

Overview of Research Trials for fruit crops



Mango



Sapota



Organic Papaya



Dragon fruit



Banana



Gauva

: Research Recommendations:

A) Production Technology:

Year: 2006

1. Effect of planting material and split application of nitrogen on growth and yield of banana (*Musa paradisiaca*) cv. Grand Nain

Farmers of south Gujarat heavy rainfall agro-climatic Zone-I (AES-III) are advised to use tissue culture plant for planting banana cv. Grand Nain. Further, they are also advised to apply 300g nitrogen/plant in four equal splits at 2,3,4 and 5 months after planting. The basal dose of FYM 10 kg/plant at the time of planting, 90 g phosphorus/plant at 3 months after planting and 200 g potash/plant in three equal splits at 3, 4 and 5 months after planting should also be applied.

2. Integrated nutrient management in banana cv. Grand Nain

Farmers of south Gujarat heavy rainfall agro-climatic Zone-I (AES-III) are advised to apply 10 kg FYM, 250 g nitrogen, 45 g phosphorus and 200 g potash per plant along with 6 kg PSM/ha and 6 kg Azotobacter/ha for getting maximum net return with higher cost benefit ratio. FYM should be applied as basal before planting. The bio-fertilizers should be applied in two equal splits after 1st and 2nd month of planting, full dose of phosphorus after 3rd month of planting while nitrogen and potash should be applied in 3 equal splits after 3rd, 4th and 5th month of planting.

Year: 2007

1. Nutritional studies in banana cv. Grand Nain

The farmers of South Gujarat heavy rainfall zone – I Agricultural Situation – III growing banana cv. Grand Nain are advised to apply 300 g N, 90 g P and 200 g K per plant for obtaining maximum net return with higher benefit cost ratio. Farm yard manure 10 kg per plant should be applied as basal. Nitrogen should be applied in four equal splits at 2, 3, 4 and 5 months after planting; full dose of phosphorus should be applied at three months after planting and potash should be applied in three equal splits at 3, 4 and 5 months after planting.

Year: 2008

1. Performance of mango cv. Kesar raised by approachgraft, softwood graft and softwood graft *in situ*

The farmers of Gujarat desiring to establish new orchard of mango cv. Kesar are advised to adopt softwood graft *in situ* for higher yield and net return.

Year: 2009

1. Mixed planting with other mango varieties in Alphonso

The farmers of South Gujarat heavy Rainfall zone-I, AES-III desiring to establish new orchard of mango cv. Alphonso are advised to plant a filler tree of cv. Neelphonso in the centre of regularly planted four Alphonso trees at 10 m x 10 m spacing upto 12 years of age for getting higher net realization and BCR.

2. Effect of post shooting treatments on yield, quality and maturity of banana (*Musa paradisiaca* L.) cv. Grand Nain

The farmers of South Gujarat heavy rainfall Zone –I, AES-III growing banana cv. Grand Nain are advised to spray GA₃ 100 mg l⁻¹ on banana bunch after complete opening and covering the bunch with blue polyethylene sleeve (50 micron) for better quality, higher production and net return.

3. Induction of early flowering in mango through chemicals

The farmers of South Gujarat heavy rainfall Zone –I, AES-III are advised to drench Paclobutrazol at 5 g a.i./tree in more than 35 years old mango cvs. Alphonso, Kesar and Rajapuri to obtain early flowering, higher net realization and BCR.

4. Feasibility of organic farming in guava (*Psidium guajava* L.) cvs. Allahabad Safeda and Sardar

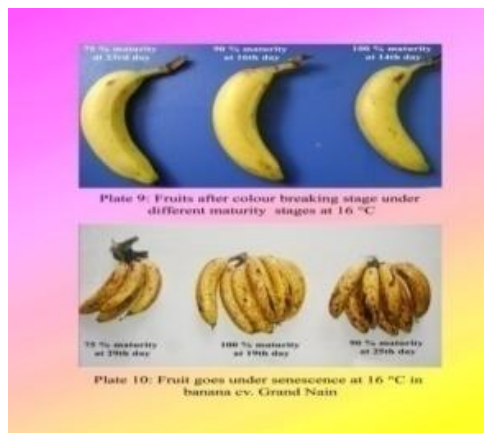
The farmers of South Gujarat heavy rainfall Zone –I, AES-III are desiring to grow Sardar (L-49) variety. They are advised to apply FYM@ 60 kg/tree (equal to 500 g Nitrogen/tree) along with bio-fertilizer 100 g/tree each of Azatobacter and PSB after mrig bahar treatment for getting higher net realization.

