Evaluation of SAAF with other Fungicides and Biocides against Sheath Blight of Paddy Caused by *Rhizoctonia solani*

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Abstract

Among the different concentrations of SAAF (Carbendazim 12% & Mancozeb 63%) i.e. 0.1, 0.2, 0.4, 0.75 and 1.0 %, 0.75% was found most effective in reducing mycelial growth of *Rhizoctoniasolani.* Comparative evaluation of SAAF with other fungicides (Companion and Carbendazim) and biocides (Neem & *T. harzianum)* revealed that SAAF is most effective in reducing mycelial growth of the pathogen, showing 2.3 cm in diameter against 9.00 cm in control. The minimum disease incidence with 14.75% was also recorded by foliar spray of SAAF @ 0.75 which was followed by companion @ 0.5% (18.22 %).

1. Introduction

Rice (*Oryza sativa* L.) is the most important food crop solely providing the food security in India. About 60% of the world and 70% of Indian populations are depending on rice. In India, it is cultivated under varied agro-ecological situation. Rice is being extensively grown in all over the world like Bangladesh, Brazil, Burma, China, Nepal, India, Pakistan, Philippines, Thailand, USA and Vietnam. This single crop contribute alone about half of the total food grains and 50% of the total cereal production in India (Viraktamath, 2007). Globally, rice covers an area of about 153.65mha with a production level of about 672.02 mt and productivity of 4.376 t ha^{-1} (FAO, 2010). In India, area, production and productivity of rice were 41.92 mha, 89.09 mt and 2125 kg ha^{-1} (rough paddy is considered for World but milled rice for India), respectively. However, the productivity of rice in India is still very low in comparison to average global productivity (Agricultural Statistics at a Glance, 2011), which solely responsible due to some biotic and abiotic constraints, that hampering in boosting higher yield of rice. Among the biotic constraints sheath blight caused by *Rhizoctoniasolani* (Kuhn) perfect stage *Thonatophorus cucumeris* (Frank) donk. is one of the most important disease of rice causing 12 to 25% in crop losses under different geographical areas (Rajan, 1987). The management of diseases can be done through cultural, chemical, biological, and use of resistant variety. But there is no doubt that application of chemicals is one of the most effective and widely recommended methods of disease management. However, continuous use of same chemical encourages development of new resistance strain among the pathogen. Therefore, there is a need to change the chemical at frequent interval of time. In these view, new fungicide, SAAF (Carbendazim 12% & Mancozeb 63%) has been under taken to evaluate the SAAF with other fungicides and biocides against sheath blight of paddy in the present investigation.

2. Materials and Methods

2.1. Isolation, Purification and identification of Rhizoctonia solani

Naturally infected paddy leaves were collected from Student's Experimental Research Farm of the University. The disease portion of leaves were cut into 2 mm. long pieces by sterilized blade and washed 3-4 times with sterilized water in order to remove the dust and other contaminant. Then the pieces were dipped in 0.1 $HgCl_2$ for about 20-30 second followed by washing with distilled water thoroughly in 3-4 times to remove the trace of $HgCl_2$. The pieces were then transferred with the

help of sterilized needle in sterilized petri-dishes containing 2% PDA medium which was previously poured aseptically. The petri-plates were incubated in BOD at 25 ±1°C. The fungus was then purified by hyphal tip isolation method (Rangaswami, and Mahadewan, 1999). The purified stock culture of *Rhizoctonia solani* was revived after every fort night and maintained on PDA at 5° C in refrigerator.

2.2. Collection of fungicides and biocides

The fungicides like SAAF 75wp (Carbendazim 12% + Mancozeb 63%), Bavistin (Carbendazim) and Companion were collected from local market. Bioagent like *T. harzianum*, was collected from Department of Plant Pathology C. S. Azad University of Agriculture and Technology, Kanpur and neem leaves were collected from the University campus for the present investigation.

2.3. Solution Preparation

The fresh neem leaves were collected from the University campus. Collected leaves were washed in tap water followed by sterile water and dried in blotter paper. Then the leaves were crushed in Pestle and mortar using 1:1 ratio of leaves and distilled water (w/v) and filtered with two layer of muslin cloth to obtain leaf extract. The extract was diluted with water to makes 5% concentration for further use. Similarly, bioagent solution was prepared from seven days old culture of *T. harzianum*. The suspension containing conidia and mycelium bit was churned in a warning blender and strained with cheese cloth. The suspension containing approximately 10^3-10^5 conidia was used for this study. As SAAF 75 wp(carbendazim 12% + mancozeb 63%), is a new fungicide and there is need to standardize it concentrations. Therefore, exactly 0.1mg, 0.2 mg, 0.4 mg, 0.7 mg and 1.0mg of SAAF were weighted and dissolved in water separately in 100 ml of water to prepare 0.1, 0.2, 0.4, 0.75 and 1.0% concentrations of fungicides.

