

Original Research Article

Evaluation of new fungicides against sheath blight of rice under field conditions

Abstract

Sheath blight of rice caused by *Rhizoctonia solani* Kuhn is emerging as a very destructive disease-causing heavy yield losses. The present study was conducted at Department of Plant pathology, JNKVV, College of Agriculture, Rewa, (M.P.). The experiment was laid in Randomized Block Design (RBD) with three replications. Seven fungicide namely Flusilazole 12.5%+carbendazim 25% SC (Luster), Azoxystrobin 18.2% w/w+difenoconazole 11.4 w/w SC (Amister), Azoxystrobin 11%+Tebuconazole 18.3% w/w SC (Custodia), Tricyclazole 18%+ mancozeb 62%WP (Merger), Zineb 68% + hexaconazole 4% WP (Avatar), Trifloxystrobin 25%+Tebuconazole 50%WG (Nativo), Mancozeb 50%+carbendazim 25%WS (Sprint), were tested for their efficacy to manage the sheath blight of rice. All the fungicide were found to reduce the sheath blight incidence significantly. Relative lesion height (RLH %) ranging from 12.3 to 43.0% with 30.3 to 71.4% reduction in RLH and Percent disease index (PDI%) ranging from 11.16 to 34.85% with 53.1 to 67.9% reduction in PDI were recorded in different treatments. Azoxystrobin 11%+Tebuconazole 18.3% w/w SC (Custodia) was found best to reduce the RLH 71.4%. Azoxystrobin 18.2% w/w+difenoconazole 11.4 w/w SC (Amister) and Trifloxystrobin 25%+Tebuconazole 50%WG (Nativo) were equally effective to reduce the RLH 64.9% and 60.7%, respectively. Significant increase in plant height ranging from 109.8 to 116.7 cm, panicle per plant ranging from 9.4 to 12.9, panicle length ranging from 22.4 to 26.7 cm, grains per plant ranging from 253.0 to 371.7 and 1000 grains weight ranging from 20.80 to 24.88 gm were also recorded. Grain yield (kg/ha) ranging from 2872.0 to 3761 kg/ha was recorded in the different treatments. An increase in grain yield ranging from 11.5 to 31.0% was recorded with maximum Azoxystrobin 11%+Tebuconazole 18.3% w/w SC (Custodia) followed by Azoxystrobin 18.2% w/w+difenoconazole 11.4 w/w SC (Amister) and Trifloxystrobin 25%+Tebuconazole 50%WG (Nativo) respectively.

Key words: Rice, sheath blight, fungicide and PDI

Introduction

Rice (*Oryza sativa* L.) is a graminaceous crop and considered as one of the most important staple food crops grown *kharif* in India and contributes 40% of total food grain production. Productivity of rice can be increased by adopting the hybrid varieties, nutrient management and biotic stresses. In India, area 46.38 Mha with production 130.29 Mt and productivity 2809 kg/ha (Anon, 2022). Sheath blight of rice caused by *Rhizoctonia solani* (teleomorph: *Thanatephorus cucumeris*), is emerging as a very destructive disease causing heavy yield losses (Suthin *et al.*, 2018). It is soil-borne fungal disease. The natural infection of the sheath blight disease occurs at the seedling, tillering and booting stages of rice. Infection usually starts near the water line of rice plants in paddy fields. Lesions develop upward to the upper leaf sheaths and leaf blades. The centre of lesion becomes grayish white with brown margin, later several spots coalesce and show blight symptoms (Ou, 1985). When humidity exceeds 95% and temperature ranges from 29 to 32°C, infection spreads rapidly which appears on plant parts, including leaf blades, causing irregularly shaped lesions with brown borders as bands. This symptom is generally referred to as “banded blight”. *Rhizoctonia solani* possesses pale to dark brown rapidly growing mycelium with septum in the branch near the point of origin. Fungicide application is the most common approach among farmers for the management of sheath blight throughout the world. Use of fungicide to control diseases causes several adverse effects *i.e.* development of resistance in the pathogen, residual toxicity, pollution to the environment etc. Resistant or tolerant sources to sheath blight are not available and biological controls are still not successful at field level. However, it is necessary to screen the new fungicidal molecules or products to manage the disease effectively to avoid resistance developments in the pathogen and minimize the fungicidal residues for ecological sustainability. The present study was undertaken to evaluate the different fungicides for efficient control of sheath blight of rice.

