Research Article

Bangladesh Journal of Plant Pathology, 39, 8-13
ISSN : 1012-9279 (Print)
ISSN : 2412-7558 (Online)

ASSESSMENT OF BIPOLARIS LEAF BLIGHT (*BIPOLARIS SOROKINIANA*) INCITED YIELD LOSS OF SOME SELECTED WHEAT VARIETIES IN BANGLADESH

Md. Ahsan Habib[1†], Md. Mobinul Islam[1†], Shahin Alom[1†], Kiswar-E-Mustarin[2] and Md. Mohidul Hasan[1]*

[1]*Department of Plant Pathology, Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200, Bangladesh*
[2]*Plant Pathology Division, Bangladesh Wheat and Maize Research Institute (BWMRI), Nashipur, Dinajpur*
[†]*Authors contributed equally;* ***Corresponding author:** mhasan@hstu.ac.bd*

How to cite this article
Habib, M. A., Islam, M. M., Alom, S., Kiswar-E-Mustarin and Hasan, M. M. 2023. Assessment of yield loss caused by Bipolaris leaf blight (*Bipolaris sorokiniana*) in selected wheat varieties in Bangladesh. Bangladesh J. Plant Pathol. 39 (1 & 2): 8-13.

ABSTRACT

Bipolaris leaf blight caused by *Bipolaris sorokiniana* is a major disease of wheat responsible for significant yield losses every year. The present study aimed to explore the response of twelve wheat varieties namely Kanchan, Shatabdi, Bijoy, Prodip, BARI Gom 25, BARI Gom 26, BARI Gom 28, BARI Gom 29, BARI Gom 30, BARI Gom 31, BARI Gom 32 and BARI Gom 33 to Bipolaris leaf blight diseases in fungicidal (Tilt 250 EC) sprayed or non-sprayed conditions and the losses of yield. The highest area under the disease progress curve (AUDPC) was recorded in Kanchan (759.9) followed by Prodip (586.9) in non-sprayed conditions. On the other hand, the lowest AUDPC was recorded in BARI Gom 33 (186.4) which received Tilt 250 EC. The maximum grain yields were recorded in BARI Gom 33 (3.67 kg/plot) which was exposed to Tilt 250 EC while the lowest was in Kanchan (2.50 kg/plot) without sprayed condition. Additionally, the highest yield loss due to Bipolaris leaf blight was observed in Kanchan (24.69%) and the lowest in BARI Gom 33 (2.99%). In the case of thousand-grain weight, no significant variation was observed in sprayed and non-sprayed conditions. The findings of the study revealed the feasibility of BARI Gom 33 for cultivation in farmer's fields with fungicidal sprayed conditions.

Keywords: Wheat, Bipolaris leaf blight, AUDPC, Yield loss

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the second most important cereal crop next to rice in Bangladesh belonging to the family Poaceae. The production of wheat was 1085834 metric tons from 314865 ha of land with an average yield of 3.449 t/ha in Bangladesh (BBS 2022). The average yield and production of wheat are comparatively low in Bangladesh due to many factors of which diseases are the most important (Momtaz *et al.* 2018). Wheat suffers about 14 seed-borne diseases where, leaf blight caused by *Bipolaris sorokiniana* is considered as the major one (Alam *et al.* 1993, Shamim 2009). The disease occurs at any growth stage of wheat and can cause yield loss of up to 95% (Malaker *et al.* 2004, Hossain and Azad 2009). Management of leaf blight is difficult as the fungus is seed-borne and soil-borne in nature. Several approaches including cultural control, biological control, use of resistant variety, chemical control, etc. apply to managing the disease (Rashid *et al.* 2013). Continuous and indiscriminate use of fungicides results in accumulating harmful chemicals in the grains and straws that can cause health hazards. For the development of efficient and eco-friendly management practices, it is urgent to update the yield loss incited by the disease. Moreover, several wheat varieties have been released in the past decade, and it is also necessary to observe their response in terms of yield against the Bipolaris leaf blight diseases. Therefore, the present work aims to estimate the loss of yield in some old and new wheat varieties in response to Bipolaris leaf blight disease.

