritional support and at the same time ensure better harvest and returns. Based on this background, the present review was compiled for understanding the importance of Zn and Fe and its effect on different legume vegetables. Zn and Fe in legumes vegetable is a concept which aims at maintenance of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity.

Brief review of literature:

Zinc

Cowpea (B.N.: *Vigna uguiculata* L.)

Nagaraju and Yadahali (1996) reported that soil application of 12.5 kg/ha $ZnSO_4$ gave significantly maximum plant height (47.58 cm), pods per plant(9.18), seeds per pod (10.89) and seed yield (1,141 kg/ha) in cowpea .

Patel *et al.* (2011) studied the effect of zinc and iron on growth and yield on cowpea. They observed that at 25 and 45 DAS number of branches per plant, no. of pods per plant, seed yield (kg/ha) with soil application of $ZnSO_4$ @ 25 kg ha^{-1} and proved to be most effective as compared to control.

Upadhyay and Singh (2016) noted that soil application of Zn @15 kg /ha recorded significantly increase number of nodules/ plant, active nodule per plants, pods per plant and grain yield in cow pea.

Broad bean (B.N.: *Vicia faba* L.)

Sharaf *et al*. (2009) revealed that maximum number of pods , number of seeds per plant and 100 seed weight yield of broad bean were recorded with foliar application $ZnSO_4$ (100 ppm) at 65 DAS, whereas lowest yield was recorded in Boric acid (75 ppm).

French bean (B.N.: *Phaseolus vulgaris* L.)

Salehin and Rahman (2012) conducted an experiment on foliar application of $ZnSO_4$ and found that the maximum plant height (84.7 cm), number of pods per plant (7.8) , number of seed per plant (5.7) and seed yield (1996.1 kg/ha) were obtained in foliar application of zinc (1 g/lit) at 35 DAS and flowering stage in bean.

Ayalew (2017) studied the effect of Zinc foliar fertilization and revealed that maximum plant height (43.86 cm), number of branches per plant (4.38), no. of pods per plant (16.86) and no. of seeds per plant (5.23) were observed in treatment of 1% $ZnSO_4.7H_2O$.

Pea (B.N.: *Pisum sativum* L.)

Osman and Abd El- Gawad (2013) found that foliar application of $ZnSO_4$ @ 2 mM was found significantly increase no. of pods per plant and green pod yield (ton/ fed) compared to remaining treatments.

Cluster bean (B.N.: *Cyamopsis tetragonoloba* L.)

Meena and Jat (2016) recorded that soil application of $ZnSO_4$ @ 20 kg per ha was found significantly increase in plant height (114.41 cm), branches per plant (7.87) and nodules per plant (6.77) compared to control.

Iron

French bean (B.N.: *Phaseolus vulgaris* L.)

Moshtagh and Aminpanah (2015) observed that foliar application of Fe @ 1 g/ lit iron chelate at both harvesting stages significantly increase in pod length in French bean.

Ayalew (2017) noted that maximum plant height (45.62 cm), number of branches per plant (4.68), no. of pods per plant (17.94) and no. of seeds per plant (5.25) were observed with the treatment of foliar application 2 % $FeSO_4.7H_2O$.

Cluster bean (B.N.: *Cyamopsis tetragonoloba* L.)

Solanki *et al*.(2017) revealed that foliar application of 0.5% $FeSO_4$ at branching + flowering stage was recorded significantly increase plant height (102.4 cm), dry matter (153.4g/plant), number of pods /plant (41.4) , seeds per pod (8.11), seed yield (1550 kg/ha) and protein content (26.8).

Zinc and Iron

Cow pea (B.N.: *Vigna uguiculata* L.)

Anitha *et al*. (2005) revealed that significantly maximum pod length (3.93 cm) and seed yield (616.33kg/ha) was observed with foliar application of 0.5% $FeSO_4$ spray + 0.5% $ZnSO_4$ spray at 45 DAS as compared to control.

Afifi *et al*. (2016) noted that significantly maximum number of pods/ plant, pod weight/ plant, pod length and pod diameter (cm) were observed with foliar application of (each 3g/lit of $FeSO_4$ + $ZnSO_4$) at 20, 35, 50 DAS.

Cluster bean (B.N.: *Cyamopsis tetragonoloba* L.)

Fathima and Sudha (2016) revealed that higher number of pod per plant and pod yield (kg/ha) were obtained with treatment of soil application of major-nutrients (20:50:50 kg/ha NPK) with micro-nutrients $FeSO_4$ (10):$ZnSO_4$ (10) (kg/ha) compared to control.

French bean (B.N.: *Phaseolus vulgaris* L.)

Bhamare *et al*. (2018) concluded that application of GRDF + soil application of $FeSO_4$ @ 15 kg ha^{-1} + $ZnSO_4$ @ 10 kg ha^{-1} was significantly increased in number of pods per plant, pod length, pod breath and pod yield (q/ha).

Conclusion

From the foregoing discussion, it can be concluded that application of Zn and Fe in ample amount can improve growth, yield as well as quality parameters of different legume vegetable crops. In soil application; Zn, Fe and its combined application from 10 to 25 kg/ha improve growth, yield, and quality parameters of cowpea, cluster bean, french bean. Moreover, foliar application of Zn, Fe and its combined from 0.01 % to 3 % improve growth, yield and quality of broad bean, french bean, pea, cluster bean and cowpea.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES 2018-2019

Speaker	:	Shah Smit Bhartiben	**Course No**	:	VSC 591 (1+0)
Reg. No.	:	2020217032	**Date**	:	06/10/2018
Major Guide	:	Dr. K. D. Desai	**Time**	:	2:00 to 3:00 p.m.
Co- Guide	:	Dr. A. K. Pandey	**Venue**	:	Swami Vivekananda Hall

Hydrogel: Boon for Agriculture

Introduction:

Dryland cultivation has much more acreage in India and it ranks 41st among 181 countries of the world with regard to water stress. More than 68% (136.8 mha) of the net cultivated area is prone to drought condition spread over 256 districts. In India, single drought causes economic crisis of Rs. 6.5 lakh crores and affects 33 crore population (Annon., 2016). Now-a-days, more than 30% of the area under moderate to high rainfall condition is also facing the main problem of either insufficient or uneven distribution of rain. Hence, there is an urgent need for efficient water management techniques to enhance water use efficiency.

Different management techniques for conserving water in agriculture is broadly divided into 2 methods *i.e. ex situ* (bunding, terracing and micro irrigation systems) and *in situ* (tillage, cultural practices and chemicals).

Hydrogel: A unique formation has tremendous potential to conserve water in large quantity with ease in its application and also economically feasible as it requires in very less quantity. Hydrogel can be used effectively as it provides water to the growing plants on need base. Further, it has no residual toxicity on plants and soil after its degradation. Hence, Hydrogel has great potentiality to become a leading component in water management techniques.

Brief review of research work:

Tomato

Hayat and Ali (2004) reported highest no. of leaves (348.3) and no. of branches per plant (20), maximum fresh weight (90.96 g) and dry weight (14.95 g) of plant with maximum fruit yield (497.7 g) per plant in tomato when soil was treated with 1.25% Aquasorb.

Mukeshkumar (2009) revealed that highest ascorbic acid (38.80 mg/100 g), lycopene (4.48 mg/100 g), no. of fruits (92.8) and fruit yield (36.6 t/ha) in tomato when 1.75 g hydrophilic polymer (Luquasorb) was applied to each plant.

Salma Sultana *et al.* (2016) recorded maximum plant height (110 cm), no. of leaves (205), no. of fruits (35), ash content (0.81), total phenols (3.25 mg/100 g) and ascorbic acid (18.6 mg/100 g) content in tomato when soil was treated with 0.5% Super Water Absorbent hydrogel.

Tomato fruit yield was found increased by 17% than control, when growing media was treated with 10 mg Cu nanoparticals in 1.0 g of Cs-PVA hydrogel by Hernández *et al.* (2017).

Capsicum

Darío *et al.* (2018) reported minimum water use (196 mm), irrigation frequency (3 to 6 days), no. of irrigations (22) and highest WUE (10.1 kg/m^3) without much reduction in yield (19.7 t/ha) of capsicum when 2.5 g of 1% potassium polyacrylamide hydrogel was applied per plant. However, the highest yield (20.53 t/ha) was observed with 5.5 kg/m^3 WUE when 0.5 g of 1% potassium polyacrylamide hydrogel was applied per plant.

Maximum fruit yield (2.04 kg/m^2, 20.4 t/ha) was obtained with maximum WUE (1.90 t/ha cm^{-1}) and minimum application of irrigation water (63 mm) in capsicum var. Indra under open field condition when 4 kg/ha Pusa Hydrogel was applied along with 50% ETc drip levels (Indu *et al.*, 2018). They also obtained maximum WUE (3.26 t/ha cm^{-1}) and minimum application of irrigation water (56.16 mm) without much reduction in fruit yield (1.83 kg/m^2, 18.3 t/ha) in capsicum var. Indra under naturally ventilated poly house condition when 2 kg/ha Pusa Hydrogel was applied along with 50 % ETc drip levels. However, highest fruit yield (2.12 kg/m^2, 21.2 t/ha) was obtained when 3 kg/ha Pusa Hydrogel was applied along with 75% ETc drip levels.

Cauliflower

Koudela *et al.* (2011) applied 3 g/l Agrisorb in the substrate of seedling cultivation along with reduced irrigation levels upto 50% and obtained maximum diameter of edible part (20.05 cm), marketable yield (388.3 kg/100 m^2) and percentage of marketable edible parts (82.24%) in cauliflower cv. Chambord after transplanting the treated seedlings in the field.

Sugarbeet

Maximum fresh biological yield (33.60 t/fed.), fresh shoot weight (8.90 t/fed), fresh root yield (24.70 t/fed), minimum root length (17 cm) and maximum root diameter (16.40 cm) was found in sugarbeet when 4g hydrogel/m^2 was applied at 100% swelling stage. (El-Karamany *et al.*, 2015).

Cowpea

Lopes *et al.* (2017) tested different hydrogels and recorded maximum seeds per pod (6.7) and seed yield (15.44 g/plant) in cow pea cv. Sempre verde when 6 g Polim-agri hydrogel was applied in each pot.

Cucumber

Though the highest yield (>5000 g/plant) of cucumber was recorded by Gholamhoseini *et al.* (2018) with the application of 2% Zeolite + 2% Hydrogel under full irrigated conditions but they also obtained the highest yield (>4000 g/plant) of cucumber with same treatment at 50% PRD.

Conclusion:

From the foregoing discussion, it can be concluded that hydrogel may prove as the crop savior in the time of water scarcity. In tomato, 1.25% Aquasorb, 1.75 g/plant Luquasorb and the combination of 10 mg Cu particals in 1.0 g of Cs PVA hydrogel improved the yield and quality. 2.5 g of 1% potassium polyacrylamide and soil application of Pusa Hydrogel @ 4 kg/ha in open condition and @ 2 kg/ha in polyhouse condition improved WUE without affecting yield and quality of capsicum. Addition of 3 g/l Agrisorb to substrate of seedlings improved the curd quality and yield of cauliflower. Maximum seeds per pod (6.7) and seed yield (15.44 g/plant) were obtained in cow pea with addition of 6 g/pot Polim-Agri hydrogel. 2% Zeolite + 2% Hydrogel improved the yield of green house cucumber under low water application. Soil application of 4 g/m^2 hydrogel at full swelling stage increased the root diameter (16.40 cm) and root yield (24.70 t/fed) of sugarbeet.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2018-2019

Speaker : Patel Jesalben Rajeshbhai	**Course : VSC-591**
(Reg. No.: 2020217021)	**Date : 20-10-2018**
Major Guide: Dr. Sanjeev Kumar	**Time : 2 to 3p.m.**
Co- Guide: Dr. A. K. Pandey	**Venue: Swami Vivekananda Hall**

Improving Nitrogen Use Efficiency for Sustainable Vegetable Production

Producing sufficient food in a sustainable manner to meet the growing global demand is one of the greatest challenges faced by the mankind in the 21st century. Since green revolution, over usage of chemical fertilizers became predominating with the concern of food security for the growing population. To maximize crop yield, farmers often apply more mineral and inorganic N than the crop requires. In most intensive agricultural production systems, over 50% and up to 75% of the N applied to the field is not used by the plant is lost by either leaching into the soil or through volatilization.Excessive use of N may cause N losses as well as crop yield reduction due to lodging. Besides this soil, water and air quality as well as ecosystem and biodiversity seem to be under threat.Extravagant use of nitrogen also causes imbalance in greenhouse gases. In such cases, Nitrogen Use Efficiency (NUE) can be a potential way to sustainable crop production in vegetable crops. NUEis a biomass or yield produced per unit of N available to the plants. Further, NUE can be improvedby many technologies or methods such as Crop improvement, soil and plant analysis, better management practices, site specific nitrogen management, use of better fertilizers*etc*(Hirel*et al*., 2011).

Review of Research Work:

Crop breeding

Navarrate *et al.* (2016) studied the genetic variation of various functions and their mutual interaction patterns using various molecular toolsand construction of genetic mapat low location. They foundthat shoot fresh weight (SFW), shoot dry weight (SDW), leaf area (LA) and NUE were reduced at low N compared to high N conditions and dry matter percentage (DM %) and root to shoot ratio (R:S) were increased. N levels had no effect on root dry weight (RDW) and Flowering (Fl), which even increased at low N conditions. Chlorophyll content (CC) was slightly but significantly negatively affected. Plants grown at high N conditions were bigger than plants grown at low N and had larger leaves with a relatively dark green colour.

Vegetable Grafting

Desire*et al.*(2013) studied the effect of nitrogen rates on tomato grafts and observed increase in NUE in the graftswith the vigorous rootstocks (Multifort and Beaufort)when 56 N/ha was applied. However, with the non-grafted plants (cv. Florida 47), NUE was significantly higher at 168 kg N/ha.

Soil and plant testing analysis:

Chatterje*et al.* (2014) studied the effect of organic amendments influencing NUE in cabbage. They reported that the nutrient schedule comprising of 75% recommended inorganic fertilizers and vermicompost (5 t/ha) along with seedling root dipping of bio-fertilizes may be practiced to achieve desired yield, higher nutrient use efficiency and sustainability of the production system.

Crop rotation:

Kristensen (2002) studied the effect of vegetable crop rotation with different rooting depths and found crop rotations in sequence of barley-leek, onion-cauliflower and pea-cabbage as best examples where less than 20% of the nitrogen is left below the rooting zone.

Mulching:

Romic*et al.* (2003) reported that lowest nitrogen leaching was observed in the treatment with black polyethylene (PE) mulch (0.81 and 0.77 kg ha^{-1}) in both the years 1995 and 1996.

Cover crops:

Araki (2016) studied the effect of different nitrogen fertilizer rate and hairy vetch (HV) cover crop on the NUE in tomato seedlings. The ratio of N uptake derived from HV to total N uptake in tomato plants was the highest at 2 weeks after transplanting (WAT), and total nitrogen uptake in N80HV (52.1%) and N0HV (51.5%) were significantly higher than in N240HV (43.6%).The maximum NUE (55.6 %) was observed in 10^{th} week after transplanting of tomato seedlings in the treatment of 0 kg Nitrogen/ha with hairy vetch.

Fertigation:

Tanskovik*et al*. (2016) studied NUE of pepper as affected by irrigation and fertilization regimes. They reported thatNitrogen Fertilizer Use Efficiency (NFUE) significantly increased with the application of nitrogen fertilizer through drip irrigation system as compared to conventional fertilization with furrow irrigation.Moreover, Drip fertigation frequency at four and two days (DF_2 and DF_1) resulted in higher yields whencompared with drip fertigation scheduled by using tensiometers (DF_3).

Match Nitrogen Supply with Crop Demand:

In an experiment conducted by Liu*et al.* (2014), studied that when nitrogen was applied in form of organic fertilisers or in the combination of organic fertilisers with liquid fertilisers, dry weight (DW) of lettuce was increased significantly (85%-180%). In case of inorganic fertilizer application, the DW of lettuce did not increase significantly compared to control.

Fertilizer Placement:

Sady*et al.* (2008) in their study observed that N fertilizer used in the form of ammonium sulphate significantly increased the cabbage yield compared to RSM (Solution of ammonium nitrate + urea). However, the method of application did not significantly have an effect on the cabbage yield in any year. The split N rates (75% N + 25% N) and foliar fertilization with reduced rate (75% N) increased yield in 2005, irrespectively of the application method. This tendency was observed in 2006 and 2007 only with broadcast method.

Site Specific Nitrogen Management (SSNM):

Graef*et al.* (2008)studied the reflectance changes of broccoli cvs. Parthanon and Marathon for different nitrogen fertilizer levels for overall period of six weeks in the wavelength range of 516_{780}nm. They indicated that both varieties increased visible spectrum significantly in the wavelength range of 516_{780}nm with decreasing nitrogen fertilization rates.

Better Fertilizer:

Tao *et al*. (2017) studied the effect of different fertilizers on uptakeand utilization rateof nitrogen on cabbage and revealed that coated slow release fertilizerwith urease and nitrification inhibitors the uptake (474.25 ± 10.36 mg pot $^{-1}$)as well as Utilization of N was maximum (41.28%).

Conclusion:

From the above enumeration, it can inferfrom the foregoing discussion that extravagant use of Nitrogen has led to imbalance at various level of ecosystem. Nitrogen use efficiency(NUE) can a potential way to retain vegetable crop production by identifying superior ideotypes in spinach either by crop breeding or grafting. Vigorous rootstocks like multifort and Beaufort in tomato can instrumental to improve NUE even at lower rate of nitrogen application. The nutrient schedule comprising of 75% of recommendedorganic fertilizer and 5 t/ha vermicompost along with seedling root dipping with bio- fertilizers may be practiced to achieve desire yield, nutrient use efficiency and sustainability in cabbage.Strategies to improve NUE at crop rotation level must be adapted to the local climate and soil condition.Improvement in NUE in context to low leaching of nitrogen can be achieved by use of black polyethene as well as cellulose mulch. A high frequency drip fertigation with continuous feeding can be recommended to maximise bell pepper yield with high NFUE. use organic fertilizers can help in slow release of nitrogeneous fertilizer there by increase the low and remaing Nitrogen uptake by lettuce.Special coated slow release fertilizers have inhibitors to slow down nitrogen release speed which ultimately increase utilization of nitrogen in cabbage.Leaf reflectance parameters derived from high resolution digital images indicated to be an effective technique for estimating the demand of nitrogen fertilizers.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2019-2020

Speaker	**:**	**Champaneri Dushyant Dipakkumar**	**Subject**	**:**	**VSC - 591 (1+0)**
Registration No		**2020218007**	**Date**	**:**	**04-10-2019**
Major Guide	**:**	**Dr. N. K. Patel**	**Time**	**:**	**4.00 - 5.00 p.m.**
Co Guide	**:**	**Dr. B. M. Tandel**	**Venue**	**:**	**Swami Vivekananda Hall**

Influence of Agro shade net in vegetable crop production

Vegetables are considered as protective food which are highly perishable in nature. High temperature due to global warming, climate change as well as excessive use of chemicals are some of the burning issues of vegetable production. Agro shade net can be a partial solution for these problems. It is a product made of plastic fibers connected together with each other, forming a regular porous structure and allowing gases, liquid and light to go through. Agro shade net types are characterized by different structural features like types of dimension and threads, types of material, texture, mesh size, porosity, solidity, thickness, weight, radiometric properties, physical properties and mechanical characteristics (Castellano *et al.*, 2008). Colour shade netting refers to covering crops by nets having the capacity to selectively filter the intercepted solar radiation, in addition to their protective function. These nets are designed to screen various spectral bands of the solar radiation and/or transform direct light into scattered light. The spectral manipulation is aiming at specifically promoting desired physiological responses, while the light scattering improves the penetration of the spectrally-modified light into the inner plant canopy, thus increasing the efficiency of light-dependent processes (Shahak,2011). Agro shade nets are available based on two colour groups *i.e.* colored - Color Nets (Red, Yellow, Green, Blue) and neutral - Color Nets (White, Pearl, Gray) (Dharini *et al.*, 2018). Vegetable crops grown under different color shade net shows different responses thus by application of various color shade net we can improve quality as well as production.

Review of research work: -

Fenugreek, Coriander and Garlic: -

Desai (2015) at NAU, Navsari found low temperature under color shade net than open field. He also measured the maximum photosynthesis in Fenugreek (25.44 μmol CO2 m-2 s-1), Coriander (25.69 μmol CO2 m-2 s-1) and Garlic (26.26 μmol CO2 m-2 s-1); highest plant height in Fenugreek (25.59 cm), Coriander (20.62 cm) and Garlic (28.08 cm); maximum no. of leaves in Fenugreek (28.47), Coriander (29.30) and Garlic (4.75) as well as noted the highest fresh biomass yield in Fenugreek (135.25 kg/100m2), Coriander (58.19 kg/100m2) and Garlic (59.47 kg/100m2) under the red color shade net as compared to other color shade nets and open field condition.

Mahajan *et al.* (2017) at College of Agriculture, Kolhapur recorded earliest harvesting (36.67 days), highest yield per plot (3.40 kg/ 6.76 m2) and yield per ha (50.23 q) under 50 % shade net.

Cucumber: -

Tafoya *et al.* (2018) at UAS, Mexico observed higher average fruit weight under aluminized shade net (303.2 ± 5.5 g/fruit) and No. of fruit (30.1 ± 2.5 fruits/plant) as well as fruit yield (88.7 ± 8.3 t/ha) under pearl shade net.

Poornima *et al.* (2017) at Rahuri recorded the highest diameter of fruit (3.61 cm), length of fruit (15.18 cm), weight of fruit (207.14 g), length of vine at last harvesting (4.74 m), No. of fruits per vine (12.68), yield per plot (1.52 kg/7.8 m2) and minimum days to 50% flowering (32.45 days) under 50 % red shade net.

Patil and Bhagat (2014) at University of Agricultural and Technology, Udaipur noted minimum days to 50 % flowering (29.25 days) under 35% shading; average length of fruit (16.76 cm) under 50 % shading while highest diameter of fruit (4.19 cm), fruit weight (170.87 g), length of vine at last harvesting (4.37 m), No. of fruit per vine (8.32 fruits) and yield (27.32 t/ha) under 75 % shading. So 75% shading net was advisable for better cucumber crop production.

Lettuce: -

Ilić *et al.* (2017) at University of Priština Kosovska Mitrovica, Serbia measured the highest LAI (3.1), head weight (331 g/plant), head diameter (22.6 cm) and leaf No. (42) under pearl shade net while highest stem-core length (9.7 mm) and early maturity (34 days) were recorded under red shade net. They also found superior quality head under color shade net as compared to open field.

Pepper: -

Nagy *et al.* (2017) at Szent István University, Hungary recorded the highest yield in two hybrid pepper cultivars *i.e.* Star Flame (2.9 kg/m2) and Fire Flame (3.2 kg/m2) under white shade net.

Ombodi *et al.* (2015) at Szent István University, Hungary in sweet pepper cultivars observed the highest total yield (7.13 kg/m2) in Kárpia F1 and (8.21 kg/m2) in Karpex F1 under red shade net.

Shahak (2008) at ARO, The Volcani Center, Israel in pepper crop found the highest fruit yield 127.6 t/ha, 136.1 t/ha and 128.3 t/ha in cultivars Caliber, Anna and Triple Star, respectively under red shade net.

Tomato: -

Milenkovic *et al.* (2012) at Lešak, Serbia registered the highest marketable yield (87%), lowest cracking (5%) and no sun scalding under 40 % as well as the highest marketable yield (81%), lowest cracking (6%) and no sun scalding under 50 % pearl color shade net as compared to other color shade nets and open field.

Caroline *et al.* (2017) at Egerton, Kenya noticed highest No. of fruits (53) from which 36.80 fruits were marketable as well as highest yield (24,938.87 kg/ha) from which 17,830.68 kg/ha fruits were marketable under white color shade net.

Caroline *et al.* (2017) at Egerton, Kenya counted the lowest pest population at 84 DATP in silver leaf white fly (0.94 No./plant), aphid (1.21 No./plant) and thrips (0.51 No./plant) under yellow, white and blue color shade net, respectively.

French bean: -

Ngelenzi *et al.* (2018) at Egerton University, Kenya recorded the lowest aphid population *i.e.* 0 No./plant (21 DAF), 0 No./plant (35 DAF), 1.94 No./plant (49 DAF) and 5.19 No./plant (63 DAF) as well as the lowest white fly population *i.e.* 0.42 No./plant (21 DAF), 0.38 No./plant (35 DAF), 0.20 No./plant (49 DAF) and 3.33 No./plant (63 DAF) under yellow color shade net.

Conclusion: -

Temperature is comparatively lower under Agro shade net so we can utilise this technique to overcome problem like high temperature due to climate change and global warming. Photosynthetic rate, plant growth parameter as well as yield is high under red color shade net in fenugreek, coriander, garlic and pepper. Higher yield was also recorded under white and pearl shade net in crops like cucumber, lettuce and tomato. French bean and tomato plants grown under yellow color shade net have the lowest population of insect pest. We can use Agro shade nets to control pests and avoid or reduce the use of excessive chemicals thus eliminating the health related issues. Thus we can conclude that, for better quality and higher yield, red, white and pearl color shade nets can be used.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI, GUJARAT
POST GRADUATE SEMINAR SERIES: 2019-2020

Speaker	: Chaudhary Bharatbhai D.	**Course**	: VSC 591 (1+0)
Reg. No.	: 2020218009	**Date**	: 19/10/2019
Major guide	: Dr. S.S. Masaye	**Time**	: 2.00 to 3.00 pm
Co-Guide	: Dr. D.K. Sharma	**Venue**	: Swami Vivekanand Hall

"Parthenocarpic vegetables: Importance and approaches"

✓ In the ever-changing global scenario of the world, security for the nutrition in the country is the important issue for agricultural sector. Vegetables occupy an important place in diversification of agriculture and have played a vital role in food and nutritional security of ever-growing population of our large vegetarian society. Vegetable consumption per capita in India is very low and that is only around 230.4 g per day against minimum of about 300 g recommended by dieticians so there is a great demand for production of more quantities of vegetables with high quality and reduces postharvest loss by increase a storage life as well as processing. Parthenocarpy is the development of the ovary into a seedless fruit without the need of pollination and fertilization. The absence of seed is usually appreciated by consumers and producers because it increases fruit quality and fruit shelf life. Parthenocarpy improves quality, storage life and processing attributes of vegetable crops like cucumber, eggplant, tomato and watermelon, where seed is a limiting factor during consumption. Parthenocarpic vegetables increase profitability for processing industries. It may occur naturally or can be induced artificially by exogenous application of hormones or their enhanced endogenous level. This trait proved highly useful to develop fruits under environmental conditions that are unfavorable for successful pollination and fertilization, particularly in green house cultivation and especially in cross-pollinated crops. It is an established fact that phytohormones play important role in fruit setting and their genetic manipulation can lead to seedlessness.

Review of literatures:

Tomato

Andrea *et al.* (1998) conducted experiment on *pat* and WT line of tomato and they revealed that all the WT fruits from the HTR and LTR regimens had more than 5 seeds, while a small percentage of low-seeded fruits were also produced in the NTR environment. In *pat* plants, the degree of parthenocarpy, detected as percentage of seedless fruits at maturity, ranged from 59 to 95%. On average, WT fruits contained more than 30 seeds in all the environments, while seeded *pat* fruits yielded less than two seeds in LTR and NTR and about six in HTR.

Rotino *et al.* (2005) studied on Mean values of percentage of fruits with seeds and number of seeds per fruit in the transgenic parthenocarpic lines (Ri4 and Ri5), the untransformed control (UC 82) and the commercial F_1 cv. all flesh. They observed in transgenic parthenocarpic lines Ri5 and Ri4 have minimum fruits with seeds *viz*., 20.0 ± 4.7 , 26.7 ± 5.4 and also minimum no. of seeds/fruits 11.4 ± 3.8, 18.4 ± 3.8. They reported that transgenic parthenocarpic line contain *DefH9-RI-iaaM* gene perform superior in term of minimum fruit with seeds as well as No. of seeds/fruits as compare to untransformed control UC8 and commercial cultivar All flesh.

Cucumber

Kumar *et al.* (2014) studied the response of fertilizers and training systems on parthenocarpic cucumber var. Dinamik under NVPH. They reported that combination of 150% RDF(where, RDF i.e. 90kg N, 75kg P2O5 & 75 K2O) through fertigation and single stem training in parthenocarpic cucumber gives higher yield (10.76 t/1000 m^2) as well as more LAI (2.15,5.82) after 30 and 60 days respectively.

Kumar *et al.* (2015) observed hybrid KPCH-1 was best in term of days to harvest(35.83), no. of fruit per plant (21.83), yield per plant (5.26 kg), yield/100 m^2(1052 kg) and Parthenocarpy (92.18%) where average fruit weight (259.96) was more in PPC-2.

Kumar *et al.* (2017) revealed that the *cv*. Multistar produced highest number of fruits per vine (34.77) with statistically close affinity in Kian and Valleysta whereas JSCU 01 expressed significantly highest fruit weight of 207.82 g. The highest fruit yield per 1000 m^2 was recorded in Oscar (13.34 tons) bearing 27.97 fruits per vine and possessing 162.23 g fruit weight having statistically similar results in RS 03602833, Kian, KUK 9, 52-23, Valleystar and Multistar, where JSCU 01 was excellent in quality parameters in term of fruit firmness (4.22 kg/cm^2), fruit colour (8.13), fruit flavor(7.83) and fruit texture (8.42).

Nagamani *et al.* (2019) observed maximum fruit diameter in the hybrid Sargon (4.22 cm). The hybrid

alexios are better expressed their superiority over other hybrids in terms of fruit length(22.80 cm), average fruit weight (221.60 g), higher fruit yield per vine (7.70 kg), and fruit yield (220.06 t/ha).

Brinjal

Acciarri *et al*. (2002) conducted experiment on genetically modified parthenocarpic eggplant production and their respective control. They found effective result of transgenic parthenocarpic hybrids as compare to control. Transgenic parthenocarpic accreted higher in yield/plant (2288 g) as well as higher in fruit weight (260.2 g).

Watermelon

Sugiyama *et al*. (2014) observed highest fruit set in watermelon (57.1%) with bottle gourd (Kachidoki 2) as pollen source.

Sravani *et al*. (2018) reported that parthenocarpy was completely achieved with CPPU @ 200 ppm and NAA @ 150 ppm in watermelon cv. Arka muthu.

Summer squash

Robinson and Stephen (1993) conducted experiment to check the ability of summer squash cultivars to set fruit without pollination in 1992. He observed the cultivar ‘Chefini Hybrid’ with the most parthenocarpic fruit set (82%).

Spine gourd

Rasul *et al*. (2008) studied response of different PGRs on parthenocarpic fruit development of spine gourd genotype rangpuri (cl 3) with seven plant growth regulators *viz*. NAA, 2,4–D, CPPU, Fulmet, GA3,TIBA and MH with three concentrations (25, 50 and 100 ppm) and they revealed that 2,4–D (100 ppm) showed better effect on growth and fruit set (87.6%) in spine gourd than Fulmet 100 ppm (86.2%) and CPPU 100 ppm (73.1%). Fruit size and weight were mostly increased with increase of concentration of PGR’s.

Conclusion:

✓ Parthenocarpic vegetables are high in yield and fruit quality. In tomato parthenocarpy is high and stable in *pat* mutants. In cucumber parthenocarpy is controlled by an incomplete dominant gene *P* and in segregating generations, early, late and non - parthenocarpy were observed. KPCH-1 hybrid which gave best performance for yield related traits and 92.18 % parthenocarpic fruit set. Oscar, Valleystar, Multistar and JSCU 01 parthenocarpic cucumber gave best performance for different yield and quality parameters. Parthenocarpic cucumber under NVPH is highly profitable through fertigation (150% RDF i.e. 90kg N, 75kg P2O5 & 75 K2O) of plants trained in single stem system. In watermelon parthenocarpy was completely achieved with CPPU @ 200 ppm and NAA @ 150 ppm. The application of CPPU @ 200 ppm resulted, more number of fruits per plant, maximum fruit diameter, highest yield per plant, lowest seed weight. 2,4-D @ 100 ppm applied at anthesis showed better performance in parthenocarpic fruit development in spine gourd.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2019-20

Speaker : Nagendra	**Course** : VSC 591 (1+0)
Reg. No. : 2020218022	**Date** : 19-10-2019
Major Guide : Dr. K. D. Desai	**Time** : 3:00 to 4:00 p.m.
Co-Guide : Dr. R. V. Tank	**Venue** : Swami Vivekananda Hall

Gene pyramiding for development of durable resistance against biotic stresses in vegetable crops

Vegetable crops are very important source of nutrition, food and also have medicinal and industrial importance. India is the second largest producer of vegetables after China but the most devastating factor in quantity and quality productions is bacterial, viral, fungal and nematode infections. Many approaches are being utilized to tackle these biotic and abiotic stresses, among which recent one is development of resistant varieties through gene pyramiding.

The development of molecular genetics and associated technology like MAS has led to the emergence of a new field in plant breeding-gene pyramiding. Pyramiding entails stacking multiple genes leading to the simultaneous expression of more than one gene in a variety to develop durable resistance expression (Ye and Smith, 2008). Gene pyramiding is gaining considerable importance as it would improve the efficiency of plant breeding leading to the development of genetic stocks and precise development of broad spectrum resistance capabilities. The success of gene pyramiding depends upon several critical factors, including the number of genes to be transferred, the distance between the target genes and flanking markers, the number of genotypes selected in each breeding generation and the nature of germplasm (Joshi and Nayak, 2010). Pyramiding (major) R-genes can be one solution to improve on both durability and level of resistance (Nelson, 1972).

Review of literature

Pyramiding of *Meladogyne hapla* resistance genes into potato was carried out by Tan *et al.* (2009). *Rmh-tar* and *Rmh-chcA* introgressed from the wild tuber-bearing potato species *Solanum tarinjense* and *Solanum chacoense* with the aid of AFLP markers. Upon inoculation with *M. hapla* the group containing *Rmh-chcA* and *Rmh-tar* showed a decline of 88% and 55% respectively in average number of egg masses developed, later effect of *Rmh-tar* was not significant. Combined effect of R-genes didn't reduce the egg masses.

Tan *et al*. (2010) studied the effect of pyramiding *Phytopthora infestans* resistance genes *Rpi-mcd1* (*S. microdontum*) and *Rpi-ber* (*S. berthaulti*) in potato. The group with *Rpi-mcd1* showed a significant delay to reach 50% infection of the leaf area of 3 days whereas, the group with *Rpi-ber* showed a delay of 3 weeks. The resistance level in the pyramid group suggested an additive effect of *Rpi-mcd1* with *Rpi-ber.*

Ozkaynak *et al*. (2014) studied pyramiding multiple genes for resistance to PVY, TSWV and PMMoV in pepper. They genetically combined resistant genes *L4* (PMMoV), *tsw* (TSWV) and *pvr* (PVY) from sources ENT-1, LET-1 and RAZ-1 respectively, in one superior sweet Charleston pepper line ''YCAR'' by pyramiding via marker assisted backcross selection and resistance assays.

Pachner *et al.* (2015) developed the oilseed pumpkin germplasm having putative durable resistance to ZYMV from *Cucurbita moschata.* It was created through a backcross programme and pyramiding of *Zym-0, Zym-1, Zym-2, Zym-3 and Zym-5* genes for resistance from different sources, using combined phenotypic and marker assisted selection.

The study was undertaken by Prasanna *et al.* (2015) to combine *Ty-2* and *Ty-3* and to determine the effect of pyramiding on infection of tomato by three diverse begomovirus leaf curl species (ToLCNDV, ToLCPalV and ToLCBV). Marker assisted selection (MAS) was used to develop pyramided tomato lines from the crosses between Ty stock (SCAR and CAPS). The pyramided lines and *Ty-3* carrying line (VRT14-1-4), exhibited a high level of resistance to the monopartite and two bipartite begomoviruses tested.

Pyramiding of *AtEDT1/HDG11* and *Cry2Aa2* into pepper (*Capsicum annuum* L.) was carried out by Zhu *et al.* (2015). They reported that constitutive co-expression of *AtEDT1/HDG11* and *Cry2Aa2* was able to increase pepper drought tolerance and insect resistance and also enhanced fruit yield, chlorophyll content, chlorophyll fluorescence, proline, soluble sugar and abscisic acid, with reduced stomatal density compared to the non-transgenic control.

The study on conventional and molecular marker assisted selection and pyramiding of genes for multiple disease (*Late blight, Bacterial wilt, ToYLCV, fusarium wilt, gray leaf spot and TMV*) resistance in tomato, study was carried out by Hanson *et al.* (2016) at AVRDC, Taiwan and developed MDR lines (*Bwr-12, Ty2, Ty-3, Ph-2, Ph-3 and I2*) were valuable in mild-altitude tropical production areas, such as east African highlands and parts of South India. Yield was high under optimal temperature but much reduced under high temperature and rainfall.

Conclusion :

From foregoing discussion, it can be concluded that the strategy of pyramiding resistance genes is valued because of epidemiological and evolutionary considerations besides raising the level of resistance, it might contribute to the durability of resistance. But when discussing durability of single or pyramided Rgenes, one should be aware that durability can't be predicted in advance but can only be reflected upon by historical evaluation.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI, GUJARAT
POST GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Savaliya Pallavkumar J.	**Course** : VSC 591 (1+0)
Reg. No. : 2020218044	**Date** : 19/10/2019
Major guide : Dr. V. K. Parmar	**Time** : 4.00 to 5.00 PM
Co-Guide : Dr. C. R. Patel	**Venue** : Swami Vivekanand Hall

"TRANSGENICS IN VEGETABLE CROPS"

It is estimated that horticultural crop production has surpassed the food production in the country since 2012 and vegetable production in India is about 18.74 thousand MT from an area of 10436 thousand hectare (Anon. 2018a). It has proven beyond doubt that productivity of horticulture crops is ascending at pace as it is one of the most important commodities after food grains to feed the increasing world population. To date, the world population is more than 6 billion people, and it is expected to reach 9 billion by the year 2050. To quench the increasing hungers of population, we might need some scientific and advanced tactics to the meet the challenges. Biotechnology is a new powerful tool that has been added in most of the breeding programs for horticultural crop which resulted in a genetically modified plants. Transgenic crops commonly referred to as genetically modified (GM) crops enable plant breeders to bring favorable genes often previously inaccessible into the elite cultivars improving their value considerably and offer unique opportunities to overcome important problems of current farming like plants with improved agronomic traits, resistance to biotic and abiotic stresses, tolerance to herbicides & enhanced nutritional quality and increase yield potential**.** Genetic transformation techniques introduce a gene for desired trait without disturbing the plant genetic architecture and also can be introduced directly into the host organism or into a cell. About 18 million farmers in 24 countries grow GM crops over 189.8 million ha (Anon. 2018b).

Brief review of research work

Brinjal (*Solanum melongena L.*)

Acciarri *et al*. (2002) conducted an experiment to study the genetically modified parthenocarpic eggplant production with their respective control. They got profound result of transgenic parthenocarpic hybrids as compare to their control. Transgenic parthenocarpic plants exerted higher yield/plant (2288 g) with higher fruit weight (260.2 g).

Krishnaraj *et al*. (2007) conducted a trial on population of fruit and shoot borer larvae in *Bt* brinjal lines and their non-*Bt* counterpart. Result showed 0.00 % population of FSB at different days interval in *Bt* brinjal line (UG *Bt* and GO112 *Bt*) as compare to non-*Bt* brinjal.

Choudhary and Gaur (2009) summarized that *Bt* brinjal had performed superior as compare to Non-*Bt* brinjal in terms of reduction in insecticide use for FSB up to 77.2 % and for all insect-pests up to 41.8% and also increased 133.6% fruit yield as compare to Non-*Bt* brinjal.

Tomato (*Solanum lycopersicum L.*)

Kramer and Redenbaugh (1994) studied the comparison of Flavr Savr tomatoes with non-transformed controls and found that Flavr Savr tomatoes have superiority in terms of viscosity and fungal resistant with plummet in the ripening by decreased softening rate as compare to non-transformed controls.

Rotino *et al.* (2005) evaluated the percentage of fruits with seeds and number of seeds per fruit in the transgenic parthenocarpic lines (Ri4 and Ri5), the untransformed control (UC 82) and the commercial F1 cultivar All flesh. They revealed that transgenic parthenocarpic lines Ri5 and Ri4 had minimum percentage of fruits with seeds (20.0 % and 26.7 %, respectively) and minimum no. of seeds/fruit (11.4 % and 8.4%, respectively).

Koul *et al.* (2014) observed that higher amount of cry1Ab toxin (0.47±0.01%) of total soluble protein (TSP) in transgenic plants of Ab25 E line which gave resistant against lepidopteran larvae. In the same study they performed an insect bioassay on Bt-transgenic tomato lines of T4 generation with 2nd instar larvae of *S. litura* and *H. armigera.* They noted effective toxicity of Ab25E against larvae as compared to non- transgenic tomato.

Potato (*Solanum tuberosum L.*)

Askari *et al.* (2012) conducted an experiment on effect pf salinity stress on transgenic and non-transgenic potatoes cv. Agria growth. Transgenic potato showed the highest salt tolerance up to 150 mol/cm3 with higher fresh weight with maximum harvesting index (79 ± 1.48).

Watermelon (*Citrullus lanatus L.*)

Park *et al.* (2005) studied the resistance test by exposing transformed and untransformed watermelon plants to cucumber green mottle mosaic virus twice at 2 weeks interval. They found that transformed watermelon plants showed PCR positive resistant against CGMMV.

Pepper (*Capsicum frutescens* L.)

Subramanyam and Shailaja (2010) studied the salt stress tolerance of transgenic and non-transgenic pepper plants. Result conformed that transgenic plants had clear phenotypic tolerance with respect to growth and development as compared to non- transgenic plants under salt stress.

Lee *et al.* (2009) conducted an experiment on resistance test of transformed and non-transformed pepper plant against cucumber mosaic virus. From the population samples, 279 plants out of 357 showed tolerant in transgenic pepper, where 0 in Non-transgenic plants. Also, 180 plant after 1st ELISA test and 112 after 2nd ELISA test were showed resistance in transgenic plants as compared to non-transgenic plants.

Chinese cabbage (*Brasicca oleracea. sp. Chinensis)*

Cho *et al.* (2000) conducted an experiment on exposure to diamond back moth larvae in control plants and cry1-C- transgenic Seoul plants and recorded that transgenic plants defined normal morphology and intact leaves, while the control plants were severely damaged by DBM.

Conclusion

Pertaining to reviewed studies the conclusion can be drawn that transgenic crops shows major positive traits to conquer the arising problems of food security. Transgenic brinjal, tomatoes and Chinese cabbage shows higher resistant to FSB, lepidoptera pest and diamond back month as compared to non-transgenic populations. To add on, transgenic watermelon and pepper plants have exerted resistance from CMV. In terms of plant growth and development characters, transgenic brinjal showed higher yield and tomato resulted in minimum seeds per fruits an important parthenocarpic trait. For biotic and abiotic tolerant factors, transgenic potato and chilli pepper have shown salt tolerance up to 150 mM and 300 mM respectively. To respond to the growing need for food worldwide, breakthrough scientific advancement in GM crops and its adaptation among the populations can prove to be a major role across the globe.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post Graduate Seminar Series 2019-20

P.G. Student	:	Bangoria Urvi Vishvasbhai	Course	:	VSC 591 (1+0)
Reg. No.	:	2020218005	Date	:	16-11-2019
Major Guide	:	Dr. N. B. Patel	Time	:	3.00 - 4.00 p.m.
Co-Guide	:	Dr. Y. N. Tandel	Venue	:	Swami Vivekananda Hall

Vegetable production through Aquaponics

With the increase in population, efficient use of resources has become a prime responsibility of the policy makers around the world.The complex and unpredictable weather also creates new challenges to the country's agriculture that highlighted the importance of developing new crop production system like aquaponics. Aquaponics is the integration of hydroponic plant production into recirculating fish aquaculture systems(Somerville *et al.,* 2014). In the aquaponics system, nutrients which are excreted directly by the fish or generated by the microbial breakdown of organic wastes are absorbed by plants cultured hydroponically. The integration of fish and vegetable production increases the diversity and yields multiple products and water is reused through the process (Rakocy *et al.,* 2016). The integration of fish and vegetables creates an ideal growing environment that is more productive than conventional methods (Geoff, 2002).The system can be used in drought prone, flood prone and coastal saline affected soil region to produce fish and vegetable round the year. It is proved that aquaponics system is environmental friendly for fish and soilless vegetable production system. Aside from extra income and direct access to organic and healthy food, aquaponics is an alternative production system even in urban areas.Organic nature of such agriculture will add extra-dimension towards the efforts to achieve the food security in India.

Review of Research Work

Tomato

Roosta and Hamidpour (2011) observed an effect of foliar application of some macro and micro nutrients on tomato plants in aquaponics and hydroponic system and found that foliar spray of K to aquaponics plants produced significantly maximum yield. All the treatments produced higher yield in aquaponics system as compared to hydroponics system except foliar spray of Cu and control treatment.

Hu *et al.* (2015) studied the performance of tomato and pak choi based aquaponics systems and reported that pak choi based aquaponics system produced highest yield of saleable part (24897.4 g) while, highest fish feed consumption (6950.0 g) and fish biomass increase (4345.0 g) were obtained in tomato based aquaponics system.

Kloas *et al.* (2015) revealed that the ASTAF-PRO system with tomato plants produced higher yield of tomato (1005.62 kg) as compared to SRAPS system.

Lettuce

Lennard and Leonard (2006)studied a comparison of three different hydroponic sub-systems (gravel bed, floating and nutrient film technique) in an aquaponics test system and revealed that significantly maximum lettuce biomass gain (2639.4 ± 28.9 g/rep.), yield (131.97 ± 6.46g/plant) and yield (5.05 ± 0.25 kg/m^2) produced with gravel type aquaponics system.

Nichols and Savidov (2012) concluded that maximum lettuce yield was produced in hydroponics system which was at par with aquaponics system with high fish density. Variety Princess produced 111% more yield in aquaponics system. All the varieties except Robinio produced higher yield in aquaponics system than the hydroponics system.

Simeonidou *et al.* (2012)observed growth of lettuce and fish nile tilapia in different experimental groups and tanks of the aquaponics systems and stated that maximum mean weight of lettuce obtained from tank 2 in experimental group 2 and 3. Maximum final mean body weight of fish nile tilapia was found in tank 1 while, maximum total final biomass and net biomass found in tank 3 in all three experimental groups.

Sace and Fitzsimmons (2013)studied the lettuce, chinese cabbage and pak choi with and withoutthe prawn aquaponics system. Amongst them maximum total biomass (1st crop 185.2 g and 2nd crop 190.0 g)and average yield (1st crop 167.9 g and 2nd crop 171 g) were obtained from pak choi in with prawn aquaponics system.

Cucumber

Shanbhag (2013) observed that aquaponics treatment produced significantly maximum yield of cucumber (177.20 kg/row) which was 18.25 % more than control. He also observed that aquaponics treatment produced significantly higher average number of fruits per plant (9.3) as compared to control.

Taro

Salam *et al.* (2014) carried out research on comparative growth performances of taro plant in aquaponics vs. other systems and reported that highest biomass content (4650 g) was obtained in aquaponics system.

Okra

Salam *et al.* (2013) revealed that significantly maximum production of water spinach (2460 kg/ha/90days) andokra (492 kg/ha/90days) was found in rackaquaponicssystem so that maximum total productionof water spinach (1025 + 2460 kg/ha/90days) and okra (205 + 492 kg/ha/90days)were observed in treatment 1 (raft aquaponics + rack aquaponics). Maximum production of fish tilapia and pungasius were also observed in treatment 1(raft aquaponics + rack aquaponics).

Conclusion

From the foregoing discussion, it can be concluded that aquaponics system was better than hydroponics system for vegetable production. In aquaponics lettuce production was more or equal to the hydroponics system for vegetable production. Pak choi produced maximum yield in with prawn aquaponics system as compared to lettuce and chinese cabbage.Amongst three aquaponics systems *viz.*gravel bed, floating and nutrient film technique,lettuce production was maximum in gravel bed aquaponics system. Pak choi produced more yield than tomato in aquaponics system. ASTAF- PRO system was more suitable for tomato production than SRAPS system. In aquaponics system tomato yield was increased by foliar application of macro and micro nutrients and highest yield was observed with foliar spray ofK application. Maximum yield and No. of fruits/plant of cucumber were obtained with aquaponics system than hydroponics. Amongst three system*viz.*aquaponics, hydroponics and soil taro gave maximum yield in aquaponics system. Water spinach and okra produced highest yield in rack aquaponics system than raft system**.**

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST-GRADUATE SEMINAR SERIES: 2019-2020

Speaker	:	**Bambhaniya Kinjal Kalubhai**	**Course No.**	:	**VSC 591 (1+0)**
Reg. No.	:	**2020218004**	**Date**	:	**07/12/2019**
Major Guide	:	**Dr. Sanjeev Kumar**	**Time**	:	**3.00 to 4.00 p.m.**
Co-Guide	:	**Dr. B. M. Tandel**	**Venue**	:	**Swami Vivekananda Hall**

"Rooftop Vegetable Gardening in Urban and Peri-urban Continuum"

Conventional farming has been facing many challenges worldwide over the years to cater the needs of ever increasing population in terms of food and dietary change. Cultivated land is decreasing with the development of industrialization and urbanization, and farmland is losing fertility while increasingly being polluted, especially in the urban and peri-urban zones that supply the readily perishable vegetables to such areas. Rooftop Garden (RTG) is proposed as a mean to augment conventional farming in favour of urban farming with potential benefits such as contributing to nutrition and urban landscaping, decreasing urban heat island effect and stormwater, alleviating high transportation cost, reducing spoilage from long food distribution chains, providing food and jobs for city residents *etc.*(Goldstein *et al.*, 2016).Rooftop agriculture/gardening is the production of fresh vegetables, herbs, fruits, edible flowers and possibly some small animals on rooftops for local consumption. Some pre-conditionslike roof strength, waterproofing, drainage, shade net, irrigation, trellis*etc.*need utmost attention while planning a RTG. A wide range of vegetables are available well suited to RTG, however a software *DietCal* developed by AIIMS, New Delhi can be very handful todesign a perfect and healthy platter as per the recommended daily allowances (Gurdeep Kaur, 2019). Some motivational drivers are also required to facilitate RTGs as conceived by Rajasthan, Andhra Pradesh and Tamil Nadu governments along with motivation of household women towards nutritional importance of RTG vegetables.

Review of Research Work

Nutritional Security

Liu *et al.* (2016) carried out a comparative nutrient analysis of RTG grown lettuce and Chinese cabbage with common, pollution free/green,organic labelled counterparts and found highest level of minerals like Ca, K, Mg and Fe in lettuce and Ca, K in Chinese cabbage as well as vitamin Cin both RTG vegetables. However, crude fibre was less in RTG compared to organically labelled vegetables and none of the RTG grown vegetables exceeded maximum residue limit of nitrate, Pb and As.

Uddin *et al.* (2016) reported tomato and chilli as the most preferred vegetable in RTG of Dhaka and Chittagong, respectively. They further perceived about 93 to 100% awareness among respondents towards nutritional importance of vegetables in Dhaka, while it was 73 to 100% in Chittagong. They concluded that RTG could be an important step towards achieving nutritional security and ensuring safe vegetables with added environmental benefits.

Urban Heat Management

Pandey *et al.* (2013) compared room temperature of a building with and without green roof at Ujjain from 8 am to 6 pm to determine their cooling potential and observed an overall reduction of 4-7°C in room with green roof. The installation of RTG was found responsible in minimizing Roof Thermal Transfer Value (RTTV) with the reduction of 73.8%.

Barreca (2016) evaluated the need of biomass thermal energy for air conditioning of two different configurations*i.e.*one with a traditional roof and other one with lettuce (green roof) and noticed a reduction of about 18% of total energy requirement in a building with RTG.

Stormwater Management

VanWoert *et al.* (2005)conducted a study to quantify differences in stormwater retention of a standard commercial roof with gravel ballest, an extensive green roof system without vegetation and a typical extensive green roof with vegetation and recorded highest percentage of rainfall water retention (~60%) in green roof. In their 2nd study, they tested the influence of roof slope andgrowing media depth and recommended rooftop platform of 2% slope with 4 cm media depth for highest mean water retention (70.7%).

Air Pollution Management

Tong *et al.* (2015) investigated local air quality as influenced by elevation and rooftop configuration at Brooklyn Grange RTG and found 7-33% reduction in average $PM_{2.5}$ concentration in rooftop compared to 3rd floor and Brooklyn street over a period of time with higher proportion of larger $PM_{2.5}$ particles at street level compared to RTG.

Biodiversity Enhancement

Gunjan Gupta and Mehta (2017) adopteda participatory rural appraisal approach to assess butterfly and birds biodiversity among 12 RTGs in South Delhi and spotted 10 butterfly species with highest percentage of small branded swift butterfly. While common myna and blue rock pigeon were the most common birds in most of the RTGs among ten different species of birds.

Planting Systems

Orsini *et al.* (2014) studied the performance of different vegetable crops under three growing systems (Modified NFT, Folating and Substrate) in different seasons and observed maximum yield in lettuce under floating system in summer and autumn while rest of the vegetables namely black cabbage, chicory, tomato, eggplant, chilli pepper, melon and watermelon performed well in substrate cultivation technique. Overall daily and cumulative yield among these systems were observed to be maximum in substrate cultivation system.

Metwally (2016) illustrated four different substrate culture systems for hot pepper on RTG and observed significantly higher yield in big pots system in both the years of study.

Growing Season

Liu *et al*. (2016) standardized the growing season for hydroponically grown vegetables on rooftop asOct.-Feb. for caraway, Oct.-Apr. for Chinese cabbage, Nov.-Mar. for lettuce, Oct.-May for leaf lettuce, Jan.-Dec. for leaf mustard, Oct.-Jan. for pot herb mustard revealing maximum yield per unit area.

Urban Waste Management

Grard*et al*. (2015) demonstrated the use of three types of urban waste on rooftop garden and reported significantly maximum yield in tomato grown in media containing42% each of compost and crushed wood layer, 16% coffee ground with mycelium. While in case of lettuce and green manure, combination of 50% compost and 50% crushed wood produced maximum yield.

Substrate Selection

Eksi *et al*. (2015) quantified the optimum percentage of compost in a green roof substrate for cucumber and pepper as 60% mixed compost with heat expanded shale and sand base for higher fruit weight and number of fruits in both the crops. While fruit length was observed to be maximum in 40% compost for cucumber and in 80% for pepper.

Monetary Returns

Dreesti Wasti and Bhusal (2019) carried out economic analysis of vegetable RTG (500 m^2) in Kathmandu and revealed total operational cost per household to be ₹ 22,213 and total income as ₹ 27,537with a profit of ₹ 5,324 The reasons identified for adopting RTG were sustainable production, minimum side effects on health and so on.

Motivation

Gayathri N. and Loganayaki (2016) carried out a systematic analysis of rural and urban area in Tamil Nadu and identified *Pazhamudir nilayam* (vegetable store) as main source of getting vegetables in urban areas while it was doorstep vendors in rural areas. The problem faced while purchasing vegetables in both the areas was expensiveness of vegetable during off-season. Respondents felt the necessity of education for neat and sound environment in urban area and recycling kitchen waste in rural area. It was found that newspapersand magazines were the prime sources of information for urban areas while in rural areas it was television which motivated them to pursue RTG with an aim to get nutritionally rich and pesticide free veggies and to provide ecological services.

Environmental Assessment

Boneta *et al.* (2019) conducted environmental assessment of soil-less urban terrace garden using climate change (CC), terrestrial acidification (TA), freshwater eutrophication (FE), marine eutrophication (ME), fossil depletion (FDP) and ecotoxicity (ET)indicators and concluded that most of the environmental impacts were generated during the operation phase of the system with maximum impact of 98.5% in ME. While the infrastructure focused mainly on the FDP (31.6%), CC (18.4%) and TA (14.1%) categories.