Year: 2010

1. Effect of maturity and storage temperature on shelf life and quality of banana cv. Grand Nain

The farmers of South Gujarat heavy rainfall zone-I, AES-III growing banana cv. Grand Naine under medium black and clay loam soils are recommended to harvest banana (1) at 75% maturity stage (75 days after shooting) and store in cold storage at 12^o C for export purpose (bunch weight will be decreased up to 19.55% at 75%

maturity as compared to 100% maturity) (2) at 90% maturity stage (90 days after shooting) and store in cold storage at 14⁰ C for distant market (bunch weight will be decreased up to 10.07% at 90% maturity as compared to 100 % maturity) (3) at 100% maturity stage (100 days after shooting) and store in cold storage at 16⁰C for local market. These treatments increase shelf life of banana fruits for 29.13, 25.17 and 21.00 days in 1, 2 and 3 case, respectively without deterioration in quality.



Year: 2011

1. Fertigation in papaya var. Madhubindu

The farmers of south Gujarat heavy rainfall zone (AES-III) growing papaya var. MadhuBindu are advised to adopt fertigation and apply 80% recommended dose of N and K₂O (160 g N and 200 g K₂O/plant) in 12 equal splits starting from 45 days after transplanting and subsequently at 15 days interval through drip irrigation along with 10 kg FYM/pit as basal and 100 g P₂O₅/plant at 1¹/₂ month and at 3 months after transplanting as soil application. By adopting drip method of irrigation and fertigation, farmers can get 32 per cent increase in yield and 20 per cent saving of water and fertilizer as compared to conventional method of irrigation along with maximum benefit cost ratio of 3.50.

The system details are:

Lateral (16 mm) spacing = 2.1 m

Dripper spacing = 30 cm (either side of the plant trunk)

Dripper discharge = 8 lph

No. of dripper per plant = 2

Operating pressure = 1.2 kg/cm²

Operational frequency = Alternate day

Operating time:

August to September = 50 min (except rainy days)

October to February = 70 min

March onwards = 2.0 hrs

2. Effect of packaging, pre-colling and cold storage on shelf-life of sapota fruits

The wholesale buyers of sapota fruit (co-operatives/ traders) are recommended to establish a cold chain for extending shelf life of sapota fruits. Immediately after harvest, sapota fruits should be pre-cooled at 10⁰C for 8 hrs in pre-cooling chamber. Subsequently, pre-cooled sapota fruits should be packed in perforated polythene bag (50 micron, 1.2 % vent) and kept in CFB box and then stored at 12⁰C temperature with 85 to 90% relative humidity in cold storage. These

treatments extend the shelf life of sapota fruits up to 15 days without adverse effect on quality.

3. Effect of calcium hydroxide and ripening retardants on shelf life of sapota fruits

The sapota growers of Gujarat are advised to dip sapota fruits in 1 % calcium hydroxide for 5 minutes and wet rubbed after drying for improving the appearance of fruits then again dipped in 2, 4-D 4 mg/l for extending the shelf life without affecting quality of sapota fruits as compared to farmers practice *i.e.* wet or dry rubbing only

Year: 2014

1. Effect of foliar application of Ca, Zn, Fe and B on growth, yield and quality of papaya cv. Taiwan Red Lady

The farmers of south Gujarat heavy rainfall zone growing papaya cv. Taiwan Red Lady are advised to spray Calcium nitrate – 1000 + Borax – 30 + Zinc sulphate - 200 + Ferrous sulphate – 200 mg/l at 60, 90 and 120 days after transplanting along with the application of RDF. By adopting 3 foliar sprays of combined micronutrients, farmers can 15 increase the yield with better quality of fruits along with higher net realization.

