J. Mycopathol. Res. **42**(2) : 155-160 (2004)

Integrated management of sheath blight of rice under rice-rice cropping system

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A field trial was conducted integrating bio-control agent, *Trichoderma harzianum*, chemical 'captan' and few soil amendmends to manage sheath blight of rice caused by *Rhizoctonia solani* Kuhn under rice-rice cropping system. Among three bio-control agents tested, integration of *T. harzianum* with captan (0.10%) was found to be the best in terms of their compatibility and latter's effectiveness against. *R. solani*, under *in vitro* tests. In nursery bed, seed treatment with captan (0.10%) and *T. harzianum* significantly influenced germination percentage, mortality percentage, shoot and root weight and *T. harzianum* population as compared to their control. In the main field of *ahu* (autumn) and *sail* (winter) rice, application of few substrates viz, FYM, *S. aculeata, S. rostrata*, enrich compost, rice straw and azolla were taken as the main treatments of soil amendment to observe their combined effect on the incidence of sheath blight. Application of *Sesbania aculeata* (@ 5 ton/ha) + FYM @ 2.5 ton/ha) was observed to be the best in *ahu* rice (var. Gopinath) recording the lowest incidence of disease (14.35%) as compared to the highest (36.6%) in control. The effect of sub plot treatments, seed + root dip over the former resulted lowest (9.16%) incidence which remained statistically at per with the same treatment under full does of FYM (10.13%). Performance in respect of yield was also recorded and found to be the maximum (31.7 q/ha) in *Sesbania aculeata* + FYM amended plots followed by FYM treatment (27 q/ha.) In *subsequent sail* rice (var. Satyaranjan), application of azolla (*Azolla pinnata*) @ 5 ton/ha along with FYM @ 2.5 ton/ha was observed to be the best treatment in reducing sheath blight recording 14.6% followed by FYM application (5 ton/ha) recording 16.06%. The highest yield (40.29 q/ha) of *sail* rice was recorded in Azolla + FYM amended plots which statistically remained at per with the application of *S. aculeata* + FYM.

Key words : Rice-rice cropping system, sheath blight, integrated management

INTRODUCTION

Sheath blight of rice caused by *Rhizoctonia solani* Kuehn [Syn. *Corticium sasaki* (Shira)] Matsumoto = *Thanatephorus cucumeris* (Frank) Donk] occurs in almost all rice growing tracts of the world (Ou, 1972). It is emerging as a major disease of rice and causes substantial loss of 5.2 to 50 % (Ou, 1973) and 5-35 % (Roy, 1997) depending upon the stage of the crop at which the disease appears. The autumn rice is found to be more vulnerable to sheath blight disease then winter rice, due to prevailing favourable temperature and humidity during the crop growth period from March to June-July (Anon. 2000) in this region of the country. Inoculum from former crop likely to cause more disease pressure to winter crop as the pathogen survives for long period either in soil or in rice stubbles (Roy, 1986). Therefore, the disease in difficult to manage using a single management practice like cultural, chemical or biological. Moreover, extensive use to chemical for disease management is not desired in the present day context of sustainable agriculture. Indiscriminate use of chemicals is also not environmentally safe to beneficial soil organisms and human being besides inducing resistance in pathogen towards chemicals. In recent years, there has been success in biological control of the disease by using antagonists like *Trichoderma harzianum, T. viride* (Das *et al.*, 1998 ; Kumarasan and Manibhushanrao, 1991). Intergrated management of the disease through organic amendmends and antagonist has also been reported to be successful (Manibhusanrao and Baby, 1991 ; Ali and Ghose, 1997). Therefore, the present investigation was undertaken to evaluate the potency of *T. harzianum* integrating with chemical (captan 0.10%) treatment followed by few soil amendmends in managing sheath blight under rice-rice cropping system an experimental farm of RARS, Titabar, AAU, Jorhat.

