

Management of bacterial blight of cotton caused by *Xanthomonas axonopodis* pv. *malvacearum*

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ABSTRACT : An experiment was carried out to see the efficacy of different chemicals and bioagents against bacterial blight disease severity (PDI) and disease incidence (PI). Significantly low disease severity and low disease incidence was recorded in treatment T₄ i.e. copper oxychloride (0.25 %) + streptomycin (100 ppm) sprays to the tune of 11.83 per cent (PDI) and 19.36 per cent (PI), respectively as against the unsprayed control 27.56 per cent and 45.51 per cent, respectively and obtained significantly higher seed cotton yield 2567.33 kg/ha followed by carbendazim (0.1 %) + streptomycin (100 ppm). Amongst the antagonist tested *Trichoderma hamatum* was significantly superior in per cent reduction of mycelia colony dia (mm) of pathogen at all the incubation periods tested followed by *T. harzianum* and *P. fluorescens*. Per cent reduction in colony dia (mm) of the pathogen after 3, 6 and 9 days of incubation in *T. hamatum* was noticed to the tune of 50.94, 48.03 and 44.12 per cent, respectively.

Key words: Bioagents, chemicals, *Gossypium* spp, management, *Xanthomonas axonopodis* pv. *malvacearum*

Amongst the several factors responsible for reduction in yield and quality deterioration of cotton in India, diseases occupies a vital place. Bacterial blight of cotton caused by *Xanthomonas axonopodis* pv. *malvacearum* is one of the serious diseases of cotton. It is recorded in almost every country in the world which grows cotton. In India, estimates of losses are often upto 30 per cent (Patil *et al.*, 2003). Considering the importance of the disease in cotton cultivation, different measures like use of chemicals and bio agents have been advocated in past for the management of this disease.

MATERIALS AND METHODS

Management of disease with chemicals

: A field experiment was carried out to study efficacy of different antibacterial pesticides against bacterial blight of cotton with 8 treatments in randomized block design (RBD) with variety Bunny Bt (NCS145) including control. First spray was undertaken after disease initiation and subsequent sprays were given at an interval of 15 days. Observations on disease incidence and severity were recorded at 30, 60, 90 and 120 DAS and also seed cotton yield.

Efficacy of bioagents :

The antagonistic

potential of *Trichoderma* spp was assessed against *Xanthomonas axonopodis* pv. *malvacearum* by dual culture technique on yeast glucose chalk agar medium as per procedure. For this 20 ml of sterilized and luke warm medium of chalk agar was poured in each petriplate and allowed to solidify. With the help of sterile inoculating needle streak the bacterial culture on half side of petriplates and other side *Trichoderma* spp were inoculated. Control was maintained simultaneously. The petriplates were observations on colony radius was recorded at 3, 6, 9 days after inoculation by incubating at 27 + 2°C).

Efficacy of chemicals : Solutions of desired conc of chemicals and their combination were prepared in a sterile distilled water. Discs of 5 mm dia were cut from Whatman filter paper No1 and sterilized. Those were then saturated with the solution. Excess solution was drained off by touching the discs inside dry surface of plate holding the solution and then placed on the agar surface of inoculated plate. Seven discs of each chemical were incubated at 27°C+2°C for 72 h. Dia zone of inhibition was measured. The observations on growth parameters were also used for statistical analysis.

RESULTS AND DISCUSSION

Management of disease with chemicals

: A field experiment had 8 spray treatments which included 6 chemical, 1 biological and 1 water spray (control). In all 8 treatments sprays starting from disease initiation were applied and subsequent sprays at an interval of 15 days were given and observation on disease incidence and disease severity were recorded at 30, 60, 90 and 120 DAS.

Disease incidence (DI) : Data on disease incidence is presented in Table 1. Results on disease incidence were significant at 30, 60, 90 and 120 DAS. All treatments recorded significantly low disease incidence over control. Mean per cent disease incidence ranged from 19.36 to 45.51 per cent. Disease incidence after 30 DAS was found significant over control and ranged from 16.93 to 23.27 per cent against 26.43 per cent in control. T_4 was significantly superior over rest of the treatments. Minimum disease incidence 16.93 per cent was observed in T_4 which was *at par* with carbendazim (80.1 %) + streptocycline (100 ppm) (17.76 %) and carbendazim (0.1 %) (17.41%). Disease incidence after 60 DAS was found significant over control and ranged from 21.80 to 40.47 per cent as against 49.11 per cent in control. The minimum disease incidence 21.80 per cent was found in copper oxychloride (0.25 %) + agrimycin (100 ppm) followed by carbendazim (0.1 %) + streptocycline (100 ppm) (27.25%) and copper oxychloride (0.25 %) + streptocycline (100 ppm) (28.97%).

