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# Efficacy of Selected Fungicides in Controlling Foliar Diseases of Rice (*Oryza sativa* L.)

**Fateh Un Tuli[1], Md. Iqbal Hossain[2, *], Shamima Akter Shapla[1], Md. Anwar Hussain[1], Md. Rabiul Basar Talukdar[1], Md. Abu Kawochar[2], Jannatul Ferdous[3]**

[1]Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh

[2]Tuber Crops Research Centre, Bangladesh Agricultural Research Institute, Gazipur, Bangladesh

[3]Biotechnology Division, Bangladesh Rice Research Institute, Gazipur, Bangladesh

### Email address:

iqbalhossain@bari.gov.bd (Md. I. Hossain)

[*]Corresponding author

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**Abstract:** An experiment was conducted at Sher-e-Bangla Agricultural University, Bangladesh to evaluate the efficacy of different fungicides against major foliar diseases of rice, namely brown spot (*Bipolarisoryzae*), blast (*Pyriculariagrisea*), narrow brown leaf spot (*Cercosporaoryzae*) and sheath rot (*Sarocladiumoryzae*). Nine fungicides such as Knowin 50 WP 0.2%, Score 250 EC 0.1%, Control 15 EC 0.1%, Proud 25 EC 0.1%, Tilt 250 EC 0.2%, Folicure 250 EW 0.1%, Sunvit 50 WP 0.7%, Cupravit 50 WP 0.7% and Bordeaux Mixture ($CuSO_4$ 2.27g: CuO 2.27g: $H_2O$ 100ml) were sprayed at maximum tillering stage to control the diseases. All fungicides were effective in reducing the incidence of aforesaid diseases at flowering, milking, dough and maturity stages. The effect of Tilt 250 EC 0.2% (Propiconazole) and Proud 25 EC 0.1% (Propiconazole) were better than the other fungicides in controlling those diseases, resulted higher yield. In maturity stage, the highest disease severity of brown spot and sheath rot were found in the control (untreated) while the lowest severity was observed in Tilt 250 EC 0.2%. Proud 25 EC 0.1% also showed the lowest severity of blast and narrow brown spot at maturity stage. The highest grain yield (4.75t $ha^{-1}$) was recorded at treatment, Tilt 250 EC 0.2%. Therefore, Tilt 250 EC 0.2% and Proud 25 EC 0.1% can be recommended to control the foliar diseases of rice which help to increase the grain yield of that crop.

**Keywords:** Fungicide, Foliar Diseases, Rice, Yield

## 1. Introduction

Rice is a staple food for the majority of the 1.7 billion South Asian populations and a source of livelihood for more than 50 million households. In South Asia, rice is being cultivated in 60 million hectares which produce above 225 million tons, accounting for 32% of global production in 2013. Both India and Bangladesh are major rice-growing countries in this region. India is the largest rice growing area in the world with 43.85 million hectares and contributes a little less than a quarter of global production [1]. In Bangladesh, rice covers more than 11.42 million hectaresof cropped area covering about 80% arable land and accounts for more than 33.83million tons grain production [2]. Rice grain yield is relatively very low in Bangladesh compared to other countries. The average yield of rice is very low (2.96 t $ha^{-1}$) which much below than the crop potential, while the world average yield is 4.3 t $ha^{-1}$ [1] [2].

There are many causes of low yield of rice in Bangladesh of which diseases play major role [3]. Diseases of rice caused by different groups of microorganisms are grouped into viruses, bacteria, fungi and nematodes. Thirty six fungal, twenty one viral, six nematode diseases are recorded in rice over the world [4]. Hot and humid climate ofAsia during the long and heavy monsoon season provide the most favorable environment for rice cultivation as well as disease

