Efficacy of Fungicides against Grain Spot Disease in Rice *(Oryza sativa)*

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Abstract: A field study was conducted to evaluate the efficacy of the five selected fungicides viz., ipordione (rovral), tebuconazole (folicur), and hexaconazole (Hayconazole, Orazole and Titan) against grain spot disease in rice. The experiment was conducted at the Field Laboratory, Bangladesh Rice Research Institute (BRRI), Gazipur and two regional stations at Barisal and Satkhira in Bangladesh. A high yielding cultivar BRRIdhan28 was selected for the study as test crop. Percentage of unfilled grain at different experimental sites showed a large variation from 4.4 to 14.1% in control. The lowest unfilled grain found in Titan treated plot at Barisal (13.6%) and Satkhira (3.8%), while the lowest unfilled grain (7.0%) found in orazole treated plot at Gazipur. Application of rovral (12.4%) and folicur (15.8%) reduced the percentage of spotted grain as compared with control (23.6%) in Satkhira site. The average 100 grain weight considerably varied among the sites and was comparatively higher in Satkhira. Seed health test revealed low rate of seed infection with *Bipolaris oryzae, Curvularia lunata, Alternaria tenuis* and *Trichoconis padwickii* irrespective of the sites. Seed infection with *B. oryzae* at Barisal, Gazipur and Satkhira in different treatments ranged from 2.88-4.34%, 3.50-5.67% and 1.10-2.55%, respectively. In all the sites, the highest incidence of *C. lunata* was observed in control treatment but the differences with fungicide application were non-significant, which indicated a minimal effect of tested fungicides against *C. lunata*. Tested fungicides were found ineffective in controlling *A. tenuis* and *T. padwickii*. The results showed that incidence of all the above mentioned pathogens in seed were comparatively higher at Gazipur site.

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Introduction

Rice (*Oryza sativa*) is the staple food of about 135 million people of Bangladesh. It provides nearly 48% of rural employment, about two-third of total calorie supply and about one-half of the total protein intakes of an average person in the country. Rice sector contributes one-half of the agricultural GDP and one-sixth of the national income in Bangladesh. Almost all of the 13 million farm families of the country grow rice. Rice is grown on about 10.5 million hectares which has remained almost stable over the past three decades. About 75% of the total cropped area and over 80% of the total irrigated area is planted to rice. Thus, rice plays a vital role in the livelihood of the people of Bangladesh (www.knowledgebank-brri.org/riceinban.php). But the rice culture is seriously affected by diseases over its whole cycle. Diseases can affect both productivity and grain quality as well (Santos *et al*., 2009). Among the diseases, brown spot (*Bipolaris oryzae*) and narrow brown spot (*Cercospora oryzae*) cause substantial loss to rice both in quality and quantity. In the last decades, a number of systemic fungicides with different modes of action and targets have been applied to reduce the losses caused by the diseases (Pasquer *et al*., 2005).

Grain spotting or discolorations caused by several microorganisms is a complex malady in rice, gaining importance in almost all rice growing areas of the world in recent years (Biswas, 2003). It becomes an increasing problem in seed production as well as crop production in Bangladesh and elsewhere (Ranganathaiah, 1985; Rodriguez *et al*., 1988; Mia *et al*., 1994). More than 50% of the farmers' saved seed in Bangladesh are spotted or discoloured (Mia, 2004). Grain spotting or discolouration causes both quantitative and qualitative losses in rice (Vidhyasekaran and Ramadoss, 1973; Vidhyasekaran *et al*., 1984) and also decreases grain yield and size (Sugha and Singh, 1989). Therefore, the present study was conduced to investigate the efficacy of fungicide against seed discolouration and/or spotting at different geographical region in Bangladesh.

Materials and methods

The experiment was conducted in 2006 during Boro season (November to May) at the Field Laboratory, Bangladesh Rice Research Institute (BRRI), Gazipur and two regional stations at Barisal and Satkhira in Bangladesh. A high yielding cultivar BRRIdhan28 was selected for the study as test crop. The experiment was carried out in Randomized Complete Block Design (RCBD) with 3 replicates. Forty five days old seedlings of the rice variety were transplanted in $2{\times}2m^2$ unit plots with a spacing of $15{\times}20cm^2$. Normal agronomic practices and fertilization were used for the study as per recommendation (BRRI, 1999).