Conclusion:

Going through the above enumerations, it can be concluded that RTGs present new opportunities offering a class of nutritionally enriched and pesticide free vegetables to residents with environmental services. Urban heat can be managed through RTG by minimizing RTTV and simultaneously, the need of energy for air conditioning of green roof can be reduced by 18%. The highest percentage of water retention in green roof with roof platform at 2% slope and 4 cm media depth can be instrumental in stormwater management in urban and peri-urban areas. RTG manifest 7-33% reduction in $PM_{2.5}$ concentration ensuring better air quality and enhancement of biodiversity. In terms of daily and cumulative yield in different vegetable crops, substrate cultivation system is recommended for RTG. Location specific identification of growing seasons for RTG of vegetables needs due consideration for maximum availability of veggies. Biodegradable urban waste could be a better option for growing vegetables in RTG. The composition of substrate for RTG should be priortized as per the availibilty at local level. RTGs not only provide nutritionally rich and pollution free vegetables but also help to get monetary returns. The motivation of urban and periurban residents towards the adoption of RTG through various means of communication requires appropriate attention. There should be proper environmental assessment of RTG through impact categories to develop future line of research and recommendation for RTGs in urban and peri-urban areas.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2019-2020

Speaker	: Monu Kumari	**Course**	: VSC 591 (1+0)
Reg. No.	: 2020218020	**Date**	: 21/12/2019
Major Guide	: Dr. N. B. Patel	**Time**	: 4.00 to 5.00 pm
Co-Guide	: Dr. C. R. Patel	**Venue**	: Swami Vivekananda Hall

Biofortification in vegetable crops

Biofortification is a way to address hidden hunger by increasing the nutritional content of plants edible parts of vegetable. It can be achieved through mineral fertilization, breeding or biotechnological approaches. The process of breeding nutrients into food crops provides a comparatively cost effective, sustainable and long term means of delivering more micronutrients. Biofortification differ from ordinary fortification because it focuses on making plant foods more nutritious as the plants are growing, rather than having nutrients added to the foods when they are being processed. These approaches are not only will lower the number of severely malnourished people who require treatment by complementary interventions but also will help them maintain improved nutritional status. Micronutrient malnutrition has an important impact on individuals, health system and societies, resulting in poor health, decreased work capacity and earning potential. The most common deficiencies due to vitamin A, foliate, iron, iodine, and zinc (Bailey *et al.*2015). Recently, (Finklestein *et al.* 2017) have shown that biofortification with Fe in staple food crops (beans, cassava, maize, pearl millet, rice, sweet potato and wheat) can increase Fe, zinc and pro vitamin A carotenoids status in populations at risk, as in the Philippines, India, and Rwanda. In the cases of iodine (I) and selenium (Se), the deficits of these elements pertain to approximately 30 and 15% of the world human population, respectively (White and Broadley, 2009).

Review of research

Cowpea

Budhani Avisha (2018) observed that the foliar spray of $FeSO_4$ @ 37.5 kg/ha at recorded economically better Fe content in 2nd (318.67 mg/kg) and 4th picking (279.67 mg/kg) of cowpea pods.

Onion

Almendros *et al*. (2015) observed that the influence of different natural and synthetic organic Zn complexes on the agronomic biofortification of onion (*Allium cepa* L.) in two types of soil: $Soil_{acid}$ (weakly acidic) and $Soil_{calc}$ (calcareous). They found that the applications of Zn-aminolignosulfonate (Zn-AML) at the rate of 10 mg Zn kg^{-1} in $Soil_{acid}$ and of Zn-DTPA-HEDTA-EDTA at the rate of 10 mg Zn kg^{-1}in $Soil_{calc}$ produced the highest Zn and soluble Zn concentrations in plants.

Spinach

Shankar *et al*. (2014) observed that the maximum zinc content in spinach leaves was higher at in PSB alone (1.38 mg/100g) treatment, maximum iron content in FYM + PSB treatment (6.76 mg/100 g) and maximum calcium, magnesium content (4.08 mg/100 g), (1.26 mg/100 g) respectively at in FYM + PSB + Citrate treatment

Tomato

Landini *et al*. (2011) studied that the iodine uptake in tomato (*Solanum lycopersicum* L.) to evaluate whether it is possible to increase the iodine concentration in its fruits with using radioactive iodine and potassium iodide with different concentrations (0, 5, 10, 20 mM) to evaluate the resulting iodide concentration both in the vegetative tissues and fruits. They show that iodine was taken up better when supplied to the roots using hydroponically grown plants, compare to leaf treated plants.

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Sweet potato

Annonymous (2015) observed that the Tainung (deep orange) variety has maximum β-carotene 10570 to 17326 mg/100 g fresh weight compare to other varieties.

Anonymous (2016a) reported that the orange flesh sweet potato Bhu Kanti β-carotene (7.4 mg/100 g) compare to Gouri and Local cultivar.

Brinjal

Anonymous (2016b) reported that the brinjal variety NSRB-1 has maximum β-carotene (0.77 mg/100 g) and anthocyanin (475.3 mg/100 g) compare to GJB-3and GOB-1 cultivars.

Cassava

Nassar *et al*. (2009) studied that the amino acid profiles of a common cassava cultivar and inter specific hybrid (ICB 300).They found that the inter specific hybrid has 10-fold lysine(0.098 g/100 g), 3 fold methionine (0.041 g/100 g) and total amino acid (1.664 g/100 g) compare to common cassava cultivar. One of these clones showed a high level of lycopene content (5 mg/kg). Tomato a lycopene rich vegetable (12-20 mg/kg) but cassava landrace UnB 400 had a high content of β-carotene.

***Brassica spp*.**

Gonnella *et al*. (2019) study that the four *Brassica* genotypes (broccoli raab, curly kale, mizuna, red mustard) were hydroponically grown with three I-IO_3 rates (0, 0.75 and 1.5 mg/l) to produce iodine-biofortified vegetables. They found that after 21days-iodine biofortification, the highest I content (49.5 µg/100 g fresh Weight), while after 43 days-iodine biofortification, I content (75.70 µg/100 g FW) was reached in broccoli raab shoots, using 1.5 mg I-IO_3/l treatment.

Potato

Chakraborty *et al*. (2000) found that the *AmA1* coding sequence was successfully introduced, expressed in tuber-specific, constitutive manner, improve the nutritional value of potato such as increase in the growth, production of tubers and total protein content with an increase in most essential amino acids 5 to 10 fold higher in transgenic populations P^{SBB8G} tuber followed by P^{SBB8} tuber, compare to wild type potato A16.

Conclusion

From the foregoing discussion, it can be concluded that soil application of $FeSO_4$ @37.5 kg/ha recorded economically better Fe content in 2ndand 4th picking of cowpea pods. Applications of Zn-aminolignosulfonate (Zn-AML) at the rate of 10 mg Zn kg^{-1} in $Soil_{acid}$ and of Zn-DTPA-HEDTA-EDTA at the rate of 10 mg Zn kg^{-1}in $Soil_{calc}$ produced the highest Zn and soluble Zn concentrations in onion bulbs. Maximum Zinc content was higher in spinach leaves in PSB alone treatment, iron content in FYM + PSB treatment and calcium, magnesium content in FYM + PSB + Citrate treatment. In tomato the uptake of iodine was better when supplied to the roots using hydroponically grown plants, compared to leaf treated plants. Tainung (deep orange) variety of sweet potato gave maximum β-carotene compared to other varieties and also orange flesh variety of sweet potato Bhu Kanti gave maximum β-carotene compared to Gouri and Local cultivar. Brinjal variety NSRB -1 had maximum β-carotene and anthocyanin compared to GJB-3 and GOB-1 cultivars. Interspecific hybrid (ICB 300) of cassava gave maximum 10-fold lysine, 3 fold methionine and total amino acid compared to common cassava cultivar.After 21 days and 43 days-iodine biofortification in *Brassica* genotypes showed the higher iodine content in broccoli raab shoots, using 1.5 mg I-IO_3/l treatment.Total protein content with an increase in most essential amino acids 5 to 10 fold higher in transgenic populations P^{SBB8G} tuber followed by P^{SBB8} tuber, compared to wild type potato A16.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI, GUJARAT
POST GRADUATE SEMINAR SERIES : 2019-20

Speaker	: Rathod Vrushabh P.	**Course**	: VSC 591 (1+0)
Reg. No.	: 2020218043	**Date**	: 04/01/2020
Major guide	: Dr. S. Y. Patel	**Time**	: 3.00 to 4.00 pm
Co-Guide	: Dr. A. K. Pandey	**Venue**	: Swami Vivekananda Hall

"Vegetable cultivation in tunnel farming"

"Growing of horticultural crops (flowers, vegetables and fruits) in tunnels out of their natural growing season is called tunnel farming". This kind of farming is normally adopted for off-season cultivation of vegetables. It is not possible to grow vegetables in open fields throughout the year because the effect of low or high temperature, high frost level *etc*. Tunnel farming operates on the principle that creating favorable condition during off season to the crop inside the tunnel. Thus, during off-season time, tunnel farming provide suitable condition to the farmer to get earlier high yield with better quality production ultimately, much return to the farmers against little more additional input cost. For this reason, it is advisable to adopt this technology where extreme weather prevailing area.

Review of literatures:

Summer squash

Kumar *et al*. (2018) studied the effect of different date of sowing under low tunnel and open field on flowering and fruiting of summer squash and they found that significantly minimum day to first female flower appearance (48.5) and days to first picking (55.5) while, fruit length (36.2 cm), fruit girth (7.81 cm), fruits/plant (8.0), fruit weight (0.97 kg), yield/plant (4.25 kg) and yield/ha (258.09 q) noted maximum at 30th December under low tunnel as compare to other tunnel and open field treatments.

Bottle gourd

Kumar *et al.* (2018) studied the effect of different date of sowing under low tunnel and open field on flowering and fruiting of bottle gourd and revealed that minimum days to female flower (61.50) and first picking (72.54). Whereas, fruit length (42.01 cm), fruit girth (8.18 cm), fruits/plant (5.60), fruit weight (1.32 kg), yield/plant (7.38 kg) and yield (221.25 q/ha) reported significantly maximum sowing on 30th December under low tunnel than rest of sowing date either in tunnel or open field treatments. Open field planting on 15th and 28th February planting showed at par only for first picking.

Rai and Dinmani (2018) evaluated the effect of plastic mulch and low tunnel on off season bottle gourd and revealed that comparatively good germination of seed (8/plot) and number of fruits/plot (30.0) under transparent plastic mulch while, the total yield (49.2 t/ha) recorded with black plastic mulch and plastic low tunnel as compare to open field and only low tunnel treatments.

Bitter gourd

Kumar *et al.* (2017) studied to find out best sowing time and growing condition for bitter gourd and they reported that significantly minimum days to female flower (53.50) and maximum fruit length (12.70 cm), number of fruits/plant (13.50), fruit weight (93.40 g), yield/plant (1.260 kg), yield/ha (258.09 q) under low tunnel sowing on 30th December over other tunnel and open field planting. The same treatment have also higher B:C ratio (2.15) than others. Open field planting on 15th and 28th February cited at par to this treatment for day to first female flower and fruit weight in addition to this, 15th January under tunnel for fruit weight only.

Chilli

Kaur *et al*. (2018) studied effect of different mulch under low tunnel on growth and yield of chilli and reported that significantly higher plant height (91.1 cm), number of fruits/plot (939), fruit yield (2.255 kg/plant) and yield (576.5 q/ha) and lower days to 50 % flowering (62.4) with black mulch under low tunnel as compare to straw mulch and no mulch treatment.

Sharma and Kumar (2017) studied different growing conditions *viz.*, low tunnel and open condition with varied spacing *viz*., 60 cm × 30 cm, 60 cm × 45 cm, 60 cm × 60 cm for chilli and reported that low tunnel condition most suitable over open condition and found significantly more plant height (52.44 cm), number of branches/plant (21.22), number of fruits/plant (103.89), yield (300.45 g/plant) and yield (111.53 q/ha) whereas, significantly higher number of branches/plant (16.17), number of fruits/plant (82.0) and yield (361.67 g/plant) planted at 60 cm × 60 cm while, high plant height in 60 cm × 30 cm then rest spacing but, yield per hectare found non-significant among spacing. For all characters interaction effect observed non-significant.

Iqbal *et al.* (2009) studied the effect of plastic mulches on vegetative and reproductive characteristics of two hot- pepper hybrids *viz.*, Sky Red and Maha under low tunnel and revealed that significant maximum plant height (91.70 cm), leaf area (7200.08 cm^2), fruit yield/plant (1.42 kg) and harvest index (66 %) with black plastic and minimum days to first flower (69.16) observed with clear plastic mulch. Between the hybrid, Maha significant exhibited for plant height (88.27 cm), fruit yield/plant (1.26 kg) and harvest index (66 %) while, high leaf area (6250.86 cm^2) and low day to first flower occurred by Sky Red. Interaction effect found significant only for growth characters.

Lettuce

Jayalath *et al.* (2017) narrated that both types of lettuce perform non significantly under tunnel and field in 2015. But, significant more in high tunnel over field for days to harvest (48 and 50), marketable yield per plot (30.6 and 34.34 kg), marketable yield per hectare (20,018 and 22,468 kg/ha) and average head weight (336 and 418) by butter head and romaine lettuce, respectively during 2016.

Musk melon

Ranjan *et al*. (2019) evaluated effect of different growing conditions *viz.*, open field and low plastic poly tunnel and planting time *viz.*, (5th, 15th, 25th Dec., 5th, 15th Jan.) over farmer practice on growth and yield of muskmelon. They reported that significant higher vine length (185.0 cm), number of fruits/plant (18.36), fruit diameter (99.96 mm) , fruit yield/plant (9.07 kg) and yield (1511.60 q/ha) under low poly tunnel sowing on 15th December except, T.S.S. (10.93) under low poly tunnel planted on 15th January than other treatments and farmer practice.

Vercera and Brown (2016) compared the performance of low, high tunnel and open field condition for muskmelon cultivars *viz.*, Athena, Lil Loupe, Sivan, Sarah's Choice and Tasty Bites and they revealed that total fruits/ha and yield per hectare found significant more in all varieties with high tunnel during 2011 over low tunnel and open field.

Green bean

Rahman *et al.* (2018) investigated the effect of mulching *viz.*, black, transparent and control along with growing conditions *i.e.*, tunnel and open field on green bean and reported that significant maximum number of leaves/plant (24.83), pod length (11.23 cm), pod weight (3.86 g) and yield (193.67 g/plant) in tunnel with black plastic mulch than open field and other mulch treatments.

Tomato

Powell *et al.* (2014) tested tomato under high tunnel and open field for assessment of late blight and yield. They revealed that significant minimum late blight assessment, maximum yield (35.0 t/ha) and total marketable yield (4.9 t/ha) was found under the high tunnel as compare to open field condition.

Rogers *et al*. (2012) determined the impact of high tunnel on tomato growth and production and they found that highest plant height (79.3 ±2.1 and 63.2 ±1.1 cm), marketable fruit weight (2.1 and 2.4 kg/plant), number of fruits/plant (23.2 and 28.7) and average fruit weight (0.3 and 0.2 kg/fruit) under the high tunnel over open field in both years, respectively.

Conclusion

From the foregoing discussion, it can be concluded that tunnel farming is suitable for off season production as against open agricultural practices for vegetable crops. In addition to this, black mulch boosts the efficiency of tunnel farming. In summer squash, bottle gourd and bitter gourd the growth and yield parameter was found maximum at 30th December under low tunnel. In chilli crop under low tunnel with or without black mulch found the maximum growth and yield. The growth and yield of green bean, was high under low tunnel with the application of black mulch. In lettuce the growth and yield was observed maximum under the high tunnel. Muskmelon growth, yield and quality attributes was more when sowing on 15th December under the low tunnel. Under high tunnel tomato, late blight assessment and disorder curve found low with higher yield as compare to open field.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
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Post Graduate Seminar Series 2019-20

P.G. Student	: Chaudhari Ritaben Ranjitbhai	Course	: VSC 591 (1+0)
Reg. No.	: 2020218008	Date	: 18-01-2020
Major Guide	: Dr. D. R. Bhanderi	Time	: 2.00 - 3.00 p.m.
Co-Guide	: Dr. R. V. Tank	Venue	: Swami Vivekananda Hall

Aeroponics in vegetable cultivation

Agricultural land is reducing day by day due to growing population needs. It is a challenge for farmers to provide food to such a great population. By natural growing process, the crops cultivated are not sufficient. In order to increase the production rate, farmers use chemicals, these chemicals lead to many skin problems and diseases to living being and disturb the entire food chain. To overcome this major problem, an aeroponic system may be used(Kaur and Kumar 2014). The term aeroponics means to cultivate plants without using soil and water as medium; by maintaining all the parameters essential for growth and development of plants. The parameters are temperature, humidity, pH and electrical conductivity of nutrient solution *etc*. resulting in a conditioned environment. The benefit of using aeroponics is plants healthier growth and nutritious vegetables by consuming fewer amounts of nutrients and water. By adopting this technique fresh and healthier vegetables can be produced throughout the year. In the recent decade, aeroponics system is used for growing potatoes and for potato seed tubers production.The aeroponics system has more advantages than hydroponics in terms of spraying high air content in the nutrient solution to provide oxygen to plant roots.A monitoring and control system intended for water and nutrients distribution has been designed to support the optimal application of aeroponics cultivation system for plant production.

Review of research work

Tomato

Osvald*et al.* (2001) studied the yield of tomato cv. 'Arletta' grown in aeroponics with different plant densities*viz.*,24, 32, 40 and 48 plants/m^2. They recorded maximum average yield/plant(526 g) with lower plantdensity (24 plant/m^2)while, maximumaverage yield/m^2(21.2 kg)with higher plant density (48 plant/m^2).

Chandra *et al.* (2014) compared average yield of different vegetables grown in the field and aeroponics systems. They found highest average yield/plantand average number of fruits/plantsunder aeroponics system.

Lettuce

Ali*et al.* (2015)compared aeroponics and hydroponics systems andfound highestfresh mass(290.84 g/plant) and dry mass (39.41 g/plant) of shootwith aeroponics system at 0.5 L/h flow rate.

Lakhiar*et al.* (2019)studied the effect of different aeroponic atomizers(A_1=air-based, A_2 = airless atomizer and A_3 = ultrasonic fogger) on growth parameters of lettuce and reportedmaximum leaf area, stem diameter, number of leaves/plant, shoot length, root length, shoot wet weight, root wet weight, shoot dry weight and root dry weight with A_2.

Potato

Ritter *et al.* (2001) compared hydroponics and aeroponics cultivation systems to produce potato mini-tubers and revealed that aeroponic system produced maximum average number of tuber/plant(12.4) and yield/plant(109.9 g) compared to hydroponic system.

Farran and Mingo (2006) carried out research on plant density and harvesting interval on potato mini-tuber production in aeroponics system and they found highestnumberof tubers/plant(13.4) and yield (118.61 g/plant) in lower plant density (60 plant/m^2)with 7 days interval.

Mateus *et al.* (2012)conducted an experiment on comparison ofyield parameters of potato cultivars grown under an aeroponics system(winter 2008- summer 2009) and noticed highest number of tubers/plant(71.7), yield(860.2 g/plant) and mean tuber weight(12.1 g/tuber) in variety Chucmarina.

Tierno*et al*. (2013) compared production of three potato cultivars under aeroponics and greenhouse beds and they noticed highest yield/plant(88.6g/plant)fromcv. Monalisa.

Bag *et al.* (2015) compared yield performance of potato mini-tubers of three varieties under aeroponics system for two years (2013 and 2014). They found thatKufriMegha showed better performance with respect to days to tuberization(32.37 and 30.00),number of mini-tubers/plant(38.12 and 42.68) and yield of mini-tubers/plant(108.94 g and 118.54 g).

Tessema*et al.* (2017) found that application of 59 g $CaNO_3$, 126 g KNO_3, 68 g KH_2PO_4 and 100 g $MgSO_4$ nutrient solution produce maximum number of tuber/plants with potato cv. Belete.

Brocic*et al.* (2018) studied the influence of the potato cultivar on the number and mass of potato mini-tuber in the aeroponics system and it was evident that the highest number of mini-tubers/m^2 (373.26)and average number of mini-tubers/plant(15.55) were recorded from the cv. Desiree, while maximum yield of mini-tuber/m^2(2304g/m^2) and average mass of a mini-tuber(8.97 g) were obtained from cv. Agria.

Ngawang and Sonam (2018) studied theeffect of cultivars on growth and yield parameter in aeroponics system at 30, 45, 60 and 75 days after transplanting and they found that maximum plant height, root length, yield and number of mini-tubers/plantin cv. NasepheyKewaKaap.

White yam

Oteng*et al.* (2017) revealed that the power dependent aeroponics unit produced maximum mean yield/cutting(3.67g), multiplication ratio/explant(477.10) and number of seed yam/explant(1393) from cv. MankrongPona of white yam.

Conclusions

From the foregoing discussion, it can be concluded that aeroponics system is better than hydroponics system for vegetable production. In aeroponics systems tomato gave maximum average yield/plant with lower plant density while, maximum average yield/m^2 with higher plant density.The average yield/plant and average number of fruits/plants was higher in the crop grown in aeroponics system as compared to those grown in the field condition. In aeroponics system lettuce production was higher than hydroponics system. Among three aeroponics atomizer *viz.*, A_1=air based, A_2 = airlessand A_3 = ultrasonic fogger, for lettuce production airless atomizer found best for all growth parameters than others.For potato mini-tubers production aeroponics system found better than hydroponics system. Potato mini-tubers production found maximum with lower plant density and less harvesting interval. Among three potato varieties *viz.*,Chucmarina, Serranita and Yana Imilla, variety Chucmarina found best for aeroponics system. Among three potato varieties *viz*., Agria, Monalisa and Zorba highest yield/plant were obtained from Monalisa cultivar in aeroponics system. Potato cv. KufriMegha found best for potato mini-tubers production than KufriHimsona and KufriHimalini in aeroponics system. In aeroponics system nutrient solution containing 59 g $CaNO_3$, 126 g KNO_3, 68 g KH_2PO_4 and 100 g $MgSO_4$ found best for potato cv. Belete. Among five potato cultivars cv. Desiree gave maximum number of mini tubers while, cv. Agria gave highest yield than other cultivars. In aeroponics system potato cv. NasepheyKewaKaap performed best for yield and growth parameters than other cultivars. Power dependent aeroponic unit found better for white yam cv. MankrongPona.

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ASPEE COLLGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI, GUJARAT
POST GRADUATE SEMINAR SERIES 2019-2020

Speaker : Patel Alkaben Karmanbhai
Reg. No. : 2020218027
Major guide : Dr. S. Y. Patel
Co-Guide : Dr. R. V. Tank
Course : VSC 591 (1+0)
Date : 18/01/2020
Time : 4.00 to 5.00 pm
Venue : Swami Vivekananda Hall

GENETIC ADVANCES IN HYBRID SEED PRODUCTION OF COLE CROPS

India is the leading country in the world occupying an area of 10.43 mha with the production of 187.47 MT and ranks second in vegetable production after China (Anonymous, 2019). Majority of the seed production of cole crop is carried out in Himachal Pradesh and area under vegetable is 88,367 ha with the production of 18,05,377 tonne (Anonymous, 2019). Negative trends for area under cultivated land with increasing population may increase high pressure on land limitation due to urbanization and industrialization. So, the probable solution is to increase the productivity per unit area. The cultivation of vegetable with high productivity can be achieve by increase seed replacement ratio through either improve variety or F_1 hybrids which have better quality and high yield ability. Diverse toward the hybrid seeds, high input cost is one of the constraints for achieving wider adaptation by the farmers. To overcome such problems use of genetic mechanism likes male sterility and self incompatibility are useful tool to minimize the cost of seed production as well as reduce the labour pressure at farm level and their by raise the hybrid seed availability up to the small and marginal farmers.

Review of research work

Self- incompatibility

Hallidri and Pertena (2002) studied the self incompatibility test in cabbage and revealed that the lines no.3 followed lines no.2, 4 and 5 with least value to them had the strongest self-incompatibility as compared to other lines. Thus, they were the best ones to be used as parental lines in a seed production program. The results of the fertility ratio after 4 years revealed that the lines no.8, 4 and 2 after every generation of selfing, improved self-incompatibility level, so its possible to be used as parental lines after some generation through backcross in hybrid seed production.

Singh *et al.* (2002) evaluated self incompatibility in different genotypes of cauliflower (*Brassica oleracea* L. var. *botrytis*). Higher seed set was observed in all the genotypes by open pollination due to allogamous nature. Among the different genotypes, Agahani Small Leaf (12.02 %) and IIVR-50 (12.95 %) at BP and Agahani-JBT-23/60 (21.20 %) at SM minimum seed set per cent over other lines showed maximum level of self incompatibility. Which offer a promise to exploit the synthetic and hybrids in cauliflower. Whereas, Aghani-31at SM and Kataki Early-29 at BP found self compatible in nature with maximum per cent seed set.

Zur *et al*. (2003) studied the environmental factors and genotypic variation for self-incompatibility in cabbage and revealed that each lines showed more siliqua containing seed stigma containing pollen tubes at BP over open pollination. It indicate that genetic background of the material determined the influence of environmental factors on SI. The four and ten lines showed higher per cent siliqua containing seeds at OP and BP at low temperature over high temperature. Uneven pattern expressed that disadvantageous effect of temperature difficult to find a universal method suitable for breaking the self-incompatibility barrier for the species.

Hamid *et al*. (2010) studied the seed setting through heterogamic BP and autogamic pollination of flowers as affected by location of bud/flower on plant, air temperature and time of pollination in self-incompatible inbred lines of head cabbage. They found maximum seed setting (10.5 seeds/pod) through heterogamic BP took place at 22° C and 8.00 hrs as compared to rest time and temp and in case of inbred line maximum seed setting take place in B-21PE-3 (9.2 seeds/pod) compared to other inbred line. Highest seed setting through heterogamic BP in mid season variety took place on first row of branching and central branch at par to them, while lines have no statistical variation. Through autogamic pollination of flowers the minimum seed setting (1.1seeds/pod) took place at 30° c and 13.00 hrs as compared to rest of pollination time and temp. whereas, in case of inbred lines, minimum seed setting take place in DT-46 (0.00 seeds/pod) and E-34 (0.2 seeds/pod) as compared to other lines. Lowest seed setting through autogamic pollination is take place on second row of branching and followed central row and first row but, significant minimum in early over mid season inbreds.

Singh *et al*. (2014) studied the effect of age of plant on compatibility levels in mid-late maturity group of cauliflower based on flowering 25; 50-75 and more than 75 percent and observed for compatibility level. There was little change in the genotypes DPCa Y-2, DPCa Y-4, DPCa Y-5 and DPCa Y-6 for the number of plants in the compatibility grade 0-10 except Palam Uphar and DPCa Y-3 at all flowering stage. Hence, those plants falling in 0-10 compatibility grade can be used for the isolation of S-allele homozygotes for the development of self incompatible.

Male sterility

Dey *et al*. (2011) developed three Ogura based improved cytoplasmic male sterile (CMS) lines of cauliflower (*Brassica oleracea* var. botrytis L.) viz., Ogu1A, Ogu2A and Ogu3A through seven generations of backcrossing with snowball group. Number of seeds per pod and seed yield per plant in Ogu3A and its respective B line was at par but reduced significantly in Ogu1A and Ogu2A after introgression of Ogura cytoplasm over respective maintainer B lines. Yield attributed characters noted similar value for A and B line.

Dey *et al*. (2013) studied the effect of chloroplast substituted ogura male sterile cytoplasm on the performance of cauliflower F_1 hybrids. They revealed that a primary and secondary branch does not significantly vary. Whereas, number of pods/plant, number of seeds/pod and seed yield cited significantly low in all A over B line except for number of seeds/pod in ogura 3A. Thus, it can be concluded that the refined ogura system is fully fit to use in large scale hybrid seed production of cauliflower.

Kumar *et al*. (2017) studied the mean performance of seed yield attributes of CMS lines of cauliflower and their respective maintainers and reported that Cal B 1A was found the highest number of seeds/pod (9.84) and seed yield (29.70 g/plant) among the CMS lines. While, primary branches in Cal B-1B, secondary branches in Sera K-25 A and ratio of secondary to primary branches in Sera K-25 B found significant more over other lines. Number of pods/plant noted significantly higher under Sera K-1B over other lines. The line Sera K-1A had significant high test weight and Sera K-1B, Cal B-1A and Cal B-1B were statistically at par to them.

Conclusion

Use of full proof self incompatibility as well as male sterility system will reduce the cost of seed production and provide high quality seed materials too. Cabbage lines 2, 3, 4, 5 had strong self incompatibility and line 8 showed increasing incompatibility per cent as compared to other lines. Cauliflower variety Aghani small Leaf, IIVR-50, Agahani-JBT-23/60 express maximum self incompatibility. Uneven expression of seed setting in cabbage is difficult to breaking the self incompatibility. Heterogamic BP noted maximum seed setting at 22° C and 8.00 hrs on first row and central branching in cabbage. Early season variety perform better than mid season variety for self incompatibility. The lines have less than 10 per cent compatability grade is better for isolation of S-allel homozygotes. Intogression of ogura cytoplasm or chloroplast substituted ogura gave positive result to develop male sterility in cauliflower. Availability of cost effective such mechanisms to produce large scale F_1 hybrid seeds by utilizing selected parental lines is prime important, which ultimately determines the commercial viability of the hybrid varieties for farmers.

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ASPEE College of Horticulture and Forestry
Navsari Agricultural University, Navsari 396 450
Post-Graduate Seminar Series: 2019-20

Speaker	:	Patel Jinal Bharatbhai	**Course**	:	VSC 591 (1+0)
Reg. No.	:	2020218029	**Date**	:	24-1-2020
Major Guide	:	Dr. S. S. Masaye	**Time**	:	4:00 to 5:00 pm
Co-Guide	:	Dr. S. S. Gaikwad	**Venue**	:	ACHF

FOLIAR NUTRITION IN VEGETABLES

Foliar nutrition is a technique of feeding plants by applying liquid fertilizer directly to their leaves. It is used as a means of supplying supplemental doses of macro and micro-nutrients, plant hormones, stimulants and other beneficial substances. Foliar nutrient uptake is a means of rapid nutrient supply, especially when soil nutrient availability or root activity is restricted. The efficiency of nutrient uptake is considered to be higher when nutrients are applied to the leaves compared to soil. Foliar nutrition can prove a great tool in correcting the nutrient deficiencies and providing much needed nutrients during stages of high nutrient demand in crop (Kaushal Shilpa *et al.*, 2014). The ability of plant leaves to absorb water and nutrients was recognized approximately three centuries ago. Studies related to the principles and mechanisms of foliar application continued during 20th century. The different methods for foliar feeding of nutrients are use of spray pumps, sprinkler system and aeroplane sprayers. The factors affecting the absorption of nutrients are spray solution, environmental conditions, leaf characteristics and plant age**.** Foliar nutrition can be helpful to provide nutrients directly to the site of metabolism, improved plant health, rapid result and reduced growth stress.

BRIEF REVIEW OF RESEARCH WORK Tomato

Habibullah *et al.* (2017) recorded minimum days for first flowering (27.33 days) and days to 50 % flowering (30.67 days). Whereas, maximum plant height (3.61 m), no. of fruits plant-1 (53.67), yield plant-1 (5.48 kg) and marketable fruit yield m-2 (14.56 kg) were obtained under the treatment RDF (N:P:K 250:125:125 Kg ha-1) along with foliar spray of all micronutrients *i.e.*, General grade 1% (Fe 5 %, Mn 2.5 %, Zn 3.5 %, Cu 1 %, B 0.65 %, Mo 0.30 %). Saravaiya *et al.* (2014) concluded that three sprays of RDF (N:P:K 75:37.5:62.5 Kg ha-1) + mixture of all micronutrients at 10 days interval starting from 40 DATP gave maximum plant height (131.73 cm), number of branches plant -1 (5.81), days to last picking (166.68), number of fruits plant -1 (34.26), fruit length (5.52 cm), fruit diameter (4.64 cm), fruit volume (67.53 cm3), fruit weight plant -1 (49.20 kg), fruit yield ha-1 (46.78 t) and marketable fruit yield ha-1 (45.62 t) of tomato cv. GT-2. Yildirim (2007) recorded the maximum fruit diameter (6.83 and 7.45 cm), fruit length (5.63 and 5.76 cm), fruit number (63 and 70) and yield plant-1 (5575 and 7693 g) in 2004 and 2005, under the treatment of 20 ml/l foliar application of humic acid. Chaurasia *et al.* (2005) assessed maximum plant height (125.4 cm), number of branches (4.2), fruit length (4.90 cm), number of fruits (24.6), in 5 times foliar application of water soluble formulation NPK 19:09:19.

Chilli

Swain *et al.* (2015) revealed that foliar spray of 3.0 % *panchagavya* at 10 days interval (6 sprays) gave higher number of fruits plant-1 (169.45), number of seeds fruit-1 (75.27), yield plant-1 (86.95 g) and yield hectare-1 (21.95 q). Kalroo *et al.* (2014) suggested that the foliar application of zinc @ 5 ml/l water resulted in maximum plant height (85.66 cm), days to flower emergence (56.33 days), plant spread (77 cm), branches plant-1 (13.00), fruits plant-1 (486.33), fruit length (5.50 cm), fresh fruit yield (705 g plant-1) and fruit yield ha-1 (16.350 t) which was statistically not differ with the foliar application of zinc at 4 ml/l water. Deore *et al.* (2010) reported that chilli plant treated with 3 % NOLF resulted in maximum plant height (60.11 cm), number of branches plant-1 (6.73), number of fruits plant-1 (42.07) and total yield (360.14 g plant-1).

Cauliflower

Chaudhari *et al.* (2017) noticed that the application of 1 % General grade-1 + Ammonium molybdate (0.1 %) had shown significant impact on length of stalk (16.59 cm), number of leaves plant-1 (23.39), plant spread (N-S: 76.81 cm & E-W: 77.79 cm), curd diameter (19.16 cm), gross weight of curd (2.65 kg plant-1), net weight of curd (883.33 g plant-1), curd yield plot-1 (37.11 kg) and curd yield hectare-1 (28.64 t).

Cabbage

Chaudhari Vibhuti *et al.* (2017) concluded that the application of 1 % General grade-1 + 0.1 % Ammonium molybdate had shown significant impact on plant height (28.54 cm), length of stalk (14.26 cm), number of wrapper leaves plant-1 (42.26), number of non wrapper leaves plant-1 (21.93), plant spread (N-S: 55.96 cm & E-W: 54.22 cm), polar diameter of head (15.46 cm), equatorial diameter of head (13.35 cm), gross weight of head (1.24 kg plant-1), net weight of head (748.00 g plant-1), yield of head plot-1 (31.42 kg) and head yield hectare-1 (24.24 t).

Cowpea

Singhal *et al.* (2015) found that the application of banana pseudostem enriched sap @ 1 % resulted in achieving maximum number of pods plant-1 (13.33), pod yield plant-1 (104.67 g), pod yield (9.71 t ha-1), dry seed yield (1453 kg ha-1) and dry plant yield (1658 kg ha-1).

Okra

Kalariya *et al.* (2018) noted maximum pod length (8.64 cm), pod diameter (1.43 cm), number of pods plant-1 (24.35), weight of pod (11.45 g), marketable pod yield (0.280 kg plant-1) and marketable pod yield (15.537 t ha-1) under the treatment of novel organic liquid fertilizer 1.5 %.

Radish Jadhav *et al.* (2014) recorded that application of water:vermiwash (1:4) gave maximum leaf length (41.62 cm), root diameter (10.41 cm), single root length (23.79 cm), single radish weight (85.21 g), yield plot-1 (56.80 kg) and marketable yield (49.25 t ha-1) of radish cv. Local.

CONCLUSIONS

Foliar nutrition can quickly correct nutrient imbalances and most effective way to apply micro nutrients and supplement the major elements. Foliar nutrients are readily available and more easily utilized by the plant than soil nutrients. In tomato, RDF (N:P:K 250:125:125 Kg ha-1) along with foliar spray of all micronutrients *i.e.*, General grade 1 %, 3 time spray of RDF (N:P:K 75:37.5:62.5 Kg ha-1) + mixture of all micronutrients at 10 days interval starting from 40 DATP, 20ml/ l foliar application of humic acid and 5 times foliar application of water soluble formulation NPK 19:09:19 increase growth as well as yield attributes. Foliar spray of 3.0 % *panchagavya* at 10 days interval (6 sprays), zinc @ 4 ml/l water and 3 % NOLF improves quality of chilli plant. Application of 1 % general grade-1 + Ammonium molybdate (0.1 %) had shown significant effect in cauliflower and cabbage. Increasing cowpea yield and yield attributes with application of banana pseudostem enriched sap @ 1 %. Novel organic liquid fertilizer 1.5 % increases the yield and yield attributes of okra. In radish, application of water:vermiwash (1:4) gave better result for growth as well as yield parameters. **REFERENCES**

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES 2019 - 2020

Name of speaker	:	Gamit Mittalkumari Dhansukhbhai	**Course**	:	VSC 591 (1+0)
Reg. No.	:	2020218013	**Date**	:	27/01/2020
Major Guide	:	Dr.K. D. Desai	**Time**	:	10:00 - 11:00 AM
Co-Guide	:	Dr.Dipal S. Bhatt	**Venue**	:	Swami VivekanandaHall

Importance of different rootstock in cucurbits

Cucurbits belong to the family Cucurbitaceae and form an important and a large group of vegetables, grown extensively in tropical and sub-tropical regions of the world.The Cucurbitaceae family comprises about 960 species. Three genera *Cucumis*, *Citrullus* and *Cucurbita*, include the most widely cultivated cucurbits worldwide. In addition to these, there are other notable cucurbits belonging to regionally cultivated genera, such as *Benincasa*, *Lagenaria*, *Momordica*, *Luffa*, *Sechium*, *Sicyos* and *Trichosanthes*. They are not only cultivated as crops but also used as rootstocks for the same or different species. Gujarat account 87,792-hectare areawith 1413578 MT production and 16.10 MT / ha productivity in cucurbits (Anonymous,2018).

Rootstock is a part of plant, often an underground part from which new above-ground growth can be produced. It could also be described as a stem with a well-developed root system to which a bud from another plant is grafted.The primary motive for grafting cucurbits is to avoid damage caused by soil borne pathogens and pests when genetic or chemical approaches for disease management are not effective.Grafting a susceptible scion onto a resistant rootstock can provide a resistant cultivar without screening and selection, required to breed resistance cultivar. Rootstocks can also influence temperature tolerance, moisture extremes (drought, flooding) and salt stress (Davis *et al*., 2008).

Review of literature

Resistancy

Huitron*et al*. (2008) found that Shintoza and RS841 rootstocks were highly resistant to *Fusarium oxysporum*f.sp.*niveum, cucumerinum, melonis, lagenariae*and also found highly resistant to low temperature and salinity.

Davis *et al*. (2008) observed that rootstocks of Shintozwa, Bur cucumber and African Horned cucumber were highly resistant to *Fusarium oxysporum*f.sp.*niveum, cucumerinum, melonis, lagenariae* and Bur cucumber also found highly resistant to *Meloidogyne halpa.* Shintozwa and figleaf gourd rootstock were highly resistant to salt and low temperature whereas,Shintozwa, bottle gourd, wax gourd and AH cucumber rootstocks were highly compatible with watermelon and cucumber.

Liu *et al*. (2015) observed that cucumber, muskmelon and watermelongrafted on*Cucumis pustulatus* rootstock gave higher total yield per vine (2032.5g, 2276.1g and 3901.8g, respectively) and single fruit weight (261.3g, 469.0g and 1900.5g, respectively)than self-rooted ones.*Cucumis pustulatus*showed high resistancy and minimal root knot nematode galling on root system and found suitable rootstock for cucumber, watermelon and muskmelon to manage *Meloidogyne incognita.*

Cucumber

Heidari*et al*. (2010) observed that cucumber cv. Khassib gave highest survival rate (71 %) and rootstock diameter (1.53 cm)when grafted on *Cucurbita maxima* rootstock.Scion diameter was measured higher when it was grafted on Azman and *C. moschata* rootstocks while internodes were found longer when it was raised without grafting.

Xu *et al*. (2015) revealed that cucumber cultivar Jinchun No. 4 recorded highest survival rate (100%) and growth indices like vine length (4.50 cm), root length (27.83 cm), leaf area (73.14

cm^2), fresh shoot (12.49 g/vine) andfresh root (1.22 g/vine) weight, dry shoot (1.08 g/vine) anddry root (0.07 g/vine)weight when grafted on Heizinangua (H) rootstock than Dongyangshenli (D) rootstock.They also found that same graft union recorded highest yield (1871.13 g/vine), fruit weight (185.26g/fruit), fruit number(10.10/vine), total solublesugar (1.59 %)than the other graft union whereas, fruit dry matter (4.81%)was found highest in graft union withDongyangshenli (D) rootstock.

Farhadi *et al*. (2016) examined growth, yield and quality ofcucumber cv. Khassib grafted on different rootstocks and revealed that graft union with Shintoza gave highest Root/Shoot ratio (0.22),vinelength(241.0 cm) and node number (43) whereas, leaf area (904.4cm^2/vine) was highest with Tanbal rootstock. The highest yield (6657g/m^2) and number of fruits per vine (29.5) were obtained with Ferro rootstockwhereas, highest marketable fruits(96.5%) and fruit diameter (3.1 cm) were obtained with Tanbal rootstock. TSS (4.8 ^{0} Brix)and fruit weight (5.15 g) were found higher in ungrafted plants. Fruit shape (4.7 L/D) was found better with 909 rootstock.Ferro rootstock gave highest survival rate (94 %).

Al-harbi*et al*. (2018) tested grafted and non-grafted plants of cucumber cv. Alosama F_1under different water stress levels andfound maximum fresh weight (289.7 g), stem fresh weight (165.3 g), root fresh weight (25.3 g), leaf dry weight (37.3 g), stem dry weight (14.7 g), root dry weight (6.1 g), fruit weight (105.4 g) and total yield (10.448 kg/vine) with highest WUE (19.24 kg/m^3) when it was grafted on Shintoza rootstock under different water stress conditions. The mean performance for all three graft was found better when they were grown under 100 % water stress condition but the highest mean WUE was obtained best under 50 % water stress conditions.

Alaaeldin*et al*. (2019)carried out an experiment for two years on cucumber cv. Gianco RZ grafted ondifferent rootstocksand found higher vine length with Hersh (3.43 m), Gordal (3.25 m) and Bottle gourd (3.11 m) rootstocks during 2017. In the same year they also obtained highest no. of leaves (43.00) with Star, highest leaf area (95.37 cm^2) with Bottle gourd, earliness of flowering (35.84 days) and harvesting (46.81 days) with Hersh rootstocks. They also foundthe highest fruit number (56.00/vine), longer fruit (14.07 cm), highest fruit diameter (3.77 cm), fruit dry matter (9.92 %), T.S.S. (5.11 %) and ascorbic acid (3.60 mg/100 g) with Star rootstock whereas, higher carbohydrate (3.13 %) was observed with Hersh rootstock. In the year 2018, graft with Hersh rootstock recorded significantly highest stem diameter (11.37 mm), earliness in flowering (36.33 days) and harvesting (47.25 days). The highestleaf area (131.30 cm^2) was recorded with Bottle gourd combination whereas, highestno. of leaves per vine (40.66), no. of fruits/vine (64.00) with the highest fruit length (14.00 cm), fruit diameter (3.76 cm), fruit dry matter (10.08 %), T.S.S. (4.26 %) and ascorbic acid (3.45 mg /100 g) were recorded with Star rootstock graft.

Kumar *et al*. (2019) observed that cucumber grafted on figleaf gourd rootstock gave highest dry mass weight of leaf (100.15 g/vine), stem (18.03 g/vine), root (7.23 g/vine) with highest stem girth of rootstock(12.03mm) and leaf area (2.06m^2). Significantly the highest.

fruit yield (4.30 kg/vine), fruit number (17.85/vine), mean fruit weight (242.6g), fruit length(19.2cm) and fruit girth (4.19cm) were also

recorded in same graft union.

Usanmaz andAbak (2019) obtained significantly the highestroot dry weight (50.37 g), shoot dry weight (113.78g) andyield (8.58kg/vine) when non grafted Falconstar cucumber grown under 2.5 dS/m salinity stress.

Watermelon

Mohamed *et al*. (2012) revealed that watermelon ‘Aswan F_1’ grafted on‘6001 F_1’and ‘Shintoza F_1’ rootstocks gave higher number of leaves (170.33/vine and 168.50/vine, respectively), shoot fresh weight (3650.0 g/vine and 4150.0 g/vine, respectively) and shoot dry weight (24.79 % and 25.72 %, respectively).

Yarsi*et al*. (2012) obtained early yield (8.5 kg/m^2) and higher total yield (10.5 kg/m^2) when watermelon cv.Falezgrafted on P360 rootstock. Same combination recorded higher values of fruit weight (1722 g), flesh firmness (8.85 Nt) and rind thickness(5.12 mm) whereas, fruit shape (0.96

De/Dp) was found better when it was grafted on BH, CF and LC. The highest TSS was obtained when Falez was grafted on BH.

Jang *et al*. (2014) noted thatinsummer the highest fruit length (17.0 cm) and width (13.50 cm)were obtained with R_6 and R_9 rootstocks, respectively. Rootstock R_9 also recorded highest fruit mass (1.92 kg/vine), totaland marketable yield (2.54 kg/m^2) than non-grafted melon whereas in autumn, the overall performance of R_9 rootstock was found better.

Poor(2015) recorded highest number of leaves (11.75) and root length (6.8 cm) when he grafted watermelon on pumpkin rootstock under drought condition butroot dry weight and wet weight was not affected significantly due to grafting.At salinity level 6.5 mS significantly highest number of leaves (10.5) and root wet weight (30.8 g) were noted whereas, at salinity level 10.5 mS significantly the highest root length (5.85 cm) and root dry weight (5.07 g) were noted.

Ozdemir*et al*. (2016) noticed that watermeloncvs. Crisby and Crimson Tride grafted on RZ841 rootstock recorded higher fruit weight (6076.50 g and 6914.47 g, respectively)without any significant difference in fruit diameter and length.

Bittergourd

Tamilselvi and Pugalendhi (2017) found that whenPalee F_1 cv. of bitter gourdgrafted onpumpkin rootstock gave maximum fruit number (28.02) per vine, individual fruit weight (182.20g), fruit length (25.30cm), fruit yield per vine (3.55kg), total number of harvest (17.08), crop duration (194.12 days) and flesh thickness(0.85 cm) with higher values offruit girth (16.25 cm), ascorbic acid (105.83mg/100g) than rootstock of sponge gourd and non-grafted bitter gourd.They also found that when CO-1 cv. of bitter gourd, grafted on pumpkin rootstock recorded highest fruit number (20.93) per vine, individual fruit weight (134.22 g), total number of harvest (13.05) and crop duration (154.97 days) with higher values of fruit yield (2.20 kg) per vine, flesh thickness (0.70 cm) and ascorbic acid (97.02 mg/100g) content.

Muskmelon

Radhouaniand Ferchichi (2010)noticed that at 64 days after transplanting of muskmelon grafted on TZ148 rootstock, recordedhigher LAI (6.14 cm^2/m^2 and 4.44 cm^2/m^2) in both sand and compost media, respectively whereas, the highest NAR (5.70 mg/cm^2/day) was recorded in compost only with same rootstock. Higher number of fruits per vine was observed in both media (6.42 and 5.66, respectively) with Ferro rootstock while, higher fruit weight was achieved in both media (0.90 kg/vine and 0.71 kg/vine, respectively) with TZ148 rootstock.

Conclusion

From the foregoing discussion, it can be concluded that providing resistant rootstock to susceptible scions prevents primary sources of infection, resulting in reduced disease incidence. Bur cucumber and wax gourd rootstocks were resistant to fusarium wilt. *Cucumis pustulatus*was a suitable rootstock for cucumber, melon and watermelon to manage *M. incognita* by producing high yield and good quality fruits. Interspecific hybrid F_1 (*Cucurbita maxima x Cucurbita moschata*) rootstock was tolerant to salinity and low temperature. To obtain highest survival rate in grafted cucumber, *Cucurbita maxima* rootstock found better. Greenhouse cucumber grafted on to figleaf gourd during winter season gave highest fruit yield.Pumpkin, bottle gourd, squash, figleaf gourd, sponge gourd, interspecific hybrids (Ferro, RS841, Shintoza) can be used as rootstock in cucumber, muskmelon and watermelon. In bitter gourd (cv. Palee F_1 and Co-1), pumpkin rootstock gave highest yield with good quality as compared to sponge gourd rootstock and self-rooted one. Rootstock of pumpkin demonstrated better performance even under drought and salinity conditions.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2020-2021

Speaker	**:** Gondaliya Bhavik R.	**Course**	**:** VSC - 591 (1+(
Reg. No.	**:** 2020219011	**Date**	**:** 06-11-2020
Major Guide	**:** Dr. K. D. Desai	**Time**	**:** 11 to 12 a.m.
Minor Guide	**:** Dr. T. R. Ahlawat	**Mode of presentation:** Online	

Fertigation: Useful technology for doubling farmer's income

India has made its presence felt at the global level by emerging as the second largest producer of vegetables in the world next to China. In the year 2018-19, India produced 185.883 million MT of vegetables from an area of 10.100 million ha with a productivity of 18.40 MT ha^{-1}. In Gujarat, the area under vegetables was 0.626 million ha with a production of 12.55 million MT with a productivity of 20.05 MT ha^{-1} (Anon., 2018-19). The productivity of vegetable crops must be increased to fulfill the daily recommended needs of the population.

Fertigation is a process in which fertilizers are dissolved, diluted and distributed along with irrigation water in drip or sprinkler irrigation system. Now a day's fertilizers are a costly input hence, there must be some way and means to minimize its use without any detrimental effect on production for which fertigation is the best technology. Vegetables responds better with increasing frequency of fertilizers and uptake of these fertilizers in moist condition is maximum, which is possible in this method. It improves plant growth and development, resulting in higher production with better quality. Ultimately, it is helpful in doubling farmer's income.

Review of Research Work:

Chilli (*Capsicum annuum* L.)

Singh *et al.* (2017) obtained higher yield of chilli cv. Pusa Jwala, best water use efficiency and highest B: C ratio with the application of 75% RDF + 2 Foliar spray of 1% urea phosphate. However, total nutrient uptake was found best with 50 % RDF.

Tomato (*Solanum lycopersicum*)

Ramachandrappa *et al.* (2004) reported that fertigation with 100% water-soluble fertilizer significantly increased the fruit yield (79.27 t ha^{-1}) of tomato over conventional method of fertilizer application with furrow irrigation (59.5 t ha^{-1}). The same method of fertilizer application with drip irrigation recorded 71.92 t ha^{-1} fruit yield. It also recorded the highest FUE (226.5 kg kg^{-1}).

Capsicum (*Capsicum annuum* L.)

Kumar *et al.* (2018) experimented on bell pepper to know the effect of combination of different levels of fertigation and training systems. They observed non-significant effect of these combinations on most of the characters except number of fruits plant^{-1}, yield plant^{-1} and yield per 1000 m^2. They reported that fertigation level of 250:250:250 NPK kg ha^{-1} imparted earliness in flowering and picking. It also gave maximum values for fruit diameter (7.31 cm), pericarp thickness (0.70 cm), fruit weight (150.40 g), fruit volume (236.31 cc), Whereas, fertigation level of 350:350:350 NPK kg ha^{-1} had a significant and positive effect on plant height and fruit length. F_3P_3 combination recorded maximum number of fruits plant^{-1} (25.79), yield plant^{-1} (3.63 kg) and yield per 1000 m^2 (10.74 t).

Brinjal (*Solanum melongena* L.)

Kharde *et al.* (2017) observed that fertigation level of 80% RDF through water soluble fertilizers remarkably improved growth and yield (458.18 q ha^{-1}) of brinjal cv. Phule Arjun.

Potato (*Solanum tuberosum* L.)

Kumar *et al*. (2006) evaluated different levels of fertigation given to potato cv. Kufri Chandramukhi and found that fertigation level of 187:63:125 NPK kg ha^{-1} recorded the maximum fresh tuber yield (27.26 and 24.16 t ha^{-1} in the year 2001-02 and 2002-03, respectively). Fertigation level of 141:47:93 NPK kg ha^{-1} recorded the highest B: C ratio and fertigation level of 93:32:63 NPK kg ha^{-1} recorded the highest NUE during both the years.

Okra (*Abelmoschus esculentus (L.)* Moench)

Padmanabha *et al.* (2018) concluded that application of 100% recommended dose of nitrogen and potassium with water soluble fertilizers applied through drip in eight equal splits at weekly intervals significantly improved growth characters of okra. Same treatment recorded significantly the highest number of pods (28.77) plant^{-1}, pod yield (460.4 g) plant^{-1} and pod yield (24.81 t) ha^{-1}.

Cucumber (*Cucumis sativus L.*)

Kumar *et al.* (2018) conducted an experiment on greenhouse cucumber to find out the combined effect of different levels of fertigation and training systems. These combinations were failed to perform significantly on most of the characters except number of fruits plant^{-1}, yield plant^{-1} and yield per 1000 m^2. They reported that fertigation level of 150% RDF imparted earliness in flowering (2.11 days) and picking (2.30 days). Fertigation level F_4 recorded significantly the highest values for plant height (326.34 cm) at 90 DAP, leaf area (542.68 cm^2) at 60 DAS, fruit length (16.10 cm), fruit diameter

(P.T.O.)

(4.15 cm) and shelf life (7.78 days). Combination F_4P_2 recorded the highest number of fruits plant^{-1} (40.24) and yield plant^{-1} (5.10 kg) whereas, the highest yield (11.09 t) per 1000 m^2 was obtained in F_4P_3 combination.

Kaur *et al.* (2019) observed earliness in cucumber with the application of 100% RDF through drip. It also improved plant height (4.54 m), number of primary branches (12.35), harvest duration (47.40 days) and harvest index (65.49 %) with fruit yield (72.62 t ha^{-1}) compared to other levels.

Cabbage (*Brassica oleracea* var. *capitata*)

Nikzad *et al.* (2020) revealed that application of 100% RDF (150:100:125 NPK kg ha^{-1}) in 12 equal splits at 5 days interval recorded significantly the highest value of all the parameters except head diameter and length which were at par with 100% RDF in 6 equal splits at 10 days intervals.

Cauliflower (*Brassica oleracea var. botrytis*)

Gadhvi *et al.* (2017) reported that application of 100% RDF (L_1) comprised with the source [urea phosphate (UP) + urea + MoP] *i.e.* S_2, recorded best values for plant height (49.5 cm), number of leaves at harvest (27.1), average curd weight (439 g plant^{-1}) and curd yield (21.754 t ha^{-1}).

Onion (*Allium cepa L.*)

Significantly the highest plant height (61.88 cm), number of leaves (8.00), neck thickness (1.30 cm), gross yield (23.30 t ha^{-1}), marketable yield (20.03 t ha^{-1}) with the best quality of bulbs were produced with drip system by Bhasker *et al.* (2018) compared to surface irrigation system.

Garlic (*Allium sativum L.*)

Gupta *et al.* (2018) reported that fertigation levels significantly affect growth and yield of garlic. Among different fertigation levels, level of 100% RDF recorded the highest plant height (73.48 cm), gross bulb yield (153.25 q ha^{-1}) and marketable bulb yield (138.91 q ha^{-1}) with the best grades of bulbs.

Conclusions

From the foregoing discussion, it can be concluded that fertigation is the most effective technique resulting in higher yield with better fertilizer and water use efficiency. It also improves B:C ratio that can be helpful for doubling farmer's income. In chilli, 75% RDF through fertigation + 2 Foliar spray of 1% urea phosphate increases yield parameters, water use efficiency and B:C ratio. In tomato, 100% water-soluble fertilizer through fertigation increases plant height, fruit yield, marketable fruit yield and FUE. In capsicum, 83.33% RDF through fertigation improved almost all parameters measured, except plant height and fruit length. Combination of same fertigation dose in four shoot training system recorded maximum values in yield parameters. In brinjal, 80% RDF through water soluble fertilizer in drip recorded maximum growth and yield. In potato, 100% RDF through drip irrigation enhanced fresh tuber yield, 75% RDF recorded maximum B:C ratio and 50% RDF recorded heighest FUE. In okra, significantly the highest growth and yield values obtained with 100% RDF through fertigation. In cucumber, 150% RDF given to single stem through drip, enhanced growth and yield. Even 100% RDF could get better results. In cabbage, 100% RDF applied through fertigation with more number of splits and less interval, increased growth and yield parameters. In cauliflower, 100% RDF made from S_2 source applied through fertigation gave maximum values of growth and yield parameters. In onion, 100% RDF through drip irrigation significantly improved growth, yield and quality over surface irrigation. In garlic, 100% RDF applied with fertigation increased growth and yield.