2. Feasibility of organic farming in mango cv. Kesar

The farmers of south Gujarat heavy rainfall zone intend to adopt organic farming in mango cv. Kesar (20 years old tree) are advised to apply 100 % RDN through 17 kg Neem cake (4.5 % nitrogen) with 100 kg FYM + *Azotobacter* (Navsari isolate) @ 250 g + PSB (Navsari isolate) @ 250 g/plant in the month of June. By adopting this organic farming, farmers can get higher yield and better quality fruits in terms of TSS, acidity and shelf life and higher net realization as compared to inorganic farming. It also improves the soil properties.

Year: 2015

1. Effect of post-shooting bunch spray of fertilizers on banana (*Musa paradisiaca*L.) cv. Grand Naine

The farmers of south Gujarat heavy rainfall zone growing banana cv. Grand Naine are advised to apply two spray of 1.5% Sulphate of Potash (SOP) on bunch after complete emergence and 15 days after first spray to get higher yield with quality fruits. Keep the bunch covered with blue polythene sleeve (18 μ).



2. Effect of different organics on growth, yield and quality of mango cv. Kesar under high density plantation

The farmers of south Gujarat heavy rainfall zone intend to adopt organic farming in high density plantation (5 m x 5 m) adult mango cv. Kesar are advised to apply N 80 % of RDN from Neem Cake at 11.5 kg/ tree (5.22 % nitrogen) with Azotobacter + PSB (108 cfu) 50 ml each /tree in the month of June to get higher yield with quality production. It also improves the soil properties.



3. Effect of heading back and training on growth, flowering, yield and quality of fruit in old orchard of mango cv. Kesar

The farmers of south Gujarat heavy rainfall zone are advised to head back their high density planted (5 m x 5 m) old mango tree cv. Kesar at 4 to 5 m height from ground level and maintain 6 newly emerged tertiary limbs to get higher yield with quality production.

Note:

1. Rejuvenation should be done after completion of monsoon (in month of October).
2. For rejuvenation slant cut should be made and cut portion should be treated with copper fungicide.
3. Care should be taken for controlling stem borer by rejuvenated



taken for controlling frequent visit of orchard.

Year: 2016

1. Effect of heading back and training on growth, flowering, yield and quality in old orchard of mango cv. Rajapuri

The farmers of south Gujarat heavy rainfall Agro-climatic zone are advised to head back their above 30 years old mango tree cv. Rajapuri at 4 to 5 m height from ground level and maintain 6 newly emerged tertiary limbs to get higher yield with quality production.

Note:

1. Rejuvenation should be done after completion of monsoon in month of October.
2. For rejuvenation slant cut should be made and cut portion should be treated with copper fungicide paste (100 g lit⁻¹) and frequently visit to rejuvenated orchard for controlling stem borer.

Year: 2018

1. Effect of time of inarch grafting on success and survival in mango cv. Kesar.

The Farmers and nurserymen of South Gujarat Heavy Rainfall Agro-climatic Zone I (AES-III) preparing inarch graft of mango are advised to prepare grafts throughout the year with uniform success rate and survival.

2. Effect of time and dose of fertilizer application on yield and quality of sapota cv.

Kallipati

The Farmers of South Gujarat Heavy Rainfall Zone-I(AES–III) having sapota orchard with adult trees of cv. Kalipattiare recommended to apply 100 percent recommended dose offertilizers @ 1000-500-500g NPK/tree/year in three splits *i.e.* 250-125-125g NPK/tree in June along with FYM @ 100kg/tree/year.Remaining 250-125-125g NPK/tree in October and 500-250-250gNPK/tree in February instead of two equal split *i.e.* in June andOctober. This treatment gives higher fruit yield of sapota withhigher net realization in winter season in comparison to summer season.

Year: 2019

1. Effect of foliar spray of KNO₃ and plant growth regulators on flowering and fruiting behaviour of mango cv. Alphonso.

The farmers of South Gujarat having adult mango orchard of Alphonso variety are advised to apply paclobutrazolat 5.0 g a.i./tree at 1st fortnight of August in soil and two foliar spray of 2% KNO₃ (20g/litre) during starting of third week of October and November to increase the yield and improve quality of fruits along with higher net realization.