development. About 31 diseases have been recorded in rice in Bangladesh including 10 major diseases [5] [6]. Among the diseases, blast (*Pyriculariagrisea*), brown spot (*Bipolarisoryzae*), narrow brown spot (*Cercosporaoryzae*) and sheath rot (*Sarocladiumoryzae*) play a profound role in reducing yield of rice. Brown spot is a wide spread rice disease occurring in all rice growing countries of Asia, America and Africa whereas narrow brown leaf spot has also a worldwide distribution excepting Europe [7]. Sheath rot caused by *Sarocladiumoryzae* is an economically important disease of rice causing severe yield loss all over the world [8]. [9] reported that yield losses in6 different cultivars under conditions of artificial inoculation in the field with *Sarocladiumoryzae* varied from 1.7 to 54.7%. Blast disease of rice caused by *Pyriculariagrisea* is the most important production constraint in modern rice cultivars in both the temperate and tropical rice-growing countries [4]. [10] conducted an experiment with propiconazole and other fungicide in rice cv. Pankaj during 1991 and 1992 at Assamin India. The most effective disease control obtained by spraying fungicide at the boot stage and the fungicides weremancozeband propiconazole. [11] reported that carbendazimis good in controlling brown spot of rice. They also found that propiconazole gave the best control of brown spot of rice caused by *Bipolarisoryzae*. [12] conducted an experiment at Jammu and Kashmir where seven fungicides (propiconazole, hexaconazole, tricyclazole, carbendazim, triadimefon, mancozeb and azoxystrobin) were tested propiconazole to be most effective. Considering the above facts the present investigation was initiatedto determine the efficacy of fungicides in controlling brown spot, blast, narrow brown leaf spot and sheath rotof rice.

## 2. Materials and Methods

The experiment was conducted at the Sher-e-Bangla Agriculture University, Dhaka, Bangladesh. Rice (*Oryza sativa* L.) *cv* BRRI dhan40 was used as test crop. The experiment was laid out in a Randomized Complete Block Design (RCBD)with three replications. The land was first opened and ploughed with a country plough. Later, the land was made saturated with irrigated water and prepared by four successive ploughing and cross-ploughings. Then the land was puddled thoroughly for ease of transplanting. All kinds of weeds were removed from the field and the land was leveled by laddering. Urea, Triple Superphosphate (TSP), Muriate of Potash (MoP) and gypsum were used as sources of N, P, K and S, respectively. The N, P, K and S were applied at the rate of 100, 18, 60 and 12 kg $ha^{-1}$, respectively. Full amount of P, K, S and cowdung (6 t $ha^{-1}$) were applied at the time of final land preparation. The nitrogen was applied in three equal splits, the first one basal, the second one at early tillering stage and the third one at 7 days before panicle initiation stage.

The unit plot size was $6m^{-2}$. The 30 days old seedlingswere planted on 20 July 2014maintaining 22cm × 15cm spacing. There were ten treatments such as $T_1$= Control (untreated), $T_2$=Knowin 50 WP 0.2% (Carbendazim), $T_3$= Score 250 EC 0.1% (Difenoconazole), $T_4$=Control l5 EC 0.1% (Hexaconazole), $T_5$=Proud 25 EC 0.1% (Propiconazole), $T_6$=Tilt 250 EC 0.2% (Propiconazole), $T_7$=Folicure250 EW 0.1% (Mencozeb), $T_8$=Sunvit 50 WP 0.7% (Copper oxychloride), $T_9$=Cupravit 50 WP 0.7% (Copper oxychloride) and $T_{10}$=Bordeaux mixture ($CuSO_4$ 2.27g: CaO 2.27g: $H_2O$ 100ml). Chemicals were sprayed as solution into the experimental plot excepting the control plot. Each spray solution was prepared by mixing definite amount of chemicals with water. The solution of the chemicals was sprayed on the whole surface of the plant. In case of control, only water was sprayed on the plants. The chemical spraying was done at maximumtillering stage of rice plant. The solution was freshly prepared prior to application and the spray tank was thoroughly cleaned before filling with the individual spray material. Special attention was given to complete coverage of the growing plants with the chemicals. Adequate precautions were taken to avoid tendency of spray materials form one plot to the neighboring ones. All the other intercultural operations, such as - weeding, mulching, irrigation were also applied following standard recommended practices. Sixteen plants from each unit plot were randomly selected and tagged for grading the severity of diseases. The severity of four diseases viz. brown spot, blast, narrow brown leaf spot and sheath rot were recorded following IRRI recommended grading scale [13]. The disease severity was recorded in the four growth stages of the plant namely flowering stage, milking stage, dough stage and maturity stage. The grades of brown spot and blast (0-9 scale; affected leaf area) are0=no incidence, 1=less than 1% leaf area affected, 2=1-3% leaf area affected, 3=4-5% leaf area affected, 4=6-10% leaf area affected, 5=11-15% leaf area affected, 6=16-25% leaf area affected, 7=26-50% leaf area affected, 8=51-75% leaf area affected, 9=76-100% leaf area affected. The grades of narrow brown leaf spot (0-9 scale; affected leaf area) are 0=no incidence, 1=less than 1% leaf area affected, 3= 1-5% leaf area affected, 5=6-25% leaf area affected, 7=26-50% leaf area affected, 9=5I-100% leaf area affected. The grades of sheath rot (0-9 scale) are 0=no incidence, 1=less than 1% Sheath area affected, 3=1-5% sheath area affected, 5=6-25% sheath area affected, 7=26-50% sheath area affected, 9=5I-100% sheath area affected. The crop was harvested on 14th December 2014 at full ripening stage. Moreover, 16 tagged plants of each unit plot were harvested separately. The data were recorded on plant height (cm), panicle length (cm), number of $paniclehill^{-1}$, number of $grainshill^{-1}$, number of $grainspanicle^{-1}$, weight of $grainshill^{-1}$ (g), weight of $strawhill^{-1}$ (g), weight of $grainspanicle^{-1}$ (g), weight of thousand seeds (g), and grains yield (t $ha^{-1}$). The analysis of variance (ANOVA) for various parameters were done following the F-test and the mean values were adjudged by Duncan's Multiple Range Test (DMRT) ($p$ = 0.05) [14]. Data were analyzed following standard procedure using MSTAT-C program (version 2.0).

