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## Management of foliar diseases of *Bt* cotton using chemical fungicides and biocontrol agent

**T Anand****Abstract**

To assess the efficacy of different chemical fungicides and a bioagent *Pseudomonas fluorescens* (TNAU-Pf1) against major foliar diseases of cotton two field trials were conducted at Cotton Research Station farm, Veppanthattai, Perambalur District, Tamil Nadu India. The results on field evaluation of different fungicides (Experiment I) revealed that the foliar application of propiconazole (0.1%) on 60, 90 and 120 DAS was effective in controlling the foliar diseases viz., *Alternaria* leaf blight, leaf spot, grey mildew and bacterial blight and recorded a maximum seed cotton yield of 23.10 q/ha. In the second experiment, the talc-based formulation of *P. fluorescens* was applied as seed treatment and foliar spray at different time intervals. The results revealed that seed treatment with *P. fluorescens* @ 10 g/kg + foliar spray @ 0.2 per cent on 50, 65, 80, 95, and 110 DAS gave better control of the foliar diseases and recorded higher seed cotton yield (21.8 q/ha) compared to chemical fungicide.

**Keywords:** bacterial blight, cotton, fungicides, leaf spot, *Pseudomonas fluorescens*

**Introduction**

Cotton, “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. India now produces around 333.00 lakh bales of cotton ranging from short staple to extra long staple from an area of 126 lakh hectares with productivity of 449 kg per hectare. In Tamil Nadu, the area under cotton cultivation is 1.85 lakh hectares with a production of 4.48 lakh bales and an average productivity of 448 kg per hectare (Anon., 2018)<sup>[1]</sup>.

However, the production potential of the crop has not been fully exploited due to several biotic and abiotic factors. The cotton crop is known to suffer from number of diseases caused by fungal, bacterial and viral diseases. Among the foliar diseases, *Alternaria* blight (*Alternaria macrospora*), grey mildew (*Ramularia areola*), leaf spot (*Cercospora gossypina*) and bacterial blight (*Xanthomonas axonopodis* pv. *malvacearum*) are the important ones and they cause the yield loss of 26-30 per cent (Chattannavar *et al.*, 2006; Hosagoudar *et al.*, 2008)<sup>[3, 6]</sup>. The use of fungicides and biocontrol agents has become inevitable in controlling the foliar diseases in the absence of suitable resistant cultivars. Thus, in the present study, the objective was formulated to investigate the effect of different fungicides and bioagent against major foliar diseases of *Bt* cotton under rainfed conditions.

**Materials and methods**

Field experiments were conducted at Cotton Research Station farm, Veppanthattai, Perambalur, Tamil Nadu, India during 2011-12 and 2012-13 under rainfed conditions in order to find out the suitable fungicide and the efficacy of talc-based formulation of bioagent *P. fluorescens* (TNAU-Pf1) for controlling the foliar diseases viz. *Alternaria* leaf blight, leaf spot, grey mildew and bacterial blight of *Bt* cotton. The talc-based formulation of TNAU-Pf1 was obtained from Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. The experiments were laid out in a randomized block design with three replications for experiment I, whereas four replications were maintained in experiment II. The *Bt* cotton hybrid RCH 2 BG II was used for both the experiments. The plot size of 20 m<sup>2</sup> with a spacing of 90 x 60 cm was maintained.

The treatments of the experiment I were T1- Propiconazole (0.1%), T2- Azoxystrobin (0.1%), T3- Difenconazole (0.1%), T4- Mancozeb (0.2%), T5- Carbendazim (0.1%), T6- Copper oxychloride (0.25%), T7- Copper oxychloride (0.25%)+Streptomycin sulphate (0.01%), T8- Propineb (0.1%), T9- Chlorothalonil (0.2%), T10- Tetraconazole (0.15%), T11- Tebuconazole (0.1%), T12- Pyraclostrobin + Metiram (0.05%) and T13- Untreated control. The fungicides were sprayed on 60, 90 and 120 days after sowing (DAS) by using ASPEE battery sprayer. The treatments of the experiment II were T1- Seed treatment (ST) with *P. fluorescens*

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(TNAU-Pf1) @ 10g/kg + Foliar spray of TNAU-Pf1 @ 0.2% on 50, 65, 80, 95, 110 DAS, T2- ST with TNAU-Pf1 @ 10g/kg + Foliar spray of TNAU-Pf1 @ 0.2% on 50, 70, 90, 110 DAS, T3- ST with TNAU-Pf1 @ 10g/kg + Foliar spray of TNAU-Pf1 @ 0.2% on 50, 80, 110 DAS, T4-Copper oxychloride @ 0.25% + Streptomycin sulphate @ 0.01% on 60, 90 and 120 DAS and T5- Untreated control.

