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Efficacy of Fungicides on Rice Sheath Blight and Grain Discolouration Diseases in Rice

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Abstract

Field experiments were conducted at Rice Research Station, Kerala Agricultural University, Moncompu during *kharif* 2020 & 2021 and *rabi* 2021-22 to evaluate the fungicides against sheath blight and grain discolouration. The evaluated seven fungicides were Difenoconazole 25 EC, Isoprothiolane 40 EC, Kasugamycin 3 SL, Iprobenfos 48 EC, Propineb 70 WP, Tebuconazole 25.9 EC and Thifluzamide 24 SC. The pooled analysis of three seasons data showed that Difenoconazole 25 EC @ 0.5 ml/l and Tebuconazole 25.9 EC @ 1.5 ml/l were found equally effective against the sheath blight and for grain discolouration. Highest yield (5779 kg ha^{-1}) was recorded by the Difenoconazole 25 EC followed by Kasugamycin 3 SL (5745 kg ha^{-1}), Isoprothiolane 40 EC (5514 kg ha^{-1}) and Thifluzamide 24 SC (5502 kg ha^{-1}) as against (4141 kg ha^{-1}) in control.

Key words: Rice, sheath blight, grain discolouration, fungicide.

Introduction

In India rice (*Oryza sativa L.*) is the most important food crop occupying about more than 45 million ha. It serves as a staple food crop of more than 60 per cent of the world's population. To increase the rice production, many high yielding varieties of rice have been developed. Occurrence of diseases has completely changed with the introduction of high yielding varieties. Rice sheath blight disease caused by *Rhizoctonia solani* AG1-1A, is one of the most devasting diseases of the crop. Morphological characters are important tool for identification and classification of fungus. The colour of the mycelium initially white later turned to light brown in all the five isolates and the angle of branching of mycelium was right angle (Sathya *et al*., 2020). Before follow up the effective crop protection against sheath blight, it is important to review the published information related to pathogenicity and disease management. Research related to disease management practices has addressed the use of agronomic practices, chemical control, biological control and genetic improvement: Optimizing nitrogen fertilizer use with enough plant spacing can reduce spread of infection while smart agriculture technologies such as crop monitoring with Unmanned Aerial Systems assist in early detection and management of sheath blight disease (Pooja Singh *et al*., 2019). Fungicidal sprays have been used successfully to control the sheath blight which is the most effective for inhibiting infection lesion enlargement. Timely application of effective fungicides is essential for the better management of the disease. Systematic evaluation of commercially available fungicides from time to time is needed for evolving recommendations on chemical fungicides, so that the farmers can choose the fungicides based on the efficacy as well as cost (Ganesha Naik *et al*., 2017).

Grain discolouration is caused by complex of fungal species such as *Sarocladium oryzae, Bipolaris oryzae (Cochliobolus miyabeanus), Pyricularia grisea (Magnaporthe grisea) Curvularia lunata, Phoma sp.,* *Microdochium sp., Nigrospora sp., and Fusarium sp.* It is an important constraint for lowland and upland rice production and becoming serious concern under changing climatic conditions. Of late the disease was found to be very severe in all over the Kerala causing 5 to 10 per cent yield loss (Surendran *et al*., 2016). Use of suitable fungicide is the primary one for the effective management of the rice diseases. The present study, considering the severity of diseases and its economic importance, the field experiments were conducted using different fungicides available in the market for the control of sheath blight and grain discolouration of rice under field conditions.

Materials and Methods

During *kharif* 2020&2021 and *Rabi* 2021-22, field experiments were conducted at Rice Research Station, Moncompu, Alappuzha under ICAR-AICRIP programme for evaluating the fungicides against location specific rice diseases *viz.,* sheath blight and grain discolouration. The trial was conducted as a part of AICRPR program. Seven commercially available fungicides were tested against sheath blight and grain discolouration. The experiments were laid out in randomized block design with 4 replications in 5x2 m^2 plots using the locally popular susceptible variety Uma (MO 16). The NPK fertilizers were applied as per the recommendations (90:45:45 kg ha^{-1}) of Kerala Agricultural University. The fungicides were applied as foliar spray at the time of booting stage for both diseases. Three sampling units of 1 m^2 area were fixed in each plot at random. The observations on sheath blight disease severity were recorded just before the spray and 15-20 days after the spray. Degree of severity was graded based on height of the plant portions affected by the disease and expressed as percentage of the total area as per the SES scale of rice (IRRI, 2013). Grain discolouration was measured based on the percentage of panicles and spikelets infection from 15 days before harvest. The panicle infection- percentage was calculated based on the number of panicles affected from the total number of panicles present in the sampling area. The spikelet infection percentage was recorded by counting the infected grains from each panicle.

