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

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A B S T R A C T

In the present study nine fungicides were evaluated against the false smut disease of rice during *kharif*-2016. Among the different fungicides tested azoxystrobin (18.2 %) SC + difenconozole (11.4 %) SC and metiram (55 %) WG + pyraclostrobin (5 %) WG @ 0.1 per cent recorded the least disease severity of 1.85 and 2.52 per cent respectively, followed by propiconazole 25 EC, Azoxystrobin 25 % SC, Difenconazole 25 % EC, tebuconozole 250 EC and flusilazole (25 %) SE + carbendazim (12.5 %) SE showed better efficacy at 0.1 per cent and enhanced the paddy yield under field condition.

Introduction

Rice false smut, also known as pseudo-smut, or green smut, has been recorded in all rice growing countries worldwide. Earlier it was regarded as a minor disease, occurring sporadically in certain regions, but now epidemics of the disease are also being reported in different parts of the world including in India (Rush *et al.*, 2000; Singh and Pophaly, 2010; Anon., 2016). Recently in India, the disease has been observed in severe form since 2001 in major rice-growing states, *viz*., Andhra Pradesh, Bihar, Gujarat, Haryana, Jammu and Kashmir, Jharkhand, Karnataka, Maharashtra, Pondicherry, Punjab, Tamil Nadu, Uttar Pradesh and Uttaranchal (Dodan and Singh 1996, Mandhare *et al.*, 2008).

It is an important devastating disease causing yield losses from 1.01 to 10.91 per cent (Atia, 2004). Disease incidence of 10-20 per cent and 5-85 per cent respectively has been reported from Punjab and Tamil Nadu on different rice cultivars (Ladhalakshmi *et al.*, 2012). In recent years, its outbreak is anticipated due to high input cultivation, increased use of hybrid varieties and climate change (Lu *et al.*, 2009).

The efficacy of several fungicides against false smut has also been reported by various workers from different parts of the world. Mohiddin *et al.*, (2012) reported that prochloraz + carbendazim was effective against false smut. Pannu *et al.*, (2010)

obtained reduction in false smut by spraying of fungicide copperoxychloride 50 WP (0.25%) at booting followed by propiconazole 25 EC (0.1%). The present study was conducted to evaluate nine fungicides at two different stages of application against false smut of rice.

Materials and Methods

A field experiment was conducted at Agricultural Research Station, Gangavathi, during *kharif*, 2016-17 to find out the effective fungicide for the control of the false smut of rice. Experiment was laid out in Randomised Block Design (RBD) with 10 treatments and three replications.

Variety used was BPT-5204 and the gross plot size was 40 sq. metres and all packages of practices were followed for conducting the experiment. Two sprays were given for each treatment at booting stage [80 days after transplanting (DAT)] and post flowering (100 DAT).

Observations on false smut infected grains / panicle and number of infected tillers/ total number of tillers per m^2 were recorded. From that percentage of infected grains, infected tillers and infected grains were calculated. The yield data was recorded at the time of harvest

Results and Discussion

There was significant difference among the treatments in false smut disease severity and yield. The data on different disease parameters is summarised in table 1. Among the different treatments, two sprays of azoxystrobin (18.2 %) + difenconozole (11.4 %) SC was highly effective in the management of disease with least infected tillers (3.43 %), which was on par with the treatment propiconazole 25 EC (3.99 %), followed by metiram (55 %) + pyraclostrobin 5 % WG, Flusilazole (25 %) + carbendazim (12.5 %) 37.5 SE, and pencycuron (22.9 %) SC recorded the lowest disease incidence of 4.01, 5.08, and 5.22 per cent infected tillers respectively. The highest per cent infected tillers was observed in untreated control (10.39 %) (Table 1).

In terms of per cent infected grains, the treatment with azoxystrobin (18.2 %) + difenconazole (11.4 %) SC recorded the lowest percentage of infected grains (0.54 %), which was on par with the treatment metiram (55 %) WG + pyraclostrobin (5 %) WG (0.63 %) followed by propiconazole 25EC (0.77 %). Azoxystrobin 25 SC (1.06 %) recorded the lowest incidence of the disease in terms of per cent infected grains. The highest per cent of infected grains was observed in untreated control (3.41 %) (Table 1).

