

Efficacy of *Pseudomonas fluorescens* against bacterial blight and leaf spot diseases of cotton (*Gossypium hirsutum*)

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Received: 22 June 2009; Accepted: 29 December 2009

ABSTRACT

An experiment was conducted during rainy (*kharif*) season of 2006 – 09 to study the efficacy of *Pseudomonas fluorescens* against foliar diseases of cotton (*Gossypium hirsutum* L.). Pooled data of 3 years showed that seed treatment with *P. fluorescens* Pf 1 @ 10 g/kg seed and foliar spray @ 0.2% at 30, 40, 50, 60, 70, 80 and 90 days after sowing gave maximum control of bacterial blight (40.25%), Alternaria leaf spot (35.16%), Helminthosporium leaf spot (50.50%) and Myrothecium leaf spot (45.37%) and recorded maximum yield of 1.46 tonnes/ha against 1.19 tonnes/ha in control. Highest benefit:cost ratio of 1.92 was obtained with seed treatment with *P. fluorescens* Pf 1 @ 10 g/kg seed + 7 foliar sprays @ 0.2% at 30, 40, 50, 60, 70, 80 and 90 days after sowing and seed treatment with *P. fluorescens* Pf 1 @ 10 g/kg seed + 5 foliar sprays @ 0.2% at 30, 50, 70 and 90 days after sowing recorded 1.87 benefit:cost ratio as against 1.66 in 7 water sprays. Seed treatment with *P. fluorescens* Pf 1, followed by 0.2% foliar spray of the same at 10 days interval starting from 30 days after sowing is cost effective in managing important foliar diseases, viz bacterial blight and leaf spots caused by *Alternaria*, *Helminthosporium* and *Myrothecium*.

Key words: Bacterial blight, Cotton, Leaf spots, *Pseudomonas fluorescens*

Cotton (*Gossypium hirsutum* L.) is the most important commercial crop in Andhra Pradesh being cultivated in 13.45 lakh ha producing 53 lakh bales with a productivity of 670 kg/ha (AICRP 2009). Among the diseases affecting cotton crop, foliar diseases including bacterial blight and leaf spots cause yield losses to the tune of 20 to 30%. Mixed sprays with copper oxychloride and streptomycin were highly effective against leaf spots as well as bacterial blight (Mayee and Mukewar 2007). In promoting eco-friendly and cost-effective plant protection methods, efficacy of biocontrol agent, *Pseudomonas fluorescens* was tested during the present investigation against cotton foliar diseases including bacterial blight and leaf spots caused by *Alternaria*, *Helminthosporium* and *Myrothecium*.

MATERIALS AND METHODS

A field trial was conducted during rainy (*kharif*) seasons of 2006–09 at Regional Agricultural Research Station, Lam, Guntur. 'NA 1325' cotton was sown adopting a spacing of 120 cm×60 cm in plots of 36 m², each. Five treatments, viz T₁, seed treatment with *P. fluorescens* Pf 1 @ 10 g/kg seed and foliar sprays @ 0.2% at 30, 40, 50, 60, 70, 80 and 90 days after

sowing; T₂, seed treatment with *P. fluorescens* Pf 1 @ 10 g/kg seed and foliar sprays @ 0.2% at 30, 50, 70 and 90 days after sowing; T₃, seed treatment with *P. fluorescens* Pf 1 @ 10 g/kg seed and foliar sprays @ 0.2% at 30, 60 and 90 days after sowing; T₄, copper oxychloride @ 0.3% + plantomycin @ 0.01% at 30, 60 and 90 days after sowing; T₅, control (water spray) were imposed with 4 replications in randomized block design. *P. fluorescens* Pf 1 isolate was supplied by TNAU, Coimbatore under All India Co-ordinated Cotton Improvement Project. Data on disease intensity was recorded following 0–4 scale (Sheo Raj 1988). Per cent disease index was calculated by the formula: sum of numerical ratings×100/number of plants infected×maximum rating. Yield data from each treatment was recorded. Per cent increase in the yield, net returns and benefit : cost ratio were calculated.