The incidence of fungal (leaf blight, leaf spot and grey mildew) and bacterial (blight) diseases were recorded at different time intervals after each spray by using 0 - 4 scale (Sheo Raj, 1988) [8]. Finally, the grades were converted into per cent disease indices (PDI) by using the formula given by Wheeler (1969) [9].

$$\text{PDI} = \frac{\text{Sum of all numerical ratings}}{\text{Total no. of leaves graded}} \times \frac{100}{\text{Maximum grade}}$$

Seed cotton yield was also recorded in each plot and expressed as q/ha.

### Statistical analysis

The data were subjected to analysis of variance (ANOVA) using the IRRISTAT version 92-1 programme developed by the Biometrics Unit, International Rice Research Institute, The Philippines. Disease incidence data were arc-sine transformed before analysis. The treatment means were compared by Duncan's multiple range test (DMRT) (Gomez and Gomez, 1984) [5].

### Results and discussion

Studies on the assessment of fungicides against different foliar diseases of *Bt* cotton revealed that foliar application of propiconazole (0.1%) on 60, 90 and 120 DAS recorded only 2.94, 3.80 and 3.25 PDI of *Alternaria* leaf blight, leaf spot and grey mildew, respectively. Whereas, the plots treated with pyraclostrobin+metiram (0.05%) and copper oxychloride (0.25%) + streptomycin sulphate (0.01%) recorded a

minimum incidence of 3.00 and 3.47 PDI of bacterial blight, respectively. However in the untreated control plots, maximum incidence of 18.74, 31.73, 24.83 and 14.20 PDI of *Alternaria* blight, leaf spot, grey mildew and bacterial blight was observed, respectively.

The highest seed cotton yield of 23.1 and 22.8 q/ha was recorded in propiconazole and pyraclostrobin+metiram treated plots and were on par with each other followed by tebuconazole (22.1 q/ha), propineb (21.8 q/ha) and tetraconazole (21.6) (Table 1). Whereas, the plots treated with propiconazole (0.1%) registered highest BC ratio (4.95) compared to other treatments. Similarly, Hosagoudar and Chattannavar (2013) [4] reported that foliar spray of propiconazole (0.1%) significantly lowered disease index of *Alternaria* leaf spot and recorded the maximum seed cotton yield of 2721.27 kg/ha. However, reported that the higher dose of propineb 70 WP (0.4%) was found to be effective in controlling leaf spot and leaf blight in *Bt* cotton. In the second experiment, seed treatment with TNAU-Pf1 @ 10 g/kg seeds + foliar spray of TNAU-Pf1 @ 0.2 per cent on 50, 65, 80, 95 and 110 DAS recorded significantly low *Alternaria* blight (7.05 PDI), leaf spot (8.33 PDI), grey mildew (6.21 PDI) and bacterial blight (4.25 PDI) followed by seed treatment with TNAU-Pf1 @ 10 g/kg seeds + foliar spray of TNAU-Pf1 @ 0.2 per cent on 50, 70, 90 and 110 DAS. Copper oxychloride (0.25%) + streptomycin sulphate (0.01%) treated plots recorded 9.35, 12.31, 10.54, 3.47 PDI of *Alternaria* blight, leaf spot, grey mildew and bacterial blight, respectively. The maximum seed cotton yield (21.8 q/ha) was recorded in seed treatment with TNAU-Pf1 + foliar spray of TNAU-Pf1 on 50, 65, 80, 95, and 110 DAS with the BC ratio of 5.06 followed by seed treatment with TNAU-Pf1 + foliar spray of TNAU-Pf1 on 50, 70 90 and 110 DAS (20.15 q/ha; BC ratio 4.88 (Table 2). The results are in accordance with (Chattannavar and 2013) [4] and who reported that the treatment of *Pseudomonas fluorescens* gave better disease control of *Alternaria* blight, bacterial blight and grey mildew.

