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Evaluation of fungicides against false smut disease of rice in rainfed lowland rice ecosystem

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Abstract
Rice (*Oryza sativa* L.) is the most important food crop of the world. Among the biotic stresses, false smut is an emerging disease caused by *Ustilaginoidea virens*. Very few rice cultivars have moderate level of resistance and majority of the commercially cultivated varieties do not show any resistance to false smut. A field experiment to evaluate bio-efficacy of solo and combination fungicides against false smut disease of rice was conducted during *Kharif* 2019. Experiment was laid in a randomized block design with seven fungicide treatments and four replications in rainfed lowland rice ecosystem. Results from the present investigations, revealed that two sprays of Tebuconazole 50% + Trifloxystrobin 25% WG at Booting + 50% Flowering(0.1%) was found significantly superior over other treatments in restricting the false smut upto 4.83% in comparison to control. Tebuconazole 50% + Trifloxystrobin 25% WG also fetched highest grain yield (39.23 q/ha) and straw yield(43.69 q/ha) was followed by Copper Hydroxide 53.8% DF (0.1%) @ Booting + 50% Flowering) and were at par with each other.

Keywords: Rice, false smut, *Ustilaginoides virens*, fungicides, disease, control

Introduction
Rice (*Oryza sativa* L.) is the most widely cultivated food crop in the world (Ou, 1985) [10]. It is the most important staple food grain for the people living in the rural and urban areas of humid and sub-humid Asia. It is being cultivated in 44.6 million hectare with a production of about 109.5 million tones In India. The productivity of rice is less (1.8 t/ha) in Maharashtra. The average productivity of rice in Maharashtra is much more less than national productivity. The major constraints for low productivity are diseases occurring on this crop. More than 70 diseases are caused by fungi, bacteria, viruses and nematodes on rice. Among them, false smut is one of the major emerging disease in recent time. (Webster *et al*., (2001) [17]. False smut of rice, caused by *Ustilaginoidea virens* (Cooke) Takah., is a common disease in rice panicles. Disease was first reported in India (1878) and was considered as a secondary disease due to their sporadic occurrence (Ladhalakshmi *et al*. 2018) [7]. Lonavla is situated in the Sahyadri ranges (2,041 ft) above sea level, that demarcate the Deccan Plateau and the Konkan coast of Maharashtra and receiving heavy annual rainfall 4650 mm in 100 to 110 rainy days. (Tirmali *et al*., (2001) [16] and Balgude *et al*. (2019) [5]. The weather climatic condition is warm and humid. These climatic conditions are most favorable for the development of various diseases. The disease occurrence can be correlate with high rainfall (6.66 to 6.67 mm), high relative humidity (90%), low temperature (25-30·c), high nitrogen application and moderate sunshine hours (6.20-6.29 hrs). (Tirmali *et al*., (2001) [16] Such congenial environment is suitable for germination of overwinter survival structures such as sclerotia and superfluous dormant spores i.e chlamydospores. Sclerotia produces ascospores which are primary source of infection to rice plants, whereas air borne chlamydospores serves as secondary source of inoculum Disease transforms individual grain into initially yellow, green and later into velvety coloured "Pseudomorphs or Smut balls". (Muniraju *et al*., 2017 and Koiso *et al*. (1994) [9, 6]. False smut not only reduces the grain yield but also affects quality by producing enormous amount of mycotoxins, like ustiloxin and ustilaginoidins including ergot alkaloids (more than 100 mg per kilogram false smut balls) which inhibit cell division in humans, animals and plants by inhibiting microtubules formation and thus affect the health of human and livestock. Very few rice cultivars have moderate level of resistance and majority of the commercially cultivated varieties do not show any resistance to false smut. (Tirmali *et al*. 2000a) [14]. Therefore presently, the best alternative to manage the disease is through the use of fungicides (Tirmali and Patil (2000b) [15], Tirmali *et al*. (2001) [16] and Balgude and Gaikwad (2016) [5].

Considering these facts, the present investigation was designed to identify the effect of solo/combination fungicides label claim fungicide against false smut in rainfed lowland rice ecosystem during *kharif* season of 2019.

Material and Methods

The field trial was laid out in randomized block design (RBD) with four replications in Rainfed lowland ecosystem during *Kharif* 2019 in experimental farm of Agricultural Research Station, Lonavala. The rice variety Phule Radha was used in the said trial. The gross plot size was 3.20 x 2.25 m^2 and net plot size was 2.80 X 1.95 m^2 with spacing 20 X 15 cm^2. The seeds of Phule radha variety were sown on 19th June, 2019 on a flat bed in seedling nursery. The 30 days old seedlings of Phule Radha were transplanted in the field on 23th July, 2019. The basal Fertilizer dose 50N:50P:50K was applied at the time of pudding and 50kg N was used as a top dressing.

The fungicides tested were trifloxystrobin 25% + tebuconazole 50% WG @ 1.0 gm/lt and Copper Hydroxide 53.8% DF @ 1.0 gm/lt. Two sprays of fungicide was given for each treatment at booting stage [80 days after transplanting (DAT)] and 50% flowering (100 DAT) stage which is shown as below.

