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Varietal Screening of Wheat against Blast Disease

Mahmuda Akter Bhuiyan[1*], A. H. M. Mahfuzul Haque[1], Md. Monirul Islam[1] and Gazi Tamiz Uddin[2]

[1]Department of Plant Pathology and Seed Science, Sylhet Agricultural University, Sylhet-3100, Bangladesh.
[2]Department of Agricultural Construction and Environmental Engineering, Sylhet Agricultural University, Sylhet-3100, Bangladesh.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The study was conducted to evaluate the effects of different wheat varieties against blast disease and to observe the status of seed health of collected wheat varieties. The study was carried out under experimental field and laboratory condition at the Plant Pathology and Seed Science Department, Sylhet Agricultural University, Sylhet during October to March (2016-2017). The seeds collected from the Regional Agricultural Research Station, Jessore including ten different varieties, viz., BARI Gom19, BARI Gom22, BARI Gom23, BARI Gom24, BARI Gom25, BARI Gom26, BARI Gom27, BARI Gom28, BARI Gom29, BARI Gom30 were used in both laboratory and field conditions. In the laboratory, different fungal pathogens like *Fusarium oxysporum, Bipolaris sorokiniana, Aspergillus sp., Alternaria sp., Rhizophus sp., Curvularia sp*. and *Magnaporthe oryzae Triticum* were detected using a standard blotter method. In the field, it was found that BARI Gom28 was moderately resistant against blast. It had the lowest disease incidence (21.66%), lowest severity (30%) and also highest result in term of grain yield (5.5 t ha-1). The highest blast disease incidence (66.67%), highest severities (78.33%) and lowest grain yield (1.6 t ha-1) were found in BARI Gom26.

**Corresponding author: E-mail: moonysau11@gmail.com;*

Keywords: Wheat; blast disease; ten varieties; seed borne pathogen; seed health status.

1. INTRODUCTION

Wheat (*Triticum aestivum L.*), a member of Gramineae family is a self-pollinated, annual crop. Total wheat production in all over the world in 2016 was 749 million tons, making it the third most produced cereal after maize and rice [1]. Next to rice, it ranks second as a major cereal crop in Bangladesh, but the yield of wheat is low in comparison to the world wheat production. In 2014-15, 436,822 hectors land was under cultivation and total yield of grain was 13, 47,926 Metric ton [2]. But in 2015-16, 444,805 hectors of land were cultivated and total grain yield was 13,48,186 M. ton. [3]. The average yield rate of wheat was 1.78% lower than the prior year but the total production increase .02% [3]. Since 1960, world production of wheat and other grain crops has tripled and is expected to grow further through the middle of the 21st century [4]. In Bangladesh, the low production of wheat has many causes and among them abnormality in seed is a major constraint [5]. Wheat is host to as many as 120 different diseases. Among them, 42 are seed borne and fungi cause 35 diseases [6]. Among these diseases, blast is the most devastating problem of wheat, causing great losses of yield and quality. Blast fungus is disseminated by air and seeds. Wheat blast caused by the fungal pathogen *Magnaporthe oryzae* [7] *Triticum* pathotype [8].

The first incidence of wheat blast in 1998 affected approximately 15% of Bangladesh's total wheat area. Comparative genome analyses showed that fungal isolates from diverse wheat regions in Bangladesh appeared clonal and were closely related to highly aggressive MoT isolates from South America [9]. The total area of wheat cultivation in Bangladesh in 2016 was about 498,000 ha (Department of Agricultural Extension, Bangladesh). Wheat blast was observed in eight southwestern districts, viz., Pabna, Kushtia, Meherpur, Chuadanga, Jhenaidah, Jessore, Barisal, and Bhola. Out of a total 101,660 ha of cultivated wheat in those eight districts, an estimated 15% were affected by wheat blast. The severity of wheat blast and associated yield losses varied among districts. The highest percentage of infected wheat fields was observed in Meherpur (70%) followed by Chuadanga (44%), Jessore (37%), Jhenaidah (8%), Bhola (5 %), Kushtia (2 %), Barisal (1%), and Pabna (0.2%). Yield losses varied in different affected districts. The highest average yield loss was recorded in Jhenaidah (51%) followed by Chuadanga (36%), Meherpur (30%), Jessore (25%), Barisal (21%), Pabna (18%), Kushtia (10%), and Bhola (5 %) [10]. The economic importance of this disease derives from the fact that the fungus can reduce yield and grain quality [11]. Grains from blast-infected spikes from highly susceptible cultivars are often small, shriveled and deformed, with low test weight [11]. These grains are often discarded during the post-harvest process of threshing or winnowing [12]. Highest yield losses occur when spike infections begin during flowering or early grain formation [11]. Yield losses up to 100%are reported for susceptible cultivars [13]. Initially, rice blast was considered as the source of wheat blast. However, genetic studies have found significant differences among isolates from the two plant species and confirmed that the wheat pathogen *Magnaporthe grisea* found in Brazil did not originate from rice [14] and differs to a large extent from the rice pathogen, *Magnaporthe oryzae* [7]. Using microsatellite markers, [14] compared sympatric populations of *Magnaporthe* spp. adapted to either wheat or rice in Brazil and revealed that there was very low historical migration between the two different populations. Wheat blast *Magnaporthe oryzae triticum* pathotype is one of the destructive diseases is becoming the main constraint against successful wheat production. Considering the above facts, the present study was undertaken to achieve the following objectives: To evaluate different wheat varieties against wheat blast and study of seed health status of collected wheat varieties.