Results and Discussion

The results of station trial at Rice Research Station, Moncompu during *kharif* 2020 **(Table 1)** revealed that the plots treated with fungicide Thifluzamide 24

Table 1: Influence of different fungicides on sheath blight disease severity (%) during *kharif* 2020, *kharif* 2021 and *rabi* 2021-22 (Pooled data of three seasons)

Sl. No.	Fungicides	Dose/ Lit	Disease Severity (%)			Mean
			***Kharif* 2020**	***Kharif* 2021**	***Rabi* 2021-22**	
1	Difenconzole 25 EC	0.5 ml	25.27 (28.95)	11.44 (19.46)	15.34 (7.00)	24.33(17.35)
2	Isoprothiolane 40 EC	1.5 g	23.05 (27.92)	26.67 (30.95)	19.73 (11.4)	28.71(23.15)
3	Kasugamycin 3 SL	2.0 g	20.83 (26.18)	27.95 (31.89)	33.84 (31)	31.54(27.54)
4	Iprobenfos 48 EC	1.0 ml	22.22 (27.58)	20.93 (26.35)	28.84 (23.3)	29.27(24.00)
5	Propineb 70 WP	3.0 g	24.16 (29.20)	25.93 (29.82)	29.51 (24.3)	30.98(26.53)
6	Tebuconazole 25.9 EC	1.5 ml	17.77 (24.88)	25.84 (30.31)	25.76 (18.9)	28.66(23.12)
7	Thifluzamide 24 SC	0.8 g	13.61 (20.63)	28.64 (32.34)	31.23 (26)	29.32(24.49)
8	Control	-	60.55 (51.23)	54.25 (47.50)	49.97 (58.6)	47.83(54.92)
	LSD @ 5% (P=0.05)		12.062	6.175	10.394	
	CV (%)		27.700	13.500	24.128	

*Figures given in parentheses are arcsine transformed values

SC recorded lower sheath blight severity (13.61%) during *kharif* 2020. This was followed by molecule Tebuconazole 25.9 EC (17.77%) and Kasugamycin 3 SL (20.83%). During *kharif* 2021, the systemic fungicide Difenoconazole 25 EC (11.44%) was found superior in restricting sheath blight disease severity followed by Iprobenfos 48 EC (20.93%) and Tebuconazole 25.9 EC (25.84%). In the season *rabi* 2021-22, also the systemic fungicide Difenoconazole 25 EC (15.34%) was found superior in restricting sheath blight disease severity followed by Isoprothiolane 40EC (19.73%) and Tebuconazole 25.9EC (25.76%).

The pooled data of station trial results showed that the Difenoconazole 25 EC gave the maximum reduction in sheath blight disease severity (24.33%) followed by Tebuconazole 25.9 EC (28.66%), Isoprothiolane 40 EC (28.71%), Iprobenfos 48 EC (29.27%) and Thifluzamide 24 SC (29.32%) (**Table 1 and Figure 1**).

