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Efficacy of different isolates of fluorescent pseudomonads against bacterial leaf blight of rice

Gokil Prasad Gangwar

Department of Plant Pathology, G. B. P. U. A. & T., Pantnagar, District: U. S. Nagar (Uttarakhand) 263 145, India.

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In the present study, experiments were conducted to test the efficacy of potential isolates of fluorescent pseudomonads against bacterial leaf blight of rice, under field condition. Different isolates of fluorescent pseudomonads were varied in terms of their comparative efficacy against bacterial leaf blight disease. Maximum reduction (50.69%) in disease severity was recorded with isolate FLP 84 followed by *Pf* 83 (48.26%) during *Kharif* 2006. However, during *Kharif* 2007, isolate *Pf* 83 (58.33%) and FLP 84 (58.33%) exhibited maximum reduction in disease severity. Maximum increase in grain yield (15.71%) and 1000 grain weight (30.22%) was recorded with isolate *Pf* 83, during *Kharif* 2006. On the other hand, isolate FLP 84 resulted in maximum increase in grain yield (16.09%) during *Kharif* 2006. In the present investigation, out of five isolates of *Pseudomonas* sp. evaluated against bacterial blight disease *Pf* 83 and FLP 84 (isolated from rice phylloplane) resulted higher effectivity in reducing disease severity and increasing grain yield during both cropping seasons.

Key words: Bacterial leaf blight of rice, *Pseudomonas fluorescens*, fluorescent pseudomonads, *Xanthomonas oryzae* pv. *Oryzae.*

INTRODUCTION

Bacterial leaf blight of rice caused by *Xanthomonas oryzae* pv. *oryzae* (Uyeda and Ishiyama) Dowson is the disease of great economic importance in all rice growing areas of the world and is particularly destructive in South East Asia including India (Anonymous, 2002). The disease is known to occur in epidemic proportions in many parts of the world. The disease causes severe yield loss up to 50% (Singh, 1972). The severity and significance of damage caused by *X. oryzae* pv. *oryzae* needs the development of strategies to manage the diseases, so as to reduce crop loss and to divert epiphytotic. There is unavailability of economic and quality agricultural antibiotics and several plant pathogens are reported to exhibit antibiotic resistance (McManus et al., 2002).

Biological control has emerged as a promising alternative to the management of plant pathogens. It is key component of integrated disease management and organic crop production. Bioagents also stimulate plant growth, even if there is no disease, which results in better yield (Mishra and Sinha, 2000). So, they are potential candidates for management of plant diseases. Antagonistic potential of fluorescent pseudomonads with *X. oryzae* pv. *oryzae* were studied by several workers including Manmeet and Thind (2002), Rangarajan et al. (2003), Velusamy and Gnanamanickam (2003), Babu and Thind (2005), Gent and Schwartz (2005) and Gangwar and Sinha (2010, 2012a, b). Anuratha and Gannamanickam (1987) found that bacterization of rice with *P. fluorescens* followed by its foliar sprays caused 40 to 60% reduction in bacterial leaf blight. Babu and Thind (2005) reported that *P. fluorescens* exhibited lowest

E-mail: gokil_prasad@rediffmail.com.

Table 1. Efficacy of different isolates of fluorescent pseudomonads on disease severity of bacterial leaf blight of rice (variety; Jaya), under field conditions (*Kharif*, 2006).

Treatment	Disease severity (%)		
	After 14 days of first spray	After 21 days of first spray	After 28 days of first spray
Pf 83	15.50	47.00	49.66
FLP 2	16.00	50.00	52.66
FLP 3	17.00	52.00	53.33
FLP 84	15.00	45.00	47.33
FLP 88	16.33	51.33	54.00
Check	21.00	66.66	96.00
CD at 5%	2.52	8.23	5.62

* Mean of three replications.

bacterial leaf blight disease index when applied as seed treatment + foliar sprays. Twenty *Pseudomonas* strains were evaluated by Rangarajan et al. (2003) for the suppression of bacterial leaf blight on susceptible rice plant and it was observed that they suppressed the incidence of bacterial leaf blight disease by 15 to 74%. A field experiment revealed that application of the 2,4-DAPG-producing strains of *P. fluorescens* as a seed coat treatment reduced bacterial blight lesions in susceptible rice cv. IR 24 plants as compared to untreated control plants (Velusamy and Gnanamanickam, 2003). Gent and Schwartz (2005) also observed that *P. fluorescens* strain A 506 reduced severity of bacterial leaf blight in field experiments.