RESULTS AND DISCUSSION

Bacterial blight and Myrothecium leaf spot were recorded in 2007–08 and 2008–09 while Alternaria and Helminthosporium leaf spots were recorded during 2006 – 09. In case of bacterial blight as well as leaf spot diseases T₁ was found to be superior or on par with T₄ (Table 1).

Lowest per cent disease index of bacterial blight (33.6), Alternaria leaf spot (16.36), Helminthosporium leaf spot (14.72), and Myrothecium leaf spot (15.75) was recorded in

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Table 1 Efficacy of *Pseudomonas fluorescens* against foliar diseases of cotton (pooled data of 2006–09)

Treatment	Mean per cent disease index (PDI)*				Per cent disease control			
	Bacterial blight	Alternaria leaf spot	Helminthosporium leaf spot	Myrothecium leaf spot	Bacterial blight	Alternaria leaf spot	Helminthosporium leaf spot	Myrothecium leaf spot
T ₁ , seed treatment with <i>Pseudomonas fluorescens</i> Pf 1 @ 10 g/kg seed + 7 foliar sprays @ 0.2% at 30, 40, 50, 60, 70, 80 and 90 days after sowing.	33.60a	16.36a	14.72a	15.75a	40.25	35.16	50.50	45.37
T ₂ , seed treatment with <i>P. fluorescens</i> Pf 1 @ 10 g/kg seed + 5 foliar sprays @ 0.2% at 30, 50, 70 and 90 days after sowing.	39.35b	17.62a	18.51abc	19.10b	30.20	30.16	37.76	33.75
T ₃ , seed treatment with <i>P. fluorescens</i> Pf 1 (@ 10 g/kg seed + 3 foliar sprays @ 0.2% at 30, 60 and 90 days after sowing	37.53ab	19.12a	22.17bc	22.58c	33.26	24.23	27.29	21.68
T ₄ , spraying Copper oxy chloride @ 0.3% + Plantomycin @ 0.01% at 30, 60 and 90 days after sowing	35.03ab	18.28a	18.08ab	17.63ab	37.70	27.55	39.21	38.85
T ₅ , control (water sprays)	56.23c	25.23b	29.74d	28.83d				
CD (P=0.05)	5.48	5.49	4.59	3.29				
CV (%)	8.8	14.9	12.8	10.2				

*Figures with the same letters did not differ significantly

T₁ plots while control plots recorded maximum per cent disease index of 56.23 (bacterial blight), 25.23 (Alternaria leaf spot), 29.74 (Helminthosporium leaf spot) and 28.83 (Myrothecium leaf spot).

Pooled data analysis showed that T₃ and T₄ were at par with T₁ in controlling bacterial blight. In case of *Alternaria* leaf spot biological and chemical treatments did not differ significantly among themselves though they were significantly superior to untreated control. Both T₂ and T₄ were on par with T₁ in managing Helminthosporium leaf spot while only T₄ was on par with T₁ against Myrothecium leaf spot.

Maximum control of bacterial blight (40.25%), *Alternaria* leaf spot (35.16%), Helminthosporium leaf spot (50.50%) and Myrothecium leaf spot (45.37) was obtained with T₁, ie seed treatment with *P. fluorescens* Pf 1 @ 10 g/kg seed and foliar sprays @ 0.2% at 30, 40, 50, 60, 70, 80 and 90 days after sowing (Table 1). T₄ (Copper oxychloride @ 0.3% + Plantomycin @ 0.01% at 30, 60 and 90 days after sowing) was next best with 37.70% control of bacterial blight, and 39.21% control of Helminthosporium leaf spot and 38.85% control of Myrothecium leaf spot whereas, T₂ was the next best in the case of *Alternaria* leaf spot (30.16%).

