RESEARCH ARTICLE

EVALUATION OF DIFFERENT FUNGICIDES AGAINST BOLL ROT AND FOLIAR DISEASES OF COTTON UNDER SOUTHGUJARAT OF INDIA

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Abstract: Cotton (*Gossypium* spp.) is one of the most important fiber crops playing a key role in economic and social scenario of the globe. It provides employment and sustenance to a population of nearly 42 Million people, who are involved directly or indirectly in cotton production, processing, textiles and related activities. Looking to the experiment, different fungicides were evaluated in cotton crop under field conditionagainst the boll rot and different diseases. Total seven treatments including control were evaluated in this trial from which, treatment T_4 (24.17 PDI) followed by T_5 (25.67 PDI) recorded minimum Bacterial leaf blight infection in comparison to the treatment T_7*i.e.* control (39.50 PDI) in RCH 2 BG II hybrid.For Alternaria leaf spot disease, treatment T_4 (5.33 PDI) were recorded significantly minimum Alternaria leaf spot disease in RCH 2 BG II hybrid as compared to the T_7*i.e.* control (17.67 PDI) followed by T_5 (8.17 PDI) and T_6 (9.00 PDI) treatment.The lowest boll rot incidence was observed in the treatment T_4 (13.83 PDI) followed by the T_5 (16.17 PDI) and T_6 (17.33 PDI) treatment as compared to the control T_7 (29.83 PDI).The highest seed cotton yield was recorded in the treatment T_4 (2682.00 kg/ha) followed by treatment T_5 (2427.00kg/ha) and treatment T_6 (2308.67kg/ha), respectively.

Keywords: Cotton, *Gossypium* spp, Treatment, Control, Fungicide

INTRODUCTION

Cotton (*Gossypium spp*.) is one of the most important economic products of the group of fibers due to volume and value of production. Its cultivation is also of great social importance, due to the number of jobs generated directly or indirectly. The fiber, the main product of cotton has many industrial applications. Examples are manufacturing of yarn for weaving of various kinds of fabrics, cotton batting for hospital use, felt clothing, blankets and upholstery, photographic films and plates for radiography among others. Cotton is grown worldwide for its natural fiber and oil. Cotton seed contain 30 per cent starch, 25 per cent oil and 16.20 per cent protein. It is also being used in the manufacture of medicinal supplies, tarpaulin, cordage and belting. The cotton hulls serve as roughage for livestock and the fuzz (short seed hair) is used in the manufacture of papers, plastics, carpets, rayon, explosives and cotton wool.The cottonseed is rich in oil, with approximately 18 to 25%, and contains 20 to 25% of crude protein. The cottonseed meal is a byproduct of oil extraction, and is used in animal feed because of its high protein content, approximately 40 to 45%. The seed coat is used to make certain types of plastics and synthetic rubber (Carvalho, 1996). The cottonseed, after the removal of the plume, is commonly used as ruminant feed. It is considered a palatable food, with characteristics of dietary fiber with high levels of energy and protein (Savastano, 1999).

The most common cotton diseases reported in India are Wilt (*Fusarium oxysporum* f. sp. *vasinfectum* (G.F. Atk.) W.C. Snyder & H.N. Hansen), Root rots (*Rhizoctonia bataticola* (Taubenh.), Verticillium wilt (*Verticillium dahliae*Kleb.), Anthracnose (*Colletotrichum gossypii* Southworth. or *C.capsici* (Syd.) Butler &Bisby), Grey mildew (*Ramularia areola* G.F. Atk.), Blackarm (*Xanthomonas campestris* pv. *malvacearum* (Pammel) Dowson), Leaf blight (*Alternaria macrospora*Zimm),Leaf curl (Cotton leaf curl virus), Corynespora leaf blight (*Corynesporacassiicola* (Berk. & M. A. Curtis) C. T. Wei, Boll rot and physiological disorders as Para wilt, Leaf reddening and sometimes leaf elongation due to improper use of weedicides etc.The bacterial blight is the most wide spread and destructive disease reported to cause yield losses of about 10 to 30 per cent (Kalpana *et al*., 2004 and Sandipan *et al*., 2016). Losses due to Alternaria leaf spot (26.6 %), grey mildew (29.2 %) and Myrothecium leaf spot (29.1 %) have been reported. Boll rot is considered as the most destructive one. In the USA, at least 170 microorganisms are capable of causing cotton boll rot. According to Hillocks (1992) a great number of microorganisms were isolated from cotton bolls rot and these pathogens can be divided into three groups: those capable of penetrating intact bolls, those which are introduced by insects and those are introduced after the bolls are damaged by insects or after the suture of the boll lobes are broken. Most of the agents that cause cotton bolls rot penetrate through wounds from insect or pests and / or rupture of the division through the lobes of the bolls. However, primary infection of boll, when the pathogen penetrates directly into the healthy boll is common in areas with high humidity or in those where the crop has dense vegetative growth.

