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# EFFICACY OF DIFFERENT FOLIAR FUNGICIDES IN CONTROLLING BIPOLARIS LEAF BLIGHT OF WHEAT

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**ABSTRACT**

Roy KK, Mustarin K, Rahman MME, Reza MMA (2019) Efficacy of different foliar fungicides in controlling Bipolaris leaf blight of wheat. *Int. J. Sustain. Crop Prod.* 14(1), 12-18.

Bipolaris leaf blight is a major disease of wheat in Bangladesh caused by a fungus named *Bipolaris sorokiniana* (Sacc.). The experiment was conducted to evaluate the efficacy of different fungicides against the disease in wheat. It was carried out in the research field of Bangladesh Wheat and Maize Research Institute, Dinajpur, Bangladesh. The design was Randomized Complete Block (RCB) with 3 replications and 8 treatments (7 fungicides + control) for the two consecutive years (2016-17 & 2017-18). All the fungicides were found effective against the disease with 66 to 90% disease control based on pooled data. The trends of disease reduction as well as other attributes were more or less similar in both the years. Among all of treatments, the lowest percent of diseased leaf area (DLA) (7.93%) and area under disease progress curve (AUDPC) (151) was obtained with Tilt 250 EC, while the highest 1000-kernel weight (50.82 gm) as well as grain yield (4006 kg/ha) was also obtained from the same treatment. The other effective fungicides were Nativo (8.43%) and Folicur (9.34%). Economic analysis showed that the highest Net returns of Tk. 30440/ha with BCR 8.53 was also obtained from applying with Tilt 250 EC fungicides followed by treatment Folicur 250 EC. The fungicidal group Propiconazole or Tebuconazole or combination of Tebuconazole + Trifloxystrobin can be recommended to the farmers for controlling the intensity of the disease as well as increasing the grain yield.

***Key words:*** *wheat, bipolaris leaf blight, disease severity, fungicide, yield, economic analysis*

## INTRODUCTION

Wheat is the second most important cereal food crop of Bangladesh after rice. Wheat consumption is increasing rapidly in our country due to rapid urbanization and industrialization and thus resulting increase in the use of frequent bakery goods. On the other hand, the world's inhabitants is increasing by 1 billion with each 11 years and at the current speed, it is predicted to be 8.5 billion by 2025 (Yadav *et al*. 2015). By 2020, around 1050 million tons of wheat productions will be needed for feeding the global people due to the increased demand of wheat grain.

More than 20 diseases are reported in wheat in Bangladesh (Talukdar 1974; Ahmed 1986). Most of the wheat diseases found in Bangladesh are seed and soil borne in nature. Some of the important diseases prevailing frequently in our country are Bipolaris leaf blight (BpLB), leaf rust, wheat blast, seedling blight, foot and root rot, head blight, black point etc. Among the diseases of wheat, Bipolaris leaf blight caused by *Bipolaris sorokiniana* Sacc. (Shoem.) is considered as one of the major diseases in Bangladesh which is favored by hot and humid weather. The disease occurs in almost all wheat growing areas of Bangladesh with varying degrees of incidence causing significant yield damages (Rashid *et al*. 1994; Alam *et al*. 1995). The disease is also found in other countries of Indian subcontinent in every year with moderate to high level severity (Duveiller *et al.* 2005). Disease epidemic occurs most frequently due to lack of durable resistant cultivar, fewer application of foliar spray and inadequacy of other management practices responsible for the phenomena (Sharma *et al*. 2007; Sharma *et al*. 2004; Sharma and Duveiller, 2004). The disease symptom is primarily found on the lower leaves causing black pointed pinhead lesions start as a few millimeters while with the extend of time it become elongated dark brown spots greater than 1-2 cm (Chand *et al*. 2002). As the disease progresses, several spot coalesce each other and results whole leaves become blighted (Bockus *et al*. 2010). Disease severity sharpens with in late crop growth stage and is generally destructive after flowering. As the fungus is seed and soil borne in nature, thus play a vital role as sources of inoculum that can survives between wheat cropping seasons (Reis 1991). Grain yield reductions due to the disease are erratic in warmer zones of South Asia (Saari 1998; Sharma and Duveiller, 2004). Genetic resistance of wheat to this fungus is found quite a low (Agarwal *et al*. 2004). In absence of genetic resistance, foliar fungicide treatment has been well thought-out as a substitute option to reduce disease intensity. Use of chemical fungicides has proven helpful and cost-effective measures for controlling Bipolaris leaf blight disease. Foliar spray with effective chemicals can control disease infection on leaves and reduce leaf blight severity of wheat (Rashid *et al*. 2001), while the use of fungicides under high disease pressure is not economical. The Triazole group especially Propiconazole have been proved to be very effective against the disease. This group of fungicides can reduce disease severity (AUDPC) up to 75 percent depending upon level of disease severity (De-Viedma and Kohli, 1997). Application of Propiconazole @ 0.1% for three times after appearance of the disease significantly increase grain yield (Singh *et al.* 2008). Some other scientists have also reported that Tilt 250 EC can reduce Bipolaris leaf blight infection with a significant level (Duveiller and Gilchrist, 1994; Singh *et al.* 1995; Mahto 1999). Researcher found that group of fungicides of Tebuconazole was superior to Propiconazole in suppressing leaf blight disease of wheat (Tewari and Zewde,

