Efficacy of Fungicides for the Management of Sheath Blight of Rice

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***Abstract*: Sheath Blight of rice caused by *Rhizoctonia solani* (teleomorph: *Thanatephorus cucumeris*), is a notorious pathogen and has a wide host range with worldwide in distribution, a very destructive disease under favorable weather conditions in rice growing areas of the world which ultimately causes substantial yield losses. Field experiment were laid out during the *kharif* season 2020-2021 at OUAT Crop protection field, Bhubaneswar, Odisha on rice cultivar Tapaswini to evaluate the effect of different fungicides in controlling sheath blight of rice. Seven fungicides viz; sheath mark (validamycin 3% L), Tilt (propiconazole 25 % EC), Beam (tricyclazole 75% WP), Folicur (tebuconazole 16%L), Contaf (hexaconazole 5% EC), Bavistin (carbendazim 50% WP) and Amistar (azoxystrobin 23% SC) were evaluated for the control of the pathogen at different stages of the plant growth while the control plots were left un-treated. Among these seven fungicides, azoxystrobin 23 % SC showed minimum disease severity (41.06 %) with 46.03 per cent disease control over check followed by Tilt (propiconazole 25% EC) (45.76 %) with 41.37 per cent disease control over check as compared to control with disease severity (80.97 %) along with maximum yield (69.93q/ha) and (67.72q/ha) respectively.**

Among fungicides tested. In vitro, Azoxystrobin 23% SC was found most effective and showed 100 percent inhibition of mycelial growth of R.solani, from 25 ppm. This study showed that, Azoxystrobin 23% SC a new generation fungicide is more effective and increases the yield upto 22.42 percent.

***Index Terms*: Sheath Blight, Rhizoctonia, Rice.**

Introduction

Rice (*Oryza sativa* L.) is regarded as one of the most important cereal crops and a major food grain contributor to the total world food grain basket. Rice is a graminaceous crop and consider as one of the important staple foods for Asian countries. In India, *indica* variety of rice is grown. To meet the global rice demand, it is estimated that about 114 million tons of additional milled rice is required. Therefore, for the production of this extra rice, productivity needs to be increased by 2035 which is equivalent to an overall increase of 26 per cent in the next 25 years [1]. With use of high yielding varieties, fertilizers, irrigation and intensive cultural practices have resulted in great increase in the occurrence and severity of disease infesting rice in several countries [2]. Sheath Blight of rice caused by *Rhizoctonia solani* Kühn is one of the most important and widely distributed diseases in all the rice growing regions of the world and causing considerable losses in grain yield [3]. The pathogen has a wide host range and can infect plants belonging to more than 32 plant families and 188 genera [4]. The importance of the disease has increased in recent years in most of the rice growing region of the world due to widespread cultivation of profusely tillering and fertilizer responsive high yielding verities and hybrids. Every year, the blight causes up to a 50 per cent reduction in the production of rice under favorable conditions around the world [5] and yield reductions up to 20 per cent may be induced when sheath blight develops epidemic and reach to the uppermost leaves of the plants [6-8]. According to Chahal *et al*. (2003) the estimation of losses due to sheath blight of rice in India has been reported up to 54.3 per cent. In India, the disease was first reported from Gurdaspur, Punjab by [9]. It is causing concern to the farmers of major rice growing states of India like:-Andhra Pradesh, Karnataka, West Bengal, Assam, Uttar Pradesh and Jammu and Kashmir. Now, it is known to occur in almost all the rice growing states of the country causing up to 50 per cent loss in yield [10].

The disease is more alarming due to intensive cultivation of modern high yielding varieties with high doses of nitrogenous fertilizers. Crop with a high plant density and close canopy associated favors disease build up from panicle initiation onwards. Poor weed management practices and increase in frequency of irrigation have aggravated the incidence of the disease. The symptoms of sheath blight disease can be observed in both nursery and transplanted crop. The symptoms usually appear at tillering stage on leaf sheath at water level in the lowland and at ground level in upland eco system. The pathogen produces elliptical or oval to irregular, greenish, grey spots on leave sheath and leaves. The centre of the spot become greyish white with brown margin. Under favorable conditions, the infection spreads rapidly to upper leaf sheaths and leaf blades of the same or adjacent tillers. Lesions on the upper parts of the plant extend rapidly, coalescing with each other to cover entire tiller from the water level to flag leaf which ultimately causing death of leaf, tiller and the plant. An increase in sheath blight severity by one percent resulted in grain yield loss of 0.38 per cent [11] and 0.74 per cent [12]. The complex genetic nature of resistance to sheath blight and genetic variability of the pathogen increases the difficulty in developing resistant host genotypes, as well as in effectively deploying available tolerant cultivars [13]. Unfortunately, at present there is no known rice varieties which is either immune or possess high degree of resistance to sheath blight disease. In the absence of suitable resistant donors, fungicides are the main answer to check these diseases. Earlier recommended fungicides such as Zineb etc. do not provide satisfactory disease control. The present study was undertaken to evaluate the different fungicides at different formulation for efficient control of sheath blight of rice.

