



RESEARCH PAPER

Assessment of bioagents against cotton diseases under South Gujarat of India

Prashant B. Sandipan*, P. S. Patel and R. K. Patel¹

Main Cotton Research Station, Navsari Agricultural University, Surat (Gujarat) India
(Email: prashantsandipan@gmail.com)

Abstract : Cotton (*Gossypium* spp.) is one of the most important economic products of the group of fibres 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 fibre, the main product of cotton has many industrial applications. The 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. Here in this experiment, different bioagents were evaluated against the cotton foliar disease. This experiment engage the total nine treatments including control from which, treatment T₅ (14.50 PDI) (Seed and soil application *Pf*CICR *i.e.*, seed application: 10⁸cfu/g @10g per kg of seed soil application: 2.5 kg/ha at 30 and 60 DAS) followed by T₈ (18.33 PDI) significantly recorded minimum bacterial leaf blight infection in comparison to the treatment T₉ *i.e.* control (42.33 PDI) in RCH 2 BG II hybrid. For Alternaria leaf spot disease, treatment T₈ (8.17 PDI) (Seed treatment with *Pseudomonas fluorescens* CICR (2 x 10⁸cfu/g) @ 10 g/kg seed + soil application of *Trichoderma viride* TNAU1 (2 x 10⁶ cfu/g) @ 2.5 kg/ha in 250 kg of vermicompost and sprays of Kresoxim methyl (0.0443%) followed by Captan 70% + Hexaconazole 5% WP @ 1.5 g/l) were recorded significantly minimum Alternaria leaf spot disease in RCH 2 BG II hybrid as compared to the T₉ *i.e.* control (19.33 PDI) followed by T₇ (9.83 PDI) and T₃ (10.50 PDI) treatment. The highest seed cotton yield was recorded in the treatment T₅ (2606.00 kg/ha) followed by treatment T₈ (2335.33 kg/ha) and treatment T₇ (2275.67 kg/ha), respectively.

Key Words : Cotton, *Gossypium* spp, Treatment, Control, Bioagents

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INTRODUCTION

Cotton known as “The White Gold” or the “King of Fibres” enjoys a pre-eminent status among all cash crops in the country and is the principal raw material for flourishing textile industry. The most common cotton diseases reported in India are Wilt (*Fusarium oxysporum*

f. sp. vasinfectum (G.F. Atk.) W.C. Snyder and H.N. Hansen), Root rots (*Rhizoctonia bataticola* (Taubenh.), *Verticillium* wilt (*Verticillium dahliae* Kleb.), Anthracnose (*Colletotrichum gossypii* Southworth. or *C. capsici* (Syd.) Butler and Bisby), Grey mildew (*Ramularia areola* G.F. Atk.), Blackarm (*Xanthomonas campestris* pv. *malvacearum* (Pammel) Dowson), Leaf

*Author for correspondence:

¹Krushi Vigyan Kendra (NAU), Surat (Gujarat) India

blight (*Alternaria macrospora* Zimm), Leaf curl (Cotton leaf curl virus), *Corynespora* leaf blight (*Corynespora cassiicola* (Berk. and 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.*, 2017a and 2017b).

Plant pathogens including fungi, bacteria, viruses and nematodes cause serious losses or damage to crops worldwide and significantly reduce the quality and quantity of agricultural commodities. These losses pose a major threat to global food production annually (El Ghaouth *et al.*, 2002; Dean *et al.*, 2012 and Singh, 2014; O'Brien, 2017). Moreover, pathogenic infection in the field or in post-harvest storage can affect the health of humans and livestock, especially if the pathogen produces toxins in or on consumable products (Brimner and Boland, 2003 and Menzler-Hokkanen, 2006).

According to Agrios (2005), the estimated 36.5% average of total losses includes 14.1 % caused by diseases (fungi, bacteria and viruses), 10.2% by insects and 12.2% by weeds. Largest crop loss (14.1 %) is by phytopathogens alone. Plant fungal diseases are the most destructive diseases where the fungal pathogens attack many economic crops causing yield losses, which affect directly many countries' economy.

Biological control is considered as a promising alternative to pesticide and plant resistance to manage plant diseases, but a better understanding of the interaction of its natural and societal functions is necessary. A reduction in chemical inputs in agriculture requires alternative methods for managing soil borne diseases for sustainable production systems. This includes the use of biological control agents (Roberts *et al.*, 2005, Spadaro and Gullino, 2005).

