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Effect of antagonists spray on rice sheath blight pathogen *Rhizoctonia solani* in pot culture

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The present study was undertaken to assess the percent disease incidence, relative lesion height, disease severity and 1000 grain weight against sheath blight of rice through two different antagonists, individually as well as in combination. One set of plants was sprayed two days before inoculation (pre-inoculation) and the other set two days after inoculation (post-inoculation). For comparison, one set of plants was also sprayed with sheathmar 3L (2.5%) and Kalisena (*A. niger* AN-27 @ 10^6 cfu ml^{-1}). Pre-inoculation spray of *Trichoderma koningii* 5201+*Chaetomium cochliodes* 3319 showed maximum reduction (39.4%) of the disease incidence, disease severity (36.3%), relative lesion height (37.5%) and 45.0% increase in 1000 grain weight followed by post inoculation of the same treatment.

Key words : Antagonists, disease assessment, *Rhizoctonia solani,* rice, sheath blight, 1000 grain weight

INTRODUCTION

Sheath blight caused by *Rhizoctonia solani* Kuhn is a threat to rice cultivation in different agro-climatic conditions. A modest estimation of losses due to sheath blight disease alone in India has been up to 54.3% (Ranjan, 1987; Roy, 1993). Many fungi from rice field soils are found to be antagonistic to *R. solani*. These fungi like *Trichoderma viride, T. harzianum*, and *T. koningii* (Roy and Sayre, 1984; Borah, 1992; Bhagwati, 1994; Dubey, 1998; Sudhakar *et al.*, 1998; Das and Hazarika, 2000; Surulirajan and Kandhari, 2003), *Aspergillus niger* (Gokulapalan and Nair, 1984; Sen *et al.,* 1993, Kandhari *et al.,* 2000), *A. terreus* (Das, 1992; Gogoi and Roy, 1993), *Gliocladium virens* and *Streptoverticillium* (Baby and Manibhushanrao, 1993) are found antagonistic against *R. solani*. In the present study, two fungi namely *Trichoderma koningii* and *Chaetomium cochliodes* which were earlier found very effective in *vitro* later tested individually and in combination against sheath glight disease in field.

MATERIALS AND METHODS

Mass multiplication of bio-control agents

Trichoderma koningii 5201 was multiplied on molasses yeast medium (Papavizas *et al.* 1984). The medium prepared was distributed @ 70 ml in each 250 ml flask and then 5 mm mycelial disc of *T. koningii* was inoculated. These flasks were incubated for 10 days at 28±2°C. A similar procedure was followed for *Chaetomium cochliodes* 3319, but was cultured in Potato Dextrose Broth.

Method of artificial inoculation

The pathogen *R. solani* was multiplied on Typha stem bits (Bhaktavatsalam *et al.,* 1978) and inoculated at maximum tillering stage between the leaf sheath and the culm of the plants just above the water level. High relative humidity was provided to the plants both 24 hours prior to and after inoculation by spraying the plants profusely with water in pot culture. For control, the plants were similarly inoculated with single, healthy, surface sterilized stem bit of Typha.

Pot culture studies

Twenty five days old Pusa Basmati-1 rice seedlings were transplanted into the earthern pots (30 cm diameter) each containing 3 kg of wetland

soil and maintained in the glasshouse by judicious water supply and fertilizers. The plants at the maximum tillering stage were inoculated with colonized Typha stem bits. High relative humidity was provided both 24 hours prior to and after inoculation by covering the plants with polythene sheets which were profusely sprayed with water. The spore suspension of fungal antagonists was prepared in sterile distilled warer using 3 days old actively growing culture with the spore concentration of 10^6 cfu ml^{-1}.

One set of plants was sprayed two days before inoculation (pre-inoculation) and the other set two days after inoculation (post-inoculation). The plants inoculated with pathogen alone served as control. For comparison, one set of plants was also sprayed with sheathmar (Validamyun) 3L (2.5%) and Kalisena (*A. niger* AN-27 @ 10^6 cfu ml^{-1}). There were three replications having five plants/pot for each treatment.

Assessment of disease incidence

Disease incidence was recorded by calculating number of infected tillers to the total number of tillers.

Assessment of relative lesion height

The lesion height and plant height were measured. Relative Lesion Height (RLH) was calculated using the following formula

$$RLH = \frac{\text{Lesion height}}{\text{Total plant height}} \times 100$$

Assessment of disease severity

The disease severity was calculated by using the rice sheath blight grade chart given by IRRI (1996) and formula given by Mew *et al.* (1986).

Grade	Lesion height
0	No infection
1	Lesion limited to lower 20 per cent of height of the plant
3	Lesion limited to lower 21–30 per cent of the height of the plant.
5	Lesion limited to lower 31–45 per cent of the height of the plant.
7	Lesion limited to lower 46–65 per cent of the height of the plant.
9	Lesion more than 65 per cent of the height of the plant.

$$\text{Severity} = \frac{0(N0) + 5(N1) + 10(N3) + 30(N5) + 50(N7) + 100(N9)}{\text{Total number of tillers observed}} \times 100$$

1000 grain weight

The earhead harvested from plant was threshed in aluminium tray and the grains were cleaned. A total of 1000 grains were counted and dried in shade for 12 hours so as to get moisture level of 14 per cent approximately. Later the weight was taken using an electronic weighing balance.

