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Article

Effect of plant extracts, BAU-Biofungicide and chemicals on Bipolaris leaf blight of wheat cv. Kanchan

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Abstract: Field experiment was conducted to evaluate the effect of seed treatment and foliar spray with four different plants extracts viz. *Lawsonia alba*, *Adhatoda vesica*, *Swertia chirayaita*, *Calendula officinalis*, two chemicals viz. Provax-200 WP (0.4%), Bavistin (0.3%) and BAU-Biofungicide (a *Trichoderma* based preparation) on disease severity, yield and yield contributing characters of wheat cv. Kanchan during the period from March, 2014 to April, 2015. The highest seedling number/m^2 (168.0) recorded in case of seed treatment + foliar spray with Bavistin and the lowest (133.0) in case of *Lawsonia alba* leaf extract at 30 DAS. The highest plant height (112.69 cm) and panical length (11.86 cm) were recorded in case of seed treatment + foliar spray with BAU-Biofungicide and the lowest in untreated control. The maximum disease severity was recorded in untreated control at all counts, but minimum disease severity was recorded in case of using seed treatment + foliar spray with BAU-Biofungicide at 4^{th} count. The highest 1000-grain weight (41.590 g) was found in case of seed treatment + foliar spray with BAU-Biofungicide followed by seed treatment + foliar spray with Bavistin (41.340 g) and the lowest (39.073 g) in untreated control. The highest grain yield/ha (4769.85 kg) was found in case of seed treatment + foliar spray with BAU-Biofungicide and the lowest (3069.85 kg) in untreated control. Seed treatment + foliar spray with BAU-Biofungicide resulted 35.64% increase of yield over untreated control. The maximum number of grade-0 seeds (89.90 %) was recorded in case of seed treatment + foliar spray with BAU-Biofungicide and the lowest (80.1%) in case of untreated control. Therefore, BAU-Biofungicide can successfully be used for eco-friendly management of leaf blight disease of wheat for obtaining higher yield by avoiding chemicals.

Keywords: wheat cv. Kanchan; leaf blight; plant extract; BAU-Biofungicide; fungicide

1. Introduction

Wheat (*Triticum aestivum* L.) is considered as one of the most important cereal crops in the world and second most important cereal crop in Bangladesh. Wheat is vulnerable to almost 200 different diseases in different parts of the world of which 42 are seed-borne and 35 are caused by fungi (Wiese, 1987). Leaf spot/ leaf blight caused by *Bipolaris sorokiniana* is the most common and severe disease in Bangladesh (Hossain and Azad, 1992). Planting quality seed is an important input for successful crop production. It is noticeable that proper disease control measures can sustainably improve the quality of wheat seeds and significantly increase the yield. Among different control practices used, seed treatment is one of the effective technique to eliminate seed-borne inocula. Treatments of seed should be done as a routine practice as it is a cheap insurance against possible disasters at a later stage (Bilgrami and Dube, 1976). The disease can be controlled by the application of fungicides. Existing practice of chemical control is too costly, particularly for poor farmers in the country. Botanicals in controlling pathogens against certain fungal pathogens have been reported by Suratuzzaman *et al*. (1994); Assdi and Behroozin (1987). BAU-Biofungicide, a Trichoderma based preparation resulted significant higher germination