2. MATERIALS AND METHODS

2.1 Collection of Seed Samples

The wheat seeds were collected from the Regional Agricultural Research Station (RARS), Jessore. Ten wheat varieties were used as replicates in my experiment.

2.2 Laboratory Experiment

Laboratory study was carried out in the laboratory of Department of Plant Pathology & Seed Science, Sylhet Agricultural University, and Sylhet 3100.

2.3 Detection of Seed Borne Pathogens by Blotter Incubation Test

The fungal pathogens associated with wheat seed samples were detected using a blotter method (ISTA, 2006). In this method, three pieces of 9 cm filter paper (Whatman no.1) were soaked in distilled water and placed in the bottom of a Petri dish (9 cm diameter). Twenty-five seeds were taken for each of the eight Petri dishes and placed in moist filter paper. The Petri dishes with seeds were then incubated at room temperature (25 ± 2)ºC in an incubation chamber in the laboratory for seven days.

After seven days of incubation, each seed was observed under a sterio-binocular microscope at 25X magnification in order to record the presence of seed borne fungal pathogens that were identified by observing their growth characters on the incubated seeds. For proper identification of fungi, temporary slides were also prepared from the fungal colonies and observed under a compound microscope. The results were expressed in percentage of seeds infected for each pathogen.

2.4 Germination Test

Germination percentage was determined by blotter paper method. Seeds were plated in the plastic Petri dish on 2 layer of blotter paper and kept for seven days of incubation. After the incubation period, germination percentage were recorded.

2.5 Moisture Content

Moisture content of the seeds of each sample was determined before planting by an electric digital moisture meter immediately after seed collection. For each sample, three readings were taken. The average moisture content was expressed as percentage of seed weight.

2.6 Design of the Laboratory Experiment

The laboratory experiment was carried out under Completely Randomized Design with three replications.

2.6.1 Field experiment

The field experiment was conducted at the research field of Sylhet Agricultural University, Sylhet. The period of studies was October 2016 to March 2017.

2.6.2 Experimental site

The location of the site is about 5 kilometer north-east of Sylhet city with 24º54'N to 33.67" latitude and 91º54'to 95.88" E longitude. The Elevation of the experimental site is 30m above the sea level.

2.6.3 Design and layout of the experiment

The experiment was laid out in Randomized Complete Block Design (RCBD) with 3 replications. There were 30-unit plot altogether in the experiment. The size of each plot was $1m^2$.

2.7 Preparation of Land

The seed bed was prepared by puddling, followed by laddering. Weeds, stubble etc. were cleared from the land. The land was first opened the first week of November, 2016, with the help of a farmer and later the final land was prepared on 10 November by deep ploughing.

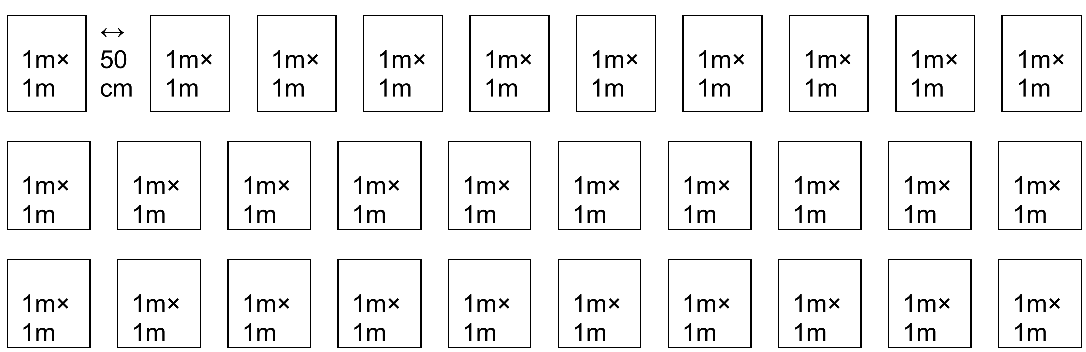

Fig. 1. Layout of experimental field

2.8 Intercultural Operation

Intercultural operations were done to ensure and maintain the normal growth and development of the crop. The intercultural operations are described below.

