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Research Article

Evaluation of fluorescent pseudomonads for the management of rice sheath blight disease

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ABSTRACT: *Pseudomonas fluorescens* cultures were isolated from rhizosphere of rice cultivated in different locations of Kuttanad. Three effective strains *viz.*, PF 43, PF 46, PF 47 and combined isolates PF 43+PF 46+PF 47 were tested in the farmers' plot of nine different locations of Kuttanad against rice sheath blight disease during Rabi 2011-12. The data on disease incidence and severity indicated that the combined isolate was performed well in restricting the disease incidence and severity. The pooled data showed that combined strains of PF 43+46+47 was found most effective against sheath blight disease and thereby increased the grain yield than other single isolates as well as standard fungicide check.

KEY WORDS: Rice, *Rhizoctonia solani*, sheath blight, fluorescent pseudomonads

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INTRODUCTION

The sheath blight of rice caused by *Rhizoctonia solani* was first noticed in Kuttanad in 1969. It is now rated as one of the most serious diseases of rice in the Kerala. The symptoms of the disease usually appear on rice from tillering to flowering stages. The locally accepted variety, Uma is cultivated in the vast area of Kuttanad for the past fifteen years, but it is highly susceptible to sheath blight disease. The farmers periodically apply many fungicides to control the sheath blight disease resulting in serious environmental pollutions and health hazards. Hence, the ecofriendly formulations are required to counter these environmental pollutions. The biocontrol agents have gained considerable importance in the control of sheath blight disease in the recent years. Many fluorescent *Pseudomonas* species have been reported to induce systemic resistance (Pieterse *et al.*, 1996), and many workers have used antagonistic bacteria against sheath blight disease (Mew and Rosales, 1986; Gnanamanickam *et al.*, 1992; Krishnamoorthy and Gnanamanickam, 1997). The objective of the present study was to test the efficacy of different fluorescent pseudomonads, either alone or in combination to manage sheath blight disease in Kuttanad.

MATERIALS AND METHODS

One hundred and fifty isolates of fluorescent pseudomonads were isolated from rhizosphere soil of different rice fields in different parts of Kuttanad using King's medium B (KMB) (King *et al.*, 1954). Antagonistic potential of the native *Pseudomonas* isolates to *R. solani* was detected by dual culture technique (Dennis and Webster, 1971) on King's B agar plates. The effective treatments *viz.*, PF 43, PF 46, PF 47 and PF 43+PF 46+PF 47 mixed strains were selected from the field experiments of Rice Research Station, Moncompu (Surendran *et al.*, 2011). These treatments were promoted for farm trial in nine locations of Kuttanad region. Talc based formulations were prepared for PF 43, PF 46, PF 47 and mixed isolates of PF 43+PF 46+PF 47 following the method described by Nandakumar *et al.*, (2001) and used for farm trials.

The farm trials were conducted during Rabi 2011-12 at three locations each from lower Kuttanad, upper Kuttanad and Kari lands. The locations were Kavalam, Pulinkunnu and Kainakary of lower Kuttanad area, Peringara, Kadapra and Kavumbhagam of upper Kuttanad region, Ambalapuzha, Karuvatta and Purakkad of Kari lands. The treatments comprised of PF 43, PF 46, PF 47,

PF 43+PF 46+PF 47 mixed isolates, P1, systemic fungicide hexaconazole (0.2%) and untreated check plot. Each biocontrol treatment included seed treatment (10 g/kg of seed), soil application (1 kg/acre at 35 DAS) and foliar application (2% at 55 DAS) of the particular strains. The seeds were soaked for 12-14h in one litre solution containing Pseudomonas talk formulation at 10g/10 kg). The excess water was decanted and the seeds allowed to sprout for 24 hours in dark room. The germinated seeds were used for direct sowing in the main plots. Soil application was carried out at 1 kg of product mixed with 20 kg of farm yard manure for one acre main field area at 35 days after sowing. The foliar treatment was done using the particular product at 2% concentration (20 g/lit) on 55 days after sowing. P1 culture was received from College of Agriculture, Vellayani and systemic fungicide Hexaconazole (0.2%) were used as standard check. The farm trial was laid out in a randomized complete block design (RBD), using MO 16 (Uma) as the test variety. Pre-germinated seeds were used for direct sowing with the plot size of 20x10 m^2. Fertilizers were applied @ 90:45:45 NPK kg/ha as per the package of practices, Kerala Agricultural University. The pathogen was multiplied on autoclaved paddy straw and artificially applied at the base of the crop during tillering stage. Observations on sheath blight incidence and severity were recorded 25 days after foliar application. Percentage of disease incidence was calculated on 25 plants per sampling unit, by counting the number of infected tillers. Degree of severity was graded (0-9 scale) based on height of the plant portions affected by the disease as per the SES of rice, IRRI (1996). Grain yield of the each plot was recorded and was converted in kg/ha for analysis. The data was subjected to statistical scrutiny after angular transformation and analysis of variance was performed with transformed values. Significance among the treatments was determined by Duncan's multiple range tests (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The farm trial results indicated that the combination treatment of PF 43+46+47 gave the maximum reduction in disease incidence (20.84%) followed by hexaconazole (21.33%), PF 43 (22.65%) and P1 (24.83%) (Table 1). The data on disease severity (0-9 scale) indicated that PF 43+46+47 reduced disease effectively (1.35) when compared with hexaconazole (1.43), PF 43 (1.54) and P1 (2.06) (Table 2). The grain yield data indicated that the highest yield (5207 kg/ha) was recorded by the treatment PF 43+46+47 followed by hexaconazole (5118 kg/ha), PF 43 (4746 kg/ha) and standard check isolate P1 (4568 kg/ha) (Table 3). The treatment involving the consortium of three isolates (PF 43+46+47) was significantly superior to all other treatments with single isolates (Table 4). Fukui *et al.*, (1994) reported that a single biocontrol strain may not grow equally well in a variety of environmental conditions to contain the disease.