Materials and Methods

To test the evaluation of new fungicide, the twenty-one day old seedlings of the PS-4 variety were transplanted in a net plot size of 3 m x 2 m with a spacing of 1 m between replication to replication. Row to row and plant to plant spacing was 25 cm and 15 cm. The experiment was laid in Randomized Block Design (RBD) with three replications. Fertilizer was applied @ N 80 P 60 K 40 Kg/ha. Fifty percent of N and total P were given as basal dose and remaining N applied in two split doses as top

dressing at tillering and panicle initiation stage. There were 8 treatments *i.e* T1- Flusilazole 12.5% + carbendazim 25% SC (Luster), T2 Azoxystrobin 18.2% w/w + difenoconazole 11.4 w/w SC (Amister), T3- Azoxystrobin 11%+Tebuconazole 18.3% w/w SC (Custodia) , T4- Tricyclazole 18% + mancozeb 62% WP (Merger), T5- Zineb 68% + hexaconazole 4% WP (Avatar), T6- Trifloxystrobin 25%+ Tebuconazole 50%WG (Nativo), T7- Mancozeb 50%+carbendazim 25%WS (Sprint), T8 - Control (Untreated). In the field conditions, sclerotia from 7-9 days old culture and rice stem bits (*Rhizoctonia solani* mycelium profusely grown) were used for inoculation of the rice plants at the maximum tillering stage. The primary tillers of each hill were tagged and inoculated gently by punching and pushing single sclerotia or rice stem bit into the sheath just 1 ½ to 2 ½ cm above the water surface level as per the position of the sheath. After 6 days of inoculation the first spray of each treatments was given, on 10th day after first spray second spray was repeated. Disease severity of sheath blight was recorded at 21 days of inoculation of the disease crop in 0-9 scales by following the procedure of Standard Evaluation System of International Rice Testing Programme.

Observations on vertical disease spread in terms of relative lesion height (RLH %) and PDI (%) were recorded at dough stage. Yield attributing parameters namely plant height (cm), number of tillers plant⁻¹, No. of panicle per plant, panicle length (cm) were recorded at dough stage and Number of grain per plant, 1000 grain weight (g) grain yield (kg plot⁻¹) was recorded at maturity and converted into kg /ha .

The percent disease index (PDI) was calculated by adopting the formula:

$$PDI = \frac{\text{Sum of numerical rating}}{\text{Total numbers of plants observed} \times \text{maximum disease scale}} \times 100$$

The disease index (%) value will be transformed by adopting the angular transformation table (Snedecor and Cochran 1967).

$$\% \text{ increase in yield} = \frac{\text{Yield of treated plot} - \text{Yield in control}}{\text{Yield in control}} \times 100$$

Results

An experiment was laid out in the field conditions during 2018-2019 at experimental field of College of Agriculture Rewa to control sheath blight disease of rice by application of new fungicides *i.e*, Flusilazole12.5%+carbendazim 25% SC

(Luster), Azoxystrobin 18.2% w/w + difenoconazole 11.4 w/w SC (Amistar), Azoxystrobin 11% + Tebuconazole 18.3% w/w SC (Custodia), Tricyclazole 18% + mancozeb 62% WP (Merger), Zineb 68% + hexaconazole 4% WP (Avatar), Trifloxystrobin 25% + Tebuconazole 50% WG (Nativo), Mancozeb 50% + carbendazim 25% WS (Sprint), were used under the study.

Data on Percent disease index (PDI %) and percent decrease over control in PDI are presented in table-1. PDI varied from 11.16 to 34.85% was significant in different treatments. Minimum PDI was recorded in the treatment T3 (Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) was found highly effective in reducing the disease severity of sheath blight 11.16% and 67.9% decrease of the disease over control treatment was at par with T2 (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC) 11.90% reducing the disease severity and 65.8% decrease disease over control, T6 (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG), 13.38 % reducing the disease severity and 61.6 % decrease the disease over control, T5 (Zineb 68% + hexaconazole 4% WP (Avatar) 14.12% reducing the disease severity and 59.4% decrease the disease over control treatment followed by T4 (Tricyclazole 18% + mancozeb 62% WP (Merger) 14.89% reducing the disease severity and 57.2% decrease the disease over control, T1 (Flusilazole 12.5% + carbendazim 25% SC) (Luster) 15.60 % reducing disease severity and 55.2% decrease the disease over control, T7 Mancozeb 50% + carbendazim 25% WS (Sprint) 16.34 % reducing the disease severity and recorded 53.1% decrease disease over control (34.85%).

Data on RLH (%) and percent decrease over control in RLH are presented in table-1. Relative lesion height varied from 12.3 to 43% was significant in different treatments. Minimum RLH (12.3%) was recorded in the treatment T3 (Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) and closely followed by T₂ (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC) and T₆ (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG). These treatments were statistically at par. Rest of the treatments were also exhibited significantly effective. Percent decrease over control in RLH ranged 30.3 to 71.4% in different treatments being maximum in (T₃) followed by (T₂) and (T₆).