and plant stand, less disease incidence and higher yield of different crops (Hossain, 2011; Hossain and Hossain, 2012; Chowdhury *et al.*, 2013). Over the past few decades, agricultural production has increased and farmers rely on chemical pesticides for protecting plants against pathogens. Many researchers have tried to find safe and economical methods to control plant diseases by using extracts of different plant parts (Bdliya and Alkali, 2008; Cohen *et al.*, 2006). Plant extracts have antifungal effect and can be used as fungicidal seed treatments for the control of seed-borne fungi of wheat and for increasing seed germination (Sobiya *et al.*, 2005). Biological control has now become one of the most exciting and rapidly developing areas in plant pathology, because it has great potential to solve many agricultural and environmental problems. The application of *T. harzianum*, has been identified as potential biocontrol agents for the management of various crop diseases (Vann, 2011). This biocontrol agent has the potential to protect seedlings against several diverse plant pathogenic fungi (Kucuk et al., 2007; Hasan and Alam, 2007). *Trichoderma* spp. have been found to be effective in reducing the foliar disease severity on wheat plants compared with untreated plants (Muthomi *et al*., 2007; Hasan and Alam, 2007; Sing *et al*., 2008). So, significance of this method is that incorporation of this control method will allow reduction in the use of chemical fungicides. Keeping in consideration present work has been undertaken to evaluate efficiency of selected plant extracts viz. *Lawsonia alba*, *Adhatoda vesica*, *Calendula officinalis* and *Swertia chirayaita*; BAU-Biofungicide and chemical fungicides viz. Bavistin and Provax-200 to control seed borne fungi associated with wheat seeds as well as to control Bipolaris leaf spot/leaf blight of wheat.

2. Materials and Methods

The experiments were conducted during the period from September, 2014 to April, 2015 in the Field Laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh. Seed samples of wheat (*Triticum aestivum* L.) var. kanchan which is highly susceptible to leaf spot/leaf blight (*Bipolaris sorokiniana*) of wheat was collected from the farmers of Dupchanchia of Bogra. The experiment was laid out in RCBD having three replications for each treatment, where block to block, plot to plot and line to line distances were 1m, 1m and 20 cm, respectively.

2.1. Preparation of fungicidal solutions, plant extracts and BAU Bio-fungicide for seed treatment and field spray

Treatments for controlling fungi were T_0 = untreated Control, T_1 = *Lawsonia alba* (Mehedi) leaf extract (1:10), T_2 = *Adhatoda vesica* (Basak*)* leaf extract (1:10), T_3 = *Swertia chirayaita* (Chirata) plant extract (1:10), T_4 = *Calendula officinalis* (Marigold) leaf extract (1:10), T_5 = BAU Bio-fungicide (3%) T_6 = Provax-200 WP (0.4%) and T_7 = Bavistin (0.3%). All the treatments were used for seed treatment as well as field spray. The seeds were soaked in different solutions as per treatment for 15 minutes. Then the solutions were drained out and the treated seeds were allowed to be dried up and the seeds were ready for sown. In case of plant parts, the extracts were prepared by crushing the plant parts in a blender with distilled water in 1:1 ratio (e.g. 1:1= 100 g plant material crushed in 100 ml water) following the method of Hossain *et al.* (1997). The extracts were 1:10 dilution ratio for seed treatment and field spray. BAU-Biofungicide (3g) mixed with 100 ml water i.e.3% BAU-Biofungicide was used. The seeds were soaked in BAU-Biofungicide solutions for 15 minutes and then subjected to dry up. The dried seeds were ready for sowing.

2.3. Assessment of leaf blight and other parameters

Disease severity of wheat of each plot was assessed following the double digit scale prescribed by CIMMYT after Saari and Prescott (1986). The first digit (D_1) indicates the disease progress in height of plant, which is shown as follows: 0 = Free from infection, 1 = Very resistant: A few isolated lesions on only the lowest leaves, 2 = Resistant: Scattered lesions on the second set of leaves with first leaves infected at light intensity, 3=Moderately resistant: Light infection of lower third of plant, lower most leaves infected at moderate to severe leaves, 4 = Low intermediate: Moderate to severe infection of lower leaves with scattered to light infection extending to the leaf immediately below the midpoint of plant, 5 = Intermediate: Severe infection of lower leaves. Moderate to light infection extending to the midpoint of the plant with upper leaves free from infections do not extend beyond midpoint of plant, 6 = High intermediate: Severe infection on the lower third of the plant, moderate degree on middle leaves and scattered lesions beyond the midpoint of the plant, 7 = Moderately susceptible: Lesions severe on lower and middle leaves with infections extending to the leaf below the flag leaf or with trace infections on the flag leaf, 8 = Susceptible: Lesions severe on lower and middle leaves. Moderate to severe infection on the upper third of the plant. Flag leaf infected in amounts more than a trace, 9 = Very susceptible: Severe infection on all leaves and spike infected to some degree.