Biological control is a method of plant disease management by inhibiting plant pathogens, improving plant immunity and or modifying the environment through the effects of beneficial microorganisms, compounds or healthy cropping systems (Bragard *et al.*, 2013, Burketova *et al.*, 2015, Vandenberghe *et al.*, 2017 and Poveda *et al.*, 2020). Thus, in the present study the objective was formulated to investigate the effect of different bioagents against the major foliar diseases of cotton.

Word cloud prepared from the introduction part :



MATERIAL AND METHODS

The experiment was laid by dibbling method with the following experimental details (Table A and B). 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 5 lower and 5 middle leaves of each plant 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).

$$\text{Disease incidence (\%)} = \frac{\text{No. of infected plants (Numerical grades)}}{\text{No. of leaves observed} \times \text{Max. grade}}$$

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 soaked vien infection along the main veins, 11-20% leaf area cover
4	>75%	S	Larger lesions, water soaked, coalescing, 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, <i>Alternaria</i> leaf spot (ALS) 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, coalescing 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

For foliar diseases, it is standard methodology of AICRP, Cotton.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized

under following heads :

The field experiment was conducted during *Kharif* 2021 at Main Cotton Research Station (MCRS), Surat (Gujarat). The results presented in the Table 1 and Fig. 1 revealed that the out of total nine treatments including control, treatment T₅ (14.50 PDI) followed by T₈ (18.83 PDI) recorded minimum Bacterial leaf blight infection in comparison to the treatment T₉, *i.e.* control (42.33 PDI) in RCH 2 BG II hybrid.

For *Alternaria* leaf spot disease, treatment T₈ (8.17 PDI) was recorded significantly minimum *Alternaria* leaf spot disease in RCH 2 BG II hybrid as compared to the T₉, *i.e.* control (19.33 PDI) followed by T₇ (9.83 PDI) and T₃ (10.50 PDI) treatment (Table 2 and Fig. 2).

The highest seed cotton yield was recorded in the treatment T₅ (2606.00 kg/ha) followed by treatment T₈ (2335.33 kg/ha) and treatment T₇ (2275.67 kg/ha), respectively (Table 3 and Fig. 2).

Comparison of the efficacy between the biocontrol

Table 1 : Experimental detail

1.	Objective	:	To find out the effective module for the management of cotton diseases
2.	Location	:	Main Cotton Research Station, Surat
3.	Year of commencement	:	2021
4.	Experimental details		
5.	Design	:	RBD
6.	Treatment	:	Eight (8) + 01 Control
7.	Replication	:	Three (3)
8.	Plot size in sq. meter	:	Gross: 6.0 x 4.5 Net: 3.6 x 3.6
9.	Name of hybrid (Susceptible, if available)	:	Bt hybrid (RCH 2 BG II)
10.	No. of rows/plot	:	5
11.	No. of dibbles/row	:	10
12.	Plot size in sq. Meter (1 plot)	:	27.0
13.	Expt. area in ha.	:	1093.5 sq. meter (0.10 ha)
14.	Spacing	:	120 x 45 cm
15.	FYM t/ha	:	-
16.	Fertilizer dose NPK kg/ha	:	240:40:00
17.	Previous crop	:	-
18.	Date of sowing	:	24.06.21
19.	Date of germination	:	26.06.21
20.	Date of gap filling	:	13.07.21 and 22.07.21
21.	No. of plant protection	:	As per the treatments
22.	No. of irrigation	:	As and when required
23.	Date of harvesting	:	-

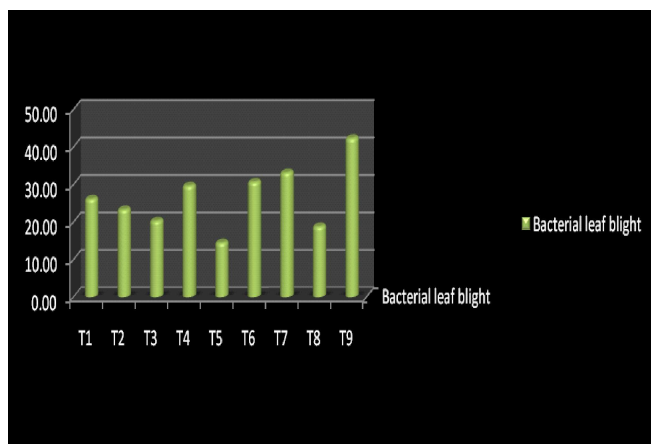


Fig. 1: Per cent disease intensity of bacterial leaf blight (BLB)