At 90 DAS disease incidence was found significant over control and ranged from 16.52 to 30.97 per cent as against 52.32 per cent in control. T_4 was significantly superior over rest of the treatments. Minimum disease incidence 16.52 per cent was observed in T_4 followed by carbendazim (0.1 %) + streptocycline (100 ppm) (20.15%) and copper oxychloride (0.25 %) + agrimycin (100 ppm) (23.90%). At 120 DAS, disease incidence was found significant over control and ranged from 15.04 to 27.47 per cent as against 54.18 per cent in control. The minimum disease incidence 15.04 per cent was found in fungicide copper oxychloride 0.25 per cent + streptocycline (100 ppm) followed by carbendazim (0.1 %) + streptocycline (100 ppm)

(18.33%), copper oxychloride (0.25 %) + agrimycin (100 ppm) (20.92%) and carbendazim (0.1 %) (23.84%).

Disease severity (PDI) : Data on disease severity is presented in Table 1. The results on disease severity were significant over control at 30, 60, 90 and 120 DAS. Mean PDI severity ranged from 11.83 to 27.56 per cent. Disease severity after 30 DAS was found significant over control and ranged from 10.25 to 13.20 per cent as against 16.00 per cent in control. T_4 was found significantly superior over rest of the treatments. Minimum PDI 10.25 per cent was observed in T_4 and which was *at par* with carbendazim (0.1 %) + streptocycline (100 ppm) (10.75%) and carbendazim (0.1 %) (10.54%). Disease severity after 60 DAS was found significant over control and ranged from 16.50 to 24.50 per cent. The minimum disease intensity or severity 16.50 per cent was found in carbendazim (0.1 %) + streptocycline (100 ppm) followed by copper oxychloride (0.25 %) + streptocycline (100 ppm) (17.54%), carbendazim (0.1 %) (18.73%) and copper oxychloride (0.25 %) + agrimycin (100 ppm) (19.25%).

At 90 DAS disease severity was found significant over control and ranged from 10.00 to 18.75 per cent as against 31.34 per cent in control. T_4 was found significantly superior over rest of the treatments. Minimum disease severity (10 %) was observed in T_4 treatment followed by carbendazim (0.1 %) + streptocycline (100 ppm) (12.20 per cent), copper oxychloride (0.25 %) + agrimycin (100 ppm) (14.47%) and carbendazim (0.1 %) (16.25 %). At 120 DAS, disease severity was found significant over control and ranged from 8.35 to 13.15 per cent as against 33.19 per cent in control. The minimum disease severity 8.35 per cent was found in T_5 followed by copper oxychloride (0.25 %) + streptocycline (100 ppm) (9.55%), carbendazim (0.1 %) (9.75%) and streptocycline (100 ppm) (11.22%).

Data on per cent disease control is presented in Table 2. Data clearly indicated that disease control after each spray was significantly influenced. Per cent disease control after first and second spraying was ranged from 4.37 to 35.93 and 40.17 to 68.09 per cent, respectively. After third spraying maximum disease control