Materials and Methods

In vitro *evaluation of fungicides against the Rhizoctonia solani*

Rhizoctonia solani was isolated from the infected sheath of rice plant and isolate was incubated on Potato dextrose agar medium (PDA) at 28°C ± 2°C and 70% relative humidity. Efficacy of seven fungicides viz; sheath mark (validamycin 3% L), Tilt (propiconazole 25 % EC), Beam (tricyclazole 75% WP), Folicur (tebuconazole 16%L), Contaf (hexaconazole 5% EC), Bavistin (carbendazim 50% WP) and Amistar (azoxystrobin 23% SC) at different concentrations was evaluated against *R. solani* by using poisoned food technique. A series of concentration as 5, 10, 15, 25, 50 and 100 ppm of all fungicides were made on the basis of active ingredient. Required amount of each fungicide was incorporated aseptically in autoclaved PDA. Twenty ml. of molten medium amended with different concentrations of the test fungicides were poured in 90 mm sterilized petriplates and allowed to solidify. Three petriplates were used for each concentration to test the sensitivity of *Rhizoctonia solani*. Suitable controls without fungicides were also maintained simultaneously. Mycelium agar discs (5 mm diameter) cut with the help of sterilized cork borer from margin of an actively growing culture of *R. solani* (3 day old) was incubated in Petri dishes containing PDA poisoned with different concentrations of test fungicides. These inoculated petriplates were incubated at 28 ± 2°C, 70% RH and observed after 72 hr. The fungal colony diameter was measured in each plate and per cent of inhibition in mycelial growth was calculated in different treatment over check. The per cent inhibition of mycelial growth was worked out by using the following formula by [14] and the data were analyzed statistically using completely randomized design.

$$I = \frac{C - T}{C} \times 100$$

Where, I = Percent inhibition in mycelia growth; C = Average colony / fungal growth diameter in control; T= Average colony / fungal growth diameter in treatment

In vivo *evaluation of fungicides against the Rhizoctonia solani*

The field trials were conducted during *Kharif* season 2020-2021 in a Randomized Block Design (RBD) with three replications and plot size of 5.0m X 2.0 m (spacing 15cm X 20 cm) on rice variety Tapaswini at Crop protection field, OUAT, Bhubaneswar to study the efficacy of different fungicides against sheath blight of rice. These fungicides viz; sheath mark (validamycin 3% L), Tilt (propiconazole 25 % EC), Beam (tricyclazole 75% WP), Folicur (tebuconazole 16%L), Contaf (hexaconazole 5% EC), Bavistin (carbendazim 50% WP) and Amistar (azoxystrobin 23% SC) were sprayed thrice 60 DAT at 10 days interval with recommended formulation/l. Grain yield was observed and recorded on plot basis and expressed as q/ha.

Percent disease index

Disease severity of sheath blight was recorded after each spray by Relative Lesion Height (RLH) method [15] by using the following formula:

$$RLH = \frac{\text{Lesion Height}}{} \times 100$$

Five sampling units of 1 m^2 area were marked in each plot at random. The disease severity was recorded on fifteen plants per sampling unit.

Per cent disease control over check was calculated by using the following formula:

$$\text{Per cent disease control over check} = \frac{(\%)\text{ disease severity in check} - (\%)\text{ disease severity in treatment}}{(\%)\text{ disease severity in check}} \times 100$$

Per cent yield increase over check was calculated by using the following formula:

$$\text{Per cent yield overcheck} = \frac{\text{Yield (q / ha) in treatment} - \text{Yield (q / ha) in check}}{\text{Yield (q / ha) in treatment}} \times 100$$

Results and Discussion

In-vitro *evaluation fungicides against Rhizoctonia solani*

All seven fungicides viz; sheath mark (validamycin 3% L), Tilt (propiconazole 25 % EC), Beam (tricyclazole 75% WP), Folicur (tebuconazole 16%L), Contaf (hexaconazole 5% EC), Bavistin (carbendazim 50% WP) and Amistar (azoxystrobin 23% SC) exhibited varying level of efficacy against *Rhizoctonia solani* for mycelia growth inhibition. These fungicides were prepared at different concentration (ppm) viz. 5, 10, 15, 25, 50 and 100 then tested by poisoned food technique. The result tabulated in **Table 1** indicate that Amistrar and Tilt was found to be highly inhibitory (100%) to *Rhizoctonia solani* (Rice) from 25 ppm concentration