Table 1: Show the name of fungicide dose

Sr. No.	Name of fungicide	Dose (%)
1	Tebuconazole 50% + Trifloxystrobin 25% WG at Booting	0.10
2	Copper Hydroxide 53.8% DF (0.1%) at Booting	0.10
3	Tebuconazole 50% + Trifloxystrobin 25% WG @ 50% Flowering	0.10
4	Copper Hydroxide 53.8% DF (0.1%) @% Flowering	0.10
5	Tebuconazole 50% + Trifloxystrobin 25% WG @ Booting + 50% Flowering	0.10
6	Copper Hydroxide 53.8% DF (0.1%) @ Booting + 50% Flowering	0.10
7	Control	--

Disease recording

The observations on disease were recorded after grain maturity, whereas, data on yield was recorded during crop harvesting. Various parameters of diseases were recorded such as, disease incidence was calculated as per the formulae given below as described previously by Mayee and Datar (1986) [8].

$$\text{Disease incidence (\%)} = \frac{\text{Number of infected tillers}}{\text{Total number of tillers}} \text{ X } 100$$

Statistical analysis

Disease severity in each treatment was analyzed in ANOVA and recorded standard error of mean and critical difference between the treatments was calculated.

Results and Discussion

False Smut Management: The data presented in Table 2 indicate that the treatment differences due to all parameters under study were statistically significant. The lowest incidence (4.83%) of false smut was noticed in the treatment with two sprays of Tebuconazole 50% + Trifloxystrobin 25% WG (0.10%) @ booting + 50% flowering and thus showed highest reduction of false smut 87.52 per cent, respectively. However, it was at par with two sprays of Copper Hydroxide 53.8% DF (0.1%) @ Booting + 50% Flowering (0.10%) that recorded 6.92 per cent incidence with 82.11 per cent reduction over control. In recent times, in paddy, many combination fungicides have been reported to be highly useful compare to other solo fungicides due to their broad spectrum action at lower dosages, target multiple diseases and most importantly low rate of fungicide resistance development. Trifloxystrobin 25% + tebuconazole 50% is an novel broad spectrum fungicide and has been reported to reduce the disease severity of many rice diseases such as sheath blight [Bag, 2009 and Pramesh *et al*., 2016] [2, 3, 11], blast [Balgude *et al*, 2016, Pramesh *et al*., 2016 and Sood and Kapoor, 1997] [4, 11, 13], grain discoloration [Bag and Saha, 2009] [2, 3] and false smut (Sharanabasav *et al.* 2020).

Grain and Straw yield

The yield data presented in Table 2 were statistically significant. The significantly highest grain (39.23 q/ha) and straw yield (44.21 q/ha) with 34.03 and 34.50 per cent increase respectively was obtained in treatment with Tebuconazole 50% + Trifloxystrobin 25% WG (0.10%) @ booting + 50% flowering . While, it was at par with Copper Hydroxide 53.8% DF (0.1%) @ Booting + 50% Flowering (0.10%) wherein, 32.63 and 32.92 per cent increase in yield in grain and straw was reported, respectively. The untreated control plot yielded just 29.27 q/ha. The results are exactly matching with the findings of earlier work at DRR (IIRR), Hyderabad (Anonymous, 2012 and Balgude and Gaikwad, 2016) [1, 4] wherein they reported that the fungicide combination trifloxystrobin 25% + tebuconazole 50% reduced the diseases *viz.*, leaf blast, neck blast, node blast, sheath rot, sheath blight, leaf scald, brown spot, false smut and seed discolouration and increased the yield of paddy to the greater extent. In this study, we report its field efficacy against false smut disease of rice.

Table 2: Efficacy of label claimed fungicides against false smut of paddy and its influence on grain and straw yield

SN	Name of fungicide	Dose (%)	False smut		Grain yield		Straw yield	
			Incidence	Reduction over control	q/ha	Increase over control	q/ha	Increase over control
1	Tebuconazole 50% + Trifloxystrobin 25% WG at Booting	0.10	8.81 17.24	77.23	32.51	11.07	37.76	14.88
2	Copper Hydroxide 53.8% DF at Booting	0.10	10.30 18.70	73.38	33.73	15.24	38.21	16.25
3	Tebuconazole 50% + Trifloxystrobin 25% WG @ 50% Flowering	0.10	13.69 21.69	64.62	34.62	18.28	36.87	12.17
4	Copper Hydroxide 53.8% DF @% Flowering	0.10	16.87 24.23	56.40	36.39	24.33	36.92	12.32
5	Tebuconazole 50% + Trifloxystrobin 25% WG @ Booting + 50% Flowering	0.10	4.83 12.68	87.52	39.23	34.03	44.21	34.50

6	Copper Hydroxide 53.8% DF @ Booting + 50% Flowering	0.10	6.92 15.24	82.11	38.82	32.63	43.69	32.92
7	Control	--	38.69 38.44	--	29.27	--	32.87	--
	SE +		1.28		0.99		0.91	
	CD (0.05)		3.83		3.10		2.85	

The figures in the bold faces are arc sin values

Conclusion

Two sprays of fungicide combination *viz.*, with Tebuconazole 50% + Trifloxystrobin 25% WG (0.10%) @ booting + 50% flowering were found to be most effective in management of false smut disease and thereby enhancing the grain yield in paddy. This was followed by two sprays of Copper Hydroxide 53.8% DF (0.1%) @ Booting + 50% flowering (0.10%)

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