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Efficacy of Novel Fungicides for the Management of False Smut of Rice Caused by *Ustilaginoidea virens*

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Abstract

In the present investigation eight fungicides were tested against the false smut disease of rice during *kharif*-2016-19. Among the different fungicides evaluated, two sprays of Trifloxystrobin 25% + Tebuconazole 50% (75 WG) at 0.03 per cent (4 gm/10 l) and Propiconazole 25 EC at 0.025 per cent (10 ml/10 l.) applied at booting and post flowering stage were found effective for the management of false smut. The other effective fungicides were Mancozeb 75 WP, Tebuconazole 25.9 EC, Tricyclazole 75 WP, Kresoxim methyl 50 SC, Azoxystrobin 23 SC and Carbendazim 50 WP.

Key Words: Rice, False smut, Fungicides, mycotoxins, *Ustilaginoidea virens.*

Introduction

Rice (*Oryza sativa* L.) is one of the important cereal crops and staple food for more than two-thirds of the Indian population and playing a crucial role in the people's food and livelihood security. False smut [*Ustilaginoidea virens* (Cooke) Takahashi] also known as green smut or pseudo-smut is emerging as one of the important diseases of rice in India and the world. The pathogen infects individual spikelets and causes direct economic losses. The disease has been reported from almost all the rice growing states of India in moderate to severe forms symbolizing a major threat to rice cultivation. Earlier it was considered as a minor disease, occurred in sporadically in certain regions, but recent scenario of epidemics of the false smut disease are also reported in different parts of the world including India (Rush *et al.,* 2000; Anon., 2016). The disease incidence of 10-20 per cent and 05-85 per cent, respectively was reported from Punjab and Tamil Nadu states on different rice genotypes (Ladhalakshmi *et al*., 2012). In recent years, its outbreak is expected due to high input cultivation practices, maximum use of hybrid varieties and change in climate (Lu *et al*., 2009). The fungus produces mycotoxins that are harmful to humans and animals. The disease is severe when environmental conditions like high humidity (>80%) and temperature range from 25 to 30°C (Mathew *et al*., 2021). Adoption of correct control measures against this disease would help reduce the economic loss.

Materials and Methods

A field experiment was conducted at Hill Millet Research Station, NAU, Waghai, Gujarat during *kharif*, 2016-19 to find out most effective fungicides for the management of false smut disease. Experiment was carried out in Randomised Block Design (RBD) with nine treatments with three replications. Cultivar used during experiment was GR-11 and the gross plot size was 3.0 m x 2.4 m. square and the recommended agronomical packages of practices were followed for conducting the experiment. Two sprays of fungicides were given for each treatment at booting stage [75 days

after transplanting (DAT)] and milking/post flowering stage (95 DAT). The false smut observations were recorded by fixing three sampling units of one m^2 at random in each treatments and data was recorded as infected spikelets/panicle and infected panicles/m^2. The grain and straw yield data was recorded at the time of harvest of crop.

Results and Discussions

The results of the experiments indicated that the different treatments had significantly reduced the per cent infected panicles over control during all the years as well as in pooled results. The results on per cent infected panicles are given in **Table 1**. In the year 2016-17, the treatment T_1 (Trifloxystrobin 25% + Tebuconazole 50% 75 WG) was found to be significantly superior and recorded minimum infected panicles (3.07%) and minimum per cent infected spikelets (10.43%) when compared to control (19.57% and 40.53%). The next best treatment is T_6 (Propiconazole 25 EC) which was on par with T_7 (Mancozeb 75 WP) and T_8 (Tebuconazole 25.9 EC). In the second year trials (2017-18), the same treatment T_1 was showed significantly superior performance and recorded minimum infected panicles (3.10%) and minimum per cent infected spikelets (10.23%) which was on par with T_6 (4.47%) and (13.03%). The next best fungicide in order of merit was T_7. Similarly, in the 3rd year of the trials, T_1 was observed significantly superior and recorded minimum percentage of infected panicles (3.70%) and minimum per cent infected spikelets (11.77%) which was on par with T_6 (5.03%) and (14.53%). The next best in order of merit was T_7. In the case of pooled results, the treatment T_1 *i.e.,*