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ASPEE College of Horticulture and Forestry
Navsari Agricultural University, Navsari 396450

Post Graduate Seminar Series: 2020-21

Speaker : Sarvaiya Jaydipbhai P. (Reg. No. 2020219038)		**Course: VSC 591 (1+0)**
Major Guide : Dr. S. N. Saravaiya		**Date : 07-11-2020**
Minor Guide : Dr. Y. N. Tandel		**Time : 3 to 4 p.m.**
Mode of presentation: Online		

Soil solarization in relation to potato production

Soil solarization is an environment friendly method used to manage weeds, nematodes, diseases and insects in the soil. It is a non-chemical and non-hazardous procedure adopted by farmers in several parts of the world. Solarization is mainly dependent on high solar radiation, as influenced by both climate and weather. It offers multiple pests control based on trapping solar energy by tightly covering the soil usually with transparent polyethylene sheet. This result in a significant increase of **10-12 °C** above normal temperature of soil, temperature up to the point where most weeds and pathogens are vulnerable to heat effects.

Potato is an important food source since it produces more food per unit area and time. It is grown commercially in almost all the agro-climates. Being grown underground, the potato crop is affected by soil-borne pathogens including fungi, bacteria and nematodes causing severe yield losses in potato. Soil solarization has previously been found effective against various diseases and pests in potato (Triki *et al.*, 2001).

Review of Research Work

Moisture

Egley (1983) studied the effects of soil solarization through transparent polyethylene covers upon soil moisture content. He observed that the soil moisture content on soil surface was within the range of 2.2 to 2.6 per cent on a dry weight basis when soil covers were put in place. On 30th June and 2nd July after a rainfall of 4.2 cm, soil moisture in the top 2.5 cm was significantly higher under the cover. Whereas, on 8th July, soil moisture dropped to 1.8 per cent in the control plot, but still relatively high at 14.9 per cent under the polyethylene cover. With no rainfall during the period, soil moisture content on 11th July under the cover fell to 3.7 per cent as compared to 1.8 per cent in the control.

Temperature

Kumar *et al*. (1993) studied the effect of soil solarization with PE film on soil temperature at three depths during mulching period. They recorded that mulching with PE increased the mean maximum soil temperatures by about 9 °C at 5 cm and 7 °C at 10 and 15 cm depths. Differences in mean minimum temperatures as a result of mulching was less than 2 °C.

Singh *et al*. (2009) found that the average weekly maximum temperatures at all the soil depths was higher in solarized plots as compared to unsolarized plots. The mean maximum soil temperature recorded under the polythylene mulch were 53.3 °C at the surface, 50.5 °C at 5 cm, 44.0 °C at 10 cm and 38.6 °C at 15 cm soil depth, which were higher by 10.96 °C, 9.4 °C, 5.6 °C and 3.9 °C, as compared to unsolarized plots at respective depths.

Pathogen

Davis and Sorensen (1986) studied the influence of soil solarization on severity of wilt caused by *Verticillium dahliae* among three potato clones. They observed that the clone NDA8694-3 was most susceptible, Russet Burbank was less susceptible and A68113-4 was most resistant. Solarization reduced colonization of *V. dahliae* in the resistant clone A68113-4, which again indicated reduction in soil population of *V. dahliae.*

Kumar *et al*. (1993) found that the soil solarization drastically reduced nematode population by about 90 per cent for parasitic and 70 per cent for saprophytic species by the end of the mulching period. However, by 70 DAS population of parasitic nematodes recovered to about 70 per cent of those on unmulched plots and the saprophytic species showed no effects of mulching**.**

Triki *et al.* (2001) studied the effects of soil solarization on soil-borne fungi and observed that the solarization reduced by 96 per cent and 76 per cent the inoculum density of *Fusarium solani* at the upper and lower 15 cm layers, respectively. They also observed that the population densities of *Pythium aphanidermatum* were heavily reduced by the solarization as nearly no oat seed (0.8 per cent) was colonized by the solarized soil sample at 0-15 cm and only 6.7 per cent at 15-30 cm deep soil sample.

Weed

Kumar *et al*. (1993) found that the soil mulching significantly reduced the population of emerged grasses and other weeds in the uncropped parts of the plots. Mulching for 32 days reduced the emergence of grasses in the first flush by 89 per cent, of *T. monogyna* by 98 per cent, of *D. arvensis* by 75 per cent and of *C. rotundus* from seed by 90 per cent.

Marenco and Lustosa (2000) observed that the solarization reduced total dry matter accumulation and density of weeds at 15, 30 and 45 days after the removal of PE films. Weed DM accumulation was reduced from 11.9 g m^{-2} in control plots to 0.89 g m^{-2} in those solarized for nine weeks indicating the effectiveness of PE mulching on weed control.

Singh *et al*. (2009) observed as a result of soil solarization significant reduction in weed population by 98 per cent and fresh weight of weeds by 99.2 per cent in the first year over unsolarized control, whereas corresponding figures in second year as 96.9 and 98.2 per cent. In unsolarized soil, number of weeds were 110.5 and fresh weight 194.85 g m^{-2} during first year, whereas corresponding figures for second year were 193 and 273.3 g m^{-2}.

Beneficial microbes

Stapleton and DeVay (1984) observed that the population densities of *Agrobacterium spp*., *Fluorescent pseudomonas*, Gram-positive bacteria, *Actinomycetes* and *Pythium spp.* in the solarized soil differed significantly from those found in both the shaded and untreated control soils; they were reduced to 44-80 per cent compared to the untreated soil.

Nutrient

Stapleton *et al*. (1985) conducted a soil assay immediately after removal of the polyethylene film observed that NO_3-N was significantly increased by 1-11 fold, NH^{+}_4-N by 4.5-43 fold, P by 1.2-1.5 fold, Ca^{2+} by 1.7-2.2 fold, Mg^{2+} by 1.8-2.7 fold and EC by 2.1-2.7 fold in the solarized soil compared to non treated one.

Singh *et al*. (2009) found that the soil nutrients (N, P and K) were influenced by soil solarization both at planting and harvesting. The increase in available nutrients was 49.0 per cent N, 67.3 per cent P and 15.7 per cent K at planting and 11.44 per cent N, 13.1 per cent P and 32.2 per cent K at harvesting.

Tuber Yield

Davis and Sorensen (1986) found the mean total yield for the NDA8694-3 clone was increased in the range from 31 to 37 per cent and in terms of U.S.#1, it was increased from 46 to 57 per cent . Similarly, total yield increased for the clone Russet Burbank was from 31 to 46 per cent; whereas in terms of U.S.#1, it was increased by 65 to 118 per cent. The increase in tuber yield for the A68113-4 clone was in the range of 15 to18 per cent and in terms of U.S.#1, it was from 18 to 25 per cent.

Sharma and Arora (2005) revealed a highly significant increase in tuber yield in almost all the cultivars, from 8.62 per cent in Kufri Pukhraj to 73.67 per cent in K. Chandramukhi. The increase in tuber yield was between 16-20 per cent in K. Jyoti, K. Jawahar and K. Dewa, between 20-30 per cent in Phulwa, K. Ashoka and K. Sherpa, between 30-40 per cent in K. Giriraj, K. Bahar, K. Sutlej and K. Badshah. Due to solarization, the highest increase in yield was recorded in K. Chandramukhi (73.7 per cent) followed by K. Lauvkar (62.02 per cent).

Singh *et al*. (2009) observed that the yield in solarized plots was 279.0 q ha^{-1} as compared to 193.2 q ha^{-1} in unsolarized plots. The mean tuber yield was highest in K. Ashoka (277.8 q ha^{-1}) followed by K. Pukhraj (234.2 q ha^{-1}) and K. Badshah (196.3 q ha^{-1}).

Conclusions

It can be concluded from the forgoing reviews that solarization of soil is a beneficial practice in potato production. It maintains soil moisture relatively high 14.9% under the polyethylene cover. Mean maximum soil temperature recorded under the polyethylene mulch were higher by 3.9 ^{0}C to 10.96 ^{0}C at different depths from surface to 15 cm compared to control. It reduced nematode population by about 90 per cent for parasitic and 70 per cent for saprophytic species and the inoculum density of *F. solani* by 96 per cent and 76 per cent. Weed DM accumulation was reduced from 11.9 g m^{-2} in control plots to 0.89 g m^{-2} in solarized plots for nine weeks. Mulching for 32 days reduced the emergence of grasses, weed population and fresh weight of weeds. Population densities of *Agrobacterium spp*., *Fluorescent pseudomonas,* Gram-positive bacteria, *Actinomycetes* and *Pythium spp.* in the solarized soil were reduced by 44-80 per cent compared to the untreated soil. It increase NO_3-N by 1-11 fold, NH^+_4-N by 4.5-43 fold and P by 1.2-1.5 fold in solarized soil. It increased available nutrients in soil namely N 49.0 per cent, P 67.3 per cent and K 15.7 per cent at planting. It increased mean total tuber yield ranged from 31 to 46 per cent. It increased tuber yield in K. Chandramukhi by 73.67 per cent followed by K. Lauvkar by 62.02 per cent. In nut'shell, soil solarization helps in increasing tuber yield, managing weeds, controls nematodes, soil borne diseases and pathogens.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2020-21

Speaker	:	Mohammad Sharif	**Course**	:	VSC 591
Reg. No.	:	2020219020	**Date**	:	19-12-2020
Major Guide	:	Dr. D. R. Bhanderi	**Time**	:	1:30 to 2:30 pm
Co- Guide	:	Dr. R. V. Tank	**Venue**	:	Online

Nutrient management of Malvaceae vegetable

Vegetables are the integral part of the balanced diet of human since time immemorial. Globally, the role of vegetables have been recognized in solving the problem of food and nutritional security. Okra [*Abelmoschus esculentus* (L.) Moench.] is an important vegetable crop of Malvaceae family, which is highly nutritious and supplies carbohydrates, fats, protein, minerals and vitamins in our diet. India is the largest producer of okra in the world.

Integrated nutrient management (INM) is now being promoted to reduce negative impacts of phosphorus and nitrogen. INM system promotes low chemical input but improved nutrient use efficiency by natural and man-made sources of plant nutrients for increased crop productivity in an efficient and environmentally prudent manner that will not sacrifice productivity of future generations.

Review of research work

Firoz (2009) studied the effect of nitrogen (60, 80, 100 and 120 kg ha-1) and phosphorus (80, 100 and 120 kg ha-1) on the growth and yield of okra. The highest yield (16.73 t ha-1) was obtained from 100 kg N ha-1. In case of phosphorus, the highest yield of (15.77 t ha-1) was obtained from P2O5 120 kg ha-1.

Dantata (2011) studied appraisal of the impact of nutrient sources as NPK compound fertilizer on okra fruit yield. The fruit yield was significantly increased (10.5 t ha-1 and 8.2 t ha-1) by 80 and 40 kg ha-1 N and P, respectively**.**

Rahman and Akter (2012) examined the five different doses of NPK fertilizer for the growth, yield and yield attributes of okra. The no of nodes on main stem (29.00), number of branches(11.00) and leaves (18.00) were maximum in treatment of 2 kg cow dung , 65 g urea , 150 g TSP and 105 g MP , applied during land preparation and 65 g urea after 25 days of sowing.

Choudhary *et al.* (2015) conducted an experiment to know the effect of chemical fertilizers and biofertilizers on growth and yield of okra. Among the different treatments, maximum plant height (96.03 cm), pod weight (11.53 g), girth of pod (4.88 cm), yield plant-1 (139.39 g) and fruit yield kgha-1 (10324.94) were observed due to application of *Azospirillum* 5 kg ha-1 + RD NPK.

Sharma *et al.* (2015) studied the effect of organic and inorganic fertilizers on the growth and yield of okra. Application of 60: 30: 30 NPK kg ha-1 significantly increased plant height (55.29 cm), stem diameter (5.71 cm), branches plant-1 (5.77), average fruit weight (15.55 g), marketable yield per plant (1.73 kg) and seed yield (12.78 q ha-1).

Thirunavukkarasu and Balaji (2015) conducted an experiment to study the effect of INM on plant height at various growth stages and number of branches of okra. The results revealed that treatment received pressmud @ 5 t ha-1 along with 50 per cent recommended dose of fertilizers registered highest available calcium and magnesium content of 0.14 and 0.28% , respectively. In addition to that, this treatment also improved growth parameters such as plant height (116.30 cm) at the harvest stage of plant and number of branches plant-1 (4.5) at all the growth stages of crop and also quality attributes.

Molik *et al.* (2016) carried out an experiment to evaluate the effect of organic and inorganic fertilizers on the yield components of okra. Application of cow dung, poultry litter, urea and NPK fertilizer had significant effects on fruit yield of okra. The application of cow dung resulted in significant increase in the yield components.

Kumar *et al.* (2017) conducted an experiment on organic manures and inorganic fertilizers applied in different combinations along with bio fertilizers in okra. Among the treatments, least numbers of days taken to first flowering (46.20) and fruiting (47.33) and maximum plant height (118.52 cm) , number of fruits per plant (16.00) and fruit yield (12.70 t ha-1) were recorded in RDF (50:50:50 kg NPK ha-1 + FYM @ 10 t ha-1.

Patel *et al.* (2018) found that significantly maximum stem thickness at 45 DAS (11.04 mm) and at 90 DAS (19.09 mm), highest plant height at 45 DAS (32.61 cm) and at 90 DAS (116.50 cm), maximum number of leaves per plant at 45 DAS (8.89), pod yield plant-1 (217.54 g), pod yield per plot (6.97 kg) and pod yield ha-1 (120.86 q) were recorded with 50 % RDF + 50 % poultry manure + PSB.

Yadav *et al.* (2019) conducted an experiment and found that 50% RDF + 50% poultry manure + *Azotobacter* was superior over other treatments in terms of growth, yield and quality of okra.

Ruchika *et al.* (2019) studied the effect of various organic manures on growth and yield of okra [*Abelmoschus esculentus* (L.) Moench]. Results revealed that maximum plant height(80.2 cm), number of leaves (38.3), stem diameter (25.5 cm), number of branches (4.6) plant-1 and minimum days to first flowering (37.3) and 50% flowering (41.3) were found with the application of the 2.5 tone vermicompost + 2.5 tone poultry manure ha-1 .

Singh and Tiwari (2020) recorded that highest fruit yield (17.58 t ha-1) with due application of 50% RDF inorganic + 50% N through vermicompost in okra.

Conclusion

The application of poultry litter, cow dung, NPK fertilizer and urea fertilizer had a significant effect on the yield and yield components of okra. Nutrient management should ensure both enhanced and sustainable production and safeguard the environment The findings revealed that the application of pressmud @ 5 t ha-1 along with 50% recommended dose of fertilizers was effective and significantly improved the growth attributes of okra crop. Developing a suitable nutrient management system that integrates use of these three kinds of nutrient source (Inorganic, Organic and bio fertilizers) may be a challenge to reach the goal of sustainable agriculture.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Chaudhari Vishalkumar M.	Course : VSC- 591 (1+0)
Reg. No. : 2020219009	Date : 19/12/2020
Major Guide : Dr. N. K. Patel	Time : 3:30 to 4:30 pm
Minor Guide : Dr. B. M. Tandel	Mode of presentation : Online

"Application of Biostimulants in Solanaceous Vegetable Crops"

Solanaceous vegetable crops play a significant role in human nutrition and to cope with malnutrition, especially as sources of Vitamin C, A, E, thiamine, niacin and pyridoxine. Besides the nutrients, they also provide variety to diet and make the food attractive by their colour, texture and flavor. Some phytochemical compounds are found in solanaceous vegetables like lycopene in tomato, capsaicin and capsanthin in chilli, solanine in brinjal and solasodine in potato. Hence, these are known as part of Protective Foods.

A plant biostimulant is a substance or microorganism applied to plants with the aim to enhance nutrition efficiency, abiotic stress tolerance and/or crop quality traits, regardless of its nutrient content. Plant biostimulants are also designated as commercial products containing mixture of such substances and/or microorganisms. Biostimulants are available in various formulations and varying ingredients but are generally classified into three major groups: (1) Humic substance (HS), (2) Hormone containing products (HCP) and (3) Amino acid containing products (AACP).

REVIEW OF LITERATURE:

Tomato

Nileema and Sreenivasa (2011) studied the effect of liquid organic manures on growth and yield parameters of tomato. They observed that application of RDF + Beejamruth (3 %) + Jeevamruth (3 %) + Panchagavya (3 %) gave maximum values for plant height (143.21 cm), root length (19.80 cm), dry matter (7.94 g plant-1), number of fruits (23.25 plant-1) and fruit weight (316.64 g plant-1). Zodape et al. (2011) conducted an experiment on tomato to find out the effect of different levels of seaweed extracts on quality of tomato fruits. They reported that application of 5.0% K. alvarezii sap enhanced ascorbic acid (52.26 %), acidity (0.92 %) and TSS (5.32 %). Colla et al. (2017) studied the effect of biostimulant on total soluble solids of tomato fruits. They observed that Legume-derived protein hydrolysate gave maximum value of TSS (4.570 Brix). Suman et al. (2017) studied the effect of fertigation and humic acid on growth and yield of tomato. They observed that 100 % RDF along with humic acid (12 %) gave maximum values for all the growth and yield parameters i.e plant height (130.4 cm), leaf area index (3.40), number of fruits (32.9 plant-1), fruit weight (74.5 g) and total yield (90.7 t ha-1). Chanthini et al. (2019) studied the seedling vigour index and biomass of tomato seeds treated with LSEs. They recorded that Ef 100 % gave maximum values for seedling vigour index (1281.31 ± 2.65), wet weight (0.308 ± 0.002) and dry weight (0.0528 ±0.002). Silvana et al. (2019) studied the effect of MP-CS and bulk CS on seed germination percent in tomato. They revealed maximum germination percentage (87 ± 2.2 %) on seed treatment with MP-CS (0.01 mg ml-1). Parmar et al. (2020) studied the effect of organic spray on plant height of tomato cv. GT 2 under south Gujarat conditions. They observed that the application of panchagavya 3% at 25 DATP improved plant heightat time of 50 DATP (82.16 cm), 75 DATP (94.13 cm), 105 DATP (104.94 cm) and final harvest (111.31 cm), number of branches at time of 75 DATP (6.07 plant-1) and final harvest (9.00 plant-1), minimum days for first flowering (26) and 50% flowering (29.67).

Brinjal

Gawad and Osman (2014) studied the effect of foliar application of seaweed extract on growth of eggplant. In 1st season they noted that application of 2000 ppm seaweed extract gave maximum values for plant height (81.43 cm) and number of leaf (89.8 plant-1) and maximum leaf area (121.94 cm2) was obtained with 1000 ppm seaweed extract. While in 2nd season they noted maximum plant height (74.91 cm) and number of leaf (81.8 plant-1) with treatment of 1000 ppm seaweed extract and maximum leaf area (118.10 cm2) obtained with 2000 ppm seaweed extract. Sam Ruban et al. (2019) studied the effect of foliar application of biostimulants on growth and yield of brinjal. They revealed that all growth and yield parameters i.e plant height (90.33 cm), primary branches (10.27), secondary branches (27.75), number of leaf (79.64 plant-1), stem girth (4.85 cm), number of fruits (55.75 plant-1), fruit weight (58.75 g), yield (3.27 g plant-1), yield (39.24 kg plot-1) and yield (65.40 t ha-1) were found maximum by applying 10 % humic acid.

Chilli

Janaki et al. (2019) studied the effect of combined application of organic and inorganic fertilizer on growth, yield and quality of Chilli cv. PKM-1. They recorded the minimum days for 50 % flowering (31 days), maximum plant height at time of 30 DATP (50.2 cm), 60 DATP (70.2 cm) and 90 DATP (79.5 cm), yield (30.5 t ha-1) and capsaicin content (0.69 %) when treated with 75 % RDF + biofertilizers humic acid liquid as soil application.

Singh et al. (2019) studied the effect of humic acid and micronutrient on growth and yield of chilli under polyhouse condition. They noted that treatment consisting of RDF + HA 10 kg ha-1 + HA 0.1 % + MN mixture gave maximum values of growth and yield parameters i.e plant height (103.91 cm), number of branches (9.33 plant-1), number of fruits (25.35 plant-1), yield (4.71 kg plant-1) and yield per 1000 m2 (188.37 q t).

Potato

Prajapati et al. (2015) studied the effect of different levels of seaweed extracts on growth and yield attributes of potato. They found that growth and yield parameters like plant height (65.48 cm), number of stem (5.05 hill-1), number of tubers (7.57 hill-1) and total tuber yield (37.00 t ha-1) were found maximum by applying 10 % G sap + RDF.

Selladurai and Tapan (2016) studied the effect of humic acid based multinutrient fertilizer on yield and shoot dry matter of potato. They observed that application of GF 45 H + 100 % RDF gave maximum values for yield (31.8 t ha-1) and shoot dry matter (1.80 t ha-1).

Conclusions:

From the foregoing discussion, it can be concluded that in tomato, application of 100%

Ulva flexuosa (Ef) i.e. liquid sea weed extract increased seed vigour index, seed weight and germination percentage. In tomato, seeds treated with micro particle chitosan (0.001 mg ml-1) responsible for increasing the germination percentage. Application of 100 % RDF + HA increased the growth and yield parameters of tomato. Panchagavya (3%) at 25 DATP exhibited maximum growth character of tomato. Highest fruit production and size along with root length and dry matter was obtained by applying RDF + Beejamruth (3 %) + Jeevamruth (3 %) + Panchagavya (3 %) in tomato. Increase in ascorbic acid, acidity and TSS of tomato fruit was resulted by foliar application of 5% seaweed extract. In tomato, when legume derived protein hydrolysate was applied,highest values for TSS and lycopene was noticed. In brinjal, foliar application of 1000 and 2000 ppm Seaweed extract increased vegetative growth characters in both the season. Growth and yield parameters showed significant increase with application of humic acid 10 % in brinjal. Application of 75 % RDF + biofertilizers showed significant effect on plant height, 50 % of flowering, yield and capsaicin content of Chilli cv. PKM 1 at 30, 60 and 90 days of transplanting. In chilli, foliar application of RDF + HA 10 kg per ha + HA 0.1% + MN mixture was found superior to enhance plant growth and yield characters. In potato, 10 % G sap + RDF showed significant increase in growth and yield of tuber. Application of GF 45 H + NPK 100 % RDF increases the tuber yield and shoot dry matter in potato.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2020-2021

Speaker : Mandaliya Jaydeep Vinubhai	**Course :** VSC 591 (1+0)
Reg. No. : 2020219018	**Date : 02-01-2021**
Major Guide : Dr. K. D. Desai	**Time :** 1:30 to 2:30 p.m.
Minor Guide : Dr. C. R. Patel	**Mode of presentation : Online**

Crop modelling in vegetable crops

Total available land throughout the world cannot be used for food production because of the limitations imposed by nature or human. This is a major hindrance in fulfilling the increasing demand of balance food to suffice the need of increasing population. Vegetables plays an important role for this balance food as they provide the essential vitamins, minerals and fibre, required for maintaining health too. Thus, we must think of alternatives to increase food production, including vegetables. For this, innovative research is needed and the outcome must be conveyed to farmers, policy makers and other decision makers, to accomplish sustainable agriculture over the wide variations in soil and climate around the world.

In this direction the use of crop models in research excavated enthusiastic results and should be encouraged. Modeling techniques applied to agriculture can be useful to define research priorities and understanding the basic interactions of the soil-plant-atmosphere system. As a research tool, model development and application can contribute to identify gaps in our knowledge, thus enabling more efficient and targeted research planning. Using a model to estimate the importance and the effect of certain parameters, a researcher can notice which factors can be most useful. An intensely calibrated and evaluated model can be used effectively to conduct research that would in the end save time and money as well as significantly contribute to develop sustainable agriculture that meets the world's needs for food (Manikandan and Vethamoni, 2017).

Review of Research Work:

Medany and Hassanein (2006) concluded that DSSAT model can be used successfully to project potato tuber yield in Egypt. Using the future climate data, a yield reduction from 1.41% to 3.98% was projected for the second cultivation and that of increased from 17.0% to 45.5% for the first cultivation.

Abdrabbo *et al.* (2010) used SUBSTOR potato model to predict sensitivity of potato tuber yield against climate change for 2005/2006 and found decreased mean estimated potato tuber yield (2.3%) in Valor cultivar which was slightly less than Dezareah cultivar (2.4%). They also estimated that there may be 8.3 to 12.1% decreased potato tuber yield in the year 2050 as compared to 2005/2006, by using climate change output models (HadCM3 and CSIRO). Irrigation level 100% gave the highest tuber yield of both cultivars with two climate change GCM models.

VegSyst model was tested and found very good by Gallardo *et al.* (2011) in muskmelon grown in greenhouse in SE Spain. They found error in simulated final values, expressed as percentage of measured final values which was -1 to 6% for final dry matter production, 2 to 11% for final nitrogen uptake and -11 to 6% for total evapotranspiration.

Intkam model adequately simulated flushes of fruit set and harvest on the basis of the supply and demand of assimilates in sweet pepper and egg plant, was the findings of Elings and Visser (2011).

Oliveira *et al.* (2012) concluded that the CROPGRO-Dry bean model accurately simulated yield of the bean cultivars 'Pérola', 'Ouro Negro' and 'Ouro Vermelho' for the soil conditions and climate of Viçosa, Minas Gerais State, Brazil.

Gimenez *et al.* (2013) worked on VegSyst simulation model on daily dry matter production, total nitrogen uptake and evapotranspiration by sweet pepper crop. Results of the research indicated that VegSyst model accurately simulated dry matter production, nitrogen uptake and evapotranspiration in both conventional and improved management systems.

Mithra *et al.* (2013) developed SIMCAS model by including important stress factors like water, nitrogen and potassium and found in good agreement of the data on tuber yield of cassava between observed and predicted value. They concluded that this model helps to develop strategies for maximizing yield by managing irrigation and N and K fertilizations.

Soto *et al.* (2014) experimented on tomato in Mediterranean region for simulation of growth, water and N dynamics using the EU-Rotate_N model in greenhouses with drip irrigation and fertigation. They recognized that simulations of seasonal dry matter production and nitrogen uptake were very accurate with linear relationships between simulated and measured values.

Aly *et al.* (2015) performed an investigation on water management in greenhouse cucumber using SALTMED model in Saudi Arabia. They found all yield data in very good agreement between simulated and observed values. The best treatment relative to final yield was 100% ETc level follow by 80% ETc level.

Anis (2015) forecasted productions of major vegetable crops by using different models and concluded that the Holt model is the best model to predict the productivity of potato, artichoke and pepper. Likewise, the ARIMA model is the best for tomato and the Winters model is the best for onion. The correlation coefficient values obtained was between 0.887 to 0.942 indicates positive and very good agreement between actual and forecasted yield.

Lino *et al.* (2017) demonstrated that the efficiency of crop growth simulation by the Dynamic model was very precise and can be used to predict the accumulation of biomass in the cucumber crop using the climatic variables (PAR, temperature, and concentration of CO2).

EU-Rotate_N model was evaluated for marketable fresh fruit yield of melon and pepper by Soto *et al.* (2018). They found a tendency to slightly overestimation by an average of about 9.82 per cent in melon. In 2006 sweet pepper treatments, the simulation of marketable fresh fruit yield was very accurate with an error of about 5% compared to measured values. In the 2005 sweet pepper treatments, the model overestimated marketable fresh fruit yield by about 50% compared to measured value.

Conclusions

From the forgoing discussion it can be concluded that DSSAT and SUBSTOR potato model can be used to predict potato tuber yield precisely in Egyptian environmental conditions. In case of long duration estimation when climate may change profoundly HadCM3 and CSIRO models can be used successfully for accurate prediction of potato tuber yield. For the region of SE Spain, VegSyst model was found in very good agreement for estimation of dry matter production, total nitrogen uptake and evapotranspiration of muskmelon and sweet pepper grown in green house. Flushes of sweet pepper and egg plant can adequately be simulated for fruit set and harvest by Intkam model. For Brazilian conditions, CROPGRO-Dry bean model found accurate to simulate the phenological development and yield of different bean cultivars. SIMCAS model can be used to develop strategies for maximum tuber yield of cassava in stress conditions. Linear relationship was found between simulated and measured values of growth, water and N dynamics by using EU-Rotate_N model in tomato. SALTMED model was found best to increase yield of greenhouse cucumber by managing water supply in Saudi Arabia. In Tunisian conditions, Holt, ARIMA and Winters models were found best to predict the productivity of different vegetables. Dynamic model very precisely predicts the accumulation of biomass in cucumber by using the climatic variables. EU-Rotate_N model slightly overestimated the average marketable fresh fruit yield of melon while for sweet pepper the average estimated data were not in agreement with observed data.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
Post Graduate Seminar Series: 2020-2021

Speaker : Patel Mansi Vijaybhai	**Course : VSC 591 (1 + 0)**
Reg. No. : 2020219029	**Date : 02/01/2021**
Major Guide : Dr. N. K. Patel	**Time : 2:30 to 3:30 pm**
Minor Guide : Dr. B. M. Tandel	**Venue : Online**

Effect of fertigation on growth, yield and quality of cole vegetable crops

India is poised to play a major role in increasing the utility of land water and other natural resources to compete with the increasing rate of population. Today, farmers face with the challenge of meeting an ever increasing demand for a wide range of high quality and safe food. Intensification of agriculture by irrigation and enhanced used of fertilizers may generate pollution by increased levels of nutrients in underground and surface water. The cole crops require careful nutrient management to obtain good quality and maximum yield. They are sensitive to several micronutrient deficiencies and require nitrogen throughout the growing season. Cole crops require moderate to high amounts of nitrogen, phosphorus and potassium. Therefore, judicious management of nutrients through different fertilizers need to be catered. The fertilizers are becoming costly input day by day. Hence, it is felt necessary to study the efficient use of this input. A higher efficiency is possible with the help of pressurized irrigation system is placed around the plant roots uniformly and allow for rapid uptake of nutrient by plant. Fertigation is the technique of supplying dissolved fertilizer to crop through an irrigation system. Application of small amount of soluble nutrients saves labour, reduces compaction in the field and thereby enhancing productivity. Cole crops being a high yielding and highly nutrient responsive requires large dose of nutrients. Fertigation is a better way for maximizing its production through efficient use of irrigation water and applied nutrients. (Kumar and Sahu, 2013).

Brief review of research work

Cabbage

Kumar and Sahu (2013) studied the effect of irrigation and fertigation levels on cabbage. They found that drip irrigation @ 100 % PE observed significant increase in plant height (19.39 cm), number of leaves (13.08), diameter of head (13.11 cm), gross weight (1.66 kg head-1), net weight (1.20 kg head-1) and net yield (30.60 t ha-1) whereas nitrogen application at 150 % observed significant increase in plant height (19.55 cm), number of leaves (12.93), diameter of head (13.63 cm), gross weight (1.63 kg head-1), net weight (1.25 kg head-1) and net yield (29.71 t ha-1).
Vasu and Reddy (2013) studied the effect of fertigation on yield, quality, nutrient uptake, fertilizer and water use efficiency in cabbage. They noted that fertigation with 125 % recommended dose of N and K at daily interval resulted maximum dry matter matter production (4793 kg ha-1). Maximum yield of head (16. 92 t ha-1) was recorded with application of 100 % recommended dose of N and K through fertigation at daily interval whereas, maximum head diameter (14.40 cm), ascorbic acid content (118.37 mg 100 g-1) and TSS content (4.16 %) were observed in 125 % RDF (N and K at daily interval). Maximum head weight (923 g) and heading percentage (96.75 %) were observed under 100 % RDF.
Nikzad *et al.* (2020) revealed that application of 100 % RDF (150:100:125 NPK kg ha-1) in 12 equal splits at 5 days interval recorded significantly the maximum value of plant height (20.53 cm, 30.53 cm and 35.46 cm) at 45 DAT, 60 DAT and at harvest respectively and lesser days required for first head initiation (40.60) and 50% head initiation (42.70).

Cauliflower

Renu Kapoor *et al.* (2014) studied the effect of drip irrigation and fertigation on yield, net returns and B:C ratio of cauliflower and observed that 100 % recommended dose of water soluble fertilizer with fertigation 1.2 CPE gave the highest yield (13.2 Mg ha-1). Whereas, the net returns (90,685) and B:C (4.40) ratio were recorded highest in control.

Gadhavi *et al.* (2017) reported that application of 100 % RDF comprised with the source [Urea Phosphate (UP) + Urea + MoP] recorded maximum plant height (49.5 cm), number of leaves at harvest (27.1), average curd weight (439 g plant-1) and curd yield (21.754 t ha-1).

Singh *et al.* (2017) stated that significantlly maximum yield (280 q ha-1) was obtained by application of drip irrigation @ 80 % PE with 75 % RDF fertigation + 2 foliar sprays of 1% urea phosphate treatment combination.

Savita *et al.* (2017) stated that maximum curd yield (282.53 q ha-1) was obtained with the application of drip 100 % OPE and fertigation 125 % RD of N & K with mulch.

Anjali Verma *et al.* (2020) revealed that application of 100 % recommended dose of RDF through drip produced maximum curd weight (873.8 g plant-1) and yield (291.0 q ha-1).

Chinese Cabbage

Prasad *et al.* (2009) studied the response of nitrogen and phosphorus levels on the growth and yield of chinese cabbage (*Brassica campestris* L. var. pekinensis) in the gangetic plains of West Bengal and stated that combined application of 100 kg nitrogen and 100 kg phosphorus ha-1 recorded maximum head diameter (48.98 kg) and head yield (294.40 q ha-1) whereas, combined application of 120 kg nitrogen and 100 kg phosphorus ha-1 recorded maximum plant height (32.57 cm), leaf area (972.43 cm) and total head weight (1.63 kg).

Broccoli

Poonam Chand *et al*. (2017) conducted an experiment to study the effect of fertigation and bio-fertilizers on growth and yield attributes of sprouting broccoli (*Brassica Oleracea* var. italica) Cultivar Fiesta and conclude that biofertilizer with *Azotobacter* + PSB in combination significantily increased head volume (77.83 cc), head diameter (10.42 cm), average weight of main head plant-1 (1.306 kg), average weight of secondary head plant-1 (0.187 kg), total head yield bed-1 (8.50 kg), total head yield (242.91 q ha-1) and biological yield plant-1 (3.14 kg).

Knolkhol

Gupta and Chattoo (2014) studied the response of knolkhol cv. Early White Vienna to drip irrigation and fertigation in Kashmir region and revealed that combination of 80 % ET through drip + 80 % recommended NPK through fertigation was superior over rest of the treatment in terms of growth and yield of contributing character of knolkhol.

Conclusion

From the foregoing discussion, it can be concluded that fertigation is the most effective technique resulting in higher yield with better nutrient and water use efficiency in cole crops. In Cabbage, application of 125 % and 100 % RDF N & K recorded maximum dry matter production and yield, quality and growth parameters respectively. In Cauliflower, application of drip irrigation of 80 % PE with 75 % RDF + 2 foliar sprays of 1 % urea phosphate treatment combindly and 100 % OPE and 125 % RD of N & K with mulch gave maximum yield. In Broccoli, application of biofertilizer in combination with *Azotobacter* + PSB significantly increased yield. In Knolkhol, combined application of 80 % ET + 80 % RD of NPK increased the growth and yield. Combined application of 100 kg nitrogen and 100 kg phosphorus ha-1. Recorded maximum growth and yield of Chinese cabbage.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2020-2021

Speaker : Thummar Paragkumar R.	Course : VSC 591 (1+0)
Reg. No. : 2020219046	Date : 16/01/2021
Major Guide : Dr. S. S. Masaye	Time : 2:30 to 3:30 p.m.
Minor Guide : Dr. S. S. Gaikwad	Mode : Online

"Organic farming in vegetable crops"

Organic farming is gaining gradual momentum across the world. The word 'organic', means living, earth friendly or plant or animal origin. Growing awareness of health and environmental issues in agriculture has demanded for production of organic food which is emerging as an attractive source of rural income generation. While trends of raising the consumer demand for organics are becoming noticeable, sustainability in production of crops has become the prime concern in development of horticulture with the awareness to buy organic food including vegetables. India can have pride of attaining second position in the vegetable production but India's contribution for export in global market is very low due to poor quality of produce. Therefore, for quality production we must go for organic farming. Organic farming produces better quality food which is good for not only human diet but also for soil health. It is also useful for sustainable agriculture. Organic produces increase export potential.

Review of Research Work:
Brinjal
Mohan (2005) performed an investigation on effect of different organic plant growth promoter treatments on growth and yield of brinjal. He observed that Bokashi @ 1250 kg ha-1 gave maximum plant height (70.9 cm) and number of branches plant-1 (6) while Bokashi @ 750 kg ha-1 gave maximum number of fruits plant-1 (52.7) and yield (30 t ha-1).
Sam Ruban et al. (2019) experimented on effect of foliar application of biostimulants on growth and yield of brinjal. They found maximum plant height (90.33 cm), primary branches (10.27), secondary branches (27.75), number of leaf (79.64), stem girth (4.85 cm), number of fruits plant-1 (55.75), fruit weight (58.75 g) and yield (3.27 g plant-1, 39.24 kg plot-1 and 65.40 t ha-1) in application of 10 % humic acid.
Tomato
Parmar et al. (2020) carried out research on effect of organic spray on plant growth of tomato cv. GT 2 under south Gujarat condition. They reported that application of panchagavya 3 % at 25 DATP gave the highest plant height at 50 DATP (82.16 cm), 75 DATP (94.13 cm), 105 DATP (104.94 cm) and final harvest (111.31 cm), number of branches at 75 DATP (6.07 plant-1) and final harvest (9.00 plant-1), minimum days for first flowering (26) and 50 % flowering (29.67).
Chilli
Sujana et al. (2018) studied yield parameters of chilli influenced by manures and organic solutions. They observed maximum fruit length (10.53 cm), number of fruits per plant (54.83), weight of hundred dry chilli fruits (131.43 g) and dry chilli yield (6.95 t ha-1) in application of jeevamrut.
Potato
Ahmed et al. (2015) carried out research on effect of organic fertilizers on growth and yield of potato. They concluded that application of chicken manure gave maximum plant height (65.8 cm), tubers (6.70 plant-1), tuber weight (354.2 g plant-1) and tuber yield (29.71 t ha-1).
Garden Pea
Gopinath and Mina (2006) studied the effect of organic manures on growth and yield of garden pea. They observed maximum plant height (75.1 cm), pods (8.1 plant-1), pod length (7.7 cm),

grains (5 pod-1) and yield (7.52 t ha-1) in the treatment of FYM 10 t ha-1 + poultry manure and vermicompost each 1.5 t ha-1 + bio-fertilizer.

Onion

Dhaker et al. (2016) performed investigation on effect of different organic and inorganic sources and their combinations on yield and quality parameters of onion. They found 100% RDF through vermicompost + PSB + Azotobactor gave maximum diameter of bulb (8.77 cm), average weight of bulb (129.08 g), bulb yield (219.44 q ha- 1) and total soluble solids (12.04 oBrix).

Garlic

Chattoo et al., (2007) conducted an experiment on response of bio-fertilizer application on garlic crop. They found maximum average bulb weight (29.08 g), average bulb diameter (4.80 cm) and yield (193.99 q ha-1) in application of Azotobacter + Phosphobacteria.

Cucumber

Bidein et al. (2013) studied number and mean weight of undamaged and damage fruits harvested from cucumber Griffaton variety grown with poultry manure. They observed maximum number of undamaged fruit
(108.63), mean weight of undamaged fruit (325.89 g), number of damaged fruit (39.26) and mean weight of damaged fruit (117.78 g) in application of 33.3t ha-1 poultry manure.

Okra

Kumar et al. (2012) carried out research on effect of homa organic farming on disease and pest incidence and yield in okra. They concluded that organics equivalent to RDF and seed treatment with bio-fertilizers at homa site + soil application of Gloria Biosol and its foliar application gave minimum powdery mildew infection (12.51
%), alternaria leaf spot infection (8.60 %), E.vitella infection (8.30 %), spodoptera (3.16 larvaes plant-1) and maximum yield (15.03 t ha-1).

Cabbage

Palande and Pokharkar (2015) performed investigation on management of DBM with T. bactrae and B. thuringiensis in cabbage. They observed maximum reduction of larvaes population (84.16 %) and yield (380.2 q ha- 1) in application of T.bactarae @ 50,000 adults release ha-1, 5 release at weekly interval + B.thuringiensis @ 1 lit. ha-1, 2 sprays at 10 days interval starting from 5 days after first release of the parasitoid.

Conclusions:

From the forgoing discussion, it can be concluded that, application of Bokashi (1250 kg ha-1) promotes plant height, number of branches plant-1 while Bokashi (750 kg ha-1) number of fruit plant-1 and yield of brinjal. The foliar application of 10 % humic acid significantly increase growth and yield parameters in brinjal. Panchagavya at the rate 3 % exhibits maximum growth character i.e plant height, no. of branches and flowering of tomato. In chilli application of jeevamrut promotes fruit length, number of fruits plant-1 as well as dry chilli yield. Chicken manure help to increase plant height, tubers per plant and tuber yield in potato. Growth and yield of garden pea can increase by use of mixture of FYM 10 t ha-1, poultry manure 1.5 t ha-1, vermicompost 1.5 t ha-1 and bio-fertilizer. Use of vermicompost, PSB and Azotobactor increase bulb size and bulb weight in onion. Mixture of Azotobacter and
Phosphobacteria promotes bulb size and weight in garlic. Application of 33.3 t ha-1 poultry manure increase number of undamaged fruit and their weight in cucumber. Soil application of Gloria Bisol and its foliar application with organics as well as seed treatment of bio fertilizer reduce the pest and disease incidence in okra. In cabbage DBM controlled by use of T.bactarae @ 50,000 adults release ha-1 with B.thuringiensis @ 1 lit. ha-1.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2020-2021

Speaker	**:**	**Madineni Tejaswini**	**Course No.**	**'SC 591 (1+0)**
Reg. No.	**:**	**2020219017**	**Date:**	**6/01/2021**
Major Guide	**:**	**Dr. Sanjeev Kumar**	**Time**	**3.30 to 14.30 hrs.**
Minor Guide	**:**	**Dr. J. M. Mayani**	**Venue:**	**)nline**

"Nutri Veggie Garden for diet diversification and increased nutritional security"

The doctrine *'Let food be thy medicine'* espoused by Hippocrates nearly 2500 years ago is receiving great interest of late by the researchers as well as common man. Despite the existing global issues like poverty, malnutrition, mental illness, climate change, economic crisis *etc.*, the unprecedented COVID-19 pandemic has distrupted public health, food systems and the world of work in recent times. The focus is now on the achievement of a balanced diet, maximization of both life expectancy and quality by identifying food ingredients that are capable of boosting immune system. Nutrition has been a developmental priority for decades, and achieving nutritional security remains a major challenge for developing countries like India. The health, productivity and well being of 2 billion people worldwide is compromised every year because of deficiency of essential micronutrients such as Vit-A, Fe and Zn (Beal *et al.,* 2017). Food based stratergies are often described as a sustainable approach because this approach empowers individuals and households to take ultimate control over the quality of diet through their own production and consumption of nutrient-rich foods. These stratergies are said to be the ideal one for achieving long-term goals like provision of assurance of access to a nutritionally adequate diet, wise consumer selection, proper preparation and adequate feeding (Anon., 2020). Vegetables are considered the most affordable and sustainable dietary sources of vitamins, trace elements, other bio-active compounds *etc*. Cultivation of nutrient rich vegetable crops by gardening in a systematic manner on small pieces of land available in households is known as "Nutri Veggie Garden (NVG)". NVG is proposed as a mean to augment sustainable food production through diet diversification leading to nutritional security and it is possible to achieve 9 out of 17 Sustainable Development Goals (SDGs) through this approach (Shubha *et al*., 2020). The UN has declared 2021 as the International Year of Fruits and Vegetables to raise awareness on consuming more fruits and vegeatbles as a part of diversified, balanced and healthy diet, NVG wherein can play an important role to attain nutritional goals.

Review of Research Work

SDG 1: NO POVERTY (NVG as constant source of income)

Talukder *et al*. (2000) studied the changes in gardening practices after 1 year of NVG intervention and found high level of vegetable production as well as consumption among people practicing nutritionally developed gardens. They concluded that
56.3% of the income earned through NVG was spent on staple food and rest of it was appropriately allocated on other household activities for overall socio-economic development.

Arya *et al.* (2018) studied the changes occurred as a result of mediation of NVG programme and observed 4.12 times increase in vegetable production, 1.75 times in consumption, which helped to curtail the household expenditure by 40% and on an average earned net remuneration worth ₹ 9870 per 100 m^2.

SDG 2: ZERO HUNGER (NVG as constant and cheapest source of nutritive food)

Kumari *et al.* (2018) studied the impact of NVG in rural areas by On Farm Training (OFT) pragramme and found that NVG of 150 m^2 area was able to fulfill the 100% requirement of vegetables for a small family (5 members), 78.79% for medium family (7 members) and 61.29% for a big family (9 members) with 285-300 g intake of vegetables almost fulfilling RDA.

Singh *et al.* (2019) investigated the role of NVG in vegetable production by implementing NVG programme for 3 consecutive years in an area of 150 m^2 and found that the availability of vegetables was 1.72 times higher than the requirement for small family. While it fulfilled 100% requirement of vegetables for a medium family as per RDA and 82.9% for large family. **SDG 3: GOOD HEALTH AND WELL BEING (NVG as a component of good health and a source of balanced diet)**

Faber *et al.* (2002) conducted a study on the production of provitamin A rich vegetables through NVG programme in anticipation of increasing intake of serum retinol among 2-5 years old children and observed significant increase in the intake of these vegetables during their follow up. Finally, they emphasized that success of any NVG programme targeting good health and well being, could only be achieved by following proper pathway of educating people, which was also reflected through the increase of serum retinol concentration from 0.73 to 0.81 $\mu molL^{-1}$among children under study.

Singh *et al.* (2020) observed 78.36% increase for per capita availability of vegetables as well as percent RDA after intervening through NVG. They further noticed a noteworthy gain in per capita availability of nutrients like protein, iron, calcium, beta-carotene, vitamin C and folic acid.

SDG 4: QUALITY EDUCATION (NVG as a source of nutrition and supplement family income)

Narayan *et al.* (2020) conducted a knowledge indexing of the trainees during pre and post training evaluation period of NVG and observed significant improvement in proper planning and execution of NVG which lead to acceleration in production per unit area. It was further concluded that such an intervention through NVG programme could result in significant jump from 59.33 to 93.33% for RDA (%) possibly because of marked increase in production level from 410 to 765 kg per unit area.

SDG 5: GENDER EQUALITY (NVG as a source of income generation for women)

Bushamuka *et al.* (2005) intervened different households through NVG programme of NGNESP organization and observed 75% hike in income of active household group. The study also revealed that 86% of women contributed towards household activities with an improvement in decision making level from 3.8 to 26.9% on household land use and 28.5 to 77.3% on choice of vegetable consumption.

Baliki *et al.* (2019) recorded the long term behavioural impact of NVG intervention programme and substantiated 16.3% increase in vegetable consumption and 73% improvement about the knowledge on food and nutrition. It was finally concluded that overall decision making of women for NVG as well as Women Empowerment Index (WEI) improved approximately by 30% as a result of this intervention.

SDG 8: DECENT WORK AND ECONOMIC GROWTH (NVG as an opportunity for entrepreneurship development)

Krishnan (2014) studied the impact of NVG on earning decent amount of income for women involving 13 different types of vegetables in backyard and concluded that NVG could be a profitable venture ensuring a profit of ₹ 2400 through sale, ₹ 2100 in terms of saving on buying from an area of 150 sq. ft. even after fulfilling their daily allowance for vegetables as well as sharing with neighbours free of cost.

SDG 11: SUSTAINABLE CITIES AND COMMUNITIES (NVG - climate and disaster resilience)

VanWoert *et al.* (2005) conducted a study to quantify differences in stormwater retention of a standard commercial roof with gravel ballest, an extensive green roof system without vegetation and a typical extensive green roof with vegetation and recorded highest percentage of rainfall water retention (~60%) in green roof. In their 2nd study, they tested the influence of roof slope and growing media depth and recommended rooftop platform of 2% slope with 4 cm media depth for higher mean water retention (70.7%).

SDG 12: SUSTAINABLE CONSUMPTION AND PRODUCTION (NVG - helping to complete nutrient cycle)

Jindal and Dhaliwal (2017) carried out a study in NVG designed on 36 m^2 area at Vegetable Research Farm (VRF) and Vegetable Training Farm (VTF) for 3 consecutive years in order to meet out daily allowance of vegetables for 4 members family and obtained 298 kg yield by cultivating 27 seasonal vegetables in 13 cropping sequences round the year. It was further concluded that this garden could serve as near to ideal NVG ensuring daily intake of 120 g leafy greens, 28 g root vegetables and 125 g others.

SDG 13: CLIMATE CHANGE (NVG strengthens climate related risks and natural calamities)

Boneta *et al.* (2019) conducted environmental assessment of soil-less urban terrace garden using climate change (CC), terrestrial acidification (TA), freshwater eutrophication (FE), marine eutrophication (ME), fossil depletion (FDP) and ecotoxicity (ET) indicators and concluded that most of the environmental impacts were generated during the operation phase of the system with maximum impact of 98.5% in ME for infrastructure as well as operation. While, the infrastructure focused mainly on the FDP (31.6%), CC (18.3%) and TA (14.1%) categories.

Conclusions:

Going through the above enumerations, it can be concluded that NVG can play an important role in addressing 9 out of 17 SDGs. NVG acted as a source of continuous supply of nutrient rich vegetables for family consumption and provided monetary returns for overall socio-economic development by curtailing household expenditure (40%) and providing liberty to spend 56.3% earning on staple food. A well executed NVG in an area of 150 m^2 is sufficiently enough to fulfil the 100% vegetable requirement of a small family, 78.79% of medium family (7 members) and 61.29% of a big family (9 members) with 285-300 g intake of vegetables almost fulfilling RDA. Role of NVG towards good health and well being of society was extracted by an increased intake of RDA (78.36%) and improvement in serum retinol concentration among children to a level of 0.81 $\mu molL^{-1}$. A proper NVG training led to marked increase in production of vegetables (765 kg), which in turn improved daily intake of vegetables. The overall decision making level of women improved from 28.5 to 77.3% on vegetable consumption while WEI augmented by 30% as a result of NVG intervention. NVG proved to be a profitable venture for entrepreneurship development which was revealed by an overall profit of ₹ 4500 from an area of 150 sq. ft. after fulfilling daily dietary allowance as well as sharing with neighbours. A NVG of 36 m^2 area could lead to sustainable consumption and production thereby ensuring daily supply of vegetables for 4 members family round the year and completing the requisite nutrient cycle of RDA. The highest percentage of water retention in green roof with roof platform at 2% slope and 4 cm media depth can be instrumental in stormwater management in urban and peri-urban areas. Urban terrace garden has a maximum impact of 98.5% in ME for infrastructure as well as operation.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Ganvit Jaydeepkumar Mohanbhai	**Course** : VSC 591 (1+0)
Reg. No. : 2020219010	**Date** : 16/01/2021
Major Guide : Dr. V. K. Parmar	**Time** : 4:30 to 5:30 p.m.
Minor Guide : Dr. T. R. Ahlawat	**Mode of presentation : Online**

Pro tray seedlings: A boon for Hi-tech vegetable cultivation

Availability of quality planting material is a career of new technology. Generally, vegetable seedlings are grown on outdoor ground beds using flats or raised beds in India. By this technology, the farmers attain only 60-70 per cent germination. When the seedlings are usually age old, infested by insect, pest and diseases having damaged root portion are planted in the main field resulting in low yield.

Seedlings or nursery plants are grown as a separate unit in modular Protrays/Plugtrays with separate cells/conical cavities containing growing media and transplanted with intact root soil. In recent years, it has been used extensively in producing quality vegetable seedling. There are different numbers of seedling tray cell like 32, 50, 72, 98, 102, 128 *etc*. and volume of each cell may vary from 3 to 300 c.c. Dark colored trays absorb more heat and tend to produce faster growth than light colored ones. It has positive aspects like improved germination, saving in cost of expensive seeds, long distance transport without any disturbances, transplanted to field or container in any season without any shock, possible to grow seedlings of cucurbit crops and reduces seedling mortality or damping off. (*Kumar et al.,* 2021)

Review of research work

Tomato (B.N.: *Solanum lycopersicum* L.; Family: Solanaceae)

Garton *et al.* (1994) studied the effect of tray size on transplant height, plant stand and yield of tomato seedling. He found that tomato seed sown in 288 cell tray had maximum transplant height (13 cm), final plant stand (97 %) and higher yield (60.5 t ha-1) in 1st June.

Singh *et al.* (2007) noticed that tomato seedlings raised in round cells with cell volume of 68.2 cm3 produced the highest fresh weight of shoot/seedling (12.8 g), fresh weight of root/ seedling (5.2 g), root length (3.8 cm), leaf area (25.6 cm2), stem diameter (3.1 mm), true number of leaves/seedling (3.0) and dry weight of seedling (156.0 mg) whereas, maximum shoot length (9.1 cm) was observed in inverted pyramid shaped cells (8.6 cm3). The minimum cost of media and fertigation for raising 100 seedling (10.6 Rs.) and total cost of raising 100 seedling (45.6 Rs.) was recorded in inverted pyramid shaped cells (18.4 cm3).

Bouzo and Favaro (2015) noticed that maximum dry weight of leaf, dry weight of stem, dry weight of root, number of leaves, leaf area and height of seedling was found in tomato seedlings grown in container V350 (black polyethylene pots 50 cm thick, 73 cm diameter, 8 cm height and 350 c.c. volume).

Ozer (2018) determined that maximum seedling height (19.77 cm) was found in commercial organic fertilizer application in small-celled seed tray (OST1) in traditional system which was higher than floating system.

Capsicum (B.N.: *Capsicum annuum* L.; Family: Solanaceae)

Ford and Russo (1984) studied the root and shoot lengths as well as dry weight for seedlings taken from the various planting trays in capsicum. They observed maximum beginning length of seedling root (19.7 cm) and shoot (10.6 cm) in white plastic tube, while beginning dry weight of root (0.52 g) and shoot (0.48 g) in plastic tray.

Watermelon (B.N.: *Citrullus lanatus* L.; Family: Cucurbitaceae)

Ban *et al.* (2007) carried out an experiment to study the effects of plug size on the development of watermelon transplants. They suggested that better quality transplants was achieved by growing watermelon seedlings in plug cells of 100 c.c. volume rather than in smaller cell sizes.

Cabbage (B.N.: *Brassica oleracea* var. *capitata* L.; Family: Brassicaceae)

Cuaresma and Valdez (2009) revealed that maximum seedling height, number of leaves, stem diameter, shoot fresh weight as well dry weight and total leaf area in cabbage was found when seedlings raised in 200 c.c. volume plug tray in all different media (100% garden soil, 100% rice straw compost, 100% biogas sludge, 50% garden soil: 50% rice straw, 50% garden soil: 50% biogas sludge and 50% rice straw compost: 50% biogas sludge).

Mitchell and Frisbie (2017) studied the effect of growing containers on emergence and growth of cabbage seedling. They found minimum average days to emergence (5.02) and average days to 1st leaf (13.62), maximum average stem diameter (1.29 mm) and average stem height (10.66 cm) in plastic container.

Cauliflower (B.N.: *Brassica oleracea* var. *botrytis* L.;Family: Brassicaceae)

Naik and Thakur (2017) assessed the comparison of automated seeder with other method of sowing of cauliflower in plug tray. They noticed minimum average time (0.20 min) were required for seed sowing in automated seeder as compared to manual sowing, vibrating seeder and needle seeder.