Among all the treatments two sprays of azoxystrobin (18.2 %) + difenconazole (11.4 %) SC was highly effective in the management of disease with least disease severity (1.85 %), followed by metiram (55 %) WG + pyraclostrobin (5 %) WG (2.52 %), propiconazole 25EC (3.07%), pencycuron (22.9 %) SC (5.79 %) and azoxystrobin 25 SC (6.66 %). The highest percentage of disease severity was observed in untreated control (35.62 %) (Table 1).

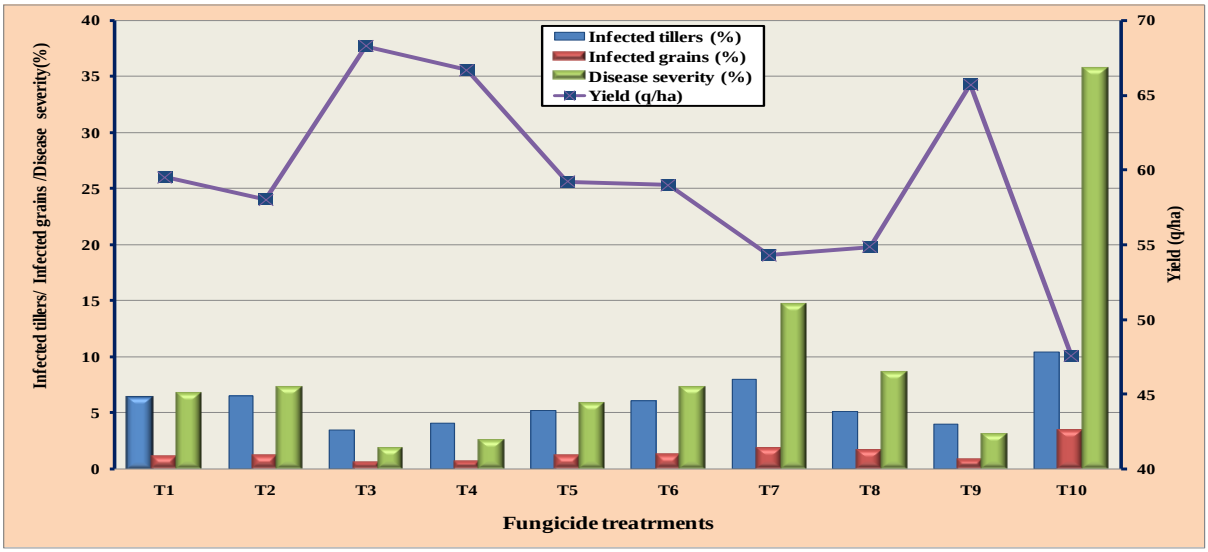
Similar results were reported previously for bioefficacy of fungicides under field condition such as carbendazim and propiconazole (Dodan and Singh, 1997), carbendazim (Hegde *et al.*, 2000), propiconazole, carbendazim and tebuconazole (Bagga and Kaur, 2006), propiconazole, carbendazim, tebuconazole and carbendazim + mancozeb (Paramjit *et al.*, 2006), trifloxystrobin + tebuconazole, propiconazole (Chen *et al.*, 2013; Ladhalakshmi *et al.*, 2014; Shivamurthy, 2017).