Data of Plant height (cm) are presented in table-2. Plant height ranging from 109.8 to 116.7 cm was recorded. Significant difference in was Plant height was

observed in different treatments. Maximum Plant height(116.7) was recorded in T₃ (Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) and closely followed by T₂ (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC)113.0cm and T₆ (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG) (112.8cm).

Data of Tiller per plant are presented in table-2. Tiller per plant ranging from 10.0 to 13.0 was recorded. Non-Significant difference was observed in different treatments. Maximum Tiller per plant (13.0) was recorded in T₃ (Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) and closely followed by T₂ (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC) (11.5) and T₆ (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG) (11.4)

Data of Panicle per plant are presented in table-2. Panicle per plant ranging from 9.4 to 12.9 was recorded. Significant difference Panicle per plant was observed in different treatments. Maximum Panicle per plant (12.9) was recorded in T₃ (Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) and closely followed by T₂ (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC) (11.2) and T₆ (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG) (10.8).

Data of Panicle length (cm) are presented in table-2. Panicle length ranging from 22.4 to 26.7 cm was recorded. Significant difference in Panicle length was observed in different treatments. Maximum Panicle length (26.7cm) was recorded in T₃ (Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) and closely followed by T₂ (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC) (25cm) and T₆ (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG) (24.7cm).

Data of Grains per plant are presented in table-2. Grains per plant ranging from 253.0 to 371.7 were recorded. Significant difference Grains per plant was observed in different treatments. Maximum Grains per plant (371.7) was recorded in T₃ (Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) and closely followed by T₂ (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325

SC) (336) and T₆ (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG) (365).

Data of 1000 grain weight (gm) are presented in table-2. 1000 grain weight ranging from 20.80 to 24.88 gm was recorded. Significant difference in was 1000 grain weight (gm) observed in different treatments. Maximum 1000 grain weight (24.88gm) was recorded in T₃ (Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) and closely followed by T₂ (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC) (24.55gm) and T₆ (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG) (24.25gm).

Data of grain yield in different treatments of fungicide control are presented in table-3. Grain yield ranging from 2872.0 to 3761.0 kg/ha was recorded. Significant difference in grain yield was observed in different treatments. Maximum grain yield (3761kg/ha) was recorded in T₃ (Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) and which was 31.0% higher than the control. The next effective treatment was T₂ (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC) (3680kg/ha) followed by T₆ (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG) (3635.0kg/ha) over untreated check.

Discussion

In the present study, seven fungicides namely Flusilazole 12.5%+ carbendazim 25% SC (Luster), Azoxystrobin 18.2% w/w+difenoconazole 11.4 w/w SC (Amister), Azoxystrobin 11%+Tebuconazole 18.3% w/w SC (Custodia), Tricyclazole 18%+ mancozeb 62%WP (Merger), Zineb 68% + hexaconazole 4% WP (Avatar),Trifloxystrobin 25%+Tebuconazole 50%WG (Nativo), Mancozeb 50%+carbendazim 25%WS (Sprint), were tested for their efficacy to manage the sheath blight incidence in rice. All the fungicides were found to reduce the sheath blight incidence significantly. Percent disease index ranging from 11.16 to 34.85% with 53.1 to 67.9% reduction in PDI were recorded in different treatments. Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) was found the best to reduce the PDI 67.9% followed by T₂ (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC) and T₆ (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG) were equally effective to reduce the PDI 65.8 and 61.6%, respectively. RLH ranging from 12.30 to 43.0% with 30.3 to 71.4% reduction in RLH were recorded in

different treatments. Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) was found best to reduce the RLH 71.4% followed by T₂ (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC) and T₆ (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG) were equally effective to reduce the RLH 64.9 and 60.7%, respectively. Significant increase in plant height ranging from 110.2 to 116.7 cm, panicle per plant ranging from 9.4 to 12.9, panicle length ranging from 22.4 to 26.7 cm, grains per plant ranging from 253.0 to 371.0 and 1000 grain weight (gm) ranging from 20.80 to 24.88 gm were also recorded. Tillers per plant ranged from 10.0 to 13.0 in different treatments, but statistically non-significant. Grain yield (kg/ha) ranging from 2872.0 kg/ha to 3780.0 kg/ha was recorded in the different treatments. An increase in grain yield ranging from 11.5 to 31.4.0% was recorded with maximum in Azoxystrobin 11% + tebuconazole 18.3% w/w SC) (Custodia) followed by T₂ (Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC) and T₆ (Trifloxystrobin 25% + tebuconazole 50% WG) (Nativo 75WG) respectively. The similar findings were also reported by Akter *et al.* (2001), Bag (2009), Pramesh *et al.* (2016), Neha *et al.* (2017), Laxmikant *et al.* (2017), Pramesh *et al.* (2017), Swamy *et al.* (2009), Bhuaneswari and Raju (2012), Kumar *et al.* (2014) and Hegde (2015) confirmed the present findings.