2000). Keeping in view the present study was undertaken for two crop season i.e. in 2016-17 and 2017-2018 to find out effective fungicides for controlling the disease.

## MATERIALS AND METHODS

### Location and treatments

The experiment was conducted at Bangladesh Wheat and Maize Research Institute, Nashipur, Dinajpur during two consecutive growing seasons from 2016-17 and 2017-18 under field conditions. The design of experiment was Randomized Complete Block (RCB) with three replications. The highly susceptible variety Kanchan was used in the trial. Seeds were sown in (1.2 x 2.5) $m^2$ plots with 20 cm row-spacing under late planting conditions during 15 December 2016-17 and 12 December 2017-18. The seed rate was used as standard @120 kg/ha, the recommend dose of wheat cultivation. All of other recommended agronomic practices including recommended doses of fertilizers were used and three irrigations were applied during the crop cycle to raise the plants successfully. Seven foliar fungicides of different groups were tested for their efficacy against the disease. The fungicides namely Tilt 250 EC (Propiconazole 25%) @ 0.5 ml/L of water, Folicur 250 EC (Tebuconazole 25%) @ 0.5 ml/L of water, Awal 72 WP (Zineb 68% + Hexaconazole 4%) @ 2 gm/L of water, Master Zeb 80 WP (Mancozeb 80%) @ 2 gm/L of water, Positive 300 SE (Difenoconazole + Propiconazole) @ 1 ml/L of water, Sun-Fighter 25 SC (Hexaconazole 22% + Tricyclazole 3%) @ 1 ml/L of water, and Nativo 75 WG (Tebuconazole 50% + Trifloxystrobin 25%) @ 0.6 gm/L of water were used as test materials. The fungicides were sprayed twice, once at just after heading/flowering stage and another at 15 days after first spraying. Fungicides were applied immediately after appearance of typical symptoms on the flag leaves. An unsprayed control was also maintained in each replication for comparison.

### Disease assessment and economic analysis

Disease severity on leaves was recorded based on percent diseased area on 10 flag leaves of 10 main tillers selected randomly in each plot using the double digit scale (00-99) developed by Zadoks *et al*. (1974) and then converted to percent diseased leaf area (DLA) according to the following formula given by Saari and Prescott (1975).

$$DLA(\%) = (D_1/9 \text{ X } D_2/9) \text{ X } 100$$

Where, $D_1$ = First digit, representing relative disease height
$D_2$ = Second digit, indicating disease severity on the foliage

The overall disease severity i.e. Area under Disease Progress Curve (AUDPC) was converted based on DLA (%) at three different growth stages such as flowering to water ripe (69-71), early milk to medium milk (73-75) and late milk to soft dough (77-83) and recorded for analysis, thereafter the data was calculated based on formula given by Sharma and Duveiller (2003).

$$AUDPC = \sum_{i=1}^{n} [(Y_{i+1} + Y_i) \text{ x } 0.5] [T_{i+1} - T_i]$$

Where, $Y_i$ = Disease severity at the ith observation,
$T_i$ = Time (days) of the ith observation and
n = Total number of observations (at least 3 observations).

Data on yield components such as grain yield (kg/ha) and 1000-kernel weight (g) was recorded after harvesting for all treatments. The recorded data were analyzed statistically using R software for analysis of variance (ANOVA). Statistical significance was tested by F-value at 5% level of probability. Economic analysis on yield advantage as well as benefit cost ratio (BCR) was obtained from foliar sprays was also calculated.