2.8.1 Weeding

The experimental plots were kept weed free by hand weeding. Weeding was done twice during the whole growing period; the first weeding was done after 15 days of sowing and the second one was the done after 30 days of sowing.

2.8.2 Thinning of seedling

After 15 days of sowing, thinning was done where plant population was found thick. For line sowing in experimental field the density of plants was more. So less the dense of the plants thinning was needed.

2.8.3 Irrigation and drainage

Two irrigations were applied, the first irrigation was made 20 days after sowing DAS at crown root initiation (CRI), the second one at 50 days at heading stage. At the starting of experiment it was dry season so irrigation is needed. But after few days the heavy rainfall is occurred so for removing excess water drainage facility was needed.

2.9 Treatments of the Experiment

Ten local wheat varieties were used in this experiment. Varieties were used as treatments.

T_1: BARI Gom19	T_6: BARI Gom26
T_2: BARI Gom22	T_7: BARI Gom27
T_3: BARI Gom23	T_8: BARI Gom28
T_4: BARI Gom24	T_9: BARI Gom29
T_5: BARI Gom25	T_{10}: BARI Gom30

2.10 Assessment of Disease Incidence

The experimental plots were monitored on 10 day intervals after the first appearance of blast disease. In experimental field it was natural inoculation of the blast disease. The incidence of disease was recorded three times (45, 60 and 75 DAS). Infected plants were identified by comparing according to following formula:

$$\text{Disease incidence (\%)} = \frac{\text{Number of infected plant}}{\text{Total number of plant}} \times 100$$

2.11 Assessment of Disease Severity

The observations were recorded and scored at 45, 60 and 75 according to disease severity score (0-5) from; Rios et al. 2013. Five infected plants were selected randomly from each plot.

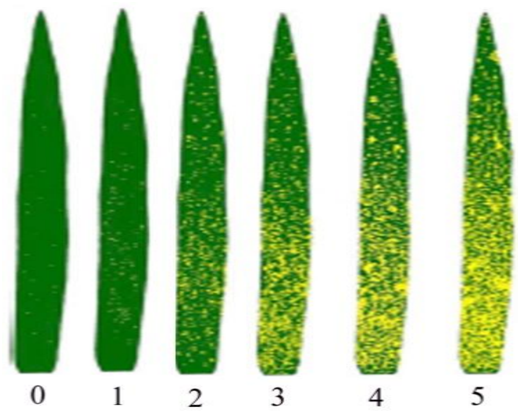

Plate 1. Disease severity rating of wheat blast

0 = Leaf free from spots; 1 = 0- 5% area infected; 2 = 6-30% area infected; 3 =31-50 % area; infected; 4 = 51-70% area infected; 5= 70-100% area infected

Disease severity was determined as PDI (severity) by using following formula [15].

$$\text{Disease severity (\%)} = \frac{\text{Sum of total rating}}{\text{Total no.of observation} \times \text{highest grade in the scale}} \times 100$$

2.12 Harvesting and Recording of Data

The crop was harvested at full ripening stage. The following parameters were recorded from laboratory and each unit plot and analyzed statistically.

i. Germination (%)
ii. Seedling health (%)
iii. Moisture (%)
iv. Disease incidence (%)
v. Disease severity (%)
vi. Yield per plot (kg)

2.13 Statistical Analysis

The data obtained for different parameters were statistically analyzed to determine significant differences among the cultivars. The analysis of variance was performed by using R program. The difference among the treatment means was estimated by LSD (Least Significance Difference) test at 5% level of probability [16].

3. RESULTS

3.1 Health and Quality of Stored Seed

3.1.1 Moisture content of seed

The moisture content of the seeds was determined at 15 days before sowing during the experimental period and presented in Fig. 1. The moisture content of the seed samples varied from 9.2 to 13.02%. The average moisture content of the seed was 11.60%. Only four samples had moisture content more than 12% but remaining 6 samples had less than 12% moisture content.

3.1.2 Performance of different varieties on germination of wheat seeds

Results on different cultivars on germination percentage are presented in Fig. 2. The highest germination was recorded in (BARI Gom27, 90%) which was statistically identical to (BARI Gom28, 85%) and (BARI Gom23, 84%). The lowest germination percentage was recorded in T_6 (BARI Gom26, 69%) that was statistically similar with (BARI Gom24, 70%).