MATERIALS AND METHODS

Three native bio-control agents *viz., Trichoderma harzianum, T. viride* and *Gliocladium virens* were evaluated in respect of their growth rate, antagonism against sheath blight pathogen *R. solani,* compatibility with fungicide 'captan' (as captaf) and vis-à-vis fungicidal effect towards *R. solani* in *in vitro* by dual culture and Poisoned Food Technique (Schmitz, 1930). Former two bio-agents wre collected from Deptt. of Plant Pathology, AAU, Jorhat and later one from HCIO, IARI, New Delhi.

Compatibility test : PDA medium was prepared in conical flasks and sterilized. Fungal concentrations viz., 0.05, 0.1, 0.15 and 0.2 per cent of captan were obtained by adding requisite quantity of the fungicide into the medium and stirred thoroughly.

Table 1 : Growth of antagonists and *Rhizoctonia solani* at different concentrations of captan

Treatment	Radial growth of antagonists and *Rhizoctonia solani* (Dia. in cm) (After 72 hours of incubation)			
	Trichoderma harzianum	*Trichoderma viride*	*Gliocladium virens*	*Rhizoctonia solani*
Captan (0.05%)	8.7	3.05	2.9	4.6
Captan (0.10%)	8.4	2.45	2.6	4.2
Captan (0.15%)	7.2	2.5	2.3	3.5
Captan (0.20%)	5.5	2.3	2.1	3.0
Control	9.0	9.0	9.0	9.0
C.D. (p=o.05)	0.12	0.11	0.14	0.73

The medium was then poured into petriplates and allowed to solidify. Seven (7) mm dia. discs of fungal growth of *T. harzianum, T. viride, G. virens* and *R. solani* were aseptically transferred to the centre of petriplates containing different concentrations of the fungicide amended medium. Three replicates were maintained for each concentration of the fungicide along with a check. Inoculated plates were incubated at 25±1°C for 72 hrs. and radial growth of the inoculated fungi were recorded (Table 1).

Nursery management against sheath blight of rice :

The effect of seed treatment integrating bio-agent with captan at different doses was observed. Percent seed germination, seedling mortality (7 days after sowing) shoot and root dry weight and *T. harzianum* population were recorded and the data is presented in Table 2.

Table 2 : Effect of seed treatment on per cent seed germination, seedling mortality shoot and root weight and *T. harzianum* population nuder unrsery bed condition.

Treatment	Per cent seed germination	Per cent seedling mortality	Dry weight of shoot (g/30 nos)	Dry weight of root (g/30 nos)	*T. harzianum* population (X 10^3cfu/g soil) on 30 days after sowing
T_1: Seed treatment with Captan 0.05% + *T. harzianum*	92.66 (72.2)	3.40	2.70	1.53	8.4
T_2: Seed treatment with Captan 0.10% + *T. harzianum*	94.66 (76.63)	1.84	3.70	2.45	12.4
T_3: Seed treatment with Captan 0.20% + *T. harzianum*	94.20 (76.06)	1.02	3.55	2.61	14.0
T_4: Seed treatment with *T. harzianum*	90.00 (73.57)	3.41	2.46	1.50	14.8
T_5: Control	87.33 (69.14)	4.63	1.75	1.46	1.46
C.D. (p = 0.05)	2.93	1.47	0.93	0.72	0.72