RESULTS AND DISCUSSION

Disease incidence

Pots sprayed with antagonistic spore suspension showed disease incidence ranging from 32.1 percent to 43.9 per cent (Table 1). Among biocontrol agents preinoculation spray of *T. Koningii* 5201 + *C. cochliodes* 3319 showed maximum disease incidence reduction of 39.4% followed by post inoculation spray of *T. koningii* 5201 + *C. cochliodes* 3319 (31.6%). Least disease incidence reduction of 19.6% was observed in post inoculation spray of *A. niger* AN27 (Kalisena). This is much lower than the value of 36% sheath blight reduction in rice reported by Kandhari *et al.* (2000).

Relative lesion height

Pre-inoculation spray of *T. koningii* 5201 + *C. cochliodes* showed 37.5% reduction in relative lesion height followed by post-inoculation spray of the same (34.3%). The least reduction of 19.7 per cent was observed in post-inoculation spray of *A. niger* AN27 (Kalisena). In general pre-inoculation spray of antagonists showed better reduction than the post-inoculation spray. The findings of the present study are corroborated by Dixit and Gupta (1999) who reported pre-inoculation spray of *T. viride* showed highest lesion height reduction than its post-inoculation spray.

Tatle 1 : Effect of antagonists spray in reducing disease incidence, Relative Lession height and disease severity.

Treatments	Disease incidence*'		Relative lesion height		Disease severity (%)	
	Mean*	Reduction over control (%)	Mean	Reduction over control (%)	Mean	Reduction over control (%)
T. koningii 5201 (Pre-inoculation)	38.3	27.2	31.6	28.1	27.1	21.9
C. cochliodes 3319 (Pre-inoculation)	41.2	22.2	34.1	22.5	26.4	23.8
T. koningii 5201+*C.cochliodes* 3319 (Pre-inoculation)	32.1	39.4	27.5	37.5	22.1	36.3
A. niger AN 27 (Kalisena) (Pre-inoculation)	42.3	20.1	34.5	21.5	28.2	18.7
Sheathmar (Validamyun) 3L (Pre-inoculation)	17.1	67.7	15.3	65.2	10.2	70.6
T. koningii 5201 (Post-inoculation)	40.4	23.7	29.5	32.9	26.9	22.4
C. cochliodes 3319 (Post-inoculation)	43.9	17.1	33.8	23.1	27.4	21.0
T. koningii 5201+*C. cochliodes* 3319 (Post-inoculation)	36.2	31.6	28.9	34.3	24.1	30.5
A. niger AN 27 (Kalisena) (Post-inoculation)	42.6	19.6	35.3	19.7	27.6	20.4
Sheathmar (Validamyun) 3L (Post-inoculation)	6.3	88.1	7.7	82.5	6.2	82.1
Control	53.0	—	44.0	—	34.7	—
CD (at 5% level)	3.1		2.6		1.9	

*Mean represents average of two observations taken at 20 and 35 days after inoculation.

Disease severity

Pots sprayed with antagonistic spore solutions showed variation in disease severity from 22.1 percent to 28.2 per cent. Highest reduction of disease severity (36.3%) was obtained in the pots treated with pre-inoculation application of *T. Koningii* 5201 + *C. cochliodes* 3319 followed by 30.5% in their post-inoculation application. Nehan and Thakur (1998) observed that the spray of *T. harzianum* @ 10^6 spores/ml concentration 48 hours before pathogen inoculation showed 28.7% reduction of disease severity in pot culture experiments. In contrast, Upadhyay (2000) reported that there is no significant difference among pre, together and post-inoculation of *Gliocladium virens* (isolate GV12) to control sheath blight in rice. Further, the huge variation between pre and post-inoculation spray of fungicide sheathmar 3L (2.5%) in reducing disease severity is mainly because post-inoculation spray was done after *R. solani* (4500) inoculation and it got killed which was not in the case of pre-inoculation.

Grain weight

Observation on 1000 grain weight showed variable results among treatments. All the pots sprayed with antagonists showed significant difference over control. Maximum of 11.6 g was obtained from the pots treated with pre-inoculation spray of *T. koningii* 5201 + *C. cochliodes* 3319. Patel and Mukopadhyay (1997) observed that spray of fungal antagonists increase the grain weight considerably in rice. The interaction between antagonists and rice plants

Tatle 2 : Effect of antagonists spray on 1000-grain weight of rice cultivar Pusa Basmati-1.

Treatments	1000-grain weight (g)	% increase over control
T. koningii 5201 (Pre-inoculation)	10.9	36.9
C. cochliodes 3319 (Pre-inoculation)	9.7	21.3
T. koningii 5201+*C. cochliodes* 3319 (Pre-inoculation)	11.6	45.0
A. niger AN 27 (Kalisena) (Pre-inoculation)	8.4	5.0
Sheathmar (Validamyun) 3L (Pre-inoculation)	9.6	20.0
T. koningii 5201 (Post-inoculation)	10.1	26.3
C. cochliodes 3319 (Post-inoculation)	10.9	36.9
T. koningii 5201+*C. cochliodes* 3319 (Post-inoculation)	10.7	33.7
A. niger AN 27 (Kalisena) (Post-inoculation)	8.1	1.3
Sheathmar (Validamyun) 3L (Post-inoculation)	11.9	48.7
Control	8.0	—
CD (at 5% level)	0.6	

probably produce some compound that helps in concentrating the photosynthetic metabolites at sink. Kandhari *et al.* (2000) observed that seed dressing with Kalisena SD (*A. niger* AN 27) reduces sheath blight disease and promotes root length, shoot length, and biomass of the plant.

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