# 3. Results

### *3.1. Efficacy of Fungicides Controlling Brown Spot*

The severity of brown spot disease was significantlyinfluenced by the different fungicides at flowering, milking, dough and maturity stages. The highest severity (0.48, 1.13, 1.58 and 2.75 for flowering, milking, dough and maturity stages, respectively) was found in the control (untreated) which was significantly higher than the other treatments (Table 1). In flowering, milking and dough stages, $T_{10}$ (Bordeaux mixture, $CuSO_4$ 2.27g: CuO 2.27g: $H_2O$ 100ml) showed the second highest severity (0.03, 0.06 and 0.55 for flowering, milking and dough stages, respectively) while other treatments showed the lower severity (Table 1). In Maturity stage, Knowin 50 WP 0.2% (Carbendazim) showed the second highest severity (0.83) followed by Bordeaux mixture while no severity was found in Tilt 250 EC 0.2%. Except control, all the treatment showed statistically similar severity. However, Tilt 250 EC 0.2% showed no severity of brown spot in all the stages.

***Table 1.*** *Efficacy of different fungicides on severity of brown spot of rice at different growth stages of rice.*

| Treatments | Disease severity grade of (0-9 scales) | | | |
|---|---|---|---|---|
| | Flowering stage | Milking stage | Dough stage | Maturity stage |
| $T_1$=Control (no fungicide) | 0.48 a | 1.13 a | 1.58 a | 2.75 a |
| $T_2$=Knowin 50 WP @ 0.2% (Carbendazim) | 0.00 b | 0.00 b | 0.08 b | 0.83 b |
| $T_3$=Score 250 EC @ 0.1% (Difenoconazole) | 0.00 b | 0.00 b | 0.17 b | 0.35 b |
| $T_4$=Controll 5 EC @ 0.1% (Hexaconazole) | 0.00 b | 0.00 b | 0.03 b | 0.25 b |
| $T_5$=Proud 25 EC @ 0.1% (Propiconazole) | 0.00 b | 0.00 b | 0.00 b | 0.17 b |
| $T_6$=Tilt 250 EC @ 0.2% (Propiconazole) | 0.00 b | 0.00 b | 0.00 b | 0.00 b |
| $T_7$=Folicure 250 EW @ 0.1% (Mencozeb) | 0.00 b | 0.00 b | 0.00 b | 0.13 b |
| $T_8$=Sunvit 50 WP @ 0.7% (Copper oxychloride) | 0.00 b | 0.00 b | 0.00 b | 0.73 b |
| $T_9$=Cupravit 50 WP @ 0.7% (Copper oxychloride) | 0.00 b | 0.00 b | 0.25 b | 0.32 b |
| $T_{10}$=Bordeaux mixture ($CuSO_4$ 2.27g: CaO 2.27g: $H_2O$ 100ml) | 0.03 b | 0.06 b | 0.55 b | 0.7 b |
| LSD value | 0.07 | 0.74 | 0.63 | 1.03 |