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According to Belot & Zambiasi (2007) there are many pathogens that can cause boll rot such as *Alternaria* spp., *Ascochyta gossypii, Aspergillus flavus, Bacillus pumilus, Colletotrichum* spp., *Diplodiagossypina, Erwinia aroideae, Fusarium* spp., *Lasiodiplodiatheobromae, Myrothecium roridum, Pantoeaagglomerans, Phomaexigua, Phomopsis* sp., *Phytophthora* spp., *Rhizoctonia solani* and *Xanthomonas axonopodis* pv. *malvacearum.* Various symptoms may be due to the existence of a complex of pathogens. Commonly, the bolls are soft and blackened and in some cases arise from lesions in both the apex and at its base. Fructifications in various colors, from white to purple are also verified.*Sclerotium rolfsii*is identified as one of the causes of boll rot in Bangladesh (Shamsi *et al.*, 2008). This on the whole state of affairs leads to felt a closer inspection of the diseases those were present on cotton crop under South Gujarat region, hence systemic explorations by using different fungicides on cotton diseases were carried out. Keeping in view, an experimentbased treatment is planned for the effective management of the boll rot and cotton diseases.

MATERIALS AND METHODS

The experiment was laid by dibbling method with the following experimental details (Table: 1 and 2). All the recommended agronomic practices were followed for raising the good crop. In each net plot of each treatment randomly tag 5 plants and score 4 lower, 4 middle leaves and 2 upper leaves of each plant/bolls in terms of 0-4 grade and work out PDI as mentioned below by using 0-4 scale as given by Sheoraj, 1988 and then these grades were converted into per cent disease incidence (PDI) by using the formula given by Wheeler, 1969 (Bacterial leaf blight and Alternaria leaf spot diseases).

The fungicides were used as per the above treatment two foliar sprays were applied at 15 days interval, first from the initiation of the disease and second after the interval of 15 days.

$$\text{Disease incidence (\%)} = \frac{\text{No. of infected plants/bolls (Numerical grades)}}{\text{No. of leaves/boll observed x Max. Grade}} \times 100$$

Table 1. Experimental detail as below:

Objective	**:**	**To find out the effective fungicides against the boll rot and foliar diseasesof cotton**
Location	:	Main Cotton Research Station, Surat (Gujarat)
Year of commencement	:	2020-21
Experimental details		
Design	**:**	RBD
Treatment	**:**	Six (6) + 01 Control
Replication	**:**	Three (3)
Plot size in sq. meter	**:**	Gross: 7.2 x 4.5 Net: 4.8 x 3.6
Name of hybrid (Susceptible, if available)	**:**	Bt hybrid (RCH 2 BG II)
No. of rows/plot	**:**	6
No. of dibbles/row	**:**	10
Plot size in sq. Meter (1 plot)	**:**	32.4
Expt. area in ha.	**:**	680.4 (0.06 ha)
Spacing	**:**	120 x 45 cm
FYM t/ha	**:**	-
Fertilizer dose NPK kg/ha	**:**	240:40:00
Previous crop	**:**	-
Date of sowing	**:**	22.06.20
Date of germination	**:**	27.06.20
Date of gap filling	**:**	-
No. of plant protection	**:**	As per the treatments
No. of irrigation	**:**	As & when required

