

Biological management of major foliar diseases of cotton

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ABSTRACT : Result revealed that, the biological agent significantly reduced foliar disease of cotton as compared to untreated control under field conditions. The minimum of 8.28 per cent *Alternaria* leaf spot, 5.86 per cent bacterial leaf blight and 2.06 per cent grey mildew disease with maximum seed cotton yield of 1379 kg/ha was recorded in T₂=seed treatment with *P. fluorescens* Pf1 @ 10 g/kg seed + foliar spray (0.2 %) on 30, 50, 70 and 90 Days after sowing (DAS), followed by T₁=seed treatment with *P. fluorescens* Pf1 @ 10 g/kg seed + foliar spray (0.2 %) on 30, 40, 50, 60, 70, 80 and 90 DAS and T₃=seed treatment with *P. fluorescens* Pf1 @ 10 g/kg seed + foliar spray @ (0.2 %) on 30, 60 and 90 DAS with 1357 and 1294 kg/ha seed cotton yield, respectively. Highest B:C ratio of 7.51 was also obtained in biological agent treatment i.e. T₂=seed treatment with *P. fluorescens* Pf1 @ 10 g/kg seed + foliar spray @ (0.2 %) on 30, 50, 70 and 90 DAS. The *Alternaria* leaf spot, bacterial leaf spot and grey mildew in control were 12.78, 8.03 and 6.01 per cent, respectively with seed cotton yield of 1102 kg/ha.

Key words: Biological agent, disease grade, foliar disease, management, per cent disease index

Cotton or “White Gold” is an important commercial cash crop of India. It plays a key role in national economy in terms of activities, employment and foreign exchange earning. However, the production potential of the crop has not fully exploited due to several biotic and abiotic factors. The crop suffers from many fungal foliar diseases like *Alternaria* leaf spot, bacterial leaf blight and grey mildew of cotton caused by *Alternaria macrospora* Zimm, *Xanthomonas axonopodis* pv. *malvacearum*-Xam (E. F. Smith) and *Ramularia areola* Atk., respectively. In view of exploring non chemical and low-cost technologies, biocontrol agent, *P. fluorescens* was tested for its efficacy against foliar disease on cotton.

MATERIALS AND METHODS

Experiment was carried out under All India Coordinated Cotton Improvement Project at Regional Cotton Research Station, Junagadh Agricultural University, Junagadh 2006-2007, to and 2008-2009. G. Cot. Hy 10 variety was selected for the experiment.

Five plants were randomly selected in each treatment; 20 leaves were observed i.e. 7 each from bottom and middle and six from top of

the each plant. Disease grading was done using 0 - 4 scale (Sheoraj, 1988) of cotton foliar disease. The per cent disease index (PDI) was calculated by following formula.

$$\text{PDI} = \frac{\text{Sum of all numerical grades}}{\text{No. of leaves assessed} \times \text{Maximum grade i.e. 4}} \times 100$$

The following frequency of sprays was carried out viz., T₁=seed treatment with *P. fluorescens* Pf 1 @ 10 g/kg seed + foliar spray (0.2 %) on 30, 40, 50, 60, 70, 80 and 90 (DAS); T₂=seed treatment with *P. fluorescens* Pf 1 @ 10 g/kg seed + foliar spray (0.2 %) on 30, 50, 70, and 90 DAS; T₃=seed treatment with *P. fluorescens* Pf 1 @ 10 g/kg seed + foliar spray (0.2 %) on 30, 60, and 90 DAS; T₄=spraying of copper oxychloride (0.3 %) + streptomycin (100 ppm) and T₅=untreated control. The randomized block design with 4 replication in 6.30 x 4.80 m, plot size at 1.20 x 0.45 m spacing were adopted. As per schedule, foliar application of respective treatment was applied. The periodical observations of *Alternaria* leaf spot, bacterial leaf blight and grey mildew were recorded and data was statistically analysed.