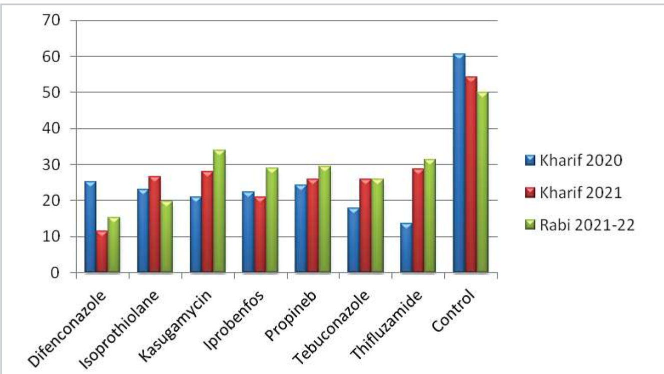

Figure 1: Effectiveness of different fungicides on sheath blight disease severity (%)

Neem essential oil (16.32%) showed maximum reduction in sheath blight incidence and severity when compared to lemon grass oil (17.85%) and standard check fungicide Carbendazim (18.91%) (Surendran *et al*., 2021). Triazole fungicides are also commonly used in sheath blight management. Application of other chemicals such as Flutolanil, Carbendazim, Iprobenfos, Mancozeb, Thifluzamide and Validamycin also offers effective control of this disease. The use of a single chemical with the same mode of application for a prolonged time leads to the evolution of resistance in the fungus (Uppala and Zhou, 2018). Hence, a combination chemical formulation such as Azoxystrobin 18.2% + Difenoconazole 11.4% (Bhuvaneswari and Raju, 2012; Kumar *et al*., 2018); Propiconazole + Difenoconazole (Kandhari, 2007); Prothioconazole + Tebuconazole 240 g/kg SC (Chen *et al*., 2021). Captan 70% + Hexaconazole 5% (Pramesh *et al*., 2017); Trifloxystrobin 25% + Tebuconazole 50% (Shahid *et al.,* 2014; Rashid *et al.,* 2020). The systemic fungicides Trifloxystrobin 25% + Tebuconazole 50 WG @ 0.4g/lit and Propiconazole 25% EC @ 1ml/lit were found to be the most effective against neck blast disease with great reduction in the per cent disease intensity and getting higher grain yield (Yadav *et al*., 2022). Surendran *et al*., (2019) reported that application of Trifloxystrobin 25% + Tebuconazole 50% WG was effectively controlled the sheath blight disease.

Grain Discolouration

The data on grain discoloration panicles and spikelets infection indicated that fungicide Isoprothiolane 40 EC reduced disease effectively (2.90 and 7.50%) when compared with fungicides *viz.,* Difenoconazole 25 EC (4.46 and 8.39%), Tebuconazole 25.9 EC (5.25 and 10.30%) and Thifluzamide 24 SC (6.26 and 10.38%) during *kharif* 2020. During *kharif* 2021, Difenoconazole 25 EC @ 0.5ml/l was found to be effective to check the grain discoloration (4.65 and 11.35%) followed by Propineb (5.93 and 11.32%), Tebuconazole (5.93 and 12.42%) and Thifluzamide 24 SC (6.40 and 11.96%). Out of seven commercially available fungicides tested, the fungicides Tebuconazole 25.9 EC (3.06 and 1.98%), and Isoprothiolane 40 EC (3.35 and 1.95%), were found superior against the grain discolouration followed by Kasugamycin 3 SL (3.37 and 2.04%) and Thifluzamide 24 SC (3.51 and 1.97%) during *rabi* 2021-22.

Table 2: Influence of different fungicides on glume discoloration panicles (%) during *kharif* 2020, *kharif* 2021 and *rabi* 2021-22 (Pooled data of three seasons)

Sl. No.	Fungicides	Dose/ lit	Panicles affected (%)			
			***Kharif* 2020**	***Kharif* 2021**	***Rabi* 2021-22**	**Mean**
1	Difenconzole 25 EC	0.5 ml	4.46	4.65	4.4	2.12
2	Isoprothiolane 40 EC	1.5 g	2.9	7.19	3.35	2.07
3	Kasugamycin 3 SL	2 g	6.8	15.9	3.37	2.81
4	Iprobenfos 48 EC	1 g	8.03	7.64	3.87	2.52
5	Propineb 70 WP	3 g	6.45	5.93	5.36	2.43
6	Tebuconazole 25.9 EC	1.5 ml	5.25	5.93	3.06	2.15
7	Thifluzamide 24 SC	0.8 g	6.26	6.4	3.51	2.30
8	Control	-	10.18	20.34	6.78	3.43
	LSD @ 5% (P=0.05)		0.067	0.044	0.014	
	CV (%)		1.866	1.020	0.454	