3.1.3 Health status of emerged seedling (Standard blotter methods)

The health of seedlings showed significant difference among the varieties (Fig. 3). The highest healthy seedling % was recorded in (BARI Gom 28; 85%) and statistically similar results were also observed in (BARI Gom 22; 83%). The lowest healthy seedling was recorded in the treatment of (BARI Gom26; 61.66%) that was statistically similar with the (BARI Gom24; 68.33%).

3.2 Association of Seed Borne Fungi in Different Wheat Varieties

3.2.1 *Fusarium oxysporum*

The study revealed that, there was a significant variation of the association of *Fusarium oxysporum* among the treatments (Table 1). The highest incidence of *Fusarium oxysporum* was recorded in the treatment of (BARI Gom26, 7.83%) which was statistically similar the treatment of (BARI Gom24, 6.58%) and (BARI Gom23, 6.50%). The lowest infection was found in the treatments of (BARI Gom 28, 1.17%) and (BARI Gom 29, 1.75%).

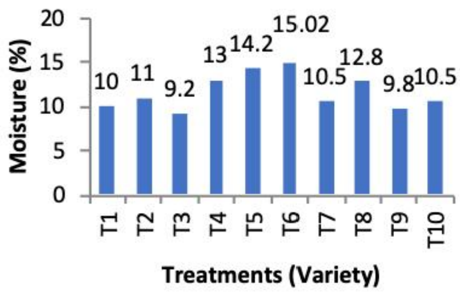

Fig. 2. Moisture (%) of the collected seeds

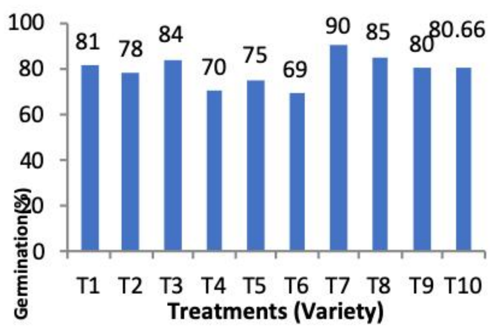

Fig. 3. Germination (%) of wheat varieties

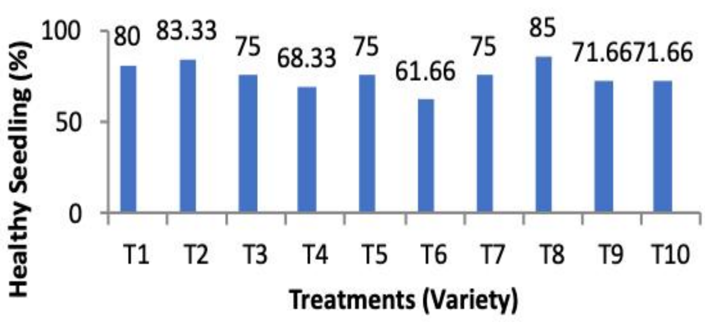

Fig. 4. Healthy seedling percentage of wheat varieties

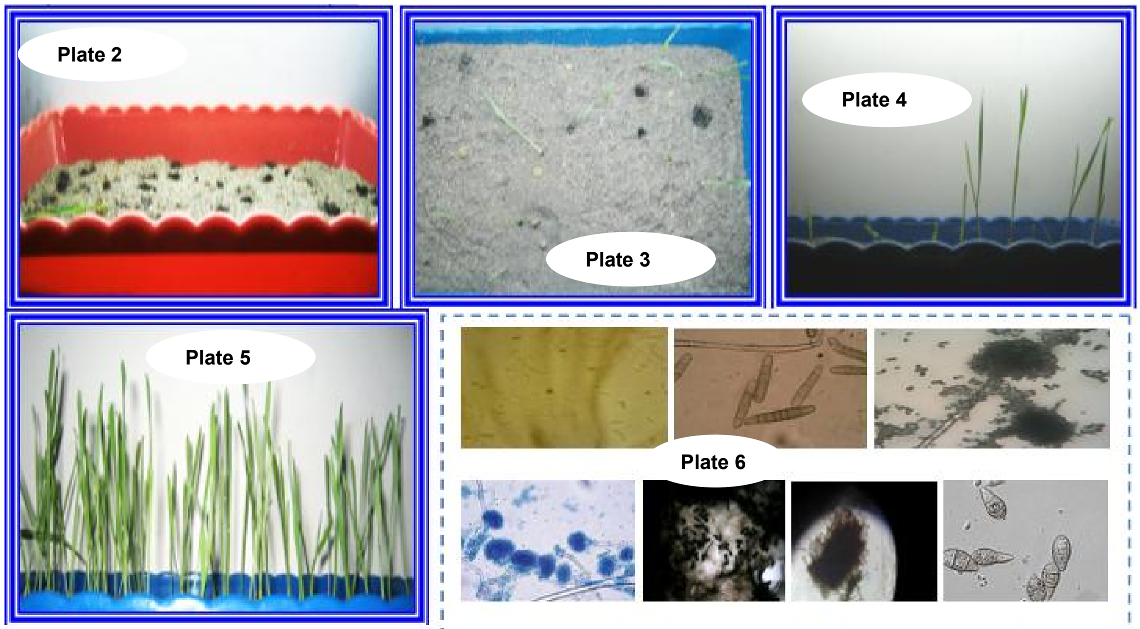

Fig. 5. Plate 2: Germination of infected seed, Plate 3: Germination of blast infected dead seeds, Plate 4: Germination of blast infected seedling, Plate 5: Germination of normal seedling, Plate 6. Conidia of detected fungi under stereo and compound microscope (standard blotter method was used and the experiment was done at the plant pathology lab)

3.2.2 Bipolaris sorokiniana

The incidence of *Bipolaris sorokiniana* is presented in Table 1. From the study the highest incidence *Bipolaris sorokiniana* was found in the treatment of (BARI Gom23; 3.08%) that was statistically similar with (BARI Gom25, 2.50%) and (BARI Gom24; 2.58%). The lowest incidence was observed in the treatment of (BARI Gom28; .50%).

3.2.3 *Aspergillus* sp.

The incidence of *Aspergillus sp.* is presented in Table 1. It is observed that maximum percentage of *Aspergillus sp.* was associated with the treatment of (BARI Gom26; 7.83%). The minimum percentage in (BARI Gom 28; 1.16%), which was statistically similar to the (BARI Gom 29; 1.75%), (BARI Gom 22; 1.92%), (BARI Gom 27; 2.08%).

3.2.4 *Alternaria* sp.