Conclusion

It is inferred from the foregoing discussion that tomato seed sown in 288 cell tray had maximum transplant height, final plant stand and higher yield in 1st June. Tomato seedlings raised in round cells with cell volume of 68.2 cm3 produced the higher fresh weight of shoot and root/seedling, root length, leaf area, stem diameter, true number of leaves/seedling and dry weight of seedling, whereas maximum shoot length observed in inverted pyramid shaped cells. The minimum cost of media with fertigation and total cost for raising 100 seedlings was obtained in inverted pyramid shaped cells (18.4 cm3). Maximum dry weight of leaf and stem, dry weight of root, number of leaves, leaf area and height of seedling was found in tomato seedlings grown in V350. Maximum seedling height was found in commercial organic fertilizer application in small-celled seed tray. Maximum beginning length of seedling root and shoot were noted in white plastic tube, while beginning dry weight of root and shoot was found in plastic tray in capsicum. Better quality transplants were achieved by growing watermelon seedlings in plug cells of 100 c.c. volume rather than in smaller cell sizes. Maximum seedling height, number of leaves, stem diameter, shoot fresh as well as dry weight and total leaf area in cabbage was found when seedlings raised in 200 c.c. volume plug tray in all different media. Minimum average days to emergence and average days to 1st leaf, maximum average stem diameter and stem height were found in plastic container. Minimum average time required for seed sowing of cauliflower was noted in automated seeder.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST-GRADUATE SEMINAR SERIES: 2020-21

Speaker	:	**Umme Fiza**	**Course No.**	:	**VSC 591 (1+0)**
Reg. No.	:	**2020219047**	**Date**	:	**30/01/2021**
Major Guide	:	**Dr. D. R. Bhanderi**	**Time**	:	**14.30 to 15.30 hrs.**
Minor Guide	:	**Dr. R. V. Tank**	**Mode**	:	**Online**

USE OF WILD RELATIVES IN CROP IMPROVEMENT

Genetic improvement of crop is the most viable approach by which food production can attempt to keep pace with the anticipated growth of the human population. For the genetic approach to succeed, we must harness the wealth of genetic variation provided by nature in crop wild relatives. These food crops were first domesticated from wild species about 10,000 years ago in agrarian societies. "Crop Wild Relatives (CWR) are the wild plants that are genetically related to cultivated crops". The allelic variations of genes originally found in the wild, but gradually lost through domestication and breeding. Such lost alleles can be recovered only by going back to the wild ancestors of our crop species (Tanksley and McCouch, 1997). The limited genetic diversity of crops renders them more vulnerable to biotic and abiotic stresses. Within each crop there is a potential pool of genetic diversity available for utilisation and a gradation of that diversity dependent on the relative crossing ability between the crop itself and primarily non-domesticated species in various gene pools of the crop. Production of hybrids of wild relatives and cultivated vegetable species might be impeded by crossing barriers and interspecific crosses may not produce any fertile offspring. The extent of crossing barriers depends on the species involved and varies between genotypes. Mixed fertilization with pollen from compatible and incompatible parents can result in viable hybrids from wide crosses but often *in vitro* methods are required to overcome the reproductive barriers.

Review of Research Work

Tomato

Stommel and Haynes (1994) conducted an experiment to study the inheritance of beta carotene content in wild tomato species *Lycopersicon cheesmanii* and elucidated that the beta carotene comprised 97% of the coloured carotenoids in *Lycopersicon cheesmanii.* F2 progeny demonstrated a continuous distribution for lycopene and beta carotene with increased level of beta carotene levels (20.91µg/fruit wt.)

Brinjal

Kumchai *et al.* (2013) conducted an experiment to develop interspecific hybrids between commercial cultivars of eggplant *S. melongena* and *S. Torvum* and revealed that through cross-hybridization between *S. melongena* and *S. torvum*, a total of 21 seedlings were recovered through embryo rescue, of which 5 were identified to be true interspecific hybrids, both by morphological traits and molecular markers.

An experiment was conducted on interspecific hybridization by Plazas *et al.* (2016) between eggplant and wild relatives from different genepools and found that the highest rate of success in interspecific hybridizations when using *S. melongena* as female parent was obtained with the 2 species of the primary genepool (*S. incanum and S. insanum*) and with secondary genepool species *S. dasyphyllum* and *S. lichtenstenii*. The highest degree of success was obtained with species of the primary genepool in MEL6 when *S. melongena* used as female and in MEL1when *S. melongena* used as male , while the lowest with tertiary genepool species.

Capsicum

Pradeepkumar *et al*. (1993) studied the compatability relationships between 4 cultivated species, *C. annuum, C. frutescens, C. chinense, C. baccatum* and a wild species *C. chacoense* with an objective of transferring desirable genes for pungency, aroma, colour from allied species to *C.*

annum and observed that hybrids between *C. frutescens* and *C. chinense* had high values of capsaicin and oleoresin. Considering the *per se* performance *C. annuum* x *C. chinense*(P) was most promising with high values of capsaicin (0.92%), oleoresin (34.40%) and colour (58.62 ASTA Unit) with higher crossability index (76.68%).

Okra

Singh *et al.* (2007) studied the role of wild species for resistance against major pests and diseases of okra and concluded that maximum yellow vien mosaic virus resistant germplasm lines were observed in wild taxa of *A. tetraphyllus* followed by *A. callei* which could be used for developing resistant varieties. While, accessions of *A . tetraphyllus* and *A. tuberculatus* were observed free from okra enation leaf curl virus and the wild relatives *A. moschatus, A. ficulneus* and *A. crinitus* species indicated to be immune to jassid infestation.

Gangopadhyay *et al.* (2016) conducted a study on diversity analysis and evaluation of wild *Abelmoschus* species for agro-morphological traits and major biotic stresses under the North-Western agro-climatic condition of India using a PCA biplot. They revealed that majority of the accessions were compactly placed within group and distinct grouping of accessions for *A. moschatus.*

Radish

Mithila and Hall (2012) studied the possibility of transfer of auxinic herbicide from wild mustard (*Sinapis arvensis*) into radish (*Raphanus sativus*) through embryo rescue and affirmed that the fruits harvested 3-4 days after pollination yielded more number of regenerated embryos than in the fruits harvested 10-12 days after pollination and these hybrids resembled both parents in several morphological traits.

Cow pea

Gomathinayagam *et al*. (1998) studied the interspecific hybridization between the cultivated species *Vigna unguiculata* (cv. Co-6) and the wild species *Vigna vexillata*. They found that the hybrid regenerants exhibited high enzyme activity for the 3 enzymes *viz*., peroxidase(PRX), polyphenol oxidase(PPO) and phenyl alanine ammonia lyase(PAL) over the cultivated parent which may be useful in conferring resistance against viral pathogens and they also inherited stem, leaf and pod hairiness of the wild species which could serve as mechanical barrier against viral vectors.

Cassava

Gomes and Nassar (2013) conducted a study to identify cassava interspecific hybrids with high protein content combined with advantageous amino acid profile and moderate cyanide levels and they noticed the hybrids ICB 300-7 and ICB 300-12 showed low cyanide levels and high protein contents. Therefore these 2 interspecific hybrids have a potential to become cassava cultivars with superior nutritional quality compared to the common cultivars.

General study

Hajjar and Hodgkin (2007) studied the use of wild relatives in crop improvement and summarized the wide variety of wild relative traits that have been incorporated into crops. Wild relatives have poor agronomic performance and it is therefore not surprising to find very few examples of wild genes being used to enhance yield in modern cultivars and concluded that over 80% of the beneficial traits conferred by CWR genes involved pest and disease resistance.

Conclusions:

From the foregoing discussion it can be concluded that the CWRs are an important source of the genes for quality and stress tolerance as they have been evolving for thousands of years in adverse environmental conditions and possess much higher degree of adaptability. In tomato, the variation for beta carotene content 2-3 times greater than that of *L. cheesmanii*. In brinjal, true interspecific hybrids between *S. melongena* and *S. torvum* can be produced to transfer disease resistance and other valuable traits from *S. torvum*. In chilli, the hybrids between *C. frutescens* and *C. chinense* will have higher values of capsaicin and oleoresin while, *C. annuum* × *C. chinense* (P) is most promising with high values of capsaicin (0.92%), oleoresin (34.40%) and colour with higher crossability index. In okra, the wild taxa *A. tetraphyllus*, *A. callei*, *A. tuberculatus*, *A. moschatus*, *A. ficulneus* and *A. crinitus* species could be used for developing resistant varieties against several pest and disease resistance. In radish, there is possibility of production of Dicamba-R hybrids between *R. sativus* and *S. arvensis*. In cow pea, the interspecific hybrid between *Vigna unguiculata* × *Vigna vexillata* possess various desirable traits like hairiness and increased activity of enzymes which are useful in defence against viral diseases and pests.The ICB 300-7 and ICB 300-12 interspecific hybrids have superior nutritional quality compared to the common cultivars. In general, 80% of the beneficial traits conferred by CWR genes involved pest and disease resistance.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2020-2021

Speaker : Baria Prakash Manaharbhai	**Course : VSC 591 (1+0)**
Reg. No. : 2020219005	**Date : 06/02/2021**
Major Guide : Dr. S. Y. Patel	**Time : 2:30 to 3:30 p.m.**
Minor Guide : Dr. A. K. Pandey	**Mode : Online**

"Physiology of drought and salt tolerance in vegetable crops"

In India, vegetable occupy an area 10.44 million ha with total production 187.47 million ton with average productivity 17.96 t/ha. In fact, vegetables constitute about 59.15 % of horticultural production. In Gujarat, vegetable occupy an area 626 thousand ha with total production 12,540 thousand ton with average productivity 20.02 t/ha (NHB, 2018-19). Drought is a major abiotic stress that decline crop productivity which weaken global food security, due to especially the current and growing impacts of climate change, frequency occurrence and severity of drought. Salt stress is abiotic stress factor, too that affect almost every aspect of physiology and biochemistry of a plant, resulting reduction in yield. Thus, it is a serious threat for agricultural productivity especially in arid and semi-arid regions.

Review of research work:
Tomato

Maggio et al. (2006) studied the effect of EC of nutrient solution on tomato. They found that decrease total leaf potential (-0.70 to -1.21 MPa) and osmotic potential (-1.49 to -2.28 MPa) whereas, increase pressure potential (0.79 to 1.07 MPa) with 2.5 to 15.0 EC salinized plants. Resulted salt stress has also increased leaf osmotic adjustment of tomato plants.
Pervez et al. (2009) researched on effect of drought stress on growth and yield of tomato cv. Money maker. They found reduction in emergence (81 %), germination (90 %), plant height (77.5 cm), shoot length (3 cm) and leaf number per plant (17.2) whereas, fruit number per plant (15.2) and weight (706 g/plant) performed better under late stress than control plants.
Babu et al. (2012) studied the effect of salinity on level of ABA and IAA in leaves of tomato cv. PKM 1. They found that NaCl treatment increased the endogenous ABA and IAA whereas, decreased plant height and number of fruits per plant, but PKM 1 variety gave good performance upto 25 mM NaCl.

Eggplant
Hassen (2018) studied the effect of salinity on growth and yield of eggplant. He found that growth and yield attributing characters affected with increase in salinity concentration, even though Barcelone gave better performance upto 8 EC salinity over Threa variety. Chilli pepper Khan et al. (2008) trialed on effect of water treatment on growth and yield characters of chilli. They observed that fruit length (39.59 mm), fruit diameter (8.72 mm), fruit weight (574.67 mg) and number of fruit (206.10) as well as yield (116.19 g/plant) significantly increased with watering at 4 days interval while, plant height (96.14 cm) increase with watering everyday over other schedules of watering.
Zhani et al. (2012) studied the effect of NaCl on growth of 60 days old plant of three chilli pepper cultivars. They summarized that higher NaCl concentration decreased the plant height and root length, but Alwad haffouz variety gave good performance than Tebourba and Korba upto 4 g/lit NaCl.

Pea
Bahadur (2011) studied photosynthetic pigments of pea leaves subjected to water deficit. He found thatsevere drought stress reduced photosynthetic pigments like chlorophyll a (18.14μg/cm2), chlorophyll b (7.78μg/cm2), β-carotene (1.98 μg/cm2), Neoxanthin (1.18 μg/cm2), Lutein (4.45 μg/cm2) and Violaxanthin (0.59μg/cm2), which might be affect the photosynthesis of plant.

Spinach

Robinson et al. (1983) studied biomass of spinach plants grown in standard nutrient solution with 200 mm NaCl. They observed that 200 mM NaCl solution resulted considerable decrease shoot and root biomass, which might be due to accumulation of electrolytes in spinach leaf as against normal water.
Broccoli

Lopez et al. (2009) studied sterol content in vesicle isolated of plasma membrane from broccoli roots treated with 0 and 80 mM NaCl. They noticed that increase of stigmasterol (10.49 ± 1.35 μg/mg protein) and decrease in sitosterol (25.4 ± 2.19 μg/mg protein) over control which reflected on response of broccoli root cells to adjust both water and ion transport during the acclimation of the plants to the saline environment.

Lettuce
Nasri et al. (2015) conducted experiment on effect of salinity (NaCl, 0 and 100 mM) on two lettuce varieties. They observed that germination (100 %), rate of germination (1.37) and mean daily germination (6) were reported by Romaine as against Vista variety.

Conclusions:
In tomato, total leaf water and osmotic potential decreases with increasing EC of the nutrient solution whereas, pressure potential and osmotic adjustment opposite to it. Drought reduced the emergence, germination and vegetative growth. Higher NaCl concentration increases ABA and IBA content which hinder the growth and development. In eggplant, growth and yield attributing characters affected with increase in salinity concentration, even though Barcelone found better upto 8 dS/m EC salinity over Threa variety. In chilli pepper, length, diameter, weight and number of fruit as well as yield per plant increased with watering at 4 days interval while, vegetative growth rose under watering everyday. Plant height, root length and leaf area were decreased with increasing in NaCl concentration but Alwad haffouz variety shows better compared Tebourba and Korba upto 4 g/lit NaCl. In garden pea, drought stress decreases photosynthetic pigments. In okra, chlorophyll content and shoot fresh weight decrease with an increasing drought severity. Photosynthetic activity and germination percentage decreased with an increasing rate of NaCl salt stress. In spinach, addition of 200 mM NaCl solution resulted in considerable decrease in biomass. In broccoli, increase in stigmasterol and decrease in sitosterol was very decisive to adjust both water and ion transport in broccoli during salt stress. In lettuce, percentage, rate and mean daily germination found higher with salt stress (NaCl 100 mM) in romaine over vista variety against control.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
Post Graduate Seminar Series: 2016-2017

Speaker	: PARVATHI BENNURMATH	**Course**	: FLA-591 (1+0)
Reg. No.	: 2020215038	**Date**	: 01/10/2016
Major Guide	: Dr. Dipal S. Bhatt	**Time**	: 4 to 5 p.m.
Co-Guide	: Dr. C. R. Patel	**Venue**	: Swami Vivekananda Hall

FLORAL WASTE UTILIZATION

Floriculture has been associated with culture and heritage since very ancient time in our country. It is estimated to cover an area of 2, 55, 000 ha with a production of 17, 54, 490 MT of loose flowers and 5, 42, 000 MT cut flowers. (Anonymous, 2014). Solid waste comprise of various organic and inorganic materials, covering or peels of various vegetables, fruits and cooked materials.The solid waste generated in urban India, is estimated to be 1.43 lakh MT daily (Anonymous, 2015). In most of the developing countries like India, the floral waste generation occurs largely during functions, worships, ceremonies, festivals *etc*. Floral waste degradation also increases the demand for agro-based products. According to Tata Energy Research Institute (TERI) estimation rate of waste generation in India is increasing at the rate of 1.0-1.33 per cent annually. It facilitates the proliferation of various group of microbial flora, which may be pathogens. Different sources of flower waste includes temples, mosque, flower market, flower exhibition and wedding halls. Among all, temple waste has a unique share of flower waste in the total waste. After fulfilling their purpose, flowers along with other waste, find their way into the garbage are discarded either into some water bodies or left up on the open available places as a waste causing various environmental problems. This floral waste can be utilized in different ways to produce valuable products and can thus help to save environment from pollution caused due to improper disposal of flower waste.

BRIEF REVIEW OF LITERATURE

Vermicomposting

Gurav and Pathade (2011) conducted an experiment on production of vermicompost from temple waste (Nirmalya) and cattle dung (50:50) and noted that 25 0C temperature, 7 pH, 1-2 mm of particle size and 80 per cent of moisture content were optimum parameters for vermicomposting using *Eudrilus euginae* earth worm species. They also reported improvement in growth with respect to plant height, maximum flower duration and more number of flower production in hibiscus plants using vermicompost prepared from temple waste.

Jadhav *et al.* (2013) evaluated flower waste degradation using microbial consortium and revealed that 5 per cent inoculum of consortium for flower waste degradation significantly reduced the height of the content in chamber having soil + flower waste + microbial consortium and biofertilizer produced by using flower waste + consortium showed significant effect on growth in terms of shoot length in wheat, jowar and green gram *i.e.* 14.50 cm, 7.40 cm and 10.30 cm, respectively at the end of 7th day.

Kohli and Hussain (2016) studied the management of flower waste by vermicomposting and stated that 250C temperature was optimum for production of vermicompost by flower waste with pH of 7.53, Electrical conductivity of 200 $\mu s/cm$ and C:N ratio of 12.3 at the end of 45th day using *Eudrilus euginae* earth worm species.

The research results of the pot study in tomato carried out by Jain Nisha (2016) revealed that the vermicompost prepared from floral waste with cow dung at 50:50 using *Eisenia foetida* resulted significant enhancement of growth *viz.*, stem diameter (1.10 cm), plant height (42 cm), average number of leaves (145) and length of roots (28 cm).

Extraction of natural dye

Innovative solvent extraction of temple waste flower of *Tagetes erecta* with ethanol was found to have high extraction efficiency allowing selective exraction of flavanoids and carotenoids which has satisfactory and very good fastness properties to dyed fabrics of cotton, wool and silk as pre-treatment with 1-2 per cent of metal mordants and 5 per cent of flower extract (Vankar Padma *et al*., 2009).

Raja *et al*. (2012) carried out an experiment on extraction of natural dye from saffron flower waste and its application on pashmina fabric. They noticed that the saffron flower waste produced bright greenish yellow and green colour on pashmina fabric at acidic pH and also found that the fabric dyed at acidic pH without mordant has anti microbial efficiency against *Staphylococcus aureus.*

Bio gas generation

Prasad *et al*. (2011) studied the production and utilization of flower waste by anaerobic decomposition process and found that the pressure fall from the composition of 10 % of chrysanthemum
flower waste with cow dung showed a increase in pressure upto 0.44 kg/cm2 under laboratory condition.

A study was carried out by Ranjitha *et al*. (2014) on anaerobic digestion of vegetable and flower wastes. They reported that the average bio-gas production potential of withered flowers was observed as 16.69 g/kg in 4.5 days as compared to vegetable wastes *i.e.* 9.089 g/kg in 6 days.

Essential oil extraction

Perumal *et al.* (2012) extracted rose oil (0.14 % v/w) from offered temple flowers of *Rosa damascena* by steam distillation and characterized by GC-MS analysis. They noted that phenyl ethyl alcohol (23.19 %) was recorded as the major component followed by octadecane (10.49 %), hexadecane (7.76 %), phenyl ethyl tetra decyl ester (5.77 %) and tetra methyl trisilocendecanol (3.45 %).

Conclusions

From the foregoing discussion, it can be concluded that the challenges to utilization of wasteges and minimize losses can be fulfilled by utilizing floral waste of marigold, rose, chrysanthemum, saffron, jasmine *etc*. for one or the other useful products like vermicompost, extraction of natural dye, extraction of essential oil, making holi colours, herbal incense sticks, hand made paper, cosmetic products, poultry/cattle feed, mosquito repellent and bio-gas generation suggest that the floral waste can not only be disposed safely in an environmental friendly manner but can also be utilized for making diversified products. Floral waste utilization would eventually be beneficial to the society as people would get to live in a clean and a healthier environment.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2016-2017

Speaker	:	EERATI SATHYANARAYANA	**Course**	:	FLA 591 (1+0)
Reg. No.	:	2020215019	**Date**	:	15/10/2016
Major Guide	:	Dr. Sudha Patil	**Time**	:	10 to 11 a.m.
Co-Guide	:	Dr. Y. N. Tandel	**Venue**	:	Swami Vivekananda Hall

Use of botanicals to improve the vase life of cut flowers

Floriculture is gaining importance throughout the world and is now considered as one of the country's sunrise industry both of cut flowers as well as loose flowers. The area under flower crops in India has increased to 2.55 million ha with the production of 54.3 million number of cut flower stems (Anonymous, 2014). The domestic industry is growing at an annual rate of 7-10 per cent. Vase life of cut flower is most attractive and economic components of cut flowers. The post-harvest longevity of cut flowers has a critical importance in determining the value of the flower crop. Yearly 20-40 per cent of the cut flowers are lost due to improper post harvest handling. Vase life of cut flower reduces due to microbes that block flower stock xylem vessels thereby reduces rate of water supply to flower. Inclusion of various antimicrobial compounds such as botanical extracts and essential oils are expanding the vase life of cut flowers. Botanical extracts are natural, safe and inexpensive compounds, is always crucial in this respect for large-scale applications. Natural plant extracts have come into prominence now a days. Some natural plant extracts (*Thyme* oil, *Geranium* oil, *Eucalyptus* oil, fruit and leaf extracts) have strong antimicrobial properties against some pathogens. These antimicrobial properties are attributed to the high levels of phenolic compounds.

Review of research work

Rose

Shanan (2012) observed that the maximum vase life (7.80 days), water uptake (0.88 ml/g), minimum bacteria count (5.30 CFU/ml) and fungi count (2 CFU/ml) with treatment of *Lavender* EO and minimum transpiration rate (0.35 ml/g) with *Geranium* EO in rose cv. Grand.

Thakur *et al*. (2014) observed that the application of 1 ppm turmeric oil EC (Emulsifiable Concentrate) increased the vase life up to 6.52 days, water uptake up to 29.36 ml and 50 % bud opening in rose cv. Poison.

Chrysanthemum

Hashemabadi and Bagheri (2013) revealed that the maximum vase life (18.86 days) and water uptake (0.77 ml g-1 FW) were recorded in 20 % tea extract while maximum total chlorophyll content (4.57 mg g-1 FW) was observed in 100 mg l-1 8-hydroxy quinoline sulfate in chrysanthemum cut flower.

Zarchini *et al.* (2013) studied the effect of *Artemisia* oil on measured traits of cut chrysanthemum cv. White and found that the highest vase life, fresh weight and dry weight were achieved in 30 % of *Artemisia* oil with 10 days, 44.50 g and 8.96 g, respectively.

Hashemi *et al.* (2014) noted highest vase life (59.58 ± 2.28 days) and flower diameter (84.85 ± 0.51 mm) with treatment of Thymol @ 125 mg/l whereas the maximum chlorophyll content (23.94 ± 4.29 mg100g-1 FW) and minimum colony number (5.8 CFU) were found under the treatment of Menthol @ 75 mg/l.

Bazaz *et al.* (2015) found maximum vase life (14.71 days) and relative fresh weight (74.21 g/ stem) in treatment of *Thyme* EO @ 100 mg/l used in chrysanthemum cut flowers.

Bidarigh (2015) observed that the maximum vase life (15.73 days) was obtained with treatment of 0.3 % *Myrtus* EO, maximum dry matter (27.42 %) with 1 % *Myrtus* EO, maximum water uptake (5.40 ml g-1 FW) with 0.3 % *Geranium* EO and maximum chlorophyll content (11.39 mg g-1 FW) along with minimum development of bacteria colonies (55) in treatment of 0.3 % *Eucalyptus* EO in chrysanthemum cut flowers.

Dashtbany *et al*. (2015) reported that the maximum vase life (18.41 days), water absorption (5.74 ml g-1 FW) and dry matter (32.41 %) were achieved in 5 cm stem splitting + 10 % geranium essential oil while the maximum fresh weight (20.06 g) was obtained in 5 cm stem splitting + 8 % geranium extract compared to other treatments.

Carnation

Bayat *et al.* (2012) reported the maximum vase life (16.4 days) and minimum colony count (120 CFU/ml) with treatment of lavender oil @ 150 mg/l whereas the maximum relative solution uptake (1.081 ml) and relative fresh weight (1.061 g) with the treatment of thyme oil @ 50 mg/l.

Gerbera

Kilic and Cetin (2014) stated that the maximum vase life (21 days) and relative fresh weight (98.63 %) were obtained in gerbera flowers which were treated with sage extract (50 µL/100 ml) and the maximum water uptake (0.88 ml/day) was noticed in flowers treated with balm extract (50 µL/100 ml).

Anthurium

Agampodi and Jayavaradena (2007) reported that the maximum vase life (20.7 days) and average solution uptake (1.56 ml/day/stem) was recorded with 50 % coconut water in anthurium cut flowers.

Gladiolus

As per the results obtained by Marandi *et al*. (2011), the maximum vase life (20.00 days), fresh weight (85.1 %), solution uptake (2.7 cm3) in treatment containing ajowan EO (500 ppm) and stem diameter (83.6 cm) were achieved in treatment of 4 % sucrose solution in gladiolus cut flower.

Tuberose

Lad (2005) reported that the maximum vase life, fresh weight, solution uptake and opening of florets were achieved in common salt @ 500 mg/l *i.e*. 11.30 days, 198.40 g, 40.43 ml and 27.63%, respectively which was followed by coconut water 20 % in tuberose cut flower.

Shahi *et al. (*2016) revealed that the vase life of tuberose was enhanced by 11.33 days under treatment of 50 % *Eucalyptus* extract + sour orange fruit extract.

Alstroemeria

Bazaz and Tehranifar (2011) noted that the highest vase life (13.03 days) along with maximum solution uptake (71.13 ml/stem) in treatment containing thyme EO @ 50 mg/l while fresh weight (4.77 g) was recorded more in Thyme EO @ 100 mg/l.

Narcissus

Shahi *et al.* (2015) recorded the maximum vase life (30.33 days) and minimum unopened bud (6.94 %) with treatment of 4 ml/l sour orange extract whereas the maximum relative fresh weight (126.61 %), water uptake (2 g) and petal TSS (2.30 %) were noted with concentration of 2.5 ml/l sour orange extract in Narcissus cut flower.

Conclusion

Essential oils and botanicals are natural, safe, inexpensive and biodegradable compounds that have strong antioxidant activities and antimicrobial properties against various microorganisms which reduces amount of bacteria in vase solution. Application of different EOs and natural preservatives considerably increased vase life of various cut flowers and foliages. Botanicals and EOs are contain carbohydrates and different phenolic compounds, these can improve the vase life of cut flower. Based on results, application of thyme oil, geranium oil, mentha oil and lavender oil @ 100-150 mg/l can improve the vase life of cut flowers. Application of 50 % coconut water and 4 % of sour orange extract also helps to improve vase life of cut flowers.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
Post Graduate Seminar Series: 2016-2017

Speaker : PARMAR NILAMBEN G.	**Course** : FLA 591 (1+0)
Reg. No. : 2020215036	**Date** : 15/10/2016
Major Guide : Dr. Sudha Patil	**Time** : 11:00 to 12:00 p.m.
Co-Guide : Dr. Shakti Arbat	**Venue** : Swami Vivekananda Hall

"TURFGRASS MANAGEMENT"

Introduction

Turfgrasses are considered as an integral part of landscape ecological systems worldwide which provide aesthetic value.Turfs are an important component in human activities and have functional and recreational values which ultimately enhances the quality of living. Many outdoor sports and recreational activities utilize turf including cricket, base ball, hockey, foot ball, golf, lawn tennis and polo. The artificial turfs- Astroturfs, which are now popular could not match some of the valuable properties of natural turfs. Rapid urbanization, expanding buildings, growing interest on the need to beautify rural and urban areas, emphasis on outdoor living and recreation have lead to evaluation of different types of turf grasses for various uses.

Turfgrass beautifies millions of home lawns, provides safe playing surfaces on over 700000 athletic fields, outdoor recreation for nearly 26 million golfers on over 17000 golf courses in world and economic opportunities for thousands of seed and sod producers, lawn care operators and landscapers. Turfgrasses serve as an inexpensive, durable ground cover and protect our valuable, non-renewable soil resources. Perennial turfgrass offers one of the most cost efficient methods to control wind and water erosion of the soil. A healthy lawn absorbs rainfall six times more effectively than a wheat field and four times more that a hay field.

Brief review of research work

Janakiram *et al.* (2014) observed maximum growth rate, germination percentage and shoot density in *Agrotis pelustris* and minimum weed intensity in bahia grass among 11 genotypes.

Ubendra *et al.* (2015) reported that chlorophyll content (1.24 mg/g), relative water content (85.62%), stomatal index (upper) (26.94%), shoot length (21.17 cm) was maximum in *Cynodon dactylon x* Cynodon transvaalensis.

Golestani *et al.* (2014) noticed maximum seed germination in ¾ rice hull and ¼ sand while uniformity of growth was obtained in mixture of Leaf compost + Tea compost + Sand + Rice hull.

Grande and Shortell (2015) conducted an experiment on application of 3 sowing depths. Among these treatments, significantly maximum ground cover *i.e* more than 90% was obtained in perennial ryegrass with rototiller 2.5 inch depth where 80% ground cover was noticed in seed sowing done by cultipacker 0-0.3 inch depth in both perennial ryegrass and tall fascue.

Abbas *et al.* (2015) recorded that significantly maximum lawn height, resiliency of lawn, visual quality, lawn uniformity, leaf fresh weight, leaf dry weight and Cholorophyll a & b were obtained with 1 day irrigation interval along with 40g/m² of superabsorbent polymer treatment in *cynodon dactylon* L.

Susan Mathew (2012) studied the effect of different forms of N fertilization by urea on turfgrass (*Cynodon dactylon*) and found that treatment T7 @ 200 kgN ha-1 yr-1 (100% foliar) score maximum mean colour (4.77) and aesthetic appearance (4.36).

Xiaoya *et al.* (2011) stated that application of 2.4g/m² gave good results on quality, leaf length and tissue potassium in both trials whereas 30% shade score maximum quality and colour in 'Captiva' cv. of St. Augastine grass. Moreover, the thatch development found minimum in grass grown in 30% shade.

Richards *et al*. (2008) reported that maximum putting green quality over the time in 2 times rolling per day. They also observed that 8 times rolling per day of sports field gave maximum ball roll distance but acceptable quality of the turfgrass was minimum on long term. In another study

Richards *et al*. (2009) reported that water infiltration rate was decreased with increase in number of rolling due to crust formation.

Roshni Agnihotri (2015) studied various genotypes in respect to mowing requirement and found that *Zoysia tenuifolia* required minimum number of mowing while maximum score with respect to turf intensity (4.76) and aesthetic rating (4.43) was gained by *C. dactylon* L. x *C. transvalensis*.

John *et al.* (2004) indicated that bensulide, siduron and prodiamine were safe to apply at 4 WASE (4 week after seedling emergence) as they didn't affect cover and quality of creeping bentgrass.

Guerrero *et al*. (2008) reported that *Trichoderma harzianum* was effective to control turfgrass disease caused by *Rhizoctonia* spp. and *Lepista* spp.

Conclusion

From ongoing discussion, it can be concluded that the better management of turfgrass leads to good quality turf. Among all types of grasses, bermuda grass found better and used more frequently in gardens, cricket field, golfcourses, tennis, polo, football court, etc. Turfgrass can perform well in sandy loam to loamy soil. However, rice hull, tea factory waste and leaf compost were also observed good as a media. Dibbling is the cheapest method as compared to turfing which is an expensive but quickest method among all. However, for large area, hydroseeding is suggested. With respect to water management, irrigating turf at 1 day interval can enhance growth and quality of barmuda grass. Similarly, 40g/m^2 superabsorbent polymer is also more suitable for reserve water in soil. Among all shade levels, 30% shade is found best. Rolling 2 times per day up to five weeks can increase green speed without decreasing turf quality or water infiltration below acceptable levels**.** Minimum mowing required in *Zoysia* grass which is good for maintenance and *Trichoderma harzianum* can be used to control turfgrass diseases caused by *Rhizoctonia* spp. and *Lepista* spp.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2016-2017

Speaker : Patel Unnatiben Rameshbhai	**Course :** FLA- 591 (1+0)
Reg. No. : 2020215045	**Date : 15-10-2016**
Major Guide : Dr. Sudha Patil	**Time :** 02:00 p.m. to 03:00 p.m.
Co- Guide : Dr. Y. N. Tandel	**Venue :** Swami Vivekananda Hall

Advances in production technology of Heliconia

Floriculture is expanding very fast as an industry world over and in India with respect to cut flowesr, loose flowers, pot plants, landscape plants, nursery, etc. The area under flower crops in India has increased to 2,55,000 ha with a production of 17,54,490 MT of loose flowers and 5.43 million number of cut flowers (Anonymous, 2014). Heliconia scientifically known as *Heliconia* spp., is herbaceous perennial rhizomatous plant. It is amongst the most attractive of all exotic tropical flowering plants. Heliconia is gaining popularity as commercial cut flower due to the diversity in their colour and form, unusual inflorescence with long lasting vase life. It is a native of South to Central America and belongs to family Heliconiaceae. Out of 200- 250 spp., 89 spp. containing more than 350 varieties are currently under cultivation in different parts of world and it is well known as Lobster's Claws, Parrot's Flower, Parrot Plantain and False Plantains. It is well adapted to all major agro-climatic zones of the country and can be cultivated at a height of 3000 to 4000 feet above MSL. In India, Andhra Pradesh, Kerala and North Eastern parts are major area under cultivation of heliconia, about 50% of the production come from coconut farm located in the west Godavari district in Andhra Pradesh, whereas major area under cultivation in the world are Barbados, Hawaii, Brazil, Venezuela, Netherlands and Germany.

Review of Research Work:

Variability

Narkar *et al.* (2013) studied the mean value of pollen size (μm) and pollen fertility (%) in different species of heliconia. They noticed that interspecific hybrids recorded lower fertility percentage where as species and cultivars recorded higher fertility. Moreover, pollen shape varied within same species in different cultivars.

Chawla *et al.* (2016) evaluated 25 genotypes of heliconia under 50% shade net house and among these different genotypes, Parrot Beak, Lobster Claw-III, Pedro Ortiz, *H. wagneria* cv. Red and Orange were found ideal for cut flowers and recommended for commercial cultivation and as a landscape plant for south Gujarat.

Cultural practices

Broschat and Donselman (1983) recorded maximum bract length (14.2cm) and post harvest life (15.5 days) in 63 % shade with application of 650g N/m2/year and 125g N/m2/year, respectively. They also noticed maximum penducle length (43.8 cm), total height (181.2 cm) and number of flowers/m2 (161.9)in full sun with 400g N/m2/year.

Sheetal Jadav *et al.* (2015) conducted the experiment on effect of plant growth retardants on vegetative growth of heliconia var. Red Torch and observed maximum number of leaves per clump (4.33), spikes per clump per year (4.46), overall presentability of spike (10.0), vase life (13.33 days), flowering duration (55.40 days), number of florets per bract (12.06), number of bracts per rachis (4.60), stalk length (110.98 cm) and minimum days to flowering (147.20) in treatment of MH @ 50 ppm whereas maximum inhibition in plant height was noticed in treatment of paclobutrazol @ 300 ppm.

Omovbude *et al.* (2016) stated that the maximum stem height (8.7 cm), stem girth (2.9 cm) and number of leaves (3.3) was produced by variety Golden Torch when grown in media of top soil + cococnut husk (1:1).

Aklade *et al.* (2016) noticed that the 75cm × 40cm spacing and application of fertilizers with 300:100 kg N and P per hectare recorded maximum number of suckers per clump (8.03) and number of leaves per longest shoot. Moreover, they also reported higher yield and flower quality of heliconia cv. Golden Torch, at 50 cm × 40 cm spacing along with application of fertilizer @ 300:100:100 kg NPK per hectare.

Intercrop

Thangam *et al.* (2014) found maximum number of suckers/plant at 12 month (41.09) in Golden Torch, number of flowering suckers/plant (14.50) in Bihai, stalk length (153.18 cm) in Sexy Pink and number of bracts/spike (16.55) in Rostrata type whereas minimum days to first flowering (123.50days) in Choconiana type of heliconia under coconut plantation. Heliconia gave additional income of Rs. 25000/ha to Rs. 90000/ha from flowers depending upon the variety and from sucker average income of Rs.50000/ha which is additional income to coconut growers.

Post harvest management

Mangave (2010) studied the effect of harvesting stages on total water uptake and vase life of heliconia inflorescence in cv. Golden Torch and found maximum total water uptake (268.94 ml) and vase life (15.41 days) in flowers harvested at bud stage but maximum overall visual noticed at 3 bract open stage.

Mangave *et al.* (2014) noticed that vase solution treatment contining α-lipoic acid 100 mg/l + 8-HQC 250 mg/l + sucrose 3 % effectively increased water uptake, retained fresh weight, maximum flower opening in bract, decreased the lipid peroxidation as well as improved vase life.

Conclusion:

From the foregoing discussion, it can be concluded that species and cultivars gave higher fertility as compare to interspecific hybrids, whereas pollen shape varied within same species in different cultivars. Among different genotypes, Parrot Beak, Lobster Claw-III, Pedro Ortiz, *H. wagneria* cv.Red and Orange were found ideal for cut flowers and recommended for commercial cultivation in south Gujarat. Use of retardants like MH @ 50ppm proved to be the best treatment for obtaining higher yield of good quality flowers. To obtain higher yield, heliconia cv. Golden Torch rhizomes should be planted at 50 cm × 40 cm spacing with application of fertilizer @ 300:100:100 kg NPK per hectare. Plants can perform well when grown in media of top soil + coconut husk (1:1). Growing of different types of heliconia like Golden Torch, Bihai, Sexy Pink, Rostrata type and Choconiana can perform well and give good yield under coconut plantation and coconut growers can fetch additional income from heliconia flowers and suckers. Heliconia inflorescence cv. Golden Torch harvested at third bract open stage gave better appearance during vase life and vase solution treatment α-lipoic acid 100 mg/l + 8-HQC 250 mg/l + sucrose 3 % can be used to enhance vase life of heliconia cut flowers.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
POST - GRADUATE SEMINAR SERIES 2016-17

Speaker	**:Patel Khyati M. (Reg. No. 2020215042)**	**Course No.**	**:FLA- 591 (1+0)**
Major Guide	**:Prof. R. B. Patel**	**Date**	**:19/11/2016**
Co-Guide	**:Dr. C. S. Desai**	**Time**	**: 10.00-11.00 am**

Dehydration technique in flowers

Drying is conventional method done by using energy sources like sun and wind. Dehydration means the process of removal of moisture from the flower under controlled condition by application of artificial temperature, humidity and airflow. In the dehydration process, the moisture is removed from flowers and foliages without affecting its aesthetic value. In recent times revolutionary changes are seen in the floriculture industry. One component contributing for this revolution is dried flower industry. Fresh flower is one of the main components in floriculture trade. The beauty and fresh look of flowers can be retained only for a few days even when some flower preservatives or chemicals are used to prolong the vase-life of flowers. Dehydrated flowers and foliage are excellent due to their special beauty, long lasting value and can be enjoyed during heat of summer and the cold of winter. The charm of flowers can be maintained and preserved for several years by the technique of dehydration or drying.

Dry flowers segment having a 77.1% of Indian floriculture export. The demand of dry flower increase at impressive rate of 8 – 10%. Dried products like lotus pods, dahlia, bell cups, marigold, jute flowers, wild roses, wild lilies *etc*. are exported to US, Israel, Hong Kong, Japan, Singapore and West European countries. U.K. was the largest importer of dried flower from India next to Germany, Italy, Netherlands and Spain. India is the 5th largest exporter of dry flowers in the world. This industry shows a growth rate of 15% annually. Potpourris is a major segment of dry flower industry valued at Rs. 55 crores in India alone (Anon., 2014).

Brief Review of Literature

Natural drying

Radha Rani *et al*. (2015) studied about approximate drying time for different flowers in air drying, water drying and press drying. In air drying, marigold and carnation took higher time *i.e.* 12 days while orchids, gladiolus have taken less time *i.e.*7 to 8 days. The flowers which are dried in water drying has taken more amount of time except daisy, gerbera and marigold which have taken less amount of time *i.e.* 8 days and they also found that carnation has taken the more time to dry *i.e.* 12 days but orchids and daisies have taken less amount of time *i.e.* 6 days to dry in press drying.

Natural drying with embedding

Sangama (2004) found no disc floret shedding and 5 per cent petal reflex were observed in fully open yellow *Helichrysum* flowers under sand embedded shade drying.

Sun drying along with silica gel resulted low moisture content at 3rd and 5th day storage of *Zinnia linearis* Benth (Singh *et al*. 2004).

Meman *et al*. (2006) studied interaction effect of different condition and media on per cent weight loss and moisture loss in the flowers of china aster were recorded the maximum weight loss (68.15%) at 4th day and maximum moisture loss (61.20%) at 3rd day and at 4th day and it was found non significant in sun drying with silica gel embedding.

Embedding with convectional methods

The low degradation of all pigments *viz.* chlorophylls, carotenes, xanthophylls and anthocyanins were observed in cabinet drying at low temperature (40 ^{o}C) with silica gel embedding media in *Zinnia linearis* Benth (Singh *et al*. 2004).

Bhalla *et al.* (2006) observed that the interaction between media and duration in microwave oven drying resulted in maximum moisture loss (82.38%), carotenes (1.39 mg/g), total sugars (1123 ppm) and reducing sugars (93 ppm) when the chrysanthemum cv. "Nanako" flowers were dried in silica gel for 90 sec.

Nirmala *et al.* (2008) observed that the treatment combination of quartz sand at 50 ^{o}C for 36 hours of drying in cabinet hot air oven were recorded the maximum anthocyanin content (16.34 mg) which was on par with 60 ^{o}C for 36 hours (16.24 mg) in carnation flowers.

Biswas and Dhua (2010) found that the diameter of flower gradually declined with the increase treatment duration. Reduction in diameter was more in flowers of both carnation var. "Cano" (13.61 %) and "Kristina" (14.21 %) when dried for 4 minutes followed by 3 minutes and 2 minutes while decrease in diameter of flower was more in variety "Kristina" than "Cano".

Naik *et al*. (2015) observed that the score on colour (3.93), texture (4.01), shape (4.04) and over all acceptability (4.12) were maximum in flowers dried in hot air oven at 45 ^{o}C for 45 hours in gerbera var. "Impireal".

Convectional methods

Chen *et al.* (2000) observed that the higher drying temperature tended to make petals stiffer/stronger. For both red and pink roses, the highest vacuum drying temperature produced the strongest petals, but not as strong as those of the control while pink carnation petals were stronger after 4 hours of freezing and red carnation petals were stronger after only 2 hours.

Ahluwalia *et al*. (2014) studied effect of different methods of drying on fuctional properties of marigold petals and they recorded that the total phenol content decrease significantly in dried samples as compared to fresh samples while β carotene content of dried sample increased significantly with decrease in moisture content as compared to fresh sample and vacuum drying gave the best results from the preservation of quality with fuctional constituents.

Other methods

Lourdusamy *et al*. (2002) observed that the bleaching chemicals sodium chlorite 15% for 6 hours bleaching and 10 hours drying after bleaching gave the highest cumulative quality scores (7.8) for dried *Gomphrena globosa* flowers.

Conclusion

Drying and preserving flowers make senses economically because ordinary flowers will only last about a week and dried flowers will last indefinitely. The commonly used flowers like carnation, chrysanthemum, daisy, gerbera, gladiolious, marigold, orchid, rose *etc.* should be drying by using different techniques like air drying, water drying, embedding technique, micro oven drying, pressing and glycerinisation. Flowers like orchids and gladiolus have taken less time in air drying whereas gerbera and marigold have taken less time in water drying whereas orchids and daisies have taken less time in press drying. Among all embedding media, silica gel with sun drying gave best result and longer storage while sand reduced petal shedding. The method of drying should be selected according to use of flowers. Higher temperature affects the quality of flowers when freeze drying and vacuum drying method are more suitable for maintaining the quality of dry flowers. Among all bleaching chemicals, sodium chlorite gave good result. The flowers dried using different techniques were used for three dimensional arrangements, preparation of greeting cards, wall hangings, table mats, photo frames, paper weights and book marks *etc*. These floral craft can become the basis of cottage industry, both for domestic and international markets.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2016-2017

Speaker	**:** Patel Dishaben Kishor	**Course**	**:** FLA- 591 (1+0)
Reg. No.	**:** 2020215041	**Date**	**:** 19-11-2016
Major Guide	**:** Dr. S. L. Chawla	**Time**	**:** 14.00 – 15.00 hrs
Co- Guide	**:** Dr. T. R. Ahlawat	**Venue**	**:** Swami Vivekananda Hall

Advances in Production Technology of Bird of Paradise

Floriculture is fast expanding agribusiness in world as well as in India with respect to cut flowers, loose flowers, pot plants, landscape plants and nursery, etc. The area under flower crops in India has increased to 2,55,000 ha with a production of 17,54,490 MT of loose flowers and 54.3 million number of cut flowers (Anonymous, 2014). Bird of paradise scientifically known as *Strelitzia reginae* is one of the most colourful flowers in the world. It is amongst the most attractive of all exotic tropical flowering plants. Bird of paradise is gaining popularity as a commercial cut flower due to unusual appearance of the spectacular flower resembling like bird, brilliant colour and attractive flower spikes with long lasting vase life. It is a native of South Africa and belongs to family Strelitziaceae. It is also known as *Strelitzia* or Crane Flower. It is an evergreen, perennial, rhizomatous but slow growing herbaceous plant and is cultivated in many parts of the world in order to produce inflorescence for both local and export markets. It is commercially growing in California, Hawaii, Israel and South Africa in world and Kerala, Karnataka and Andhra Pradesh in India.

Review of Research Work

Evaluation

Anuradha Sane *et al.* (2011) recorded maximum leaf length (252.33 cm) while maximum number of florets/spike (11.40) with BOP 45 selection and spike yield/plant (160.50) with BOP 16 selection.

Seed germination & survival

Yahiro *et al.* (1984) noticed that treatment of BOP seeds with KNO_3 @ 0.2 per cent was best for dormancy breaking after incubation at 25^0C with concentrated sulphuric acid for 5 minutes followed by ethrel @ 100 ppm and GA @ 100 ppm and thiourea @ 0.2 per cent.

Anuradha Sane and Jankiram (2010) revealed that the maximum seed germination (72.00 %) of BOP was recorded with treatment of colchicine 0.2 per cent, MES 0.05 and MES 0.1 per cent whereas minimum days taken for germination (30.00 days) was recorded in colchicine 0.2 %. Maximum plant height (88.27 cm), number of leaves per plant (15.89) and leaf length (77.22 cm) were recorded with the application of MES 0.1 %.

***In vitro* propagation**

Shreevatsa *et al.* (2004) found minimum days taken by explants to turn into green colour (8.033), maximum shoot length (31.30 mm), shoot height (44.60 mm) and number of shoots/explants (3.16) with *in vitro* medium containing 0.5 mg/l IBA with 7 mg/l BPA in BOP.

Kantharaju *et al*. (2008) reported that soaking the explants of BOP in pre- treatment solution containing citric acid (200 ppm) for 24 hours and inoculated into MS medium having activated charcoal was effective in reducing degree of browning (1.00), mortality per cent (5.00), early initiation of shoot tip (9.50 days) and maximum per cent of established (95.00).

Nutrient management

Nair *et al*. (2010) observed that application of 110: 35: 70 kg NPK/ha + 50% FYM/ha enhanced Plant height (66.3 cm) leaf length (39.91 cm), leaf breadth (6.06 cm) and improved the flowering characters like flower stalks/plant (5.55) and flower stalk length (9.25 cm) in bird of paradise.

Jainag *et al*. (2013) observed that the application of 120 % RD with application of 12 liters of water/plant/day through drip irrigation improved the vegetative characters like plant height (113.26 cm), leaf length (85.70 cm), number of leaves/plant (12.75) and flowering characters like number of inflorescences/plant/month (2.72) stalk length (100.30 cm), diameter of stalk (13.19 cm), weight of inflorescence (148.22 g), length of bracts (19.80 cm), length of sepals (12.29 cm) and length of petals (11.79 cm) in bird of paradise.

Yathindra *et al*. (2016) reported that application of 80% RDF (WSF) + VC (300 g) + *Azotobacter* + PSB + KMP significantly improved the plant height (117.72 cm), leaf length (36.96 cm), leaf width (16.14 cm), number of leaves (75.77), number of suckers (13.88) and plant spread (9787.11 cm^2) in bird of paradise.

Post harvest management

Bayogan *et al.* (2008) reported longest post harvest life (13.50 days) and maximum number of opened florets (1.80) with treatment of sucrose + 8-HQC + Citric acid with sucrose as holding solution.

Glaucia *et al*. (2013) reported that BOP flowers packed in cardboard box showed the lowest percentage of damage in the stems, maintained the visual appearance with maximum opened florets (99.12 %).

Post harvest treatment with 8- HQS at 250 ppm or GA_3 at 200 ppm was recommended for maximum vase life (11.76 days) and number of opened florets (3.63) as well as post harvest quality of bird of paradise flowers, (Ali and Hassan ,2014)

Conclusions

From the above discussion, it can be concluded that BOP 16 and BOP 41 selection produced maximum spikes per plant. Multiple shoots were successfully rooted through *in vitro* medium containing 0.5 mg/l IBA with 7 mg/l BPA. Application of 110: 35: 70 kg NPK/ha + 50 % FYM enhanced the growth and flowering in bird of paradise. Use of drip irrigation schedule at 120% RDF with 12 litre of water/plant/day improved the vegetative growth and flower yield with better flower quality of bird of paradise. Combined application of inorganic fertilizers, biofertilizers and vermicompost (80 % RDF (WSF) + VC (300 g) + *Azotobacter* + PSB + KMB) were improved the growth beneficial for bird of paradise. However, to increase vase life and minimize the losses of bird of paradise, chemicals *viz*., GA_3 200 ppm and 8 HQC @ 250 ppm can be used. Cardboard box packing is better to reduce the mechanical damage.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
Post Graduate Seminar Series: 2016-2017

Speaker	: PADHIYAR BIPINKUMAR M.	**Course**	: FLA-591 (1+0)
Reg. No.	: 2020215033	**Date**	: 26/11/2016
Major Guide	: Dr. Dipal S. Bhatt	**Time**	: 4 to 5 p.m.
Co-Guide	: Dr. K. D. Desai	**Venue**	: Swami Vivekananda Hall

NUTRITION MANAGEMENT AND MEDIA IN ORNAMENTAL POT PLANTS

Flowers and foliage have integrated relationship with mankind since ancient times as they are entwined with human culture. Flowers and green plants are not only important for environmental conservation micro climate regulation, bio-aesthetic outlook but also for positive work culture, good health and happiness and also can be postioned in urban landscaping (Singh, Alka 2016). Floriculture has emerged as one of the most dynamic and advanced sectors of contemporary agribusiness in world as well as in India with respect to cut flowers, loose flowers, pot plants, landscape plants and nursery etc. The area under flower crops in india has increased to 2, 55,000 ha with a production of 17, 54,000 MT loose flowers and 54.3 million numbers of cut flowers (Anonymus, 2014). The sector of ornamental plants is worth of about $9.4 billions in the world flower trade (UNCOMTRADE Statistics, 2014). Rapidly growing urbanization and population explosion with hasty life style have created space paucity for living,wherein pot plants offers some relief with a great scope for urban greenscaping. Consiquently, the potted plants are becoming increasingly popular though the world. For plants grown in pots, substrates are used as a culture media, restricting the volume exploited by the root system and making it necessary to apply nutrient solutions with the appropriate concentrations of nutrient for the pot plants. The quality production of potted ornamental plants can be obtained by the use of appropriate potting media capable of supplying essential nutrient besides providing good anchorage to plants in pots. (Vendrame *et al*., 2005).

BRIEF REVIEW OF LITERATURE

Media

Kumar *et al.*,(2012) conducted an experiment on effect of growing media on flowering characters of chrysanthemum *cv*. Mother Teresa and noted that the minimmum number of days taken to flowering, highest number of flowers per plant and flower longevity were recorded in the treatment cocopeat + sand + FYM (2:1:1), cocopeat + sand + vermicompost (2:1:1) and cocopeat respectively.

Lalitha kameshwari *et al.* (2014) studied the effect of potting media on floral characters of chrysanthemum *cv*. Punjab Anuradha and noted that the plants grown in cocopeat + sand + FYM + Vermicompost (2:1:0.5:0.5v/v) media produced significantly more number of flowers per plant and spray length. However flower diameter and flowering duration were recorded best in soil + sand + FYM + Vermicompost (2:1:0.5:0.5v/v) and cocopeat respectively.

Jawaharlal *et al.* (2001) found that leaf mould + cocopeat was best growing media for Anthurium with respect to all flowering characters.

Dhananjaya and Sulladmath (2003) reported that maximum number of suckers/plant and improvement in other flowering characters in the treatment Coffee cherry husk + FYM+ soil + sand with 2:1:1:1 ratio.

Aklade *et al.* (2009) carried out an experiment on standardization of growing media for anthurium and stated that Saw dust + Brick pieces + Wooden charcoal + Soil + Sand + FYM (2:1:1:1:1) is best for the flowering characters also best in leaf area and petiole length further Saw dust +Wooden charcoal + Soil + Sand + FYM (2:1:1:1:1) found maximum number of leaves per plant and numbers per plant .

Singh *et al.* (2010) studied the Influence of potting media on growth performance in Dieffenbachia and revealed that maximum plant height , number of leaves per plant, diameter of shoots in soil + leaf mould (1:1) and also found maximum number of sprouts per plant in sand + Vermicompost or soil + Vermicompost (1:1).

Mani and Nagaraju (2004) studied on Influence of potting media on morphological character of Cymbidium hybrids and concluded that cocopith and cocopith + sand found better media for morphological characters of Cymbidium hybrids.

Rumrunghsri *et al*. (2007) studied on Flower quality of Phalaenopsis hybrid supplied with different Nitrogen and phosphorus levels and found that 150 mg/l nitrogen recorded maximum inflorescence length, number of flower per stem further recorded 100 mg/l phosphorus recorded maximum flower length, inflorescence length and number of flower per stem.

Panj *et al*. (2007) reported that media combination of coco peat: rice husk: vermicompost (1:2:1) was found to be best for the vegetative parameters and also revealed the media combination of coco peat: FYM (1:1) for flower vase life and coco peat: vermicompost (1:1) maximum flowers per plant in gerbera.

Influence of potting media on growth performance in *diffenbachia amoena* was found to have maximum plant height, number of leaves per plant and diameter of shoots in soil + leaf mould also recorded higher number of sprouts per plant in sand + vermicompost (singh *et al*., 2010).

Phytometric parameters evaluated at 210 days in potted *Adenium obesum* plants grown in six potting media was found vermiculite + cocopeat fibre is best media for its growth (Ronan Carlos Colombo *et al*., 2016).

Nutrition management

Abd El-Aziz (2007) carried out experiment on effect of NPK fertilizers on growth characters of croton and revealed that 4g/plot NPK gave best result on its growth.

Bellubb *et al*. (2015) studied on influence of INM on vegetative growth in gerbera and they revealed that RDF+ vermicompost gave maximum number of leaves per plant and leaf area they also recorded highest plant height and plant spread in the treatment RDF +FYM, 75%RDF +GF +TH + PG +AP +DM +AA respectively.

Sujatha and sujatha (2010) studied on effect of variyieng nutrient level on vegetative and flowering parameters of orchid was found treatment 4 gave maximum number of spikes per plant, number of florets per spike, length of spike they also recorded t2 for maximum leaves per plant and t5 for maximum vase life.

Flower quality of phalenopsisi hybrid supplied with different nitrogen and phosphorus level they was found 150mg/l nitrogen and 100mg/l phosphorus best for its quality also recorded 200mg/l nitrogen gave maximum flower stalk length (Rumarungsri *et al*., 2007).