CONCLUSION:

It can be concluded that Among the tested fungicides, Azoxystrobin 11%+Tebuconazole 18.3% w/w SC (Custodia) was found highly effective for controlling sheath blight of rice.

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Table -1. Effect of fungicides on percent disease index of sheath blight of rice

	Treatments	Conc.	PDI (%)	% Decrease Over Control	RLH (%)	% Decrease Over Control
T1	Flusilazole 12.5% + carbendazim 25% SC (Lusture 37.5 SE)	1 ml/l	15.60 (23.23)	55.2	25.2 (30.10)	41.3
T2	Azoxystrobin 18.2% w/w + difenoconazole	1 ml/l	11.90 (20.14)	65.8	15.1 (22.81)	64.9

	11.4% w/w SC (Amistar Top 325 SC)						
T3	Azoxystrobin 11% + tebuconazole 18.3% w/w SC (Custodia)	1.5 ml/l	11.16 (19.42)	67.9	12.3 (20.50)	71.4	
T4	Tricyclazole 18% + mancozeb 62% WP (Merger)	2.5 g/l	14.89 (22.66)	57.2	23.8 (29.19)	44.5	
T5	Zineb 68% + hexaconazole 4% WP (Avatar)	2.5g/l	14.12 (22.03)	59.4	20.8 (27.12)	51.6	
T6	Trifloxystrobin 25% + tebuconazole 50% WG (Nativo 75WG)	0.4 g/l	13.38 (21.44)	61.6	16.9 (24.16)	60.7	
T7	Mencozeb 50% + carbendazim 25% WS (Sprint)	2.5g/l	16.34 (23.82)	53.1	30.0 (33.14)	30.3	
T8	Control		34.85 (36.16)		43.0 (40.94)	0.0	
	CD (5%)		1.652		4.121		

Table -2. Effect of fungicides on yield components of rice

	Fungicide	Conc.	Plant height (cm)	tiller per plant	Panicles per plant	Panicle length (cm)	Grains per plant	1000 grain weight (gm)
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T1	Flusilazole 12.5% + carbendazim 25% SC (Lusture 37.5 SE)	1 ml/l	111.1	10.3	9.7	24.2	340.0	23.00
T2	Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC)	1 ml/l	113.0	11.5	11.2	25.0	366.0	24.55
T3	Azoxystrobin 11% + tebuconazole 18.3% w/w SC (Custodia)	1.5 ml/l	116.7	13.0	12.9	26.7	371.7	24.88
T4	Tricyclazole 18% + mancozeb 62% WP (Merger)	2.5 g/l	111.4	10.5	10.3	24.5	348.0	23.50
T5	Zineb 68% + hexaconazole 4% WP (Avatar)	2.5g/l	112.3	10.9	10.5	24.7	360.7	23.75
T6	Trifloxystrobin 25% + tebuconazole 50% WG (Nativo 75WG)	0.4 g/l	112.8	11.4	10.8	24.7	365.0	24.25
T7	Mencozeb 50% + carbendazim 25% WS (Sprint)	2.5g/l	110.2	10.1	9.7	22.7	333.7	22.66
T8	Control	-	109.8	10.0	9.4	22.4	253.0	20.80
	MEAN		112.2	11.0	10.9	24.7	342.3	16.7
	CD (5%)		2.16	2.05	1.80	1.91	9.73	1.08

Table -3. Effect of fungicides on grain yield of rice

	Treatments	Conc.	Grain yield (kg/ha)	% Increase Over Control
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T1	Flusilazole 12.5% + carbendazim 25% SC (Lusture 37.5 SE)	1 ml/l	3293.3	14.7
T2	Azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC (Amistar Top 325 SC)	1 ml/l	3680.0	28.1
T3	Azoxystrobin 11% + tebuconazole 18.3% w/w SC (Custodia)	1.5 ml/l	3761.0	31.0
T4	Tricyclazole 18% + mancozeb 62% WP (Merger)	2.5 g/l	3431.7	19.5
T5	Zineb 68% + hexaconazole 4% WP (Avatar)	2.5g/l	3446.7	20.0
T6	Trifloxystrobin 25% + tebuconazole 50% WG (Nativo 75WG)	0.4 g/l	3635.0	26.6
T7	Mencozeb 50% + carbendazim 25% WS (Sprint)	2.5g/l	3203.3	11.5
T8	Control		2872.0	0.0
	MEAN		3415.4	
	CD (5%)		311.01	