The incidence of *Alternaria sp.* I show in Table 1. The maximum association of *Alternaria sp* was observered in the treatments of (BARI Gom26; 10.33%) that was statistically similar with (BARI Gom25; 7.83%) and (BARI Gom24; 9.25%). The minimum incidence of *Alternaria* sp was in the (BARI Gom28; 2.00%).

3.2.5 *Rhizophus* sp.

The incidence of *Rhizophus sp.* is presented in Table 1. The maximum incidence of *Rhizophus sp.* was found in (BARI Gom26; 4.66%) that was similar with (BARI Gom23; 4.00%) and (BARI Gom24; 4.00%). The minimum *Rhizophus* sp incidence was observed in (BARI Gom27; 1.25%) and (BARI Gom28; 1.25%).

3.2.6 *Curvularia* sp.

The incidence of *Curvularia sp.* is illustrated in Table 1. The minimum incidence of *Culvolaria sp.* was recorded in the treatment of (BARI Gom28; 1.25%) that was similar with (BARI Gom27; 1.33%). The maximum incidence of these fungi was found in the treatment of (BARI Gom24; 7.25%).

3.2.7 Magnaporthe oryzae triticum

The incidence of *Magnaporthe oryzae triticum* is presented in Table 1. The highest incidence was observed in (BARI Gom24; 7.33%) that was statistically similar to (BARI Gom23; 6.83%). The lowest was in (BARI Gom22; 2.00%) which was statistically identical to (BARI Gom28; 2.28%).

3.3 Crop Health and Grain Yield of Wheat

3.3.1 Evaluation of different treatments on germination of seed in field condition

The germination percentage of seeds under different treatments was recorded at 4, 7 and 14 days after sowing (Table 2).

At, 5 DAS, statistically the maximum germination was observed in T_2 (BARI Gom22; 81.11%) that was statistically similar to T_7 (BARI Gom27; 67.78%), T_8 (BARI Gom28; 59.99%), T_9 (BARI Gom29; 66.67%). On the other hand the minimum data was recorded was for T_6 (BARI Gom26; 36.66%). In case of 7 DAS the highest germination percentage recorded at T_2 (BARI Gom22; 86.66%) followed by T_9 (BARI Gom29; 73.33%), T_8 (BARI Gom28; 71.11%), T_1 (BARI Gom19; 71.11%). The lowest was found in T_6 (BARI Gom26; 51.12%). At 14 DAS, statistically the maximum result was recorded in T_2 (BARI Gom22; 88.88%) and T_9 (BARI Gom29; 85.55%). The minimum was recorded in T_6 (BARI Gom26; 64.44%).

3.3.2 Evaluation of different treatments on disease incidence of wheat blast in field condition

Disease incidence of rice blast at 45, 60 and 75 days after sowing (DAS) under different treatments (variety) were observed and presented in the Table 3.