Conclusions

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post-Graduate Seminar Series: 2016-2017

Speaker	**: Raghuram Pawar**	**Course: FLA-591 (1+0)**	
Reg. No.	**: 2020215052**	**Date**	**: 03/12/2016**
Major Guide	**: Dr. S. T. Bhatt**	**Time**	**: 11 to 12 a.m.**
Co-Guide	**: Dr. S. S. Gaikwad**	**Venue**	**: Swami Vivekananda Hall**

Medicinal value of orchid a novel perspective

Introduction

Orchids are the members of the family Orchidaceae, one of the largest families of flowering plants (Atwood 1986). The estimated number of orchid species varies from 12,000 to 35,000 (Heywood 1985), contributing up to 10% of all flowering plant species in the world (Dressler 1981). Orchids form 9%of our flora and about 1331 species are reported from India (Mishra 2007).Orchids are extremely popular for their mesmerizing marvellous flowers in the whole world, but it is in the lesser know that many species are used in traditional system of medicine and form remedial measures fornumber of ailments.Out of many medicinal and aromatic plants, many orchids have been used as traditional system
of medicines. This may account for the use of orchids as aphrodisiacs in ancient civilization. When we study the history of the ancient alternative system of medicine Ayurveda and Traditional Chinese Medicine (TCM) are one the forefront. Asthavargha, is important ingredient of various classical Ayurveda formulations like chyavanprasha. Out of eight constituents of Asthavargha, four have been reported to be orchids as ‘Jivaka’ (*Malaxis muscifera*), ‘Rishbhaka’ (*M. acuminate*), ‘Riddhi’ (*Habenaria intermedia*), and ‘Vriddhi’ (*H. edgeworthii*). A wide range of chemical compounds are presented including alkaloids, bibenzyle derivatives, flavonoides, phenanthrenes and terpenoides which have been isolated from various orchids from different parts of the world. Extracts and metabolites of these plants, particularly those from flowers, stem and leaves, possess useful in pharmacological activities, viz. diuretic, anti-rheumatic, anti- inflammatory, anti-carcinogenic, hypoglycaemic activities, anti-microbial and anti- convulsive activity.

Brief Review of Literature

Anticonvulsant activity

Pathan and Ambavade, (2014) observed that the ethanolic extract of roots of *Vanda roxburghii* (100 mg/kg) showed significant increase in latency to clonic convulsions, and it shows anticonvulsant activity of plant extract (100 mg/kg) against Pentylenetetrazole (PTZ) and plant extract (50 mg/kg) against Maximal Electroshock(M.E.S.) induced convulsions in mice.

Aphrodisiac activity

kumar *et al*. (2000) revealed that the maximum number of mounts per 15 minute was observed in flower extract (2 g/kg) and to some extent the root of *Vanda tessellata* was also noted to stimulate the mounting behaviour of male mice, whereas heated alcohol extract of the flower (200 mg/kg) was increased mating performance in the mice. The pups fathered by the extract treated mice were found to be normal with an increasing trend in the male/female (sex) ratio of these pups.

Anti-inflammatory activity

Methanolic leaf extract of *Rhynchostylis retusa* (L.) Blume was evaluated for analgesic and anti-inflammatory activities in mice by Al-Amin *et al*. (2011). The analgesic activity was studied using acetic acid induced writhing and the anti-inflammatory activity was studied on carrageenan induced paw edema. It was observed that the extract showed 35.81 percent inhibition of acetic acid induced writhing at doses of (400 mg/kg) and 14.32 percent mean inhibition of carrageenan induced paw edema at (400 mg/kg),respectively.

Antibacterial and antifungal activity

Marasini and Joshi, (2012) studied that antibacterial activities of different extracts of epiphytic orchids, and reported that all orchid extracts showed good bacterial Zone of Inhibition (ZOI) against *Staphylococcus aureus*. The crude extracts of *Pholidota imbricata* and *Coelogyne cristata* were noted highest activity against *Vibrio cholerae* and *Staphylococcus aureus* respectively. Only *Pholidota imbricata* and *Pholidota articulata* extracts were shown fairly good activity but all other extracts have very less activity or even failed to show any activity against fungal organisms.

Antitumor activity in T-Cell Lymphoma

Prasad and Koch, (2014) conducted a study to evaluate the anticancer property of the ethanolic extract of *Dendrobium formosum* on Dalton's lymphoma. The *in vivo* anticancer activity study illustrates that there was significant increase in the survival time of Dalton's lymphoma bearing mice on treatment with ethanolic extract (350 mg/kg) when compared to control. These results substantiate the antitumor properties of ethanolic extract of *Dendrobium formosum* (150 mg/kg) showed highest survival days and suggest an alternative in treatment of cancer.

Antimicrobial efficacy

Paul *et al*. (2013) investigated the bioactivity of orchids against antibiotic resistance of *Escherichia coli*. Three orchid species namely *Aerides odorata*, *Acampe papilosa* and*Acampe ochracea* have shown good antimicrobial efficacy against Kanamycin and Ampicillin resistant *E. coli*. Water extract of *A. ordata* showed 0.5 cm, 0.7 cm and 0.5 cm, *A. papilosa* showed 0.5 cm, 0.6 cm and 0.5 cm and *A. ochracea*showed 0.5 cm, 0.8 cm and 0.6 cm inhibition zone against antibiotic susceptible *E. coli,* ampicillin resistant *E. coli* and kanamycin resistant *E. coli* respectively. The results suggest that all the three-orchid species has good antimicrobial activity against the three strains of *E. coli*.

Conclusion

On above ongoing discussionit can be concluded that the medicinal orchids belong mainly to the genera *Dendrobiun, Coelogyne, Cymbidium, Eria, Calanthe, Bulbophyllum, Habenaria, Pholidota, Galeola, and Gastrodia* used as medicinal property. A number of alkaloids have been extracted from these orchids, such as chysine, drobine, dendronine, grandifolin and crepidine. A wide range of chemical compounds are presented including alkaloids, bibenzyle derivatives, flavonoides, phenanthrenes and terpenoides which have been isolated from various orchids from different parts of the world. Extracts and metabolites of these plants, particularly those from flowers, stem and leave possess useful pharmacological activities. Particular attention has been given to diuretic, anti-rheumatic, anti- inflammatory, anti-carcinogenic, hypoglycaemic, anti-microbial, anti-convulsive, relaxation and neuroprotective activities.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
P.G. SEMINAR SERIES 2016-17

Speaker	**:** Patel Vaishaliben Dipakbhai	**Course**	**:** FLA- 591 (1+0)
Reg. No.	**:** 2020215047	**Date**	**:** 3-12-2016
Major Guide	**:** Dr. G. D. Patel	**Time**	**:** 3:00 p.m. to 4:00 p.m.
Co- Guide	**:** Dr. K. D. Desai	**Venue**	**:** Swami Vivekananda Hall

Crop-Ecology and Agronomy for Floral Essential oil

Floriculture is a discipline of horticulture concerned with the cultivation of flowering and ornamental plants for gardens and for floristry, comprising the floral industry. Floriculture is gaining importance throughout the world and considered as one of the country's sunrise industry both in case of cut flowers as well as loose flowers. The area under flower crops in India has increased to 2, 55, 000 ha with a production of 17, 54, 490 MT of loose flowers and 5.43 million number of cut flowers (Anonymous, 2014). An Essential oil is a concentrated, hydrophobic liquid containing volatile aroma compounds from different plant part like viz., root, flowers, leaves, seeds and bark of plant. Essential oils are obtained either by hydro distillation or solvent extraction. Use of essential oils in the fragrance, food and pharmaceutical industries and also by paint, pesticide, mining, petroleum industries and Aromatherapy. Total production of essential oil: 32,974 MT (2011). India share the 3rd largest producer natural essential oils next to USA and Brazil. Total Indian exports about 2800 tonns of essential valued at Rs.327.44 lakhs.

Brief Review of Research Work

Geology/Topography

Kachapi *et al.* (2014) studied that the mean from efficiency and common components *in Stachys lanvadulifolia* from three habits and observed maximum total percentage of component and Essential output at western Alborz, Hexadecanoic acid and α- Terpineol at Eastern Alborz and α- Cadinol at Central Alborz.

Soil

Mohamed *et. al* (2015) evaluated that different some constituent of essential in concrete extracted from petals of flowers collected from Shafa and Hada farms and higher concrete extracted from Hada farm when soil is Moderately alkaline and pH 8.26.

Aziz *et al.* (2013) studied that the effect of salinity on the vegetative characters and essential oil production of sage plants and found maximum in control (tap water).

Temperature

Emrahimi *et al.* (2011) Studied that the effect of variety and temperature on essential oil percent and found maximum essential oil percent at 12^0C temperature in Germiana variety of chamomile plant

Season

Vogel *et al.* (1999) observed the essential oil yield on different harvest date in lemon verbena plant gave maximum essential oil yield in 10^{th} March.

Cultivar

Younis *et al*. (2009) evaluated four rose cultivars of different species maximum quality essential oil in *Rosa damascena* cultivar Gulqandi.

Spacing

Berimavandi, A. R. (2011) evaluated highest flower yield and essence/area unit (ml) in plant density of 60 plant/m^2 and essence (ml/100g dry flower) in plant density 20 and plant/m^2 are observed *Calendula officinalis* L.

Cruz *et al.* (2014) studied that oil produced per plant and Oil yield per hectare of *Tagetes tenrniflora by the* management different plant distances and maximum essential oil/plant (ml) and litre observed planting distance 60 × 80 cm and 15 × 80 cm respectively.

Nutrient

Omidbaigi *et al.* (2008) studied different nitrogen level on the essential oil content of Tagetes minuta L. and noted highest essential oil observed 200 (kg/ha).

Bagheri *et al.* (2013) noted highest flower yield, essential oil % and essential oil yield (g/ha) in three spraying (at bud appearance, 10 and 20 days later) of 4g Fe solvedbin 2L water foliar application each plant of damask rose.

Far *et al.* (2015) observed quantitative and qualitative characteristics different concentration of chelated zinc foliar application in marigold gave highest in 0.5 g/thousand chelated zinc.

Ibrahim *et al.* (2015) noted highest essential oil content in foliatrian of 3ml/L nutrient application on lemon verbena plant.

Irrigation

Azimi *et al.* (2012) observed means comparison of essential oil percentage in *Calendula officinalis* L. under different irrigation regime in one harvest gave highest oil percentage from 120 mm regime.

PGR

Saffari *et al.* (2004) observed highest plant height, oil content and flower yield in Rose an application of kinetin (25mg/L) and Average flowering period application of Ethrel (1000 mg/L).

Pruning Type and Time

Saffari *et al.* (2004) studied that different time of pruning and observed highest plant height, oil content and flower yield in rose and in pruning done in 1st week of March.

Hassanein (2010) noted maximum flower weight pruning done during second week of November and essential oil content during third week October respectively in light pruning.

Harvesting

Mactavish and Menary (1997) studied that concentration of six different volatiles in five developmental stage in *Boronia megastigma* plant and noted highest volatiles open flower stage.

Younis *et al.* (2009) evaluated effect of flower harvesting time on essential oil extraction from Rose flowers are harvested in morning (5:00 hr) and evening (17:00 hr) and highest quality of essential oil obtained in morning (5.00hr).

Bhani Ram (2013) studied evolution for fragrant and overall acceptability of spider lily extract during time of storage and recorded maximum fragrant score and overall acceptability score in Petal of flower (200g each repetition) and fresh flower respectively.

Conclusions:

From the foregoing discussion it can be concluded that essential oil yield / percent is significantly effected by ecological and agronomical factor. Ecological factors like location, Constitute of essential oil higher in moderately alkaline soil and pH range 8.26**.** Increase the oil percentage and flower yield in low temperature , relative humidity, light and season are increase the quality and quantity of essential oil and relative amount of each chemical component. Agronomical factors like selection of Varieties, Foliar application of nutrient increase the growth and yield but modified its chemical composition and increase essence percentage. Increase of irrigation intervals increase percentage of essential oil but not raise the yield of essential oil because reduce flower yield. Pruning done early increase plant height, oil content and flower yield. PGR' s regulate the flowering, increase oil content of petal and flower yield. Harvesting done most of flowers early morning and open flowers stage approximately 70% flowers have reached anthesis in order to achieve higher yield and higher quality of essential oil.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
Post Graduate Seminar Series: 2016-17

Speaker	: Desai Maitri Yagneshchandra	**Course**	: FLA-591 (1+0)
Reg. No.	: 2020215017	**Date**	: 03/12/2016
Major Guide	: Dr. G. D. Patel	**Time**	: 4.00 to 5.00 p.m.
Co-Guide	: Dr. N. K. Patel	**Venue**	: Swami Vivekananda Hall

Graveness of Boron, Iron and Zinc for quality cut flower production

Flowers are an integral part of human civilization and culture. Floriculture is the art and knowledge of growing flowers to perfection. Floriculture is a fast emerging and highly competitive industry and gaining importance as an industry world over and in India with respect to cut flowers, loose flowers, pot plants, nursery etc. The area under flower crops in India has increased to 2,55,000 ha with a production of 17,54,490 MT of loose flowers and 5.45 million number of cut flowers (Anonymous, 2014).
The essential elements which are required in very small amount (less than 100 mg/kg of dry matter) or traces by the plants which can not be replaced by any other nutrients are called as trace elements. In the absence of these trace elements, the plants are known to suffer from physiological disorders which eventually lead to imbalanced growth and low yield. Micronutrients are involved in all metabolic and cellular functions. Flower crops differ in their need for micronutrients; boron (B), iron (Fe), zinc (Zn), copper (Cu), chloride (Cl), manganese (Mn), molybdenum (Mo) and nickel (Ni). These elements are active that makes them essential as catalytically active cofactors of enzymes, others have enzyme-activating functions, and yet others fulfill a structural role in stabilizing proteins. Now a days, micronutrients especially B, Fe and Zn are gradually gaining momentum among the flower growers because of scarcity in soil as well as their beneficial nutritional support and at the same time ensure better harvest and returns. Based on this background, the present review was compiled for understanding the importance of B, Fe, Zn and its effect on different cut flowers.

BRIEF REVIEW OF LITERATURE

Rose (B.N. : *Rosa hybrida* L., Family : Rosaceae)

Jagtap *et al.* (2012) recorded the vegetative growth in term of number of primary branches (2.72), number of secondary branches (7.64), number of leaves per shoot(16.83), number of leaves per plant (66.51), length of flowering stem (70.92) were found maximum in the rose plants receiving through foliar application of 0.3% $ZnSO_4$ + 0.3% $MnSO_4$ + 0.3% $FeSO_4$ under poly house.
Patel *et. al.* (2016) noted significantly maximum plant height (60 cm) and number of flowers (30.2 /plant and 166.5/ m^2) were maximum in 0.4% $FeSO_4$ while stalk length (56.23 cm), stalk girth (8.88 cm), length of bud (36.2 mm), diameter of flower (9.11 cm) and extended vase life (9.47 days) were observed maximum in foliar application of 0.4% $ZnSO_4$ in rose cv. Top Secret under polyhouse condition.

Gerbera (B.N. : *Gerbera jamesonii* L., Family : Asteraceae)

Swathi *et al.* (2014) reported that an application of 0.6% $FeSO_4$ gave significantly maximum plant height (44.1cm), plant spread (71.1cm), vase life (7.8 days) and number of flowers per plant (14.7) in gerbera cv. Rosaline grown under poly house conditions of plains of West Bengal.
Muthumanickam *et al.* (1999) stated that the combined application of 0.2% $MnSO_4$, 0.2% $ZnSO_4$ and 0.2% $FeSO_4$ resulted significantly maximum yield (46.66 g), stalk length (58.40 cm), flower diameter (11.80 cm), stalk girth (2.10 cm) and plant height (76.4 cm) in gerbera var. Ibiza.

Carnation (B.N. : *Dianthus caryophyllus* L., Family : Caryophyllaceae)

Kumar *et al.* (2003) observed that 800 ppm $ZnSO_4$ recorded significantly highest plant height (75.12 cm), maximum number of branches per plant (28.60), days to first flower bud (97.80), number of flowers per plant (40.86), biggest flower (6.88 cm) with maximum flower duration (43.37 days).

Chrysanthemum (B.N. : *Chrysanthemum morifolium* Ramat., Family : Asteraceae)

Barman and Pal (1993) noticed that length of flower stalk, diameter of flower and highest number of flowers were found maximum with combine foliar application of 400 ppm $ZnSO_4$ and 200 ppm Boron.

Karuppaiah (2014) concluded that foliar spray of 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ to chrysanthemum gave significantly maximum number of flowers per plant (89.91), flower stalk length (8.92 cm), flower yield (201.74 g/plant) and 21.14 t/ha in chrysanthemum.

Gladiolus (B.N. : *Gladiolus grandiflorus,* Family : Iridaceae)

Chopde *et al.* (2015) observed that foliar application of Zn 0.4 % + Fe 0.4% gave significant result in terms of leaf area, spikes per plant, length of spike, floret per spike and length of rachis in gladiolus.

In gladiolus, Pratap *et al.* (2004) recorded significantly maximum spike length (73.31cm), number of florets per spike (14.58) and anthocyanin content (4.82 mg/cm^2) in foliar spray of 0.75% $FeSO_4$.

Maurya and Kumar (2014) observed that plants treated with 300 mg/l Zn gave significantly highest number of leaves per plant (7.89), number of corms per plant (2.03), number of cormels per plant (38.17), weight of corms (92.64 g) and cormels (8.48 g) per plant as well as yield of corms (115.80 q/ha).

Dahlia (B.N. : *Dahlia variabilis* L., Family : Asteraceae)

Khan (2000) reported that foliar application of 0.4% Zn+ 0.2% B+ 0.4% Fe + 0.2% Mn noted significantly maximum in plant height (43.2cm) and number of branches (4.5) per plant while 0.4% Fe + 0.2% Mn resulted maximum tuber length (21.7cm) and tuber weight (234.3g) per plant.

Lilium (B.N. : *Lilium longiflorum*, Family : Liliaceae)

Under Bangalore condition, Hembrom and Singh (2015) noted that foliar application of $FeSO_4$ (0.2%) + $ZnSO_4$ (0.4%) resulted maximum number of leaves per plant (87.67), length of flower stalk (13.83 cm) while maximum stem diameter (15.99 mm) and number of buds per plant (4.67) were recorded in foliar application of $FeSO_4$ (0.4%) of Lilium.

Orchid (B.N. : *Dendrobium spp.*, Family : Orchidaceae)

Ganga *et al.* (2009) noticed that orchid plants treated with NPK (0.2% @ 20:10:10) + 1000 ppm Fe gave significantly maximum plant height (39.31cm), number of leaves per plant (7.51), number of spikes per plant (6.73), number of florets per spike (6.73) and longest spike (35.24 cm), while maximum longevity (34.14 days) and vase life (16.11 days) of orchid was reported with the plants treated with NPK (0.2% @ 20:10:10) + 1000 ppm Zn.

Conclusions

From the foregoing discussion, it can be concluded that application of B, Fe and Zn in ample amount can improve growth, yield and quality parameters of different flower crops. Individual foliar application of $ZnSO_4$ @ 0.4% or $FeSO_4$ @ 0.4% is effective for good quality flower production of rose and gladiolus while combined application of $ZnSO_4$ @ 0.3% + $FeSO_4$ @ 0.3% is effective for better quality of cut rose. For obtaining good growth and flowering of gerbera, 0.6 % $FeSO_4$ is found effective while 0.2 % $FeSO_4$ + 0.2% $ZnSO_4$ enhance yield and floral characters. Foliar spray of Boron @ 1.0 g / m^2 / week is effective to control calyx splitting while 800 ppm Zinc is very effective for superior quality of carnation. Individual application of 200 ppm B or combine application of $ZnSO_4$ @ 0.5% + $FeSO_4$ @ 0.5% found more efficient to improve flowering characters of chrysanthemum. For obtaining better vegetative growth of dahlia, 0.4% Zn + 0.2% B + 0.4% Fe is found useful while 0.4% $ZnSO_4$ + 0.4% $FeSO_4$ increase the flowering of Lilium under polyhouse condition. In *Dendrobium* orchids, foliar application of 1000 ppm Fe or 1000 ppm Zn with 0.2% NPK is most prominent for superior flower quality.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post Graduate Seminar Series: 2017-18

Speaker	: Kitty Rajan	**Course**	: FLA-591 (1+0)
Reg. No.	: 2020216012	**Date**	: 16/09/2017
Major Guide	: Dr. Dipal S. Bhatt	**Time**	: 9 to 10 a.m.
Co-Guide	: Dr. C. R. Patel	**Venue**	: Swami Vivekananda Hall

EFFECT OF LIGHT MANAGEMENT IN FLOWER CROPS

Light is probably the most complex and variable ambient factor that act on plants.It has a very important role to give energy for photosynthesis and to act as a stimulus for growth and development. Plants respond to light quantity, quality,direction and periodicity. A good lighting system will place the proper quantity and quality of light where it is needed in a cost effective way. The amount of light needed is highly dependent on the tasks that need to be performed. Depending on the culture, climate and other factors artificial light or alternatively shading materials are needed to reach the optimal light level.Artificial light can be applied in ornamental plants for two main objectives: to increase the irradiance level for photosynthesis and to increase the effective day length (photoperiodism). Photoperiodism is a response to the seasonal variation of day length and changes in day length above or below the critical level affects the blooming of flower (Irwin, 1982). Many flowering plants have a photoreceptive protein, such as phytochrome or cryptochrome to sense seasonal changes in day length which act as signals to flower. Photoperiodic response to flower induction and development of many plant species are synchronized temporarily during the year with night length. Off-season flowers can be produced by use of photoperiod and light intensity that provide a year-round production of flowers.

Brief review of literature

Artificial light sources (Grow light)

Lolapuri Neelofar and Arora (1995) stated that extension of day length by 6 hrs produced significantly taller plants and increased no. of flowers per plant (6.19) whereas, significantly early flower bud initiation (84.62 days) and flowering (129.39 days) with minimum calyx splitting (14%) were obtained under 4 hrs light extension in Sim carnation cv.Scania.

Lian *et al.* (2002) tested the effect of LEDs on the *in vitro* induction and growth of bulblets of *Lilium* oriental hybrid „Pesar‟ and stated that red plus blue LED was suitable for bulblet growth in terms of highestbulblet diameter (1.19 cm), fresh weight of bulblet (766.8 mg), maximum no. of roots (11.8) and fresh weight of roots (404.1 mg).

Effect of light quality on photosynthetic rate and growth of chrysanthemum plantlets after 5 weeks of culture was studied by Kim *et al*. (2004) and reported that net photosynthetic rate was consistent with plantlet growth, showing highest rate in blue plus red (B+R) light followed by fluorescent light.

Application of additional light by incandescent bulbs (60 W) for 6 hrs after sunset significantly increased plant height (76 cm) induced early flowering (156.3 days) and maximum no. of flowers per plant(7) along with longer flowering stems (69.9 cm) in carnation cv.Tasman (Singh *et al.,* 2006).

Cristiano *et al.* (2008) studied the influence of supplementary lighting in autumn for different gerbera cultivars and revealed that the day length extension by 4 hrs with 400 Watt mercury vapour lamps (HPL) increased 16 per cent yield as compared tonatural condition. Further, they stated that cultivar „Zembla‟ produced higher no. of stems per plant followed by „Rosalin‟ and „Cornice‟.

Harada and Komagata (2014) studied the effects of long day treatment using fluorescent lamps of 20W and supplemental lighting using white LEDs on the yield of cut roses in Japan and reported that supplemental lighting at 250 μmolm¯2s-1 increased the number of cut flowers as compared to other treatments.They also stated that irradiation at 250 μmolm¯2s-1, PPFD significantly increased stem length (80 cm), flower stem weight (45.5 g), number of nodes (15.1) and stem diameter (6.3 mm) of cut roses.

Velmurugan *et al.* (2010) investigated the effect of photoperiod on nutritional characteristics of chrysanthemum cv. Co 1 and stated that artificial short day condition by 14 hrs shade significantly increased total nitrogen, phosphorus, potassium and calcium contents during February, April and June month planting. Further, significantly highest total nitrogen, phosphorus, potassium and calcium contents were recorded in the plants grown under 2 hrs extended light during August, October and December monthplanting.

Photoselective shade nets

Shahak *et al*. (2002) observed the dwarfing effect of the blue net (60% shade) was expressed by shorter petioles, lower harvest yield and smaller plants while yellow net increased all leaf dimensions as well as harvest yield in Japanese aralia (*Fatsia japonica*).

Ada *et al.* (2008) studied the effect of shade net colour on flowering of *Crowea* „Poorinda Extasy" and revealed that pot plant of *Crowea* grown under pearl light scattering net produced significantly maximum number of flowers per branch during summer and autumn season in Israel condition.

Ovadia *et al.*(2009) compared different shade net colours on growth and yield of *lisianthus* and stated that longer stem length, inflorescence length and maximum weight of stem were seen under yellow shade net while the coloured nets had no effect on the number of flowers in cv. Mirage Pastel under Israel condition.

Sangma Palmsey (2012) evaluated the effect of different covering materials on off season cut flower production of chrysanthemum and concluded that covering of chrysanthemum cultivars using HDPE (High Density Polyethylene) resulted in maximum plant height (110.78 cm), earliest flower bud formation (91.07 days) with maximum number of cut stems (4.21) for off season flower production under Nauni, Solan condition.

Conclusions

From the foregoing discussion, it can be concluded that extended daylength of 6 hrs (incandescent and LED light) increased the growth and yield of carnation and chrysanthemum. Red + Blue LEDs light enhanced growth of chrysanthemum and *lilium*. Additional 4 hrs day length increased the yield of gerbera in autumn season. Supplemental lighting by white LED (250 µmolm¯2s-1) is best for yield of cut roses. Pot plants *viz.*, japanese aralia and *lisianthus* performed best under yellow colour shade net while *Crowea* plant gave maximum production under pearl shade net. Artificial shade condition (14 hrs) with HDPE improved growth, flower quality and yield of chrysanthemum.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
Post Graduate Seminar Series: 2017-18

Speaker	: Patel Rital J.	**Course**	: FLA-591 (1+0)
Reg. No.	: 2020216025	**Date**	: 07/10/2017
Major Guide	: Dr. S. A. Aklade	**Time**	: 9.00 to 10.00 a.m.
Co-Guide	: Dr. S. J. Patil	**Venue**	: Swami Vivekananda Hall

Natural colour extraction from flowers and ornamental crops

Natural colours are obtained from plants, animal and mineral sources without any chemical treatment. Due to causing health hazard and polluting environment by synthetic dye, people preferred using of natural dye and also it is renewable and sustainable bio resource product with minimum environmental impact. Natural colour is used in colouring of food, pharmaceutical, cosmetic and textile products. Flowers and ornamentals crops are used for natural colour extraction like marigold, flame of forest, rose, hibiscus, indigo, calendula, etc. as well as annatto seed are also used whereas, Indigo is one of the oldest natural dye and now a days, natural colour extracted from marigold is extensively used. In India, there are more than 450 species that can yield natural colours (Naik *et al*. 2012). Extraction of dyes is in general affected by various factors like time, temperature, methods (like soxhlet, supercritical fluid extraction, subcritical water extraction and sonicator methods), mordants, pH, M: L ratio, etc.

REVIEW OF LITERATURE:

Time and Temperature

Assad *et al*. (2013) studied the effect of time (30, 60, 90 and 120 minutes) for extraction of marigold dye by soxhlet method and observed that the optimum time for extraction of marigold dye was 90 minutes which resulted in highest colour strength value of 2.86, lighter value of 60.10 and yellow value of 25.90. Whereas, in another experiment in marigold through same method with different temperature levels they obtained higher colour strength value of 2.86, lighter value of 60.00 and yellow value of 25.90 at 100 ºC temperature.

Sinha *et al*. (2012 a) recorded the different time intervals (45, 60, 90 and 120 minutes) for dye extraction from flame of forest and observed that optimum time for extraction of colour from petals was 120 minutes. Further they also noticed that the temperature highly influence the extraction process and the maximum dye was achieved at 70 ºC temperature from flowers.

Sinha *et al*. (2012 b) studied the effect of different time intervals (10, 30, 50, 60, 75, 90 and 120 minutes) for extraction of dye from butterfly pea flower and notice that maximum dye was extracted at 120 minutes.

Saha Papita and Sinha (2012) conducted an experiment on effect of time (10, 20, 30, 40, 50 and 60 minutes) on the extraction of dye from annato seeds and observed that the absorbance of dye increase as time increase due to increase in concentration of dye and obtained maximum dye at 60 minutes. They also recorded maximum extraction of dye at 100 ºC temperature rather than 30, 50, and 80 ºC from annatto seeds.

Mordants and Methods

Thiyagarajan *et al.* (2015) recorded maximum colour strength value of 90.48, yellow value of 49.84 in cotton with *Hibiscus vittifolius* dye by using copper sulphate as a mordant.

Jothi (2008) studied the effect of different mordants (alum, ferrous sulphate, copper sulphate and stannous chloride) on colour strength value of cotton and silk dyed with marigold flowers and observed the best result in copper sulphate on cotton and ferrous sulphate on silk with good colour strength value of 1.17 and 1.27 respectively, than other mordants.

Patil *et al.* (2016) conducted an experiment on effect of different mordants with different extraction methods and observed different shades of colours like grey, black, brown, yellow, pink, dark red, copper, violet, and dark pink in rose.

Vankar Padma *et al.* (2009) studied the different methods like aqueous and ethanolic method for extraction of dye from marigold flower and observed the best results under the ethanolic method, which gave the maximum dye content (3.45g dye content from 100 g flowers).

Vankar Padma and Srivastva Jyoti (2008) found that the red canna flowers gave good colour strength value of 111.84 by alcoholic extraction method as compared to other flowers like yellow canna and hibiscus which gave 96.0 and 99.94 colour strength value, respectively.

pH and M:L Ratio

Assad *et al.* (2013) studied the effect of different M:L ratio at 1:10, 1:20, 1:30 for extraction of marigold dye and observed the highest colour strength value of 2.87, lighter value of 60.00 and yellow value of 25.90 in 1:20 material to liquor ratio.

Saha Papita and Sinha (2012) reported that the maximum dye of 9400 mg/l can be extracted from annato seeds in the basic medium than salt and acidic medium.

Vankar Padma and Srivastva Jyoti (2008) conducted an experiment on different pH level at 4.0, 4.5, 7.0 and 9.0 for extraction of dye from canna flowers and obtained the highest colour strength value of 194.82% at 9 pH.

Saha Papita and Datta (2007) studied the effect of different pH on extraction of China rose and butterfly pea flowers dye and observed the best result under basic medium.

CONCLUSION

From the foregoing discussion, it can be concluded that the various factors affect the dye content extracted from the flowers and ornament plants. Maximum dye content can be extracted from flame of forest and butterfly pea in 120 minutes while marigold flowers and annato seeds required 90 and 60 minutes, respectively. In case of temperature, maximum dye can be obtained at 100^oC from marigold flowers as well as annatto seeds and 70^oC was found to be optimum for flame of forest. As far as mordants are concerned, copper sulphate and ferrous sulphate were found to be best for achieving higher colour strength values. Whereas, basic medium was the best for achieving maximum dye content from China rose, butterfly pea and canna flowers, while the material : liquor ratio should be 1:20 for getting higher colour strength values in marigold.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post Graduate Seminar Series: 2017-18

Speaker	: Gamit Dipika R.	**Course**	: FLA 591 (1+0)
Reg. No.	: 2020216007	**Date**	: 24/11/2017
Major Guide	: Dr. G. D. Patel	**Time**	: 4:00 p.m. to 5:00 p.m.
Co-Guide	: Dr. S. S. Gaikwad	**Venue**	: Swami Vivekananda Hall

Use of plant growth regulators for pot culture

Floriculture has emerged as one of the most dynamic and advanced factor of contemporary agribusiness in world as well as in India with respect of cut flowers, loose flowers, pot plants, landscape plants and nursery *etc*. The area under floriculture crops in India has increased to 3,28,000 ha with a production of 16,95,000 MT loose flowers and 5,82,000 MT of cut flowers (Anonymous, 2016-17). The sector of ornamental plants is worth of about $9.4 billions in the world flower trade (UNCOMTRAE statistics 2014). Rapidly growing urbanization and population explosion with hasty life style have created space paucity for living, where in pot plant offer some relief with a great scope for urban green scaping. Export the pot plant is worth about $10.86 and import $7.47. It improves the bio aesthetic value of different place, reduce or eliminate volatile organic compound from indoor air, remove harshness of building construction and overcome the mental fatigue as well as. The NASA researchers suggest that for the indoor plants to be effective "air cleaners", it is necessary to use 1 potted plant per 100 square feet of home or office space (Wolverton *et al.,* 1989).

For the pot management, different cultural practices should be done like planting, watering, nutrient management, training, pruning, plant growth regulators as well as control of pest and diseases. Plant growth regulators play a vital role for the management of pot culture. Plant growth regulators are a broad term which includes natural and synthetic plant hormones and retardants. The major plant growth regulators are auxin, gibberellins, ethylene, cytokinin and abscisic acid.

Review of literature:

Deo (1999) studied the effect of plant growth regulators on rooting of stem cutting of bougainvillea and stated that highest percentage of bougainvillea sprouting was recorded in 3000 ppm IBA treatment.

Bhattacharjee and Islam (2014) observed that combination of BAP + NAA (1.5 + 0.5 mg/l) was found most suitable for seedling growth of *Vanda tessellate* in MS medium.

Parvin *et al*. (2009) studied the effect of different levels of NAA on *in vitro* growth and development of shoot of *Dendrobium* orchid. They noted that NAA @ 0.1 mg/l gave maximum weight of shoot, number of shoots and number of leaves.

Nambiar *et al*. (2012) studied the effect of 6-benzylaminopurine (BAP) on flowering of *Dendrobium* orchid and recorded that maximum flowers per inflorescence and length of inflorescence with early inflorescence emergence were resulted through application of BAP @ 200 mg/l.

Cochran and Fulcher (2013) studied different plant growth regulators and concentration on influence of floral growth of hydrangea. They found that lower concentration of Dikegulac sodium, Benzyladenine and Ethephon were found effective to produce maximum number of flower, flower length and width as well as flower index.

Henny *et al.* (1999) found that GA_3 @ 2000 mg/l produced maximum number of cane, number of flower per plant and number of flower per cane in syngonium cv. White Butterfly.

Azzaz *et al.* (2007) observed that GA_3 @ 150 ppm was effective for earliness and number of flower per plant while CCC @ 3000 ppm was found effective for plant height control and number of branches per plant in *Calendula officinalis*.

Foliar spraying of Paclobutrazol @ 100 mg/l was found useful to control plant height and inflorescence height as well as obtained longer flowering duration, stem strength and leaf colour without any phytotoxicity symptoms in Dutch grown Bleeding Heart as a flowering potted plant (Kim *et al.,* 1998).

Wanderley *et al*. (2014) observed the highest number of new shoots formed in *Arundina graminifolia* by foliar application of Paclobutrazol (5mg/l).

Whipker and Hammer (1997) observed that uniconazole @ 0.125 mg a.i./pot was suitable for earliness and maximum inflorescence diameter for compact potted dahlia cv. Red Pigmy.

Wang and Hsu (1994) observed that foliar application of paclobutrazol @ 250 mg/l at emergence of 10 cm flower spike stage was beneficial for reduce inter-nodal length between first two flower and increase the first flower width of *Phalaenopsis*.

Cramer and Bridgen (1998) tested different growth retardants on *Mussaenda* cv. Queen Sirikit and found that application of ancymidol was significantly control plant height and increase flowering duration.

Shivangi Sheth (2012) studied pot culture management with the use of plant growth retardants under polyhouse condition in rose cv. Valentine and noted that Alar (500 mg/l) was found superior in case of plant spreading, plant height, number of flowers and duration of flowering with good overall plant preventability.

Conclusion

From the foregoing discussion it can be concluded that adequate use of plant growth regulators were found effective for modify the physiological process of several potted ornamentals. For plant propagation IBA @ 3000 mg/l gave concrete result to increase sprouting of bougainvillea cuttage. NAA alone or combinations with BAP are most promising for shoot elongation in micro-propagation of different species of orchids. BAP @ 200 mg/l gave maximum flower per inflorescence and length of inflorescence with early inflorescence emergence in *Dendrobium* orchid. Dikegulac sodium and Benzyladenine were found effective to produce maximum number of flower, flower length and width as well as flower index in hydrangea. GA_3 can enhance the profuse flowering in *Calendula officinalis* and Syngonium. Judicious application of growth retardants like viz. PBZ, Alar, Ethephon, CCC and Uniconazole modified plant structure by increasing number of shoots, number of flowers and duration of flowering in different ornamental potted plants.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post Graduate Seminar Series: 2017-2018

Speaker	: NAIK BHOOMI PARIMAL	**Course**	: FLA-591 (1+0)
Reg. No.	: 2020216019	**Date**	: 24/11/2017
Major Guide	: Dr. S. T. Bhatt	**Time**	: 5.00 to 6.00 PM
Co-Guide	: Dr. S. S. Gaikwad	**Venue**	: Swami Vivekananda Hall

VALUE ADDITION AND INDUSTRIAL UTILIZATION OF MARIGOLD

The common term ‘marigold’ embraces a diversity of plants with golden flowers, belongs to family asteraceae is an important loose flower crop, mainly cultivated for decorative purposes and industrial use throughout the world. The genus *Tagetes* comprises about 33 species of which the four species namely, *T. erecta* L., *T. patula* L., *T. minuta* L., and *T. signata*, are found in India. Among these, the first two species have been grown widely at commercial in different agro climatic conditions, whereas *T. minuta* commonly known as wild marigold has been grown in colder regions only. They fetch higher price during festivals and marriage seasons for decorations and also from commercial products *viz.* pigment extraction, natural colour dyes, oil extraction and pharmaceutical compounds. The genus *Tagetes* holds promise as a bioresources for a variety of useful phytochemicals. There is a high variability in the phytochemicals; well known among them are terpenoids, flavonoids, carotenoids and thiophenes, most of these are biologically active.

BRIEF REVIEW OF LITERATURE

Pigments

Rao *et al.* (2005) recorded significantly maximum carotenoid pigment (2.69 mg/g fresh wt.) in the petals of marigold cv. Pusa Narangi Gainda. Whereas, flower yield (21.91 t/ha) and total carotenoid (51.07 kg/ha) were significantly highest in African marigold cv. Orange Double.

Jidapha *et al*. (2006) studied the total carotenes, total xanthophylls and total carotenoid contents of fresh and dried petal extracts from various flowers in the North Thailand and noted that the highest pigments with respect to total carotene (619$\pm$ 0.50 mg/kg, 1954 $\pm$ 0.35 mg/kg), total xanthophylls (685 $\pm$ 0.30 mg/kg, 2,443 $\pm$ 0.30 mg/kg) and total carotenoids (1,304 $\pm$ 0.40 mg/kg, 4,397 $\pm$ 0.25 mg/kg) were obtained from fresh and dry petals of *T. erecta* plant, respectively.

Singh *et al.* (2008a) reported that the flowers harvested at half bloom stage were having both higher total carotenoid and carotene content as compared to full bloom stage irrespective of genotypes; large flowers were having higher total carotenoid and carotene content than smaller flowers. Among genotypes, Pusa narangi gainda reported highest total carotenoid content at all harvesting stages and grades whereas the half blooms of selection 19 were having higher carotene content than full bloom large flowers of same genotype.

Singh *et al.* (2008b) stated that pre-treating of the petals of marigold cv. Pusa Narangi Gainda drying in a cabinet drier and packing in 400 LDPE gave better retention of carotenoids and its fractions. They also studied the effect of drying method on constituents of petals of marigold cv. Pusa Narangi Gainda and found that cabinet drying was significantly superior with resect to moisture (2.40%) with maximum drying rate (0.15 kg/ha) and retain maximum total carotenoid (355.04 mg/100g) and carotene (18.43 mg/100g) content.

Ingkasupart *et al*. (2015) studied the antioxidant activities and lutein content of 11 marigold cultivars (*Tagetes spp*.) grown in Thailand and found that maximum lutein (20.59 g), gallic acid (25.77g) and quercetin (12.61 g) were obtained in marigold cv. ‘Optiva Orange’, while the maximum phenolic content with maximum antioxidant activity was observed in marigold cv. ‘Rodeo Gold’.

Essential oil

Janick and Whipkey (2002) stated that the essential oil of *Tagetes minuta* showed antimicrobial activity against some human pathogens *viz. Aspergillus niger, Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus* and *Saccharomyces cerevisiae.*

Rondon *et al.* (2006) analysed the constituents of the essential oil of *T. patula* and reported major compounds *viz.* piperitone (33.77 %), Trans-β- ocymene (14.83 %), terpinolene (13.87 %) and β-caryophylla (9.56 %) in *T. patula*.

Natural dye

Extraction of natural dye from African marigold flowers (*Tagetes erecta* L.) was studied by Jothi (2008) and resulted that highest k/s value with maximum darkness was exhibited in the cotton fabric with $FeSO_4$ as a mordant. Whereas, silk fabrics dyed with marigold flower dye gave maximum darkness with mordant $CuSO_4$.

Assad *et al*. (2013) studied the effect of extraction time for extraction of marigold dye by soxhlet method and observed that 90 min. was the optimum time for extraction of marigold dye which resulted higher colour strength value 2.86, lighter value 60.10 and yellow colour value 25.90 and also found that higher colour strength value 2.86, lighter value 60.00 and yellow colour value 25.90 was obtained at 100^0 C for extraction of marigold dye.

Trap crop

Sandhu and Arora (2014) was conducted an experiment test to study the ovipositional and larval preference of *Helicoverpa armigera* on the test plants of marigold and coriander. They revealed that maximum number of eggs were laid on the two varieties of marigold plants var. Pusa Narangi and Summer Saugat (83.6, 80.8) which were significantly higher than the number of egg laid on coriander plants. They also found that larval preference among the trap crop genotypes, Pusa Narangi cultivar of marigold was the most preferred with closely followed by the second marigold cultivar Summer Saugat.

Taye *et al*. (2012) studied the effect of plant extract application in root-knot nematode infested field of tomato. They found that the application of lantana and Mexican marigold leaves extract at 5 per cent concentration reduced root-knot nematode infestation (50%) with reduction in final population over control by 59 per cent.

Conclusions

From foregoing discussion it can be concluded that marigold (*Tagetes spp*.) is a valuable bioresource of major bioactive phytochemicals *viz*. carotenoid, flavanoids, terpenoid and thiophene. The composition of extract from flowers, foliages, stems and roots vary with carotenoid pigments predominantly in *T. erecta* cv. Pusa Narangi Gainda (2.70-4.15 mg/g), total lutein(569 mg/100g) in *T. patula*. The major constituents of Ocimenones E & Z (15-25%), Z-B Ocimene (35-50%), Dihydrotagetone (10-34%), tagetone (7-17%) are present in essential oil of *T. minuta*. Leaves and root extracts of *Tagetes* spp. are leading source of thiophene (15-21mg/kg). Mordants like copper sulphate and ferrous sulphate were found to be best for dying of cotton and silk fabrics.The nematicidal compounds like thiophene and α-terthienyl obtained from the roots of *Tagetes* spp. showed efficiency against different species of nematodes. India possessing an ideal agro-climatic conditions for year round production of marigold and has tremendous potential to expand the area of cultivation and diversify it towards value added products which can be utilized in medicine, food additives, perfumery and pesticide sectors.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
Post Graduate Seminar Series 2017-2018

Speaker	: Patel Vipul H.	**Course**	: FLA-591 (1+0)
Reg. No.	: 2020216026	**Date**	: 6/01/2018
Major Guide	: Dr. G. D. Patel	**Time**	: 04:00 to 05:00 pm
Co-Guide	: Dr. N. K. Patel	**Venue**	: Swami Vivekananda Hall

Foliar fertilizer application for quality cut flower production

Flowers are an integral part of human civilization and culture. Floriculture is the art and knowledge of growing flowers to perfection. Floriculture is a fast emerging and highly competitive industry and gaining importance globally as an industry with respect to cut flowers, loose flowers, pot plants, nursery etc. The area under flower crops in India has increased to 3,28,000 ha with a production of 16,95,000 MT of loose flowers and 5,82,000 MT of cut flowers (Anonymous, 2016).

Intensive cut flower production requires high level of fertilization and its imbalance may reduce quality flower production and may also result in soil and environmental pollution. Foliar feeding is a way of supplementing the nutrients quickly and specifically and also for stimulation of plant metabolism. Foliar fertilization has been used as a means of supplying supplemental doses of major and minor nutrients, plant hormones, stimulants and other beneficial substances. The plant nutrients which are absorbed through roots can also be absorbed with equal efficacy through foliage and often several times more efficiently than from soil treatments (Del, 1971). Foliar sprays minimize wastage and the quantity to be sprayed is fairly a fraction of what be required for soil application. Effects of foliar fertilization include yield increases, resistance to disorder and insect pests, improved drought tolerance and plant growth (Sebastian and Christopher, 2007).

BRIEF REVIEW OF LITERATURE

NPK and its combination

Jamwal *et al.*(2007) found that 2 per cent urea spray at 20, 40 and 60 days after planting improve plant height (111.10 cm), leaf area (603.0 cm^2), spike length (104.23 cm), rachis length (56.80 cm) and minimize days for florets open at time (4.00) in gladiolus cv. American Beauty.

Naggar *et al.* (2009) noted that maximum stem length (78.99 cm), biggest flower diameter (9.51 cm) total fresh weight (35.92 g), highest number of flower (9.58) per plant with early flowering (133.66) ware observed with foliar application of 100 ppm phosphorus in *Dianthus caryophyllus* cv. Red Sim.

Naggar and Nasharty (2014) revealed that foliar application of 2 per cent K and 75 per cent K as soil dressing at 21 days interval after planting up to growing season found promising for early flowering, produce maximum number of floret per spike, and floret diameter in Gladiolus cv. Rose Supreme.

Khosa *et al.* (2011) observed that gerbera plants treated with NPK (2g/pot) noted significantly maximum plant height, number of leaves per plant, longest stalk and biggest flowers diameters.

Singh *et al.* (2015) reported that application of 250 ppm N and 250 ppm K in the form of urea and MOP, respectively through fertigation along with foliar spray of NPK at 250 ppm through sujala once a week in carnation cv. Master produced significantly early flower bud formation (102.18 days) with maximum number flowers/plant (6.90), largest flower size (7.00 cm) with highest A-grade flowers (88.58).

Gurjar *et al.* (2012) recorded maximum spathe length (4.99 cm), spathe width (3.99 cm) and flower stalk length (21.98 cm) in the treatment apply weekly once @ 0.2 per cent foliar spray of NPK nutrients with the ratio of (30:20:40) in anthurium cv. Flame.

Micro nutrient and its combination

Bhaskarwar *et al.* (2017) concluded that concentration of 0.25 percent zinc found promising to produce better plant height, stem diameter, flowers per plant and vase life with early days for flowering in rose cv. Centenary.

Ganesh *et al.* (2013) found that higher plant height (40.04 cm), spike length (82.61 cm), number of florets/spike (40.49) and diameter of unopened flower bud (6.47 cm) ware observed with foliar spray of H_3BO_3@0.1%+ $ZnSO_4$@0.5%+ $FeSO_4$@0.2% in tuberose cv. Prajwal.

Ganesh *et al.* (2014) recorded that maximum plant height (132.54 cm), flower stalk length (120.15 cm), open flower circumference (10.59 cm) and cut stem yield (76.50/m^2) ware observed in 100% RDF @16:4:16 g NPK/m^2 + foliar spray of 0.2% EDTA chelated micronutrient mixture in chrysanthemum.

Macro and micro nutrient

Giri *et al*. (2017) noted that maximum flower length (9.50 cm), flower width (16.50 cm), bulb weight (34.83 g) and minimum days to bud appearance (18.67) ware observed in foliar application of MS (macro+micro+vitamins) @ 1ml/l in lilium plants cv. Tresor.

Naggar and Sayed (2008) recorded significantly maximum flower /plant (11.21), biggest flower diameter (11.87 cm), flower fresh weight (42.07 g) and flower dry weight (3.26 g) with early flowering (113.63 days) were obtained in carnation by spray of 0.6 per cent Sangral, which contains macro - elements (20% N, 20% P, 20% K, 0.12% Mg) and micro - elements (70 ppm Fe, 14 ppm Zn, 16 ppm Cu, 42 ppm Mn, 72 ppm B and 24 ppm Mo).

RDF with others

Sathyanarayana *et al*. (2017) reported that maximum spike length (66.63 cm), number of florets/spike (11.30), number of spikes/plant (2.50), vase life (14.93 days) and early spike initiation (48.10 days) were recorded in application of 100% RDF + FYM @ 7.5 t/ha + *Azotobacter* + *PSB* + *KMB*+ 1% foliar spray of *Nauroji Novel* Organic Liquid Fertilizer in gladiolus cv. American Beauty.

Pradeep *et al*. (2014) observed that highest plant height (104.84 cm), spike length (51.35), no.of florets/spike (44.20), flower weight (4.99 g) and no. of marketable spikes/plot (50.45) were noted in application of Vermicompost @ 2.5 t ha^{-1} + VAM + 0.2 % foliar spray of humic acid in gladiolus.

Kumar *et al.* (2012) noted maximum spike length (90.68 cm), rachis length (47.07 cm), vase life (10.02 days) and minimum days to spike initiation (81.73 days) in combined application of VAM **+** vermicompost as soil application and foliar application of vermiwash in gladiolus cv.White Prosperity.

Naik *et al.* (2013) concluded that foliar application of *panchgavya* at 1:30 (*panchgavya*: water) in orchids resulted significantly highest number of spikes per plant (2.60), maximum number of florets per spike (10.60), longest spike (44.60 cm) and rachis length (21.20 cm).

CONCLUSION

From the foregoing discussion it can be concluded that, the foliar application of the correct nutrients in relatively appropriate concentration at critical stage in crop development contributes significant role to get higher yields with improved quality. Epiphytic plant like orchid and anthurium can fertigated with foliar feeding with NPK helps to produce more number of quality flowers. In gladiolus and carnation individual spray of nitrogen, phosphorus and potassium increase the vegetative growth and reduce the days to flowering of quality cut flowers. Individual application of micro elements or combination of different micronutrient mixture can enhanced the growth, yield and quality of rose, tuberose and chrysanthemum. Foliar application of natural source of nutrients like *nauroji novel* Organic Liquid Fertilizer, humic acid, vermiwash and *panchagavya* can improve spike quality of gladiolus and orchids. Combined application of macro, micro and vitamins significantly improve the flower quality and earliness in lilium.

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Speaker	:	Patel Snehakumari Maheshbhai	**Course**	:	FLA 591 (1+0)
Reg. No.	:	2020217024	**Date**	:	29/09/2018
Major guide	:	Dr. S. A. Aklade	**Time**	:	4.00 to 5.00 p.m.
Co-guide	:	Dr. B. M. Tandel	**Venue**	:	Swami Vivekananda Hall

Recent Advances in Production Technology of Anthurium

Floriculture has been emerging as a future thrust industry in India and referred as tomorrow's green cultivation. Today, floriculture is a lucrative profession with higher potential for returns than most of the field and other horticultural crops. The area under flower crops in India has been increased to 3,06,000 ha with a production of 16,99,000 MT of loose flowers and 6,93,000 MT of cut flowers (Anon, 2017). The demand of flowers both in India as well as international markets is increasing at a faster rate owing to the liberalization of economy and globalization of trade.

The leading flowers which are great in demand are rose, chrysanthemum, carnation, gladiolus and anthurium. Globally, anthurium ranks 11th position among the cut flowers and 2nd position among tropical cut flower. It belongs to family Araceae and is native of Tropical America (Columbia). The genus anthurium has around 600 species and among them, *A. andreanum* and *A. scherzerianum* are the two important species cultivated extensively for the flower production. *Anthurium andreanum* is also known as oil cloth flower, tail flower or painter's palette, it is an excellent plant for interior and as cut flower, especially for flower arrangement. The most suitable part of anthurium is modification of leaf and botanically known as 'spathe'. The heart shaped spathe appears on a long flower stalk with a cute spadix. In India, growing of anthurium has been a hobby earlier but at present it has become an important export oriented crop and farmers started cultivating it commercially. For higher production and improved quality, several new technologies have been evolved in anthurium.

Review of research work

Varieties

Agasimani *et al.*(2010) reported that among different varieties, Esmeralda produced maximum number of leaves, leaf length, leaf breadth, leaf area, stalk length, stalk diameter, stalk girth, spathe length, spadix length, number of flowers and vase life. Whereas, the maximum number of suckers and spathe breadth were obtained in variety Ivory and Titicaca, respectively.

Sahare (2015) observed maximum spathe length, spathe width, spadix length, stalk length and vase life in variety Sante Royal while, the maximum number of flowers per plant and flowers per m^2 were recorded in variety Xavia under South Gujarat condition in winter season.

Anand *et al.* (2017) evaluated different varieties of anthurium and observed maximum plant height, number of leaves and leaf length in variety Calisto. Whereas, significantly maximum plant spread and leaf breadth were obtained in variety Fantasia, while the number of suckers were found higher in Lumina. They also studied floral characters of these varieties, in which Calisto was found better with respect to all the parameters under the study.

Media

Singh *et al.* (2011) studied the different media combinations and reported that the treatment T_6 (saw dust : wooden charcoal : soil : sand : FYM in 2:1:1:1:1 ratio) was found optimum for vegetative as well floral parameters in anthurium cv. Flame.

Muraleedharan and Karuppaiah (2015) observed significantly maximum plant height (48.82 cm), plant spread (72.55 cm), number of flowers per plant (5.13), flower stalk length (43.39 cm), spathe length (9.47 cm) and breadth (9.66 cm) in treatment T_5 (75 % shade & coir pith + coconut husk), while significantly minimum days (102.91) for flower bud appearance was also recorded under the same treatment combination.

PGR and Nutrient management

Pancholi *et al*. (2010) observed that among different treatments of foliar spray, application of GA_3@ 150 ppm produced maximum number of leaves (5.2), number of suckers (1.8), length of spathe (6.2 cm) as well as spadix (4.0 cm) along with significantly higher number of flowers (4.3) per plant in variety Coralis.

Gurjar *et al.* (2012) studied the flowering parameters as affected by different nutrient sprays at different frequency and recorded minimum days to flower opening, maximum length and width of spathe along with stalk length under the treatment F_7 (30:20:40). Whereas, flower longevity and vase life was found better in treatment F_6 (20:20:40), while number of flowers were found significantly higher in F_1 (NPK @ 30:30:40) but was at par with F_7.

Shajma and Sabina (2012) observed the maximum vegetative growth in terms of plant height, number of leaves and leaf area at 225 DAT and higher petiole length at 4 WAE were recorded with cow dung extract at 4 g/l per plant. Similarly, organic manure mix at 25 g/plant resulted in significantly taller plants with greater leaf area, while higher petiole length and minimum days to phyllachron were observed significantly under 75 g and 50 g/plant organic manure mix, respectively.

Handaragall *et al.* (2013) observed that the application of (NPK @ 30:10:10) at 0.2 % spray + *Azospirillum* + Phosphobacteria + VAM + GA_3 @ 100 ppm recorded significantly minimum days for flower bud appearance as well as for flower opening and this treatment also gave maximum flowers per plant and per m^2, while longevity of spikes was found highest in NPK (15:0:10) at 0.2 % spray + *Azospirillum* + Phosphobacteria + VAM + GA_3 @ 100 ppm.

Handaragall *et al.* (2013) observed that all the parameters like spathe length and width, spadix length and girth, stalk length and girth and vase life were found better as compared to other treatments with application of NPK (30:10:10) at 0.2% spray + *Azospirillum* + Phosphobacteria + VAM + GA_3 @ 100 ppm.

Maitra and Roychowdhury (2014) recorded maximum number of suckers per plant and minimum days to flower bud initiation with spraying of BA @ 1000 ppm (T_2) in anthurium. Whereas, application of GA_3 @ 500 ppm (T_3) resulted in maximum number of flowers (3.33) per plant but was at par with T_2.

Muraleedhan and Karuppaiah (2015) tried the different treatment combinations and revealed that the significantly maximum plant height, plant spread, number of flowers per plant, stalk length, spathe length, spathe breadth and minimum days taken for flower bud appearance were recorded under the treatment of humic acid + gibberellic acid.