* Values in parentheses are angular transformed values

Integrating captan (0.1 and 0.2 %) with *T. harzianum* for seed treatment showed significantly higher seed germination (%) than when treated with either *T. harzianum* alone or that of control. Mortality percentage was observed to be lowest (1.02) in seed treatment (S.T.) with captan (0.20%) + *T. harzianum* (T.h.) which was however, satistically at per with S.T. with captan (0.10%) + T. H. Baker (1987) reported that inoculation of seeds with fast growing *Trichoderma* may prevent seed diseases. The effect of different seed treatment on root and shoot weight of sedling were assessed. It was observed (Table 2) that in all the treatments, root and shoot weight of seedling were significantly more than the control. The beneficial effect of seed treatment with fungicides and antagonists on root length and shoot length, dry matter production and index value was reported by Jawahara Raju and Sivaprakasam (1989). With regard to the initial population of *T. harzianum* of nursery soil, it was found to be 6.5×10^3 cfu/g soil. Soil population of *T. harzianum* was increased more than double after 30 days of sowing. Seed treatment with *T. harzianum* was increased more than double after 30 days of sowing. Seed treatment with *T. harziaum* alone recorded the highest population density of 14.8×10^3 cfu/g of dry soil. However, integrating captan 0.10% and *T. harzianum* also resulted significant increase in *T. harzianum* population as compared to control. Admas (1990) stressed the need for establishment and maintenance of threshold population of antagonist in soil to obtain economic bio-control, which resulted least seedling mortality in the present study.

Effect of different treatment of percent tiller infection (PTI) in *ahu* rice (var. Gopinath) :

Table 3 : Effect of integrated seed treatments and soil amendments on the incidence of sheath blight in *ahu* rice (var. Gopinath)

Treatment	Per cent Tiller Infection (PTI)				
	Seed treatment (S.T.)*	Root dip treatment (R.D.T.)*	S.T. + R.D.T.*	Control*	Mean
T_1: FYM (@ 5 ton/ha)	22.97 (28.51)	18.96 (25.81)	10.13 (18.56)	25.40 (30.26)	19.36 (25.78)
T_2: *Sesbania aculeata* + FYM (@ 2.5 ton/ha)	15.19 (22.94)	12.37 (20.59)	9.16 (17.62)	20.66 (27.03)	14.35 (22.09)
T_3: *Sesbania rostrata* + FYM (@ 2.5 ton/ha)	21.96 (27.94)	17.39 (24.65)	12.17 (20.42)	24.31 (29.54)	18.96 (25.64)
T_4: Enriched compost + FYM (@ 2.5 ton/ha)	27.12 (31.38)	25.34 (30.22)	24.55 (29.70)	30.60 (33.58)	26.90 (31.22)
T_5: Control	38.85 (38.56)	32.06 (34.48)	36.74 (37.31)	38.80 (38.53)	36.61 (37.22)
Mean	25.22 (29.86)	21.22 (27.15)	18.55 (24.72)	27.95 (31.79)	

* Mean of three replications

* Values in parentheses are angular transformed values.

	S.Ed(±)	C.D. (p = 0.05)
Treatment	0.378	0.87
Application	0.251	0.50
Treatment X Application	0.563	1.12

The effect of seed, seedling treatment as well as soil amendmends on the incidence of sheath blight in *ahu* rice was assessed (Table 3).

All the treatments significantly reduced incidence of sheath blight in comparison to control. *S. aculeata* + FYM was most effective among all the treatments in reducing the disease incidence to 14.35%. Soil amended with *S. rostrata* + FYM was observed to be the second best (18.96%) in reducing the disease following by application of FYM (@ 5 ton/ha) recording 19.36%. However, no significant difference in term of disease reduction was observed between treatments, FYM and *S. rostrata* + FYM. Significant difference was observed among seed treatment, root dip treatment, seed + root dip treatment and control in terms of disease incidence. Alagarsamy and Jayarajan (1994) reported enhancement of *Trichoderma* population in the introduced soil in the root rhizosphere, which might be the cause for reduction in disease incidence. The interaction of method of application and soil amendments revealed the performance of seed + root dip treatment under *S. aculeata* + FYM resulted significantly lowest (9.16%) incidence followed by FYM @ 5 ton/ha where PTI recorded only 10.13% and statistically at per with the former. Disease reduction of soil borne pathogen using organic manures had been reported by several workers (Purkayastha and Menon 1985 ; Narasimhalu and Bhasakaran, 1987). Reduction in respect of sclerotial germination of *R. solani* by *S. aculeata* had been documented by Roy (1985) and exhibition of low disease might be inferred to be a cause as reflected in the present study.

