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RESEARCH ARTICLE

Management of sheath blight disease of rice through bio control agents in west central table land zone of Odisha

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Abstract

Among different fungal diseases of rice, sheath blight caused by *Rhizoctonia solani* Kuhn has currently become one of the most important diseases on all the major high yielding rice varieties. Because of lack of resistant donor lines no variety was found as completely immune to the disease. Till date, chemical control is the most widely used means to control the disease which may have several adverse effects on the environment. Considering the environmental safety, biological control is the most feasible method of disease control. Keeping this in view, field experiment was conducted to study the efficacy of bio control agents, *Trichoderma viride* and *Pseudomonas fluorescens* against sheath blight disease of rice. The bio control agents were applied as seed treatment and in combination of seed treatment and foliar spray and were also compared with standard chemicals like validamycin @ 2.5 ml/l and propiconazole @ 1ml/l. The percent disease index (PDI) as well as the growth parameters of individual treatments were recorded. The yield of the crop in q/ha as well as 1000 grain weight were also worked out. The result revealed that, seed treatment + 3 spraying with *T. viride* @ 1% was the most effective bio control treatment recording 10.93% pooled PDI against 34.41% in control plot and its performance was at par with the standard fungicide propiconazole @ 1%. The treatment also exhibited maximum increase in all the yield attributing factors recorded and gave a yield increase of 41.1% over control. The 1000 grain weight was also found highest (22.2 g) among all the treatments.

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INTRODUCTION

Sheath blight disease caused by the fungus *Rhizoctonia solani* Kuhn [*Thanatephorus cucumeris* (A.B Frank) Donk] is a very destructive disease of rice under favourable weather conditions causing substantial yield loss. Losses due to the disease were estimated up to 69% (Khan and Sinha, 2007). Management of the disease through resistant cultivars has not been successful because of lack of adequate level of resistance (Mew and Rosales, 1986). Therefore, sheath blight control has mainly focussed on fungicides or antifungal antibiotics which are again of environmental concern. Instead, there are also other adverse effects of using chemicals like residual toxicity, development of resistance in the pathogen, high cost etc. Taking all these factors into concern, management of the disease in an eco friendly manner becomes increasingly important. Under these circumstances, management using bio control agents is the most suitable approach to control the disease. The bio agents inhibit the pathogen by competition, siderophore production, antibiosis induced resistance or by plant growth promotion (Weller, 1988) and have a long lasting effect without environmental hazards. In the present study, two bio control agents namely, *Trichoderma viride* and *Pseudomonas fluorescens* which were earlier proved to be very effective to manage the disease in different parts of the country, were tested under field condition as seed treatment alone or combining it with foliar spray and simultaneously compared with the effective chemicals to manage sheath blight disease.

Materials and Methods

Field experiment was conducted during kharif season of two consecutive years (2013 and 2014) at the experimental site of All India Co-ordinated Rice Improvement Project (AICRIP), Regional Research and Technology Transfer Station (RRTTS), Chiplima, Sambalpur, Odisha. A high yielding popular and susceptible variety to sheath blight, Swarna (MTU 7029) was taken. The trial consisted of seven treatments which were T₁- Control, T₂- Seed treatment (ST) with *P. fluorescens* @ 1%, T₃ - ST with *T. viride* @ 1%, T₄- ST+ 3 spraying with *P. fluorescens* @ 1%, T₅ - ST+ 3 spraying with *T. viride* @ 1%, T₆ - 3 spraying with validamycin @ 2.5 ml/l and T₇ - 3 spraying with propiconazole @ 1ml/l.

Talc based bio formulations of *Trichoderma viride* and *Pseudomonas fluorescens* consisting carboxy methyl cellulose (CMC) was used in the experiment having 2×10^8 cfu/g. Seed treatment with biocontrol agents was carried out before sowing as per the treatment. The experiment was laid out in RBD with three replications. The size of the plot was 20 square metres with spacing of (20 x 15) cm. Thirty days old seedlings were transplanted. The fertilizer was applied @ 100:50:50 Kg NPK/ha and natural infection of the disease was permitted. The bio control agents and fungicides were sprayed thrice in the crop season at 15 days interval starting from the initial appearance of the disease. The final disease severity was recorded 15 days after the last spray using SES scale (IRRI, 1996).

