

VARIETAL SCREENING OF WHEAT AGAINST BLAST DISEASE

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 variety. The study was carried out at the experimental field and laboratory condition of Plant Pathology and Seed Science Department, Sylhet Agricultural University, Sylhet during October to March (2016-2017). The seeds were collected from the Regional Agricultural Research Station, Jessore. Here, 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 laboratory condition, different fungal pathogens like *Fusarium oxysporum*, *Bipolaris sorokiniana*, *Aspergillus sp.*, *Alternaria sp.*, *Rhizopus sp.*, *Curvularia sp.* and *Magnaporthe oryzae* *Triticum* were detected by standard blotter method. In the field condition, it was found that BARI Gom28 was moderately resistant against blast. The lowest disease incidence (21.66%), lowest severity (30%) was found in BARI Gom28 and also found 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. The result of present studies suggested that BARI Gom28 is the best variety among all the varieties to as resistance to wheat blast.

Keywords: Wheat, Blast disease, Ten varieties, Seed borne pathogen, Seed health status

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is 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 is second major cereal crop in Bangladesh, but the yield of wheat is too low in comparison to the world wheat production. In 2014-15, 436822.1338 hectors land was under cultivation and total yield of grains was 13, 47,926 Metric ton [2]. But in 2015-16, 444805 hectors land cultivated and total yield of grains was 13,48,186 M. ton. [3]. The average yield rate of wheat is 1.78% lower than last year but the total production is .02% higher than last year [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 production of wheat is low due to the many reasons and among them abnormality in seed is a major constraint [5]. Wheat is suffered by as much as 120 different diseases, among them, 42 are seed borne and fungi cause 35 diseases [6]. Among of these diseases blast is the most devastating problem of wheat that causes 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].

This first incidence of wheat blast affected approximately 15% of Bangladesh's total wheat area. Comparative genome analyses showed that fungal isolates from diverse wheat region

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 in different affected districts varied. 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 has not originated 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 that cause huge losses and the main constraint against the successful Wheat (*Triticum aestivum* L.) 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 variety.

2. MATERIAL 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 experimental unit.

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 by 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 the petridish (9 cm diameter). Twenty-five seeds were taken for each of the eight petridish and placed in moist filter paper within the petridish. The petridish with the seeds were then incubated at room temperature (25 ± 2 °C) at incubation chamber of the laboratory for seven days.

After seven days of incubation, each seed was observed under stereo-binocular microscope at 25X magnification in order to record the presence of seed borne fungal pathogens and 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 compound microscope. The results were expressed in percentage.

2.4 Germination test

Germination percentage was determined by blotter paper method. Seeds were plated in the plastic petridish 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 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.

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 24°54'N to 33.67" latitude and 91°54' 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 Completely Block Design (RCBD) with 3 replications. There were 30-unit plot altogether in the experiment. The size of each plot was 1m².

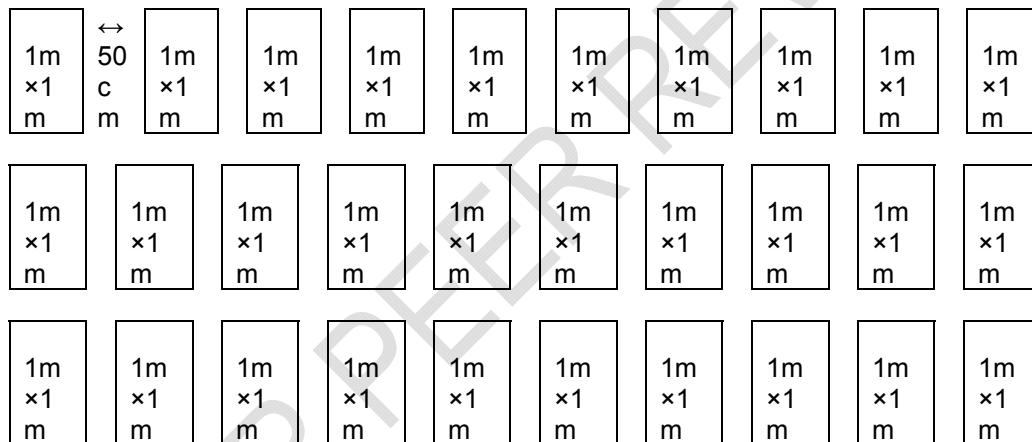


Fig. 1: Layout of experimental field

2.7 Preparation of land

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

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.