Table 2. Treatment details

Trt No.	Treatment details	Dose	Application Time	Observations to be taken
T_1	Kresoxim methyl 44.3% SC @ 0.044 %	• 1 ml/litre of water	• Foliar spray at the time of disease initiation and second after 15 days of first spray.	Per cent Incidence (PDI) and seed cotton yield
T_2	Propiconazole 25% EC @ 0.025 %	• 1 ml/litre of water		
T_3	Propineb 70% WP @ 0.175%	• 2.5 g/litre of water		
T_4	Fluxapyroxad 167 g/litre + Pyroclostrobin 333 g/litre SC @ 0.3%	• 0.6 g/litre of water		
T_5	Metiram 55% + Pyroclostrobin 5% WG @ 0.12 %	• 2 g/litre of water		
T_6	Azoxystrobin 18.2% w/w + Difenoconazole 11.4% w/w SC @ 0.029%	• 1 ml/ litre of water		
T_7	Control (Water spray)	---	--	

For, Boll rot disease

Score	Description
0	Immune, Without any fungal or bacterial spot
1	Resistant (R), Minute spots not spreading on the surface of the bolls
2	Moderately Resistant (MR), Spots increasing in size but not penetrating and also not affecting the lint and seed
3	Moderately Susceptible (MS), Infection spreading to one or two locules and causing damage to lint and seed
4	Susceptible (S), more than two locules affected by fungal/ bacterial infection causing damage to lint and seed

For, Bacterial leaf blight (BLB) disease

Scale	PDI	Grade	Symptoms
0	0.0	Immune	No Infection
1	1-25%	R	Few spots, scattered, 1mm in dia, no coalescing, reddish, no angular, veins free, around 5% leaf area covered
2	26-50%	MR	Spots initially wet but rapidly drying, several, larger 2 mm in dia, no coalescing, reddish brown, veins and veinlets free or with dry lesions, 10% leaf area covered
3	51-75%	MS	>2mm dia lesions, angular, turning brown and black, coalescing, spreading linearly along the small viens, or water soakedvien infection along the main veins, 11-20% leaf area cover
4	>75%	S	Larger lesions, water soaked, coalesing, or veins infected and extended up to pulvinus and petioles, larger lesions turning to brown black, in severe cases branches and stem also attacked and covering more than 20% leaf area

For, Alternaria (ALS), Cercospora (CoLS), Myrothecium (MLS) and Rust disease

Scale	PDI	Grade	Symptoms
0	0.0	Immune	No Infection
1	1-25%	R	A few small spots, less than 2mm, scattered, which over less than 5% leaf area
2	26-50%	MR	Spots bigger in size up to 3mm and cover 6-20% leaf area covered
3	51-75%	MS	Spots increasing in size 3-5mm, irregular in shape, coalesing and 21-40% leaf area cover
4	>75%	S	Many spots coalesce to make bigger lesion, irregular in shape and size and covering more than 40% leaf area

It is the standard methodology of AICRP on Cotton and similar disease scale was used by Anil, G. H. in his thesis on Studies on leaf blight of Bt cotton caused by Alternaria spp. in 2013 submitted to the University of Agricultural Sciences, Dharward and Hosagoudar *et al.*, 2008 ab.

RESULTS AND DISCUSSION

The field experiment was conducted during *Kharif* 2020 at Main Cotton Research Station (MCRS), Surat (Gujarat). The results presented in the Table: 3and Graph: 1revealed that the out of total seventreatments including control treatment T_4 (24.17 PDI) followed by T_5 (25.67 PDI) recorded minimum Bacterial leaf blight infection in comparison to the treatment T_7*i.e.* control (39.50 PDI) in RCH 2 BG II hybrid.