MATERIALS AND METHODS

The experiment was conducted at Bangladesh Wheat and Maize Research Institute (BWMRI) Nashipur, Dinajpur. Twelve different wheat varieties named Kanchan, Shatabdi, Bijoy, Prodip, BARI Gom 25, BARI Gom 26, BARI Gom 28, BARI Gom 29, BARI

Gom 30, BARI Gom 31, BARI Gom 32, and BARI Gom 33 were used for the experiment. The experiment was laid out following a split-plot design with two replications. Each replication was divided into two main plots such as fungicide sprayed and non-sprayed plots. Each of the main plots was then again subdivided into 12 sub-plots based on varieties. The size of the unit plot was 1.4 m×5 m =7 m^2. Seeds were sown as continuous line sowing at 20 cm spacing between rows to row. To control Bipolaris leaf blight, Tilt 250 EC (Propiconazole) was sprayed 3 times @ 1 mL/L of water starting from the heading stage at 15-day intervals.

Collection of data:

Leaf blight severity (%) was measured and recorded three times at 60, 70, and 80 days after sowing (DAS). Leaf blight severity (%) was scored as a percent leaf area disease (% LAD) (Duveiller *et al.* 2005) from ten randomly selected flag leaves from ten main tillers in each plot and was calculated by the following formula using double-digit (00-99) scale (Saari and Prescott 1975):

$$\text{LAD (\%)} = \frac{D1}{9} \times \frac{D2}{9} \times 100$$

Where, D1 = First digit of the score, D2 = Second digit of the score

The AUDPC was calculated according to the method of Das *et al.* (1992).

$$\text{AUDPC} = \sum_{i=1}^{n} \left[\{ (Y_i + Y_{(i+1)})/2 \} \times (t_{(i+1)} - t_i) \right]$$

Where- Y_i = Disease severity at the i^{th} observation, t_i = Time (days) of the i^{th} observation, and n = Number of dates on which disease was recorded

Days of heading, number of tiller/m^2 area, days of maturity, plant height (cm), and spike length (cm) were recorded from ten randomly selected plants in each plot. Thousand-grain weight (g) and yield (Kg/plot) were recorded at the time of harvesting. Yield loss (%) was calculated by the following formula:

$$\text{Yield loss (\%)} = \frac{\text{Yield of sprayed plot} - \text{Yield of non sprayed plot}}{\text{Yield of sprayed plot}} \times 100$$

Statistical analysis

Data on different parameters were statistically analyzed by using Statistix 10 software. The treatment means were compared by Duncan's Multiple Range Test (DMRT) at a 5% level of probability (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Response of different wheat varieties against Bipolaris leaf blight

Percent leaf area diseased were recorded at 60, 70, and 80 DAS in all of the tested wheat varieties under fungicidal sprayed or non-sprayed conditions and presented in Table 1. At 60 DAS, no significant variation was observed between sprayed and non-sprayed conditions. But, at 70 and 80 DAS, significant variation was observed and the highest LAD was recorded in non-sprayed plots of Kanchan (21.60 and 50.62%, respectively) followed by Prodip (18.96 and 44.12%, respectively) and the lowest in BARI Gom 33 (2.41 and 16.67%, respectively) fungicidal sprayed plots. Likewise, LAD, the area under diseased progress curve (AUDPC) was found maximum in Kanchan (759.9) cultivated in non-sprayed conditions followed by Prodip (589.6), BARI Gom 26 (512.2) where the lowest recorded in BARI Gom 33 (186.4) which cultivated in fungicide sprayed condition (Table 1). BARI Gom 33 showed tolerance against Bipolaris leaf blight disease and on the other hand, Kanchan and Prodip were found to be susceptible against leaf blight disease. Similarly to the present investigations, a higher degree of seed and plant infection by *Bipolaris sorokiniana* was found in Kanchan (Bailey *et al.* 2009). Application of various fungicides including Tilt was found to reduce the severity of Bipolaris leaf blight (Chaurasia *et al.* 2011). In addition to the suppression of diseases, Tilt can completely inhibit the mycelial growth of *Bipolaris sorokiniana* in *in-vitro* (Magar *et al.* 2020). Tilt is a carcinogenic compound that can directly kill the pathogen, and is a contact fungicide it makes a chemical barrier by making a thin film of the chemical ingredient on the surface of the plant body as well as making the environment unfavorable for disease development by the plant pathogen (Mian *et al.* 2009).