The Percent Disease Index (PDI) was calculated by using the following formula:

$$\text{PDI} = \frac{\text{Sum of all numerical ratings}}{\text{No. of observations} \times \text{Max. rating}} \times 100$$

Observations on yield attributing factors like plant height, panicle length, number of panicles/hill were also recorded before harvesting. The grain yield of each plot was recorded at the time of harvest and 1000 grain weight for each treatment was also recorded. For this, the harvested earheads were threshed and grains were cleaned properly. A total of 1000 grains were counted and dried in shade for 12 hours to attain approximately 14% moisture level. Later the grain weight was recorded using an electronic weighing balance. All these collected data were analyzed statistically.

Results and Discussion

A perusal of data presented in table 1 revealed that all the treatments reduced the disease significantly as compared to untreated control and almost similar trend in result was obtained from the treatments during both the years of experiment. Among the treatments with bio control agents, seed treatment + 3 spraying with *Trichoderma viride* (T₅) performed best with a pooled PDI of 10.93 % followed by seed treatment + 3 spraying with *Pseudomonas fluorescens* (T₄) recording a pooled PDI of 18.71 % (Fig.1). Both the treatments differed significantly from each other in reducing the sheath blight disease severity.

Considering all the treatments included in the trial, 3 spraying with the antifungal antibiotic validamycin @ 2.5ml/l showed the least pooled percent disease index (PDI) of 6.67 % followed by fungicide propiconazole @ 1ml/l recording a pooled PDI of 9.82 % and both of the treatments differed significantly from each other. While considering the performances of T₂ (seed treatment with *P. fluorescens*) and T₃ (seed treatment with *T. viride*) i.e., only seed treatments, T₃ performed better than T₂ during both the years of experiment recording a pooled PDI of 20 % as compared to 25.93 % in T₂ and both of them were significantly different from each other.

Among all the treatments tested, T₃ (seed treatment with *T. viride*) and T₄ (seed treatment + 3 spraying with *Pseudomonas fluorescens*) were statistically at par with each other with a pooled PDI of 20 % and 18.71 % respectively but both of the treatments differed significantly from T₂ (seed treatment with *Pseudomonas fluorescens*) recording the highest PDI of 25.93 %.

It was evident from the result that, combination of seed treatment + spraying performed much better than only seed treatment with a particular bio agent. In the present experiment, T₅ i.e., seed treatment + 3 spraying with *Trichoderma viride* resulted minimum pooled PDI value (10.93 %) among the bio control treatments and did not differ significantly from the fungicide propiconazole (T₇) recording a pooled PDI of 9.82 % though validamycin (6.67% pooled PDI) performed best compared to all the treatments and it also differed significantly from all other treatments. Prasad *et al.*, (2011) found *Trichoderma* spp as an effective bio control agent against rice sheath blight. A relatively good number of previous workers also reported that combination of two or more methods of bio agent application was more effective in reducing sheath blight disease as compared to single method of application (Kumar *et al.*, 2012; Singh *et al.*, 2013.).

Remarkable increases in plant height, panicle length, panicle number as well as 1000 grain weight were recorded in case of treatments with bio control agents as compared to control (table 2). The maximum increase of all the growth parameters was observed in T₅ (seed treatment + 3 spraying with *Trichoderma viride*). This treatment recorded 12.71 % increase in plant height, 7.61 % increase in panicle length, 42.46 % increase in panicle number and 18.09 % increase in 1000 grain weight as compared to control plots. Baby and Manibhushan Rao (1993) also

recorded 25 % increase in growth of rice plants after application of antagonists to soil. Patel and Mukhopadhyay (1997) found that spraying of fungal antagonists increase the grain weight in rice. So, it can be said that, bio control agents can effectively control the disease and moreover improve the growth parameters and so proved to be a better alternative to chemical control. Singh and Sinha (2009) demonstrated enhancement in the growth of rice crop after seed treatment with *Trichoderma harzianum* and *Pseudomonas fluorescens* which might be attributed to the enhanced nitrogen uptake and drought tolerance as a result of the bio control treatments.