## RESULTS

### Disease Parameters

### Percent Diseased Leaf Area (DLA)

Significant variation was found with various fungicides in reducing diseased leaf area (Table 1). The results revealed that in both the years similar trend of disease reduction was found. During the year 2016-17, among all of treatments, the least DLA was recorded in Folicur resulted about 4.96% which is statistically similar with Tilt (5.76%) and followed by Nativo (6.46%). The other fungicide sprayed plots showed varying levels of disease severity on the leaves with ranges from 10.96-26.63%, while the highest amount of disease infection was found on control (48.70%). In the year 2017-18, the minimum DLA (%) was recorded with the application of Tilt (10.16%) which was followed by Nativo (10.43%). On the other hand, the unprotected plots, there was 54.46% disease incidence which was significantly higher than any other treatments and the third one was Folicur (13.73%). The other treatment plots showed a good level of disease reduction ranging from 16.03-26.63% (Table 1). The two years results combined together and were made a pooled data which is expressed in Table 1. It can be seen that the Tilt was the most effective fungicide (7.93%) with 90% reduction in disease over control

followed by Nativo (8.43%) (89% disease reduction) which is statistically similar. The third least disease was observed in Folicur treated plots (9.34%) which showed very close results to Tilt and Nativo. The highest disease incidence was observed in control (51.56%).

**Disease Severity or Area Under Disease Progress Curve (AUDPC)**

Regarding the disease progress curve, the eight treatments showed various levels of disease frequency in both years and their mean. The disease intensity during the first year was highest in control (953) while the least severity was found with Tilt application (113). The second least diseased treatment plot was Nativo (121) and followed by Folicur (212). The other fungicide application blocks gave different types of disease reaction which ranged from 222-524. During the study of second year, AUDPC data were relatively higher than previous year due to change in environmental conditions. The least amount of AUDPC was encoded in the treatment Nativo (188) which was statistically similar to treatment Tilt, represents close to 189. On the other hand, the maximum number of disease altitude was in control plot (1059) which represents significant variations from the treatment plots. The remaining other treatments also showed significant level of disease reduction than control plots ranged from 266-524. The two years average data showed that the minimum number of AUDPC was calculated in protected plot of Tilt (151) followed by Nativo (154) and they were statistically at par with each other. On the other hand, the highest disease frequency was observed on control plot showed about 1006, and the remaining other plots showed varying level of severity but significantly lower than unprotected treatment (Table 1).


Fig. 1. Effect of fungicide sprays in reduction of disease severity over control; (a) fungicide application by a knapsack sprayer by creating a barrier, (b) unprotected plot, and (c) fungicide sprayed plot

Table 1. Effect of different fungicides on diseased leaf area (% DLA) and AUDPC due to Bipolaris leaf blight of wheat on variety Kanchan during two consecutive years and their pooled mean

| Treatments | DLA (%) | | | Reduction in disease incidence (%) | AUDPC | | |
|---|---|---|---|---|---|---|---|
| | 2016-17 | 2017-18 | Pooled | | 2016-17 | 2017-18 | Pooled |
| Tilt 250 EC | 5.76 | 10.16 | 7.93 | 90 | 113 | 189 | 151 |
| Folicur 250 EC | 4.96 | 13.73 | 9.34 | 88 | 212 | 266 | 239 |
| Sun-Fighter 25 SC | 10.96 | 16.03 | 13.53 | 83 | 222 | 317 | 269 |
| Positive 300 SE | 19.63 | 23.20 | 21.36 | 73 | 383 | 456 | 419 |
| Master Zeb 80 WP | 26.63 | 26.63 | 26.63 | 66 | 524 | 524 | 524 |
| Awal 72 WP | 21.70 | 25.36 | 23.50 | 70 | 417 | 496 | 457 |
| Nativo 75 WG | 6.46 | 10.43 | 8.43 | 89 | 121 | 188 | 154 |
| Control | 48.70 | 54.46 | 51.56 | - | 953 | 1059 | 1006 |
| LSD | 7.42 | 5.69 | 6.33 | - | 152.64 | 117.09 | 129.21 |
| Level of significance | *** | *** | *** | - | *** | *** | *** |

**Yield Parameters**

The yield contributing parameters like 1000-kernel weight and grain yield were recorded to know the influence of these fungicides over unprotected plot. Significant boosts in the yield attributing characters were observed in fungicide sprayed plots as compared to control. The data on effect of different treatments on 1000-kernel weight and grain yield are presented in the Table 2.