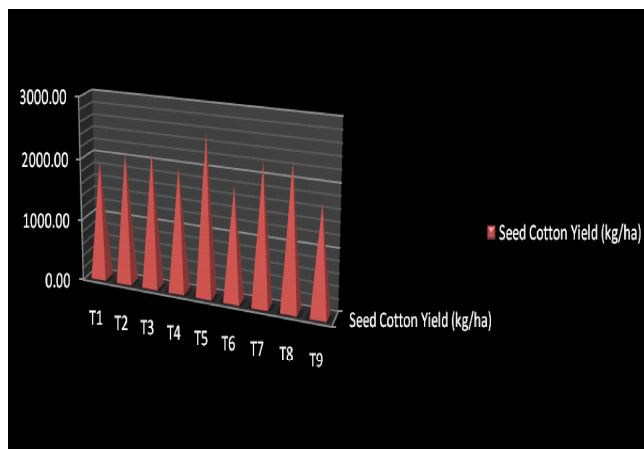


Fig. 3: Seed cotton yield

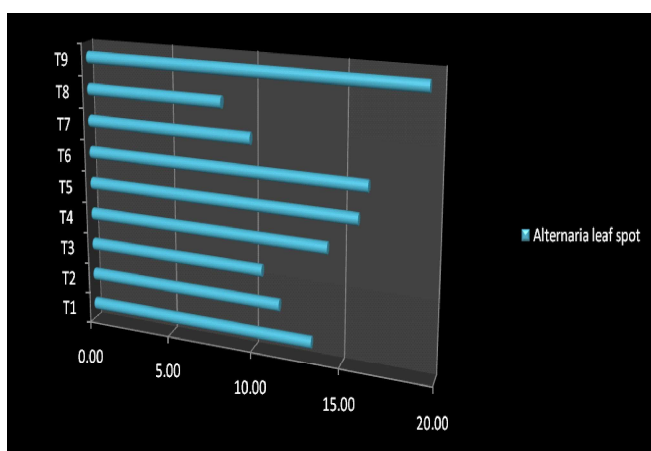


Fig. 2 : Per cent disease intensity of alternaria leaf spot (ALS)

agents used in different treatments at Surat centre indicated that treatment T₅: Seed and soil application of *Pf* CICR (Seed application 10⁸ cfu/g @ 10g per kg of seed and soil application 2.5 kg/ha at the time of sowing and also applied at 30 and 60 days was found effective in reducing the Bacterial leaf blight infection. And for Alternaria leaf spot disease, treatment T₈: Seed treatment: *Pf* CICR (2 x 10⁸cfu/g) @ 10 g/kg seed Soil application: *T. viride* TNAU 2 x 10⁶ cfu/g) @ 2.5 kg/ha in 250 kg of vermicompost

Spray: Kresoxim methyl (0.0443%) followed by Captan 70% + Hexaconazole 5% WP @ 1.5 g/l was found effective in reducing the Alternaria leaf spot disease in RCH 2 BG II hybrid cotton.