It was evident from table 1 that, all the bio control and chemical treatments were effective to increase the yield significantly over control plots. The highest yield of 39.92 q/ha (pooled of 2013 and 2014) was obtained from T₆ (3 spraying with validamycin) and was closely followed by T₅ (seed treatment + 3 spraying with *Trichoderma viride*) recording a pooled yield of 39.5 q/ha (Fig.2). The treatments T₃ (seed treatment with *T. viride*) and T₄ (seed treatment + 3 spraying with *Pseudomonas fluorescens*) also gave good results with 26.18% and 33.04% yield increase over control respectively. The treatment T₂ (seed treatment with *Pseudomonas fluorescens*) gave minimum increase (18.14 %) in grain yield over control. So, among the bio control treatments, T₅ (seed treatment + 3 spraying with *Trichoderma viride*) was found best resulting 41.1 % yield increase over control and was statistically at par with the best chemical validamycin resulting 42.57 % yield increase over control. The antifungal antibiotic validamycin might be very toxic to *Rhizoctonia solani* resulting comparatively higher effectiveness than the bio control treatments but might have some harmful effects on soil and environment. On the contrary, the application of bio control agents not only reduced the disease severity, promoted the plant growth and ultimately increased the grain yield significantly compared to control without any hazardous effect on environment. Dennis and Webster (1971) also observed in a study that *Trichoderma viride* significantly decreased sheath blight infection and increased grain yield in rice.

Table 1: Evaluation of bio control agents against sheath blight disease and yield of rice

Treatment no.	Treatments	Percent Disease Index (PDI)			Yield (q/ha)			% Yield increase over control
		2013	2014	Pooled	2013	2014	Pooled	
T ₁	Control	32.96 (34.98)*	35.93 (36.81)	34.45 (35.92)	28.83	27.17	28.00	-
T ₂	Seed treatment(ST) with <i>P. fluorescens</i>	24.07 (29.27)	27.78 (31.77)	25.93 (30.58)	32.67	33.50	33.08	18.14
T ₃	Seed treatment with <i>T. viride</i>	20.74 (27.02)	19.26 (25.96)	20.00 (26.50)	33.67	34.67	35.33	26.18
T ₄	ST+ 3 spraying with <i>P. fluorescens</i>	16.67 (24.03)	20.74 (27.07)	18.71 (25.60)	37.83	36.67	37.25	33.04
T ₅	ST+ 3 spraying with <i>T. viride</i>	10.37 (18.74)	11.48 (19.77)	10.93 (19.29)	40.33	38.67	39.50	41.07
T ₆	3 spraying with validamycin @ 2.5ml/l	5.56 (13.58)	7.78 (16.08)	6.67 (14.95)	40.00	39.83	39.92	42.57
T ₇	3 spraying with propiconazole @ 1ml/l	9.63 (18.03)	10.00 (18.41)	9.82 (18.23)	38.67	38.33	38.50	37.50
	SEM(±)	1.53	1.03	0.95	0.74	0.46	0.30	
	CD (at 5%)	4.76	3.22	2.94	2.32	1.43	0.95	

*Figure in the parenthesis is angular transformed value

Table 2: Effect of bio control agents on plant growth and yield components of rice (Pooled of 2013 and 2014)

Treatment no.	Treatment details	Plant height (cm)	% Increase over control	Panicle length (cm)	% Increase over control	No. of panicles per hill	% Increase over control	1000 grain weight (g)	% Increase over control
T ₁	Control	70.47	-	20.63	-	7.63	-	18.8	-
T ₂	Seed treatment(ST) with <i>P. fluorescens</i>	75.43	7.04	21.27	3.10	8.63	13.11	20.4	8.51
T ₃	Seed treatment with <i>T. viride</i>	75.17	6.67	21.33	3.39	8.87	16.25	21.1	12.23
T ₄	ST+ 3 spraying with <i>P. fluorescens</i>	78.73	11.72	21.90	6.16	10.10	32.37	21.7	15.43
T ₅	ST+ 3 spraying with <i>T. viride</i>	79.43	12.71	22.20	7.61	10.87	42.46	22.2	18.09
T ₆	3 spraying with validamycin @ 2.5 ml/l	76.97	9.22	21.87	6.01	10.47	37.22	22.1	17.55
T ₇	3 spraying with propiconazole @ 1ml/l	74.20	5.29	21.60	4.70	9.20	20.58	21.8	15.96
	SEM(±)	0.89		0.18		0.28		0.35	
	CD (at 5%)	2.78		0.56		0.88		1.08	