Table 1. Effect of different treatments on bacterial blight incidence of cotton

Tr.Treatments No.	Per cent disease incidence and intensity (DAS)								Mean		Seed cotton yield (kg/ha)
	30		60		90		120		DI	PDI	
	DI	PDI	DI	PDI	DI	PDI	DI	PDI			
T₁ Carbendazim (Bavistin, 0.1 %)	17.41 (24.64)	10.54 (18.79)	30.94 (33.77)	18.73 (25.62)	26.84 (31.19)	16.25 (23.74)	23.84 (29.21)	9.75 (18.13)	24.76 (29.70)	13.81 (21.57)	2070
T₂ Copper oxychloride (Blue copper, 0.25 %)	23.12 (28.72)	14.00 (21.94)	37.04 (37.48)	22.42 (28.25)	30.15 (33.29)	18.25 (25.27)	27.68 (31.73)	12.25 (20.46)	29.50 (32.80)	16.73 (23.98)	1610
T₃ Streptocycline (100 ppm)	21.80 (27.79)	13.2 (21.29)	40.47 (39.50)	24.50 (29.60)	33.04 (35.07)	20.00 (26.54)	31.74 (34.28)	11.22 (19.52)	31.76 (34.16)	17.23 (24.23)	1517
T₄ Copper oxychloride (0.25 %) + Streptocycline 100 ppm)	16.93 (24.25)	10.25 (18.64)	28.97 (32.55)	17.54 (24.74)	16.52 (23.96)	10.00 (18.35)	15.04 (22.80)	9.55 (17.95)	19.36 (25.89)	11.83 (19.92)	2567
T₅ Carbendazim (0.1 %) + Streptocycline 100 ppm)	17.76 (24.90)	10.75 (19.07)	27.25 (31.45)	16.50 (23.92)	20.15 (26.64)	12.20 (20.40)	18.33 (25.34)	8.35 (16.76)	20.87 (27.07)	11.95 (29.04)	2456
T₆ Copper oxychloride (0.25 %) + Agrimycin 100 ppm)	23.27 (28.82)	14.09 (22.03)	21.80 (27.81)	19.25 (26.01)	23.90 (29.24)	14.47 (22.32)	20.92 (27.21)	11.27 (19.56)	22.47 (28.27)	14.77 (22.48)	2030
T₇ <i>Pseudomonas fluorescens</i> (0.2 %)	25.38 (30.23)	15.30 (23.01)	48.24 (43.98)	29.20 (32.68)	30.97 (33.80)	18.75 (25.63)	27.47 (31.60)	13.15 (21.24)	33.01 (34.90)	19.25 (25.64)	1456
T₈ Control (Water spray)	26.43 (30.92)	16.00 (23.56)	49.11 (44.48)	29.73 (33.02)	52.32 (46.32)	31.34 (34.01)	54.18 (47.39)	33.19 (35.16)	45.51 (42.27)	27.56 (31.48)	1181
SE + P=0.05	0.59 1.78	0.76 2.31	0.73 2.22	0.6 1.84	0.72 2.18	1.06 3.22	0.34 1.04	0.73 2.23			134 406

DI= Disease incidence; PDI = Per cent disease intensity; DAS = Days after sowing

was recorded in copper oxychloride (0.25 %) + streptomycin (100 ppm) to the tune of 74.84 per cent Disease severity after 60 DAS was found significant over control and ranged from 16.50 to 24.50 per cent. The minimum disease intensity or severity 16.50 per cent followed by carbendazim (0.1 %) + streptomycin (100 ppm) (71.22 %) and carbendazim (0.1 %) (70.62 %). Mean disease control (Table 2) achieved with all the treatments ranged from 34.97 to 59.62 per cent. The highest mean disease control of 59.62 per cent recorded in copper oxychloride (0.25 %) + streptomycin (100 ppm). The second and third best fungicides were carbendazim (0.1 %) + streptomycin (100 ppm) (55.03 %) and carbendazim (0.1 %) (50.96 %).

Results obtained in respect of the efficacy of fungicides and bactericides in effectively controlling the disease are in conformity with earlier workers *i.e.* Islam *et al.*, (2003) and Hosagoudar and Chattannavar (2008).

Seed cotton yield : Data on seed cotton yield is presented in Table 1. Result of different chemical treatment on the seed cotton yield was found significant over control and ranged from 2567 to 1456 kg/ha as against 1181 kg/ha seed cotton yield in control.

T₄ found significantly superior over rest of the treatments. Maximum seed cotton yield 2567 kg/ha was observed in T₄ followed by carbendazim (0.1 %) + streptomycin (100 ppm) 92456 kg/ha, carbendazim (0.1 %) (2070 kg/ha) and copper oxychloride (0.25 %) + agrimycin (100 ppm) (2030 kg/ha).

Mean per cent disease intensity found significant over control (27.56 %). The lowest mean per cent disease severity 11.83 per cent was observed in T₄ followed by carbendazim (0.1 %) + streptomycin (100 ppm) (11.95%), carbendazim (0.1 %) (13.81%) and copper oxychloride 0.25% + agrimycin (100 ppm) (14.77%). Mean per cent disease incidence found significant over control (45.51 per cent). The lowest mean per cent disease incidence 19.36 per cent was observed in T₄ followed by carbendazim (0.1 %) + streptomycin (100 ppm) (20.87%) and copper oxychloride (0.25 %) + agrimycin (100 ppm) (22.47%).