**Thousand Grain Weight (gm)**

Thousand grain weights showed similar trend in both the years (2016-17 and 2017-18). The maximum 1000 grain weight was observed in Tilt (51.52 and 50.11 gm respectively) followed by Nativo (50.99 and 49.07 gm respectively) while the lowest was observed in control (29.99 and 27.24 gm respectively) (Table 2). The third higher yield was observed in Folicur treated plots, which was more or less similar for both the years (48.34 and 47.21 gm respectively). The remaining other treatments showed statistically similar results regarding thousand grain weight. The two years average data showed that maximum 1000 grain weight as well as percent increase was recorded in the same treatment i.e. Tilt treated plots (50.82 gm and 78% respectively) followed by Nativo (50.03 gm and 75% respectively) which was at par with Tilt. On the other hand, the minimum 1000 grain weight (gm) was observed in control treatment (28.62 gm) (Table 2).

**Grain Yield (kg/ha)**

The grain yield showed significant variation among treatment in both the years. All the treatments enhanced the grain yield significantly in contrast to unprotected plot and they are negatively correlated with the disease severity in both the years and their average mean also (Table 2). The grain yield was higher in previous year as compared to proceeding year due to less disease severity. In both the years, the highest grain yield was obtained from the same treatment Tilt (4101 and 3910 kg/ha respectively) followed by Folicur (3907 and 3812 kg/ha respectively). The remaining fungicides showed various levels of yield ranged from 2864-3636 kg/ha and 2720-3545 kg/ha for the year 2016-17 and 2017-18 respectively. Likewise the pooled mean showed that the maximum grain yield as well as percent increase over control was also recorded from treatment Tilt (4006 kg/ha and 76% respectively) which is statistically similar with foliar sprays of Folicur treated plots (3860 kg/ha). On the other hand, the least grain yield was harvested from control in both the years and also in pooled mean (2343, 2221 and 2282 kg/ha respectively) (Table 2).

Table 2. Effect of different fungicides on grain yield (kg/ha) and 1000 grain weight due to Bipolaris leaf blight of wheat for two consecutive years and their pooled mean

| Treatments | TGW (gm) | | | Increase in TGW (%) | GY(kg/ha) | | | Increase in GY (%) |
|---|---|---|---|---|---|---|---|---|
| | 2016-17 | 2017-18 | Pooled | | 2016-17 | 2017-18 | Pooled | |
| Tilt 250 EC | 51.52 | 50.11 | 50.82 | 78 | 4101 | 3910 | 4006 | 76 |
| Folicur 250 EC | 48.34 | 47.21 | 47.78 | 67 | 3907 | 3812 | 3860 | 69 |
| Sun-Fighter 25 SC | 44.11 | 43.06 | 43.59 | 52 | 3344 | 3285 | 3315 | 45 |
| Positive 300 SE | 40.17 | 38.10 | 39.14 | 37 | 2864 | 2720 | 2792 | 22 |
| Master Zeb 80 WP | 41.58 | 39.55 | 40.57 | 42 | 3056 | 2991 | 3024 | 33 |
| Awal 72 WP | 39.11 | 38.28 | 38.70 | 35 | 2937 | 2850 | 2894 | 27 |
| Nativo 75 WG | 50.99 | 49.07 | 50.03 | 75 | 3636 | 3545 | 3591 | 57 |
| Control | 29.99 | 27.24 | 28.62 | - | 2343 | 2221 | 2282 | - |
| LSD | 4.05 | 5.68 | 5.46 | - | 6.31 | 6.10 | 6.18 | - |
| Level of significance | *** | *** | *** | - | *** | *** | *** | - |

**Economic Analysis**

The cost effectiveness of different fungicides revealed that the additional gross return was increased due to application of different fungicides and it varied in case of different fungicides (Table 3). The highest additional gross return of Tk. 34480/ha with BCR 8.53 was obtained from application of Tilt. The second highest additional gross return of Tk. 27310/ha was obtained from Folicur apply with BCR (7.42), while the lowest additional gross return with the lowest BCR was obtained from Positive 300 SE and Awal 72 WP of Tk. 3860 and 2.61 respectively.