The second digit (D2) represents the percentage area covered by the blight pathogen on the flag leaf and one below it, which is as follows: 1 = 10% coverage, 2 = 20% coverage, 3 = 30% coverage, 4 = 40% coverage, 5 = 50% coverage, 6 = 60% coverage, 7 = 70% coverage, 8 = 80% coverage and 9 = 90% coverage and above.

2.4. Data recording

Data on different parameters were recorded as: No. of seedling/$m^{2,}$ Height of seedlings, Disease incidence (%), Height of plants (cm), Length of panicle (cm), 1000 grain wt (g), Grain yield/m^2, Grain yield (kg/ha) and % Healthy and diseased grain. The collected data were analyzed by using Duncan's Multiple Range Test (DMRT) following the MSTAT-C program following the procedure as described by Gomez and Gomez (1984).

3. Results and Discussion

The effect of seed treatment with selected plant extracts, BAU-Biofungicide and chemical fungicides on seedling number/m^2 and seedling height at 30 DAS of wheat cv. Kanchan were studied and results are presented in Table 1. The Seedling number/m^2 varied significantly among the treatments. Significantly highest Seedling number/m^2 (168.0) was recorded in case of using Bavistin and the lowest (133.0) in case of leaf extracts of *Lawsonia alba*. Seedling height ranged from 27.64 to 30.16 cm at 30 DAS. Significantly highest seedling height (30.16 cm) was observed in case of seed treatment with BAU-Biofungicide and the lowest in case of untreated control (27.64 cm). The disease severity of 1^{st}, 2^{nd}, 3^{rd} and 4^{th} counts ranged from 00 to 22, 22 to 45, 62 to 74 and 77 t0 97, respectively. Maximum disease severity was recorded in untreated control at all counts, but minimum disease severity was recorded in case of using seed treatment + foliar spray with Provax-200 and Bavistin at 1^{st} and 2^{nd} counts, Bavistin at 3^{rd} count and BAU-Biofungicide at 4^{th} count (Table 2). The plant height varied significantly among the treatments. The highest plant height (112.69 cm) was recorded in case of seed treatment + foliar spray with BAU-Biofungicide and the lowest plant height (103.13 cm) in case of seed treatment + foliar spray with untreated control plots (Table 3). The panicle length ranged from 10.03 to 11.86 cm, while the highest panicle length was observed in case of seed treatment + foliar spray with BAU-Biofungicide and the lowest in case of untreated control.

Table 1. Effect of seed treatment and foliar spray with selected plant extracts, BAU-Biofungicide and chemical fungicides on seedling number/m^2, seedling number/ha and seedling height at 30 DAS of wheat cv. Kanchan (Field experiment).

Sl. No.	Treatment	Seedling number/m^2	Seedling height (cm)
1	Untreated Control	138.3 e	27.64 g
2	Leaf extract of *Lawsonia alba* (1:10)	133.0 f	28.94 e
3	Leaf extract of *Adhatoda vesica* (1:10)	157.3 c	30.12 b
4	*Swertia chirayaita* plant extract (1:10)	153.0 d	29.51 d
5	Leaf extract of *Calendula officinalis* (1:10)	158.3 c	30.12 b
6	BAU-Biofungicide (3.0%)	160.1 b	30.16 a
7	Provax-200 (0.4%)	160.3 b	28.20 f
8	Bavistin (0.3%)	168.0 a	29.91 c
Level of significance		**	**

Values within the same column having a common letter (s) do not differ significantly.

