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EFFECT OF FUNGICIDES ON LEAF BLAST AND GRAIN YIELD OF RICE IN KYMORE REGION OF MADHYA PRADESH IN INDIA

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Abstract

Field experiment was conducted to evaluate the efficacy of 11 foliar fungicides against leaf blast pathogen *Magnaporthe grisea* in susceptible rice variety Basmati in Rewa, Madhya Pradesh in India. All the fungicides show effective management of the disease over untreated check. However, among the treatments tricyclazole @ 0.6 g/l/kg, was found significantly superior in controlling the disease severity, number of tillers/plant, number of spikelet/panicle, panicle length, grain yield and 100 seed weight, whereas the tallest plant of the cultivar was noticed in plot sprayed with Carbendazim 50 WP in the same concentration.

Introduction

Rice blast caused by *Magnaporthe grisea* Barr (anamorph, *Pyricularia oryzae* Cav. or *Pyricularia grisea*) is the most destructive pathogen of rice worldwide causing significant yield losses (Kunova *et al.* 2013) ranging up to even 100% (Filippi *et al.* 2014). The outbreaks of rice blast are a serious and recurrent problem in all rice-growing regions of the world (Kapoor and Katoch 2014) and in tropical region, especially in India the disease is a serious threat to rice crop (Sireesha 2013). Blast is a major contributor to the yield gap and in this era of rapidly increasing world population, limitations to increase cultivated land and non-availability of water for irrigation, reducing the loss due to blast can prove to be a critical component towards mitigating the world food security (Sharma *et al.* 2012).

The cultivation of resistant varieties and the use of fungicides have been advocated by several workers for rice blast management (Fang *et al.* 2009, Faivre-Rampant *et al.* 2011, Kunova *et al.* 2014). The efficacies of various systemic and broad-spectrum fungicides have gained favour for rice blast control throughout the world especially in temperate or subtropical regions. The fungicides have efficiency to control leaf blast up to a range of 40 to 84% (Swamy *et al.* 2009). New generation chemicals like tricyclazoles, carpropamid, etc., are environmentally safe and provide quite long protection (Singh *et al.* 2000). The judicious use of fungicides will help reduce the risk of adaptation by the target fungi and at the same time will reduce residues in the environment and on the produce and new fungicides will continue to be developed to protect the ever more precious cultivars, where they do not have sufficient genetic disease resistance (Morton and Staub 2008). However, during the selection of fungicides low toxicity to humans and wildlife, low environmental impact, low residues in food, and compatibility with integrated pest management (IPM) programs are increasingly important considerations for development (Knight *et al.* 1997). In view of the above facts, this research aimed to determine comparative efficacy of different foliar fungicides and their least possible concentrations in controlling leaf blast and enhancing grain yield of rice.

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Materials and Methods

The field experiments were conducted in Rewa, Madhya Pradesh in India during 2011 and 2012. Blast susceptible cultivar Basmati was selected to study the efficacy of fungicides. The seed nursery was prepared in mid-June of each experimental year. The seedlings were transplanted after 3 weeks in 5 × 2 m plot using randomized block design with three replications. The plants were spaced 15 cm by 15 cm. Fertilizer was applied @ 100 : 50 : 50 Kg NPK/ha and chloropyriphos was used as insecticides @ 1185 ml/ha. and Pretilaclor as weedicide @ 1.5 lt/ha. Commercial fertilization rates (80:60: 40 N:P:K kg/ha) were used at regular interval according to standard recommendations.

Five plants from each plot were randomly selected and from each selected plants, three leaves were selected for recording disease index. The disease incidence was recorded by using 0 - 9 scale (IRRI 2002) at weekly interval for five successive weeks and per cent disease index (PDI) was calculated using the formula.

$$\text{PDI} = \frac{\text{Sum of numerical ratings} \times 100}{\text{Total number of leaves observed} \times \text{Maximum disease scale}}$$

Eleven fungicides along with their trade name that were tested for leaf blast control are given

Trade name	Fungicidal formulations
Tilt 25EC	Propiconazole
Kasu-B	Kasugamycin
Amistar	Azoxystrobin + difanconazole
Beam75 WP	Tricyclazole
Bavistin	Carbendazim 50 WP
Fongorene	Pyroquilon 50 WP
Hinosan	Ediphenphos 50 EC
Kitazin 48 EC	Eprobenfos
Phytox	Zineb 75 WP
Saaf 75 WP	Carbendazim 12% + Mancozeb 63%
Baycor 25 WP	Bitertanol

The least possible doses of the fungicides were sprayed thrice at weekly interval starting with the initiation of the disease. Disease incidence and intensity were recorded firstly at initial stage before spraying the products, secondly after one week of spraying and finally at harvest.

$$\text{LGW (\%)} = \frac{\text{Total weight of filled and unfilled grain weight} - \text{filled grain weight} \times 100}{\text{Total weight of filled and unfilled grain}}$$

The observations of yield traits *viz.*, plant height, tiller numbers, number of spikelet and panicle length were determined at 40 DAT. The 100 panicle grain weight (LGW) were calculated at harvest as follows:

Per cent increase in yield (PIY) was calculated by the following formula

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

The pooled data were subjected to standard statistical procedure ANOVA and Tukey´s test at 0.05 probability levels.