Results obtained in respect of the efficacy of chemicals in effectively controlling the

disease and increasing seed cotton yield are in conformity with those reported earlier in cotton by Mishra *et al.*, (2001).

Management of disease bioagents *in vitro* : Five different species of *Trichoderma viz.*, *Trichoderma viride*, *T. hamatum*, *T. harzianum*, *T. lignorum*, *T. koningii* and one bacterial origin bioagent *i.e.* *P. fluorescens* were tested as biological agents for the *bacterial blight* control *pv. malvacearum*. The effect of bioagents tested by dual culture technique are given in Table 3.

The mycelial growth of the pathogen and antagonist was recorded at 3, 6 and 9 days of incubation and per cent reduction in colony dia (mm) of pathogen over control was calculated. At 3 days of incubation all the species of *Trichoderma* except *T. viride* and *T. lignorum* reduced the growth of *X. axonopodis pv. malvacearum* over control. The maximum reduction of the pathogen was observed with *T. hamatum* (50.94%) followed by *T. harzianum* (33.58%) and *P. fluorescens* (33.52%). Amongst antagonists maximum growth was observed with *T. harzianum* (28.07 mm) followed by *P. fluorescens* (25.79 mm) and *T. hamatum* (23.57 mm).

At 6 days of incubation all the species of *Trichoderma* except *T. lignorum* reduced the growth of pathogen over control. The maximum reduction of the pathogen was observed with *T. hamatum* (48.03%) followed by *T. harzianum* (40.39%) and *P. fluorescens* (43.72%). Amongst antagonists maximum growth was observed with *T. hamatum* (55.85 mm) followed by *P. fluorescens* (50.60 mm) and *T. harzianum* (49.70 mm). At 9 days of incubation all the species of *Trichoderma* reduced the growth of pathogen over control. The maximum reduction of the pathogen was observed with *T. hamatum* (44.12%) followed by *T. harzianum* (41.70%) and *P. fluorescens* (41.02 per cent). Amongst the antagonists maximum growth was observed with *T. hamatum* (60.73 mm) followed by *P. fluorescens* (58.85 mm) and *T. harzianum* (56.91 mm). Considering the per cent reduction of colony dia (mm) of the pathogen over control after 3, 6 and 9 days incubation period (Table 3) *T. hamatum* was found best followed by *T. harzianum* and *P. fluorescens*. Results obtained in respect of efficacy of bioagent in effectively inhibiting the *Xanthomonas* are in conformity with those reported earlier by Arya and Prashar

Table 2. Effect of different treatments on disease intensity

Tr. No.	Treatment details	PDI after spraying			Mean PDI	PDC after spraying			Mean PDC
		I	II	III		I	II	III	
T ₁	Carbendazim (Bavistin, 0.1 %)	10.54 (18.79)	16.25 (23.74)	9.75 (18.13)	12.18	34.12	48.14	70.62	50.96
T ₂	Copper oxychloride (Blue copper, 0.25 %)	14.00 (21.94)	18.25 (25.27)	12.25 (20.46)	14.83	12.50	41.76	63.09	39.11
T ₃	Streptocycline 100 ppm	13.2 (21.29)	20.00 (26.54)	11.22 (19.52)	14.80	17.50	36.18	66.19	39.95
T ₄	Copper oxychloride (0.25%) + Streptocycline 100 ppm)	10.25 (18.64)	10.00 (18.35)	9.55 (17.95)	9.93	35.93	68.09	74.84	59.62
T ₅	Carbendazim (0.1 %) + Streptocycline 100 ppm)	10.75 (19.07)	12.20 (20.40)	8.35 (16.76)	10.43	32.81	61.07	71.22	55.03
T ₆	Copper oxychloride (0.25%) + Agrimycin 100 ppm)	14.09 (22.03)	14.47 (22.32)	11.27 (19.56)	13.27	11.93	53.82	66.04	43.93
T ₇	<i>Psuedomonas fluorescens</i> (0.2 %)	15.30 (23.01)	18.75 (25.63)	13.15 (21.24)	15.73	4.37	40.17	60.37	34.97
T ₈	Control (Water spray)	16.00 (23.56)	31.34 (34.01)	33.19 (35.16)	26.84				
	SE +	0.76	1.06	0.73					
	P=0.05	2.31	3.22	2.23					