Effect of different treatment on yield in *ahu* rice (var. Gopinath) :

Significant difference in yield of *ahu* rice (var. Gopinath) was observed among all the treatments (Table 4). All the treatments significantly varied to control, which yielded the lowest of 17.64 q/ha. The highest yield (31.71 q/ha) was observed in treatment with *S. aculeata,* followed by application of FYM (27 q/ha). Less disease recorded in *S. aculeata* treated plots might have contributed to higher yield of the crop.

Table 4 : Effect of integrated seed treatments and soil amendments on yield of *ahu* rice (var. Gopinath) under field condition.

Treatment	Yield of *ahu* rice, var. Gopinath (q/ha)				
	Seed treatment (S.T.)*	Root dip treatment (R.D.T.)*	S.T. + R.D.T.*	Control*	Mean
T_1: FYM (@ 5 ton/ha)	26.79	26.60	29.21	25.40	27.0
T_2: *Sesbania aculeata* + FYM (@ 2.5 ton/ha)	31.50	31.77	34.42	29.15	31.71
T_3: *Sesbania rostrata* + FYM (@ 2.5 ton/ha)	22.63	26.00	28.85	25.12	25.65
T_4: Enriched compost + FYM (@ 2.5 ton/ha)	23.97	22.40	25.50	20.65	23.13
T_5: Control 40 : 20 : 20 NPK kg/h	17.00	18.21	19.25	16.10	17.64
Mean	24.38	24.97	27.44	23.28	

* Mean of three replications

	S.Ed(±)	C.D. (p = 0.05)
Treatment	0.67	0.55
Application	0.27	0.56
Treatment X Application	0.62	1.24

Effect of different treatment on percent tiller infection (PTI) in *sali* rice (var. Satyaranjan) :

Influence of seed, seedling treatment and soil amendmends in main field on the incidence of sheath blight was observed and presented in Table 5.

Data on PTI revealed that all the treatments significantly reduced incidence of sheath blight as compared to control. Application of azolla (T_6) was observed to be the best treatment in reducing the disease (14.63%) followed by FYM application (T_1) recording 16.06% Azolla contains high protein and helps to increase organic matter to the soil (Das, 1998), which not noly benefit the plant but also others soil microbes. These microbes might compete with *R. solani* and hinder disease development. FYM provides nutrients to enable to condia of *Trichoderma* to germinate, grow and sporulate so as to increase the effectiveness inoculum levels (Campbell, 1989). In the present study, introduced population of *Trichoderma* along with the native ones might result in reduction of the disease. No significant difference was observed between T_1 and T_2 in terms of disease reduction. The highest disease incidence was observed in control (32.45%) followed by application of rice straw (21.94%), *S. rostrata* (21.22%) and enriched compost (19.03%).

Table 5 : Effect of integrated seed treatments and soil amendments on the incidence of sheath blight in *Sali* rice (var. Satyaranjan)

Treatment	Per cent Tiller Infection (PTI)				
	Seed treatment (S.T.)*	Root dip treatment (R.D.T.)*	S.T. + R.D.T.*	Control*	Mean
T_1: FYM (@ 5 ton/ha)	20.25 (26.74)	13.35 (21.43)	10.64 (19.03)	20.00 (26.56)	19.06 (23.44)
T_2: *Sesbania aculeata* + FYM (@ 2.5 ton/ha)	21.11 (27.35)	15.06 (22.83)	10.67 (19.06)	22.20 (28.11)	17.26 (24.33)
T_3: *Sesbania rostrata* + FYM (@ 2.5 ton/ha)	26.97 (31.09)	20.10 (26.64)	12.00 (20.26)	26.21 (30.79)	21.22 (27.19)
T_4: Enriched compost + FYM (@ 2.5 ton/ha)	24.40 (29.60)	18.00 (25.10)	24.55 (29.70)	23.56 (29.03)	19.03 (25.57)
T_5: Rice Straw + FYM @ 2.5 ton/ha	26.56 (31.02)	19.85 (26.45)	15.75 (23.38)	25.60 (30.39)	21.94 (27.81)
T_6: Azolla + FYM @ 2.5 ton/ha	18.12 (25.19)	10.90 (19.27)	9.50 (17.95)	20.00 (26.56)	14.63 (22.24)
T_7: Control 40 : 20 : 20 NPK kg/h	31.45 (34.11)	33.25 (35.21)	34.50 (35.97)	30.60 (33.58)	21.94 (34.71)
Mean	24.08 (29.30)	18.64 (25.27)	14.74 (22.03)	24.02 (29.78)	