Post harvest

Sankari *et al.* (2013) reported that the maximum days for spathe blackening, spathe blueing, loss in glossiness of spathe, minimum loss of weight and maximum vase life were obtained with sodium hypochlorite solution @ 500 ppm as a pulsing treatment.

Sumathi *et al.* (2017) observed higher water uptake and maximum vase life of flowers in F_2 treatment (12:61:40) as well as in M_5 (coconut husk + charcoal at 3:1 ratio) either individually or in their combination.

Conclusion

From the foregoing discussion, it can be concluded that among the different varieties of anthurium, Esmeralda and Calisto gave overall good performance for vegetative as well as floral characters, while in South Gujarat varieties Sante Royal and Xavia were found better. In case of media, combination of saw dust: wooden charcoal : soil : sand : FYM (2:1:1:1:1) increased vegetative growth as well as yield and quality of flowers, however coir pith + coconut husk media was also found better for overall growth & development of anthurium under protected condition. Further application of GA_3 @ 150 and 500 ppm found to increased sucker production as well as flower life and yield. As far as nutrition is concerned, weekly once 0.2 % foliar spray of NPK at 30:20:40 ratio gave higher flower yield and spathe quality, while NPK (30:10:10) at 0.2% spray + *Azospirillum* + Phosphobacteria + VAM + GA_3 @ 100 ppm also found to increased the yield and quality of flowers. Moreover, cow dung extract at 4 g/l per plant and organic manure mix at 25 g/plant increased the vegetative growth and the application of humic acid + GA_3 also significantly affected the growth and yield of anthurium. Pulsing with Sodium Hypochlorite @ 500 ppm was found to extend the life of flowers and also the treatment of NPK (12:61:40) along with coconut husk + charcoal (3:1) either individually or in their combination increased the vase life of anthurium flowers.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
P.G. SEMINAR SERIES: 2018-2019

Speaker	**:** Ranjita Kulkarni	**Course**	: FLA-591
Reg. No.	**:** 2020217029	**Date**	: 06.10.2018
Major Guide	**:** Dr. Sudha Patil	**Time**	: 3.00 to 4.00 p.m.
Minor Guide	**:** Dr. D. K. Sharma	**Venue**	: Swami Vivekananda Hall

Therapeutic garden: The healing landscape

'Quality life', 'well-being' and 'healing' are phrases that embody concepts being with increasing importance in the 21st century. Due to rapid growth of cities as an offspring of modernization and urbanization, population has tended to choose urban areas as their environment over natural rural areas resulting in denser urban areas. This happened without considering psychological and social aspects of design of public space and buildings properly. Moreover, this led contributions to have infrastructure and less nature, while on the other hand modern lifestyle has provided various choices such as computers, internet, TV, mobile and all other modern electronic gadgets which renders us to experience pressure to fulfill all the demands of a so called social life. Accordingly, the rate of stress and stress related diseases are significantly increased.

Through history, it is known that people have used nature for various purposes in order to find health. Nowadays, many scientists are studying the effect of natural and regulated environment on human health and healing. It has been prove through research that some special landscape arrangements encourage people to be more comfortable and better. The garden designs applied to make people feel better psychologically and physiologically are called therapeutic gardens. These gardens offer healing, instructive and self-improving activities based on elements such as plants, land and nature to the urban people and to the individuals who do not feel well, physically and psychologically.

Review of research work

Ulrich (1984) worked with cholecystectomy patients reported that patients randomized to post-operative rooms with a view of an area having trees had faster recovery, consumed less analgesics than patients who were assigned a room with a view of brick wall.

Marcus and Barnes (1995) evaluated gardens of four hospitals in the US. Their findings showed that 95% of people experienced a positive change of mood in the garden. Similarly, 79% of them felt more relaxed and calmer.

Marcus and Barnes (1999) studied the response of blood pressure and muscle tension to nature. They stated that viewing plants could have significant positive effect on physiology of body even when individual viewed indirectly through window.

Park (2006) described that the systolic blood pressure and heart rate was significantly lower and stable with the patients of plant group, as compared to control on the day before surgery to 3 days after surgery.

Asano (2008) conducted research on healing at hospital garden. According to studies, the top three uses of the garden reported by the respondents were relaxation, walking and appreciating plants. More than half of the nurses (53%) thought that the garden could be used as healing space for rehabilitation and mentioned its relaxation effects as well as openness as the reasons.

Toone (2008) studied the effects of healing garden on pre/post symptoms and emotional distress experienced by parents of patients in a pediatric hospital. The results showed maximum stress reduction in the participants who were sitting in the therapeutic garden area as compared to participants sitting in surgery waiting area and north family lounge.

Wu *et al.* (2008) carried out research at psychiatric centre on beneficial effect of horticultural activities on patients and revealed that the attention scores increased significantly from 45.78 to 52.89 in the activity group while in the control group, it changed from 53.11 to 47.66 over the study period. Moreover, they found significant increase in different skills like community/ survival, basic work, dealing with authority, orderliness/organizational skills and communication skills by horticulture therapy after completion of horticulture programme.

Petros and Julia (2011) studied the landscape preference evaluation for hospital environment design. The results showed that maximum per cent of doctors (90), nurses (50), administrative staffs (63.6) and medical students (52.8) preferred green area around the hospital instead of parking area, rest areas, isolated areas and water formations. Similarly, 90% of doctors, 70.8% of nurses, 77.3% of administrative staffs and 80.6% of medical students prefer trees and bushes in the garden. Moreover, all the respondents strongly believed that garden would help the patients to recover fast. They also reported that all respondents believed that green areas of landscape design positively affect their own psychological status.

Riaz *et al*. (2012) opined that special children enjoyed gardening at home which helped them to develop a closer relationship with their parents (85%) and 46% of children felt very happy when fountains was nearby. According to 47% of teachers and 48% of parents, children enjoyed flowers at school as well as at home, where they found these activities as a source of relaxation (54%) and stress reduction (52%). Due to all these benefits, 95 per cent of the parents and 77 per cent of the teachers recommended that gardening activities should be a part of the school curriculum.

Mitchell (2013) suggested that horticulture therapy has strong positive impacts on the emotional well-being of youth. He reported that respondents strongly agreed that horticulture therapy increased emotional well-being by creating feelings like being proud (33%), enthusiasm (32%), provides opportunities for creativity (28%), happiness (25%), confidence (25%), promotes personal interest (23%) and socialization (22%).

Nagarajan and Ravi (2014) studied landscape preference evaluation for hospital premises. The results showed that majority of respondents (42.50%) liked to visit entrance façade and among these, 80% respondents like entrance façade because of aesthetically designed landscape. Also, 46% of respondents selected *Azadirachta indica* followed by *Ficus religiosa* as a garden plant. Likewise, 35% of people recommended interior landscaping and flowering trees inside the hospital premises.

Conclusion

Over the past decades, many people have become aware of the positive benefits of human interaction with plants and gardens. The therapeutic garden is being revived in modern times because of comprehensive therapeutic benefits. It is a natural method to reduce stress, tension, fatigue, pain, sadness, depression and anxiety which helps in faster recovery of patients. Viewing plants can reduce muscle tension and blood pressure. It positively affects a person’s emotion and improve their sense of well-being by creating feeling like being proud, enthusiastic, happiness, confidence, promoting personal interest, socialization and providing opportunities for creativity. Therapeutic gardens also provide emotional and social support to special children and mentally disabled persons. People involved in hospital strongly believed that green area and beautiful gardens have positive impact on health and psychology of patients. Therapeutic garden significantly contributes in improvement of personal and professional life of people thus, it should be a part of school curriculam. The significant contribution of therapeutic garden can help in advancing health which has just begun to be understood.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
POST GRADUATE SEMINAR SERIES 2018 - 2019

Speaker	:	Lad Jesikaben Thakorbhai	**Course**	:	FLA 591 (1+0)
Reg. No.	:	2020217014	**Date**	:	06/10/2018
Major guide	:	Dr. Alka Singh	**Time**	:	4.00 to 5.00 p.m.
Co-guide	:	Dr. B. N. Patel	**Venue**	:	Swami Vivekananda Hall

Edible flowers: A new perspective in floriculture

Introduction

With modernization, urge of new and eye pleasing products has led chefs to adopt new approaches. The high consumption of industrialized foods associated with physical inactivity and overweight have caused an increase in chronic diseases. Besides, synthetic food colours and flavours used by food industries may favour mutagenic and carcinogenic effects on body. Hence, scientists and chefs have come up with a niche concept of edible flowers. Edible flowers are among the important plant sources in terms of their nutritional content as well as aesthetic appearance. Edible flowers are obtained from 97 families, 100 genera and 180 species worldwide (Luana *et al*., 2017). Edible flowers can be utilized in versatile food products like salads, sauce, syrup, vinegar, jam and jelly, cocktails and drinks. Baked, fried and stuffed flowers are also novel products of cuisine industry. With its different original flavours, texture and colour, edible flowers have gained popularity as a creative and innovative ingredient in the culinary world.

Review of research work

Utility

Guine *et al.* (2017) in their survey investigated the way in which the participants had already consumed edible flowers and results showed that 72.4% participants confirmed option of use of flowers in form of salad. Among 10 flowers, chamomile (60.5%) and sunflower (47.4%) appeared to be more consumed while, orchid was least consumed flower (2.6%).

Mineral and nutritional composition

Diane *et al.* (2009) compared placebo beverage and hibiscus tea drink and found presence of high phenolic content and antioxidant activity in hibiscus tea drink while, placebo beverage contained none of anthocyanin compound. This led to significant reduction in Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP) and Mean Arterial Pressure (MAP) in participants who consumed hibiscus tea instead of placebo beverage.

Kaisoon *et al.* (2011) determined phenolic compound and antioxidant activity of edible flowers and found that *Cassia siamea* (88.5 mg GAE/g dry weight) and *Cosmos sulphureus* (86.8 mg GAE/g dry weight) had highest soluble total phenolic content (TPC) while, *Bougainvillea hybrida* (147.72 mg GAE/g dry weight) and *Nelumbo nucifera* (148.73 mg GAE/g dry weight) had highest bound TPC. *Tagetes erecta* had highest soluble total flavonoid content (67.9 mg RE/g dry weight) and bound TFC (36.7 mg RE/g dry weight).

Rop *et al.* (2012) studied different compositions of edible flowers and found that among 12 flowers, *Viola wittrockiana* showed highest potassium content. However, maximum TPC, total antioxidant capacity (TAC), TFC, calcium, iron and copper were found in *Dianthus caryophyllus.* Moreover, magnesium and zinc were found to be higher in *Tagetes patula*.

Li *et al.* (2013) in their experiment found higher TPC in *Rosa hybrida*, *Pelargonium hortorum*, *Osmanthus fragrans*, *Limonium sinuatum* and *Jatropha integrrima* while, *Iris japonica* had lowest TPC.

Benvenuti *et al.* (2015) reported that red coloured flowers like *Antirrhinum majus,* Dianthus X *barbatus, Petunia hybrid, Viola* X *wittrockiana* showed highest antioxidant activity and anthocyanin content while, white coloured flowers have least values.

Periago *et al.* (2015) undertook an experiment to estimate nutritional value in edible flowers and found highest total carbohydrates in *Tagetes erecta*, higher total dietary fibre, protein, fat, ash content as well as energy in *Spilanthes oleracea* and high water content in *Tropaeolum majus*. In case of mineral composition, overall minerals were found maximum in *Spilanthes oleracea* except calcium, copper, magnesium, strontium and zinc.

Ngoitaku *et al.* (2016) reported that tea drink of *Tagetes erecta* flowers brewed at 100^{o}C for 3, 5 and 10 minutes contained highest level of TPC.

Luana *et al.* (2017) studied nutritional and mineral composition of edible flowers and found highest fibre in *Tagetes erecta*; fat and energy in *Madhuca indica*; protein in *Erythrena caribaea*; calcium in *Viola* X *wittrockiana*; potassium in *Tagetes patula*; phosphorus in *Centaurea cyanus* and iron as well as sodium in *Fuchsia* X *hybrida*.

Sensory evaluation

Benvenuti *et al.* (2016) undertook organoleptic evaluation of various edible flowers and results showed that in terms of spiciness, *T.majus* showed highest values. Referring to different sensory tests, *T. majus* and *B. offinalis* scored high for sweetness while, softness was judged as excellent for *T. majus*, *V. wittrockiana* and *P. hybrida*. In terms of flowers' scent, *V. wittrockiana*, *T.majus* and *P. hybrida* showed an excellent performance. Above all *B. semperflorens* was reported as being notably bitter. *T.majus* was regarded the most attractive, since overall it scored 8.3, with a taste similar to radish.

Marketing and consumer preference

Kathleen *et al.* (2002) undertook a survey and found that considering gender preference, male (100%) were more likely to purchase specifically for garnishing if grown organically while, fewer males (67%) than females (100%) would purchase without a designated specific use. Keeping education in mind, results showed that 100% graduates would eat edible flowers in future. Further, people with income higher than $ 40,000/annum were found more likely to grow as well as purchase edible flowers. In case of marketing, maximum containers were sold during second week when price was around ($ 2.99) while, sales remained fairly consistent even when price was decreased to $ 1.99.

Guine *et al.* (2017) reported that most common form of consumption of edible flowers was cooked (98.4%) rather than fresh form, although to maximize health effects, scientists favoured use of fresh flowers.

Conclusion

Apart from decorative and aesthetic purposes, flowers can be a part of nutrition drive with fruits and vegetables. However, not every flower can be safe for consumption. Despite of many possible ways to consume edible flowers, more preference was given to salad of camomile and sunflower. However, out of fresh and cooked form of consumption, the most popular was cooked form as per the survey. In context to value addition of edible flowers, hibiscus tea has higher phenolic and anthocyanin content as well as antioxidant capacity. This tea can be used to control blood pressure while, marigold tea drink have high phenolic content. Total phenolic content was found higher in flowers of *Rosa hybrida, Cosmos sulphureus, Bougainvillea hybrida, Viola wittrockiana, Pelargonium hortorum, Nelumbo nucifera, Cassia siamea, Limonium sinuatum, Jatropha integrrima and Osmanthus fragrans* among various flowers. Total flavonoid content was found higher in *Tagetes erecta* and *Dianthus caryophyllus.* Red coloured flowers show highest antioxidant power and anthocyanin content, clearly indicating the effect of colour of flower on its neutraceutical composition. Marigold, carnation and pansy have been found to be rich in mineral compositions *viz.*,K, Ca, Fe, Mg, Cu, Zn. *Tagetes erecta* and *Spilanthes oleracea* have significantly high nutritional compositions *viz.*, carbohydrates, fat, protein, energy etc. Consumer preference was found depended on unique sensory profile of edible flowers like *T. majus* and *V. wittrockiana* being more preferred for sweetness and softness. Edible flowers are novel item and may not be purchased for everyday use, but probably be purchased for entertaining, during the holidays or for special occasions. Hence, edible flowers can be product for remunerative business.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
Post Graduate Seminar Series 2018-2019

Speaker	: Vamaja Shanikumar Mansukhbhai	**Course**	: FLA-591 (1+0)
Reg. No.	: 2020217036	**Date**	: 20/10/2018
Major Guide	: Dr. Dipal S. Bhatt	**Time**	: 3:00 pm to 4:00 pm
Co-Guide	: Dr. B. M. Tandel	**Venue**	: Swami Vivekananda Hall

CONSEQUENCE OF MULCHING ON FLOWER CROPS

Floriculture is a lucrative profession with higher potential for returns than most of the field and other horticultural crops. It is estimated to cover an area of 3, 06,000 ha with a production of 16, 99,000 MT of loose flowers and 6, 93,000 MT of cut flowers (Anon., 2017). Different management practices have to be done to obtain more desired flowers in a suitable time with minimum cost. Moisture management is essential practices to produce quality flowers. Even small improvement in quality can generate significant economic and aesthetic returns. In soil management, mulch act as protective cover placed over the soil to hold moisture, provide nutrients, moderate erosion, encourage seed germination and suppress weed development.Mulching is one of the important cultural practices aimed to conserve soil moisture, regulate soil temperature, control weed growth and it may promote plant tolerance to the attack of insect pests.It also improves the soil organic matter content. Mulching is an effective method of manipulating the crop growing environment to increase crop yield and improving product quality.

Brief review of research work

Rose

Bohra Mamta *et al.* (2015) studied the effect of mulching on growth parameters of rose var. Laher. They reported that significantly maximum plant height, plant spread, numbers of branches per plant, maximum leaf area with early flowering were found from rose plants mulched with 200 µ black polythene mulch during winter and spring season.

Sardar *et al.* (2016) recorded significantly highest number of leaves per plant (190.87) and number of shoots per plant (8.76), maximum flower diameter (5.22 cm), highest number of flowers per plant (79.77) and minimum fresh (5.88 g) and dry weight (2.04 g) of weed with black polythene mulch (400 µ). They also observed that 400µ black plastic mulch conserved maximum soil moisture percentage at 15 and 30 cm depth while, minimum soil temperature was noticed in rice straw mulch (2 inch) at 20 cm depth after 30 and 60 days of mulching.

Jadhav *et al.* (2018) revealed that significantly maximum plant height (87.00 cm), number of branches per plant (4.19), number of flowers per plant (38.03) and longest stem length (52.86 cm) with biggest flower diameter (6.43 cm) were recorded with 300 µ black polythene mulch. They also found that weed count, fresh and dry weight of weed were recorded minimum with 400 µ black polythene mulch.

Horo Punam *et al.* (2018) studied the effect of mulching on growth, flowering and weed management in rose cv. Maine Pearl. They reported that significantly maximum number of shoots per plant (11.47), flower diameter (12.33 cm), highest number of flowers per plant (47.0), longest shoot (35.89 cm) with minimum weed count ($29.0/m^2$) and dry weight of weed ($335\ g/m^2$) were found with 200 µ black polythene mulch.

Marigold

African marigold cv. African Tall grown with 25 µ black polythene mulch produced significantly maximum plant height (66.61 cm), number of branches per plants (3.80) and flower yield (8.37 t/ha).While, maximum net income (Rs. 60, 200 /ha) was obtained from plant grown with sugarcane trash mulch @5 t/ha (Anon., 2006).

Chawla (2008) reported that use of 50 µ black plastic mulch significantly enhanced plant height (60.05 cm), plant spread (44.15 cm), flower diameter (5.47 cm), number of flowers per plant (53.45), flower yield (11.66 t/ha) and also improved water use efficiency (45.47 kg/ha/mm) in African marigold cv. Double Mix.

Malshe *et al.* (2017) recorded significantly maximum plant height (119.03 cm), number of branches per plants (26.40), longest stalk length (16.17 cm), biggest flower diameter (9.53 cm), number of flowers per plant (56.00) and highest yield (312.70 q/ha) from marigold plants grown with black polythene mulch of 50 µ.

Chrysanthemum

Reza *et al.* (2011) reported that soil covered with 50 µ black polythene mulch in chrysanthemum produced significantly maximum plant height (48.20 cm), number of leaves per plant (559.17), number of suckers per plant (3.09), highest number of flowers per plant (255.71) with early first flower bud appearance (50.70 days) and 50 % flowering (80.34 days).

Tuberose

Patel *et al.* (2014) reported that paddy straw mulch @ 10 t/ha recorded significantly maximum plant height (70.35 cm), number of leaves per plants (38.59), spike length (99.45 cm), number of spike per plant (5.46), spike per ha (4.47 lakh) and floret diameter (3.96 cm) with early rachis emergence (82.09 days) in tuberose.

Gerbera

Sarmah Dipika *et al.* (2014) stated that soil covered with black polythene mulch (100 µ) produced maximum plant height (43.57 cm), number of leaves per plant (26.00), number of suckers per clump (23.13), number of flowers per plant (45.33) and longest stalk length (43.97 cm) with early flower bud visibility (62.50 days) in gerbera under open field condition of Assam.

Gladiolus

Gantait (2015) reported that mulching in gladiolus cv. Pusa Suhagin with 400 µ black polythene mulch produced significantly maximum plant height (72.80 cm), number of florets per spike (13.91) and maximum spike length (75.08 cm) with early floret opening (74.96 days) in West Bengal.

China aster

Solaiman *et al.* (2008) reported that significantly maximum plant height and highest number of flowers per plant were recorded in china aster grown with black polythene mulch (150 µ).

Bajad *et al.* (2017) studied the effect of mulching on growth and flower yield of china aster cultivars Kamini and Poornima under mid hill condition of Himachal Pradesh and reported that silver plastic mulch (100 µ) significantly increased plant height, plant spread, flower diameter, number of flowers per plant, flower yield per plant and flowering duration with minimum days taken for 50 per cent flowering for both the cultivars.

Conclusion

From the foregoing discussion, it can be concluded that application of black polythene mulch of 200 to 400 µ in rose improve plant growth, quality of flowers and flower yield. Moreover, black polythene mulch proved both to conserve maximum soil moisture percentage as well as suppress weed growth whereas, organic mulch reduced soil temperature in rose. Black polythene mulch of 25 µ and 50 µ resulted effective to increase plant growth, improve flower quality and yield and improved water use efficiency in marigold cultivars. However, application of sugarcane trash mulch @ 5 t/ha in marigold obtained highest net return. Paddy straw mulch @ 10 t/ha improved plant growth and yield in tuberose. Black polythene mulch of 50 µ, 100 µ and 400µ resulted best for increasing growth, yield and quality of chrysanthemum, gerbera and gladiolus, respectively. China aster plants mulched with 100 µ and 150 µ black and silver plastic mulch resulted in production of healthier plants with more flower yield.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES 2018-2019

Speaker	:	Zala Kuvarsinh Ravisinh	**Course**	:	FLA-591 (1+0)
Reg. No.	:	2020217038	**Date**	:	20/10/2018
Major Guide	:	Dr. S. T. Bhatt	**Time**	:	4:00 pm to 5:00 pm
Co-Guide	:	Dr. B. M. Tandel	**Venue**	:	Swami Vivekananda Hall

Indoor Plants: A Novel Source for Improving Air Quality

INTRODUCTION

According to the United States Environmental Protection Agency (USEPA), people living in urban areas spend up to 85–90% of their time indoors, often unaware that they might be continually exposed to air pollution (Anon., 2018).According to the WHO, indoor air pollution has been ranked among the top five risks to public health(Anon.,2016a).According tothe Institute for Health Metrics and Evaluation (IHME), 2.6 million people diedprematurely in 2016 from illness attributable to household air pollution (Anon., 2016b). Indoor air pollutants primarily originate from buildingproducts, human activities inside the building and infiltration of outdoor air. Indoor air pollutants include volatile organic compounds (VOCs), particulate matter, ozone, and biological contaminants.

Exposure to these pollutants can cause acute illnesses (asthma, nausea) and chronic diseases (cancer, immunologic, neurologic, reproductive, developmental and respiratory disorders)(Spengler and Sexton,1983). Good quality of indoor air can be maintained by the methods of controlling pollution sources, designing ventilation systems to expel contaminated air and applying air cleaning systems. However, these practices are costly, inefficientand require maintenance.

Biological methods have shown a certain potential for VOCs removal from indoor air (Guieysse*et al.,* 2008).These plants absorb the VOCs mainly through their stomatal openings and also whichever microbes present in the soil of the pots are able to utilize these compounds.Plants also reduce indoor temperature and increase indoor humidity (Aydogan and Montaya, 2011).

BRIEF REVIEW OF LITERATURE

Su and Lin (2015) studied the removal of indoor CO_2 and HCHO using green walls made from Bird Nest Fern and showed that Bird Nest Fern (*Asplenium nidus* Linn.) reduced the concentration of CO_2 from 2000 ppm to a safe 800 ppm within 3 h 49 min and 3 h 40 min in daytime lighting and night time lighting respectively. Moreover, HCHO was also reduced 0.1 ppm within 3 h 18 min and 3 h 8 min in daytime and nighttime lighting, respectively. When the combination of CO_2 and HCHO were released into the chamber,the result showed that the bird nest fern reduced CO_2upto800 ppm in 3 h 14 min and 3 h 12 min in daytime and nighttime lighting, respectively, whereas HCHO was reduced upto 0.1 ppm within 5 h 22 min and 6 h 4 min in daytime and nighttime lighting, respectively.

Cetin and Sevik (2016) revealed that the CO_2 concentration in the air decreased from 2798 ppm to 933 ppm by *Ficuselastica*, 3310 ppm to 732 ppm by *Yucca massengena*, 1565 ppm to 1148 ppm by *Ocimumbasilicum*, 2583 ppm to 1858 ppm by*Sinningiaspeciosa* and 1861 to 1071ppm by *Codiaeumvariegatum* during daytime planted as indoor plants. They also observed that the amount of CO_2 consumed during the day was greater than the amount of CO_2 given off at night for all the plants.

Hong *et al.* (2017) evaluated the ability of plants to purify indoor air. They found that *Rhapisexcelsa*and*Ficuselastica*reduced the VOCs *viz*., benzene, toluene, xylene, formaldehyde and acetaldehyde after its planting in day care centre.

Lin *et al.*(2017) revealed that potted *Hedera helix* can reduce 70% of the required time to reach 0.5 ppm of gaseous HCHO as compared to natural dissipation.Whereas, the HCHO removal rate by potted *Hedera helix* was significantly faster in the slow discharge mode than in the comparison of fast discharge mode.

Montacchini*et al.*(2017)carried out a questionnaire survey to evaluate the feasibility of installing an indoor green wall at a university campus and analyzed that campus locations with greenery systems is perceived better and considered more attractive than those without such amenities.In case of benefits of LWS (Living Wall Systems) they noted that most of the students gave maximum score to improved the aesthetic value, reduced stress, improved air quality followed by thermohygrometric control. In relation to the drawbacks of green walls, majority of the respondents gave the maximum score to the high level of maintenance followed by high initial and maintenance costs. Whereas, the presence of bad smell and damage to the building obtained the lowest score.

Sevik*et al.* (2017) studied the influence of house plants on indoor CO_2 under light and dark depending on temperature and they stated that all the plant species*viz*., *Ficus, Spathiphyllum, Diffenbachia and Yucca* reduced the CO_2 amount in illuminated environment at all the temperature levels. However *Diffenbachia* was not able to absorb the CO_2 above 35ºC temperature. *Ficus* reduced maximum amount of CO_2 (480.74 ppm) in 1m^3 of air at 25°C temperature. They also noticed that in the dark least amount ofCO_2 (7.04 ppm) was released by *Diffenbachia*at 15°C.

Teiri*et al.*(2018)observed that about 90 – 100 % of HCHO was removed from the polluted air by *Nephrolepisobliterata* with an inlet HCHO concentration range of 0.63 – 9.73 mg/m^3. Whereas the chlorophyll content, carotenoid level, and average height of the plants were increased by 9.58%, 21.79%, and 6.46%,respectively, during the fumigation.

CONCLUSION

Indoor plants are effective tool for combating against poor air quality. Many indoor plant species *viz*.,*Asplenium nidus, Ficuselastica,Hedera helix, Nephrolepisobliterata, Sinningiaspeciosa,Ocimumbasilicum, Yuccamassengena,Spathiphyllumwallisi, Diffenbachia*spp., *Rhapisexcelsa*can effectively reduce the VOCs (*viz*., HCHO, Toluene, Xylene, Acetaldehyde etc.) and CO_2 from indoor air and increase aesthetic value. Indoor plants used in LWS(Living Wall Systems) reduce stress, improve air quality and thermohygrometric control thus improve learning behavior as well as working efficiency of people. Indoor plants are cost effective, eco-friendly and sustainable tools for improving air quality.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2018-2019

Speaker	: DudhatRinkalHimmatbhai	Course	: FLA 591 (1+0)
Reg. No.	: 2020217007	Date	: 17/11/2018
Major Guide	: Dr.Sudha Patil	Time	: 2:00 to 3:00pm
Co-Guide	: Dr. S. J.Patil	Venue	: Swami Vivekananda Hall

PEOPLE-PLANT RELATIONSHIPS: PERCEIVED BENEFITS

The relationship between people and plants has always been profoundly important. Plants affect every aspect of our lives and indeed, without them life would not be possible at all. Cities worldwide have sought to improve their environmental quality through the enhancement of their green space. It seems apparent that if these green spaces are to flourish then there is a critical need to understand and describe the beneficial relationships that exist between plants, peopleand places therefore, it develops an appropriate paradigm that leads to sustainable green space. The paradigm needs to be a dynamic entity, ever shifting due to changes in the environmental, social, economic lifestyle and demographic drivers. In recent years, these drivers have become more crucial with unprecedented urban growth and the need to adapt to the agents of climate change. Such a paradigm reinforces the fact that horticulturists, economists, ecologists, planners, social and health scientists need to retain closer linkages among their disciplines and how the effects of such a paradigm can influence food production, biodiversity, behavior, health and wellbeing as well as human survival. Plants have both physiological and psychological benefits for people. Ornamental plants were perceived as affecting many aspects of the environment (*e.g.* the physical surroundings, the social climate, image of the workplace, *etc.*), the individual's well-being (*e.g.* mood, general well-being, emotions, self confidence, *etc.*), and to some degree the workplace's competitiveness. However, the actual effects are the results of a complex interaction among the way the ornamental plants are applied, characteristics of the present ornamental plants (*e.g.* size, species and condition) and characteristics of the individual employee (*e.g.* personal experiences, preferencesand values).

Brief review of research work

Fjeld(2000)stated that a significant reduction was observed in neuropsychological symptoms, mucous membrane symptoms and skin symptoms due to plant intervention.The responses from the participants also indicated that green plants in the office were regarded as a positive element for feelings of well-being.Eighty two percent of the participants felt more comfortable if they have plants in office and Eighty two percent were agreed to have plants in office in the future. Highly significant reduction was found in the specific symptoms like fatigue; feeling heavy-headed; headache; dry or hoarse throat; and hands with dry, itching, or red skin was observed after changing the interior environment of a hospital radiology department. Moreover, complaints regarding headache and dry or hoarse throat were found to belower among pupils in biological classrooms compared to the control. The results indicated significant changes in the perception of the classrooms due to the intervention of plants.

Lohr and Pearson-mims (2000) revealed that the room was more associated with positive characteristicssuch as cheerful, calming, pleasant, attractive, inviting and tasteful on most of the descriptive scales than the control room and room with nonplant objects.

Chang and Chen (2005) reported that window scenes and the presence of indoor plants can significantly changed the brain waves activity, muscles activity, blood volume pulse and state-anxiety.They also compared the psychophysiological effect of different windows and found thatwindows with a view of nature had the best effect on electroencephalography-a,electroencephalography-b,electromyography,blood volume pulse and state-anxiety.

Tests conducted byDravigne*et al.* (2008)showed statistically significant differences in the subcategories of supervision,nature of workandcoworkers. There were no significant differences in the subcategories of promotion and communication but overall job satisfaction scorewas found maximum with plants + windows in all categories.

Park and Mattson (2008) reported that analgesic intake was significantly reduced for the plant group compared with the control group from first to third day after surgery. Patients exposed to plants were less frequently given weak and moderate analgesics compared with patients in the control group. They also noted that at the day of surgery and the first day after surgery, there were significant differences in systolic blood pressure and heart rate, which were lower with the plant group as compared to the control group.

Park and Mattson (2009) opined that pain intensity, pain distress, anxiety and fatigue were significantly lower in patients who exposed to plants compared with no plants on the first, third and fifth dayafter surgery. While, the EAS responses to plantsindicated that patients during the recovery periods reported their rooms had a pleasant smell and were more satisfying, relaxing, comfortable, colorful, happy, calming, and attractive compared with those in the control rooms.

Raanaas*et al.* (2010) observed that self-reported physical and mental health had been improved over the time spent at the rehabilitation center. The degree of change in subjective well-being was sensitive to both the plant intervention and patient group.Emotional states also appearto have improved over the course of the rehabilitation

program. Moreover, with the interior, generally women expressed more satisfaction with the presence of the plants than the men did, and they were also more satisfied with the interior generally after the plants were installed. These interactions between gender and plant intervention were significant.

DeWolfe*et al.* (2011) noted that varying greenness levels in the study of the relationship between levels of greenery/landscaping at track and field sitesaffect the sport performance.Attendance and performance of collegiate tracks and field athletes was increased with increase in greenness ratings.

Thomsen *et al.* (2011) revealed that employees think to great extent that ornamental plants belong in the workplace. Employees preferred more flowering plants as compared to non-flowering plantsand they also preferred to brought along ornamental plants to work.

Qin *et al.* (2013)reported that the satisfaction degree and pleasant feelingof participants was high in the environment with pelargonium compared to other plants. Evaluation on color illustrated that the green plants obviously provided the highest degree of satisfaction, the average value of which was up to 2.1. Almost 70% of the participants were satisfied with the green plants. Evolution on odour resulted slightly scented plants were the highest one among all the three conditions, with the average value up to 1.44 and 60% of them felt satisfied. The condition with strong scent plants was subsequently a favorite one, with the average value of 1.3. There were 63% of the participants who were satisfied with this condition. In caseof plantssize, it was observed that small size plants were preferred the most with the average value of 2with80% satisfaction andnone of the participants felt dissatisfaction. The second pleasant condition was created by medium-size plants.

Sadek*et al.* (2013) indicated that male participants carefully observed the details of the green-whitecoloured variety of *Hedera helix* plant as evidenced by long fixation duration and higher fixation numbers of eye movements compared with their responses to the dark green plant whereas female participants carefully observed and saw the details of the green-yellow plant to a greater extent than the dark green or green-white species.

Asnani and Singhvi (2014) reflected that utilization of house plants in residential buildings resulted into a great impact onenhancement of the O_2 level in indoor air. They also observed that foliage plants were able to release more O_2 (0.12%) as compared to succulent plant (0.10%) and it wasapparent that with increase in the number of houseplants, the average mean of O_2 enhancement also increased.

Jumeno and Matsumoto (2014) reported that there was a significant increase in attention, reaction time, typing accuracy, typing speed and logic productivity due to presence of plants.

Conclusion

From the foregoing discussion it can be conclude that since the year of implementation of people-plant relationship, some positive benefitsare observed in the number of ways like production (food, fibre and medicinal), environmental, economical, educational, social and health.There are also some hidden benefits like positive change in physical, psychological and mental health. In case ofinterior planting with respect to health and comfort,commonly used plantsare aglaonema, dracaena, philodendron, aralia, pothos, bamboo palm, kentia palm, poinsettia, sansevieria, dumbcane, alocasia, syngonium, etc. which reduce discomfort neuropsychological symptoms, mucous membrane symptoms and skin symptoms and increase positive characteristics.Window views of nature and existence of plants can reduce length of hospitalization, pain intensity and help in recovery of patients.Plant intervention program is more successful in case of rehabilitation. Higher greenness levels positively affect attendance and performance of athletes. Plants characteristics like colour, odour and size also influence the degree of satisfaction among peoples.Finally, plants are a requisite element of the human environment as they help to increase O_2levels.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI
Post Graduate Seminar Series 2018-2019

Speaker : Sangeetha Priya S.	**Course : FLA 591 (1+0)**
Reg. No. : 2020217031	**Date : 17.11.2018**
Major Guide : Dr. Dipal S. Bhatt	**Time : 3.00 to 4.00 p.m.**
Co-Guide : Dr. S. J. Patil	**Venue : Swami Vivekananda Hall**

Approaches for Modification of Flower Colour

Every flower is a soul blossoming in nature. It adds beauty to the environment with its attractive colours. Botanically, flower is the reproductive structure of seed bearing plants. Flower colour is responsible for pollination, photosynthesis and seed dispersal. The pigments responsible for flower colour act as an intermediary compounds in different biosynthetic pathways. In floriculture industry, the market value of flower crops are highly determined by its colour and also are used in horticultural therapy for curing mental ailments. Even though flowers produce a wide range of colours in nature, the mankind is still searching for more and more novel flower colours. The plant compounds perceived to produce colour are called pigments. The major pigments responsible for flower colour are flavanoids, carotenoids and taxonomically restricted betalains. Pigment structure, its concentration, co-pigments, metal ions, vacuolar pH and shape of surface cells are the important factors influencing the final flower colour. Scientists at different periods have adopted different approaches like hybridization, polyploidisation, mutation and genetic engineering for modifying flower colours.

Brief Review of Research:

Hybridization

An interspecific *Epidendrum* hybrid was developed by Devadas *et al.* (2010) using *E. radicans* and *E. xanthinum*. The selected line (NRCO-*Epidendrum* cross/2005-01) was characterized and found that the selected line was bigger than both parents with bright saffron orange colour (RHS44A) which was acquired from female parent whereas, the shape and lobular characteristics attributed from male parent. Further, the F1 progeny of the selected line flowered with different shades *viz*., red-orange, orange-yellow and yellow.

Magdalita and Pimentel (2013) developed seven hybrids with unique and new flower traits namely, *Hibiscus rosa-sinensis* 'Domini M. Torevillas', 'Cynthia A. Villar', 'Marilyn D. Maranon', 'Maria Rosario O. Montejo', 'Arlene B. Arcillas', 'Connie S. Angeles' and 'Sylvia P. Lina' which were collectively called as "Women in Public Service Series II".

Mutation

Hase *et al*. (2010) examined the effect of pretreatment on frequency of flower colour mutants induced by ion beams. They found that 8 days old petunia seedlings pre-treated with 3 % sucrose following 8 Gy of 320 MeV carbon ion beam irradiation (1.52, 1.20 and 1.26 %) increased frequency of flower colour mutants as compared to non-pretreated group (0.56, 0.58 and 0.47 %) for all the three experiments.

Ohmiya *et al*. (2012) studied the mechanism behind petal colour mutation induced by heavy ion beam irradiation of chrysanthemum cv. Jimba. They noted that irradiation of heavy ion beam to the budsport of cultivar Jimba obtained mutants with pale yellow flower (IB-1 lines) and much deeper yellow flowers (IB-2 lines). Moreover, the number of *CmCCD4a* homologs decreased stepwise by irradiation, resulting in stepwise increase of carotenoid level in ray petals.

Yamaguchi (2013) investigated the characteristics of ion beams as mutagens for flower colour modification in chrysanthemum cv. 'Taihei' and found that 5 Gy of 320 MeV carbon ion beams resulted in comparatively higher mutation frequency (16.3 %) followed by 5 Gy of 220 MeV carbon ion beam (14.5 %) and 15 Gy of 100 MeV Helium ion beam (12.3 %).

The efficiency of gamma ray was worked out by Madhu Bala and Singh (2015) in generating mutation populations of *Rosa hybrid* L. cv. Raktima and they revealed that *in vitro* mutagenesis using 40 and 55 Gy gamma rays exhibited two mutants, RK-1 with 7.48 % flower colour variation and RK-2 with 8.51 % flower colour variation, respectively.

Polyploidisation

In the flavonol biosynthetic pathway of *Petunia* ‘Mitchell’, polyploidy has a differential effect increasing the relative concentration of the major metabolite Quercetin-3-sophoroside (Q32) and decreasing the relative concentration of the minor metabolite Quercetin-3,7-diglucoside (Q3,7) (Griesbach and Kamo, 1996).

Genetic Engineering

Tsuda *et al.* (2004) modified the flower colour of *Petunia hybrida* commercial varieties by metabolic engineering and reported that the complete suppression of *F3H* and *DFR* genes in Surfinia Purple yielded pale flowers while, the down-regulation of *F3’5’H* gene in Surfinia Purple altered the flower colour similar to Surfinia Hot Pink. Further, suppression of *F3’5’H, AR-AT* and *FLS* genes in Surfinia Purple Mini and Surfinia Purple redirected the metabolic pathway from malvidin to cyanidin. For the generation of orange petunias, *F3’H* gene was down-regulated and rose *DFR* gene was over-expressed. They also indicated that over-expression of *FLS* and *FNS* genes increased the flavonol and flavone contents in petals, respectively.

Noda *et al*. (2013) studied the modification of anthocyanin biosynthetic pathway in chrysanthemum to produce delphinidin based anthocyanins instead of cyanidin based anthocyanidins by metabolic engineering and resulted that *Chrysanthemum F3H* promoter driven *ADH* translational enhancer fused with *Campanula F3’5’H* (1408-9 line) efficiently induced delphindin production in chrysanthemum ray florets, leading to high accumulation of delphinidin.

Regulation of Vacuolar pH

Yoshida *et al*. (2003) observed the correlation between the sepal colour variation and vacuolar pH of *Hydrangea macrophyllus* using micro-spectrophotometry and proton-selective microelectrode. They found that the average values for the vacuolar pH of blue (λvismax: 589 nm) and red cells (λvismax: 537 nm) were 4.1 and 3.3, respectively with vacuolar pH of blue cells being significantly higher.

Plant Growth Regulators

Banon *et al*. (2002) investigated the influence of paclobutrazol on flower colorimetric values in *Dianthus caryophyllus* cv. Mondriaan and stated that red colour flowers of the cultivar turned to purple tone after drenching of 0.25 mg paclobutrazol during winter season with reduced chroma value (33.4) and hue angle (354.0) under conditions of Spain.

Cavins (2006) revealed that foliar spray of 2000 mg/L A 1699-DF increased lightness and decreased hue value with less saturation which resulted in light pink coloured petals compared to dark red coloured petals of *Impatiens walleriana* ‘Accent Cranberry’. Further, he stated that Geranium plants treated with foliar spray of 1000 mg/L A 1699-DF produced pale orange flowers with maximum lightness and minimum values of hue and saturation compared to control.

Yaghoub *et al*. (2017) studied the modification of flower colour pigments with hormonal treatments and sucrose in *Tulipa gesneriana* ‘Kingsblood’ and reported that the highest total flavanoid content (2.912 mg/gfw) and anthocyanin content (2.406 mg/L) were found in the perianthes of tulips sprayed with 500 mg/L GA3 without sucrose.

Tinting

Safeena *et al.* (2016) stated that the spikes dipped in 1.5 % sunset yellow + carmosine orange red edible dye for 24 hrs immersion time resulted in highest overall acceptability of tuberose cvs. Mexican Single and Pearl Double.

Ranchana *et al*. (2017) standardized the tinting techniques in China aster cv. Local White and revealed that food dyes *viz*., Apple Green, Lemon Yellow and Orange Red at 4 % concentration expressed full bright coloured flowers with quick uptake of dyes in a short period of two hours duration.

Conclusion

Development of flower with novel colours had been a dream in floriculture industry as flower colour is the key element in consumer selection. Nowadays, it came into reality by the adoption of various approaches which mainly affects the vacuolar pH, metal ions and co-pigments responsible for flower colour variation. Colour change in flowers through hybridization is achieved through introgression of target gene from wild genotype and co-dominance. A wide spectrum of colour variation can be obtained by exploiting heavy ion beam radiation for mutation which has higher linear energy transfer and mutation efficiency. As the size, volume and thickness of plant parts or cells increase with ploidy level, the concentration of pigments can also be enhanced which results in more intensely coloured flowers. Modification of flower colour is possible with genetic engineering by either suppression of endogenous gene, over-expression of target gene or combination of both. This approach has been found more beneficial due to extensive available information on pigment biosynthetic pathway. Regulation of metal ions in flower petals results in change of vacuolar pH which in turn influences the flower colour. Plant growth regulators alter the flower colour by affecting the enzymes involved in pigment biosynthesis. Tinting is the easy and economical way to modify the flower colour which can be adopted even by the farmers to get remunerative price out of their produce. Efforts should be taken to improve the phenotypic stability of colour-altered plants and also to access more information about carotenoid and betalain biosynthetic pathways.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
Post Graduate Seminar Series: 2018-19

Speaker	: Gohel Ketan Parbatbhai	**Course**	: FLA-591 (1+0)
Reg. No.	: 2020217010	**Date**	: 17/11/2018
Major Guide	: Dr. S. T. Bhatt	**Time**	: 4 to 5 p.m.
Co-Guide	: Dr. B. M. Tandel	**Venue**	: Swami Vivekananda Hall

Role of biostimulants on ornamental flower crops

Introduction

Post globalization, floriculture has become an important commercial industry in agriculture. Floriculture activities deals with cultivation/production and marketing of flowering and foliage plants, garden and bedding plants, cut flowers and cut greens etc. The production rate is growing 8-10% per annum. There are nearly 120 countries which are active in floricultural production in large scale. In India, floriculture occupies 3,06,000 ha area with 6,93,000 MT cut flowers and 16,99,000 MT loose flower production(Anon.,2018). Flower crops production depends on numbers of agronomic practices. Among them, biostimulants application is significantly increased the growth and yield of many flower crops. Biostimulants may either directly interact with plants signaling cascades or act through stimulation of endophytic and non-endophytic bacteria, yeast and fungi to produce molecules of benefit to the plant. The benefit of the biostimulant is derived from the reduction in assimilated that are diverted to non productive stress response metabolism. Biostimulants faster the plant growth and developments throughout the crop life cycle from seed germination to plant maturity,which are available in humic substance, hormonal containing products and amino acid containing products for commercial utilization.

Brief review of literature

Panchgavya

Naik *et al.* (2013) reported that application of *Panchgavya*:water (1:30) on media resulted the highest number of spikes per plant, no. of florets per spike with maximum spike and rachis length in *Cymbidium* orchid hybrid.

Bini Sundar *et al.* (2014) studied the off season flower induction through fertigation and biostimulants spray in jasmine (*Jasminum sambac* Ait.) and reported that fertigation with 125% RDF along with foliar spray of humic acid (0.4%) & *Panchgavya* (3%) produced significantly maximum flower buds (14,783.29 kg/ha) throughout the year in jasmine (*Jasminum sambac* Ait.).

Sendhilnathan *et al.* (2017) studied the effect of bio regulators along with organics on growth and yield of gundumalli (*Jasminum sambac* Ait.).They noted that and significantly increased the plant height (124.52 cm), numbers of primary shoots(10.71), numbers of secondary shoots (10.41) and flower yield (677.74 g/plant, 3.78 t/ha) with the application of Vermicompost @ 2.5 t/ha + *Panchgavya* @ 3% foliar spray in Gundumalli (*Jasminum sambac* Ait.).

Naik Bhoomi (2018) studied the off season flower induction through various stimulants in *Jasminum sambac* Ait. and reported that highest benefit cost ratio (1.63) and higher yield (1204.28 kg/ha) obtained from application of 0.5% *Panchgavya* immediately after pruning and then three spray at 20 days interval in *Jasminum sambac* Ait.

Humic acid

Sankari *et al.* (2015) reported that significantly highest spike length, no.of florets per spike and yield of spike per plant with early spike emergence and 50% flowering were found due to foliar application of 0.2% humic acid in gladiolus cv. White Prosperity.

Pansuriya *et al.* (2018) revealed that foliar application of 0.2% humic acid along with *Azotobacter* @ 2.5 ml/plant + PSB @ 2.5 ml/plant + KSB @ 2.5 ml/plant at 30, 45 and 60 DAP significantly increased no. of florets per spike (16.90), no. of spikes (2.92 per plant, 35.04 per plot, 3.18 lakh per ha), no. of corms per plant (2.21), no. of cormels per plant (35.33), diameter of corm(5.39 cm) and weight of corm (53.33 g/plant) in gladiolus cv. American Beauty.

Banana Pseudostem Enriched Sap

Anonymous (2017) studied the effect of foliar spray of polyamines and banana enriched sap on rose (*Rosa hybrida* L.) and reported the significantly higher yield and B:C ratio was found in treatment of foliar application of Novel organic liquid fertilizer @ 2% two times at 15 days interval starting from second week of November under polyhouse condition.

Patel *et al.* (2017) revealed that the maximum plant height (69.89 cm), plant diameter (6.73 cm) with maximum no. of flowers per plant(84.20) and maximum flower yield (10.02 t/ha) with maximum longevity (7.17 days) were recovered with application of FYM @ 5 t/ha + 75% RDF(150:100:100 NPK kg/ha) + *Azotobacter* + PSB +KMB + 1% foliar spray of Nauroji Novel organic liquid fertilizer in African Marigold (*Tagetes erecta* L.).

Sathyanarayana *et al*. (2017) observed that the early spike initiation, maximum plant height, higher no. of leaves per plant, highest spike length along with maximum florets and number of spikes per plant when treated with 100% RDF (200:200:200 NPK kg/ha) +FYM @ 7.5 t/ha +*Azotobacter*+PSB+KSB+1% foliar spray of Nauroji Novel organic liquid fertilizer in gladiolus (*Gladiolus grandiflorus* L.) cv.American Beauty.

Desai Supal (2018) studied the effect of plant growth enhancers on growth, flowering and yield of tuberose(*Polianthus tuberosa* L.) cv. Prajwal and reported the maximum plant height (74.8 cm), numbers of leaves (70.20), leaf area (65.20 cm^2), numbers of spike per plant (2.67), numbers of bulbs/plant (2.60) numbers of bulblets per plant (11.30) was obtained with foliar application of banana enriched pseudostem sap @ 15000 ppm at 60, 90, and 120 DAP in tuberose cv. Prajwal.

Biofertilizers

Bohra Mamta and Kumar (2014) studied the effect of organic manures and bioinoculants on vegetative attributes on chrysanthemum and obtained maximum plant height (30.17 cm), numbers of primary branches per plant (3.78), numbers of secondary branches per plant (19.78), plant spread (28.53 cm), average flower weight (1.67 g) and maximum no. of flowers per plant (70.56) with an application of VAM (20 g/plant) + Vermicompost (300 g/m^2).

Sea Weed Extract

Hegde *et al.* (2018) revealed that the maximum flower diameter, stem length and individual flower weight were found with foliar application of Biovita (0.5%) in chrysanthemum (*Dendranthema grandiflora* Tzvelev.) under naturally ventilated polyhouse condition.

Conclusion

Biostimulants enhance growth, yield and quality of flowering crops like jasmine, orchid, chrysanthemum, gladiolus, rose, tuberose, marigold *etc*. in open field as well as polyhouse. It is also important tools for off season flowering strategies that generates higher income. *Panchgavya*, Banana Pseudostem Enriched Sap, bio-fertilizers *etc*. are ecofriendly and cheapest and locally available source of farming which enhance the farmer economy.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI, GUJARAT
POST GRADUATE SEMINAR SERIES: 2019-2020

Speaker : Mangroliya Ronak Mukeshbhai	**Course** : FLA 691 (1+0)
Reg. No. : 2020218018	**Date** : 04/10/2019
Major guide : Dr. S. T. Bhatt	**Time** : 3.00 to 4.00 pm
Co-Guide : Dr. B. M. Tandel	**Venue** : Swami Vivekanand Hall

MEDICINAL VALUES OF ORNAMENTAL PLANTS

Floriculture is an aesthetic and spiritual side of horticulture. Since the beginning of human civilization, ornamental plants have been known for their soothing and healing effects. They have been an integral part of human beings since ancient times for various purposes like ornamental, decoration, medicine (fresh, distillate, decoction and powdered form). A wide range of chemical compounds are presented including alkaloids, bibenzyle derivatives, flavonoids, tannins, terpenoids, phenols which are isolated from various ornamental plants parts extracts and metabolites of these plants, particularly those from flowers, stems and leaves possessed pharmacological activities. Particular attention has been given to diuretic, anti-rheumatic, anti-inflammatory, anti-carcinogenic, hypoglycemic activities, anti-microbial, anti-convulsive, relaxation, neuroprotective and anti-virus activities. Ornamental plants are used complementary alternative medicine. Oil is “essential” in the sense that carries a distinctive scent of the plant and therefore used in food, perfumery and therapeutically in aromatherapy. In the modern age of herbal medicines, the main ingredients for their medicine are plants, flowers, seeds or root. Herbs have been used to promote and safeguard of health, relieve pain, heal diseases, wound as well refresh the mind. Keeping ornamental flowers around the home environment is an excellent way to minimize the stress and anxiety.

Brief review of research work

Antioxidant activity

Siddhuraju *et al.* (2002) studied an antioxidant activity from different parts of *Cassia fistula L*. They reported that highest super oxide radical scavenging activity (89.00 ± 1.4 and 27.5 ± 2.12 %) was exhibited with 20 ppm stem bark and 20 ppm leaves extracts of *cassia fistula*, respectively.

Ebrahim *et al.* (2013) studied an antioxidant activity of *Adenium obesum* from water/ methanol and water / ethanol petal extracts. They observed that highest super oxide radical scavenging activity at 100 per cent alcoholic concentration of both water /methanolic and water / ethanolic petal extracts of *Adenium obesum.*

Reena Patel *et al.* (2012) studied the secondary metabolites and antioxidant properties of various plant parts of *Hibiscus rosa-sinensis* cultivars. They stated that leaves of *Hibiscus rosa-sinensis* were found to posses highest amount of flavonoid in all cultivar compare to stem and root except for ‘YELLOW’ cultivar. They also noted that higher antioxidant capacity was observed from leaves of ‘RED’ cultivar.

A quantitative assessment of bioactive phytochemicals of *Nerium indicum* was done by Dey *et al.* (2012) in west Bengal. They reported that highest percentage of alkaloid (67.86 g/100g) and saponin (12.4g/100g) have been detected from roots of *N. indicum* which are used as antitumor and as antimalarial activity for medicinal purpose.

Trichogenous activity

Adhirajan *et al.* (2003) conducted an experiment on effect of petroleum ether extract of *Hibiscus rosa-sinensis* on hair length of female albino rats and stated that dried powdered leaves extract (5 % w/w) showed significantly maximum hair length until the end of the treatment course compared to control and ‘Placebo’ standard.

Anti cancer activity

Dantu *et al.* (2012) resulted that the hydroalcoholic extract of *Tabernaemontana divaricata* flowers has a moderate anticancer activity. As the concentration increased there was increased in the cell growth inhibition of cell (34.34%) at 300 μg flower extracts.

Antimicrobial activity

Nandita Dasgupta *et al.* (2012) reported that mexican marigold leaf extracts has maximum antibacterial properties for *Acinetobacter baumannii* (Acitvity Index = 0.91) and *Propionibacterium acne* (Acitvity Index = 0.90) while minimum was for *Streptococcus pneumoniae* (Activity Index = 0.02). Therefore Mexican marigold has antibacterial effect against air borne diseases causing gram positive and gram negative bacteria against skin infection causing bacteria.

Sharmila and Gomathi (2010) evaluated antibacterial activity of leaf extracts of *crossandra infundibuliformis* against pathogenic bacteria. They noted that 250µg/ml ethanol extract of *crossendra infundibuliformis* showed maximum antibacterial activities against *Pseudomonas aeruginosa* (29 mm diameter of inhibition zone) followed by *Proteus mirabilis* (26 mm) and *Shighella dysenteria* (22 mm).

Kumar *et al.* (2012) reported that extracts from all the parts *viz*, leaves, stem and roots of *Rosa indica* posses antibacterial activity. The results showed that the inhibition of microbial growth of gram negative bacteria *E. coli*, *P. aeruginosa* as well as gram positive bacteria *B. licheniformis* and S. aureus was greater by the stem extracts of *R. indica*.

Aneja *et al.* (2010) studied an experiment on antimicrobial activity of *Barleria prionitis* bark extracts against dental caries causing oral pathogens by agar well diffusion method. They revealed that among the tested bacteria it showed the highest zone of inhibition against *Bacillus sp.* (28.65mm).

Analgesic activity

Nidhi Sengar *et al.* (2010) reported that ethanol root extracts of *Jasminum sambac* (EJS) has moderate effect of analgesic activity as concentration increased there was reduced in writhing count upto (49.21%) at 400 mg/kg.

Antidiabetic activity

Judy *et al.* (2003) concluded that extract from the leaves of *Lagerstroemia speciosa* standardized to 1 per cent corsolic acid (GlucosolTM) showed significant reduction in blood glucose level at the 48 mg per day dose in both soft gel and hard gel formulations. Furthermore, soft gel form of GlucosolTM showed a 30 ± 3.4 per cent decrease in blood glucose level in type II diabetics.

Increasing blood cell count

Kannan *et al.* (2007) reported that treatment of 200 mg/kg ethanol extracts of *Nyctanthe arbotristis* leaves applied to rats for 21 days and found significantly increased the total counts of white blood cells (WBC) and red blood cells (RBC).

Antiulcer activity

Yahya *et al.* (1990) stated that 500 mg/kg ethanolic extract from rhizome of *Alpinia galangal* significantly decreased gastric secretions and ulcer in rats.