Nineteen isolates of fluorescent pseudomonads isolated from different sources (FLP 2, 3, 4, 11, 12, 18, 25, 27, 28 and 31 from soil of rice field, *Pf* 82, 83 and FLP 84, 85, 86, 87, 88, 89 and 90 from rice phylloplane) were screened *in vitro* for their biocontrol ability against *Xanthomonas oryzae* pv. *oryzae* (Gangwar and Sinha, 2010, 2012a). Among which eight potential bacterial bioagents that is, seven isolates of fluorescent pseudomonads (FLP 2, FLP 3, FLP 28, FLP 84, FLP 88, FLP 90 and FLP 85) and *Pseudomonas fluorescens* isolate 83 (*Pf* 83) were evaluated for their comparative antagonistic potential against bacterial leaf blight disease, under glasshouse condition (Gangwar and Sinha, 2012b). In the present studies, experiment was conducted to test the efficacy of potential isolates of fluorescent pseudomonads against bacterial leaf blight of rice, under field condition.

MATERIALS AND METHODS

Mass multiplication of *Pseudomonas* isolates

Four isolates of fluorescent pseudomonads and *P. fluorescens* isolate *Pf* 83 showed higher antagonistic potential under glasshouse conditions were tested for their comparative efficacy, under field conditions. *Pseudomonas* isolates were multiplied on King's B broth. The isolates were inoculated in the flask containing 100 ml KB broth and incubated on shaker at 150 rpm for 48 h at 25±2°C. For formulation, bacterial suspension was mixed directly with sterilized talc powder (at 1.2, v/w), air dried and mixed well under sterile conditions and the concentration 10^6 cfu/g was prepared by diluting it with talc powder (with 1% CMC).

Field experiment

Experiment was conducted at Crop Research Center, G. B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) using Randomized Block Design (RBD). Susceptible rice cultivar Jaya was used for experiment. General agronomic practices were followed for cultivation of experimental plots. This experiment was carried out in *Kharif* sessions, 2006 and 2007. Pathogen was inoculated at maximum tillering stage by clipping off the leaf tip at 10^6 cell/ml inoculum (Kauffman et al., 1973). Five *Pseudomonas* isolates (*Pf* 83, FLP 2, FLP 3, FLP 84 and FLP 88) were applied at the rate of 10 g per liter as foliar spray a day after inoculation of pathogen in the evening hours to avoid exposure to direct sunshine. Two foliar sprays of bioagents were given at one week interval. Check plots were sprayed with sterilized water. Each treatment was replicated thrice. Data was recorded as percent disease severity on artificially inoculated leaves (average 50 leaves/plot) at 14, 21 and 28 days after treatment. After harvesting yield components (number of filled and unfilled grains per plants, 1000 grain weight and grain yield) were recorded. Data obtained was analyzed by ANOVA.

RESULTS

Effect on disease severity

All the isolates of fluorescent pseudomonads significantly reduced disease severity over check during *Kharif* 2006 and 2007. Maximum reduction (50.69%) in disease severity was recorded with FLP 84 (Table 1). The isolate *Pf* 83 which reduced disease severity by 48.26% during *Kharif* 2006. On the other hand, during *Kharif* 2007 (Table 2) maximum reduction in disease severity (58.33%) was observed with the isolate *Pf* 83 and FLP 84 followed by FLP 88 (57.60%).

Effect on filled grains

All the treatments exhibited significant increase in number

Table 2. Efficacy of different isolates of fluorescent pseudomonads on disease severity of bacterial leaf blight of rice (variety; Jaya), under field conditions (*Kharif,* 2007).

Treatment	Disease severity (%)		
	After 14 days of first spray	After 21 days of first spray	After 28 days of first spray
Pf 83	16.00	27.00	38.33
FLP 2	18.00	29.00	43.33
FLP 3	18.33	31.00	45.00
FLP 84	16.33	26.66	38.33
FLP 88	17.00	26.66	39.00
Check	21.00	41.66	92.08
CD at 5 %	2.03	2.75	8.06

*Mean of three replications.

Table 3. Effect of different isolates of fluorescent pseudomonads, on number of filled and unfilled grains per plant of rice (variety; Jaya), under field conditions (*Kharif,* 2006 and 2007).