For Alternaria leaf spot disease, treatment T_4 (5.33 PDI) were recorded significantly minimum Alternaria leaf spot disease in RCH 2 BG II hybrid as compared to the T_7*i.e.* control (17.67 PDI) followed by T_5 (8.17 PDI) and T_6 (9.00 PDI) treatment (Table: 3 and Graph: 2).The lowest boll rot incidence was observed in the treatment T_4 (13.83 PDI) followed by the T_5 (16.17 PDI) and T_6 (17.33 PDI) treatment as compared to the control T_7 (29.83 PDI) Table: 3 and Graph: 3.

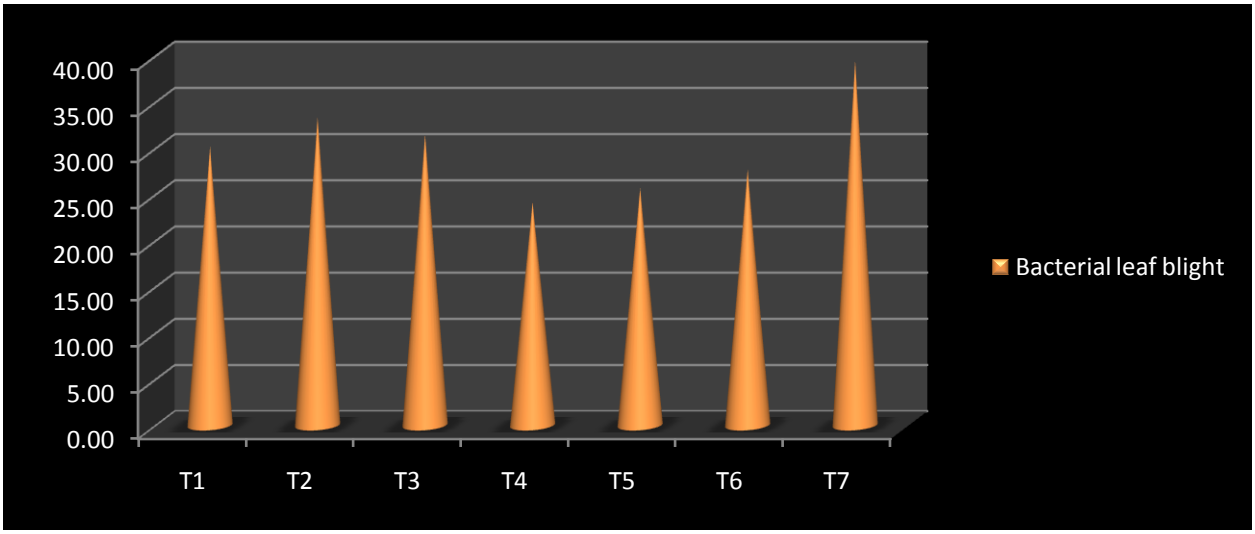
The highest seed cotton yield was recorded in the treatment T_4 (2682.00 kg/ha) followed by treatment T_5 (2427.00kg/ha) and treatment T_6 (2308.67kg/ha), respectively (Table: 3 and Graph: 4).

Table 3. Statement showing the per cent disease intensity of Bacterial leaf blight (BLB), Alternaria leaf spot (ALS), Boll rot and Seed cotton yield in different fungicides against cotton diseases 2020-21.