* Mean of three replications

* Values in parentheses are angular transformed values.

	S.Ed(±)	C.D. (p = 0.05)
Treatment	0.24	0.54
Application	0.12	0.24
Treatment X Application	0.32	0.63

Effect of different treatments on yield of *sali* rice (var. Satyaranjan).

All the treatments significantly increased the yield in comparison to control (Table 6). Among the treatments, application of azolla + FYM (@ 2.5 ton/ha) recorded the highest yield (40.29 q/ha) which was, however, found to be statistically at per with that of application of *S. aculeata* and FYM (@ 2.5 ton/ha) recording 39.64 q/ha. Azolla is an ideal bio-fertilizer for paddy growing area of Assam, (Das, 1998) and add to the soil 40 kg of nitrogen, 5-9 kg phosphorus and 20-60 kg of potash from 1 ton of decomposed azolla. It also added organic matter to the soil and made soil environment favourable for growth and multiplication of soil microbs and thereby suppressing the saprophytic survival of *R. solani* and multiplication of soil microbs and thereby suppressing the saprophytic survival of *R. solani* and multiplication of soil microbs and thereby suppressing the saprophytic survival of *R. solani* and enchancing yield of rice. Application of FYM @ 5 ton/ha was found next in rank (37.31 q/ha) followed by application of *S. rostrata* + FYM recording 36.21 q/ha. Zentmeyer (1963) stated that addition of inorganic amendments to soil can act in a variety of ways to control soil borne plant pathogen which resulted less disease and enhancing the yield of rice (Table 6). The interaction of method of application and soil amendments revealed that seed + root dip treatment performed best in enhancement of yield in all the treatments as compared to seed or root dip treatment alone and control.

Table 6 : Effect of integrated seed treatments and soil amendments on yield of *sali* rice (var. Satyaranjan)

Treatment	Yield of *Sail* rice, var. Satyaranjan (q/ha)				
	Seed treatment (S.T.)*	Root dip treatment (R.D.T.)*	S.T. + R.D.T.*	Control*	Mean
T_1: FYM (@ 5 ton/ha)	37.70	36.30	38.50	36.74	37.31
T_2: *Sesbania aculeata* + FYM (@ 2.5 ton/ha)	41.0	39.20	41.46	36.90	39.64
T_3: *Sesbania rostrata* + FYM (@ 2.5 ton/ha)	36.60	35.85	38.71	33.68	36.21
T_4: Enriched compost + FYM (@ 2.5 ton/ha)	34.24	34.05	34.69	31.42	33.60
T_5: Rice straw + FYM @ 2.5 ton/ha	34.43	35.30	37.00	33.75	35.12
T_6: Azolla + FYM @ 2.5 ton/ha	41.40	40.10	42.51	37.15	40.29
T_7: Control 40 : 20 : 20 NPK kg/h	26.25	26.0	26.50	25.65	26.10
Mean	35.94	35.25	37.05	33.61	

* Mean of three replications

* Values in parentheses are angular transformed values.

	S.Ed(±)	C.D. (p = 0.05)
Treatment	0.37	0.80
Application	0.26	0.50
Treatment X Application	0.70	1.37

ACKNOWLEDGEMENT

The research work is being carried out under the ICAR (New Delhi) funded project in the form of NATP (CGP) sanctioned to the senior author.

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(Accepted for publication August 4, 2004)