Table 3. Economic analysis on yield advantage obtained from spraying with foliar fungicides

| Fungicides | Grain yield (kg/ha) | Yield increase (kg/ha) | Additional gross return (Tk./ha) | Additional cost (Tk./ha) | Net return (Tk./ha) | BCR |
|---|---|---|---|---|---|---|
| Tilt 250 EC | 4006 | 1724 | 34480 | 4040 | 30440 | 8.53 |
| Folicur 250 EC | 3860 | 1578 | 31560 | 4250 | 27310 | 7.42 |
| Sun-Fighter 25 SC | 3315 | 1033 | 20660 | 4450 | 16980 | 4.62 |
| Positive 300 SE | 2792 | 510 | 10200 | 3860 | 7340 | 2.64 |
| Master Zeb 80 WP | 3024 | 742 | 14840 | 5400 | 9440 | 2.74 |
| Awal 72 WP | 2894 | 612 | 12240 | 4680 | 8790 | 2.61 |
| Nativo 75 WG | 3591 | 1309 | 26180 | 6575 | 19605 | 3.98 |
| Control | 2282 | - | - | - | - | - |

Additional cost (retail price, 2 applications):
Nativo = Tk. 4575, Folicur = Tk. 2250, Tilt = Tk. 2040, Sun-Fighter = Tk. 2450, Positive = Tk. 1860, Master Zeb = Tk. 3400 and Awal = Tk. 2680.
Spraying cost: Tk. 2000/ha = 4 Labours/ha for 2 applications @ Tk. 500/Labour/Day
Selling price of wheat (local market price): Tk. 20/kg

**DISCUSSION**

The present study demonstrated that two applications of foliar fungicides are effective in reducing the severity of Bipolaris leaf blight with higher grain yield. Application of Propiconazole at tillering and boot leaf stages can cause significant reduction in disease severity, it has been reported by some researchers (Yadav *et al*. 2015). In the present study also Propiconazole (0.5ml/L) was found most effective than any other fungicides in reducing disease severity. Although previous studies showed that Tebuconazole was superior to Propiconazole in suppressing leaf blight disease of wheat (Tewari and Zewde, 2000). Singh *et al.* (2008) proposed that application of Propiconazole @ 0.1% for three times after appearance of the disease significantly increase grain yield. The highest BCR was also observed with the application of Tilt fungicide (Propiconazole). The usefulness of Tilt 250 EC in reducing Bipolaris leaf blight infection was also showed by some other scientists (Lapis 1985; Duveiller and Gilchrist, 1994; Singh *et al.* 1995; Mahto 1999). Similar findings were reported by Rashid *et al*. (2001), who stated that foliar spray with Tilt 250 EC can successfully control *B. sorokiniana* infection on wheat foliage. We also found that the sole Tebuconazole as well as combination of Tebuconazole and Trifloxystrobin group of fungicide application as preventive spray also caused significant reduction in disease incidence and higher grain yield. The fungicide group Strobilurin is systemic in nature and these exert their function by stopping the mitochondrial respiratory process in fungi (Balba 2007). Strobilurin in addition to the existing Triazoles fungicides, gave a broad-spectrum results based on sterol biosynthesis inhibitors (Yadav *et al.* 2015). Some other reporter stated that Propiconazole along with Tridimefon and Hexaconazole were found most effective for management of leaf rust of wheat (Kalappanavar and Patil, 1998). Mesta *et al.* (2003) showed that Propiconazole (0.1%) was also effective against some other disease such as Alternaria blight of sunflower. Researcher reported that fungicides have some effects in boosting yield in wheat and corn (Nelson and Meinhardt, 2011). The plots sprayed with the other fungicides Hexaconazole, Tricyclazole and Mancozeb also gave a good average grain yield increase. Comparatively higher reduction in incidence and severity of Bipolaris leaf blight was observed by application of Tilt fungicides which was significantly higher than other treatments. Results from estimation of cost-effective returns in this study indicated that fungicide application for the Bipolaris leaf blight disease control in wheat can be profitable. Fungicidal sprays also increase yield giving the farmers an economic advantage.

**CONCLUSION**

In the present study it was found that Bipolaris leaf blight can be successfully controlled by fungicides. Application of fungicides not only control the disease but also increase the grain yield. Among the treatments Propiconazole, Tebuconazole, and combination of Tebuconazole + Trifloxystrobin showed best results regarding reducing of disease intensity as well as higher benefit cost ratio.

## CONFLICT OF INTEREST

The authors have not declared any conflict of interest.

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