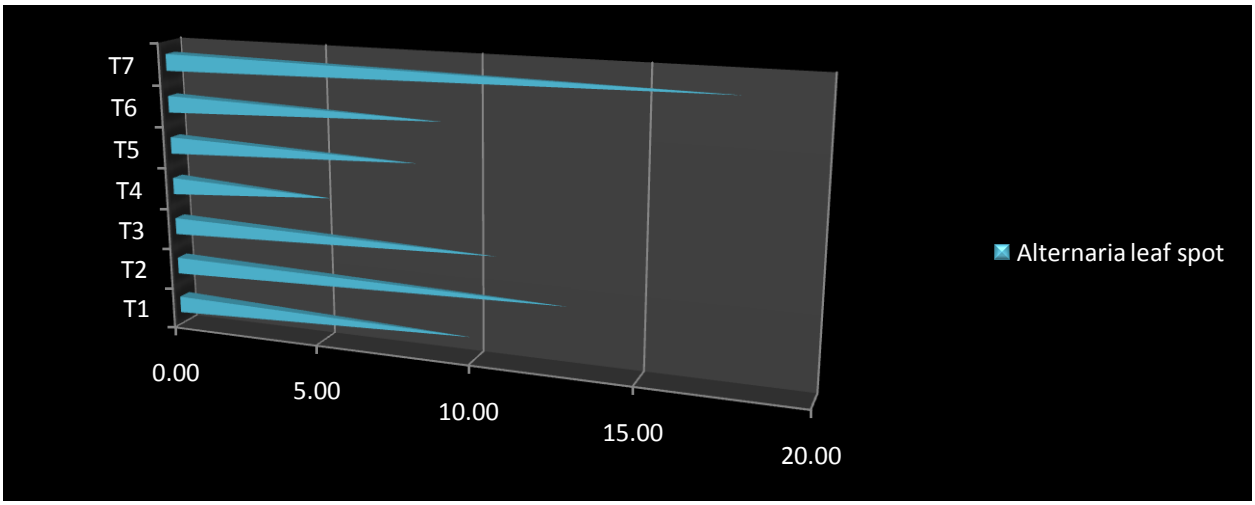
Sr. No.	Treatment	Bacterial leaf blight (PDI)	Control (%)	Alternaria leaf spot (PDI)	Control (%)	Boll rot (PDI)	Control (%)	Seed cotton yield (Kg/ha)
T_1	Kresoxim methyl 44.3% SC @ 1 ml/litre of water	30.17 (33.15)	23.65	9.83 (18.25)	44.34	20.83 (27.07)	30.17	2169.00
T_2	Propiconazole 25% EC @ 1 ml/litre of water	33.33 (35.13)	15.61	12.83 (20.98)	27.36	25.50 (30.28)	14.53	1944.67
T_3	Propineb 70% WP @ 2.5 g/litre of water	31.50 (33.98)	20.25	10.67 (19.02)	39.62	24.00 (29.29)	19.55	2039.00
T_4	Fluxapyroxad 167 g/litre + Pyroclostrobin 333 g/litre SC @ 0.6 g/litre of water	**24.17 (29.14)**	**38.82**	**5.33 (13.22)**	69.81	**13.83 (21.76)**	53.63	**2682.00**
T_5	Metiram 55% + Pyraclostrobin 5% WG @ 2 g/litre of water	25.67 (30.18)	35.02	8.17 (16.51)	53.77	16.17 (23.66)	45.81	2427.00
T_6	Azoxystrobin 18.2% w/w + Difenoconazole 11.4% w/w SC @ 1 ml/ litre of water	27.67 (31.56)	29.96	9.00 (17.44)	49.06	17.33 (24.53)	41.90	2308.67
T_7	Control (Water spray)	39.50 (38.84)	-	17.67 (24.82)	-	29.83 (33.07)	-	1811.67
S. Em.± (T)		1.79		0.89		1.16		162.65
C.D.at 5% (T)		5.51		2.73		3.56		501.20
C.D. (Y x T)		-		-		-		-
C.V. %		9.36		8.25		7.39		12.82