Table 1: Effect of different treatments on per cent infected panicles and per cent infected spikelet/panicle of rice false smut

Sr. No.	Treatments	Per cent infected panicles/ m^2				Per cent infected spikelet/panicle			
		2016	2017	2019	Pooled	2016	2017	2019	Pooled
T_1	Trifloxystrobin 25% + Tebuconazole 50% (75 WG)	3.07 (10.01)	3.10 (10.10)	3.70 (11.07)	3.29 (10.39)	10.43 (18.84)	10.23 (18.64)	11.77 (20.04)	10.81 (19.17)
T_2	Kresoxim methyl 50 SC	7.87 (16.29)	7.33 (15.71)	11.90 (20.11)	9.03 (17.37)	19.37 (26.09)	19.50 (26.16)	22.37 (28.22)	20.41 (26.82)
T_3	Azoxystrobin 23 SC	7.93 (16.35)	8.07 (16.47)	7.87 (16.28)	7.96 (16.37)	20.90 (27.18)	20.17 (26.59)	20.03 (26.57)	20.37 (26.78)
T_4	Tricyclazole 75 WP	7.17 (15.52)	6.23 (14.43)	6.90 (15.20)	6.77 (15.05)	18.63 (25.56)	17.87 (24.96)	19.60 (26.25)	18.70 (25.59)
T_5	Carbendazim 50 WP	10.57 (18.93)	10.33 (18.71)	8.60 (17.03)	9.83 (18.22)	21.13 (27.36)	22.00 (27.96)	21.93 (27.88)	21.69 (27.73)
T_6	Propiconazole 25 EC	4.80 (12.66)	4.47 (12.16)	5.03 (12.96)	4.77 (12.59)	12.97 (21.09)	13.03 (21.10)	14.53 (22.37)	13.51 (21.52)
T_7	Mancozeb 75 WP	5.40 (13.42)	4.90 (12.76)	5.33 (13.33)	5.21 (13.17)	14.37 (22.23)	14.83 (22.62)	15.87 (23.45)	15.02 (22.77)
T_8	Tebuconazole 25.9 EC	6.10 (14.29)	5.83 (13.89)	6.40 (14.59)	6.11 (14.25)	17.03 (24.34)	17.03 (24.33)	17.98 (25.04)	17.35 (24.57)
T_9	Control (No spray)	19.57 (26.22)	17.33 (24.53)	15.97 (23.49)	17.62 (24.75)	40.53 (39.53)	34.60 (36.01)	28.17 (32.03)	34.43 (35.85)
	S.Em ±	0.65	0.86	0.74	0.82	0.93	1.25	1.04	1.17
	C.D. at 5%	1.95	2.58	2.22	2.34	2.79	3.75	3.11	3.34
	C.V.%	7.06	9.68	8.01	8.97	6.24	8.53	6.97	7.89
	Y x T				N.S				N.S

Note: Figures in the outside parenthesis are the original values while in parenthesis are arcsine transformed value. NS: Non-significant

Trifloxystrobin 25% + Tebuconazole 50% (75 WG) significantly reduced the infected panicles (3.29%) and per cent infected spikelets (10.81%) which was statistically on par with (T_6) Propiconazole 25 EC (4.77%) and (13.51%). The year effect was found non-significant.