*Figures given in parentheses are square root transformed values

The pooled data of three season station trials showed that the fungicides Isoprothiolane 40 EC (2.07%) and Difenoconazole 25 EC (2.12%) were found most effective in restricting discoloured grain panicle incidence followed by Tebuconazole 25.9 EC (2.15%) and Thifluzamide 24 SC (2.30%). The analysis of pooled data on panicle percentage affected showed that both Difenoconazole 25 EC and Isoprothiolane 40 EC were found equally effective than other fungicides **(Table 2 and Figure 2).**

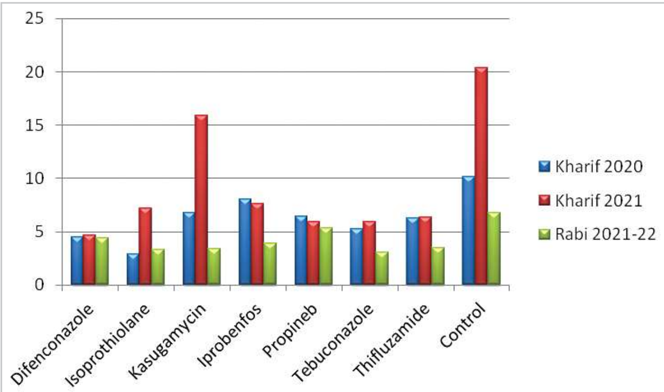

Figure 2: Effectiveness of fungicides on grain discoloration diseases (panicles %)

Table 3: Influence of different fungicides on glume discolouration spikelets (%) during *kharif* 2020, *kharif* 2021 and *rabi* 2021-22 (Pooled data of three seasons)

Sl. No.	Fungicides	Dose/ lit	Spikelets affected (%)			
			***Kharif* 2020**	***Kharif* 2021**	***Rabi* 2021-22**	**Mean**
1	Difenconzole 25EC	0.5ml	8.39	11.35	1.55	2.50
2	Isoprothiolane 40 EC	1.5g	7.5	8.75	1.95	2.36
3	Kasugamycin 3 SL	2 g	8.35	10.92	2.04	2.54
4	Iprobenfos 48 EC	1 g	9.22	9.83	2.05	2.53
5	Propineb 70 WP	3 g	8.01	11.32	2.05	2.54
6	Tebuconazole 25.EC	1.5ml	10.3	12.42	1.98	2.71
7	Thifluzamide 24 SC	0.8 g	10.38	10.26	1.97	2.69
8	Control	-	12.61	13.69	2.26	2.91
	LSD @ 5% (P=0.05)		0.012	0.004	0.084	
	CV (%)		0.271	0.085	4.018	

*Figures given in parentheses are square root transformed values

Table 4: Influence of different fungicides on grain yield (kg ha^{-1}) during *kharif* 2020, *kharif* 2021 and *rabi* 2021-22 (Pooled data of three seasons)

Sl. No.	Fungicides	Dose/ lit	Grain yield			
			***Kharif* 2020**	***Kharif* 2021**	***Rabi* 2021-22**	**Mean**
1	Difenconzole 25EC	0.5ml	3625	6149	7565	5779
2	Isoprothilane 40 EC	1.5g	3750	6708	6085	5514
3	Kasugamycin 3 SL	2 g	4000	6418	6818	5745
4	Iprobenfos 48 EC	1 g	3500	6300	5798	5199
5	Propineb 70 WP	3 g	3625	6160	5885	5223
6	Tebuconazole 25.9 EC	1.5ml	3375	6172	6895	5480
7	Thifluzamide 24 SC	0.8 g	3625	6181	6700	5502
8	Control	-	3125	3813	5485	4141
	LSD @ 5% (P=0.05)		NS	1291.517	NS	
	CV (%)		20.210	14.785	16.990	

The pooled data of three season station trials showed that both systemic fungicides *viz.,* Isoprothiolane 40 EC (2.36%) and Difenoconazole 25 EC (2.50%) were very effective in restricting discoloured grain spikelet incidence followed by Iprobenfos 48 EC (2.53%) and Kasugamycin 3 SL (2.54%).