S. No.	Fungicide	*Rhizoctonia solani* Radial growth (mm)						Growth Inhibition (%)					
		5 ppm	10 ppm	15 ppm	25 ppm	50 ppm	100 ppm	5 ppm	10 ppm	15 ppm	25 ppm	50 Ppm	100 ppm
1	validamycin 3%	49.00	46.10	36.00	27.67	8.25	0.00	45.56	48.78	60.00	69.26	90.83	100.00
2	propiconazole 25% EC	19.08	9.75	6.08	0.00	0.00	0.00	78.80	89.16	93.25	100.00	100.00	100.00
3	tricyclazole 75%WP	45.60	34.33	14.82	7.90	2.29	0.00	49.34	61.86	83.54	91.23	97.45	100.00
4	tebuconazole 16% L	51.70	35.60	28.48	8.93	2.70	0.00	42.56	60.45	68.36	90.07	97.00	100.00
5	hexaconazole 5% EC	33.10	29.17	14.35	1.77	0.00	0.00	63.22	67.59	84.06	98.04	100.00	100.00
6	carbendazim 50% WP	61.17	47.53	42.48	36.53	21.33	3.40	32.04	47.19	52.80	59.41	76.30	96.22
7	azoxystrobin 23% SC	18.50	12.35	11.75	0.00	0.00	0	79.44	86.27	86.94	100.00	100.00	100.00
8	Control	90	90	90	90	90	90	0.00	0	0	0	0	0
	A=Fungicide					**B=concentration**				**A*B**			
	CD at 5%	=1.09				0.94				2.26			
	SEm±	=0.38				0.33				0.95			
	CV	=6.07											

but in case of Amistrar maximum inhibition (79.44%) was recorded from 5ppm, while in case of Contaf complete inhibition was recorded at 50 ppm and 100 ppm. This study resembles with the experiment conducted by [16] for the management of sheath blight of rice *in vitro* conditions and found that azoxystrobin at 10, 20 and 40 ppm completely inhibits mycelium growth of *Rhizoctonia soalni*.

In vivo *evaluation of different fungicides*

Field trial conducted during *kharif* season 2020-2021 and all the test fungicides reduced disease severity and increased grain yield of cultivar Tapaswini significantly (**Table 2**). Amistar (azoxystrobin 23 % SC) was proved to be best followed by Tilt (propiconazole 25% EC) in reducing disease and increasing yield.

Table 2 Effect of fungicides on disease parameter in sheath blight of rice during *Kharif* 2020-2021

S.No.	Treatments	Disease severity (%)	Disease incidence (%)	Per cent disease control over check	Yield (q/ha)	Per cent (%) increase in yield over check (Average)
1	Validamycin 3%	52.19 (46.25)	80.34 (63.67)	31.18	64.51	15.90
2	Propiconazole 25% EC	45.76 (42.56)	68.08 (55.60)	41.37	67.72	19.89
3	tricyclazole 75 % WP	48.69 (55.76)	71.97 (58.04)	37.02	65.28	16.90
4	Tebuconazole 16% L	55.76 (48.31)	86.01 (68.04)	30.02	62.32	12.95
5	hexaconazole 5% EC	46.36 (42.91)	71.05 (57.45)	37.89	66.93	18.95
6	carbendazim 50% WP	58.53 (49.91)	92.86 (74.51)	27.95	58.55	7.34
7	Azoxystrobin 23% SC	43.16 (41.06)	65.36 (53.95)	46.03	69.93	22.42
8	Control	80.97 (64.15)	99.39 (86.35)	-	54.25	-
CD at 5%		0.94	2.28		3.95	
S.Em±		0.31	0.75		1.30	
CV		1.13	2.01		3.55	

In the present study Amistar (azoxystrobin 23%SC) was found highly effective against sheath blight of rice and gave good result with 69.93 q/ha yield which was 22.42 per cent higher than check, followed by Tilt (propiconazole 25% EC) (67.72 q/ha) with 19.89 per cent more yield as comparison to check. This study showed that, Amistar (azoxystrobin 23% SC) a new generation fungicide is more effective for the management of sheath blight of rice present study corroborating the earlier reports of [17-20]

who reported that spray of azoxystrobin at 125, 250 and 500 g/ha suppresses the development of sheath blight and enhances the yield level.

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