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Reaction of Some Wheat Varieties to Seed Borne *Bipolaris sorokiniana* and *Fusarium moniliforme*

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Abstract: Reaction of five wheat varieties to *Bipolaris sorokiniana* and *Fusarium moniliforme* was assessed in terms of prevalence of the pathogen on the seeds, symptom severity on the growing plants and effects of the pathogens on the yields. Prevalence of *B. sorokiniana* was 4-4.25% in kanchan and Akbar and of *Fusarium monilifome* was 2.25-2.75% in Gourab and Kanchan. Disease severity was the highest in Barkat both in laboratory and field conditions. However, *Bipolaris sorokiniana* infection was more severe than that of *Fusarium moniliforme*. Percent diseased grains were high in Barkat, while grain yield was low in barkat and sonalika due to inoculation of *B. sorokiniana* and *F. moniliforme*. Thus, there was a significant variation in reaction among the wheat varieties to the pathogens.

Key words: Seed borne, *Bipolaris sorokiniana*, *Fusarium moniliforme*, diseases severity, fungi

Introduction

Wheat (*Triticum aestivum* L.) is staple food crop for about one billion people in as many as 43 countries and provides about 20% of the total food calories. In fact it has the broadest adaptation of all the cereal crop species in the world. Bangladesh has moved from the rank of nontraditional wheat growing countries into traditional wheat growing countries (Klatt, 1988).

There are many factors being the low yield of sheat in Bangladesh. Among these, diseases play a vital role. Diseases reduce wheat yields approximately 15-20% and cause 20-30 million tons loss to developing countries annually (Hanson *et al.*, 1982). In Bangladesh, about 10% yield reduction was reported due to diseases (Miah, 1985). The crop suffers from as many as 200 diseases of which 50 were routinely important (Wiese, 1985) and damaging ones are seed borne (Noble and Richardson, 1968).

Among the various constraints threatening to wheat cultivation in the country, diseases caused by different pathogens particularly *Bipolaris sorokiniana* play a vital role. The pathogen is seed borne and seed transmitted in nature (Bazlur Rashid, 1998) and may exist in different parts of the seeds. It can cause seedling blight, head blight, leaf blotch, leaf spot, leaf blight, foot rot, discoloured grain, black pointed grain and also may result in sterile spikes if the infection is severe (Mitra, 1931). Not a single cultivated wheat variety in the county is found free from *B. sorokiniana* (Hossain *et al.*, 1992b). The disease causes a serious problem to the wheat cultivation all over the world (Duveiller and Glchrist, 1994).

Fusarial diseases are certain to be significant constraints to wheat constraints to wheat production. They are quiet widespread and appear to be alarming due to their increase (Anonymous, 1982). *Fusarium* head blight of wheat or scab is an important fungal disease in many areas of the worked especially where humid moist conditions prevail from heading to maturity (Zhuping, 1994). It is also a prominent problem in Europe, USA, Canada (Wiersma *et al.*, 1996). The same fungi also cause seedling blight, crown rot, stem and node blight and grain rot on all small grain cereals. In Bangladesh head blight or scab of wheat was first reported by Anderson (1976). Fakir *et al.* (1998) found seedlings to be the foliar parts to become paler. Some times the white mycelial growth of the pathogen was visible on the infected parts and the seedlings die quickly.

In view of the above facts, the present research work was undertaken to know the prevalence of seed-borne fungal pathogens (*B. sorokiniana* and *F. moniliforme*) of wheat varieties and to find the effect of variety and pathogens or disease severity and grain yield of wheat.