Yield data pooled for three consecutive years showed that maximum yield of 1.46 tonnes/ha was recorded with T₁ in

comparison with 1.19 tonnes/ha with control. T₂ with a yield of 1.40 tonnes/ha was next to T₁, followed by T₄ (1.35 tonnes/ha). Maximum increase in the yield of 22.45% was obtained with T₁, while 17.76% increase was recorded in T₂ plots. All treatments significantly increased the yield over the control (Table 2). Highest benefit:cost ratio of 1.92 was obtained with T₁ and T₂ recorded 1.87 benefit: cost ratio in comparison with 1.52 in T₅ (control). These observations clearly indicate that seed treatment with *P. fluorescens* Pf 1, followed by 0.2% foliar spray of the same at 10 days interval starting from 30 days after sowing is cost-effective in managing important foliar diseases, viz bacterial blight and leaf spots caused by *Alternaria*, *Helminthosporium* and *Myrothecium* avoiding losses to the tune of 18.33%.

Similar observations of the benefit of biological control agent was reported with seed bacterization with endo PR8 (*P. fluorescens*) which reduced the cotyledonary infection by *Xanthomonas campestris* pv *malvacearum* to the tune of 60% and damping off by *Rhizoctonia solani* (84%) and *Sclerotium rolfsii* (76%) in cotton (Bhowmik *et al.* 2002). *P. fluorescens* CHAOS was reported to be effective against *Alternaria* leaf spot (Bhattiprolu and Prasada Rao 2009) and grey mildew. The ability of *P. fluorescens* to control bacterial as well as fungal pathogens in cotton makes it an ideal component in integrated disease management.

Table 2 Efficacy of *Pseudomonas fluorescens* against foliar diseases of cotton (pooled data of 2006–09)

Treatment	Mean yield (tonnes/ha)	Per cent increase in yield over control	Cost of spraying (Rs)	Gross expenditure	Additional yield (tonnes/ha)	Gross returns (Rs)	Net profit (Rs)	Benefit: cost ratio	Avoidable yield loss (%)
T ₁ , seed treatment with <i>Pseudomonas fluorescens</i> Pf 1 @ 10 g/kg seed + 7 foliar sprays @ 0.2% at 30, 40, 50, 60, 70, 80 and 90 days after sowing.	1.46	22.45	1 062	19 062	0.27	36 550	17 488	1.92	0.0
T ₂ , seed treatment with <i>P. fluorescens</i> Pf 1 @ 10 g/kg seed + 5 foliar sprays @ 0.2% at 30, 50, 70 and 90 days after sowing.	1.40	17.76	762	18 762	0.21	35 150	16 380	1.87	3.83
T ₃ , seed treatment with <i>P. fluorescens</i> Pf 1 (@ 10 g/kg seed + 3 foliar sprays @ 0.2% at 30, 60 and 90 days after sowing	1.29	8.29	462	18 462	0.10	33 325	14 863	1.81	11.56
T ₄ , spraying Copper oxy chloride @ 0.3% + Plantomycin @ 0.01% at 30, 60 and 90 days after sowing	1.35	13.82	1 575	19 575	0.16	33 975	14 400	1.74	7.05
T ₅ , control (water sprays)	1.19			18 000		27 350	9 350	1.52	18.33
CD (<i>P</i> =0.05)	0.02								
CV (%)	5.8								

REFERENCES

- AICRP. 2009. AICCIP. *Annual Report (2008–09)*. All India Co-ordinated Cotton Improvement Project, Coimbatore, Tamil Nadu.
- Bhattiprolu S L and Prasada Rao M P. 2009. Management of *Alternaria* leaf spot on cotton by biological approach. *Journal of Cotton Research and Development* **23** (1): 135–7.
- Bhowmik B, Singh R P, Jayaraman J and Verma J P. 2002. Population dynamics of cotton endophytic *Pseudomonas*, their antagonism and protective action against the major pathogens of cotton. *Indian Phytopathology* **55** (2): 124–32.
- Mayee C D and Mukewar P A. 2007. Loss-inducing disease of cotton and their management with special reference to Andhra Pradesh. (in) *Cotton in Andhra Pradesh*, pp 197–9. Rao N G P, Appa Rao A and Siddiq E A. (Eds), Farm and Rural Science Foundation and ANGRAU, Hyderabad.
- Sheo Raj 1988. Grading System for cotton diseases, *Technical Bulletin*, pp 1–7, CICR, Nagpur.