**Table 1:** Effect of different fungicides against foliar diseases of *Bt* cotton (Pooled mean of two seasons)

Treatments	PDI				Yield (q/ha)	CBR
	<i>Alternaria</i> blight	Leaf spot	Grey Mildew	Bacterial blight		
T1- Propiconazole (0.1%)	2.94 <sup>a</sup>	3.80 <sup>a</sup>	3.25 <sup>a</sup>	5.20 <sup>ab</sup>	23.1 <sup>a</sup>	4.95
T2- Azoxystrobin (0.1%)	4.83 <sup>b</sup>	8.08 <sup>c</sup>	7.86 <sup>cd</sup>	8.19 <sup>cd</sup>	21.4 <sup>c</sup>	4.02
T3- Difenconazole (0.1%)	7.49 <sup>c</sup>	8.08 <sup>c</sup>	8.37 <sup>d</sup>	8.15 <sup>cd</sup>	20.5 <sup>d</sup>	3.76
T4- Mancozeb (0.2%)	8.72 <sup>cd</sup>	12.47 <sup>e</sup>	10.80 <sup>ef</sup>	9.86 <sup>d</sup>	18.1 <sup>g</sup>	2.82
T5- Carbendazim (0.1%)	8.72 <sup>cd</sup>	10.52 <sup>d</sup>	10.74 <sup>ef</sup>	9.25 <sup>d</sup>	18.8 <sup>f</sup>	3.14
T6-Copper oxychloride (0.25%)	9.78 <sup>e</sup>	14.25 <sup>f</sup>	12.07 <sup>f</sup>	7.52 <sup>bc</sup>	18.2 <sup>g</sup>	2.97
T7- Copper oxychloride (0.25%) + Streptomycin sulphate (0.01%)	9.35 <sup>cd</sup>	12.31 <sup>e</sup>	10.54 <sup>ef</sup>	3.47 <sup>a</sup>	19.7 <sup>e</sup>	3.66
T8- Propineb (0.1%)	3.93 <sup>ab</sup>	6.93 <sup>b</sup>	7.44 <sup>cd</sup>	5.98 <sup>b</sup>	21.8 <sup>bc</sup>	3.92
T9- Chlorothalonil (0.2%)	11.84 <sup>f</sup>	15.28 <sup>f</sup>	10.97 <sup>ef</sup>	8.31 <sup>cd</sup>	17.1 <sup>h</sup>	2.80
T10- Tetraconazole (0.15%)	5.04 <sup>b</sup>	7.73 <sup>b</sup>	6.06 <sup>bc</sup>	5.54 <sup>b</sup>	21.6 <sup>c</sup>	3.72
T11-Tebuconazole (0.1%)	3.98 <sup>ab</sup>	4.29 <sup>a</sup>	5.32 <sup>b</sup>	6.60 <sup>bc</sup>	22.1 <sup>b</sup>	4.56
T12-Pyrclostrobin+Metiram (0.05%)	3.15 <sup>a</sup>	4.90 <sup>a</sup>	4.06 <sup>ab</sup>	3.33 <sup>a</sup>	22.8 <sup>a</sup>	4.58
T13- untreated control	18.74 <sup>g</sup>	31.73 <sup>g</sup>	24.83 <sup>g</sup>	14.20 <sup>e</sup>	13.3 <sup>i</sup>	-

Values are means of three replications. In a column, means followed by a common letter are not significantly different at 5% level by DMRTs

**Table 2:** Effect of talc-based formulation of *P. fluorescens* against foliar diseases of *Bt* cotton (Pooled mean of two seasons)

Treatments	PDI				Yield (q/ha)	CBR
	<i>Alternaria</i> blight	Leaf spot	Grey Mildew	Bacterial blight		
T1-Seed treatment TNAU-Pf1 @ 10g/kg + Foliar spray @ 0.2% on 50,65,80,95,110 DAS	7.05 <sup>a</sup>	8.33 <sup>a</sup>	6.21 <sup>a</sup>	4.25 <sup>a</sup>	21.8 <sup>a</sup>	5.06
T2-Seed treatment with TNAU-Pf1 @ 10g/kg + Foliar spray @ 0.2% on 50,70,90,110 DAS	9.03 <sup>b</sup>	10.98 <sup>b</sup>	8.97 <sup>b</sup>	6.39 <sup>b</sup>	20.2 <sup>b</sup>	4.88
T3-Seed treatment with TNAU-Pf1 @ 10g/kg + Foliar spray @ 0.2% on 50, 80, 110 DAS	11.76 <sup>c</sup>	14.13 <sup>d</sup>	11.20 <sup>c</sup>	8.67 <sup>c</sup>	18.0 <sup>d</sup>	4.59
T4-Copper oxychloride (0.25%) + Streptomycin sulphate (0.01%) on 60, 90, 120 DAS	9.35 <sup>b</sup>	12.31 <sup>c</sup>	10.54 <sup>c</sup>	3.47 <sup>a</sup>	19.7 <sup>c</sup>	3.66
T5- Untreated control	18.74 <sup>d</sup>	31.73 <sup>d</sup>	24.83 <sup>d</sup>	14.20 <sup>d</sup>	13.3 <sup>e</sup>	-

DAS - Days after sowing

Values are means of four replications. In a column, means followed by a common letter are not significantly different at 5% level by DMRTs

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