**= Significant at 1% level of significance.

T_0 = untreated Control, T_1 = Leaf extract of *Lawsonia alba* (1:10), T_2 = Leaf extract of *Adhatoda vesica* (1:10), T_3 = *Swertia chirayaita* plant extract (1:10), T_4 = Leaf extract of *Calendula officinalis* (1:10), T_5 = BAU Bio-fungicide (3%), T_6 = Provax-200WP (0.4%), T_7 = Bavistin (0.3%).

Table 2. Effect of seed treatment and foliar spray with selected plant extracts, BAU-Biofungicide and chemical fungicides on disease severity of wheat cv. Kanchan (Field experiment).

Sl. No.	Treatment	Disease severity (00-99)a			
		1st count at 45 DAS	2nd count at 60 DAS	3rd count at 75 DAS	4th count at 90 DAS
1	Untreated Control	22	45	74	97
2	Leaf extract of *Lawsonia alba* (1:10)	22	42	66	88
3	Leaf extract of *Adhatoda vesica* (1:10)	11	44	65	87
4	*Swertia chirayaita* plant extract (1:10)	22	44	65	87
5	Leaf extract of *Calendula officinalis* (1:10)	11	34	66	88
6	BAU-Biofungicide (3.0%)	11	32	64	77
7	Provax-200 (0.4%)	00	22	66	78
8	Bavistin (0.3%)	00	22	62	78

DAS = Days after sowing

a. Scale of Saari and Prescott (1986)

Table 3. Effect of seed treatment and foliar spray with selected plant extracts, BAU-Biofungicide and chemical fungicides on plant height and panicle length at maturity stage of wheat cv. Kanchan (Field experiment).

Sl. No.	Treatment	Plant height (cm)	Panicle length (cm)
1	Untreated Control	103.13 d	10.03
2	Leaf extract of *Lawsonia alba* (1:10)	104.67 cd	10.50
3	Leaf extract of *Adhatoda vesica* (1:10)	104.73 cd	10.65
4	*Swertia chirayaita* plant extract (1:10)	104.50 cd	10.42
5	Leaf extract of *Calendula officinalis* (1:10)	111.08 ab	11.64
6	BAU-Biofungicide (3.0%)	112.69 a	11.86
7	Provax-200 (0.4%)	107.65 bc	11.47
8	Bavistin (0.3%)	109.15 b	11.04
Level of significance		**	NS

Values within the same column having a common letter (s) do not differ significantly
**= Significant at 1% level of significance
NS= Non significant

The 1000-grain weight under different treatments ranged from 39.073 to 41.590g where, the highest 1000-grain weight was found in case of seed treatment + foliar spray with BAU-Biofungicide followed by seed treatment + foliar spray with Bavistin and lowest in untreated control (Table 4). The grain weight/m^2 and grain yield (kg/ha) under different treatments ranged from 306.985 to 476.985 g and 3069.85 to 4769.85 kg, respectively where the highest grain weight/m^2 and grain yield/ha were found in case of seed treatment + foliar spray with BAU-Biofungicide and the lowest in untreated control. Seed treatment + foliar spray with BAU-Biofungicide resulted 35.64% increase of yield over untreated control. Effect of seed treatment and foliar spray with selected plant extracts, BAU-Biofungicide and chemical fungicides on formation of different grades seeds (0-5 grade) of wheat cv. Kanchan were studied and results are presented in Table 5. The grade-0 seeds i.e. apparently healthy looking seeds of good quality ranged from 80.10 to 89.90 %, while the maximum number of grade-0 seeds was recorded in case of seed treatment + foliar spray with BAU-Biofungicide and lowest in untreated control. The grade-1 seeds ranged from 2.3 to 7.6, while the maximum number of grade-1 seeds was recorded in case of untreated control seeds and lowest in seed treatment + foliar spray with BAU-Biofungicide. The grade-2 seeds ranged from 2.1 to 3.1, while the maximum number of grade-2 seeds was recorded in case of plant extract of *Swertia chirayaita* and the lowest in seed treatment + foliar spray with BAU-Biofungicide. The grade-3 seeds ranged from 1.6 to 4.9, while the maximum number of grade-3 seeds was recorded in seed treatment + foliar spray with extracts *of Swertia chirayaita* and lowest in seed treatment + foliar spray with Provax-200. The grade-4 seeds ranged from 1.8 to 3.8. The maximum number of grade-4 seeds (3.8) was recorded in case of untreated control and lowest in seed treatment + foliar spray with Bavistin. The grade-5 seeds ranged from 1.5 to 3.4 while the maximum number of grade-5 seeds was recorded in untreated control and the lowest in seed treatment + foliar spray with BAU-Biofungicide.

