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Field evaluation of some novel fungicides for the management of sheath rot disease in rice

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Abstract

Sheath rot caused by *Sarocladium oryzae* (Sawada) is one of the most important diseases of the major high-yielding rice varieties. The use of same fungicide continuously year after year can cause fungicidal resistance to the pathogen. Keeping this in view, a field experiment was conducted at Regional Research and Technology Transfer Station, Chiplima, Sambalpur, Odisha during kharif seasons of 2022-23 and 2023-24 to assess the effect of nine novel and commercially available fungicides for the management of sheath rot disease in rice. They were sprayed twice at 15 days interval starting from the panicle initiation stage. Among all the fungicides Kresoxim-methyl 40% + Hexaconazole 8.0% WG @ 1g/l was found best to manage the disease during both the years of experiment. It gave 72.6% disease control and 49.6% yield increase over check plots in rice.

Keywords: Rice, sheath rot, management, fungicides

Introduction

Rice is one of the most important cereal crops and staple food for over half the world's population (Singh *et al.*, 2019) ^[15]. Plant diseases are one of the major causes of yield losses in rice. Among the various fungal diseases, sheath rot caused by the fungus *Sarocladium oryzae* (Sawada) is a very destructive disease of rice and was first reported from Taiwan by Sawada (1922) ^[13]. In India, the disease was 1st reported by Agnihorthrudu (1973) ^[1]. Later the disease was reported by several workers from different parts of the country (Ghuffran *et al.*, 1980) ^[4]. The disease, under favourable weather conditions during the crop growth period can cause substantial yield losses which can vary from 9.6- 85% (Phookan and Hazarika, 1992; Naeimi *et al.*, 2003; Pal *et al.*, 2015) ^[11, 7, 9]. The disease is now known to occur in most of the rice growing states of India.

The major problem in sheath rot resistance breeding is the lack of knowledge on the genetic variability and virulence pattern of the pathogen; therefore, it is difficult to develop sheath rot resistant varieties (Sharma *et al.*, 2013) ^[14]. Hence one has to depend mostly on fungicides for the management of the disease. But the use of same fungicide continuously for the management of the disease can increase the chances of pathogen to develop resistance to a particular chemical (Brent and Hollomon 1998; Zhang *et al.*, 2009) ^[2, 16]. So, there is a need to use or evaluate new fungicides or combination fungicide products to overcome such pathogen resistance against a particular fungicide. Moreover, fungicides should be rotated periodically to prolong their efficacy. Identification and recommendation of appropriate and contemporary fungicides are essential for mitigating the impact of the disease. Therefore, the main objective of the study is to evaluate the effectiveness of various fungicides for the management of sheath rot disease in rice.

Materials and Methods

Field experiment was conducted during kharif seasons of 2022-23 and 2023-24 respectively to assess the effect of different combination fungicides for the management of sheath rot disease in rice at Regional Research and Technology Transfer Station, Chiplima, Sambalpur, Odisha. The station is located at 20°21'N latitude and 80° 55'E longitude with an elevation of 178.8 m above mean sea level. Sheath rot disease susceptible variety MTU 1001 was selected for the study and twenty-five days old seedlings were transplanted in plot size of 15

m² with a spacing of 15cm X 20cm having bunds all around the plots. The experiment was laid out in RBD with 10 treatments and 3 replications. Replications were separated with a gap of 1 meter for irrigation channels. The experiment was conducted with recommended package of practices except plant protection measures. Recommended dose of NPK @ 80:40:40 kg/ha was applied in the form of Urea, DAP and MOP. Full dose of DAP and MOP were applied as basal and urea was applied in three split doses as basal, at maximum tillering stage and at booting stage. The treatment consisted of T₁: Azoxystrobin 11% + Tebuconazole 18.3% SC @ 0.15%, T₂: Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 0.1%, T₃: Azoxystrobin 18.2% + Difenconazole 11.4% SC @ 0.1%, T₄: Propiconazole 13.9% + Difenconazole 13.9% EC @ 0.1%, T₅: Kresoxim-methyl 40% + Hexaconazole 8.0% WG @ 0.1%, T₆: Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.04%, T₇: Hexaconazole 4% + Zineb 68% WP @ 0.2%, T₈: Tricyclazole 18% + Mancozeb 62% WP @ 0.25%, T₉: Propiconazole 25% EC @ 0.1% and T₁₀: Untreated control. Two spraying of all the treatments were done at 15 days interval starting from the panicle initiation stage. Only water was sprayed for the untreated check. Weeds were controlled by hand picking. The data on sheath rot disease severity was recorded 15 days after the last spray. From each treatment, 10 hills were selected randomly, and the plants were assessed for vertical spread of the disease individually using the scale (0–9) (IRRI, 2014) [5]. The rating scale is described in Table 1.