Yield and yield contributing characters of wheat varieties to the application of fungicide

The majority of wheat cultivars did not show any significant variation in regards to the spike length and grains per spike (Table 2). However, maximum thousand-grain weight (g) and yield kg/plot were recorded in BARI Gom 33 (58.91g and 3.67 kg, respectively) which received fungicide, and lowest in Kanchan (47.51g and 2.50 kg, respectively)

which did not receive fungicide (Table 2). The reasons for the reduced yield in Kanchan might be due to the infection of *Bipolaris* leaf blight as the same variety exhibited higher AUDPC. Bipolaris leaf blight incited reduced yield or thousand seed weight are of well established (Chaurasia *et al.* 2011, Rashid *et al.* 2013).

Table 1. Response of various wheat varieties against Bipolaris leaf blight to the application of fungicide

Varieties	Fungicide	Leaf Area Disease (%)			AUDPC
		60 DAS	70 DAS	80 DAS	
Kanchan	NS	4.94 a	21.60 a	50.62 a	759.9 a
	S	3.70 ab	14.81 bc	30.25 de	512.4 bc
Shatabdi	NS	1.85 bc	6.17 efg	34.57 cd	448.9 de
	S	1.24 c	4.93 fg	16.67 g	298.1 jk
Prodip	NS	3.98 ab	18.96 ab	44.12 b	586.9 b
	S	2.95 bc	14.1 bc	27.16 def	390.2 fg
Bijoy	NS	3.81 ab	12.96 bcd	36.9 cd	455.2 bcd
	S	1.85 bc	8.96 cde	25.93 ef	294.3 ef
BARI Gom 25	NS	3.70 ab	12.9 bcd	38.89 bc	465.4 cde
	S	1.85 bc	7.41 def	21.60 fg	301.6 ghij
BARI Gom 26	NS	3.94 ab	14.81bc	39.71 bc	512.2 bc
	S	2.32 bc	9.26 cde	24.69 efg	320.4 fghi
BARI Gom 28	NS	2.25 bc	7.41 def	30.25 de	312.4 fgh
	S	1.24 c	4.91 fg	22.22 efg	264.8 ijk
BARI Gom 29	NS	3.12 ab	9.21 cde	35.56 bc	432.3 de
	S	1.94 bc	4.91 fg	23.46 efg	278.7 hij
BARI Gom 30	NS	1.85 bc	6.17 efg	27.78 def	298.1 fghi
	S	1.23 c	4.94 fg	19.75 fg	212.9 ijk
BARI Gom 31	NS	2.96 bc	8.96 cde	32.67 de	355.4 fgh
	S	1.85 bc	4.82 def	24.69 efg	295.5 fghi
BARI Gom 32	NS	2.98 bc	9.11 cde	27.78 def	322.5 ef
	S	1.85 bc	6.17 efg	22.22 efg	285.5 hij
BARI Gom 33	NS	2.47 bc	3.70 fg	25.93 ef	282.4 hij
	S	1.24 c	2.41 g	16.67 g	186.4 k
LSD		1.67	3.45	7.31	82.86