Year: 2020

1. Integrated nutrient management in sapota cv. Kalipatti

The farmers of South Gujarat having adult tree of sapota orchard cv. Kalipatti are recommended to apply 50 kg farm yard manure and 80 per cent recommended dose of chemical fertilizer (800-400-400 NPK g/tree in three split of NPK i. e. 200:400:100 g/tree in June, 400:00:200 g/tree in August and 200:00:100 g /tree in October) along with soil application of bio fertilizers (Azatobactor, phosphorus solubilizing bacteria and potash mobilizing bacteria) @ 50 ml/tree of each in June, October and February month for getting higher yield, TSS of fruit and net return.

2. Effect of graded doses of paclobutrazol on flowering, yield and quality of mango cv. Alphonso

The farmers of South Gujarat having more than 35 years old mango orchard of Alphonso variety are recommended to apply paclobutrazol through soil drenching during 1st fortnight of August in the ratio of 10:5:10:5 g *a.i.*/tree in 1st, 2nd, 3rd and 4th year, respectively along with 150 % RDF (150 kg FYM and 1125:240:1125g NPK per tree) for getting early flowering, higher fruit yield and net return.

3. Effect of post flowering spray of chemicals on fruit retention and yield of mango cv. Kesar

The farmers of South Gujarat having mango orchard of Kesar variety are recommended to spray 2% novel organic liquid nutrients at pea and marble stage to increase the yield and improve quality of fruits along with higher net return.

4. Impact of pre-soaking treatments on germination and growth of mango (*Mangifera indica* L.) stones.

Farmers and nurserymen of South Gujarat are recommended to sow the mango stones after soaking in solution of GA₃ 100 mg/litre for 24 hours to get mango seedlings with better plant growth and higher survival.

Year: 2021**1. Evaluation of different bio fertilizers with graded chemical fertilizers for nutrient management in papaya var. Red Lady**

The farmers of South Gujarat growing papaya var. Red Lady are recommended to apply 60 per cent recommended dose of chemical fertilizer (120-120-150 NPK g/plant, As per the schedule given in table below) along with soil application of biofertilizers (*Azotobacter*, *Phosphate solubilizing bacteria*, *Potash mobilizing bacteria*) @ 20 ml per plant of each at the time of planting, 3 and 6 months after planting for getting higher yield and net realization

| Time of Fertilizer application | Application of Fertilizer | | | | | |
|--------------------------------|---------------------------|-------------|-------------|--|---|---|
| | N (g/plant) | P (g/plant) | K (g/plant) | <i>Azotobacter</i> (1 x 10 ⁸ cfu/ml) (ml/plant) | PSB (1 x 10 ⁸ cfu/ml) (ml/plant) | KMB (1 x 10 ⁸ cfu/ml) (ml/plant) |
| At the time of planting | - | - | - | 7.00 | 7.00 | 7.00 |
| Two month after planting | 30 | 30 | 30 | - | - | - |
| Three month after planting | - | - | - | 6.50 | 6.50 | 6.50 |
| Four month after planting | 30 | 30 | 30 | - | - | - |
| Six month after planting | 30 | 30 | 30 | 6.50 | 6.50 | 6.50 |
| Eight month after planting | 30 | 30 | 30 | - | - | - |

Year: 2022**1. Effect of liquid fertilizers foliar spray on growth, yield and quality of sapota cv. Kalipatti**

Farmers of South Gujarat growing sapota cv. Kalipatti are recommended to apply foliar spray of 1 % potassium nitrate (13:00:45) (100 g in 10 liter water) in adult orchard during second fortnight of September. November and January months along with RDF (100 kg FYM + 1000 : 500: 500 NPK g/plant) for obtaining higher yield and net returns.

For Scientific Community

Year: 2014**1. Standardization of preservative solution for different fruits as sample**

The fresh fruits of different varieties of mango and citrus can be preserved with their natural colour at acceptable level up to six months in Ethanol 75% solution compared to other solutions viz. general solution (50 ml Formaldehyde 40% + 300 ml Ethyl Alcohol 95% + 2000 ml water) and Hessler's solution. Banana fruits could not be preserved in any tested solution.