*Figure in the parenthesis are retransformed values

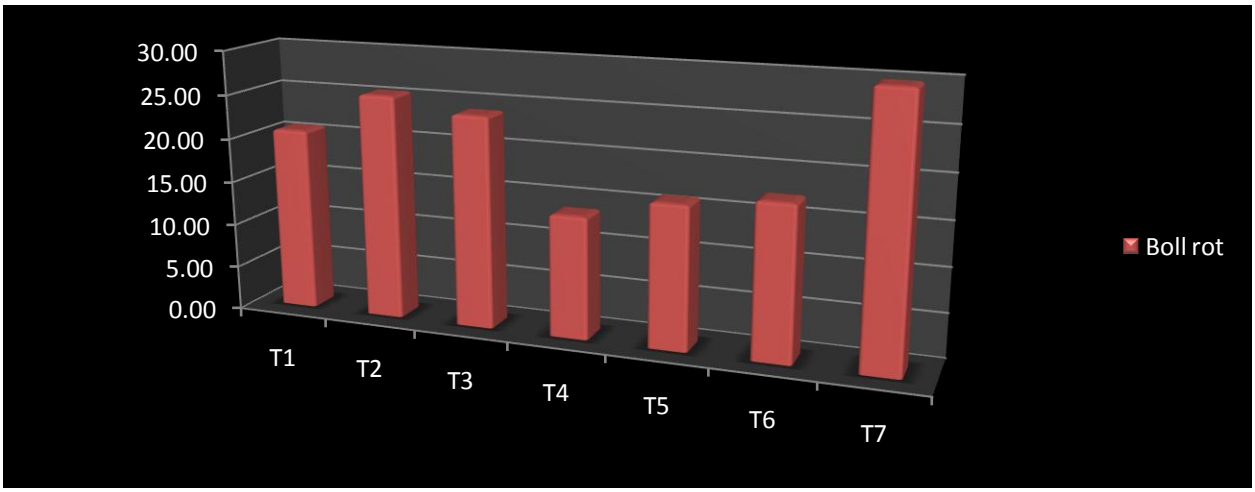
Graph 1. Per cent disease intensity of Bacterial leaf blight (BLB)



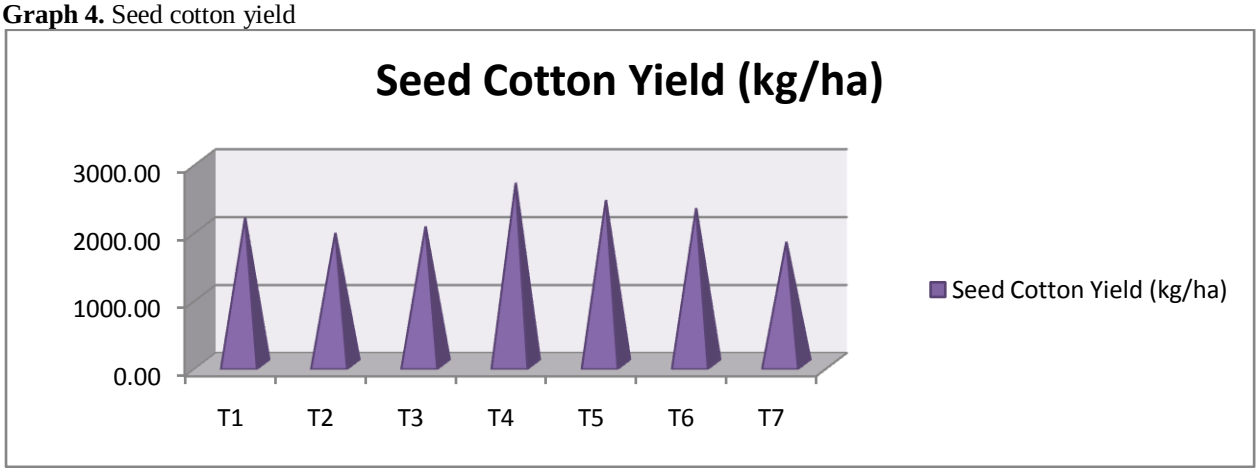
Graph 2. Per cent disease intensity of Alternaria leaf spot (ALS)



Graph 3. Per cent disease intensity of Boll rot



Graph 4. Seed cotton yield



CONCLUSION

It is found from the result that the Treatment T_4(Fluxapyroxad 167 g/litre + Pyroclostrobin 333 g/litre SC @ 0.6 g/litre of water)with two sprays first from the initiation of the disease and second after the interval of 15 days recorded the lowest incidence of Bacterial leaf blight, Alternaria leaf spot disease and boll rot and recorded the highest seed cotton yield (2682.00 kg/ha).

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