Figure (s) in column having common letter (s) do not differ significantly at 1% level of probability

### *3.2. Efficacy of Fungicide in Controlling Blast*

The severity of blast disease was significantly variable among the treatments at flowering, milking, dough and maturity stages. In flowering stage, the highest severity (0.47) was found in the control which was significantly higher than the other treatments (Table 2). $T_3$ (Difen console) showed the second highest severity (0.18) while no severity (0.00) was recorded in $T_4$ (Controll 5 EC @ 0.1%), $T_5$ (Proud 25 EC @ 0.1%), $T_6$ (Tilt 250 EC @ 0.2%) and $T_7$ (Folicure 25 EW @ 0.1%) (Table 2). The highest severity was also recorded in the control at milking, dough and maturity stages, which was significantly higher than the other treatments (Table 2). $T_9$ (Copper oxychloride) showed the second highest severity of blast (0.37) which was statistically identical to all other treatments. No severity (0.00) was recorded in $T_5$ (Proud 25 EC 0.1%) and $T_7$ (Folicure 250 EW 0.1%) in milking stage while Proud 25 EC 0.1% showed no severity in flowering, milking and dough stages (Table 2). In case of maturity stage, (Difenconsole) showed the second highest severity (0.97) and the minimum severity (0.17) was noted in Proud 25 EC 0.1%. Considering all the stages, Proud 25 EC 0.1% was found to be better for controlling blast disease of rice.

***Table 2.*** *Efficacy of different fungicides on severity of blast of rice at different growth stages.*

| Treatments | Disease severity grade of (0-9 scales) | | | |
|---|---|---|---|---|
| | Floweringstage | Milking stage | Dough stage | Maturity stage |
| Control (no fungicide) | 0.47a | 0.90 a | 1.30 a | 2.10 a |
| Knowin 50 WP @ 0.2% (Carbendazim) | 0.11b | 0.13b | 0.22b | 0.78b |
| Score 250 EC @ 0.1% (Difenoconazole) | 0.18b | 0.18b | 0.33b | 0.97bc |
| Controll 5 EC @ 0.1% (Hexaconazole) | 0.00b | 0.02b | 0.19b | 0.32c |
| Proud 25 EC @ 0.1% (Propiconazole) | 0.00 b | 0.00 b | 0.00 b | 0.17c |
| Tilt 250 EC @ 0.2% (Propiconazole) | 0.00 b | 0.02b | 0.38b | 0.57bc |
| Folicure 250 EW @ 0.1% (Mencozeb) | 0.00 b | 0.00 b | 0.02b | 0.27c |
| Sunvit 50 WP @ 0.7% (Copper oxychloride) | 0.017b | 0.17b | 0.33b | 0.92bc |
| Cupravit 50 WP @ 0.7% (Copper oxychloride) | 0.1 0b | 0.37b | 0.55b | 0.70 b |
| Bordeaux mixture ($CuSO_4$ 2.27g: CaO 2.27g: $H_2O$ 100ml) | 0.10 b | 0.17b | 0.53b | 1.33ab |
| LSD value | 0.26 | 0.38 | 0.63 | 0.95 |

Figure (s) in column having common letter (s) do not differ significantly at 1% level of probability

### *3.3. Efficacy of Different Fungicides on Severity of Narrow Brown Spot of Rice*

The severity of blast disease was significantly influenced by the different fungicides at flowering, milking, dough and maturity stages. The highest disease severity was found in the control (Table 3) which was significantly higher than the other treatments. Sunvit 50 WP 0.7% (Copper oxychloride)

showed the second highest severity (0.18 and 0.38 for flowering and dough stages, respectively) in flowering and dough stages while Bordeaux mixture showed the second highest severity (0.22 and 3.42 for milking and maturity stages, respectively) in milking and maturity stages. In milking stage, no severity was found in Folicure 250 EW 0.1% (Mencozeb) and Cupravit 50 WP 0.7% (Copper oxychloride) while Proud 25 EC 0.1% (Propiconazole) showed the minimum severity (0.04 and 0.21 for dough and maturity stages, respectively) in dough and maturity stages (Table 3). It was observed that the Proud 25 EC 0.1% (Propiconazole) showed better performance to control brown spot disease of rice.