Materials and Methods

The experiment was undertaken in the Seed Pathological Laboratory (SPL) and the Field Laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh during 2000-2001. Seeds of wheat varieties viz. Kanchan, Barkat, Sonalika, Akbar and Gourab were collected from Bangladesh Agricultural Research Institute, Gazipur and used in this experiment. Seedborne *Bipolaris sorokinia* and *Fusarium moniliforme* were isolated from the wheat seeds following incubated moist blotter method. Single conidium of each of the organism was carefully taken with the help of a fine pointed needle and transferred to PDA. and pure cultures of the fungi were maintained and made ready for inoculation. To make the inoculum suspension 6 ml sterilized water was poured into the 7 days old pure culture on PDA plates and rubbed gently by a clean brush to flood the conidia. The concentration of conidial suspension was prepared to 10^4 conidial suspension was prepared to $2.3x10^5$ conidia ml^{-1} (Mihuta and Forster, 1989).

The factorial experiment was conducted in randomized complete block design with three replications. There were 20 different treatment combinations. The treatments were as follows: Five wheat variety; V_1= Kanchan, V_2= Barkat, V_3= Sonalika, V_4= Akbar and V_5= Gourab and Pathogens used for inoculation T_0= Control (no inoculation), T_1= *Bipolaris sorokiniana*, T_2= *Fusarium moniliforme* T_3= *Bipolaris sorokiniana*± *Fusarium moniliforme*. The unit plot size was 2.0x1.5 m^2. In each unit plot there were 6 rows of plants having 20 cm distance between the rows and 5 cm distance between the seeds within rows, where block to block and plot to plot distances were 1m and 50 cm respectively. The field was fertilized at the rate of 200 kg Urea, 200 kg TSP, 80 kg MP and 20 ton cowdung per hectare. The seeds were sown at the rate of 120 kg ha^{-1}. Intercultural operations like weeding and irrigation were done in order to maintain the normal hygienic conditions of crop growth. At the botting stage the plants were sprayed as per treatment with the respective spore suspensions by using a hand sprayer.

Data were collected on disease severity (%), diseased grains/ear and grain yield. Disease index of the leaf blight reaction was recorded at anthesis stage. Disease index of leaf blight severity was scored following 0-5 scale of Bazlur Rashid *et al.* (1987). The disease index (DI) was calculated by the formula of Singh (1984). Data in respect of different growth and yield contributing characters were statistically analyzed and means were compared following LSD.

Results and Discussion

Percent seed germination was found almost similar, although the maximum (99%) was found in variety Barkat and minimum (91%) was in variety Akbar (Table 1). Seed health test by blotter method indicated that the prevalence of seed borne *Bipolaris sorokiniana* and *Fusarium moniliforme* varied depending on the wheat

Table 1: Germination of wheat seed and prevalence of seedborne *Bipolaria sorokiniana* and *Fusarium moniliforme in vitro*

Variety	% germination	Prevalence (%)		
		B. sorokiniana	*F. moniliforme*	*B. sorokiniana* and *F. moniliforme*
Kanchan (V_1)	95	4.25a	2.25a	0.500b
Barkat (V_2)	99	3.25bc	1.00c	0.250c
Sonalika (V_3)	99	3.75b	2.00b	0.500b
Akbar (V_4)	91	4.00a	1.50bc	0.750a
Gourab (V_5)	95	3.00c	2.75a	0.750a
LSD (0.05%)	NS	0.25	0.522	0.195

Table 2: Effect of varieties and seed borne fungi on the leaf spot severity, diseased grains/ear and grain yield

Treatments	Diseased severity (%)	Diseased grains/ear (%)	Grain yield (kg/ha)
Varieties			
V_1 (Kanchan)	52.13b	16.25A	1263.88a
V_2 (Barkat)	57.66a	17.00A	1022.22b
V_3 (Sonalika)	55.59ab	12.93B	1002.77b
V_4 (Akbar)	46.03c	15.48ab	1041.66b
V_5 (Gourab)	45.73C	13.94ab	1230.55a
LSD (0.05%)	4.629	3.047	84.79
Fungi			
T_0 (Control)	31.53c	8.92c	1315.00a
T_1 (*B. sorokiniana*)	61.83a	18.73a	980.00c
T_2 (*F. moniliforme*)	58.21ab	17.72ab	1041.66bc
T_3 (*B. sorokiniana* and *F. moniliforme*	54.15b	18.10b	1112.19b
LSD (0.05%)	4.159	2.725	75.84