S, Spray; NS, Non-spray; TGW, Thousand Grain Weight (g); AUDPC, Area Under Disease Progress Curve

Table 2. Response of yield and yield contributing characters of different wheat varieties to the application of fungicide

Varieties	Fungicide	Yield contributing character			Yield (kg/plot)
		Spike length (cm)	Grain/spike	TGW (g)	
Kanchan	NS	9.0 abc	43.0 cde	47.51 j	2.50 k
	S	10.0 abc	44.0 bcde	48.53 hij	3.32 cde
Shatabdi	NS	9.00 abc	51.5 abc	47.74 ij	2.87 hij
	S	9.00 abc	52.0 abc	48.8 hij	3.21 cdefgh
Prodip	NS	8.5 bc	41.5 de	55.06 bcde	2.52 jk
	S	9.5 abc	50.0 abcde	55.43 abcde	3.10 cdefghij
Bijoy	NS	10.5 ab	49.0 abcde	56.0 abcd	2.65 jk
	S	11.0 ab	48.0 abcde	57.15 abc	3.03 defghij
BARI Gom 25	NS	9.5 abc	44.0 bcde	50.99 efghij	2.81 ijk
	S	9.0 abc	46.0 abcde	51.81 efghi	3.24 cdef
BARI Gom 26	NS	9.5 abc	53.0 ab	48.91 hij	3.02 efghij
	S	9.0 abc	50.5 abcd	50.29 ghij	3.47 abc
BARI Gom 28	NS	10.0 abc	51.0 abc	53.87 cdefg	3.38 abc
	S	9.0 abc	51.0 abc	54.26 cdef	3.65 ab
BARI Gom 29	NS	9.5 abc	50.5 abcd	49.61 hij	3.01fghij
	S	9.5 abc	52.5 ab	51.79 efghi	3.29 cdef
BARI Gom 30	NS	8.50 bc	50.0 abcde	49.02 hij	3.12 cdefghij
	S	9.0 abc	51.5 abc	51.71 efghi	3.36 bcd
BARI Gom 31	NS	9.5 abc	48.0 abcde	47.64 ij	2.93 ghij
	S	10.0 abc	47.0 abcde	48.39 hij	3.23 cdefg
BARI Gom 32	NS	9.5 abc	47.0 abcde	51.9 efghi	3.14 cdegh
	S	8.0 c	41.0 e	52.57 defgh	3.41 abc
BARI Gom 33	NS	11.0 ab	52.5 ab	58.68 ab	3.56 abc
	S	11.5 a	53.5 a	58.91 a	3.67 a
LSD		1.89	7.76	3.38	2.68

S, Spray; NS, Non-spray; TGW, Thousand Grain Weight (g)