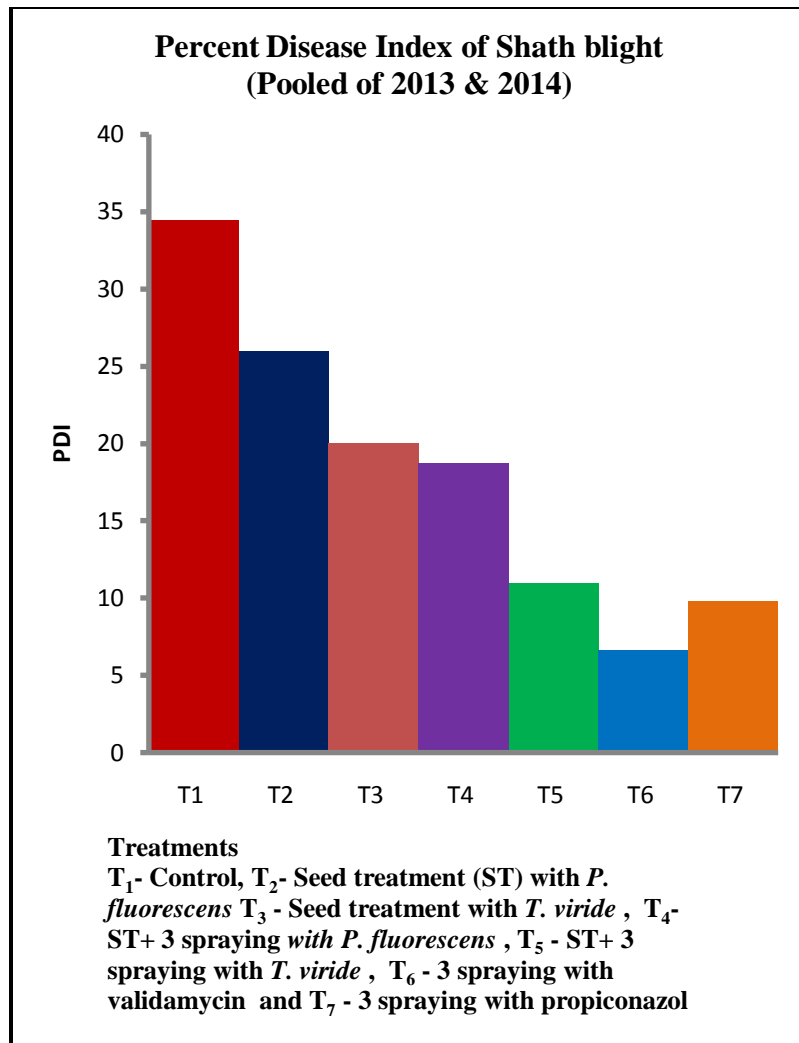


Fig.1

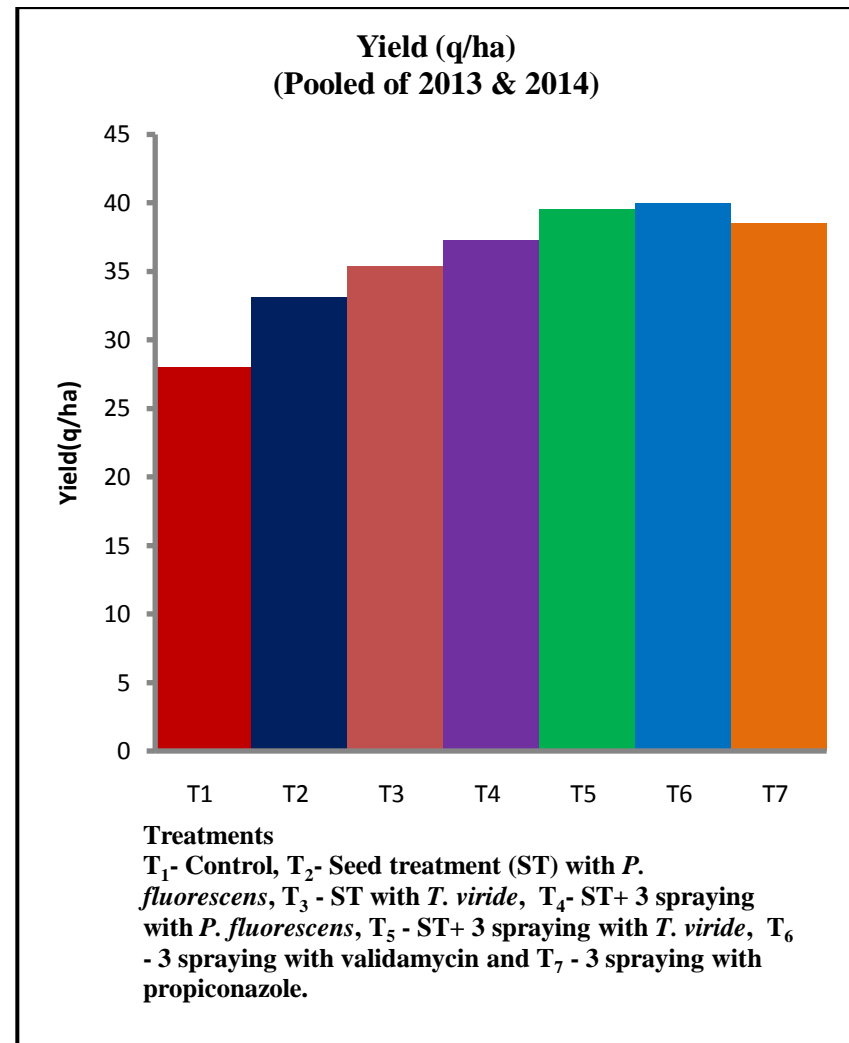


Fig.2

Conclusions

After comparing all the bio control treatments, it can be concluded that, seed treatment + 3 spraying with *Trichoderma viride* was the most effective treatment against sheath blight disease of rice whose performance was at par with the standard chemicals and thus can be recommended to the farmers without any residual toxicity to either soil or plant. The treatment will be easy to apply in the field by the farmers and further it will also promote plant vigour and thus increasing the yield of the rice crop.

References

- Baby, U.I. and Manibhushan, Rao. K. (1993): Control of rice sheath blight through the integration of fungal antagonists and organic amendments. *Tropical Agriculture (Trinidad)*, 70: 240-244.
- Dennis, C. and Webster, J. (1971): Antagonistic properties of species-groups of *Trichoderma*. III. Hyphal interaction. *Transactions of the British Mycological Society*, 57: 363-369.
- Khan, A.A. and Sinha, A.P. (2007): Biocontrol potential of *Trichoderma* species against sheath blight of rice. *Indian Phytopathol.*, 60: 208-213.