Table 4. Effect of seed treatment and foliar spray with selected plant extracts, BAU-Biofungicide and chemical fungicides on 1000-grain wt. (g), Grain wt./m^2 and Grain yield (kg/ha) of wheat cv. Kanchan (Field experiment).

Sl. No.	Treatment	1000-grain wt. (g)	Grain wt./m^2	Grain yield (kg/ha)	Yield increased over control (%)
1	Untreated Control	39.073 e	306.985 c	3069.850 c	
2	Leaf extract of *Lawsonia alba* (1:10)	39.640 d	436.985 ab	4369.850 ab	29.75
3	Leaf extract of *Adhatoda vesica* (1:10)	39.733 d	327.313 bc	3273.130 bc	6.21
4	*Swertia chirayaita* plant extract (1:10)	39.424 d	377.313 abc	3773.130 abc	18.64
5	Leaf extract of *Calendula officinalis* (1:10)	40.263 c	431.313 ab	4313.130 ab	28.83
6	BAU-Biofungicide (3.0%)	41.590 a	476.985 a	4769.850 a	35.64
7	Provax-200 (0.4%)	41.240 b	381.656 abc	3816.516 abc	19.56
8	Bavistin (0.3%)	41.340 a	438.985 ab	4389.850 ab	30.07
Level of significance		**	*	*	

Values within the same column having a common letter (s) do not differ significantly
**= Significant at 1% level of significance
*= Significant at 5% level of significance

Table. 5. Effect of seed treatment and foliar spray with selected plant extracts, BAU-Biofungicide and chemical fungicides on formation of seeds under different grades (0-5 grade) of wheat cv. Kanchan (Field experiment)

Sl. No.	Treatment	% Seeds under different grades					
		0	1	2	3	4	5
1	Untreated Control	80.1	7.6	2.2	2.9	3.8	3.4
2	Leaf extract of *Lawsonia alba* (1:10)	83.8	4.5	2.5	2.9	3.5	2.8
3	Leaf extract of *Adhatoda vesica* (1:10)	83.5	5.8	2.8	3.6	2.5	1.8
4	*Swertia chirayaita* plant extract (1:10)	80.9	6.7	3.1	4.9	2.1	2.3
5	Leaf extract of *Calendula officinalis* (1:10)	85.6	5.2	2.4	2.9	2.2	1.8
6	BAU-Biofungicide (3.0%)	89.9	2.3	2.1	2.1	2.1	1.5
7	Provax-200 (0.4%)	87.9	2.4	2.8	1.6	2.6	1.7
8	Bavistin (0.3%)	87.6	3.3	2.5	2.2	1.8	1.6

0 = free from infection, 1 = only embryo blakish, 2 = embryo and its adjacent area slightly infected, 3 = embryo and less than ¼ of grains are discolored, 4 = embryo and ½ of grains are infected and 5 = grains are shriveled and almost completely discolored or more than ½ of grains discolored.