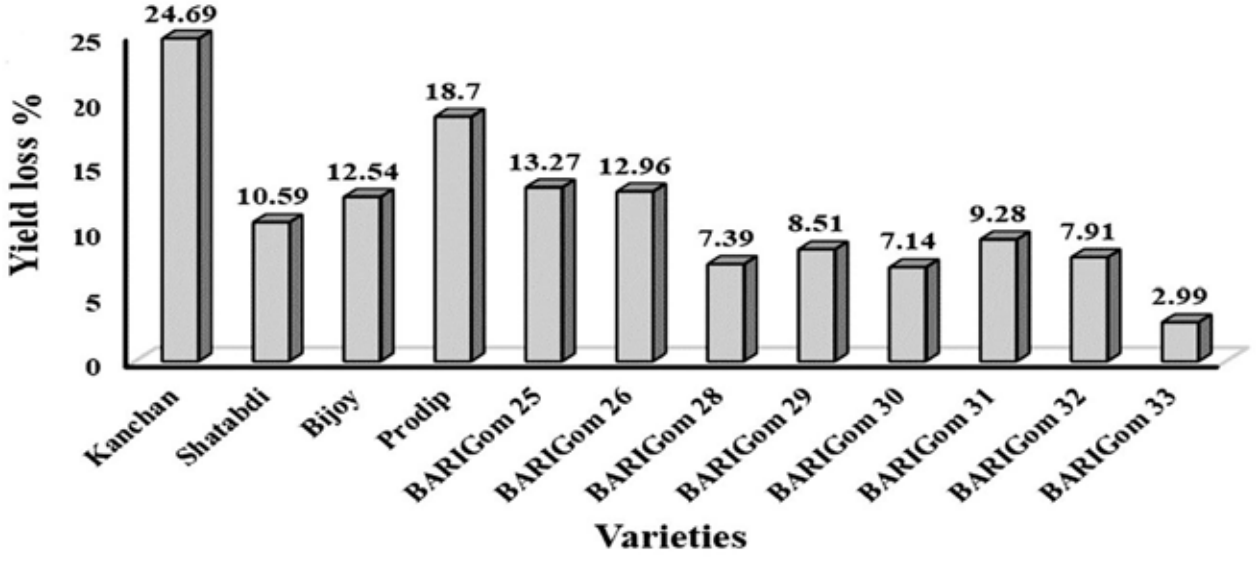

Figure 1. Yield loss (%) occurred in different wheat varieties

Table 3. Agronomic attributes of different wheat varieties to the application of fungicide

Varieties	Fungicide	Heading (days)	Plant height (cm)	Number of tiller/m^2 area	Number of spike/m^2 area	Maturity (days)
Kanchan	NS	71.0 ab	100.0 ab	468.5 a	448.5 ab	112.0 a
	S	72.0 a	101.0 ab	476.5 a	514.0 a	110.0 ab
Shatabdi	NS	71.5 a	95.5 abcd	442.0 ab	402.5 bcde	111.0 a
	S	69.0 bcd	96.5 abc	442.0 ab	417.5 bcde	111.0 a
Prodip	NS	67.0 defg	94.5 abcd	406.0 ab	389.5 bcde	106.0 cd
	S	69.0 bcd	96.5 abc	421.0 ab	423.5 bcde	106.5 cd
Bijoy	NS	67.5 cdef	85.5 cd	380.0 ab	362.0 bcde	105.5 cd
	S	68.5 bcd	93.0 abcd	391.0 ab	400.0 bcde	107.0 cd
BARI Gom 25	NS	68.0 cde	94.0 abcd	354.5 ab	358.0 cde	105.5 cd
	S	68.5 bcd	101.5 a	459.5 ab	398.5 dcde	107.0 cd
BARI Gom 26	NS	67.0 defg	95.5 abcd	358.0 ab	314.0 f	107.0 cd
	S	68.0 cde	93.0 abcd	428.5 ab	374.0 bcde	107.0 cd
BARI Gom 28	NS	65.0 gh	90.0 abcd	369.0 ab	352.0 de	105.5 cd
	S	65.0 fgh	92.0 abcd	404.0 ab	377.0 bcde	107.0 cd
BARI Gom 29	NS	67.5 cdef	83.0 d	324.0 b	337.5 e	106.0 cd
	S	68.5 bcd	88.0 bcd	448.0 ab	408.0 bcde	106.5 cd
BARI Gom 30	NS	65.5 efgh	92.0 abcd	436.5 ab	343.0 de	108.5 abcd
	S	66.5 defg	93.0 abcd	436.5 ab	383.5 bcde	108.5 abcd
BARI Gom 31	NS	70.0 abc	95.5 abcd	373.5 ab	431.0 abcd	108.0 bcd
	S	70.0 abc	92.0 abcd	452.5 ab	448.0 abc	108.5 abcd
BARI Gom 32	NS	64.0 h	90.0 abcd	398.5 ab	422.0 bcde	105.5 cd
	S	64.5 gh	92.5 abcd	403.5 ab	443.0 abc	105.5 cd
BARI Gom 33	NS	65.0 fgh	93.5 abcd	393.4 ab	347.0 de	105.0 d
	S	65.5 efgh	95.0 abcd	398.0 ab	389.0 bcde	105.0 d
LSD		2.23	11.31	111.4	75.58	2.59