Table 3: interaction effect of different wheat varieties and inoculation pathogens on the leaf spot severity, grain yield of wheat

Treatment x Variety	Diseased severity (%)	Diseased grain/ear (%)	Grain yield (kg/ha)
T_0V_1	32.00de	9.68	1263.88
T_0V_2	34.99de	9.69	1022.10
T_0V_3	32.66de	9.39	1002.77
T_0V_4	26.66e	9.23	1041.66
T_0V_5	31.33de	6.61	1230.55
T_1V_1	57.50abc	16.25	1041.66
T_1V_2	68.16a	16.99	916.66
T_1V_3	64.50ab	12.86	958.33
T_1V_4	40.93d	15.47	966.66
T_1V_5	39.63d	13.94	1016.66
T_2V_1	58.33abc	20.35	1141.66
T_2V_2	59.16abc	15.03	991.66
T_2V_3	58.86abc	13.44	1008.33
T_2V_4	61.50abc	18.36	991.66
T_2V_5	53.16c	21.43	1075.00
T_3V_1	60.66abc	18.73	1608.33
T_3V_2	68.33a	26.27	1158.33
T_3V_3	66.33a	16.03	1041.66
T_3V_4	53.83bc	18.85	1166.66
T_3V_5	60.00abc	13.78	1500.00
LSD (0.05%)	9.300	NS	NS

In a column, figures having a common letter(s) do not differ significantly
NS= non significantly

variety and pathogen. As high as 4.25 and 4.0% prevalence of *B. sorokiniana* were recorded in var. Kanchan and Akbar respectively and the prevalence were statistically similar. While maximum of 2.75 and 2.25% *F. moniliforme* were recorded in var. Gourab and Kanchan respectively (Table 1).

The disease severity under different inoculation treatments were found significantly different at 1% level (Table 2). The highest severity (57.66%) was recorded in V_2 (Barkat) followed by V_3 (Sonalika) and the lowest (45.73%) was recorded in V_5 (Gourab) which was also statistically similar to V_4 (Akbar). The highest disease severity (61.83%) was recorded in case of T_1 (*B. sorokiniana*) while lowest was recorded in T_0 (control). Percent disease severity differed significantly due to interaction of variety and inoculation treatment combination of T_1V_2 and T_3V_3. The lowest percent of disease severity (26.66%) was obtained by the treatment combination of T_0V_5 which was statistically identical with that of T_0 V_4, T_0 V_3, V_2 and T_0 V_1 (Table 3).

The percent diseased grains/ear differed significantly from one variety to another (Table 2). It varied from 12.93 to 17.00%. The highest and the lowest values were recorded in Barkat (V_2) and Sonalika (V_3), respectively. The impact of inoculation treatments has also been found prominent in percent diseased grains/ear (Table 2). The highest percent of diseased grains/ear (18.74) were found in T_1 (*B. sorokiniana)* followed by T_2 (*F. moniliforme*) and the lowest (8.92) was found in T_0 (control) which was highly significant. Percent of diseased grains/ear differed significantly due to interaction of variety and inoculation treatment as well (Table 3). The highest percent diseased grains/ear (26.27) was obtained with the treatment combination of T_3 V_2. The lowest percent of diseased grains/ear (6.61) was obtained by the treatment combination T_0V_5 which was statistically identical with that in T_0V_1, T_0V_2, T_0V_3 and T_0V_4. The second highest percent diseased grains/ear (21.43) was obtained in T_2V_5 being statistically identical with the treatment combinations T_2V_1 and T_3V_1.