Year: 2017**1. Seasonal influence on nutritional and physiological changes associated with flowering and fruiting behaviors in mango**

- The nutrient contents viz. nitrogen, potassium, calcium, magnesium, manganese, iron and zinc in leaves of mango cultivar 'Kesar' and 'Alphonso' were higher during the months of October to January, thereafter the nutrient contents started to decrease and were recorded lower during the months of April to July. Photosynthetic rate and internal CO₂ content of leaves of cultivar 'Kesar' and 'Alphonso' increased significantly during the months of November to March and declined during the months of August–September.
- Correlation analysis indicated that nitrogen, potassium, calcium, magnesium, sulphur, manganese, photosynthetic rate and internal CO₂ content of leaves of cultivar 'Kesar' and 'Alphonso' have significant negative correlation with minimum temperature and maximum relative humidity.

Year: 2018

1. Screening of salt tolerant rootstock for mango from South Gujarat region

Genotype 73-2 was found better in terms of germination, seedling growth and survival at EC 4 to 5 dSm⁻¹ salinity level. Scientists, those who are interested to work on salt tolerant rootstock of mango may take advantage in hybridization programme.

2. Determination of nutritional composition of minor fruits

Minor fruits (mentioned below) of South Gujarat are found rich in following parameters as compared to banana and sapota.

| Fruits | Composition better than banana and sapota |
|-----------------|--|
| Palmyra palm | K (3902ppm), Ca(739ppm), P (268ppm) and Zn(2.79ppm) |
| Jamun | Total phenol (241.6 mg/100g), Antioxidant activity (126.5 mg/100g), Ca (324ppm) and Mg(241ppm) |
| White wax apple | Antioxidant activity (16.4 mg/100g) |
| Carambola | Vitamin-C (16.1 mg/100g), Total phenol (20.8 mg/100g), Antioxidant activity (28.4 mg/100g), K(4099ppm), Ca (657ppm), Mn (3.01ppm) and Cu(2.75ppm) |
| Tamarind | Carbohydrates (62.8%), Protein (2.81%), Vitamin-C (18.9 mg/100g), Total phenol (25.6 mg/100g), Antioxidant activity (30.4 mg/100g), K(12433ppm), Ca (2759ppm), Mg (1286ppm), P(1099ppm), Fe (154.3ppm), Mn (6.47ppm), Zn(7.11ppm) and Cu (6.13ppm) |
| Jackfruit | Total phenol (31.8 mg/100g), Antioxidant activity(62.9 mg/100g), K (5135ppm), Ca (405ppm), Mg(533ppm) and Mn (5.12ppm) |
| Star gooseberry | Protein (4.31%), β carotene (100.7 μg/100g), Vitamin-C (17.1), Total phenol (105.0 mg/100g), Antioxidant activity (83.7 mg/100g), K(4411ppm), Ca (4933ppm), Mg (1518ppm), P(545ppm), Fe (17.2ppm) and Zn (3.94ppm) |
| Lasoda | β carotene (62.7 μg/100g), Total phenol (41.8mg/100g), Antioxidant activity (55.7 mg/100g), K (4644ppm), Ca (656ppm), P (431ppm), Mn(3.51ppm) and Zn (2.06ppm) |
| Kair | Protein (2.24%), Total phenol (61.5 mg/100g), Antioxidant activity (77.7 mg/100g), K(7313ppm), Ca (1011ppm), Mg (723ppm), P(999ppm) and Zn (4.71ppm) |

| | |
|-------|---|
| Rayan | β carotene (87.63 μ g/100g), total phenol (157.4 mg/100g), Antioxidant activity (92.6 mg / 100g), Ca(284ppm) and P (321ppm) |
|-------|---|

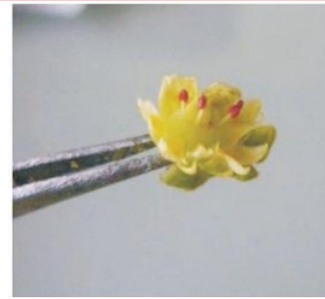
3. Assessment of genetic diversity through molecular markers in mango (*Mangifera indica* L.)

Scientific community is informed to use markers OPA-04, OPG-17, OPA-18 and OPB-19 for genetic diversity analysis in mango. Amarapali and Dashehari varieties were found to be genetically most similar, followed by Sonpari and Baneshan; Neelphanso and Sonpari; Dashehari and Mallika; Ratna and Sindhu and Sonpari and Alphanso. Whereas, Banglora and Neelphanso were found to be genetically most diverse varieties followed by LalMalgoa and Amrutang; and LalMalgoa and Vanraj.