Maximum disease severity was recorded in untreated control at all counts, but minimum disease severity was recorded in case of using seed treatment + foliar spray with BAU-Biofungicide at 4th count. The severity of leaf blight was found to increase with the increase in age of the plants. This result supported by Alam *et al.* (1994) and Malaker *et al.* (2007). They reported that disease occured at any stage of plant growth but severity increases with plant age. Among the treatments BAU-Biofungicide was found superior in case of seed treatment + foliar spary in controlling leaf blight of wheat. This result is similar to Hossain (2012) who reported that BAU-Biofungicide was found superior in case of seed treatment + foliar spary in controlling leaf blight of wheat. Hossain (2009) used BAU-Biofungicide in controlling leaf blight of wheat and observed that the foliar spray of BAU-Biofungicide was most effective in reducing the leaf blight severity of wheat and significantly increased grain yield of wheat. Seed treatment + foliar spray with BAU-Biofungicide resulted the maximum number of grade-0 seeds and 1000-grain weight over control. This result is supported by Hossain (2012) who reported seed treatment + foliar spray BAU-Biofungicide higher grade-0 seeds and 1000-grain weight over control. In the present investigation, grain weight/m^2 and grain yield/ha were increased in case of seed treatment + foliar spray with BAU-Biofungicide. BAU-Biofungicide increased 35.64% yield over untreated control. Hossain (2012) reported BAU-Biofungicide increased the grain yield 29.87% over control. Sultana *et al.* (2009) observed that

the foliar spray of BAU-Biofungicide reduced the remarkable disease severity and singnificantly increased the grain yield 33.36% higher over control.

4. Conclusions

BAU-Biofungicide showed superior effect in controlling leaf blight of wheat and increased yield significantly. It may be concluded that BAU-Biofungicide can successfully be used for eco-friendly management of leaf blight disease of wheat for obtaining higher yield by avoiding chemicals as an important alternative to disease management of wheat.

Conflict of interest

None to declare.

References

Ahmed S, 1994. Effect of water stress in wheat progress. Bangladesh J. Agril. Res., 5**:** 7-11.

Alam KB, MA Shaheed, AU Ahmed and PK Malakar, 1994. Bipolaris leaf blight (spot blotch) of wheat in Bangladesh. In: Saunders, D. A. and G. P. Hettel (eds.), Wheat in Heat-Stressed Environments: Irrigated, Dry Areas and Rice-Wheat Farming Systems, Mexico, D. F.: CIMMYT. pp. 339-342.

Assdi P and M Behroozin, 1987. The effect of bulb extracts of onion and garlic on the mycellial growth of *Fusarium* spp. and *Sclerotium capivorum*. Iran. J. Plant. Pathol., 23: 1-3.

Bazlur Rashid AQM, MB Meahand and M Jalaluddin, 1987. Effect of leaf blight caused by *Drechslera sorokiniana* (Sacc.) Subram. and Jain. on some yield components of wheat. Crop Protection, 6: 256-260.

Bdliya BS and G Alkali, 2008. Efficacy of some plant extracts in the management of cercospora leaf spot of groundnut in the Sudan savanna of Nigeria. Archives Phytopathol. Plant Protect. pp. 1–12.

Bilgrami KS and HC Dube, 1976. A Text Book of Modern Plant Pathology. Vikas Publishing House PVT, Ltd. New Delhi. pp.164

Chowdhury MMH, I Hossain, P Day, M Ahmed and H Mahmud, 2013. Effect of seed sources and seed treatments on disease incidence, severity and seed yield of rice in Bangladesh. J. Agrofor. Environ., 7**:** 23-27.

Cohen Y, W Wang, BHB Daniel and YB Daniel, 2006. Extracts of *Inula viscose* control downy mildew of grapes caused by *Plasmopara viticola*. Phytopathol., 96**:** 417-424.

Gomez KA and AA Gomez, 1984. *Statistical procedure for agricultural research*. 2nd Edition. John Willey and Sons., New York. pp. 97-111.

Hasan MM and S Alam, 2007. Efficacy of *Trichoderma harzianum* treated seeds on field emergence, seedling disease, leaf blight severity and yield of wheat cv. Gourab and Shourav under field condition. Intl. J. Boi. Res., 3: 23-30.