***Table 3.*** *Efficacy of different fungicides on severity of narrow brown spot of rice at different growth stages.*

| Treatments | Disease severity grade of (0-9 scales) | | | |
|---|---|---|---|---|
| | Flowering stage | Milking stage | Dough stage | Maturity stage |
| Control (no fungicide) | 0.47a | 1.10 a | 2.07a | 5.06a |
| Knowin 50 WP @ 0.2% (Carbendazim) | 0.02 b | 0.02b | 0.05b | 1.18c |
| Score 250 EC @ 0.1% (Difenoconazole) | 0.07 b | 0.03b | 0.25b | 0.59d |
| Controll 5 EC @ 0.1% (Hexaconazole) | 0.00 b | 0.02b | 0.05b | 1.52cd |
| Proud 25 EC @ 0.1% (Propiconazole) | 0.00 b | 0.02b | 0.04b | 0.21e |
| Tilt 250 EC @ 0.2% (Propiconazole) | 0.00 b | 0.02b | 0.05b | 0.37d |
| Folicure 250 EW @ 0.1% (Mencozeb) | 0.00 b | 0.00 b | 0.12b | 0.95c |
| Sunvit50 WP @ 0.7% (Copper oxychloride) | 0.18b | 0.20 b | 0.38b | 0.63de |
| Cupravit 50 WP @ 0.7% (Copper oxychloride) | 0.00 b | 0.00 b | 0.35b | 2.23bc |
| Bordeaux mixture ($CuSO_4$ 2.27g: CaO 2.27g: $H_2O$ 100ml) | 0.07b | 0.22b | 0.53b | 3.42b |
| LSD value | 0.20 | 0.36 | 0.76 | 1.29 |

Figure (s) in column having common letter (s) do not differ significantly at 1% level of probability

### *3.4. Efficacy of Fungicides in Controlling Sheath Rot*

The highest severity of sheath rot disease was found in the control at all growth stagesexcept the flowering stage while Tilt 250 EC 0.2% (Propiconazole) showed the lowest severity (Table 4). In maturity stage, the control also showed the highest severity (3.38) which was statistically similar with Cupravit 50 WP 0.7% and Bordeaux mixture. The lowest severity (0.09) was recorded in Tilt 250 EC 0.2%. Among the fungicides, Tilt 250 EC 0.2% showed better performance to reduce sheath rot disease of rice.

***Table 4.*** *Efficacy of different fungicides on severity of sheath rot of rice at different growth stages*

| Treatments | Disease severity grade of (0-9 scales) | | | |
|---|---|---|---|---|
| | Flowering stage | Milking stage | Dough stage | Maturity stage |
| Control (no fungicide) | 0.04 | 0.14 | 0.27a | 3.38a |
| Knowin 50 WP @ 0.2% (Carbendazim) | 0.01 | 0.03 | 0.11b | 0.19bc |
| Score 250 EC @ 0.1% (Difenoconazole) | 0.06 | 0.08 | 0.14ab | 0.15bc |
| Controll 5 EC @ 0.1% (Hexaconazole) | 0.02 | 0.04 | 0.10 b | 0.13bc |
| Proud 25 EC @ 0.1% (Propiconazole) | 0.03 | 0.07 | 0.09b | 0.13bc |
| Tilt 250 EC @ 0.2% (Propiconazole) | 0.00 | 0.00 | 0.01b | 0.09c |
| Folicure 250 EW @ 0.1% (Mencozeb) | 0.03 | 0.02 | 0.05b | 0.16bc |
| Sunvit50 WP @ 0.7% (Copper oxychloride) | 0.02 | 0.04 | 0.05b | 0.22bc |
| Cupravit 50 WP @ 0.7% (Copper oxychloride) | 0.02 | 0.03 | 0.04b | 0.26ab |
| Bordeaux mixture ($CuSO_4$ 2.27g: CaO 2.27g: $H_2O$ 100ml) | 0.00 | 0.00 | 0.11b | 0.27ab |
| LSD value | NS | NS | 0.13 | 0.14 |

Figure (s) in column having common letter (s) do not differ significantly at 1% level of probability