At 45 DAS, the highest disease incidence was recorded in T_6 (BARI Gom26; 43.33%) and the lowest disease incidence was recorded from T_8 (BARI Gom28; 15.33) which was statistically similar with T_2 (BARI Gom22; 17.33%). At 60 DAS, statistically significant variation was found in different plot. The highest disease incidence was recorded T_6 (BARI Gom26; 53.33%) and lowest in T_8 (BARI Gom28; 17.33%) that was similar with T_7 (BARI Gom27; 20.00%) and T_2 (BARI Gom22; 20.00%). At 75 DAS, different treatment showed a remarkable variation in disease incidence of wheat blast. The highest disease incidence was recorded in T_6 (BARI Gom26; 66.667%) and the lowest was recorded from T_8 (BARI Gom28; 21.66%) that was statistically similar with T_2 (BARI Gom22; 24.33%).

3.3.3 Evaluation of different treatments on disease severity of wheat blast in field condition

Disease severity of wheat blast at three different days after sowing (DAS) under different treatments were observed and presented in the Table 4. All the treatments resulted significant effect on blast disease control.

At 45 DAS, the maximum disease severity was recorded in T_6 (BARI Gom26; 53.33%) which was statistically similar to T_4 (BARI Gom24; 46.67%). Minimum blast severity was recorded at T_2 (BARI Gom22; 20.00%) that was statistically similar with T_8 (BARI Gom28; 23.33%) and T_9 (BARI Gom29; 25%). At 60 DAS highest severity was recorded in T_6 (BARI Gom26; 71.66%) that was statistically similar with T_4 (BARI Gom24; 63.33%) and lowest severity was recorded in T_8 (BARI Gom28; 28.33%). After T_2 (BARI Gom22; 30%), T_9 (BARI Gom29; 36.66%) significantly reduced blast severity at 60DAS. At 55 DAS, disease severity was minimum in T_8 (BARI Gom28; 30.00%). T_2 (BARI Gom22; 36.66%) showed statistically similar result with T_7 (BARI Gom27; 36.66%). On the other hand, Maximum severity was found in T_6 (BARI Gom26; 78.33%).

3.3.4 Performance of different treatments on yield and yield contributing attributes

3.3.4.1 Plant height (cm)

The effect of different treatments on plant height were observed and presented in the Table 5. From the experiment we found that treatment significantly affected the height of the wheat plant. The maximum height of the wheat plant was observed in T_8 (BARI Gom28, 82.96).

3.3.4.2 Spikelet per panicle

Spikelet is the main yield contributing attribute of wheat plant. If the number of spikelets is higher in each panicle, yield will be maximum. From the results of the experiment it is revealed that all the treatments have significant effect in number of spikelets per panicle. In this case T_8 (BARI Gom28, 19.73) resulted highest number of spikelets per panicle. It is also statistically similar to T_2 (BARI Gom22, 17.83). The lowest number of spikelets was recorded in T_6 (BARI Gom26, 9.33) (Table 5).

3.3.4.3 No. of effective tiller per hill

There was no difference observed among the treatments in number of effective tillers per plant (Table 5).

Table 1. Prevalence of stored seed borne fungi from collected seed samples

No. of variety	*Fusarium oxysporum*	*Bipolaris sorokiniana*	*Aspergillus sp*	*Alternaria sp*	*Rhizophus sp*	*Culvolaria sp*	*Magnaporthe oryzae*
1	4.00 c	2.25 bc	4.58 c	4.33 cde	2.58 bcd	2.83 cde	4.83 bcd
2	1.91 de	1.91 bc	1.92 de	5.91 bcd	1.58 cd	1.75 de	2.00 e
3	6.50 ab	3.08 a	6.50 b	7.16 abc	4.00 ab	3.66 bcd	6.83 ab
4	6.58 ab	2.58 ab	6.58 b	9.25 ab	4.00 ab	7.25 a	7.33 a
5	5.91 b	2.50 ab	5.91 b	7.83 ab	3.00 bc	4.50 bc	3.91 cde
6	7.83 a	2.58 ab	7.83 a	10.33 a	4.66 a	5.66 ab	5.50 abc
7	2.08 de	1.50 c	2.08 de	3.91 cde	1.25 d	1.91 de	3.08 cde
8	1.16 e	.50 d	1.16 e	2.00 e	1.25 d	1.25 e	2.25 e
9	1.75 de	1.50 c	1.75 de	2.66 de	2.33 cd	1.33 e	3.16 cde
10	2.75 cd	2.58 ab	2.75 d	3.75 de	2.75 bcd	1.91 de	2.83 de
CV	22.82	21.51	17.77	34.80	33.54	42.53	35.13
LSD	1.50	.76	1.24	3.38	1.50	2.32	2.49