Grain and Straw yield

The results on grain and straw yield of rice are given in **Table 2**. The results indicated that each fungicide treatment influenced the grain and straw yield during all the three years as well in pooled result. All the treatments were found to be significantly superior over control. Among the treatments, higher grain yield (6065 kg/ha) and straw yield (7361 kg/ha) was recorded in the treatment T_1 (Trifloxystrobin 25% + Tebuconazole 50% 75 WG) which was on par with the treatment T_6 (Propiconazole 25 EC) and T_7 (Mancozeb 75 WP) in the year 2016-17. Similarly, during the 2nd year, significantly higher grain yield (5977 kg/ha) and straw yield (7269 kg/ha) were recorded in treatment T_1 which was on par with the treatments T_6 and T_7. In the 3rd year trials, the treatment T_1 recorded significantly higher grain (5949 kg/ha) and straw yield (7037 kg/ha) that were at par with treatment T_6 grain yield (5657 kg/ha) and treatment T_6 and T_7 straw yield *i.e.,* 6690 and 6366 kg/ha, respectively. In the case of pooled results, the lowest grain yield (3511 kg/ha) and straw yield (4901 kg/ha) were recorded in control plot and the treatment T_1 *i.e.,* Trifloxystrobin 25 + Tebuconazole 50 (75 WG) @ 0.4 g/l was recorded significantly higher grain yield (5997 kg/ha) and straw yield (7222 kg/ha) which was statistically at par with T_6 *i.e.,* Propiconazole 25 EC @ 1.0 ml/l for grain yield (5798 kg/ha) and straw yield with treatment Propiconazole 25 EC (T_6) @ 1.0 ml/l and Mancozeb 75 WP (T_7) @ 3.3 g/l *i.e.,* 6983 and 6420 kg/ha, respectively. More or less similar results were reported by earlier workers for efficacy of different fungicides under field condition that is carbendazim and propiconazole (Dodan and Singh, 1997), Carbendazim (Hegde *et al*., 2000), Propiconazole, Tebuconazole and Carbendazim (Bagga and Kaur, 2006), Propiconazole, Tebuconazole, Carbendazim and Carbendazim + Mancozeb (Paramjit *et al*., 2006), Tebuconazole + Trifloxystrobin, Propiconazole, (Chen *et al*., 2013; Ladhalakshmi *et al*., 2014; Shivamurthy, 2017). Muniraju *et al.,* (2017) reported that Azoxystrobin+ Difenconozole and Metiram + Pyraclostrobin, (Surendren *et al.,* (2023) reported that Difenconazole and Isoprothiolane were found best in efficacy against sheath blight and grain discoloration. Systemic fungicide Trifloxystrobin + Tebuconazole

Table 2: The effect of fungicidal treatments on yield parameters

Sr. No.	Treatments	Grain Yield (kg/ha)				Straw Yield (kg/ha)			
		2016	2017	2019	Pooled	2016	2017	2019	Pooled
T_1	Trifloxystrobin 25% + Tebucona-zole 50% (75 WG)	6065	5977	5949	5997	7361	7269	7037	7222
T_2	Kresoxim methyl 50 SC	4639	4583	4421	4548	5833	5741	5370	5648
T_3	Azoxystrobin 23 SC	4481	4259	4583	4441	5579	5648	5602	5610
T_4	Tricyclazole 75 WP	4644	4606	4639	4630	6019	5926	5671	5872
T_5	Carbendazim 50 WP	4074	3981	4495	4184	5486	5463	5532	5494
T_6	Propiconazole 25 EC	5903	5833	5657	5798	7153	7106	6690	6983
T_7	Mancozeb 75 WP	4963	5000	4745	4903	6505	6389	6366	6420
T_8	Tebuconazole 25.9 EC	4653	4676	4704	4677	6111	5949	5972	6011
T_9	Check (No spray)	3565	3449	3519	3511	5120	4815	4769	4901
	S.Em ±	372	389	283	380	398	386	373	418
	C.D. at 5%	1116	1168	850	1086	1196	1159	1120	1194
	C.V. %	13.50	14.33	10.35	13.89	11.30	11.10	11.01	12.04
	Y x T				N.S				N.S

and Propiconazole were shown to be effective against neck blast and recorded maximum yield (Yadav *et al.,* 2022).

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