Hossain I and AK Azad 1992. Reaction of wheat of *Helminthosporium sativum* in Bangladesh. Sereditas, 116: 203-205

Hossain I, AK Azad and AA Khan, 1992. Screening of Wheat Germplasm against Some Isolates of *Helmenthosporium sativum*. Bangladesh Agricultural University, Mymensingh, Research Programme 6: 199-202.

Hossain MH and I Hossain, 2012. Effect of seed treatment with different botanicals, Bavistin and BAU Bio-fungicide on germination and seedling vigor of groundnut. Bangladesh Agron. J. 16: 87-94.

Hossain MM, 2012. Biological control of leaf blight (*Bipolaris sorokiniana*) of wheat, PhD Thesis, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. pp. 123-126

Hossain S, 2009. Efficacy of foliar spary of Amister and BAU-Biofungicide in controlling leaf blight of wheat. M. S. thesis, Dept. of Plant Pathology, BAU, Mymensingh.

Hossain I, 2011. Unique ecofriendly means and new dimension of plant disease control in Bangladesh. Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Kucuk C, M Kivanc, E Kinaci and G Kinaci, 2007. Efficacy of *Trichoderma harzianum* (Rifaii) on inhibition of ascochyta blight disease of chickpea. Annals Microbiol., 57: 665-668.

Malakar PK, MA Reza, SM Alam and M Shaheed, 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.

Malaker PK, MU Ahmed and MMA Reza, 2007. Research on cereals diseases management under BARI. Paper presented at the National Workshop on Plant Pathology held at BARI during 11-12 February, 2007.

Malaker PK, Mian IH, Bhuiyan KA, Reza MMA and Mannan MA, 2009. Effect of black point disease on quality of wheat grain. ISSN 0258-7122. Bangladesh J. Agril. Res., 34: 181-187.

Muthomi JW, GM Riungu and JM Wagacha, 2007. Management of fusarium head blight of wheat using antagonistic microorganisms. Departments of Plant Science and Crop Protection, University of Nairobi, Kenya.

Rahaman MM, MS Ali, A Nahar, MM Karim and K Begum, 2013. Efficacy of fungicides in controlling leaf blight of wheat. Int. J. Expt. Agric., 3: 1-3.

Saari EE and QM Prescott, 1986. A letter addressed to Dr. H.S. Schmidt/Dr. Richard Lowrynowicz on their queries while investigating Infestation of wheat seeds by black point disease at BARI/ Bangladesh- German Seed Development project. Dhaka, Bangladesh. p. 40.

Singh DP, AK Sharma, P Kumar and AK Singh, 2008. Management of leaf blight complex of wheat caused by *Biopolaris sorokiniana* and *Alternaria triticina* in different agroclimatic zones using an integrated approach. Indian J. Agric. Sci., 78: 513-517.

Sobiya S, S Shazia and J Arshad, 2005. Fungitoxicity of aqueous extracts of allelopathic plants against seed-borne mycoflora of maize. Mycopath., 3: 23-26.

Sultana R, I Hossain, S Ahmed and MAA Mamun, 2009. Efficacy of BAU-Biofungicide in controlling leaf spot of Wheat (*Triticum aestivitm*). Eco-friendly Agril. J., 22**:** 392-395.

Suratuzzaman M, I Hossain and GA Fakir, 1994. Control of seed-borne fungi of two rice varieties with some plant extracts. Progressive Agriculture, 5*:* 11-15.

Vann S, 2011. University of Arkansas, Division of Agriculture, Cooperative Extension Service, USA. http://www.uaex.edu. Wang H, Fernandez MR, Mcaig TN, Gan YT, DePauw RM, Clarke JM 2003: Kernel discoloration and downgrading in spring wheat varieties in western Canada. Canadian J. Plant. Pathol., 25: 350-361.

Wiese MV, 1987. Compendium of wheat diseases (2rd Ed). The American Phytopathological society, St paul.