Note: Different letter (s) in the same column showed the significant difference at 0.05 level of probability

Table 2. Effect of treatments on the germination of seeds

Treatments	Germination (%)		
	4 DAS	**7 DAS**	**14 DAS**
T_1 (BARI Gom19)	56.66 bcd	71.11 b	78.88 abc
T_2(BARI Gom22)	81.11 a	86.66 a	88.88 a
T_3(BARI Gom23)	41.11 cd	61.10 bcd	66.66 d
T_4(BARI Gom24)	39.99 cd	56.66 cd	68.88 cd
T_5(BARI Gom25)	39.99 cd	62.22 bcd	72.22 bcd
T_6(BARI Gom26)	36.66 d	51.12 d	64.44 d
T_7(BARI Gom27)	67.78 ab	73.33 b	81.11 ab
T_8(BARI Gom28)	59.99 abc	71.11 b	78.88 abc
T_9(BARI Gom29)	66.67 ab	73.33 b	85.55 a
T_{10}(BARI Gom30)	53.33 bcd	65.55 bc	73.33 bcd
LSD (0.05%)	22.46	13.14	10.30
CV	24.10	11.34	7.92

Note: Different letter (s) in the same column showed the significant difference at 0.05 level of probability

Table 3. Effect of treatment on the incidence of blast disease of wheat

Treatments	Disease incidence (%)		
	45 DAS	**60 DAS**	**75 DAS**
T_1 (BARI Gom19)	23.33 f	26.67 d	33.33 de
T_2(BARI Gom22)	17.33 h	20.00 e	24.33 fg
T_3(BARI Gom23)	33.33 c	40.00 c	46.67 c
T_4(BARI Gom24)	40.00 b	46.67 b	53.33 b
T_5(BARI Gom25)	30.00 d	36.67 c	43.33 c
T_6(BARI Gom26)	43.33 a	53.33 a	66.67 a
T_7(BARI Gom27)	20.00 g	20.00 e	25.33 f
T_8(BARI Gom28)	15.33 h	17.33 e	21.66 g
T_9(BARI Gom29)	26.67 e	26.67 d	30.00 e
T_{10}(BARI Gom30)	26.67 e	30.00 d	36.67 d
LSD (0.05)	2.50	3.74	3.35
CV	5.29	6.88	5.12

Note: Different letter (s) in the same column showed the significant difference at 0.05 level of probability

Table 4. Effect of treatment on the severity of blast disease of wheat

Treatments	Disease severity (%)		
	45 DAS	**60 DAS**	**75 DAS**
T_1 (BARI Gom19)	35.00 cd	46.67 c	51.67 c
T_2(BARI Gom22)	20.00 g	30.00 e	36.67 ef
T_3(BARI Gom23)	36.67 cd	60.00 b	70.00 ab
T_4(BARI Gom24)	46.67 ab	63.33 ab	66.67 b
T_5(BARI Gom25)	40.00 bc	56.67 b	63.33 b
T_6(BARI Gom26)	53.33 a	71.67 a	78.33 a
T_7(BARI Gom27)	30.00 def	43.33 cd	36.67 ef
T_8(BARI Gom28)	23.33 fg	28.33 e	30.00 f
T_9(BARI Gom29)	25.00 efg	36.67 de	41.67 de
T_{10}(BARI Gom30)	33.33 cde	46.67 c	50.00 cd
LSD (0.05)	8.68	8.78	9.23
CV	14.75	10.59	10.25

Note: Different letter (s) in the same column showed the significant difference at 0.05 level of probability

3.3.4.4 Number of grains per spike

The number of grains per spike was playing an important role to increase yield. From the results of experiments, it is found that all the treatments have significant effect in number of grains per spike. The highest number of grains per spike was recorded in T_8 (BARI Gom28, 47%) that was

Table 5. Effect of different treatments on yield and yield contributing attributes