Conclusion:

From the forgoing discussion it can be concluded that ornamental plants have high aesthetic values among them many have medicinal value due to presence of different useful bioactive compounds in ornamental plants. These can used in complementary alternative medicine as herbal medicine. It influence physiological or cellular activities in the animals or humans.Stem bark extract of *C. fistula* has super oxide radical scavenging activity, leaf extract of *H. rosa-sinensis* has highest antioxidant properties, anti tumor and anti malarial properties are found in root extract of *N. indicum. T. divaricata* flowers has capacity to inhibit the growth cancer cells. mexican marigold, crossendra, rose and barleria posseses anti microbial properties which can affects air borne diseases, skin infections, dental oral pathogens significantly, root extract of *J. sambac* root extracts has analgesic properties. decrease in blood glucose level in type-II diabetics is possible with 48 mg per dose of *Lagrestromia speciosa* standardized to 1% corsolic acid (Glucosol TM) formulation, *Nyctanthes arbotristis* has ability to increase total counts of WBC and RBC in animal, *Alpinia galangal* rhizome has anti ulcer activity, *Adenium obesum* petals has antioxidant activity. Demands for plant based therapeutic systems has continued to increase in recent year because of herbal medicines do not carry any risk of side effects.

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ASPEE COLLGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI, GUJARAT
POST GRADUATE SEMINAR SERIES 2019-2020

Speaker : Vidyashree S	**Course : FLA 591 (1+0)**
Reg. No. : 2020218049	**Date : 30/11/2019**
Major guide: Dr. Sudha Patil	**Time : 3.00 – 4.00 p.m.**
Co-guide : Dr. T. R. Alhawat	**Venue : Swami Vivekanand Hall**

SEED PRIMING IN ORNAMENTAL PLANTS

Establishment of crop is the primary importance for optimizing horticulture production. Every year mankind awaits for the miraculous transformation of seeds into plants and again into seeds. Crop growers have always faced problems associated with seeds like more time taken for germination, poor seed germination, adverse weather conditions, seed dormancy, less germination percentage, etc. which further leads to yield loss (Bose *et al*., 2018). In the last two decades, Several seed enhancement techniques have been adopted to enrich the seed quality, which includes priming, steeping, pregermination, hardening and pelleting. Among the different seed enhancement techniques, seed priming is most commonly used at farmer's field. Seed priming is the process of controlled hydration of seeds to a level that permits pregerminative metabolic activity to proceed, but prevents actual emergence of radicle. The purpose of seed priming is to minimize the period of emergence and to protect seeds from environmental stresses during critical phase of seedling establishment to synchronise emergence which leads to uniform as well as vigorous seedling establishment and enhances yield by improving final germination percentage and seedling health (Sisodia *et al*., 2018).

Brief Review of Research Work

Dalmatian pyrethrum

Delac *et al.* (2018) reported that seeds of Dalmatian pyrethrum treated with distilled water for 24 hours showed maximum germination (23.50 %), germination index (0.59) and mean germination rate (0.09) whereas it reduced mean germination time (12.30 days).

Gerbera

Ahmad *et al*. (2017) stated that seed priming with 50 mM $CaCl_2$ reduced mean germination time (8.91 days) and time taken for 50 % germination (3.25 days), enhanced final germination (84.00 %) with maximum root length (2.00 cm), shoot length (1.53 cm), fresh weight of seedling (3.91 g) and dry weight of seedling (1.15 g) of gerbera.

Zinnia

Ahmad *et al*. (2017) revealed that priming of zinnia seeds with 50 mM $CaCl_2$ enhanced final germination (96.33 %), reduced mean germination time (8.18 days) and time taken for 50 % germination (1.95 days) with maximum root length (7.76 cm), shoot length (5.67 cm), fresh weight of seedling (5.56 g) and dry weight of seedling (1.67 g).

Among all treatments and cultivars of zinnia under study, Szopinska and Politycka (2016) observed that osmopriming (PEG at -1 MPa**)** was more effective method of improving the germination at first count (67.8 %), germination at second count (88.0 %) and α-Amylase (54.7 µmol maltose 100 mg/h) with minimum abnormal diseased seedling (0.8), time to 10 % germination (19.00 days) and mean germination time (18.6 days) in cv. Jowita**.**

Calendula

Karimi and Varyani (2016) revealed that treating calendula seeds with GA_3 at 100 mg/litre was found to be most effective in enhancing shoot length (4.15 cm) and root length (2.63 cm) while distilled water for 72 hours was found effective for minimal mean germination time (6.00 days). Moreover, maximum seed germination (97.00 %) and catalase activity (12 units/mg protein) were noted down in seeds treated with distilled water as well as with GA_3 at 100 ppm for 72 hours, whereas highest seed vigour index (525.75) was obtained in seeds soaked in water for 24 hours.

Mexican fir tree

Rodríguez *et al*. (2015) reported that seeds of *Abies hickelii* treated with hydropriming + *Pseudomonas fluorescens* recorded maximum height (9.2 cm), stem diameter (1.65 mm), root length (10.2 cm), total biomass (1.15 g), radicle volume (1.12 cm^2) and seed germination percentage (91.00).

Salvia

Dastanpoor *et al*. (2013) observed that hydropriming of *Salvia officinalis* (L.) seeds for 12 hours at 30°C was found best for the final germination (85.50 %), mean germination time (4.76 days), germination index (9.50) and time taken for 50 % germination (2.81 days).

Sweet william

Zahedi *et al*. (2012) studied effect of priming on germination and initial growth of sweet william and the results showed that seed inoculate with GA_3 at 100 ppm recorded 100 % germination with maximum germination rate (0.99), radicle length (2.1 cm), plumule length (2.9 cm), fresh weight of radicle (0.003 g), fresh weight of plumule (0.035 g), dry weight of radicle (0.001 g) and dry weight of plumule (0.005 g).

Gladiolus

Mushtaq *et al*. (2012) stated that maximum germination percentage at 15 days (66.67 %) and 30 days (83.33 %) as well as germination test in growth room (80.00 %) was obtained by using lower concentrations of KNO_3 (0.25 %). While same treatment helped to reduce time taken for 50 % germination (7.08 days) and mean germination time (14.75 days) of gladiolus seeds.

Marigold

Afzal *et al*. (2011) reported that priming with 2 % mannitol gave maximum germination (94 %), germination index (6.37), required minimum mean germination time (1.2 days) and time taken for 50 % germination (1.60 days) with maximum shoot length (6.21 cm) and root length (6.21 cm) in African marigold. Similarly in French marigold, application of 2 % mannitol was found best with respect to increased germination (91.00 %), germination index (6.28), shoot length (6.24 cm) and the root length (5.91 cm) with minimum mean germination time (1.7 days) and time taken for 50 % germination (1.59 days). Moreover, seeds treated with 2 % Mannitol showed maximum α amylase, total sugar and reducing sugar in both species of marigold.

China aster

Zhao *et al*. (2004) revealed that application of fungicide (Rovral 50 WP at 0.2 %) to China aster seeds before priming with polyethylene glycol at osmotic potential of -1.25 MPa proved to be the best because of high germination capacity (70.7 %) and minimum mean germination time (1.62 days) whereas minimum infested seeds (11.5 %) were recorded in seeds treated with fungicide at 10 ℃ in both the samples. However, minimum dead seeds (2.3 %) were found in fungicide treatment at 20 ℃.

Butterfly weed

Pill *et al.* (2000) reported that seeds of butterfly weed treated with 10^{-6} M GA_3 showed maximum final germination (54.00 %) and shoot dry weight after 40 days of planting (353 mg) with minimum time taken for 50 % germination (5.9 days).

Gaillardia

Pill *et al.* (2000) stated that seeds of gaillardia treated with 10^{-6} M GA_3 recorded maximum final germination (57.00 %) and dry weight after 40 days of planting (711 mg) with minimum time taken for 50 % germination (4.1 days).

Conclusion

From the foregoing discussion, it can be concluded that seed priming is very important technique to increase seed germination and growth though it varies from crop to crop. Dalmatian pyrethrum seeds treated with distilled water gave maximum germination percentage and germination index with minimum mean germination time. Pre sowing halopriming with 50 mM $CaCl_2$ was most effective for invigoration of gerbera and zinnia seeds. Hydropriming was a simple and effective technique for improving seed germination and seedling emergence in calendula. Seeds of *Abies hickelii* treated with hydropriming along with *Pseudomonas flurescens* recorded maximum height, stem diameter, root length, total biomass and radicle volume. Hydropriming at 30 ℃ was most effective in improving the seed germination and FGP was increased by 25.5 % as compared to that of non primed seeds in salvia. Seed treatment with GA_3 100 ppm showed significant effects on sweet william growth components like germination percentage, germination rate as well as length and fresh weight of radicle and plumule, respectively. Germination percentage can be increased by using lower concentrations of KNO_3 at 0.25 % in gladiolus. Seeds of African and French marigold treated with 2 % mannitol showed maximum final germination percentage, germination index, shoot and root length, α- amylase, reducing and total sugars with minimum time to 50 % germination. Mean germination time of China aster seeds was reduced with fungicide treatment after PEG at osmotic potential of – 1.25 MPa priming. Seeds of butterfly weed and gaillardia treated with 10^{-6} M GA_3 recorded maximum final germination percentage and dry weight of seedlings with early germination.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES 2019-2020

Speaker	: Patel Shivangeeben A.	**Course**	: FLA 591
Reg. No.	: 2020218036	**Date**	: 07 - 12 - 2019
Major Guide	: Dr. B. B. Patel	**Time**	: 2.00 - 3.00 pm
Minor Guide	: Dr. N. K. Patel	**Venue**	: Swami Vivekananda Hall

EFFECT OF PRE HARVEST FACTORS ON QUALITY OF CUT FLOWERS

Flowers have been considered as the symbol of grace and elegance and a feast for our eyes. They are used on all religious festival occasions. Importance of flowers is not restricted up to the beautification, decoration or preparation of Bouquets but also have the industrial importance too. With the increase in buying capacity of people, they have now started buying them from the markets to beautify their home as well as for different uses. Demand of cut flowers increasing day by day hence we require more production. Area under flower growing in India is about 324 thousand ha with 1962 thousand MT production of loose flowers and 823 thousand MT productions of cut flowers. The total area under flower crops in Gujarat is 20.43 thousand ha with total flower production of 152.16 thousand MT (Anon., 2018). Quality cut flowers are playing an important role in the success of floriculture industry. But, the quality of cut flowers can be affected by many pre harvest factors e.g. quality of planting material, growing condition, nutrient management, environmental factors, growth regulators, crop specific practices, harvesting time and stage etc.

- **Brief Review of Research Work:**

Quality of planting material

Uddin *et al.* (2002) reported that maximum plant height (89.22 cm), length of flower stalk (66 cm), rachis length (23.49 cm) and number of spikelets per spike (11.94) and minimum time of 80% plant emergence (15.89 days) and better performed with use of large size corms in gladiolus cv. Friendship.

Ferdousi *et al.* (2018) studied that use of large size corm gives maximum spike length (78.92 cm), number of florets per spike (10.47), number of flowers per plant (1.77), number of corms per plant (2.03) and minimum days required for spike initiation (73 days) and flower initiation (13.25 days) in gladiolus cv. GL-20.

Growing conditions

Celikel and karacaly (1995) obtained better result under glass covering material with maximum flower life (16.8 days), stem top diameter (2.7 mm), stem length (50.3 cm), stem fresh weight (7 g), petal anthocynin A (1.6) and leaf chlorophyll A (0.6) in carnation cv. Astor.

Plant density

Asghari (2014) observed maximum flower diameter (5.7 cm), stem length (57 cm) and longevity (13.3 days) in the treatment of growing media 20 % cocopeat + 60 % perlite + 20 % vermi compost and one plant per pot in carnation cv. Chaubad.

Aklade *et al.* (2016) found least days to flower appearance (214 days) with maximum spike length (119.65 cm), number of bracts per flower (4.89), shelf-life (21.92 days), vase life (10.29 days), number of flower per clump (4.57) and number of flowers per hectare (2.3 lakh) when planted at 50 cm × 40 cm in heliconia cv. Golden Torch..

Subiya *et al.* (2017) observed that maximum number of branches/ plant (18.51), shelf-life of flower (49.98 hours) when planted with 0.90 m × 0.90 m whereas flower yield/ plant (1.02 kg) in 0.60 m × 0.60 m (Triple row).

Sheikh *et al.* (2017) stated that maximum number of leaves per plant (7.38), leaf length (48.60 cm), rachis length (41.20 cm), spike length (72.40 cm) and number of florets per spike (10.57) when planted at 25 cm × 25 cm whereas number of flower per plot (62.25), yield of flower (2.07 lakh/ha) and yield of corms (23.08 lakh/ha) were found maximum with planting distance at 25 cm × 10 cm in gladiolus cv. Red Beauty.

Nutrient management

Aklade *et al.* (2016) observed that maximum spike length (cm), number of bracts per flower, shelf life (days), vase life (days), number of flowers per clump ,number of flowers per hectare (lakh) and minimum days to first flower appearance (days) were recorded with application of 300 kg/ha N and 100 kg/ha P in heliconia cv. Golden Torch.

Navyashree *et al.* (2017) obtained maximum flower spathe length (19.98 cm), stalk thickness (21.62 mm), number of florets per spathe (4.72) and stalk length (96.23 cm) were noted when applied 62.5:25:62.5 g NPK/ plant/ year + ZnSO4 (0.05%) + Boron (0.25%) in bird of paradise.

Tovika *et al.* (2017) observed highest flower diameter (14.47 cm), stalk length (46.47 cm), stalk diameter (0.90 cm), vase life (14.87 days) and number of flowers per plant (12.87) with application of 20:30:40 g/m^2 NPK in gerbera cv. Ruby Red.

Shah *et al.* (2018) found better plant height (38.93 cm), number of shoots per plant (4.60), inflorescence length (42 cm), number of inflorescence per plant (4.13), number of florets per inflorescence (14.87) and post harvest life of inflorescence (30.53 days) were noted with treatment (30% N + 30% K) + Cow urine in *Dendrobium* orchid cv. Sonia 17.

Sathyanarayana *et al.* (2018) obtained least days to spike initiation (48.10 days) whereas, highest spike length (66.63 cm), number of florets per spike (11.30), vase life (14.93), number of spikes per plant (2.50) and number of corms per plant (2.43) when treated with 100% RDF + FYM @ 7.5 t/ha + Azotobacter + PSB + KMB with 1% foliar spray of Nauroji Novel Organic Liquid Fertilizer in gladiolus cv. American Beauty.

Madhuri and Barad (2018) noted maximum harvesting span (81.01 days), fresh weight of single cut flower (22.35 g), dry weight of single cut flower (1.36 g), number of petals per flower (77.08) and minimum days for first flower opening (132.40 days) when 6000:4000:2000 ppm NPK were applied through foliar spray in carnation cv. Bacarat.

Environmental Factors

Longchar and Keditsu (2013) observed highest stalk length (37.50 cm), flower diameter (9 cm) and number of flowers per plant (29.8) when planted on 15th June whereas; highest stalk diameter (0.70 cm) was found when planted on 15th May in gerbera.

Wesley *et al.* (2017) reported maximum number of floral stem (182), number of floral stem/m^2 (91), floral stem length (69 cm) and floral stem diameter (0.74 cm) when grown under black screen light condition in heliconia cv. Golden Torch.

Irrigation

Fetouh and Hassan (2014) obtained more number of inflorescence (3.1), stalk length (90.20 cm), stalk diameter (1.4 cm), spadix length (19.8 cm), inflorescence fresh weight (29.9 g) and inflorescence dry weight (4.4 g) when irrigation was given at 10 days interval in bird of paradise.

Patel *et al.* (2014) observed that 1.0 PEF irrigation level was found better for all growth and flowering attributes like number of leaves/plant, spike length (cm), flower spike weight (g), vase life (days) as compared to flood irrigation in tuberose cv. Prajwal.

Growth regulators

Patel *et al.* (2013) observed maximum plant height (79.20 cm), spike length (83.50 cm), number of florets per spike (12.70), vase life (13.50 days), shelf life (15.70 days) and number of spikes per plant (2.4) when application of 300 ppm GA_3 as foliar spray in gladiolus cv. American Beauty.

Desai *et al.* (2018) studied least days to rachis emergence (37.53 days) whereas, more plant height (74.8 cm), spike length (103 cm), rachis length (27.20 cm) and vase life (11.20 days) when enriched sap of banana pseudostem @ 15000 ppm was applied as foliar application in tuberose cv. Prajwal

Crop specific practices

Patel *et al.* (2014) reported the experiment comprised three different mulches (no mulch, paddy straw mulch @ 10 t/ha and sugarcane trash mulch @ 5 t/ha). Among mulching treatments, paddy straw mulch @ 10 t/ha was found significantly highest in growth and flowering attributes in tuberose cv. Prajwal.

Patel (2015) observed maximum plant height (66.70 cm) and stalk length (68.97 cm) when Cut made on basal at 25 cm above ground level with modified bending in cut rose under green house condition. Singh *et al.* (2016) observed more days of vase life (11.94 days) and longevity (15.61 days) in single pinching whereas, highest number of flowers per plant (6.75) and Yield of flowers/m^2 (222.75) were found in double pinching in carnation cv. Farida.

Nirala *et al.* (2018) found that performance of three varieties of carnation was found better in maximum number of branches, length of flower (cm), flower bud length (cm), flower diameter (cm), number of flowers/m^2 when 120% of RDF of NPK through fertigation.

Harvesting time and stage

Obsuwan *et al.* (2015) observed that spikes harvested at 30 % open flowers were noted longest vase life in *Dendrobium* Burana Jade (12.1 days) and *Dendrobium* Sonia Earsakul (12.7 days) with higher maintenance of relative fresh weight and fewer flower drops.

Conclusion:

From above discussion, it can be concluded that quality of planting materials, different growing condition *i.e.* glass house, plant spacing, integrated nutrient management, environmental factors, PGRs are play vital role to maximal growth, flowering and yield attributes of cut flowers like gladiolus, rose, orchid, carnation, heliconia and bird of paradise which also directly affect on production as well as productivity of cut flowers. Crop specific practices like mulching and fertigation are directly affect on production of cut flowers, while pinching in carnation, bending in rose and harvesting time and stage affects display life of orchid.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI, GUJARAT
POST GRADUATE SEMINAR SERIES 2019-20

Speaker	**: Miss Alka**	**Course**	**: FLA 591 (1+0)**
Reg. No.	**: 2020218002**	**Date**	**: 21.12.2019**
Major Guide	**: Dr. Dipal S. Bhatt**	**Time**	**: 2.00 to 3.00 PM**
Co-Guide	**: Dr. K. D. Desai**	**Venue**	**: Swami Vivekananda Hall**

Flower induction through plant growth regulators in flower crops

Flowers have been considered as the symbol of grace and elegance which play important role in making the life of a human being more cheerful and happy. Besides beauty and aesthetic values of flowers, they are also important for their economic value as loose flowers, cut blooms, value added products like essential oils and pigments. Thus, floriculture is an intensive type of agriculture. In India, flower crops are cultivated in an area of 3.24 lakh ha with the loose flower production of 19.62 lakh MT and cut flower production of 8.23 lakh MT (Anon. 2018). Most of the growers produce a particular flower crop in the normal season following the traditional production technology. As a result, larger quantities of flowers are being produced during the normal blooming period, creating glut in the market which lower the price of the produce. To produce flowers at desired periods for fetching at higher prices than the normal blooming season flower induction or forcing at particular time is required by using various cultural practices. Flower initiation involves interaction between hormones leading to the synthesis of some flowering stimulating compounds. Photo inductive conditions for flowering are concerned with the regulation of the levels of the endogenous hormones like gibberellic acid, NAA, cytokinine, etc. cause flower initiation at specific concentration.

Brief review of research work

Marigold

Kumar *et al.* (2014) revealed that foliar application of GA_3 @ 300 ppm at 30 days after transplanting resulted in minimum days to first flower bud initiation and opening of first flower with maximum flowering duration, number of flowers per plant and flower yield in African marigold (*Tagetes erecta*) cv. Pusa Narangi Gainda.

Narayan (2015) observed that application of 100 ppm NAA at 15 days after transplanting significantly enhanced flowering with quality flowers in marigold cv. Pusa Basanti in Allahabad condition.

Jasmine

Sudhagar and Kamalakannan (2017) noted that early flower bud appearance (59.07 days), highest weight of hundred buds (9.90 g) and flower bud yield (4.23 kg/ plant and 14.1 t/ha) were obtained from jasmine plants sprayed twice with 1500 ppm CCC after pruning.

Kalaimani *et al.* (2017) studied the influence of time of pruning and plant growth retardants on growth and off season flower production in *Jasminum sambac* (L.). They revealed that number of days taken for first flower bud harvest was registered earliest with highest flower bud yield in the plants pruned during last week of September along with foliar spray of mepiquat chloride @ 50 ppm at fifteen days after pruning.

Chrysanthemum

Dutta *et al.* (1998) studied the regulation of flowering in chrysanthemum cv. Co.1 by applying different concentrations of gibberellic acid and reported early commencement of flowering (83.33 days) with spray of 150 ppm GA_3 at 30 and 45 days of transplanting with largest flower (5.9 cm) and highest number of flowers (437.00/ plant) while longest flowering duration (214.3 days) was noted with the application of 50 ppm GA_3 at 30 and 45 days after planting.

Dahiya and Rana (2001) noted that foliar application of 100 ppm GA_3 at 45 days after transplanting was found best for early flowering along with increased duration of flowering and yield of chrysanthemum cv. Vasantika.

Sajid *et al.* (2016) studied the effect of gibberellic acid on enhancing flowering time in chrysanthemum cv. Fanfare and reported that plants sprayed with 250 ppm GA_3 twice after transplanting resulted early flowering (110.80 days) than control with highest number of flowers (31.90) per plant.

Kannan *et al.* (2016) stated that early bud appearance (44.72 days) and days to harvest (81.83 days) with increased yield (77.34 cut stem/ m^2) were recorded with foliar application of daminozide @ 2500 ppm at 7^{th} day after darkening in chrysanthemum cv. Punch under greenhouse in Tamil Nadu.

Rose

Baghele *et al.* (2016) stated that foliar application of 100 ppm GA_3 at 15 and 30 days after bending resulted minimum days required for bud initiation (21.90) and bud opening (9.60 days) with maximum bud diameter (17.68 mm), flower diameter (71.29 mm) and no. of flowers (46.47 / plant) in rose cv. Poison under NVPH.

Gerbera

Dalal *et al.* (2009) noted that significantly early flower bud appearance (27.98 days) and flowering from bud initiation (14.13 days) in the plants sprayed with GA_3 50 ppm whereas, highest flowers per plant (12.36) with maximum length of flower stalk (54.21 cm) and flower diameter (9.06 cm) were obtained with foliar application of GA_3 @ 150 ppm at 30 and 60 days after transplanting in gerbera under polyhouse condition.

Sangma *et al.* (2017) reported that gerbera plants sprayed four times with 150 ppm GA_3 resulted early flower bud emergence (39.90 days) with maximum flower diameter (14.74 cm), stalk length (52.90 cm) and number of cut flowers (12.50/plant) in gerbera cv. Pink Elegance under naturally ventilated polyhouse.

Orchid

Barman *et al.* (2014) reported that 46 per cent plants produced inflorescence with foliar spray of BA 100 ppm along with GA_3 @ 100 ppm twice in April and July months to *Dendrobium* hybrid Thongchai Gold while in control only 15 per cent plants produced inflorescence in September month. Moreover, plants treated with GA_3 @ 100 ppm gave maximum flowering during September to November followed by spray of BA 100 ppm along with GA_3 @ 100 ppm twice in April and July months and decreased slowly thereafter.

Tuberose

Singh and Desai (2013) reported that soaking of tuberose bulbs in 200 mg/l GA_3 for 24 hours before planting along with foliar application of 200 mg /l GA_3 significantly minimize days required for spike emergence (96.2) and increased spike length (101.3 cm), number of spikes / plant (3.5) and number of florets per spike (47.4).

Gladiolus

Patel *et al.* (2010) reported early spike initiation (65.07 days) in gladiolus with foliar application of 200 mg/l ethrel while significantly minimum days required for first flowering (77.44 days), maximum number of spike per plant (2.30), length of spike (96.76 cm) and number of florets / spike (13.47) were obtained with the application of GA_3 @ 50 mg/l in gladiolus cv. American Beauty.

Ashwini *et al.* (2019) revealed that gladiolus corms cv. Adigo Yellow soaked in GA_3 @ 150 ppm for 24 hours resulted minimum days taken for spike initiation (54.73 days), maximum spike length (68.10 cm), number of florets/spike (15.07) and number of spike per plant (1.47) in Bangalore conditions.

Conclusion

From the foregoing discussion, it can be concluded that foliar application of 300 ppm GA_3 at 30 days after transplanting and NAA 100 ppm enhanced flowering and increased yield of African marigold. Foliar application of plant growth retardant *i.e.* 1500 ppm CCC and mepiquat chloride 50 ppm after pruning in jasmine produced maximum flower bud yield during off season. Flowering in chrysanthemum plants can be enhanced by spraying of 50 to 250 ppm GA_3 at 30 and 45 days after planting. Moreover, damiozide at 2500 ppm also found effective for induction of flowers in chrysanthemum. Spray of GA_3 100 ppm resulted early flowering with better quality flowers in rose under NVPH. GA_3 50 ppm to 150 ppm found effective for induction of early flowering and quality flower yield in gerbera. *Dendrobium* orchids sprayed with 100 ppm BA along with 100 ppm GA_3 increased flowering during September to November. Soaking of tuberose bulbs in 200 mg/l GA_3 for 24 hours along with 200 mg/l GA_3 spray resulted early flowering and maximize spike yield. Foliar application of 50 mg/l GA_3 as well as soaking of corms in 150 ppm GA_3 found effective for early flowering and increased yield with quality spikes.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES 2019-2020

Speaker	: Mistry Kinjal Dipakkumar	**Course**	: FLA 591
Reg. No.	: 2020218019	**Date**	: 04- 01- 2020
Major Guide	: Dr. G. D. Patel	**Time**	: 2.00 - 3.00 pm
Minor Guide	: Dr. S. J. Patil	**Venue**	: Swami Vivekananda Hall

ADVANCE PRODUCTION TECHNOLOGY FOR CUT ROSES

Floriculture has been emerging as a future thrust industry in India and referred as tomorrow's green cultivation. Today, floriculture is a lucrative profession with higher potential for returns than most of the field and other horticultural crops. The area under flower crops in India has been increased to 3.24 lakh ha with the production of 19.62 lakh MT of loose flowers and 8.23 lakh MT of cut flowers. (Anonymous, 2018). The demand of flowers both in India and international markets is increasing at a faster rate owing to the liberalization of economy and globalization of trade.

The leading flowers which are great in demand are rose, chrysanthemum, carnation, gladiolus and anthurium. Globally, roses rank 1st position among the all cut flowers. It belongs to family Rosaceae and is native of India (Northern hemisphere). The genus *Rose* has around 120 species. *Rosa* spp. is also known as "Queen of flower" or "Perfume of God". It is an excellent plant for interior and as cut flower, especially for flower arrangement**.**

Brief Review of Research Work:

Open field cultivation

Genotype

Maximum bud length (3.46 cm), flower length (3.70 cm), flower diameter (10.85 cm), number of flowers per plant (29.50) and vase life (7.52 days) were noted in rose genotype Abha under open field condition at Ranchi. (Annon 2014)

Spacing and Variety

Subiya *et al.* (2017) reported that maximum number of flower branches per plant (18.51) were observed with spacing of 0.90 m × 0.90 m. Moreover, cultivars of maximum number of flower branches per plant (18.52) was recorded in cultivar Sophia, while maximum stalk length (17.71 cm) was noted in cultivar Gladiator.

Growing conditions

Patil *et al.* (2010) noted that maximum plant height (99.78 cm), flower stalk length (61.44 cm), flower diameter (11.63 cm) and fresh weight of flower (10.16 g) were obtained in rose cv. Gladiator grown under 50 % shade net.

Integrated Nutrient Management

Tukaram (2018) stated that maximum number of branches per plant (15.62), number of flowers per plant (34.28), minimum days to 1st flower harvested (33.03 days) and vase life (10.75) were recored in rose plant treated with Biomix biofertilizer (3 ml/plant). Moreover, more number of branches per plant (14.43), number of flowers per plant (29.89), earliness for 1st flower harvest (36.35 days) and longest vase life (9.93 days) with the application of 100 % RDF (14:7:7 g NPK/plant) in rose cv. Gladiator.

Pruning

Hassanein (2010) noted that light pruning during autumn at 75 cm from ground level found promissing for obtaining highest number of cut flowers per plant (20.3), number of flowering buds per plant (35.2), number of petals per flower (31.2) and number of total flowers per plant (55.5) in rose cv. Eiffel Tower.

Mulching

Jadhav *et al.* (2018) observed that 300 micron thick black polyethylene mulch found effective for producing more number of cane per plant (4.19) and no. of flower per plant (38.03) with better flower diameter (6.36 cm) in rose cv. Gladiator.

Protected cultivation

Genotype

During testing of new genotypes, maximum bud length (3.30 cm) and bud diameter (2.50 cm) were recorded in IIHR-7-1 genotype, highest flower diameter (7.70 cm) recorded in Naranga, more number of flowers per plant (28.00) was obtained from Top Secret and longest vase life (8.00 days) was recorded in Nobless under polyhouse condition at Pune. (Annon. 2014)

Shivaprasad *et al.* (2017) recorded that early flower bud initiation (16.30 days) and first flower harvest (36.24 days) with longest vase life (9.22 days) were observed in rose cv. Grand Gala. While maximum no. of leaves per shoot (11.37) was found in rose cv. Konfetti. However, maximum benefit cost ratio (3.55) was recorded in rose cv. Tajmahal under NVPH.

Growing Media

Chavada *et al.* (2017) stated that maximum flower diameter (8.23 cm), leaf area (36.98 cm2), number of leaves per stalk (20.23), stalk length (36.23 cm) and number of flowers per plant (19.48 kg) were observed in rose cv. Top Secret grown in soil + cocopeat + perlite (1:1:1) under protected condition.

Rootstock

Otiende *et al.*(2015) revealed that maximum number of harvestable stems (12.59) and highest stem length (76.31 cm) were noted in '*Rosa progress'* rootstock. While higher stem weight (42.76 g) and rooting percentage (84.0%) were recorded in '*Natal briar*' rootstock.

Izadi *et al.* (2014) reported that maximum number of roots (3.34) was recorded in S_2R_2 (Peach Avalanch grafted on *Rosa manetti* rootstock), while longest root size (2.55 cm) was noted in S_2R_1(Peach Avalanch grafted on *Rosa indica* rootstock) and highest healing percentage (78.49 %) in S_3R_2 (Dolcevita grafted on *Rosa manetti* rootstock).

Fertilizer

Pooja *et al.* (2017) observed that maximum leaf area (30.53 cm2) and size of flower (8.74 cm) with early flower bud initiation (127.47 days) were obtained with water soluble fertilizer (F_1) application. While maximum plant height (69.67 cm) and vase life (7.72 days) were observed with application of commercial straight fertilizer (F_2) in Dutch rose under protected condition.

Micronutrient

Henaxi Patel (2015) revealed that maximum number of flower yield with respect to number of flowers per plant (30.1 and 30.2) and number of flowers per square meter (165.7 and 166.5) increased with foliar spray of 0.4 % $ZnSO_4$ and 0.4 % $FeSO_4$, respectively in rose cv. Top Secret under polyhouse condition.

Irrigation

Fascella *et al.* (2010) observed that rose plants irrigated with MIS (2 L/ h, 1 dripper / plant) as per ISR (Accumulative Solar Radiation) produced more number of stems per plant (21.0), with longest stem (58.3 cm), maximum stem thickness (8.1 mm), bud width (4.8 cm) and more number of leaves per stem (8.5).

Plant Growth Regulator

Parmar *et al.* (2015) recorded that maximum number of flowers (28.07/ plant and 140.33/ m2) with longest vase life (12.23 days) were noted with foliar application of GA_3 200 ppm in Dutch rose cv. Passion under polyhouse condition at Junagadh.

Crop specific practices

Nital Patel (2015) reported that basal cut on rose plant at 25 cm above ground level with modified bending resulted maximum plant height (66.70 cm) and stalk length (68.97 cm) under NVPH.

Conclusion:

From the foregoing discussion, it can be concluded that open field cultivation of rose varieties Abha and Gladiator planted at 0.90 m× 0.90 m perform better for vegetative and flower character. Rose cv. Gladiator perform better through the application of 100 % RDF (14:7:7 g NPK/ plant), Biomix (3 ml/ plant) and providing 50 % shade during summer. However, light pruning at 75 cm above soil during winter more effective for quality cut flower in open field. In case of protected cultivation of rose, various genotype and varieties were selected accordingly to flower colour, stem length and yield basis. Rose cv. Top Secret grown under soil+ cocopeat+ leaf mould (1:1:1 v/v) found effective for higher cut flower production. Different rootstock *viz.*, *Natal briar*, *Rosa progress*, *R. canina* and *R. manetti* were utilized for grafting purpose. INM (Water soluable fertilizer, Biofertilizers and micronutrients) play a vital role for enhancing the yield attributes. Greenhouse rose crop can be irrigated as per Pan evaporation and accumulative solar radiation for better performance. Modified bending, cane development technique and application of GA_3 @ 200 ppm cane augmented quality cut flower production under protected cultivation of rose.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURE UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES 2019-2020

Speaker	:	Chotaliya Kautik Arjanbhai	**Subject**	:	FLA-591(1+0)
Registration No.	:	2020218010	**Date**	:	04-01-2020
Major Guide	:	Dr. G. D. Patel	**Time**	:	04.00-05.00 pm
Co-Guide	:	Dr. B. M. Tandel	**Venue**	:	Swami Vivekananda hall

Seed production technology in marigold

Marigold gained popularity amongst gardeners and flower dealers due to it's easy culture, wide adaptability and it's habit of free flowering, short duration to produce marketable flowers and wide spectrum of attractive odour, shape, size and good keeping quality. Marigold is cross pollinated crop, pollination is done by honey bees as well as by wind. Marigold is propagated sexually as well as asexually but, sexual method of propagation is widely used so, seed production is necessary in marigold due to high demand of flower as well as planting material. Seed production in flowering annuals has a definite place in crop diversification programme owing to better returns. Marigold is highly heterozygous in nature, cultivation for seed production requires constant attention, in-depth knowledge, skill and specialization. Seed production technology is the creation and application of the knowledge on seed for its better usage in agriculture. With such an advancement, production and marketing of seeds have assumed international importance. In India, about 600–800 ha area is under ornamental crops specially annual flower crops seed production. Of the total production, Punjab alone contributes for 45–50%, Sangrur, Ludhiana and Patiala being major seed-producing centres. The rest is being contributed by Karnataka (Bangalore and Ranebennur), West Bengal (Kalimpong and tarai area), Bihar (Ranchi), Maharashtra (Pune), Haryana (Panipat and Sirsa), Himachal Pradesh (Kulu Valley) and Jammu and Kashmir (Srinagar Valley).

Brief Review of research work

Murali *et al.* (2018) described cultivar identification and varietal distinction techniques of marigold and reported that maximum seed yield per plant (6.12 g and 6.25 g) and 1000 seed weight (2.83 g and 2.86) was observed in Pusa Narangi Gainda during 2015-16 and 2016-17 respectively.

Patel *et al.* (2018) conducted experiment on genetic divergence in marigold and reported that maximum seed yield per plant (171.55) and 1000 seed weight (3.5 g) were obtained in cluster IV which have genotype of Local selection 15 under the South Gujarat condition.

Nimisha Augustine *et al.* (2015) obtained higher seed weight per flowers in Local Yellow, Orange Giant and Sonata Orange in African marigold. They also observed that there was not found any significant difference between seed production under open as well as rain shelter condition during rainy season.

Pramila *et al.* (2011) studied seed production in African and French marigold with special reference to seasons and observed that maximum number of seed per flower (165 and 44), seed yield per plant (14.51 g and 4.86 g), 1000 seed weight (2.63 g and 2.35 g) were obtained during *Kharif* season, respectively. While, maximum germination percentage (88.40 and 86.40) observed during *Rabi* season in African and French marigold respectively.

Rao *et al.* (2002) conducted experiment on timing of reproduction, flower and seed yield in marigold species as influenced by different sowing dates and revealed that maximum number of flowers per plant (49 and 162) and seed yield per plant (12.7 g and 30.4 g) were observed in African and French marigold sown at 20th June, respectively.

Meena *et al.* (2015) studied effect of spacing on seed attributes in African marigold cv. Pusa Narangi Gainda and reported that maximum seed yield per flower (0.6 g), seed yield per plant (17.71 g) and seed yield per plot (262.20 g) were observed in marigold plants transplanted at 30cm x 30cm spacing.

Singh *et al.* (2015) studied effect of INM on seed yield in marigold cv. Pusa Basanti and reported that minimum days taken for 1st flowering (41.96), maximum number of flowers per plant (58.32), yield of flower per plant (531.18 g) and seed yield (71.12 g) were noted in marigold plants treated with 75% RDF + vermicompost (80 q/ha) + *Azotobacter* (3.3 kg/ha).

Mohanty *et al.* (2015) studied effect of pinching on seed traits in African marigold cv. Sirakole and reported that maximum weight of seed per head (0.25 g), weight of seeds per plant (10.13 g), 1000 seed weight (1.50 g), seed yield per plot (202.73 g), germination (83.64 %) and vigour index (1861) were observed in single pinching.

Singh *et al.* (2017) studied effect of pinching, urea and GA_3 on growth, flowering and seed attributes in African marigold and revealed that double pinching (30 and 60 days after transplanting) + foliar spray of urea 2% in African marigold resulted maximum number of seeds per flower (316.45), weight of seeds per flower (0.53 g) and seed yield per plant (30.15 g).

Rajhansa *et al.* (2013) studied effect of growth regulators on seed yield of African marigold cv. Pusa Narangi Gainda and reported that maximum seed yield per plant (16.63g and 17.97 g) and seed yield per ha (693.00 kg and 749.11 kg) were observed in African marigold sprayed with GA_3 200 ppm during 2012-13 and 2013-14 respectively.

Priyanka Thakur *et al.* (2015) studied effect of mulching on seed yield of African marigold cv. Pusa Narangi Gainda and reported that maximum number of seeds per head (243.57), seed yield per plant (18.60 g), seed yield per plant (171.30 g) and 1000 seed weight (3.46 g) were obtained from plants mulched with silver black plastic mulch under Himachal Pradesh condition.

Bhaskaran and Jha (2016) conducted experiment on seed development and maturation of marigold and reported that maximum number of seed per flower (270) and maximum weight of 100 seed (0.390 g) was observed at 6th week after bud initiation.

Gopichand *et al.* (2014) studied effect of bioregulators and stage of harvesting on seed maturity and quality in African marigold and reported that maximum seed yield per flower (g) was obtained at 28th days after anthesis.

Conclusion:

From the foregoing discussion it can be concluded that quality seed is an important part of marigold production. A well planned seed production is essential to support a successful crop production. This can happen only through following scientific and systemic guideline given by CSCB, New Delhi for field standard and seed standard for Foundation and Certified seed of marigold as well as DUS testing guideline of marigold. Among different genotype Pusa Narangi Gainda found best for production of maximum seed. Marigold is a versatile flower crop but *Kharif* season especially 20th June sowing time is favourable for marigold to increase seed yield while maximum germination percentage is observed during *Rabi* season. Pusa Narangi Gainda cultivar of African marigold planted at 30cm x 30cm gives better flowering and seed yield. Maximum flowering and seed yield can be obtained from a combination of 75% RD of NPK + vermicompost (80 qt/ha) + *Azotobacter* (3.3 Kg/ha) as well as GA_3 200 ppm and 300 ppm. Single pinching as well as Double pinching + Urea 2% increased the flower yield in African marigold. Silver black plastic mulch found effective to increase maximum flowering and seed yield. In case of harvesting time, at 42nd days after budding or at 28th days after anthesis of flower resulted maximum seed yield for marigold.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES 2019-2020

Speaker : Patel Kalpesh M.	**Subject :** FLA-591 (1+0)
Registration No. : 2020218031	**Date :** 18/01/2020
Major Guide : Dr. S. A. Aklade	**Time :** 03.00 to 04.00 pm
Co-Guide : Dr. B. M. Tandel	**Venue :** Swami Vivekananda hall

Recent Advances in Turfgrass Management

The word Turf (*Torf*, *Torfa*) is derived from Sanskrit word 'Darbhus' meaning a turf of grass which includes aportion of the medium in which the grasses are grown. Turfgrasses have been utilized by humans for more than centuries to enhance their environment, but the modern turfgrass industry development during the past three decades islargely in response to the increased population growth and urbanization. Utility of turf exists to stabilize the soil, reduce dust, glare and control pollution from road side traffic. It is the most important feature on golf courses, cricket, football, athletics and other sports fields requiring a resilient playing surface. It is also considered as 'The Heart of The Garden' as garden cannot be said complete without lawn. Lawn serves as a decorative function by enhancing the beauty of landscape by providing areas for recreational play and as a natural green carpet. It is also considered as soul of the garden because lush green lawn provides a great satisfaction to owner and becomes a center of the garden for major activities. For better establishment of turf, besides selecting a suitable genotype adaptable to the location, land preparation, frequent irrigation, timely fertilization, mowing, providing aeration to root zone and management of weeds, pest and diseases is also essential.

Brief Review of research work

Genotype/Species

Roshni Agnihotri *et al*. (2017) carried out an experiment to evaluate the different species and varieties of turfgrass for the morphological characters under South Gujarat agro-climatic condition and found that, *Cynodondactylon* var. Local recorded minimum days for 90 per cent establishment with maximum root depth, while highershoot density was found in *Zoysia tenuifolia*. Whereas, *C. dactylon* × *C. transvaalensis* 'Tifdwarf' showed better performance in respect to lowest leaf width, days to 90 % establishment and maximum leaf chlorophyll content in all the seasons among all the genotypes and also had prostrate growth habit, thus could be used under this region.

Sowing

Patton *et al*. (2004) reported 95 % coverage in bermuda grass in 30 to 60 DAS when seeded from 1st June to1st August and in contrast to this, *Zoysia* take 90 to 105 days to reach 95 % coverage when seeded from 1st June to 15 June. Similarly for getting rapid coverage and higher densities, seeding with 12 to 24 and 49 to 98 kg/ha were found best for Bermuda and *Zoysia* grass, respectively.

Media

Golestani *et al*. (2014) evaluated the use of low cost organic matter on seed germination and uniformity of turfgrass in sod production of *Lolium prenne* and found that the mixture of rice hull and sand (3:1 v/v) increased germination percentage over other treatments, while the lowest and highest uniformity rate were recorded in sand media and mixture of treatments, respectively.

Nutrient Management

Dyke *et al.* (2009) studied the influence of humic acid on the establishment of Kentucky Blue grass at different rates with multiple application timings in combination with a starter fertilizer as compared to only starter fertilizer but found no significant effect of humic acid.

Susan Mathew (2012) in *Cynodon dactylon* evaluated the effects of different levels and methods ofapplication of N fertilizer (Urea) and recorded maximum average score for grass intensity with the application of N @200 kg/ha/year in 100 % granular form (T9), while higher aesthetic appearance score of turf grass was found with 100% foliar application of N @ 200 kg/ha/year (T7). Whereas,

during whole growth period of lawn, maximum scores for the parameters were recorded during the month of July.
Oh *et al*. (2015) studied the effects of late fall nitrogen application in *Zoysia* grass spring green up and revealed that the slow-release N (Methylene Urea) was more effective for turf grass color and quality than fast-release N (Urea) in spring.

Irrigation

Busey and Johnston (2006) carried out an experiment to know the impact of irrigation and N fertilizer on various parameters of St. Augustine grass and obtained better results when irrigation was given daily for percent coverage of grass, dry weight and turf quality as compared to weekly and at severely wilted conditions. Similarly, N at 28 g/m2/year was found best for all above parameters.
Zhang *et al.* (2007) studied the evapotranspiration rate (ET) of six different turfgrasses during their whole growth period under two water conditions (full and deficit) and observed that among the 3 cool season turfgrasses, perennial ryegrass had the maximum water conservation capacity while tall fescue consumed most water. Whereas, among the 3 warm-season turfgrasses, Japanese lawn grass consumed least water and the maximum by Bermuda grass.
Uddin *et al*. (2012) studied the effect of salinity on leaf relative water content (RWC) of six different turfgrass species and observed maximum values in *Paspalum vaginatum* at all the EC levels among all the species.

Mowing

Palmesy Sangma (2015) in *Cynadon dactylon* var. Tifdwarf 419 studied the effect of different mowing heights and intervals on shoot density, dry weight, chlorophyll a, b and total chlorophyll content and obtained highest shoot density and chlorophyll contents when grass was mowed at 3 cm height and at 7 days interval, whereas maximum shoot dry weight was recorded at 9 cm mowing height and 14 days interval.
Lakshmipathy (2017) studied the effects of different levels of shade on leaf length, leaf width and days taken for mowing of turfgrass and reported maximum leaf length in 90 % shade and minimum in 0 % shade. Likewise, minimum leaf width was observed in 0 % shade and maximum in 50 % shade along with maximum days taken for mowing.

Weeding

Maitry Desai *et al*. (2017) studied the effect of herbicides on different attributes of lawn and found that leaf width, leaf length, visual appearance and phytotoxicity were maximum under manual management followed by
Halosulfuron Methyl 75% WG @ 2.4 g/10 l and 3.3 g/10 l. However, significantly lowest re-emergence and higher weed control efficiency of *Cyperus rotundus* L. was obtained in Halosulfuron Methyl 75 % WG @ 3.3 g/10 l when sprayed at 4 to 6 leaf stage and vice versa in control followed by manual management at both 30 and 60 DAT.

Disease Management

Bagal (2014) in Korean grass studied the effect of different treatments on controlling *Fusarium* wilt and observed that the least disease incidence and higher disease control was obtained with the application of formaldehyde 40 % @ 20% followed by carbendezim 50 WP @ 0.10%.

CONCLUSION:

From the above discussion, it can be concluded that for an effective management strategy of turfgrasses, one should starts with selecting an appropriate genotype suitable to the prevailing environmental situations, as for South Gujarat conditions *C. dactylon* × *C. transvaalensis* Tifdwarf was found best as it had superior quality attributes, while *Paspalum vaginatum* recorded highest RWC at all EC values then other species. Similarly Perennial rye grass and Japanese lawn grass needs least water for their growth, while St. Augustine grass performed better when irrigated daily. As far as media is concerned rice hull and sand (3:1) was found best to improve aeration of the root zone andthus, provides conditions for better germination and WHC. Whereas, seeding rates of 12 to 24 and 49 to 98 kg/ha were found adequate for Bermuda and *Zoysia* grass, respectively. Further, slow release nitrogen as late fall fertilization was also effective for turfgrass color and quality in spring of Zoysia grass, while N @ 28 g/m2/yr was found best for St.Augustine grass. For weed control, Halosulfuron Methyl 75 % WG @ 3.3 g/10 l was found best. Likewise, mowing at 3 cm height and at interval of 7 days gave best results for chlorophyll retention and for controlling wilt carbendezim 50 WP @ 0.10% was found best.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY NAVSARI
POST GRADUATE SEMINAR SERIES2020-2021

Speaker	**:**	SolankiKaushikkumar S.	**Subject**	**:**	FLA-591(1+0)
Registration No.	**:**	2020219042	**Date**	**:**	06-11-2020
Major Guide	**:**	Dr. G. D. Patel	**Time**	**:**	10.00-11.00 am
Co-Guide	**:**	Dr. S. S. Gaikwad	**Venue**	**:**	Online

Palm: Versatile group of plant material for landscape gardening

Ornamental palms are important components of tropical, subtropical, and even warm temperate climate landscapes. In colder climates, they are important interiorscape plants and are often a focal point in malls, businesses hubs, buildings, avenue and other public areas.There are 181 genera with around 2,600 species are belonging to the Family Arecaceae (Palmae). The grate botanist Linnaeus, called them “Princes of the vegetable kingdom”. In many historical cultures, palms are symbol for such ideas as victory, peace and fertility.While, today it represents symbol for tropics and vacation spots. The production of ornamental palm is a relatively small industry, yet quite popular for those who produce on small acreage or ranchettes. Ornamental palms are widely used in landscaping for their exotic appearance, making them most economically important plants in the world. The easy cultivation of palms and their delightful appearance make them great favorites in the garden with purify the indoor air and used as cut foliage in domestic or international market too.

Brief review of research work

Qureshimatva*et al.*(2018) did the survey of south Gujarat region and found maximum diversity of palm in Surat district. They observed total 33 species of palm among them fivewerecultivated and remains in wild and ornamental form.

Stein (2015) explored the desert area of California and Arizonato examine the behavior of different palm species and observed that different Fan palms tends to survive in hotdry climate better than pinnate leaved or feather palm

Bezona*et al.* (2009) differentiated several salt and wind tolerant as well as moderately tolerant palm species near beach site of Hawaii.

Oyama*et al*. (1992) reported that*Astrocaryummexicanum* covered maximum area (1244.25 m^2) with average plant height (7.60 m) compared to other most common species of tropical rainforest area of Japan.

Pivetta*et al.* (2005) found maximum seed germination (79.40 %) and seed germination index (1.2190) of Queen Palm (*Syagrusromanzoffiana)* at 30^0C temperature in control environmental condition of Brazil.

Petterson*et al*. (2008) stated that maximum plant height and stem diameter were observed through the foliar fertilizer application of NPK @ 8:9:9 compared to granular application of NPK@ 10:10:10 in lady palm seedling.

Mohamed (2018) reported areca palm (*Dypsiscabadae*)grown in compost + peat moss + perlite produced maximum plant height, number of leaves, show value of plant as well as fresh weight of leaves, stem and roots.

AbouDahab*et al.* (2017) found that*Chamaedoreaelegans*grown in greenhouse resulted maximum plant height (56.76 cm), number of leaves per plant (7.06), stem diameter (16.17 cm) as well as fresh weight (42.64 g) and dry weight (21.19 g) of shoots.

Habib (2012) revealed that NPK each @ 4 g per pot noted maximum plant height (127.70 cm), stem diameter (18.52 cm), number of leaves/plant (8.20) and leaf area (759 cm^2) in fishtail palm (*Caryotamitis*).

Broschat (1995) described procedure of transplanting of old pygmy date palms. He observed that transplanting of old pygmy date palms at the original depth or up to the top of the visible portion of the root initiation zone (0cm to 15cm) resulted optimum survival with good plant quality.

Ali and Bernick (2010) found that annually drenching of Paclobutrazol @ 1.6 g a.i. detained the vertical growth of mature Royal palm (*Roystonearegia*).

Wolverton *et al.* (1989) noted that bamboo palm (*Chamaedoreaseiterzii*) removed highest amount of benzene (34,073 µg) and formaldehyde (76,707 µg) through maximum leaf surface area (10,325 cm^2) from a sealed experimental chamber during 24 hr exposure period.

Baosheng*et al.* (2009)observed that purification capability (P_a) of plant can enhanced with an increase in room temperature from 26°C up to reaching range 34^0C at 1000 lx light intensity.Moreover, purification capability of *Phoenix robelenii*(34.0) relatively high as compared to*Epipremnumaureum* (27.1) for purification from formaldehyde 8 ppm.

Shewaikh*et al.* (2018) recorded that GA_3(50 ppm) + BA (20 ppm) + 8- HQC (300 ppm) + CA (300 ppm) + Sugar (2%) significantly increased the vaselife (84.00 days) and dry weight (1.63 g) of *Chamaedoreaelegans*with higher general appearing score (4.0).

Powar*et al.* (2014) found that wax coating @ 0.5 % of fishtail palm (*Caryotaurens*) leaf had maximum useful vaselife and total vaselife.

Kumar (2004) recommended certain location specific technique for soil moisture conservation from the wasteof palm species especially, coir dust, dry leaves and husk of fruits.

Conclusion

From the forgoing discussion, it can be concluded that palm is most versatile and exciting group of plant and give the highest esteem by garden armature with wide range of selection in different landscape *viz*. tropical, rainforest, desert as well as sea shore area. Higher germination capacity of palm seed can be achieved at 30 ^{0}C temperature.Media in combination of compost + peat moss + perlite found promising for better growth and development of pot plant.Green house condition is very much suitable for commercial cultivation of quality cut foliage production. Foliar feeding through NPK @ 8:9:9 and NPK each @ 4g / plant profound for better growth of palm seedling and pot plant. Transplanting of old palm at the depth from visible portion of the root initiation zone (0cm to 15cm)achieved higher survive rate. Annually drenching ofPaclobutrazol @ 1.6 g a.i. found effective for reduce the vertical growth in landscaping. Certain palm species have the ability to remove benzene, Formaldehyde and certain VOCs from the indoor air and purify it.Areca palm, Fish tail palm and Bamboo palm can also cultivated commercially for cut foliage purposes and vaselife can be enhanced through GA_3 (50 ppm) + BA (20 ppm) + 8- HQC (300 ppm) + CA (300 ppm) + Sugar (2%) or wax coating @ 0.5 % treatment. Moreover, waste of palm species especially coir dust, dry leaves and husk of fruits may utilize for soil moisture conservation.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
Post graduate seminar series: 2020-2021

Speaker : Mallika Ravjibhai Sindha	**Course : FLA 591 (1 + 0)**
Reg. No. : 2020219040	**Date : 07/11/2020**
Major Guide : Dr. S. T. Bhatt	**Time : 2:00 – 3:00 pm**
Co – Guide : Dr. B. M. Tandel	**Venue : Webinar**

AROMATHERAPY- A holistic healing treatment through flowers

Aromatherapy is a holistic healing treatment that uses natural plant extracts to promote health and well-being. Sometimes it is called essential oil therapy. In Aromatherapy aromatic essential oils are used medicinally to improve the health of the body, mind and spirit. It enhances both physical and emotional health. The word is derived from two words: "aroma" and "therapy". "Aroma" means smell or fragrance and "therapy" means treatment. Complementary and alternative medicines usually use aromatherapy in their treatments by using essential oils derived from volatile liquid plant materials and other aromatic compounds from plants. Different modes of aromatherapy are through massage, vapour inhalation, compress, lotion and bathing.

Brief review of research work

Tapanee (2010) studied the stimulating effect of aromatherapy massage with jasmine oil on emotional parameters of human and revealed that 1 ml of 20 % (w/w) solution of jasmine oil massage for 5 minutes resulted significant increase in subjective emotional behavior *i.e.* more alertness, vigor and less relaxation as compared to control group.

Sayorwan *et al.* (2012) conducted an experiment on effect of lavender oil inhalation on autonomic nervous system of human and stated that 10 % (v/v) lavender oil inhalation sifgnificantly decreased systolic blood pressure (108.0 mmHg), diastolic blood pressure (68.52 mmHg), heart rate (65.68 bpm) and skin temperature (31.0 0 C) of 20 healthy persons.

Olapour *et al.* (2013) studied the effect of aromatherapy blend containing lavender essential oil on cesarean postoperative pain on 60 pregnant women for post operative pain of caesarean and revealed that 10 % lavender essence inhalation for 5 minutes reported 90 % satisfaction in caesarean post operative pain than placebo group (50 % satisfaction).

Sayowan *et al.* (2013) conducted an experiment on influence of jasmine oil inhalation on brain wave activities and emotions. They revealed that jasmine oil has stimulatory effects on the function of nervous system and increased beta wave power (13 – 30 Hz) in the anterior centre as well as the left posterior region. They also stated that the positive emotions with respect to the feeling of well – being, active, fresh and romantic have been increased and the negative emotion like feeling drowsy was significantly decreased in participants.

Lotfipur-Rafsanjani *et al.* (2015) stated that aromatherapy massage through 2 % geranium essential oil blending in sweet almond oil for 30 minutes found beneficial for reduction of depression symptoms in postmenopausal women.

Venkataramana *et al.* (2016) conducted an experiment on effect of aromatherapy in the reduction of dental anxiety for 3 age group. They stated that aromatherapy by using inhalation of lavender essential oil effectively decreased the anxiety score with an increasing age of dental patients.