S, Spray; NS, Non-spray

Bipolaris leaf blight and yield loss of wheat

The maximum yield loss was found in Kanchan (24.69%) followed by Prodip (18.70%), BARI Gom 25 (13.27%), BARI Gom 26 (12.96%), Bijoy (12.54%), BARI Gom 31 (9.28%) and lowest obtained in BARI Gom 33 (2.99%) and BARI Gom 30 (7.14%) (Figure 1). BARI Gom 33 demonstrated less disease severity which plays a vital role in the prevention of yield losses. Bipolaris leaf blight may result in up to 100% yield loss in wheat (Hossain *et al.* 1998, Hossain and Azad 1994, Ahmed 1999, Kumar *et al.* 2019). However, 13.9 to 16.2% yield loss was estimated in the different locations of Bangladesh including Dinajpur, Jessore, Jamalpur, and Ishurdi (Hossain *et al.* 2015). The environmental conditions and genetic makeup of the wheat cultivars are considered as the key players for the severe infection of Bioplaris leaf blight especially in the South Asian region (Dubin and Van Ginkel 1991).

Agronomic attributes of wheat varieties to the application of fungicide

Among the wheat varieties, the earlier heading was observed in BARI Gom 32 (64 days) with fungicide-sprayed plots and late heading in Kanchan (72.0 days) and Shatabdi (71.5 days) without sprayed plots (Table 3). The highest plant height 101.5 cm was observed in BARI Gom 25 which received fungicide and the lowest in BARI Gom 29 (83.0 cm) without fungicidal spray. The variation in the plant height in different wheat varieties might occur due to the different genetic makeup of each variety (Ahmad *et al.* 2016). Maximum tillers and the number of spikes per square meter were observed in Kanchan (476.5 and 514.0) which did not receive fungicides whereas the minimum was found in BARI Gom 29 with fungicide sprayed condition (324.0 and 337.5 respectively) (Table 3). BARI Gom 33 matured early (105 days) and late maturity was observed in Kanchan (112 days) without fungicide spray (Table 3).

CONCLUSION

The findings of the study revealed the feasibility of BARI Gom 33 for cultivation in farmer's fields with fungicidal sprayed conditions.

REFERENCES

Ahmad, I., Mahmood, N., Khaliq, I. and Khan, N. 2016. Genetic analysis for five important morphological attributes in wheat (*Triticum aestivum* L.). J. Anim. Plant Sci. 26(3): 725-730.

Ahmed, S. 1999. Integrated management of late blight of winter tomato with sanitation, fungicide and plant extract. M.S. Thesis. Department of Plant Pathology, Bangladesh Agricultural University.

Alam, K.B., Shaheed, M.A., Ahmed, A.U. and Malakar, P.K. 1993. Bipolaris leaf blight disease of wheat in Bangladesh. A paper presented at the BARI-CIMMYT Int. Conference on Wheat in Warm area. Rice Farming System, Wheat Research Centre, Dinajpur, Bangladesh. February 13-15 (pp.9).

Bailey, A.K., Kumari, M., Singh, V.P., Reddy, C.M., Kumar, S., Rane, J. and Chand, R. 2009. Evaluate the effect of different levels of seeds and plants infection by *Bipolaris sorokiniana* on wheat. Bangladesh J. Plant Pathol. 23(1-2): 43-50.

BBS, 2022. Yearbook of agricultural statistics, Bangladesh bureau of statistics, Statistics and informatics division, Ministry of Planning, Government of the People's Republic of Bangladesh. (pp. 80).