Results and Discussion

Application of fungicides for leaf blast treatment was significant when the pooled data of both the experimental years were subjected to analysis of variance (Table 1). Application of tricyclazole recorded least disease severity (35.62%), followed by carbendazim and ediphenphos, 32.91 and 30.5%, respectively during both the years. The weather conditions are always favorable in leaf blast incidence and severity. Year 2012 receives more rainfall compared to previous year. Response of disease severity was found to be suppressed following fungicidal spray over control. It is shown that tricyclazole are melanin biosynthesis inhibitors (MBI) group fungicide and prevent melanin biosynthesis in appressoria of *Pyricularia oryzae* and penetration of rice plants via

Table 1. **Effect of fungicides on disease severity of leaf blast.**

Treatment	Dose	Disease index %		Average	% disease control
		2011	2012		
Amistar	1 ml/l	25.70	33.80	29.75	20.20
Bavistin	1 g/l/kg	18.90	24.60	21.75	32.91
Hinosan	1 ml/l	18.80	26.40	22.6	31.41
Tilt 25 EC	1 ml/l	22.18	29.80	25.99	26.07
Kasu-B	2 ml/l	25.80	35.20	30.5	18.99
Baycor 25 WP	1 g/l	29.20	30.80	30	19.74
Kitazin	1 ml/l	23.20	28.83	26.01	25.90
Saaf 75 WP	1.5 g/l	25.20	37.30	31.25	17.93
Phytox	1 g/l	30.60	36.80	33.7	14.23
Beam 75 WP	0.6 g/l/kg	18.50	21.80	20.15	35.62
Fongorene	1 g/l	25.80	30.90	28.35	22.32
Control	Untreated check	35.70	51.80	43.75	
SEm		0.045	0.018		
CD at 5%		0.146	0.059		

appressoria by inhibiting polyhydroxynapthaline reductase (Kumar *et al.* 2013) and at increased concentration flaviolin accumulation enhances, indicating possible secondary sites of inhibition in the main and branch biosynthetic pathways (Woloshuk *et al.*1980). Similar results regarding the efficacy of various fungicides have been reported by several researchers. Ganesh *et al.* (2012) used ten fungicides for management of rice blast and found that the per cent disease index was significantly less (15.56) in tricyclazole sprayed plots followed by kitazine (17.63) and ediphenphos (18.03). The findings are in line with Iqbal *et al.* (2014) and Kumar and Veerabhadraswamy (2014) who reported that tricyclozole was most effective in reducing the leaf blast severity. Kapoor and Katoch (2014) observed that seed dressing with tricyclazole have been found effective from fungal pathogen *Magnaporthe oryzae* to provide protection to seed up to 8 weeks after sowing. Tricyclazole exhibited better protective than curative activity and epoxiconazole at 112.5 g a.i/ha provided over 75% rice blast control efficacy, which was similar to tricyclazole with 300 g a.i./ha and better than carbendazim with 562.5 g a.i./ha as observed by Chen *et al.* (2013).

Table 2. Effect of fungicides on yield traits of rice.

Treatment	Dose	Plant height (cm)			No. of tillers/plant			No. of spikelet/panicle			Panicle length (cm)		
		2011	2012	Mean	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
Amistar	1 ml/l	90.30	93.70	92	13	16	14.5	189	193	191	24	26	25
Bavistin	1 g/l/kg	94.30	98.60	96.45	20	27	23.5	214	220	217	27	28	27.5
Hinosan	1 ml/l	93.10	96.20	94.65	20	26	23	215	219	217	26	28	27
Tilt 25 EC	1 ml/l	92.40	96	94.2	19	25	22	210	215	212.5	25	27	26
Kasu-B	2 ml/l	90	90.10	90.05	14	20	17	182	188	185	23	25	24
Baycor 25 WP	1 g/l	90	91.80	90.9	17	22	19.5	197	199	198	24	26	25
Kitazin	1 ml/l	92	95	93.5	18	24	21	209	213	211	25	27	26
Saaf 75 WP	1.5 g/l	83.80	85.50	84.65	13	18	15.5	192	196	194	25	26	25.5
Phytox	1 g/l	91.40	91.60	91.5	16	21	18.5	181	188	184.5	25	27	26
Beam 75 WP	0.6 g/l/kg	93.20	97.90	95.55	21	29	25	219	222	220.5	28	29	28.5
Fongorene	1 g/l	91.40	94.10	92.75	17	23	20	199	207	203	25	27	25.5
Control	Untreated check	83	84.60	83.8	10	14	12	177	187	182	22	23	22.5
SEm		0.255	0.235		0.113	0.096		0.787	0.254		0.673	0.509	
CD at 5%		0.817	0.751		0.362	0.307		2.517	0.813		2.152	1.627	