The yield performance of wheat for different varieties (Table 2) indicated that the maximum grain yield/ha (1263.88 kg) was recorded in V_1 (Kanchan) followed by V_5 (Gourab). The lowest grain yield/ha (1002.77 kg) was recorded in V_3 (Sonalika), which was statistically similar to V_2 (Barkat) and V_4 (Akbar). Different inoculation treatments differed significantly from each other. The highest grain yield ha^{-1} (1315 kg) was found in T_0 (control) and the lowest (980.0 kg) was in T_1 (*B. sorokiniana*). Interaction effect of variety and inoculation treatments was non significant for grain yield ha^{-1}. Numerically, the highest grain yield ha^{-1} (1608.33 kg) was obtained with T_3V_1 and the lowest (916.66 kg) was obtained by T_1V_2 (Table 3).

Germination of wheat seeds cv. Kanchan, Barkat, Sonalika, Akbar and Gourab was studied *in vitro*. The results indicated that the germination rates of the seeds were quite good and statistically non significant and all varieties begot the prevalence of seedborne infection by the pathogens *B. sorokiniana* and *F. moniliforme* but it did not affect the seed germination. Chaudhary (1984) reported that germination of the diseased seeds both in blotter and in pot soil was found to decrease by 11.6 and 16.0%, respectively. Seed health test following blotter method indicated that the prevalence of seedborne *Bipolaris sorokiniana* and *Fusarium moniliforme* varied depending on the wheat varieties were free from seedborne *Bipolaris sorokiniana* and *Fusarium moniliforme*. Hossain *et al.* (1992b) reported that not a single cultivated wheat variety in the country was free from *B. sorokiniana*.

Hossain and Azad (1992a) reported the leaf blight or leaf spot of wheat as the major disease of wheat in Bangladesh. Alam *et al.* (1994) also reported the leaf blight or spot blotch as the number one disease of wheat in Bangladesh. Windels and Holen (1989) found that *Bipolaris sorokiniana* was the most prevalent fungus causing necrosis of basal stems, crowns, subcrown internodes and roots of wheat. Fakir *et al.* (1998) reported that wheat seedlings were more frequently affected by *Fusarium* sp. The seedlings were attacked at or below the soil level by the *Fusarium* sp.

Regarding the variation in grains/ear and yield of wheat due to seedborne *Bipolaris sorokiniana* and *Fusarium moniliforme*. It was observed that the varieties differed significantly from one another. This variation might be due to I) the effect of *B. sorokiniana* on formation of grains ii) effect of *Fusarium* sp. on formation of grains iii) variation of genetic make up of wheat materials and iv) growth conditions of plants. Bazlur Rashid *et al.* (1987) and Alam *et al.* (1983) reported yield reduction of wheat due to *B. sorokiniana*. They reported higher yield with largest size grains when the plants showed tolerance to *B. sorokiniana*. They also reported that grain yield and gain number along with the number of tillers decreased when the disease severity was increased.

Noble and Richardson (1968) have listed 35 seed-borne pathogens of wheat occurring in different countries of the world. Out of

these *Fusarium* sp., *F. nivale*, *F. graminearum*, were of major importance. Zwatz (1975) recorded high infestation of wheat seeds by *F. graminearum*, *F. nivale* and *F. avenaceum* in 1974 in Australia, which resulted in reduction of the grain quality and yield losses by 10-20%. Ali (1981) recorded 16 different fungi on seven wheat cultivar from Bangladesh where *F. graminearum* and *F. oxysporium* were more frequent. Singh and Aujla (1994) reported that head scab of wheat caused by *Fusarium moniliforme* and *F. subglutinans* reduced wheat yield and resulted in shriveled grains reducing the value of the crop. Khalil *et al.* (2000) stated that nineteen cultivars and 21 genotypes of wheat were evaluated for their reaction to head scab, grain formation and seed infection. Five cultivars and five genotypes were free from head scab, but the rest were highly susceptible.

Finally it has been concluded that the prevalence of seedborne *Bipolaris sorokiniana* and *Fusarium moniliforme* varied depending on the wheat variety and the pathogen. The tested wheat varieties differed significantly from one another as regards the disease severity, percent diseased grains/ear and grain yield ha^{-1} (kg). From the findings of the present study it has been indicated that the pathogens either alone or in combination showed significant effect in reducing the yield of wheat by creating higher disease severity.

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