RESULTS AND DISCUSSION

Alternaria leaf spot : Result presented in Table 1 revealed that the significantly minimum of 8.60 per cent Alternaria leaf spot disease was recorded in T₁ followed by T₂ during 2006-2007. Maximum of 12.36 per cent Alternaria disease was recorded in untreated control. During 2007-2008 significantly lowest (6.13 %) Alternaria leaf spot disease was recorded in T₁ followed in T₂ and T₃ with 6.25 and 6.73 per cent disease intensity, respectively. It remained *at par* with each other. Highest Alternaria leaf spot disease was recorded in untreated control *i.e.* (10.74%). Significantly minimum disease intensity (10.11%) with Alternaria leaf spot was recorded in T₂ during 2008-2009. It was followed by T₃ and T₁ with 11.58 and 11.83 per cent disease, respectively. Maximum of 15.46 per cent disease was noted in untreated control. Looking to the 3 year pooled data for the disease indicated that the significantly minimum disease (8.28%) was noted in T₂ followed by T₁ and T₃ with disease intensity of 8.70 and 9.51 per cent, respectively. It was found *at par* with each other. Highest PDI was observed in control (12.78%). Similarly, the seed treatment with *P. fluorescens* CHAOS@ 10g/kg followed by foliar spray @ 0.2 per cent significantly reduced the disease (37.61 %) with 30.05 and 61.6 per cent increase in the yield during consecutive years(2003-2004 and 2004-2005) as recorded by Bhattiprolu and Prasada Rao (2009).

Bacterial leaf blight : Significantly minimum of 13.0 per cent disease intensity was recorded in T₂ during 2006-2007, followed by T₂₁ and T₃ with 13.47 and 13.99 PDI, respectively (Table 1). While the maximum PDI was found in control (15.72). Significantly minimum 5.72 per cent disease intensity was recorded in T₁ in 2007-2008, followed by T₄, T₃ and T₂ with 5.90, 6.38 and 6.85 PDI, respectively. All treatments remained *at par* with each other. The maximum (10.11 %) PDI was noted in control. Result revealed that all treatments were found non significant in year 2008-2009. However,

numerically minimum (0.83%) disease was recorded in T₄. Next effective treatment (1.08) was T₂. The highest PDI was noted in control (1.84%). Looking to the pooled data of disease significantly minimum (5.78 %) PDI was obtained in T₄ followed by T₁, T₂ and T₃. All treatments except control were found *at par* with each other, whereas control recorded maximum PDI (8.03 %). Eddin *et al.*, (2007) studied talc based powder formulation of *P. fluorescens*, as seed treatment and foliar spray to test their efficacy in controlling bacterial leaf blight under greenhouse conditions and found the wet seed treatment of *P. fluorescens* Pf 1 as best.

Grey mildew: The individual year data of grey mildew was found statistically significant but quite low (Table 2). Maximum (8.07) in control (2006-2007), while, it was found very low in some treatments during 2007-2008 and 2008-2009, respectively. The three years pooled data revealed significant differences among the treatments. Minimum (2.06 %) PDI was noted in T₂ (2.12 %), T₃(2.44 %) and T₃ (2.54 %) as against control (6.01 %). Although, all spray schedule of biological agents and chemical remain *at par* with each other.

Seed cotton yield:The significantly higher yield of 1522 kg/ha was obtained in T₂ in 2006-2007, followed by T₃ and T₁ (Table 2). In year 2007-2008 significantly maximum yield of 1508 kg/ha was recorded in T₁ followed by T₂ and T₄ which remained *at par* with each other. Minimum (1202 kg/ha) yield was recorded in control.

In 2008-2009 significantly maximum yield of 1253 kg/ha was recorded in T₂ followed by T₁ and T₄. Except later treatment previous 3 remained *at par* with each other. Minimum (957 kg/ha) yield was recorded in control.

The 3 year pooled data revealed that, significantly maximum seed cotton yield of 1379 kg/ha was recorded in T₂ followed by T₁ and T₃ with 1357 and 1294 kg/ha seed cotton yield, respectively. Minimum seed cotton yield of 1102 kg/ha was recorded in control. All the treatments

Table 1. Effect of different biological agent on seed treatment with spray schedules and chemical on foliar diseases of cotton