Table 1. Percentage Incidence of Sheath blight in different locations at Kuttanad

Sl. No.	Treatment	Locations									Mean
		1	2	3	4	5	6	7	8	9	
1	PF 43	15.1 (6.8)	25.6 (7.2)	23.2 (15.5)	32.0 (28.1)	13.9 (5.8)	16.2 (7.7)	49.3 (57.5)	19.8 (11.5)	18.7 (10.3)	22.7
2	PF 46	24.3 (16.9)	28.1 (22.2)	25.8 (19.0)	31.8 (27.8)	26.9 (20.5)	21.9 (14.0)	53.6 (64.7)	20.3 (12.0)	26.2 (19.5)	28.8
3	PF 47	23.7 (16.2)	25.5 (18.5)	30.7 (26.1)	44.3 (48.8)	33.5 (30.5)	22.1 (14.1)	55.9 (68.6)	29.1 (23.6)	10.8 (3.5)	30.6
4	PF 43+PF 46+PF47	25.8 (19.0)	10.0 (3.0)	25.0 (17.9)	24.7 (17.5)	17.6 (9.1)	12.7 (4.8)	37.1 (36.3)	10.6 (3.4)	24.1 (16.9)	20.8
5	P1 (Std)	21.8 (13.8)	20.3 (12.0)	21.6 (13.5)	30.3 (25.5)	10.5 (3.3)	17.1 (8.6)	57.4 (70.9)	29.4 (24.1)	15.2 (7.4)	24.8
6	Hexaconazole	21.2 (13.1)	27.1 (20.8)	23.1 (16.4)	26.4 (19.6)	16.2 (7.8)	20.5 (12.5)	18.7 (10.3)	27.5 (22.0)	11.2 (3.8)	21.3
7	Control	36.6 (35.5)	46.6 (52.7)	41.0 (43.1)	30.4 (25.6)	42.4 (45.5)	36.6 (38.5)	33.8 (30.8)	38.4 (31.0)	28.7 (38.5)	37.2
	CD (P = 0.05)	7.33									

Table 2. Severity scale of Sheath blight (0-9 scale)

Sl. No.	Treatment	Locations									Mean
		1	2	3	4	5	6	7	8	9	
1	PF 43	1.3	2.0	1.5	1.3	2.1	1.8	1.2	1.9	0.8	1.54
2	PF 46	2.9	1.9	2.7	2.4	2.3	2.4	4.0	2.5	1.8	2.55
3	PF 47	4.0	5.1	3.8	2.2	3.6	4.0	1.1	3.3	3.0	3.34
4	PF 43+PF 46+PF47	0.7	0.5	1.1	1.2	1.1	2.3	3.2	0.3	1.7	1.35
5	P1 (Std)	1.1	1.8	2.8	1.5	2.6	2.2	1.3	3.1	2.1	2.06
6	Hexaconazole	1.2	1.1	1.9	2.8	0.9	2.1	0.4	1.8	0.8	1.43
7	Control	6.0	6.8	7.1	3.6	6.4	5.8	7.0	3.9	5.6	5.80
	CD (P = 0.05)	0.86									

Table 3. Influence of Bioformulations on Grain yield

Sl. No.	Treatment	Locations									Mean
		1	2	3	4	5	6	7	8	9	
1	PF 43	5805	6596	3870	6235	2709	4541	4408	4356	4192	4746
2	PF 46	5805	5319	3978	5375	2494	4919	3010	2682	2445	4004
3	PF 47	6343	6102	3978	4193	1505	3625	3763	3960	3367	4093
4	PF 43+PF 46+PF47	6558	7633	3978	5375	2537	4885	4515	4347	7033	5207
5	P1 (Std)	6235	6932	3870	5375	2408	4984	4408	3410	3487	4568
6	Hexaconazole	4932	4579	5581	4005	6215	5039	4985	6012	4805	5118
7	Control	4988	6465	3548	3655	2064	4162	3870	3225	3225	3911
	CD (P = 0.05)	866.26									

Table 4. Influence of Bioformulations on Disease incidence and Grain yield

Sl. No	Treatment	Disease incidence (%)	Disease score (0-9 scale)	Grain Yield (kg/ha)
1	PF 43	22.7	1.54	4746
2	PF 46	28.8	2.55	4004
3	PF 47	30.6	3.34	4093
4	PF43+PF46+PF47	20.8	1.35	5207
5	P1 (Std)	24.8	2.06	4568
6	Hexaconazole	21.3	1.43	5118
7	Control	37.2	5.80	3911
	CD (P = 0.05)	7.33	0.86	866.26

In the current study, the combination of PF 43+46+47 registered the maximum reduction in sheath blight disease incidence and severity followed by Hexaconazole, PF 43 and P1 as compared to others (PF 46, PF 47). Our findings corroborate with the reports of several workers in the management of the disease with application of fungicides like carbendazim (Bavistin) (Reddy *et al.*,1981), Mancozeb (Dithane M-45) (Roy and Saikia, 1976), Validamycin A (Dev and Mary 1986) and Kitazin (Rajan *et al.*, 1979). Further, the combination of different treatments of biocontrol agents has an additive effect for better suppression of the disease as indicated by Van Loon

(1998), concur with our present observations. Enhanced disease control over individual application of bioagents was reported by Guetsky *et al.,* (2002) while, Nandakumar *et al.,* (2001) observed that the mixtures of PGPR strains gave better suppression of sheath blight in rice than when they were applied individually.

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