Treatments	Plant height (cm)	Number of panicle/spikelets	Number of effective tiller/plants	Number of grain/spikes	Wt. of 1000 grain	Yield kg/plot	Yield ton/ha
T_1 (BARI Gom19)	80.00 a	15.00 bcd	5.00 a	42.00 abc	40.86 ab	.083 f	2.4
T_2(BARI Gom22)	82.53 a	17.83 ab	5.00 a	46.33 a	44.20 a	.170 b	5.1
T_3(BARI Gom23)	73.10 b	12.66 def	3.66 ab	37.00 c	35.06 b	.059 g	1.7
T_4(BARI Gom24)	81.63 a	11.33 ef	3.66 ab	39.00 bc	37.60 b	.061 g	1.8
T_5(BARI Gom25)	74.50 b	13.33 cde	4.00 ab	39.66 bc	40.80 ab	.075 f	2.2
T_6(BARI Gom26)	79.63 a	9.33 f	3.00 b	38.33 bc	37.23 b	.054 g	1.6
T_7(BARI Gom27)	82.26 a	16.73 abc	4.00 ab	44.00 ab	40.90 ab	.117 d	3.5
T_8(BARI Gom28)	82.96 a	19.73 a	4.66 a	47.00 a	45.36 a	.183 a	5.5
T_9(BARI Gom29)	79.33 a	16.33 abc	4.00 ab	44.33 ab	40.86 ab	.125 c	3.7
T_{10}(BARI Gom30)	74.10 a	15.00 bcd	4.66 a	42.00 abc	39.80 ab	.099 e	2.9
LSD (0.05)	3.84	3.56	1.34	6.64	6.35	.007	
CV	2.83	14.09	18.97	9.23	9.20	4.47	

Note: Different letter (s) in the same column showed the significant difference at 0.05 level of probability similar to T_2 (BARI Gom22, 46.33%) and the lowest data was recorded in T_6 (BARI Gom26, 38.33%) (Table 5).

3.3.4.5 Weight of 1000 (g) grain

The highest grain weight of 1000(g) wheat was observed in T_8 (BARI Gom28, 45.36 g) that was statistically similar to T_2 (BARI Gom22, 44.20 g). The lowest grain weight observed in T_3 (BARI Gom23, 35.06 g) (Table 5).

3.3.4.6 Yield

The grain yield was statistically different from one variety to another variety. The minimum yield was recorded in T_6 (BARI Gom26, 1.6-ton ha^{-1}) and maximum was found in T_8 (BARI Gom28, 5.5-ton ha^{-1}). Yield differed among the varieties due to disease severity, lower number of spikelet's per panicle, lower number of grains per spike, weather factors (Table 5).

4. DISCUSSION

The seed sample was collected from the Regional Agricultural Research Station (RARS), Jessore viz., BARI Gom19, BARI Gom22, BARI Gom23, BARI Gom24, BARI Gom25, BARI Gom26, BARI Gom27, BARI Gom28, BARI Gom29 and BARI Gom30. From the study, moisture content of four sample seeds were 12% but rest of them were less than 12%. On the other hand, germination percentage was tested and it varied from 90% to 96% also seedling percentage varied from treatment to treatment. Review of this research showed that higher healthy seedling was found from BARI Gom28 [17] conducted an experiment to characterize the presence of blast sign and symptoms on basal leaves of the wheat. He worked on four wheat cultivars (Karl 92, Everest, Bobwhite, and Fielder) and five *Magnaporthe oryzae Triticeae* (T-25, B-102, B-108, and B-103, and B-113) strain. Among all the cultivar, Karl 92 showed susceptibility to blast. Isolate B-103 affected higher percentage of the cultivar seedling. From the results of the field experiment it was established that among all the varieties BARI Gom28 showed the best result in reducing the disease incidence. In the field experiment the lowest disease incidence (15.33% DAS, 17.33% DAS, 21.66% DAS) was recorded in the BARI Gom28. The findings also showed similar result of Urashima et al., (2009) and reported that the BRS208 presented significant higher disease incidence (76.2%) comprising an average of 315.7 heads with blast symptom whereas CD104 had 32.0% which corresponded to 121.8 heads. The higher disease susceptibility of BRS208 was also visible when severity was examined. From the experiment, it was also found that the lowest blast disease severity was recorded in BARI Gom28 (23.33% DAS, 28.33% DAS, 30.00% DAS). The variety of BARI Gom28 showed significant result and the incidence of blast is comparatively lower and increases the yield. Here BARI Gom28 is moderately resistance against blast and increase grain yield with lower disease incidence and severity.

5. CONCLUSION

Wheat is an important cereal crop in Bangladesh. But Wheat blast disease has become a serious on production of the crop. Under favorable climatic condition it caused 100% yield loss also. Now-a-days it is a great problem in our country. So, it is necessary to development blast resistant variety.

Screening of these ten varieties, it was found that BARI Gom28 showed moderately resistant against Blast. From the result of the present study among all the varieties, BARI Gom28 provided the highest germination percentage in field condition and reduced the blast disease incidence and severity to a greater extent. BARI Gom22 also could reduce disease incidence and produced satisfactory yield.

Results from the present investigation suggest that, BARI Gom28 is moderately resistant variety to control blast. It provided highest germination rate, reduced disease incidence and severity and gave satisfactory yield. The obtained results are applicable for SAU farm area at Sylhet. These results do not reflect the performance of the varieties for the whole country. In future, further studies need to conduct the effectiveness of the varieties to control blast disease at different field condition.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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