Table.1 Management of false smut of rice during *Kharif*- 2016

Sl. No.	Treatments	Dosage (g or ml/l)	Per cent infected tillers	Per cent infected grains	Disease severity (%)	Reduction in disease severity over control (%)	Yield (q/ha)	Increase in yield over control (%)	B : C ratio
1	Azoxystrobin25 % SC	1.0	6.29 (14.48)*	1.06 (5.88)	6.66 (14.93)	81.30	59.50	25.22	1:2.84
2	Difenconazole 25 % EC	1.0	6.49 (14.73)	1.11 (6.04)	7.20 (15.47)	79.79	58.00	22.06	1:2.99
3	Azoxystrobin 18.2 % + Difenconazole 11.4 % SC	1.0	3.43 (10.54)	0.54 (4.13)	1.85 (7.34)	94.81	68.27	43.68	1:3.34
4	Metiram 55 % + Pyraclostrobin 5% WG	1.0	4.01 (11.54)	0.63 (4.51)	2.52 (9.01)	92.93	66.67	40.31	1:3.43
5	Pencycuron 22.9% EC	1.0	5.22 (13.10)	1.11 (6.05)	5.79 (13.74)	83.75	59.18	24.55	1:3.07
6	Tebuconazole 250 EC	1.0	6.04 (14.14)	1.20 (6.29)	7.25 (15.53)	79.65	58.97	24.10	1:3.03
7	Thiafluzamide 24% SC	1.0	7.92 (16.35)	1.85 (7.80)	14.65 (22.48)	58.87	54.27	14.21	1:2.68
8	Flusilazole 25%+ carbendazim 12.5% SE	1.0	5.08 (12.96)	1.69 (7.48)	8.58 (17.05)	75.91	54.84	15.41	1:2.68
9	Propiconazole 25 % EC	1.0	3.99 (11.50)	0.77 (5.02)	3.07 (10.03)	91.38	65.67	38.20	1:3.41
10	Untreated control	-	10.39 (18.79)	3.41 (10.63)	35.62 (36.58)	-	47.52	-	1:2.57
S. Em ±			**0.75**	**0.32**	**1.19**		**2.26**		
CD at 5%			**2.20**	**0.93**	**3.49**	**-**	**6.62**	**-**	
CV (%)			**10.21**	**10.31**	**15.23**		**7.91**		

*Figures in parentheses indicate angular transformed values

Fig.1 Effect of different fungicides on false smut disease of paddy under field condition during *Kharif*-2016



Combination fungicides are better compare to the other solo fungicides due to their broad range of action, lower dose and also posses lower risk of fungicide resistance development in target fungal population. In rice, efficacy of such combi products in managing many fungal diseases has been reported (Bag and Saha, 2009; Bhuvaneshwari and Raju, 2012; Kumar and Veerabhadraswamy, 2014; Pramesh *et al.*, 2016 a&b). In the present study, different combination products such as azoxystrobin (18.2 %) SC + difenconazole (11.4 %) SC, metiram (55 %) WG + pyraclostrobin (5 %) WG, tebuconazole 250 EC, flusilazole (25 %) SE + carbendazim (12.5 %) SE showed their superior bioefficacy in reducing false smut disease incidence and they can be utilized under epidemic condition. In case of rice, resistance varieties for false smut are still not developed/available to the farmer. Moreover, bio-efficacy of the bio-control agents under the severe epidemic condition are not demonstrated, therefore, chemical control is an inevitable and ultimate means for disease management for farmers. Thus, cultural practices combined with foliar spray of fungicide is the only practice available to manage the disease and even in integrated pest management system need based application of fungicide has been recommended (Bag *et al.*, 2016) (Fig. 1).

On comparison with the grain yield obtained from each plot it was found that the treatment with azoxystrobin (18.2 %) + difenconazole (11.4 %) SC gave the highest grain yield per plot (68.27 q/ha) which was on par with the metiram (55%) WG+ pyraclostrobin (5 %) WG (66.67 q/ha) followed by treatment with propiconazole 25EC (65.67 q/ha), azoxystrobin 25 SC (59.50 q/ha) and pencycuron (22.9 %) SC (59.18 q/ha). Grain yield per plot was found to be minimum in untreated control (47.52 q/ha) (Table 1). The highest B: C ratio was recorded in plots treated with combi fungicides metiram (55 %) + pyraclostrobin (5 %) WG having 1:3.43, followed by propiconazole 25 EC with 1:3.41 and azoxystrobin (18.2 %) + difenconazole (11.4 %) SC with 1:3.34.

In case of rice, many researchers have reported the increased grain yield after application of fungicides due to reduction in biotic stress on plant during critical growth

stages (Sood and Kapoor, 1997; Tirmali *et al.*, 2001; Prabhu *et al.*, 2003; Usman *et al.*, 2009; Naik *et al.*, 2012; Bhuvaneshwari and Raju, 2012; Bag *et al.*, 2016, Pramesh *et al.*, 2016a&b). For management of false smut disease, efficacy of many fungicides has been reported previously (Chen *et al.*, 2013; Kumar, 2015; Raji *et al.*, 2016).

In the present study, in addition to the previously reported fungicides, the efficacy of new combination of fungicides such as azoxystrobin (18.2 %) SC + difenconazole (11.4 %) SC, metiram (5 5%) WG + pyraclostrobin (5 %) WG and flusilazole (25 %) + carbendizim (12. 5%) at 0.1 per cent or the management of false smut disease under field condition.

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