The data on panicles and spikelet affected indicated that fungicides Difenoconazole 25 EC and Isoprothiolane 40 EC were significantly superior to all other fungicides tried **((Table 3 and Figure 3)**. Several workers have reported on the scope for controlling grain discolouration disease by application of fungicides like Edifenphos and Copper oxychloride (Govindarajan and Kannaiyan, 1982), Propiconazole (Lore *et al.*, 2007) and Captan 70% + Hexaconazole 5% (Kumar and Kumar, 2011).

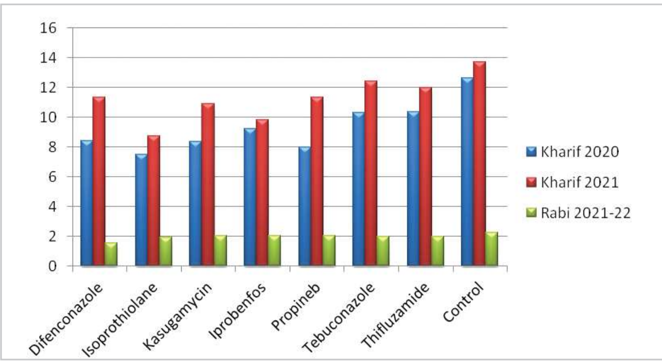

Figure 3: Effectiveness of fungicides on grain discolouration diseases (spikelets %)

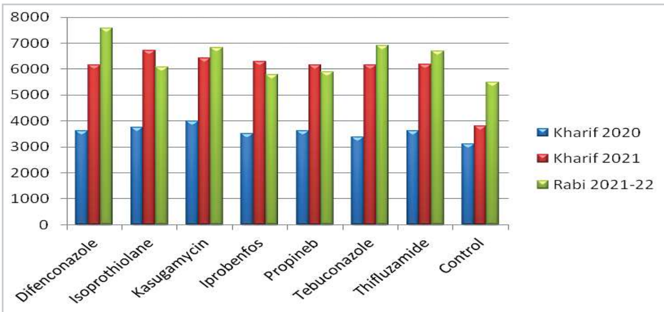

Figure 4: Effectiveness of different fungicides on grain yield (ton/ha)

Grain yield of each plot was recorded and expressed in kg ha^{-1} at 14 per cent moisture. Significance among mean treatments was determined according to Duncan's multiple range tests (Gomez and Gomez, 1984). The maximum yield was obtained from Kasugamycin 3 SL (4000 kg ha^{-1}) followed by Isoprothiolane 40 EC (3750 kg ha^{-1}) and Thifluzamide 24 SC (3625 kg ha^{-1}). The control plot recorded with lowest yield of 3125 kg ha^{-1} during *kharif* 2020. There was significant difference in the grain yield among the treatments in *kharif* 2021. The maximum yield was obtained from Isoprothiolane 40 EC treated plot (6708 kg ha^{-1}) followed by Kasugamycin 3 SL (6418 kg ha^{-1}) and Iprobenfos 48 EC 6300 kg ha^{-1}. During *Rabi* 2021-22, the highest yield was obtained from Difenoconazole 25 EC (7565 kg ha^{-1}) treated plot followed by Kasugamycin 3 SL (6818 kg ha^{-1}). The control plot recorded with lowest yield of 5485 kg ha^{-1} **(Table 4 and Figure 4)**.

The pooled data of three season station trials showed that Difenoconazole 25 EC treated plot yields high (5779 kg ha^{-1}) followed by Kasugamycin 3 SL (5745 kg ha^{-1}), Isoprothiolane (5514 kg ha^{-1}), Thifluzamide 24 SC (5502 kg ha^{-1}) and Iprobenfos 48 EC (5199 kg ha^{-1}).

Conclusion

It is concluded that systemic fungicides Difenoconazole 25 EC and Isoprothiolane 40 EC was found most effective against the sheath blight and grain discolouration. Thus fungicides, Difenoconazole 25 EC @ 0.5 ml/l and Isoprothiolane 40 EC @ 1.5 g/l can be recommended for the management of sheath blight and grain discoloration and improve the quality of seeds in Kuttanad region.

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