Chaurasia, P.C.P., Prasad, J.B. and Mandal, A. 2011. Chemical management of leaf blight (*Bipolaris sorokiniana*) of wheat in central terai of Nepal. Nepal Agric. Res. J. 11: 113-115.

Das, M.K., Rajaram, S., Mundt, C.C. and Kronstad, W.E. 1992. Inheritance of slow rusting resistance to leaf rust in wheat. Crop Sci. 32: 1452-1456.

Dubin, H.J. and Van Ginkle, M. 1991. The status of wheat diseases and disease research in warmer area. Wheat for the Non-traditional warm areas Mexico, D.F.; CIMMYT (pp. 125-145).

Duveiller, E., Kandel, Y.R., Sharma, R.C. and Shrestha, S.M. 2005. Epidemiology of foliar blights (spot blotch and tan spot) of wheat in the plains bordering the Himalayas. Phytopathol. 95(3): 248-256.

Gomez, K.A. and Gomez, A.A. 1984. Statistical procedures for agricultural research, 2nd ed.; Wiley Inter Science: New York, NY, USA (pp. 1-690).

Hossain, I. and Azad, A.K. 1994. *Bipolaris sorakiniana*: its reaction and effect on yield of wheat. Prog. Agric. 5(2): 63-65.

Hossain, I. and Azad, A.K. 2009. Reaction of wheat to *Helminthosporium sativum* in Bangladesh. Hereditas. 116: 203-205.

Hossain, I., Rashid, A.Q.M.B., Fakir, G.A. and Meah, M.B. 1998. Leaf blight of wheat: its status and impact on grain formation. Paper presented at: First National Workshop on Seed Pathology; 1998, Jun 9-12; Bangladesh Agricultural University, Mymensingh.

Hossain, S.M.M., Islam, A.T.M.S. and Hassan, S.M.E. 2015. Effect of different levels of black pointed seed on prevalence of Bipolaris leaf Blight of wheat. J. Sci. Technol. 8: 135-141.

Kakraliya, S.S., Zacharia, S., Bajiya, M.R. and Sheshma, M. 2017. Management of leaf blight of wheat (*Triticum aestivum* L.) with bio-

agents, neem leaf extract and fungicides. Int. J. Curr. Microbiol. App. Sci. 6(7): 296-303.

Magar, P.B., Baidya, S., Koju, R. and Adhikary, S. 2020. In-vitro evaluation of botanicals and fungicides against *Bipolaris sorokiniana*, causing spot blotch of wheat. J. Agric. Nat. Resour. 3(2): 296-305.

Malakar, P.K., Reza, M.A., Alam, S.M. and Shaheed, M.A. 2004. Bipolaris leaf blight: A major constraint to sustainable production of wheat grown under humid conditions. 4th International Crop Science Congress (ICSC). Brisbane. Australia. 26 September-1 October, 2004.

Mian, I.H. and Malaker, P.K. 2009. Effect of seed treatment and foliar spray with fungicides in controlling black point disease of wheat. Bangladesh J. Agril. Res. 34(3): 425-434.

Momtaz, S., Shamsi, S. and Kumar, T. 2018. Prevalence of fungi associated with Bipolaris leaf blight; Biores. Comm. 4: 530-540.

Rashid, A.Q.M.B., Sarker, K. and Khalequzzaman, K.M. 2013. Control of Bipolaris leaf blight of wheat with foliar spray of Tilt-250 EC. Bangladesh J. Pl. Pathol. 17(1-2): 45-47.

Saari, E.E. and Prescott, L.M. 1975. A scale for appraising the foliar intensity of wheat diseases. Plant Dis. Rep. 59: 377-380.

Shamim, I., Shahazd, A., Anjum, M., Amir, S. and Iftikhar, A. 2009. Hosts of *Bipolaris sorokiniana* the major pathogen of spot blotch of wheat in Pakistan. Pak. J. Bot. 41(3): 1433-1436.