2.4. Effect of SAAF on mycelial growth of Rhizoctonia solani

The experiment was conducted by using poisoned food technique as described by Schmitz (1930). The fungicide SAAF 75 wp (carbendazim 12% + mancozeb 63%) was thoroughly mixed in PDA medium @ 1.0 mg, 0.7 mg, 0.4 mg, 0.2 mg, 0.1 mg per 100 ml of PDA in 250 ml flask. The medium containing fungicide was mixed thoroughly and poured in petri-plate and allow to solidify. Each treatment was replicated three times. One petri-plate contain only medium without any fungicide was served as a control. Discs of 0.5 cm diameter, mycelial bit was cut by the cork borer and placed at the centre of petri-plate and incubated at 28±1°C. Observation on the mycelial growth of fungi in each petri-plate was recovered at every 24 hrs. up to seven days of incubation.

2.5. Comparative study of SAAF with other fungicides and biocide on mycelial growth of Rhizoctonia solani

The experiment was conducted by using three fungicides and two biocides to evaluate their effectively against *Rhizoctonia solani* by poison food technique (Schmitz, 1930). Three fungicides namely SAAF (0.25mg), Carbendazim (0.75 mg) and Companion (0.5mg) and Neem extract @ 5 ml were thoroughly mixed with 100 ml of PDA in 250 ml conical flask. The medium contains fungicides were mixed thoroughly and was poured in petri-plate and allow to solidified. In one petri-plate, 5 mm diameter of bio agent and pathogen were placed in sterilized petri-plate poured with PDA at the end of two diameter point leaving behind 0.5 cm distance from the periphery. Each treatment was replicated three times. One petri-plate contain only medium without any fungicide and biocide serve as a control. The 0.5 cm diameter, mycelial bit was cut by the cork borer and placed at the centre of all petri-plate. Then petri-plates were incubated at 28±1°C and after 7 days, observation on mycelial growth in each petri-plate was recorded.

2.6. Disease severity

The experiment was conducted at glass house condition to find out the effect of foliar spray, with fungicides and biocides on development of disease (glass house condition). Paddy seed of variety PR-840 was treated with fungicides and bioagents and are sown in 30 cm earthen pots which were previously filled with sterilized soil. At three to four leaf stages, seedlings were inoculated with *Rhizoctonia solani*. After inoculation with pathogen, the plants were covered with polythene bags for 48 hours to provide suitable humidity for development of disease. After another 48 hours, plants were sprayed with SAAF @ 0.75%, Carbendazim @ 0.5%, Companion @ 0.25%, Neem 5% and spore suspension of *T. harzianum*. Then, the seedling was kept on the bench the glass house. During the course of this experiment, plant inoculated only with *Rhizoctonia solani* was kept as control. The PDI was calculated after 10 days of last spraying using 0-9 linear scales as described in the Standard & Evaluation System for rice (Kandhari, 2002).

2.7. Effect of foliar spray with fungicide and biocide against sheath blight of rice (in field condition)

The field trial was conducted at Crop Research Farm, C.S Azad University of Agriculture and Technology, Kanpur to evaluate the efficacy of three fungicides and two biocides against sheath blight of rice (*Rhizoctonia solani*). The experiment was laid out in Randomized Block Design (RBD) with three replications using a high susceptible variety (PR-840) of rice. The plot size was 3.25 m x 4 m, recommended agronomical practices were followed. The plants were sprayed with SAAF (0.75%), Carbendazim (0.05%) and Companion (0.25%) twice at 10 days interval. The first spraying was done after initiation of disease

and second spray after 10 days, control plant was sprayed with water only. PDI was recorded after 7 days of last spraying using 0-9 linear scale as described in the Standard Evaluation System for rice (Kandhari, 2002). The PDI was calculated by the following formula:

$$\text{Disease severity(PDI)} = \sum \frac{\text{Class rating x class frequency}}{\text{Total no. of leaves x maximum class rating}} \text{ x } 100$$

3. Resulits snd discussion

3.1. Effect of different concentrations of SAAF on mycelial growth of Rhizoctonia solani

The effect of different concentrations of SAAF on suppression of mycelial growth of *R. solani* was recorded after every 24 hour up to 7 days of inoculation. It was evident from the Table 1 that suppression of mycelial growth of *R. solani* began at second days of inoculation. It has also found that the growth of fungus was fast up to 4 days and after that it is gradually reduced. The maximum inhibitory effect with 70% was recorded in the concentration of 0.75 % which is also as same with 1.0%. It is cleared that maximum per cent of inhibition was recorded at 6 days of inoculation and after that there is no further reduction of mycelial growth of the pathogen. The result summarized that per cent of reduction in mycelial growth was gradually increased with the increase concentration of solution up to 0.75 %.