### *3.5. Efficacy of Deterrent Fungicides on Yield Attributes of Rice*

The yield contributing characters were significantly influenced by the different fungicides. The highest plant height (114.2 cm) was found in $T_6$ (Tilt 250 EC 0.2%) which was statistically identical to $T_3$ (Score 250 EC @ 0.1%), $T_4$ and $T_5$. The highest panicle length (10.66) was recorded in $T_9$ (Cupravit 50 WP 0.7%) followed by $T_5$ (Prude 25 EC 0.1%) and the lowest panicle length (9.47 cm) was found in the control (Table 5). $T_3$ (Score 250 EC 0.1% (Difenoconazole)) showed the highest grain panicle$^{-1}$ (88.4) followed by $T_2$ (Knowin 50 WP @ 0.2%) (85.7) and the minimum was in the control (Table 5). Thousand grain weight and weight of grains hill$^{-1}$ significantly varied among the treatments. The highest 1000-grain weight (24.0 g) was found in $T_5$ (Proud 25 EC 0.1% (Propiconazole)) followed by $T_2$ and $T_6$. The lowest 1000-grain weight (20.4 g) was in the control (Table 5). Proud 25 EC 0.1% (Propiconazole) also showed the highest weight of grain hill$^{-1}$ (25.14) which was followed by $T_3$ (24.27g) and T4 (24.15g). The lowest weight of grain hill$^{-1}$ (24.15g) was recorded in the control (Table 5).

***Table 5.*** *Efficacy of different fungicides on the plant growth and yield contributing characters of rice.*

| Treatments | Plant height (cm) | Panicle length | No. of Paniclehill$^{-1}$ | No. of grains panicle$^{-1}$ | Wt. of 1000-seed (g) | Wt. of grainshill$^{-1}$ ( g) |
|---|---|---|---|---|---|---|
| Control (no fungicide) | 104.4b | 9.47b | 12.14 | 69.21c | 20.42c | 20.01c |
| Knowin 50 WP @ 0.2% (Carbendazim) | 104.9b | 10.09a | 12.83 | 85.71a | 23.59ab | 21.61bc |
| Score 250 EC @ 0.1% (Difenoconazole) | 110.7a | 10.03b | 13.83 | 88.38a | 22.36ab | 24.27ab |
| Controll 5 EC @ 0.1% (Hexaconazole) | 110.2a | 10.03b | 14.26 | 79.98a-c | 23.31ab | 24.15ab |
| Proud 25 EC @ 0.1% (Propiconazole) | 109.6a | 10.37a | 14.38 | 83.39ab | 23.99a | 25.14a |
| Tilt 250 EC @ 0.2% (Propiconazole) | 114.2a | 9.94b | 14.19 | 84.07ab | 23.51ab | 23.84ab |
| Folicure 250 EW @ 0.1% (Mencozeb) | 104.7b | 10.28a | 13.37 | 78.28a-c | 22.88ab | 23.89ab |
| Sunvit 50 WP @ 0.7% (Copper oxychloride) | 104.1b | 10.13a | 13.90 | 72.87bc | 23.17ab | 22.86a-c |
| Cupravit 50 WP @ 0.7% (Copper oxychloride) | 104.8b | 10.66a | 13.40 | 76.68abc | 22.49ab | 23.94ab |
| Bordeaux mixture ($CuSO_4$ 2.27g: CaO 2.27g: $H_2O$ 100ml) | 104.8b | 10.31a | 11.98 | 82.23ab | 22.04bc | 23.18ab |
| LSD value | 4.56 | 0.57 | NS | 12.4 | 1.91 | 2.85 |

Figure (s) in column having common letter (s) do not differ significantly at 1% level of probability

### *3.6. Effect of Fungicidal Treatments on the Yield of Rice*

The grain yield of rice (t ha$^{-1}$) was significantly influenced by the treatments through managing the rice diseases. The highest yield (4.75 t ha$^{-1}$) was found in Tilt 250 EC which was followed bySunivt 50 WP 0.7% (4.64 t ha$^{-1}$). The lowest yield (3.39 t ha$^{-1}$) was recorded in the control (Table 6). UsingTilt 250 EC 0.2% fungicide increased > 40.12% grain yield over the control by managing the rice diseases (Table 6).