Table 3. Mean colony dia (mm) and reduction in colony dia of pathogen and antagonist per cent at 3, 6 and 9 days

Sr. No.	Antagonists	Mean colony dia (mm) at 3 days		Reduction in colony dia over control (%)	Mean colony dia (mm) at 6 days		Reduction in colony dia over control (%)	Mean colony dia (mm) at 9 days		Reduction in colony dia over control (%)
		Pathogen	Antagonist		Pathogen	Antagonist		Pathogen	Antagonist	
T ₁	<i>T. viride</i>	16.93	13.51	-6.28	30.56	18.01	21.5	35.67	50.93	16.28
T ₂	<i>T. hamatum</i>	7.8	23.57	50.94	20.23	55.85	48.03	23.81	60.73	44.12
T ₃	<i>T. harzianum</i>	10.56	28.07	33.58	20.87	49.7	46.39	24.84	56.91	41.7
T ₄	<i>T. lignorum</i>	19.53	11.94	-22.83	40.56	34.21	-4.19	41.95	43.67	1.55
T ₅	<i>T. koningii</i>	12.57	19.94	20.94	27.2	31.61	30.13	30.78	54.82	27.76
T ₆	<i>P. fluorescens</i>	10.57	25.79	33.52	21.91	50.6	43.72	25.13	58.85	41.02
T ₇	Control	15.9	—	—	38.93	—	—	42.61	—	—
	SE +	0.75	0.71		1.05	0.78		0.53	0.78	
	P=0.05	2.24	2.11		3.13	2.34		1.59	0.33	
	CV (%)	11.29	6.73		7.38	3.78		3.34	2.88	

Table 4. Efficacy of different treatments against *Xanthomonas axonopodis* pv. *malvacearum*

Sr. No.	Mean inhibition zone (mm)	Growth of pathogen (mm)	Per cent inhibition
T ₁	25.00	75.00	16.66
T ₂	10.00	80.00	11.11
T ₃	11.00	79.00	12.22
T ₄	18.33	71.00	20.36
T ₅	15.00	75.00	16.66
T ₆	14.33	75.00	15.92
T ₇	14.00	76.00	15.55
T ₈	—	90.00	—
SE +		0.378	
P=0.05	—	1.172	—

et al., (2002) and Patil *et al.*, (2003).

Efficacy of different chemicals : Efficacy of different chemicals *in vitro* was evaluated against *Xanthomonas axonopodis* pv. *malvacearum*. The data from Table 4 clearly showed that the maximum mean inhibition was in the treatment T₄ (18.33 mm) and T₁ were *at par* to each other (15.00 mm). It was followed by T₆ (14.33 mm), T₇ (14.00 mm). The minimum mean inhibition zone was found in T₂ (10 mm). The maximum per cent inhibition was found in T₄ (20.36 %) and the minimum per cent inhibition was found in the T₂ (0.25 %). The results in the present investigation are agreement with those reported in the past.

REFERENCES

- Arya, Sanjay and Parashar, R.D. 2002.** Biological control of cotton bacterial blight with phyloplane bacterial antagonists. *Tropical Agri.*, **79** : 51-55.
- Hosgoudar, G. N. and Chattannovar, S.N. 2008.** Chemical and biological control of foliar diseases of cotton. *J. Cotton Res. Dev.* **22** : 225-28.
- Islam, M.Z., Khalequzzaman, K.M., Rahman, G.M.M., Islam, M.T. and Hosain, M.M. 2003.** Effect of chemicals in controlling bacterial blight of cotton. *Asian J. Plant Sci.* **2** : 539-43.
- Mishra, S.P. and Krishna, A. 2001.** Assessment of yield losses due to bacterial blight in cotton. *J. Mycol. Pl. Pathol.*, **31** : 232-33.
- Patil, P.V., Patel, J. R. and Patel, U.G. 2003.** Assessment of avoidable yield losses caused by bacterial blight in G. cotton Hy 10 cotton and its parents. *J. cotton Res. Dev.*, **17** : 45-47.

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