Table 2 : Treatment detail

Trt No.	Treatment details	Dose	Application Time	Observations to be taken
T ₁	Seed and soil application of <i>Bacillus aryabhatai</i>	<ul style="list-style-type: none"> Seed application: 10⁸cfu/g @10g per kg of seed Soil application: 2.5 kg/ha (30 and 60 DAS) 	<ul style="list-style-type: none"> At the time of sowing 30 and 60 DAS 	Per cent incidence for foliar diseases and seed cotton yield
T ₂	Seed and soil application of <i>Bacillus tequilensis</i>	<ul style="list-style-type: none"> Seed application: 10⁸cfu/g @10g per kg of seed Soil application: 2.5 kg/ha (30 and 60 DAS) 	<ul style="list-style-type: none"> At the time of sowing 30 and 60 DAS 	
T ₃	T ₁ +T ₂	<ul style="list-style-type: none"> Seed application: 10⁸cfu/g @10g per kg of seed Soil application: 2.5 kg/ha (30 and 60 DAS) 	<ul style="list-style-type: none"> At the time of sowing 30 and 60 DAS 	
T ₄	Seed and soil application of Commercial product <i>Bacillus subtilis</i>	<ul style="list-style-type: none"> Seed application: 10⁸cfu/g @10g per kg of seed Soil application: 2.5 kg/ha (30 and 60 DAS) 	<ul style="list-style-type: none"> At the time of sowing 30 and 60 DAS 	
T ₅	Seed and soil application <i>Pf</i> CICR	<ul style="list-style-type: none"> Seed application: 10⁸cfu/g @10g per kg of seed Soil application: 2.5 kg/ha (30 and 60 DAS) 	<ul style="list-style-type: none"> At the time of sowing 30 and 60 DAS 	
T ₆	Chemical seed treatment (Vitavax power @ 0.2%)	<ul style="list-style-type: none"> 2 g/kg seed 	<ul style="list-style-type: none"> At the time of sowing 60 DAS 	
T ₇	Foliar application of Pyroclostrobin @0.1%	<ul style="list-style-type: none"> 1.0 g/lit of water 	<ul style="list-style-type: none"> 60 DAS 	
T ₈	Seed treatment with <i>Pseudomonas fluorescens</i> CICR (2 x 10 ⁸ cfu/g) @ 10 g/kg seed + soil application of <i>Trichoderma viride</i> TNAU1 (2 x 10 ⁶ cfu/g) @ 2.5 kg/ha in 250 kg of vermicompost and sprays of Kresoxim methyl (0.0443%) followed by Captan 70% + Hexaconazole 5% WP @ 1.5 g/l		<ul style="list-style-type: none"> Foliar spray at the time of disease initiation 	
T ₉	Control (Untreated Control)	---	--	

Table 3: Statement showing the per cent disease intensity of bacterial leaf blight (BLB), Alternaria leaf spot (ALS) and seed cotton yield in efficacy of bioagents against cotton diseases 2021-22

Sr. No.	Treatments	Bacterial leaf blight (PDI)	Alternaria leaf spot (PDI)	Seed cotton yield (Kg/ha)
T ₁	Seed and soil application of <i>Bacillus aryabhattai</i> Seed application: 10 ⁸ cfu/g @10g per kg of seed at the time of sowing Soil application: 2.5 kg/ha (30 and 60 DAS) with FYM/compost	26.17 (30.64)	13.33 (21.33)	1926.33
T ₂	Seed and soil application of <i>Bacillus tequilensis</i> Seed application: 10 ⁸ cfu/g @10g per kg of seed at the time of sowing Soil application: 2.5 kg/ha (30 and 60 DAS) with FYM/compost	23.33 (28.81)	11.50 (19.76)	2105.00
T ₃	T ₁ +T ₂ Seed application: 10 ⁸ cfu/g @10g per kg of seed at the time of sowing Soil application: 2.5 kg/ha (30 and 60 DAS) with FYM/compost	20.33 (26.56)	10.50 (18.80)	2158.33
T ₄	Seed and soil application of Commercial product <i>Bacillus subtilis</i> Seed application: 10 ⁸ cfu/g @10g per kg of seed at the time of sowing Soil application: 2.5 kg/ha (30 and 60 DAS) with FYM/compost	29.67 (32.91)	14.17 (22.04)	1990.00
T ₅	Seed and soil application <i>Pf</i> CICR Seed application: 10 ⁸ cfu/g @10g per kg of seed at the time of sowing Soil application: 2.5 kg/ha (30 and 60 DAS) with FYM/compost	14.50 (22.09)	15.83 (23.37)	2606.00
T ₆	Chemical seed treatment (Vitavax power @ 0.2%) 2 g/kg seed at the time of sowing	30.67 (33.53)	16.33 (23.77)	1838.33
T ₇	Foliar application of Pyraclostrobin @ 0.1% gm/lit of water Seed treatment: <i>Pf</i> CICR (2 x 10 ⁸ cfu/g) @ 10 g/kg seed Soil application: <i>T. viride</i> TNAU 2 x 10 ⁶ cfu/g @ 2.5 kg/ha in 250 kg of	33.18 (35.10)	9.83 (18.17)	2275.67
T ₈	vermicompost Spray: Kresoxim methyl (0.0443%) followed by Captan 70% + Hexaconazole 5% WP @ 1.5 g/l	18.83 (25.66)	8.17 (16.48)	2335.33
T ₉	Control	42.33 (40.54)	19.33 (26.03)	1763.33
S.E.± (T)		1.71	1.32	147.42
C.D. (P=0.05) (T)		5.12	3.95	441.97
C.D. (Y x T)		-	-	-
C.V. %		9.67	10.83	12.09

*Figure in the parenthesis are retransformed values

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