Observations on yield traits *viz.,* plant height, tiller numbers, number of spikelet and panicle length were recorded at 40 DAT. All the yield characters responded significantly following chemical treatments compared to non-treated control (Table 2). Plant height was significantly higher in carbendazim treated plot in both the years of experimentation with a pooled mean value of 96.45 cm, closely followed by tricylazole (95.55 cm) and ediphenphos (94.65 cm). Carbendazim are benzimidazole group fungicide that are single site inhibitors of fungal microtubule assembly during mitosis, via tubulin-benzimidazole-interactions (Smith 1988). Several workers have found that the application of *Strobilurins* (referred as QoI fungicides) (Vincelli 2002) in combinations with other groups (Kumar *et al.,* 2011) were found effective in improving the growth of the plant in terms of height, test weight and yield. Spraying of tricylazole resulted in significantly better number of tillers/plant (25), numbers of spikelet per panicle per plant (220.5) and panicle length (28.5 cm) followed by carbendazim and ediphenphos compared to untreated plot. The two years pooled data reveal that all these tested parameters differed during the year 2011 than 2012 which may be due to congenial meteorological factors. Koutroubas *et al.* (2009) reported that infection of plants during the generative growth stages mainly results in panicle or neck infections that may cause necrosis of the plant neck and incomplete grain filling. The findings are in line with Devaraju *et al.* (2013) who studied the efficacy of different fungicidal sprays *viz.,* carbendazim, mancozeb and tricyclazole at three growth stages *viz.,* 50 per cent flowering, milk/dough stage and physiological maturity for control of blast disease (*Pyricularia grisea*) in rice and observed that tricyclazole significantly increased number of tillers/hill (8.63) and productive tillers/hill (8), number of filled spiklets/panicle (58) in compared to different treatment combinations.

Table 3. **Effect of fungicides on yield and 100 seed weight.**

Treatment	Dose	Yield (kg/ha)			% increase in yield	100 seed weight (g)		
		2011	2012	Mean		2011	2012	Mean
Amistar	1 ml/l	3115	2648	2881	26.69	1.76	1.80	1.78
Bavistin	1 g/l/kg	3402	2892	3147	38.39	1.98	2.04	2.01
Hinosan	1 ml/l	3388	2880	3134	37.82	1.97	2.01	1.99
Tilt 25 EC	1 ml/l	3182	2892	3037	33.55	1.96	2.00	1.98
Kasu-B	2 ml/l	2666	2266	2466	8.44	1.67	1.70	1.685
Baycor 25 WP	1 g/l	2966	2522	2744	20.67	1.69	1.75	1.72
Kitazin	1 ml/l	3254	2766	3010	32.37	1.86	1.91	1.885
Saaf 75 WP	1.5 g/l	3168	2693	2930	28.85	1.82	1.86	1.84
Phytox	1 g/l	3126	2656	2891	27.13	1.81	1.84	1.825
Beam 75 WP	0.6 g/l/kg	3516	2990	3253	43.05	2.03	2.12	2.075
Fongorene	1 g/l	3192	2713	2953	29.86	1.83	1.88	1.855
Control	Untreated Check	2458	2090	2274		1.56	1.65	1.605
SEm		0.976	0.535	24.5		0.010	0.007	
CD at 5%		3.121	1.712	78.4		0.033	0.024	

The experimental pooled data on100 seed weight and grain yield after spraying of fungicides showed significant variations (Table 3). The result reveals that the fungicide tricyclazole was highly effective in increasing seed weight and grain yield (2.075 g and 43.05%), followed by carbendazim (2.01 g and 38.39%) and ediphenphos (1.99 g and 37.82%) over untreated check. The results are in line with Hai *et al.* (2007) who reported that spraying of tricyclazole can improve 1000 grain weight of rice cultivar. The alteration in yield in non-treated plots than the treated plots during both the year indicating that yield is affected by seasonal changes and disease

level. Ganesh Naik *et al.* (2012) observed that tricyclazole, kitazine and ediphenphos were found significantly superior in increasing the grain yield. Sachin and Rana (2011) also observed increase in grain yield with the application of tricyclazole.

Thus the grain yields under lowland irrigated conditions are risk prone to leaf blast and require judicious use of fungicides. Results of this research have shown that even though the potential of tricyclazole in controlling leaf blast to increase yield traits, yield and grain weight, the validation of these results should be tested in multilocation on-farm trials for generalized recommendation to include as an essential input in leaf blast management of rice.

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