Five selected fungicides viz., ipordione (rovral), tebuconazole (folicur), and hexaconazole (Hayconazole, Orazole and Titan) were used in this experiment (Table 1). Tap water alone served as control. Fungicides were sprayed twice at recommended dose in the booting and flowering stages. At maturity stage, hills from the central $1m^2$ area were harvested separately for each treatment in each site. Unfilled, apparently healthy and spotted seeds were separated and presented as percentage. Weight of 100 randomly selected seeds was recorded and adjusted to 14% moisture content. The incidence of seed-borne fungi associated with the seed was determined following modified blotter method using 200 seeds per sample (ISTA 1996). Data were subjected to 2-way ANOVA between treatment and geographical region under either seed category or disease incidence using Standard Evaluation System for Rice (IRRI, 1996). Means were separated using Least Significant Difference (LSD) test at 5% level of significance.

Results and discussion

Percentage of unfilled grain at different experimental sites showed a large variation from 4.4 to 14.1% in control (Table 2). There was no significant difference among the treatments in each site. The lowest unfilled grain found in Titan treated plot at Barisal (13.6%) and Satkhira (3.8%), while the lowest unfilled grain (7.0%) found in orazole treated plot in Gazipur (Table 2). Percentage of healthy grain was significantly higher over control treated by rovral and folicur in Satkhira. Application of rovral (12.4%) and folicur (15.8%) reduced the percentage of spotted grain as compared with control (23.6%) at Satkhira site (Table 2). Although there was a reduction of spotted grain in all the chemical sprayed plots at Barisal site as compared with control, but statistically there was no significant difference. The spotted grain by chemical treated plots was higher over control at Gazipur site, but statistically they also were non significant (Table 2). The average 100 grain weight considerably varied among the sites and was comparatively higher at Satkhira. But there was no significant difference among the treatment on 100 grain weight as compared with control in all the sites (Table 2). It means grain weight might be influenced by environment and soil fertility.

Seed health test revealed low rate of seed infection with *Bipolaris oryzae, Curvularia lunata, Alternaria tenuis* and *Trichoconis padwickii* irrespective of the sites (Table 3). Seed infection with *B. oryzae* at Barisal, Gazipur and Satkhira in different treatments ranged from 2.88-4.34%, 3.50-5.67% and 1.10-2.55%, respectively (Table 3). Rovral significantly reduced the seed infection of *B. oryzae* in all the sites as compared with control. At Gazipur site application of folicur also showed significant reduction of *B. oryzae* incidence in seed (Table 3). In all the sites, the highest incidence of *C. lunata* was observed in control treatment but the differences with fungicide application were non-significant, which indicated a minimal effect of tested fungicides against *C. lunata*. The tested fungicides were ineffective to *A. tenuis* and *T. padwickii*. The results showed that incidence of all the above mentioned pathogens in seed were comparatively higher at Gazipur site (Table 3).

Efficacy of different fungicides against grain spot disease under field condition was investigated during this research. To study of different fungicides, a similar strategy was employed by Ghazanfar *et al*. (2009) that the evaluation of different fungicides on leaf and neck blast under field conditions and their ultimate effect on crop yield. The application of various fungicides against leaf blast after the first week, the fungicides Armure (Propiconazol + Difenoconazole), Rabicide (Tetrachlorophthalide), Score (Difenoconazole), showed the best results with disease percentage of 28.11%, 30.61% and 30.92%, respectively (Ghazanfar *et al*., 2009). Captan and Acrobat were the most effective fungicides among Captan, Acrobat, Bayeltan, Sunlet, Dithane M-45 Trimiltox and Derosal against *Pyricularia oryzae* under the laboratory conditions (Haq *et al.,* 2002). The eight fungicides for control of *Pyricularia oryzae*, Topsin M + Indofil M-45 proved to be the most effective against leaf blast disease of rice (Dubey, 1995). The fungiside, probenazole induce a resistant reaction in rice plants against infection by rice blast fungus (Minami and Ando, 1994). The fungicides carbendazim, pyroquilon, thiophanate methyl and chlobenthiazone reduce the leaf blast disease of rice on the other hand tricyclazole was effective in reducing the neck blast (Gouramanis, 1995).