Table 1: Standard evaluation system (SES) scale

Score	Description
0	No incidence
1	Less than 1%
3	1 - 5%
5	6 - 25%
7	26 - 50%
9	51 - 100%

The disease severity was noted as Percent Disease Severity (PDS) and was averaged. The Percent Disease Index was calculated by using the following formulae:

Percent Disease Index (PDI)=

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

The grain yield was recorded on plot basis and converted to q/ha. Per cent increase in grain yield was calculated using following formula:

$$\text{Avoidable yield loss (AYL)} = \frac{(Y_p - Y_u)}{Y_u} \times 100$$

Where, Y_p = Yield under protected condition and Y_u = Yield under unprotected condition (Nagaraja *et al.*, 2012) [8]. The data obtained were subjected to statistical analysis and were tested at five per cent level of significance to interpret the treatment differences following Gomez and Gomez (1984) [3].

Results and Discussion

Efficacy of nine fungicides were tested against sheath rot (*Sarocladium oryzae*) of rice on a susceptible variety MTU 1001 by spraying twice on the plants under field condition. Observations related to disease severity, per cent disease control, yield, per cent increase in yield and B: C ratio are given in Table 2 and Table 3.

During kharif 2022, it was observed that, among the fungicides Kresoxim-methyl 40% + Hexaconazole 8.0% WG was most effective in reducing sheath blight disease severity (PDI 8.89) and it was at par with combination fungicide Azoxystrobin 18.2% + Difenconazole 11.4% SC (PDI 10.37). It was followed by Hexaconazole 4% + Zineb 68% WP (PDI 13.33). The grain yield data showed that Kresoxim-methyl 40% + Hexaconazole 8.0% WG recorded highest yield of 60.89 q/ha followed by Azoxystrobin 18.2% + Difenconazole 11.4% SC (58.89 q/ha), Tebuconazole 50% + Trifloxystrobin 25% WG (57.55 q/ha) and Hexaconazole 4% + Zineb 68% WP (56.22 q/ha) respectively and they were statistically at par with each other.

During kharif 2023, two sprays of Kresoxim-methyl 40% + Hexaconazole 8.0% WG resulted 11.10 % sheath rot disease severity in terms of PDI and produced 66.44 q/ha of grain yield and proved to be the best treatment among the combination fungicide. The grain yield was statistically at par with Azoxystrobin 18.2% + Difenconazole 11.4% SC (63.78 q/ha). The next best treatment was Azoxystrobin 18.2% + Difenconazole 11.4% SC with 12.21 % disease severity in terms of PDI. The highest disease severity (PDI 37.74) and lowest yield (41.33 q/ha) were recorded from the control plots.

Table 2: Effect of different fungicides on sheath rot disease in rice

Treatments	Percent disease Index (PDI)			Disease control (%)
	2022	2023	Pooled	
T ₁ : Azoxystrobin 11% + Tebuconazole 18.3% SC @ 0.15%	17.41 *(24.64)	22.20 *(28.08)	19.81 *(26.41)	45.7
T ₂ : Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 0.1%	19.63 (26.25)	22.57 (28.31)	21.10 (27.29)	42.1
T ₃ : Azoxystrobin 18.2% + Difenconazole 11.4% SC @ 0.1%	10.37 (18.70)	12.21 (20.29)	11.29 (19.61)	69.0
T ₄ : Propiconazole 13.9% + Difenconazole 13.9% EC @ 0.1%	14.07 (21.93)	17.76 (24.89)	15.92 (23.49)	56.3
T ₅ : Kresoxim-methyl 40% + Hexaconazole 8.0% WG @ 0.1%	8.89 (17.32)	11.10 (19.39)	10.0 (18.39)	72.6
T ₆ : Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.04%	12.96 (21.06)	14.80 (22.53)	13.88 (21.81)	61.9
T ₇ : Hexaconazole 4%+Zineb 68% WP @ 0.2%	13.33 (21.39)	21.46 (27.58)	17.40 (24.63)	52.3
T ₈ : Tricyclazole 18% + Mancozeb 62% WP @ 0.25%	22.22 (28.09)	24.42 (29.59)	23.32 (28.86)	36.0
T ₉ : Propiconazole 25% EC @ 0.1%	15.56 (23.14)	18.87 (25.71)	17.21 (24.46)	52.8
T ₁₀ : Untreated control	35.19 (36.34)	37.74 (37.88)	36.46 (37.13)	-
CD (0.05)	3.63	3.39	2.41	
SEm(±)	1.21	1.13	0.81	