Treatment	*Kharif* 2006		*Kharif* 2007	
	No. of filled grains/plant	No. of unfilled grains/plant	No. of filled grains/plant	No. of unfilled grains/plant
Pf 83	2280.33	723.00	2354.66	768.33
FLP 2	2226.33	806.33	2106.66	806.66
FLP 3	2237.33	804.66	2320.66	849.66
FLP 84	2272.66	778.00	2368.00	798.66
FLP 88	2252.66	836.66	2346.66	825.33
Check	1839.00	956.00	1852.33	1122.33
CD at 5%	269	ns	305.83	124.30

* Mean of three replications.

of filled grains per plant, during *Kharif* 2006. However, the effect of antagonists on number of unfilled grains per plant was non-significant (Table 3). Maximum increase (23.99%) in number of filled grains per plant was observed with *Pf* 83 which is followed by FLP 84 (23.58%) and FLP 88 (22.49%). Maximum reduction (24.37%) in the number of unfilled grains per plant was recorded with *Pf* 83.

All isolates of fluorescent pseudomonads tested were found significantly effective in increasing number of filled grains per plant during *Kharif* 2007, except FLP 2 which did not show significant increase in number of filled grain per plant, compare to check (Table 3). Maximum increase in number of filled grains per plant (27.84%) was observed with FLP 84 followed by *Pf* 83 which showed 27. 12% per plant. However, maximum reduction in number of unfilled grains per plant (31.53%) was observed with *Pf* 83 which is followed by FLP 84 which resulted in the reduction of unfilled grains per plant by 28.83%.

Effect on grain yield and 1000 grain weight

Significant increase in grain yield and 1000 grain weight was observed in all treatment as compared to check during *Kharif* 2006 and 2007. The results in Table 4 showed that during *Kharif* 2006 foliar application of *Pf* 83 resulted in maximum increase in grain yield (15.71%) and 1000 grain weight (30.22%). FLP 88 was next in order to effectivity in increasing grain yield (14.48%). During *Kharif* 2007 of the five isolates of fluorescent pseudomonads, four isolate were found significantly effective in increasing grain yield as compare to check (Table 4). However, isolate FLP 84 resulted in maximum increase (16.09%) in grain yield followed by *Pf* 83 (14.40 %). Maximum increase in 1000 grain weight (51.56%) was observed with FLP 88 followed by FLP 84 (51.03%).

DISCUSSION

In the present investigation, out of five isolates of *Pseudomonas* sp. evaluated against bacterial blight disease *Pf* 83 and FLP 84 were found most effective in reducing disease severity and increasing grain yield, during *Kharif* seasons 2006 and 2007. This indicates that bioagents *Pf* 83 and FLP 84 isolated from rice phylloplane, could multiply and established on rice host

Table 4. Effect of different isolates of fluorescent pseudomonads on grain yield and 1000 grain weight of rice (variety; Jaya), under field condition (*Kharif*, 2006 and 2007).

Treatment	*Kharif* 2006		*Kharif* 2007	
	Grain yield (q/h)	1000 grain weight (g)	Grain yield (q/h)	1000 grain weight (g)
Pf 83	27.07	25.56	27.11	25.23
FLP 2	26.22	24.97	26.35	24.82
FLP 3	25.80	24.87	25.73	24.47
FLP 84	25.97	25.50	27.51	25.37
FLP 88	26.79	25.46	24.54	25.46
Check	23.40	19.63	23.70	16.85
CD at 5%	1.82	3.12	1.68	1.65

* Mean of three replications.

and reduced bacterial leaf blight disease. The isolate FLP 2 was also found effective in controlling the disease and increasing the yield. Present study indicated that different isolates of fluorescent pseudomonad was varied in terms of their comparative efficacy against bacterial leaf blight disease. Babu and Thind (2005) studied efficacy of *P. fluorescens* against *X. oryzae* pv. *oryzae* and found decreased disease index and increased shoot and root length and number of tillers under various treatments.

Present study revealed that *Pf* 83 and FLP 84 showed higher efficacy against bacterial leaf blight as compare to remaining isolates. This indicates that bioagent *Pf* 83 and FLP 84 which was isolated from rice phylloplane, could multiply and established on rice host effectively and resulted in maximum reduction in bacterial leaf blight disease and increasing grain yield as compared to other isolates obtained from soil of rice field. The observed results should be verified on large scale rice planting.

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