In this experiment higher amount of spotted grains decreased the amount of healthy seeds (Table 3). A similar phenomenon reported that Bion, Amistar and Tilt resulted in 25.87, 32.17 and 26.76% higher grain yield, respectively over the untreated control when sprayed at tillering stage (Hossain *et al*., 2011). Propiconazol (Tilt) is the most promising fungicide that provided 47.5% and 26.5% reduction in disease incidence and severity, respectively along with 7.7% increase in grain yield (Kumar *et al*., 2003). The result also reported that seed treatment with Bion and Amistar increased 53.33 and 53.00% grain yield, respectively of wheat over untreated control (Aminuzzaman and Hossain, 2007). Sood and Kapoor (1997) evaluated 7 fungicides against leaf and neck blast of rice caused by *Magnaporthe grisea.* The efficacy of new fungicides in controlling rice neck blast caused by *Pyricularia oryzae* on rice cultivar Ek-70 (blast susceptible) treated with win 30 sc (Capropamid), Folicur 250, WE Swing 250 Ec and Beam 75 WP at maximum tillering panicle initiation and at heading stage of crop and found that all these new fungicides have significantly reduced neck blast (Tirmali *et al*., 2001). Our results are in conformity with those of Sood and Kapoor (1997), Tirmali *et al.* (2001), and Prabhu *et al*. (2003) reported that fungicides application increases the yield of rice.

The results of this paper indicate that only rovral reduced the seed infection by *B. oryzae* in all three sites. None of the tested fungicides could effectively control all the seed infecting fungi. The tested fungicides were not effective to control *A. tenuis* and *T. padwickii*. Therefore, further research is needed using large number of fungicides individually or mixing among them including the nutritional and environmental parameters aspects.

Table 1: List of different fungicides with their active ingredient (AI), dose and source or company name

Name of fungicide	AI	Dose	Company
Folicur	Tebuconazole	500gm/ha	Haychem (Bangladesh Ltd.)
Rovral	Iprodion	1Kg/ha	Bayer Crop Sciences
Hayconazole5EC	Hexaconazole	500ml/ha	Haychem (Bangladesh Ltd.)
Orazole 5EC	Hexaconazole	500ml/ha	Orion International Ltd.
Titan 5EC	Hexaconazole	500ml/ha	Larsen Chemical Industries

Table 2: Effect of different chemicals on seed quality of rice at the different geographical region in Bangladesh

Fungicides	% Different categories of seed											
	Unfilled			Healthy			Spotted			100-grain wt (g)		
	Barisal	Gazipur	Satkhira	Barisal	Gazipur	Satkhira	Barisal	Gazipur	Satkhira	Barisal	Gazipur	Satkhira
Folicur	14.2	9.0	4.1	65.7	64.8	80.1	20.0	26.2	15.8	1.90	2.20	2.32
Rovral	14.2	9.5	4.1	66.9	70.0	83.5	18.9	20.5	12.4	1.98	2.08	2.31
Hayconazole	14.0	9.9	4.1	69.0	66.2	73.0	17.0	23.9	23.0	2.04	1.94	2.31
Orazole	16.2	7.0	4.1	63.4	68.8	73.9	20.4	24.2	22.0	1.86	1.84	2.30
Titan	13.6	7.8	3.8	71.2	64.5	74.0	15.2	27.7	22.1	2.04	1.99	2.23
Control	14.1	9.1	4.4	64.5	72.0	72.0	21.3	18.9	23.6	1.89	2.08	2.20
LSD at 5%	4.3	2.4	1.1	10.5	18.3	4.4	9.0	19.0	4.1	0.24	0.40	0.11

Data were subjected to 2-way ANOVA (LSD test, $P < 0.05$) between treatment and geographical region under each parameter of seed category

Table 3: Effect of different fungicides on incidence of seed associated fungi of rice at the different geographical region in Bangladesh

Fungicides	Percent incidence of different seed associated fungi											
	B. oryzae			*C. lunata*			*A. tenuis*			*T. padwickii*		
	Barisal	Gazipur	Satkhira	Barisal	Gazipur	Satkhira	Barisal	Gazipur	Satkhira	Barisal	Gazipur	Satkhira
Folicur	3.95	4.25	1.91	1.33	2.99	1.29	0.71	2.64	1.27	0.80	0.98	0.90
Rovral	2.88	3.50	1.10	1.10	2.82	1.53	0.80	1.98	1.67	0.71	1.10	1.00
Hayconazole	3.60	4.96	1.61	1.07	2.96	1.85	0.71	1.78	1.29	1.33	0.90	1.53
Orazole	4.27	5.40	2.14	1.19	3.07	1.64	0.90	2.27	1.97	0.90	1.22	1.14
Titan	3.84	5.53	2.29	1.34	3.27	1.57	0.88	2.72	2.05	0.90	1.50	1.32
Control	4.34	5.67	2.55	1.37	3.49	2.09	0.80	2.35	1.96	0.80	1.33	1.22
LSD (5%)	1.00	0.94	0.72	0.51	0.71	0.93	0.30	0.67	1.14	0.32	0.55	0.50

Data were subjected to 2-way ANOVA (LSD test, $P < 0.05$) between treatment and geographical region under individual disease incidence

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