***Table 6.*** *Effect of fungicidal treatments on the yield of rice.*

| Treatments | Grain yield (t ha$^{-1}$) | % Grain yield increased over control |
|---|---|---|
| Control (no fungicide) | 3.39b | - |
| Knowin 50 WP @ 0.2% (Carbendazim) | 4.19ab | 23.6 |
| Score 250 EC @ 0.1% (Difenoconazole) | 4.47a | 31.86 |
| Controll 5 EC @ 0.1% (Hexaconazole) | 3.94ab | 16.23 |
| Proud 25 EC @ 0.1% (Propiconazole) | 4.11ab | 24.19 |
| Tilt 250 EC @ 0.2% (Propiconazole) | 4.75a | 40.12 |
| Folicure 250 EW @ 0.1% (Mencozeb) | 4.24ab | 25.08 |
| Sunvit 50 WP @ 0.7% (Copper oxychloride) | 4.64a | 36.88 |
| Cupravit 50 WP @ 0.7% (Copper oxychloride) | 4.50 a | 32.75 |
| Bordeaux mixture($CuSO_4$ 2.27g: CaO 2.27g: $H_2O$ 100ml) | 4.28ab | 26.26 |
| LSD value | 0.99 | - |

Figure (s) in column having common letter (s) do not differ significantly at 1% level of probability

# 4. Discussion

All fungicides were effective in reducing the severity of brown spot at flowering, milking, dough and maturity stages compared to the control. Several workers reported that the application of propiconazole decreased disease severity of brown spot in rice [15] [16]. The effect of Bordeaux mixture was not so strong at flowering stage because the chemical showsits effect normally 10-12 days after application on the plants. [17] reported that activation of inducing chemical needs 7 days after application. It was also observed that all the fungicides were effective in reducing the severity of narrow brown leaf spot at flowering, milking, dough and maturity stages. Tilt 250 EC 0.2% was very much effective in reducing severity of brown spot disease while Proud25 EC 0.1% (Propiconazole) showed better performance in reducing the severity ofnarrow brown spot. Though the severity of narrow brown leaf spot gradually increased from flowering to maturity stage, the fungicideshowed better performance. The effect of Tilt 250 EC 0.2% and Proud 25 EC 0.1% (Propiconazole) in controlling narrow brown leaf spot was better than the other treatments at maturity stage. [18] also reported that propiconazole under *in-vitro* conditions was most effective in controlling brown spot disease which in agreement with the findings of result. Similar results were also observed by [19] where propiconazole at 0.1% resulted in reduction in disease severity of brown spot of rice and increased yield.

Though the severity of blast increased with increase in age of plant but the effect of Tilt 250 EC 0.2% was better to decrease severity. [20] reported that Propiconazole at 0.8 and 1.2 literha$^{-1}$ active ingredient (a.i.) showed good control and Carbzandazim at 1 kgha$^{-1}$ a.i. ensured adequate protection of the foliage. From the discussion it was found that Propiconazole is the most effective fungicide in reducing blast incidence. At flowering and milking stage, fungicidal effect was not significant in controlling sheath rot of rice. The effect of Tilt 250 EC 0.2% (Propiconazole) was better than the other fungicides. Though the disease severity was increased with increase in age of plant but the effect of Tilt 250 EC 0.2% was better to decrease sheath rot severity. The fungicide Propiconazole was sprayed at the pre-flowering stage which significantly reduced disease in all the seasons [21]. Propiconazole was the most effective fungicide in reducing sheath rot incidence by 46.5%. In the present study, Tilt 250 EC 0.2% was the best for controlling sheath rot disease of rice (*cv.* BRRI dhan40). [22] also reported that

propiconazole 25 EC at 0.1% effective against sheath blight, sheath rot and brown spot in rice. Plant height, panicle length and number of grainspanicle$^{-1}$were significantly influenced by the different fungicides. In case of panicle length, fungicides had significant effect and Cupravit 50 WP 0.7% showed the best result on panicle length. The Score 250 EC 0.2% showed better performance than the other fungicides in number of grains panicle$^{-1}$. Proud 25 EC 0.1% showed the highest 1000 grain weight and weight of grain hill$^{-1}$. The highest grain yield found in Tilt 250 EC 0.2% might be due to reduction of disease severity after spraying.

## 5. Conclusion

Among the fungicides, Proud 25 EC 0.1% and Tilt 250 EC 0.2% (Propiconazole) performed better against some major diseases of rice, resulted increased yield. Therefore, Tilt 250 EC 0.2% and Proud 25 EC 0.1% can be recommended to control the foliar diseases of rice.

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