Year: 2019

1. Effect of environment on behaviors and structures of flowering, pollen and fruit set characters in mango.

- Pollen viability was higher in 'Kesar' and 'Alphonso' mango, but the flowers with germinated pollen in-vivo were very less (20- 23%) in field conditions. Pollen germination at 35° C decreased by 3.87 and 5.00 % in Kesar and Alphonso, respectively; when compared with 20° C.
- Correlation of weather data with different flowering and fruit set parameters of 'Kesar' mango indicated that, the number of male flowers per panicle was positively correlated with minimum relative humidity but negatively correlated with sunshine hours. Ovule dimension was negatively correlated with minimum temperature and minimum relative humidity whereas positively correlated with sunshine hours. Fruit set at marble stage was negatively correlated with maximum temperature in 'Kesar' variety.
- Correlation of weather data with different flowering and fruit set parameters of 'Alphonso' mango indicated that, the length of panicle was negatively correlated with minimum temperature while width of panicle was negatively correlated with sunshine hours. Style dimension was negatively correlated with maximum temperature. Pollen viability was negatively correlated with minimum relative humidity.



Year: 2021

1. Response of media, fertilizer and chemicals application on growth of mango rootstock

Scientists those who are working on raising of mango rootstock are recommended to sow the mango stone in poly bag having potting media of red soil + FYM + vermicompost (2:1:0.5) and to fertilize @ 75:16:75 mg NPK /Kg through soil application with foliar application of Novel organic liquid nutrients 10 ml per litre at 2nd and 3rd MAS for better germination, growth and higher survival of mango rootstock.

Research Recommendation for PSMA crops

Production Technology:

Year: 2019

1. Evaluation of nutrient management under coconut based cropping systems for different agro climatic regions.

The farmers of South Gujarat growing coconut cv. D x T at 7.5 m x 7.5 m are advised to grow banana, elephant foot yam, tannia and turmeric as a component crop under coconut garden and apply the nutrients as per following schedule to increase the yield of coconut and component crops along with higher remuneration.

| SN. | Name of Crop and variety | In-organic and Organic nutrients | | | | | Time of application | |
|-----|------------------------------|--------------------------------------|--|--|--|--------------------|--|--------------------------|
| | | 50% RDF of NPK | Recycling of Biomass (vermicompost) (Kg/plant) | Biofertilizer (ml/plant) <i>Azotoactor</i> | <i>In situ</i> green manuring (kg/plant) | Vermiwash (lit/ha) | Organics (two splits) | In-organics |
| | | | | | | | | |
| 1 | Coconut (DxT) | N 750 P 375 K 750 (g/plant) | 40 (20 + 20) | 100 (50+50) | 20 (10+10) | 100 (50+50) | one month after application of In-organics | As per the recomondation |
| 2 | Banana (G-9) | N 150 P 45 K 100 (g/plant) | 6 (3+ 3) | 20 (10+10) | 5 (2.5 + 2.5) | 10 (5+5) | First at basal and second 3 MAP | |
| 3 | Elephant Foot Yam (Gajendra) | N 40 P 30 K 50 (Kg/ha) | 3 (1.5 + 1.5) | 10 (5+5) | 3 (1.5 + 1.5) | 5 (2.5+2.5) | | |
| 4 | Tannia (Local) | N 40 P 30 K 50 (Kg/ha) | 1 (0.5 + 0.5) | 5 (2.5+2.5) | 2 (1.0 + 1.0) | 5 (2.5+2.5) | | |
| 5 | Turmeric (Sugandham) | N 30 P 30 K 30 (Kg/ha) | 5 t/ha (at time of planting) | 20 lit/ha (5+5) | 100 kg/ha (at time of planting) | 10 (5+5) | | |

2. Performance of cocoa varieties/hybrids for their performance as intercrop in coconut gardens

Farmers of south Gujarat growing coconut cv. WCT at 7.5 x 7.5 m are advised to grow VTLCH-4 cocoa clone as intercrop at intra spacing of 3.75 m under coconut garden for getting higher yield of coconut and cocoa.