*Figures in the parenthesis are transformed values

No phytotoxicity symptoms like necrosis, epinasty, hyponasty, chlorosis, leaf tip injury, stunting or wilting was recorded within seven days of each spray of the fungicide

tested during both the years of experiment and hence they may be considered as safe for use in rice crop.

Table 3: Effect of different fungicides on grain yield in rice

Treatments	Yield (q/ha)			Yield increase over control	B: C ratio
	2022	2023	Pooled		
T ₁ : Azoxystrobin 11% + Tebuconazole 18.3% SC @ 0.15%	51.11	55.33	53.22	25.0	1.74
T ₂ : Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 0.1%	48.89	54.22	51.56	21.1	1.68
T ₃ : Azoxystrobin 18.2% + Difenconazole 11.4% SC @ 0.1%	58.89	63.78	61.33	44.1	1.98
T ₄ : Propiconazole 13.9% + Difenconazole 13.9% EC @ 0.1%	54.0	57.33	55.67	30.8	1.83
T ₅ : Kresoxim-methyl 40% + Hexaconazole 8.0% WG @ 0.1%	60.89	66.44	63.67	49.6	2.02
T ₆ : Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.04%	57.55	60.22	58.89	27.7	1.93
T ₇ : Hexaconazole 4%+Zineb 68% WP @ 0.2%	56.22	56.0	56.11	31.8	1.84
T ₈ : Tricyclazole 18% + Mancozeb 62% WP @ 0.25%	47.11	51.78	49.44	16.2	1.62
T ₉ : Propiconazole 25% EC @ 0.1%	52.45	56.44	54.45	27.9	1.81
T ₁₀ : Untreated control	43.78	41.33	42.56	-	-
CD (0.05)	7.35	6.13	4.71	-	-
SEm(±)	2.46	2.05	1.57	-	-

The pooled data of two years revealed that, at recommended doses all fungicides have produced notable disease control as compared to untreated control. Among the fungicides, Kresoxim-methyl 40% + Hexaconazole 8.0% WG resulted in maximum reduction in disease severity (72.6 %) followed by Azoxystrobin 18.2% + Difenconazole 11.4% SC (69.0 %). Experimental pooled yield data revealed that the highest grain yield (63.67 q/ha) and maximum B:C ratio (2.02) was recorded by Kresoxim-methyl 40% + Hexaconazole 8.0% WG and it was statistically at par with Azoxystrobin 18.2% + Difenconazole 11.4% SC (61.33 q/ha) which resulted 44.1 % yield increase over the control plots.

A study conducted by Patra (2015) ^[10] reported that two foliar sprays of Kresoxim methyl 44.3 SC was highly effective in maximum reduction of sheath rot disease and maximum increase of yield in rice. Kindo and Tiwari (2015) ^[6] reported that foliar spray of Hexaconazole 5SC was highly effective in reducing sheath rot disease intensity (45%) and recorded 44.89% decrease of sheath rot disease over control. The present finding is in accordance with the findings of Rajnandni and Tiwari (2022) ^[12] who reported Kresoxim-methyl 40% + Hexaconazole 8.0% WG was found superior for reducing sheath rot disease (18.15), gave highest grain yield (88.4q/ha) and test weight of grain (19.06g).

Conclusion

Two foliar spraying with Kresoxim-methyl 40% + Hexaconazole 8.0% WG @ 1g/l of water at 15 days interval starting from panicle initiation (PI) stage is most effective in reducing the sheath rot disease incidence in rice by 72.6% and increasing the grain yield by 49.6% over untreated control. Maximum B:C (2.02) was also achieved by the same fungicidal treatment.

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