Dehkordi *et al.* (2017) examined the effect of aromatherapy using damask rose essential oil on depression, anxiety and stress in hemodialysis patients and reported that inhalation of damask rose oil in aromatherapy decreased the level of depression, anxiety and stress in hemodialysis patients.

Lotfipur-Rafsanjani *et al.* (2018) revealed that aromatherapy massage using blend of 2 % geranium essential oil and sweet almond oil decreased physical and mental symptoms of premenstrual syndrome (PMS) as compared to massage therapy and control.

Sulung and Aulia (2018) revealed that rosemary aromatherapy significantly improved short term memory score (26.50) than pre treatment score (24. 31) of the elderly.

Sriasih *et al.* (2019) studied the effect of massage treatment using frangipani (*Plumeria*) essential oil aromatherapy for reducing the pain after childbirth. They observed that after receiving aromatherapy massage severe pain intensity (7 – 9 pain scale) was decreased from 97.14 % to 45.71 % and moderate pain intensity (4 – 6 pain scale) was increased from 2.86 % to 54.29 % which was converted from severe pain to moderate pain in women after giving child birth.

The effectiveness of aromatherapy massage using lavender and chamomile oil on the anxiety and sleep quality of burn patients was evaluated by Rafii *et al.* (2020). They observed that aromatic oil massage using lavender and chamomile oil for 20 minutes significantly reduced anxiety score (42.27 ± 3.25) and improved sleep quality (8.45 ± 3.24) in patients with burn injury.

Conclusion

From the foregoing discussion it can be concluded that, aromatherapy regulates the physiological, spiritual and psychological upliftment for the new phase of life. Inhalation of lavender oil in aromatherapy helps to decrease blood pressure, heart rate and skin temperature in human. Moreover, lavender essential oil helps to reduce post operative caesarean pain in pregnant women as well as decrease the anxiety level and improve sleep quality in patients having burn injury and dental problems. Use of jasmine essential oils in aromatherapy enhanced beta wave power in brain and thereby increased positive emotions in human. Aromatherapy with 2 % geranium oil was found effective for reduction of depression symptoms in post menopausal as well as premenstrual syndrome in women. Depression anxiety and stress can be reduced by use of damask rose oil inhalation. Short term memory can be improved in elder person by using rosemary oil through aromatherapy. Frangipani (*Plumeria*) oil massage in aromatherapy reduced the child birth pain intensity in pregnant women. This therapy is not only preventive but also can be used in the acute and chronic stages of disease.

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ASPEE COLLGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI, GUJARAT
POST GRADUATE SEMINAR SERIES 2020-2021

Speaker : Nutan Gujarati	**Course : FLA 591 (1+0)**
Reg. No. : 2020219023	**Date : 27/11/2020**
Major guide: Dr. Sudha Patil	**Time : 4.00-5.00 PM**
Co-guide : Dr. A. K. Pandey	**Venue : Online**

Advances in production technology of *Phalaenopsis* orchid

Phalaenopsis, which is derived from Latin words *Phalaina* means “moth” and *Opsis* means "resemblance”, is also called as Moth Orchid. It is an epiphytic orchid with crassulacean acid metabolism (CAM). This genus includes approximately 70 species and originates from tropical Asia and Australia (Chen and Chen, 2011). It is the second most valuable and popular flowering potted plant and cut flower due to its easy cultural practices, diversity in flower colour, size, shape, year round availability, delicacy and lengthy vase life. *Phalaenopsis* has high economic value and is regarded as the most commercially important orchid. In the Dutch Flower Auction, 135 million pots worth as much as $ 494 million were sold in 2017, being the best-selling flowering potted plants (Anon., 2018) while, in the United States in 2018, a total wholesale value of potted orchids including *Phalaenopsis* were $ 293 million (34.7 million pots) and *Phalaenopsis* accounted for over 75% of orchids (Anon., 2019).

Brief Review of Research Work

Evaluation

Singh *et al*. (2014) evaluated 10 different *Phalaenopsis* varieties and among them, Acc. No. 321239 showed maximum plant height (6.82 cm), number of roots/plant (9.60), leaf breadth (7.0 cm), leaf area (86.6 cm2), flower length (7.30 cm), flower width (8.46 cm) and spike length (57.14 cm) with minimum days taken for 1st floret opening (151.40). While, number of leaves/plant were maximum (5.20) in Acc. No. 351068, leaf length (18.9 cm) in Acc. No. 33605 but the spike emergence was early (57 days) in Acc. No. 351068.

Tissue culture

Chen and Chang (2006) reported that the maximum proliferation rate of fresh mass (5.4) and mean number of embryos (13.8) in plant regeneration through direct somatic embryogenesis from leaf explants of *Phalaenopsis amabilis* was obtained by using Thidiazuron (TDZ) @ 3.0 mg/lit.

Park *et al*. (2002) studied PLB induction in *Phalaenopsis* ‘Taisuco Hatarot’ from explant after 12 weeks of culture on MS medium with BA and NAA. They found that BA (88.8 μM) with NAA (5.4 μM) recorded maximum mean percentage of PLB forming explants (85.0) and number of PLBs per explant (12.0). Moreover, they took four varieties for study and found highest percent of PLB in variety Tinny Sunshine ‘Annie’ while number of PLBs per explants and number of PLBs produced per PLB section were noted down maximum in var. Tinny Starry Sky ‘Annie’.

Light

Wang (2005) stated that plants kept under 160 μ mol/m2/s photosynthetic photon flux took minimum days to spiking (28.00) and days taken to anthesis (156.00) while plants kept at PPF 60 μ mol/m2/s gave maximum number of flowers (14.0). However, plants in PPF 8 μ mol/m2/s took minimum days from spiking to anthesis (123). In further study on darkness duration, it was found that when plants kept in complete darkness for 2 weeks then it resulted into early spike initiation (45 days) and days to anthesis (137) with maximum flower production per spike (10.9).

Temperature

Jeong *et al*. (2020) reported that *Phalaenopsis* plants under controlled temperature *i.e.* 28 °C for 30 days required minimum days to visible inflorescence (40.8), days from visible inflorescence to flower (115.2), total days to flower (155.9) with maximum number of inflorescence per plant (2.1), inflorescence length (43.3 cm), inflorescence thickness (5.45 cm), number of flower buds per plant

(31.3), flower diameter (5.7 cm) and number of branches per plant (1.3). Furthermore, decrease in qualitative and quantitative parameters was also noted with increase in temperature.

CO2

Guo and Lee (2006) worked out total net CO2 uptake in different aged leaves and results showed L2 leaf (2nd leaf basipetally positioned) had the highest night and daily net CO2 uptake. In contrast, young L1 leaf (1st leaf basipetally positioned) had the highest proportion of total net CO2 uptake during daytime. Moreover, CO2 uptake was more in top 3 leaves when placed in shade while lower 3 leaves absorb more CO2 when placed without shading during day time only.

Humidity and Air

Kim *et al*. (2018) revealed that 85% relative humidity with air supplied through air pump recorded highest stomatal width (3.68 µm) and width/length ratio (1.05) while highest stomatal length (4.14 µm) and stomatal area (53.87 µm2) were observed in *Phalaenopsis* kept at 75% RH with air circulation. Furthermore, during 10 days acclimatization period, the relative water content of the medium decreased gradually. The maximum decrease was observed in the 75% RH with air supply (35.95%) and the lowest decrease was recorded in the 85% RH with non-air (6.58%).

Fertilizer

Vendrame *et al*. (2010) studied the effect of silicon on *Phalaenopsis* and results showed that application of 1% Si recorded maximum shoot fresh weight (2.8 g and 2.9 g), shoot dry weight (0.35 g and 0.09 g), root fresh weight (1.1 g and1.8 g) and root dry weight (0.26 g and 0.07 g) in exp. 1 & 2, respectively. While, silicon content in leaf was recorded highest (1.30 % and 1.70 %) in exp. 1 & 2, respectively when 2% silicon was applied.

Plant growth regulators

Wang and Hsu (2004) studied the application of paclobutrazol (250 mg/lit.) at various stages of flower spike development of *Phalaenopsis* and revealed that inflorescence length from base to 1st floret opening was found minimum (22.1 cm) when paclobutrazol applied at pre-emergence stage of spike development. While, minimum internode length between 1st two florets (3.5 cm) and maximum 1st floret width (10.6 cm) was recorded when treatment applied to 10.0 cm spike. However, minimum days to bloom (78.5) and maximum inflorescence diameter (6.0 mm) was noted when treated at 1 cm and 5 cm spike length, respectively.

Cardoso *et al*. (2012) revealed that spraying of *Phalaenopsis* var. 'Dai-Itigo' with GA3 @ 125 mg/lit. was found to be most effective for enhancing leaf length (18.1 cm), leaf width (5.8 cm), flowering rate (50.0 %), number of flowers (6.6), flower diameter (9.4 cm) and petal diameter (5.8 cm) whereas, inflorescence length was recorded maximum (47.0 cm) when GA3 @ 250 mg/lit. was sprayed.

Post-harvest management

Hou *et al*. (2010) observed that potted *Phalaenopsis* 'Sogo Yukidian' had minimum number of yellowed leaves (0.1) when shipped in control condition. Relative water content on 0 and 6th day was recorded maximum (92.5 % and 91.3 %, respectively) in potted plants which were in simulated dark shipping for 7 days with minimum ABA concentration (7.6 pmol/g and 11.6 pmol/g) on 0 and 6th day, respectively.

Nguyen *et al*. (2018) reported that carotenoid and polyphenol content found maximum (0.82 ± 0.02 mg/g and 446.00 ± 60.03 mg/g, respectively) in flowers of *Phalaenopsis* 'Sogo Meili' whereas flowers of *Phalaenopsis* 'Queen Beer' had maximum flavonoids and anthocyanin (138.70 ± 3.03 mg/g and 147.48 ± 11.85 µmol/g, respectively) among flowers of three varieties studied as compared to other plant parts.

Disease management

Dewi and Eti (2019) revealed that *Phalaenopsis* plant had been treated with endosymbionic bacteria with soak + flush method recorded minimum intensity of bacterial soft rot (37.78 %) at 14th day.

Conclusion

From foregoing discussion, it can be concluded that *Phalaenopsis* is very important potted flowering plant in international trade. *Phalaenopsis* can be successfully propagated by tissue culture. TDZ at 3 mg/lit. found suitable to form maximum number of explants while PLB formation was found maximum in media containing 88.8 µm BA and 5.4 µm NAA. Light and temperature are very important factors for flower induction. 160 µ mol/m2/s PPF for 6 weeks at 20 °C day/ 15 °C night cycles and 2 weeks of complete darkness helped to induce early spike initiation. The spike initiation was delayed with deterioration of quality as temperature increased. CO2 uptake was more by younger leaves as compared to older leaves. Relative humidity should be maintained from 75 % to 85 % with air supply to keep plants fresh and healthy. Application of 1.0 % Si was found best to increase shoot and root fresh weight as well as dry weight. Spray of GA3 @ 125 mg/lit. was found best for growth and flowering of *Phalaenopsis* but to keep plant dwarf, application of paclabutrazol @ 250 mg/lit. should be done before spike emergence. For transportation, potted plants can be shipped upto 7 days of simulated dark shipping. Maximum pigments, flavonoids, polyphenols and anthocyanin content were present in flowers than other parts of *Phalaenopsis*. Soft rot in *Phalaenopsis* can be controlled by endosymbionic bacteria with soak + flush method.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2020-21

Speaker	: Sheetalbahen Shaileshbhai Patel	**Course**	: FLA 591 (1+0)
Reg. No.	: 2020219032	**Date**	: 05/12/2020
Major Guide	: Dr. Dipal S. Bhatt	**Time**	: 1.30 to 2.30 pm
Co-Guide	: Dr. B. M. Tandel	**Venue**	: Webinar

Flower forcing in chrysanthemum

Chrysanthemum (*Dendranthema grandiflora* Tzvelev.) popularly known as "Queen of East" is an herbaceous perennial plant, belongs to family Asteraceae. It is one of the leading commercial flower crops grown all over the world due to its wide variations in form, colour, growth habit and utility for loose as well as cut flowers, in landscaping and as a pot plant. Chrysanthemum is a short day plant. It develops flower buds when days are less than 12 hours long and the blooming period is short under traditional cultivation. For year round availability of flowers, flower forcing is necessary to produce off season flowers which helps to obtain higher price of flowers and reduce glut in the market during peak flowering time. Flower forcing is a process that induces a plant to bloom outside the normal blooming period time of the year. Photoperiodic manipulation, pinching, planting times, use of plant growth regulators and offseason cultivars are various tools for flower forcing in chrysanthemum.

Brief review of research work

Dutta *et al.* (1998) conducted an experiment on regulation of flowering in chrysanthemum cv. Co-1 by artificial photoperiod and gibberellic acid. They revealed that combination of long days (18 hours artificial light) and GA3 at 150 ppm delayed bud formation than the control and extended the flowering duration with maximum flower diameter. Whereas, application of GA3 at 100 ppm along with long day condition recorded the highest number of flowers as well as flower yield per plant.

Dahiya and Rana (2001) noted that foliar application of 100 ppm GA3 at 45 days after transplanting was found best for early flowering along with increased duration of flowering and yield of chrysanthemum cv. Vasantika.

Shinde *et al.* (2010) stated that early flower initiation and peak flowering with maximum flowering duration, fresh weight of flower, number of flowers per plant and flower yield were obtained with foliar application of GA3 at 150 ppm in chrysanthemum cv. IIHR-6.

Parit *et al.* (2015) studied the effect of planting time and different cultivars on flowering and yield of chrysanthemum under Northern dry zone of Karnataka. They revealed that the June planted chrysanthemum plants were late to initiate flower buds (75.5 days) while December planted chrysanthemum were the earliest (15.1 days). Duration of flowering was maximum in the October plantings (66.5 days) while minimum duration was recorded in December plantings (30.7 days). Among the cultivars, Accession No. 1 was early to initiate flower buds (15.1 days). Garden Beauty had maximum flowering duration (78.2 days). They also observed that June planting resulted in the maximum number of flowers per plant (115.8) and flower yield (19.3 t / ha).

Sangma *et al.* (2016) evaluated the effect of different covering materials on off season cut flower production of chrysanthemum cultivars and concluded that covering of chrysanthemum plants using HDPE (High Density Polyethylene) resulted in earliest flower bud formation (91.07 days) with maximum number of cut stems (4.21) for off season flower production under Nauni, Solan condition.

Hawa *et al.* (2018) stated that chrysanthemum plants planted on 15th October produced maximum number of flowers per plant and flower yield per plant. They also noted that single pinching at 30 days after transplanting of chrysanthemum increased number of flowers per plant and yield of flowers per plant in both the years of experimentation as well as in pooled data.

Palai *et al.* (2018) studied the effect of planting date and photoperiod on flowering of chrysanthemum cv. Yellow Reagan and stated that early flowering (41.33 days) and maximum size of flower (5.93 cm) were observed in plants planted on 1st December (Natural photoperiod) and 1st August planting (Natural photoperiod), respectively. Maximum number of flowers per plant (42.33) was obtained from chrysanthemum planted on 1st June with 14 hours dark and 10 hours daylight whereas, maximum weight of flower (2.77 g) was recorded in 1st August planting which was at par with 1st June planting with 14 hours dark and 10 hours daylight photoperiod under Odisha condition.

Choudhari *et al.* (2018) conducted an experiment on influence of photoperiod manipulation on performance of potted chrysanthemum cultivars in naturally ventilated polyhouse at Arabhavi, Karnataka. They observed that among the photoperiodic modules, early flowering was observed in photoperiodic module P3 *i.e.* 16 hours dark, 8 hours light while maximum number of flowers and better quality flowers were observed in photoperiodic module P1 (12 hours dark, 12 hours light). The early flower bud initiation and highest number of flowers per plant were noted in cv. Red Deco Spoon while cv. Yellow Decorative reported early flowering with better display life of flowers and cv. Yellow Deco produced flowers with maximum diameter. They also observed that the interaction effect of photoperiodic module and cultivars significantly influenced early bud initiation and flowering in P3V1, maximum number of flowers per plant and display life of flowers were recorded in P1V6 while biggest flower size was observed in P2V2 combination.

Thakur and Grewal (2019) conducted an experiment on growth regulation and off season flowering through night breaks in chrysanthemum cv. Anmol and revealed that the days taken to flower bud appearance, days to colour break stage, days to full bloom stage and number of flowers increased with increased duration of photoperiodic night interruption (120 minutes) which delayed the flower bud appearance by two months. Whereas, longest duration of flowering was observed in 60 minutes night interruption but there was reduction in flower diameter with increased duration of night interruption.

Conclusion

From the ongoing discussion, it can be concluded that foliar application of GA3 @ 150 ppm along with 18 hours artificial light delayed the flowering and extended flower duration in var. Co-1. GA3 @ 150 ppm and 100 ppm increased flower yield in chrysanthemum cv. IIHR-6 and Vasantika, respectively. Planting of chrysanthemum cvs. Garden Beauty, Dundi, Karnool and Accession No. 1 performed best when planted in June month. Artificial shade condition for 14 hours with HDPE improved growth, flower quality and yield of chrysanthemum. Planting annual chrysanthemum on 15th October was found best with respect to flower yield. Single pinching at 30 days after transplanting of annual chrysanthemum increased flower yield. Short day condition for 16 hours found most suitable for chrysanthemum planted in 1st June. Best quality potted chrysanthemum can obtained by imposing photoperiodic manipulation (12 hours dark, 12 hours light) while 16 hours dark and 8 hours light period found better for early flowering under naturally ventilated polyhouse. Night interruption for 120 minutes found helpful to schedule sustainable flowering time in chrysanthemum cv. Anmol which extend by two months.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
Post Graduate Seminar Series: 2020-2021

Speaker : Baraiya Ajay Himmatbhai	**Course : FLA 591 (1+0)**
Reg. No. : 2020219004	**Date : 05/12/2020**
Major guide: Dr. Sudha Patil	**Time : 4.30 – 5.30 PM**
Co-guide : Dr. D. K. Sharma	**Venue : Webinar**

Gypsophila – A promising filler crop

Gypsophila (*Gypsophila paniculata*) belongs to family 'Caryophyllaceae' which is perennial flowering plant. It is native of Eastern Europe and is now grown everywhere in the world. Gypsophila is currently grown on large commercial farms in Ecuador and Colombia with additional production in Mexico and Peru. United States annually imports approximately 100 million gypsophila cut flower stems with import value of about $ 20-24 milllion (Anon. 2018). Flowers of gypsophila are numerous, produced in large inflorescence, usually in profusely branched panicles. Each flower is small (3-10 mm diameter) with white or pink petals. It valued as a cut flower in floristry to add as a filler in flower bouquets. It is commonly used in sweet arrangements for new babies or in romantic bouquets of roses and wall or ceiling decorations. The light airy masses of small white or pink flowers make good contrast to larger flowers in the bouquets.

Review of research work

Variety

Barrera and Arenas (1999) compared the production of the three clones of *Gypsophila paniculata.* They observed maximum number of bunches (104.6/8 m2), bunches/m2 (13.07), bunches/plant (1.8) and bunches/ha (130700) in clone Balborts than other two clones.
Fudano *et al.* (2007) stated that maximum fresh weight of flowers (107.0 g) and number of dichasia (357.0) were observed in var. Perfecta of *G. paniculata* whereas, maximum branch length (420.0 cm), number of florets per dichasium (6.9) and number of florets (1696) were observed in var. Bristol Fairy.

Propagation

Rady and Hanafy (2004) studied encapsulation of gypsophila shoot tip and stored for 30 days. They found that beads prepared in MS medium with 4% and 3% sodium alginate in MS medium containing 0.5 mg/l. NAA + 0.5 mg/l produced highest number of shoots (4.0 ± 0.30 cm) and maximum shoot length (4.9 ± 0.13 cm), respectively. Similarly, beads prepared in SDW with 4% sodium alginate in MS medium containing 0.5 mg/l. NAA + 0.5 mg/l produced maximum number of shoots (3.6 ± 0.25 cm) and shoot length (4.74 ± 0.19 cm).
Samiei *et al.* (2019) studied the effect of cytokinins on *in vitro* plant development and auxins on root induction in *Gypsophila aretioides* and they found maximum number of shoot (9.75) and leaf (42.33) in TDZ (0.05 mg dm-3) whereas, longest shoot (1.59 cm) was observed in TDZ (0.1 mg dm-3). In addition to that, application of IBA (0.6 mg dm-3) increased the root number (7.85) while IBA (0.3 mg dm-3) increased the root length (4.7 cm).

Light and temperature

Hicklenton (1986) reported that 42 days of supplemental lighting resulted in 16.9 number of nodes to inflorescence whereas, maximum number of flowering branches (7.7), inflorescence length (19.8 cm), stem length (101.1 cm) and stem diameter (0.87cm) were recorded when light supplied for 63 days to *Gypsophila paniculata*.
Shillo and Halevy (1992) stated that plants kept in full sunlight produced higher number of flowers per plant (26.4) with minimum blind plants (2.3 %). Moreover, maximum flowering plants (83 %) was observed when 270C day temperature and 22 0C night temperature was maintained along with long day condition for 16 hrs.

Soil Solarization

Gamliel *et al.* (1993) studied the effect of soil disinfestation on growth and flower yield of *Gypsophila paniculata.* Maximum dry weight of shoots (2.60 g/plant), number of flowers (68.00) and flower weight (1.44 kg) were observed when soil was treated with Methyl Bromide (50 g/m2).

Soilless cultivation

Wahome *et al*. (2011) observed maximum number of shoots/plant (14.4) and number of flowers/branch (36.1) when plants grown in bag culture using vermiculite media whereas, maximum stem length (67.0 cm) was recorded in bag culture using saw dust media.

Media and pruning

Hohn *et al.* (2018) stated that *Gypsophila paniculata* grown on substrate having combination of CRH+S10 recorded maximum stem length (93.4 cm), number of side branches/stem (9.7), average stem weight (34.55 g) and stem yield (3076.1 g/m2) while, plants grown in CRH alone produced maximum number of stems (103.5/m2). However, increased in stem diameter (4.7 mm) was found in RRH+S10. Furthermore, early pruning showed maximum stem diameter (5.0 mm), number of side branches/stem (10.3) and average stem weight (32.7 g) whereas, maximum stem length (93.4 cm), number of stems/m2 (116.3) and stem yield (2596.7 g/m2) was noted in late pruning.

Organic manure

Zwane *et al.* (2019) revealed that maximum cut flower stem length (48.6 cm and 53.9 cm) and number of marketable cut flowers (6.7 and 6.5) were obtained with application of 80 t/ha of kraal manure and 40 t/ha of chicken manure, respectively.

Plant growth regulator

Li *et al.* (2019) studied the effect of frequency of GA3 spray on the growth of *Gypsophila paniculata* and reported that var. Cloudstar 8 had maximum plant height, crown width and dry weight while, maximum fresh weight was reported in var. Cloudstar 5 when GA3 was sprayed 8 times during entire growing season.

Vase life

According to Khenizy *et al.* (2014), the holding solution containing moringa (25 %) + sucrose (2 %) + salicylic acid (150 mg/l) resulted maximum vase life of 23.8 days and 21.3 days in *Gypsophila paniculata* 'Perfecta' cut flowers when kept in solution immediately after harvesting and after 7 days of storage, respectively. Moreover, same treatment recorded maximum flower opening (90.8 % and 85.6 %) when put without storage and after 7 days of storage, respectively.

Value addition

Bajad and Viradia (2015) observed maximum colour intensity (77.89 %) and overall acceptability (7.33) in minimum time to change colour (1.0 day) when flowers of gypsophila treated with Blue ink, Kesar yellow and Classic blue, respectively.

Disease

Yephet *et al.* (2006) studied the effect of compound fertilizer (20:20:20 + ME) rate on disease incidence in *Gypsophila paniculata* mother plants planted in naturally infested tuff. They reported that minimum disease incidence of 9.8 %, 5.7 %, 9.2 %, 6.0 % and 6.9 % on 34, 42, 49, 57 and 64 days, respectively was recorded with the application of fertilizer @ 720 mg/lit.

Conclusion

From foregoing discussion, it can be concluded that Balborts clone performed well in terms of yield as compared to Raham Meristem and Cor Van Duyn. clone Bristol Fairy possessed good inflorescence architecture as compared to var. New Face and var. Perfecta. Encapsulation of shoot tips prepared with Na- alginate @ 4% performed better in MS medium containing 0.5mg/l NAA + 0.5 mg/l BA. Highest shoot and leaf number was observed at lower dose of TDZ in micropropagation of gypsophila whereas, IBA increased root number and root length. Supplemental lighting should be applied to induce flowering in gypsophila otherwise they can be grown in full sunlight to produce quality blooms. Disinfestation of soil using Methyl Bromide @ 50 g/m2 should be done before planting. Organic chicken manure @ 40 t/ha and kraal manure @ 80 t/ha enhanced the growth and yield of gypsophila. Application of GA3 (8 times) helped to promote the growth and flowering of gypsophila plant. Natural extract of moringa along with sucrose and salicylic acid increased vase life and opening of flowers. Compound fertilizer 20:20:20 @ 720 mg/lit. should be applied to reduce disease incidence in gypsophila.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2020-2021

Speaker : Patel Tejalbahen Prakashbhai	**Course : FLA 591 (1 + 0)**
Reg. No. : 2020219033	**Date : 19/12/2020**
Major Guide : Dr. Dipal S. Bhatt	**Time : 2:30 - 3:30 pm**
Co – Guide : Dr. B. M. Tandel	**Mode : Online**

Response of music towards ornamental plants

Music is an art form whose medium is sound and silence. It produces beauty of expression, emotion in significant forms through the elements of rhythm, melody, harmony and colour. A property of living things is that they respond to stimuli. Sir Jagadish Chandra Bose, an Indian plant physiologist and physicist concluded that plants react to attitude with which they were nurtured and plants just like human being, are sensitive to the external environment. Sound is known to affect the growth of plants and respond to music like humans do. Classical or devotional music enhances the plant growth. Classical music has a gentle vibration, and can cause changes in plants metabolism. Plants enjoy music and they respond to the different types of music and its wave-length. On the other hand, music or sound can also have detrimental effects on plant growth. Some reports indicate that certain types of music can wreak havoc on plants. Even played at a low volume, heavy metal music can be very damaging to a sensitive plant.

Brief review of research work

Liu *et al.* (2002) carried out an experiment on effect of sound field on the growth of chrysanthemum callus. They noted that activity of SOD in chrysanthemum callus increased with increasing the intensity (100 dB) and frequency (800 Hz) and it decreased below that range.

Li *et al.* (2008) conducted an experiment on effect of sound wave stress on antioxidant enzyme activities and lipid peroxidation of *Dendrobium candidum*. They stated that SOD activities of leaves, stems and roots elevated averagely by 26.5 %, 17.3 % and 31.2 %, respectively as compared to control group. Moreover, CAT activities in leaves, stems and roots increased at varying degrees under the stress and enhanced averagely by 12.3 %, 8.5 % and 26.6 %, respectively. They also noted that the POD activities in leaves, stems and roots stimulated by the sound wave increased averagely by 26.8 %, 7.9 % and 7.7 %, respectively. They also stated that APX activities of leaves, stems and roots on the stimulated groups increased averagely by 15.7 %, 29.5 % and 21.5 %, respectively. However, the MDA contents in leaves, stems and roots of the stimulated groups enhanced averagely by 20.7 %, 10.6 % and 9.7 %, respectively than the control group.

Vidya Chivukula and Ramaswamy (2014) studied the effect of different types of music on rose plants. They stated that rose plants exposed to vedic chants for 60 minutes in the morning for a period of 62 days enhanced the growth in terms of plant height and increased the number of flowers with maximum diameter than other types of music.

Anindita Roy Chowdhury and Anshu Gupta (2015) carried out an experiment on effect of light Indian music, meditation music and noise on growth and health of marigold and found that under the exposure to all three types of music and control, marigold plants showed similar growth patterns in the beginning but in the second week onwards marigold plants treated with light Indian music and meditation music resulted in better plant growth and flowering than noise treatment.

Deepti Sharma *et al*. (2015) studied the effect of music on morphological and physiological parameters of ornamental plants. They revealed that increase plant height and number of leaves were observed in plants exposed to soft melodious music for 3 hours daily for 1 month. Ornamental plants *viz., Tagetes erecta, Catharanthus roseus* and *Dendranthema grandiflorum* obtained maximum number of flowers with early flower bud occurrence and flowering with music treatment than control. They also observed that ornamental plants of treated set showed increase in concentation of starch, protein and phenol than control.

Heidari *et al*. (2020) conducted an experiment on effect of sound stimulation on physiological and biochemical response of *Salvia splendens* cv. Vista. They stated that the stem length, root length, shoot weight and shoot dry weight showed an ascending trend with an incease in intensity to 110 dB in 1000 hz frequency and increased as compared to control. They also observed that biochemical content and activities like protein content, catalase activity (CAT), peroxidase activity (POD) and MDA content were observed maximum in *Salvia splendens* cv. Vista when exposed to sound wave for one month at a frequency of 1000 Hz at 110 dB intensity for one hour a day.

Conclusion

From the foregoing discussion, it can be concluded that sound of 100 dB intensity and 800 Hz frequency enhanced the SOD activity in chrysanthemum callus. Induction of lipid peroxidation and enhancement of antioxidant enzyme activities in *Dendrobium candidum* through sound stress helps to reduce the build up accumulation of active oxygen species (AOS) and ultimately protects plant cells from oxidative damage. Vedic chants for 60 minutes upto 62 days enhanced the growth and flowering in rose. Light Indian music and meditation music found better for healthy growth of marigold plants. Soft melodious music for 3 hours a day for one month duration showed positive results in terms of plant growth and metabolites like starch, phenol, protein and chlorophyll content in various ornamental plants *viz. Tagetes erecta, Catharanthus roseus* and *Dendranthema grandiflorum.* The sound treatment at 1000 Hz frequency with 110 dB intensity for one hour per day found better for higher MDA content and antioxidant enzyme activities with rapid vegetative growth in *Salvia splendens.*

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2020-2021

Patel Jeminiben Dhansukhbhai	**Course: FLA 591(1+0)**
Reg. No:2020219027	**Date: 19-12-2020**
Major Guide: Dr. B. B. Patel	**Time: 4:30 to 5:30 pm**
Co-Guide: Dr. T. R. Ahlawat	**Venue: Webinar**

Sansevieria: The Unique Indoor Plant

Sansevieria name is derived from that of *Duke Raimondodi Sangrio*, Prince of Sanseviero (Italy). It is also known as snake plant and mother in law's tongue. There are more than 100 species in this genus native to Tropical and South Africa. According to Chinese people, the snake plant is one of the lucky plants that help to bring good fortune, were grown and cherished well before the Chinese Ti-plant (*Dracaena spp.*) also known as good luck bamboo. It is perennial herb with stiff, ornamental leaves. *Sansevieria* tops the list as being most tolerant of all decorative plants to survive the most unsuitable growing conditions. The durability of *Sansevieria* makes it an excellent choice for apartment dweller that often have limited success with house plant due to lighting issues. Snake plant is classic yet versatile house plant with sword like foliage design. It is excellent for forgetful gardener and it's considered a top air purifier plant for indoor environment and also eliminates considerable amount of benzene, formaldehyde, trichloroethylene and toluene (Harrison and Lorraine, 2012). Placing *Sansevieria* trifasciata in the office could reduce the CO2 concentration by 10.47% to 19.29% (Kannittha *et al.* (2020). A clean air study conducted by NASA showed that snake plants are one of the few plant that convert carbon dioxide into oxygen at night, which make them perfect to place in bedroom.

Brief Review of Research Work

Wolverton *et al*. (1984) reported that among top ten air purifying indoor plants, *Sansevieria laurenti* ranked second in removing formaldehyde and fourth in removing benzene and trichloroethylene. Wilson *et al.* (1992) assessed that *Sansevieria trifasciata* plant quality was rated best (4.4 rank) after four weeks of water stress without any leaf defoliation as compared to other plants. David and Peter (2005) recorded that *Sansevieria trifasciata* was an excellent (Grade-I) plant to keep in office according to hardiness (Insufficient light, Excessive heat, Dry air and Drought). Pajaree *et al*. (2015) observed the highest carbon dioxide absorption by four snake plants in controlled room (28.36%) and academic room (22.9%). They also noted that average absorption of CO2 (4.71 ppm/m3/sec) by using four pots of snake plants in controlled room from Monday to Friday during working hours (8:30am to 4:30pm). Gupta *et al.* (2016) observed that S*ansevieria trifasciata* effectively increased Chl a (0.89 µ/g (FM)), Chl b (1.07 µ/g (FM)) and total Chl (a+b) (2.03 µ/g (FM)) under the low temperature stress (0ºC for one week) and also noted that *Sansevieria trifasciata* showed maximum net photosynthetic rate (11.9µmol m-2s-1) and water use efficiency (190 mol(CO2)mol-1(H2O)) whereas, minimum transpiration rate (0.1mmol m-2s-1) and stomatal conductance (0.03 mol m-2s-1). Suhaimi *et al.* (2016) recorded that snake plant absorbed highest amount of CO2 (23.9%) in glass chamber which was followed by syngonium plant (23.1%). Wahjutami *et al*. (2016) observed in S*ansevieria trifasciata* that weight was increased during 10 days measuring period when growing media dried, it showed that plants continued photosynthesis as growing media dried. Plants continued photosynthesis by night in Crassulacean Acid Metabolism (CAM) mode and consumed CO2 and released O2. They also stated that density level of stomata was relatively same and spread evenly in every part of plants (tip, mid and base). Kulkarni and Zambre (2018) observed that Snake plant and *Aloe vera* recorded highest rate (5:1) of absorption of CO2 and emission of O2 with the help of Sensor Network Server technique. Lu *et al*. (2018) recorded that *Sansevieria trifasciata* showed minimum rate of changes (1.26%, 3.25% and 6.90%) in peroxidase activity under the benzene concentration of 25.00 mg/m3, 50.00 mg/m3 and 100.00 mg/m3, respectively.

Sharah *et al*. (2018) observed that *Sansevieria trifasciata* inhibits the growth of aerial pathogenic micro fungi, namely *Aspergillus fumigates, A. flavus, Cladosporium spp., Mucor spp. etc* from the tutorial room. They also recorded 28.26 (CFU/m3), 23.55 (CFU/m3) and 30.62 (CFU/m3) aerial pathogenic micro fungi in II, VI and VII room after placing *Sansevieria trifasciata* plants. Hematharshini and Sheran (2019) recorded highest leaf area (20.43 cm2) in soil:compost (1:1) with middle leaf segment (P2L2), highest number of root per segment (23.00), fresh weight of roots (0.69 g) and dry weight of roots (0.088 g) in soil:compost (1:2) with apical leaf segment (P3L1) whereas, longest shoot length (14.60 cm) in soil:compost (1:2) with middle leaf segment (P3L2) in *Sansevieria trifasciata* for indoor culture.

Janah *et al*. (2019) observed that *Sansevieria trifasciata* absorbed more CO at 25ºC, 30ºC and 35ºC (0.07 ppm, 0.11 ppm and 0.14 ppm, respectively) of water temperature for plant nutrition (Nitric acid and Perchloric acid) in bright room whereas, it absorbed 0.08 ppm CO at 35ºC in dark room. Sharma *et al*. (2019) noted that some indoor plants removed indoor air pollutants in which snake plant effectively removed ethylbenzene, toluene and other Volatile Organic Compounds (VOCs). Zonic *et al*. (2019) observed that the overall VOCs values, CO2 concentration and methane (CH4) concentration were suddenly increased in stage III after removal of *Sansevieria trifasciata* plants from observed room. **Conclusion:** From above discussion it can be concluded that *Sansevieria* can be used for indoor decoration and it is a very good pot plant to keep in home as well as office. It is a very hardy plant, which can survive with water stress without any leaf defoliation and also showed minimum rate of change under benzene stress. It is good for indoor decoration but also useful to remove VOCs *like* benzene, toluene, formaldehyde and trichloroethylene. *Sansevieria* uses CAM process of photosynthesis in which it absorbs CO2 and releases O2 in night-time so, it is an ideal plant to keep in bedroom. *Sansevieria* inhibits the growth of aerial pathogenic micro fungi *like Aspergillus spp., Cladosporium spp., Mucor spp. etc*. It was found that it produced good amount of Chl a, Chl b and Chl (a+b) under low temperature stress. For indoor culture, soil:compost (1:1) was found best for maximum leaf area whereas soil:compost (1:2) for longest shoot length, fresh weight and dry weight of roots.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
Post Graduate Seminar Series: 2020-21

Speaker : Chandana Shivaswamy	**Course : FLA591 (1 + 0)**
Reg. No. : 2020219007	**Date : 02/01/2021**
Major Guide : Dr. Sudha Patil	**Time : 3:30 – 4:30 pm**
Co – Guide : Dr. A. K. Pandey	**Venue : Webinar**

Plant neurobiology- Their intelligence and behaviour

In recent years, the topic of plant intelligence has triggered discussion especially when cast under the label of plant neurobiology which claimed that plants exhibit intelligent behaviour and they possess internal control structures in many ways functionally similar to neuron-based control structures. Plant neurobiology is a branch of plant science that deals with signaling and behavior of plants and parts/systems responsible for the sensitivity as well as the complexity of plant signal transduction provedthe ability of plants to learn, memorize, communicate and compute responses. The pioneering studies on root brain hypothesis by Charles Darwin and plant responses in transmission of signals by Dr. Jagadish Chandra Bose gave birth to plant neurobiology. Plants use chemical signals for communication however, they produce electric signals like action potentials, variable potentials and surface potentials depending upon intensity of stimulus. Plants not only respond to physical and chemical stimuli, but they are capable of knowing the emotions and thoughts of entities around them called as primary perception/Backster effect which provided new dimension in plant intelligence studies. The common assumption that plants are passive, insensate automata is wrong. Plants not only behave, their behaviour is intentional.

Review of research work

Electrical signals in plants

Fromm and Lautner (2007) studied the physiological effects of electrical signals in plants and found that different stimulus produced action potential and variable potential in different plants which affect physiological processes like leaf movement, respiration rate, protein synthesis, photosynthesis, etc. In further study of electrical signalling in Poplar and *Mimosa pudica,* they observed that both action potential and variable potentialare capable of informing distant cells about local stimuli, causing them to act appropriately and perform numerous functions. In *Mimosa,* when the leaf pinna was stimulated by cooling, then AP was evoked and transmitted with the speed of 20–30 mm s-1 but no further transmission occurred whereas, when stimulated by cutting, variable potential evoked but speed was slower *i.e.,* 5–6 mm s-1 and transmitted for longer duration. Moreover, they observed response of CO_2 and H_2O of the opposite, right leaf at a distance of 15 cm upon flaming of the left leaf in poplar. At 180 s after stimulation, the net CO_2 uptake rate decreased immediately and then recovered almost completely after 900 s, while the H_2O remained stable.

Plant response to smell

Ueda *et al.* (2012) observed that volatile organic compounds (VOC) emitted by injured plants have a specific ratio and concentration of components. They revealed that pyrethrin amount in intact young seedlings of *Chrysanthemum cinerarifolium* was increased by placing intact seedlings in the vicinity of wounded seedlings where, upon receiving a VOC message from their family, plants respond by inducing a particular defense mechanism using specific metabolic activity.

Plants response to touch

Jaffe (1973) recorded delay in flowering and an inhibition of inflorescence elongation in *Arabidopsis,* when plants were touched repetitively that induced changes in morphogenesis which were correlated with increased production of strengthening tissue and improved resistance to mechanical perturbation induced damage.

Plants response to sound

Monica Gagliano *et al.* (2012) conducted an experiment on response of young roots of *Zea mays* to a continuous 220 Hz sound and revealed that root tip clearly bend towards the sound source only.

Appel and Cocroft (2014) observed that anthocyanin levels were significantly higher in plants that were pretreated with chewing vibrations than in the control in *Arabidopsis thaliana*. The vibrations generated by low-velocity wind lack the high frequencies produced by chewing. Whereas, leafhoppers produced vibrational signals with a frequency spectrum similar to that produced by caterpillar chewing, but with a different temporal pattern.

Jung *et al.* (2018) stated that *Arabidopsis* treated with 500 Hz sound at 80 dB for 1 hr induced the production of the growth-related hormones like indole acetic acid and gibberlic acid as well as the defense related hormones like salicylic acid and jasmonic acid. Increased IAA levels and reduced abscisic acid levels were also detected in chrysanthemum exposed to a 1400 Hz sound stimulus at 95 dB for 1 hr. Moreover, increased yield was observed in rice, spinach and sweet pepper, while increased photosynthesis was noted in strawberry at sound frequency of 100- 1000 Hz at 70 dB for 3 hr.

Plants response to music

Popescu and Mocanu (2013) reported that maximum weight of salad plants (151.4g) and apple fruits (134.5g) was obtained when plants were treated with music for 3 hrs/day followed by music for 1 hr/day as compared to plants without music.

Deepthi Sharma *et al.* (2015) observed earlier bud and flower occurrence in plants like *Tagetes* (19th day and 25th day), *Catharanthus* (25th day and 28th day) and *Dendranthema* (21th day and 29th day) when plants were treated with music as compared to untreated plants.

Plants response to temperature and drugs

Bose (1922) recorded automatic pulsations in small leaflets of *Desmodium gyrans* which were surprisingly similar to those of the cardiac tissue in animal. Lowering of temperature resulted in reduced frequency and enchanced amplitude of pulsation. Arrest of pulsations was recorded in action of ether and when immedietly substituted by fresh air, slow revival of pulsation was recorded.

Primary perception in plants

Backster (1968) studied primary perception in *Dracaena massangeana* and revealed that plant tracing contour resembled human tracings containing verified emotional arousals. Whereas, when he decided to obtain a match to actually burn the plant leaf, at instant of his decision he observed dramatic change in the tracing pattern in the form of an abrupt and prolonged upward sweep. Similarly, when he left examination room for a match and lit match, changes in tracing pattern was recorded showed perception in plant.

Vogel (1974) studied the effect of mental and vocal threat on *Philodendron* and revealed hike in tracing pattern when mental and vocal threat of burning the plant was given.

Conclusion

From the foregoing discussion, it can be concluded that plants are conscious and have ability to respond in various ways. Plants like *Mimosa pudica* inform distant cells about touch or stimuli and act accordingly. Different plants respond to different stimuli by producing AP and VP which can be observed in changes occured in physiological processes. Wounded seedlings of chrysanthemum emit volatile organic compounds in vicinity of healthy seedlings which affected the biosynthesis of pyrethrin in healthy seedlings. Plants don't like repetitive touch to its growing point as they restricted their growth but increased the production of strengthening tissue enabling plants to withstand additional mechanical force stresses. Plants have capacity to hear and respond to sound by changing metabolic activity. Music has positive impact on growth and flowering of different plants. Even the weight of salad plants and apple fruits can be increased with the treatment of music. Plants are also sensitive to temperature and drugs like ether. They can arrest and release pulsation in response to temperature and drug for survival. It has been proved that plants have primary perceptions as observed in dracaena and philodendron which showed changes in pattern when match was lit as well as when mental and vocal threat was given to plants.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2020-2021

Speaker	**: Soujanya M. B.**	**Course: FLA 591 (1 + 0)**
Reg. No.	**: 2020219043**	**Date : 02/01/2021**
Major Guide	**: Dr. S. T. Bhatt**	**Time : 4:30 - 5:30 pm**
Co – Guide	**: Dr. B. M. Tandel**	**Mode: Online**

Role of potassium for production of flower crops

Potassium (K) is an essential nutrient for plant growth. It is classified as a macronutrient because plants take up large quantities of potassium during their life cycle. Potassium is associated with the movement of water, nutrients and carbohydrates in plant tissue and involved with enzyme activation within the plant, which affects protein, starch and adenosine triphosphate (ATP) production. Potassium also helps to regulate the opening and closing of the stomata, which regulates the exchange of water vapor, oxygen and carbon dioxide. It also enhances resistance to attack from pest and diseases. If potassium is deficient or not supplied in adequate amounts, which leads to chlorosis on older leaves, necrosis from least margin and tip, stunted plant growth, reduced yield and more susceptibility of plants to pest anddiseases.

Brief review of research work

Marigold

Pal and Ghosh (2010) stated that application of 200 kg / ha potassium increased plant height (63.52 cm), number of primary branches (5.69), number of secondary branches (22.11) and plant spread (57.67 cm) followed by 150 kg/ha potassium and 100 kg/ha potassium in African marigold. They also reported that maximum flower diameter (5.87 cm), weight of flower (5.58 g) and flower yield (24.45 kg/plot) were obtained with the application of 200 kg/ha potassium followed by 150 kg/ ha and 100 kg/ha potassium in African marigold cv. Siracole under West Bengal conditions.

Rose

Ghaffoor*et al.* (2000) reported that maximum plant height (57.67 cm), , flower diameter (8.08 cm), weight of flower (4.6 g),number of flowers/plant (20.33)and vase life (3.08 days) were observed with combined application of 20 g nitrogen and 12 gpotassium per plant in rose at Pakistan.

Tuberose

Amin *et al*. (2013) noted that maximum rachis length (10.60 cm), spike length (34.00 cm), spike diameter (0.93 cm), number of florets/spike (25.30), weight/spike (25.20 g), flower yield (16.40 t/ha), side bulbs/plant (13.70), bulb length (6.80 cm), bulb diameter (3.40 cm), bulb weight/plant (155.30 g) and bulb yield (22.00 t/ha) were obtained from the tuberose plant applied with soil application of K_2O at 190 kg/ha.

Gladiolus

El-Naggar and El-Nasharty (2016) stated that 2 % foliar application of K along with soil dressing of 100 % K resulted enhanced plant growth with respect to plant height, number of leaves per plant, fresh weight of leaves, dry weight of leaves and leaf area in gladiolus. They also reported that early flowering was observed with 2 % foliar application of K with 75 % K application as soil dressing while maximum number of florets per spike, floret diameter and spike length were obtained from the plants applied with combined application of 2 % foliar spray of K with 100 % K as soil dressing in gladiolus cv. Rose Supreme under Egypt conditions.

Gerbera

Amin *et al.* (2015) conducted an experiment on effect of potash levels on flower attributesofgerberaandobserved thatminimumdaystoflowering(82.42days),maximumflowerstalk length (22.87 cm), flower diameter (7.30 cm), number of flowers/plant (15.68) and vase life (7.00 days) were obtained from the plants treated with potassium at 15 g/m^2 in a form of sulphate of potash.

Carnation

Manikandan and Rachana (2018) revealed that maximum number of laterals were obtained with an application of KCL while minimum days taken for 50 % flowering and maximum number of cut flowers / m^2 with enhanced vase life were produced with the application of K_2SO_4at 100 mg K_2O per plant during vegetative growth and 250 mg K_2O per plant atflowering in carnation variety Kiro.

Orchid

Shah *et al*. (2019) conducted an experiment on effect of different combination of nitrogen, potassium and organic fertilizers on growth of *Dendrobium* cv. Sonia Red and reported that maximum number of shoots, inflorescence length and rachis legth were observed with foliar application of 30 % N + 30 % K at 0.2 % along with 2 % cow urine. Furthermore, number of inflorescence, number of florets and vase life were also found highest with the same treatment during both the experimental year in *Dendrobium* orchid.

Crossandra

Gowthami*et al.* (2017) studied the effect of different levels of potassium on flower yield of crossandra and observed that maximum number of spike/plant (22.09), weight of 100 flowers (13.05 g) and flower yield/plant (816.27 g) were obtained with the application of potassium at 60kg/ha under West Godavari conditions.

Zinnia

Mohammad Shah *et al.* (2014) revealed that maximum plant height, number of primary and secondary shoots, number of leaves per plant and leaf area were found with the application of potassium at 20 g/m^2 in zinnia. They also noted that 20 g/m^2 potassium enhanced number of flowers per plant,flower diameter, fresh and dry weight of flower with early flowering in zinnia under Pakistan conditions.

Conclusion

From the foregoing discussion it can be concluded that, application of 100 kg/ha potassium would be more remumnerative with respect to flower quality and yield of African marigold cv. Siracole. Combined application of 20 g nitrogen and 12 g potassium found most suitable for highest flower production with better quality in rose. Highest flower yield with good quality flower as well as maximum bulb yield of tuberose can be obtained with soil application of 190 kg/ha K_2O. Foliar application of 2 % K along with 100 % K as soil dressing in gladiolus cv. Rose Supreme enhanced growth of plant and flower yield and improved quality of flowers. Gerbera plants applied with 15 g K_2O/m^2produced maximum flowers with good quality. Highest number of quality cut flowers can produced with an application of K_2SO_4 at the rate of 100 mg K_2O/plant during vegetative growth and 250 mg K_2O/plant at flowering stage in carnation. Foliar application of 30 % N + 30 % K at 0.2 % along with 2 % cow urine enhanced vegetative growth and flowering yield with good flower quality in *Dendrobium* orchid cv. Sonia Red. Highest flower yield of crossandra can be obtained with an application of potassium at 60kg/ha. 20 g/m^2 potassium showed potential effect on growth and yield of zinnia.

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ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI
POST GRADUATE SEMINAR SERIES: 2020-2021

Speaker Chaudhari Roshankumar Anilbhai	**Course** FLA-591 (1+0)
Registration No. 2020219008	**Date** 30/01/2021
Major Guide Dr. S. A. Aklade	**Time** 03:30 to 04:30 p.m.
Co-Guide Dr. B. M. Tandel	**Venue/Mode** Online

Role of ornamental plants in controlling air pollution

Air pollution is a serious problem mainly due to rapid industrialization and vehicular traffics throughout the world which leads to deterioration of air quality by adding toxic gases and other substances to the atmosphere. Various strategies exist for controlling atmospheric pollution but vegetation provides one of the best natural ways of cleaning the atmosphere, so planting of shrubs and trees is an effective and easy way for controlling air pollution. Air pollutants affect plant growth adversely and by monitoring plants tolerance toward air pollution they can be screened and can be employed as biological indicator or monitors of air pollution. This can be used effectively by planners and green belt developers in managing the urban air pollution. Scientific management of landscape techniques and selection of plant species has also opened the doors to minimize the deleterious effects of air pollution. As plants plays an important role in monitoring the ecological balance by collecting heavy metals from the air, provide psychological push through mood lifting and enhanced alertness.

Among the various adopted approaches, use of plants for the removal of ambient air pollutants has considerable potential and there are four main ways in which plants improve air quality parameters viz.; reduction of temperature, removal of air pollutant, emission of volatile organic compounds (VOCS) and energy effects on building. The effectiveness of a plant suitable for air quality improvement can be determined with proper selection of plant species and determining their air pollution tolerance index (APTI) value which denotes capability of a plant to combat against air pollution. The plants which have higher index value are tolerant to air pollution and can be utilized to mitigate pollution, while plants with low index value show less tolerance and can be used to indicate levels of air pollution (Singh and Rao, 1983).

Brief review of research work

Air Pollution Tolerance Index (APTI) values of the ornamental plants

Begam and Harikrishna (2010) reported that among different tree species, *Delonix regia* had 13 air pollution tolerance index value which was least as compared to other tree species under study while the higher index was obtained in *Syzygium cumini* (35).

Kumar *et al.* (2012) reported that among different plant species, *Rosa indica* had more sensitivity for environmental pollution with least APTI value of 12 as compared to others, while more tolerance was found in *Bougainvillea spectabilis* (30).

Nugrahani *et al.* (2012) found that, *Mussaenda philippica* had 8.01 air pollution tolerance index value which was least as compared to other ornamental shrubs under study while the higher index was obtained in *Codiaeum variegatum* (10.91).

Babu *et al*. (2013) studied the air pollution tolerance index (APTI) of selected plant species and found least APTI value in *Bougainvillea spectabilis* (7.73) and highest value in *Aegle marmelos* (9.60).

Enete *et al.* (2013) studied the evaluation of air pollution tolerance index of ornamental shrubs and recorded highest and least APTI values in Ixora red (14.32) and Yellow bush (10.60), respectively.

Pallavi and Chirashree (2013) recorded the APTI values at four different sites in selected plant species and found that *Dracaena* and *Dianthus* resulted in highest and lowest values, respectively at all the sites.

Chibuisi *et al*. (2014) studied the air pollution tolerance indices (APTI) of six ornamental plants, viz; *Ficus*, hibiscus, ixora, phitis, thuja and red rose and observed higher and least APTI values of 15.26 and 9.74 in thuja and hibiscus, respectively.

Archana *and* Deshmukh (2015) studied the effect of air pollution using roadside trees and found lowest APTI value in *Bougainvillea spectabilis* (7.72) at industrial area and in *Lantana camara* (5.95) at non-industrial area, while higher values were observed in *Hibiscus rosa-sinensis* (9.35) and *Mangifera indica* (7.95) indicating that they were more tolerant in industrial and non-industrial areas, respectively.

Zamble *et al*. (2015) compared the air pollution tolerance indices in four ornamental plants arranged along roadside and obtained least APTI value in *Cassia surattensis* which was 9.78 and 9.76 at parks and main roads, respectively while *Ficus benjamina* recorded higher values at both the situations.

Agarwal (2017) estimated higher ATPI value (9.45) in *Ficus benjamina* that appeared to be the most tolerant species among the tested indoor plants followed by *Scindapsus aures*, so it must be included in indoor landscape as good air purifiers along with *Aglaonema crispum* (lowest ATPI value of 7.37) as bio-indicators to sense the pollution in indoor environment.

Chemical removal efficiency of ornamental plants

Willard (1989) carried out an experiment to know the chemical removal efficiency by different house plants and observed that the maximum formaldehyde was removed by mass cane @ 70 %, benzene by Gerber daisy @ 68 % and trichloroethylene by pot mum @ 41%.

Yang *et al.* (2009) studied the volatile organic pollutant removed by indoor plants and they found superior benzene, toluene, octane, TCE as well as α- pinene removal efficiency in *Hemigraphis alternata* @ 5.54, 9.63, 5.58, 11.08 and 12.21 µg/m3/m2/h, respectively.

Kim *et al.* (2010) studied the variation in formaldehyde removal efficiency among different foliage plants species under sealed chambers and found maximum efficiency after one hour (0.48 µg/m3/cm2), two hours (0.73 µg/m3/cm2), three hours (0.95 µg/m3/cm2) and four hours (1.11 µg/m3/cm2) of exposures in *Tillandsia cyanea* Linden. Whereas after 5 hours, maximum formaldehyde removal efficiency was found in *Chlorophytum bichetii* (1.25 µg/m3/cm2).

Abbass *et al.* (2017) recorded the effectiveness of indoor plants for passive removal of indoor ozone and found highest ozone deposition velocity of 5.61 m/h in golden pothos during all the three exposures while the peace lily had the lowest rate.

Saxena and Sonwani (2020) studied the remediation of ozone pollution by ornamental plants species like *Dracaena*, *Tagetes* and *Lilium* in indoor environment and observed that *Dracaena* had maximum ozone deposition velocity of 7.7 m/h as compared to others.

Conclusions

It is inferred from the foregoing discussion that, air pollution tolerance index (APTI) can be uses to measure plants responses towards air pollution and species like *Delonix regia*, *Rosa indica*, *Mussaenda philippica*, Yellow bush, Dianthus, *Lantana camara*, *Cassia surattensis*, *Aglaonema crispum*, *Delonix regia*, *Baugainvillea spectabilis, etc* were found useful as they recorded least APTI values indicating there sensitiveness and thus can be used as bio-indicators against air pollution, while the plants having higher APTI value like *Syzygium cumini*, *Codiaeum variegatum*, *Aegle marmelos*, Ixora red, *Dracaena*, *Thuja*, *Ficus benjamina*, *Scindapsus aures*, *etc* which are more tolerant to pollution should be given priority for plantation program in urbanize and industrial areas; so as to reduce the effects of air pollution and make ambient atmosphere clean and healthy.

Whereas, plants like Golden Pothos and *Dracaena* recorded higher ozone deposition velocity, while *Tillandsia cyanea*, *Chlorophytum* and Mass cane were found most effective in removing formaldehyde. Similarly, Gerber daisy for benzene and Pot mums for trichloroethylene removals were found effective and the superior VOC removal efficiency was found in *Hemigraphis alternata*.

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Education is not the preparation for life;
education is life itself

John Dewey

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