Treatments	Per cent disease intensity											
	Alternaria leaf spot				Bacterial leaf blight				Grey mildew			
	2006- 2007	2007- 2008	2008- 2009	Pooled	2006- 2007	2007- 2008	2008- 2009	Pooled	2006- 2007	2007- 2008	2008- 2009	Pooled
T₁	8.60 (2.93)*	6.13 -2.48	11.83 -3.44	8.70 -2.95	13.47 -3.67	5.72 -2.39	1.34 -1.16	5.79 -2.41	5.11 (2.26)*	0.13 -0.36	3.07 -1.75	2.12 -1.46
T₂	8.73 -2.96	6.25 -2.50	10.11 -3.18	8.28 -2.88	13.00 -3.61	6.85 -2.62	1.08 -1.04	5.86 -2.42	4.97 -2.23	0.35 -0.59	2.21 -1.49	2.06 -1.44
T₃	10.58 -3.25	6.73 -2.60	11.58 -3.40	9.51 -3.08	13.99 -3.74	6.38 -2.53	1.19 -1.09	6.01 -2.45	5.48 -2.34	0.30 -0.55	3.22 -1.80	2.44 -1.56
T₄	10.97 -3.31	7.37 -2.72	12.23 -3.50	10.08 (3.18)	14.98 -3.87	5.90 -2.43	0.83 -0.91	5.78 -2.40	3.99 -2.00	1.47 -1.21	2.46 -1.57	2.54 -1.59
T₅	12.36 -3.52	10.74 -3.28	15.46 -3.93	12.78 -3.58	15.72 -3.97	10.11 -3.18	1.84 -1.36	8.03 -2.83	8.07 -2.84	5.50 -2.35	4.71 -2.17	6.01 -2.45
S.Em.+	0.1	0.06	0.09	0.06	0.08	0.10	0.11	0.09	0.14	0.22	0.11	0.22
C.D. (p=0.05)	0.32	0.19	0.27	0.20	0.24	0.31	NS	0.29	0.44	0.69	0.33	0.71
C.V. (%)	6.49	4.55	5	3.94	4.09	7.62	19.67	6.84	12.28	44.39	12.32	16.92
Year												
S.Em. +	-	-	-	-0.028	-	-	-	-0.038	-	-	-	-0.06
C.D. (p=0.05)	-	-	-	-0.079	-	-	-	-0.11	-	-	-	-0.18
Year x Treatment												
S.Em. +	-	-	-	-0.062	-	-	-	-0.086	-	-	-	-0.14
C.D. (p=0.05)	-	-	-	-0.177	-	-	-	-0.246	-	-	-	-0.41

ALS-Alternaria leaf spot

BLB - Bacterial leaf blight

*Figures in parentheses indicate square root transform values

Table 2. Effect of different biological agent with seed treatment and spray schedules on seed cotton yield and economics

Treatments	Seed cotton yield (kg/ha)			Pooled	Net return (Rs)	CBR
	2006-2007	2007-2008	2008-2009			
T₁	1439	1508	1123	1357	5671	4.79
T₂	1522	1361	1253	1379	6747	7.51
T₃	1486	1262	1136	1294	4532	6.2
T₄	1378	1333	1033	1248	1566	1.61
T₅	1146	1202	957	1102	-	-
S.Em. +	75.16	61.7	61.61	38.37	-	-
C.D. (p=0.05)	231.61	190.13	189.85	110.15	-	-
C.V. (%)	10.78	9.26	11.2	10.42	-	-
Year						
S.Em. +	-	-	-	29.72	-	-
C.D. (p=0.05)	-	-	-	85.32	-	-
Year x Treatment						
S.Em. +	-	-	-	66.46	-	-
C.D. (p=0.05)	-	-	-	NS	-	-

GM - Gray mildew

*Figures in parentheses indicate square root transform values

gave significantly higher yield as compared to control. The present findings are in accordance with the results of Bhattiprolu and Prasada Rao (2009).

Looking to the B:C ratio, all the *P. fluorescens* treatment showed higher net increase in income with maximum (7.51) B:C ratio in T₂ followed by T₃ and T₁ with B:C ratio of 6.20 and 4.79, respectively (Table 2). These results are in confirmatory with Singh and Singh (2007) and Chattannavar *et al.*, (2013).

The ability of *P. fluorescens* to control bacterial as well as fungal pathogens in cotton makes it an ideal component in integrated disease management. All spray schedule of biological agents effectively reduced foliar diseases with higher seed cotton yield and B:C ratio.

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