3.2. Comparative study of SAAF with other fungicides and biocide on mycelial growth of Rhizoctonia solani

Three fungicides and two biocides have been tested against mycelial growth of *R. solani* and the result presented in the Table 2 indicated that both SAAF and Carbendazim are able to suppress completely the mycelial growth *R. solani*. The maximum reduction in mycelial growth of *R. solani* was found with the use of SAAF @ 0.75% and carbendazim 0.5%. The Foliar spray of fungicides and biocides on the rice plants revealed that the drastic decline in lesion formation of *R. solani* under glass house condition (Table 3). Among the treatments foliar spray of SAAF @ 0.75% was found most effective against disease, showing 2.13% disease area against control (7.36%) which was followed by foliar spray with companion @ 3.23%. The foliar spray with spore suspension of *T. harzianum*, also able to lowering down disease area upto 5.84%. Biswas et al. (2008), also reported that seed treatment with biocide and foliar spray with fungicides is the best management of strategies for management of sheath blight. Singh and Sharma (1973), also reported that systemic activity of Brestanol, Brestan and Duster on rice seedling and suggested possibility of control by these fungicides.

3.5. Effect of foliar spray with fungicide and biocide against sheath blight of rice (in field condition)

Table 1: Effect of different concentrations of SAAF on spore germination and mycelia growth of *Rhizoctonia solani* (Food poison method)

Conc. of fungicides (%)	Mycelium growth (Diameter in cm) 1-7 days							% reduction of growth
	1	2	3	4	5	6	7	
1.00	0.6	1.5	2.1	2.3	2.3	2.3	2.3	74.44
0.75	0.6	1.5	2.1	2.5	2.5	2.5	2.5	72.22
0.40	0.6	1.6	2.2	3.1	3.8	4.4	4.8	46.66
0.20	0.6	1.6	2.6	3.4	4.8	5.3	5.93	34.11
0.10	0.6	2.6	3.9	4.8	5.4	6.2	6.74	25.11
Control	0.6	2.9	4.2	5.8	7.1	7.8	9.00	0.00
SEm±							0.49	
CD (p=0.05)							0.23	

A field trial experiment was conducted using fungicides and biocide as foliar spray against sheath blight disease of paddy. The data presented in the Table 3 revealed that all the treatment were effective in minimizing sheath blight disease of rice over control. The foliar spray of SAAF@ 0.75% twice were found more effective against the disease, showing 14.75% disease severity against 43.50% in control, which was followed by spraying with carbendazim @0.5% (27.33%). Foliar spray with neem extract (37.10%) apparently showing superior to minimize disease severity than *Trichoderma harzianum* (34.28%) and control but inferior to others. Surulirajan and Kandahari (2003) also reported that soil amendment with *T. viride*, carbendazim singly or in combination was found effective in controlling the sheath blight disease of rice. Ratan et al. (2003) also reported that seed treatment with thirum and foliar spray companion was found best in reducing disease severity of brown leaf spot with significant increased in yield.

Table 2: Effect of fungicides and biocides on mycelial growth of *Rhizoctonia solani* (*in vitro*)

Treatment	Concentrations of fungicides (%)	Mycelium growth (diameter in cm)	Growth reduction (%)
SAAF	0.75	0.95	89.44
Carbendazim	0.50	5.21	42.11
Companion	0.25	3.15	65.00
T. harzianum (cfu)	105 conidia m^{-1}	4.31	52.11
Neem	5.0	5.94	34.00
Control	-	9.00	-
SEm±		0.23	
CD (p=0.05)		0.49	

Table 3: Effect of fungicides and biocides against sheath blight of paddy under glass house and field condition

Treatment	Concentrations of fungicides (%)	Under glass house condition						Disease severity (field condition)
		Total leaf tiller^{-1}	No. of infected leaf	No. of spot	Total disease affected area (cm^2)	Average leaf area (cm^2)	Disease severity	
SAAF	0.75	31	4	7	2.24	105.0	2.13 (8.392)	14.75 (22.000)
Carbendazim	0.50	31	6	10	3.2	102.0	3.26 (10.402)	27.33 (31.010)
Companion	0.25	32	5	10	3.2	99.0	3.23 10.353	18.22 (20.207)
T. harzianum	105 conidia ml^{-1}	30	7	11	3.52	60.23	5.84 (13.984)	34.28 (30.007)
Neem	5.0	30	6	12	3.84	91.66	4.18 (11.797)	37.10 (37.024)
Control	--	31	8	16	4.8	65.2	7.36 (15.724)	43.50 (41.203)
SEm±							0.259	0.272
CD (p=0.05)							0.55	0.58

4. Conclusion

The result summarized that the optimum concentration of SAAF is 0.75 % in reducing spore germination and mycelial growth of *R. solani.* Foliar spray with SAAF @ 0.75 % twice is highly effective in lowering down disease severity in rice. Therefore, SAAF can be recommending for management of sheath blight disease of rice.

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