- Kumar, Pawan., Abhilasha, A. Lal., Singh, Lakhveer and Simon, Sobita. (2012): Antagonistic potential of *Trichoderma harzianum* and *Pseudomonas fluorescens* against brown spot of rice. *Ann. Pl. Protec. Sci.*, 20: 487-488.
- Mew, T.W. and Rosales, A.M. (1986): Bacterization of rice plants for control of sheath blight caused by *Rhizoctonia solani*. *Phytopathology*, 76: 1260-1264.
- Patel, L.A. and Mukhopadhyay, S. (1997): Mass multiplication of antagonists and standardization of effective dose for management of sheath blight in rice. *Eco. and Env't.Sci.*, 206-209.
- Prasad, B.N., Reddi, M. and Kumar, M.R. (2011): Comparative efficacy of different isolates of *Trichoderma* spp. against *Rhizoctonia solani*, incitant of sheath blight of rice. *Indian Journal of Fundamental and Applied Life Science*, 1(3): 107-111.
- Singh, Rajbir and Sinha, A.P. (2009): Biological control of rice sheath blight with antagonistic bacteria. *Ann. Pl. Protec. Sci.*, 17: 107-110.
- Singh, V., Lal, M. and Singh, G. (2013): Effect of application method of bio control agents on management of sheath blight and growth promotion of rice. *Ann. Pl. Protec. Sci.*, 21(1): 215-216.
- Weller, D.M. (1988): Biological control of soil borne plant pathogens in the rhizosphere with bacteria. *Annu. Rev. Phytopathol.*, 26: 279-407.