2.8.3 Irrigation and drainage

Two irrigation were applied, the first irrigation after 20 days of the sowing at crown root initiation (CRI), the second one at 50 days at heading stage. Excess water of the field was drained out.

2.9 Treatments of the experiment

There were ten treatments 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 experiment plots were being monitored after 10 days of interval for the first appearance of blast disease. The incidence of disease was recorded for three times (45, 60 and 75 DAS). The infected plant was identified by comparing its symptoms critically 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.

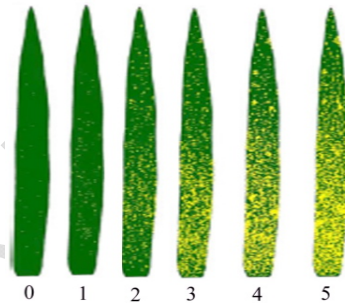


Plate 1: Disease severity rating of wheat blast

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

Formula [15].

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

2.12 Harvesting and Recording of Data

The crop was harvested at full ripening stage. 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 find out the significant difference among the treatment. 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 figure 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.

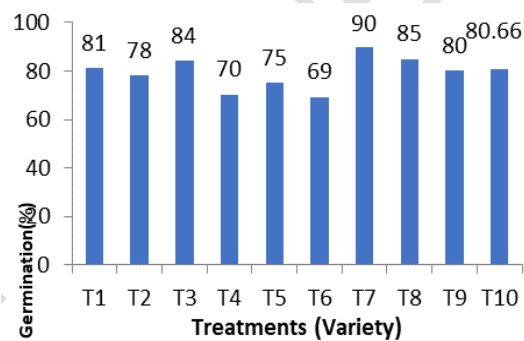
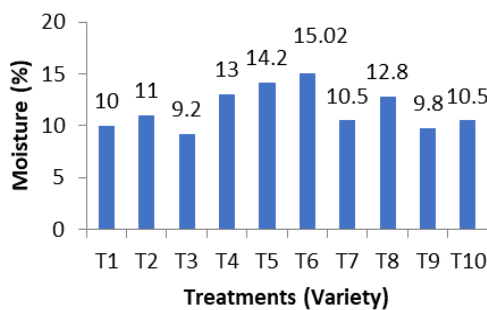


Fig. 2: Moisture (%) of the collected seeds Fig. 3: Germination (%) of wheat varieties

3.1.2 Performance of different varieties on germination of wheat seeds

Results on different treatments on germination percentage are presented in Fig. 2. The highest germination was recorded in treatment T₇ (BARI Gom27, 90%) which was statistically identical to T₈ (BARI Gom28, 85%) and T₃ (BARI Gom23, 84%). The lowest germination percentage was recorded in T₆ (BARI Gom26, 69%) that was statistically similar with T₄ (BARI Gom24, 70%).

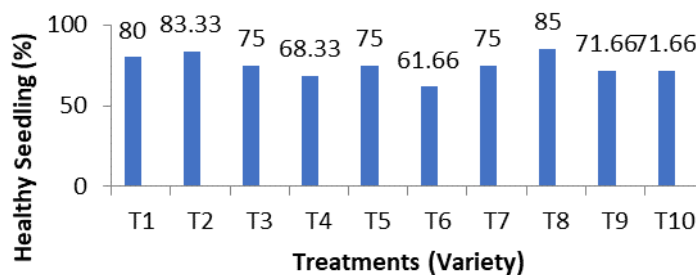


Fig. 4: Healthy seedling percentage of wheat varieties

3.1.3 Health status of emerged seedling

The healthy seedling showed significant difference among the treatments (Figure 3). The highest healthy seedling was recorded in T₈ (BARI Gom 28; 85%) and statistically similar results were also observed in T₂ (BARI Gom 22; 83%). The lowest healthy seedling was

recorded in the treatment of T₆ (BARI Gom26; 61.66%) that was statistically similar with the T₄ (BARI Gom24; 68.33%).

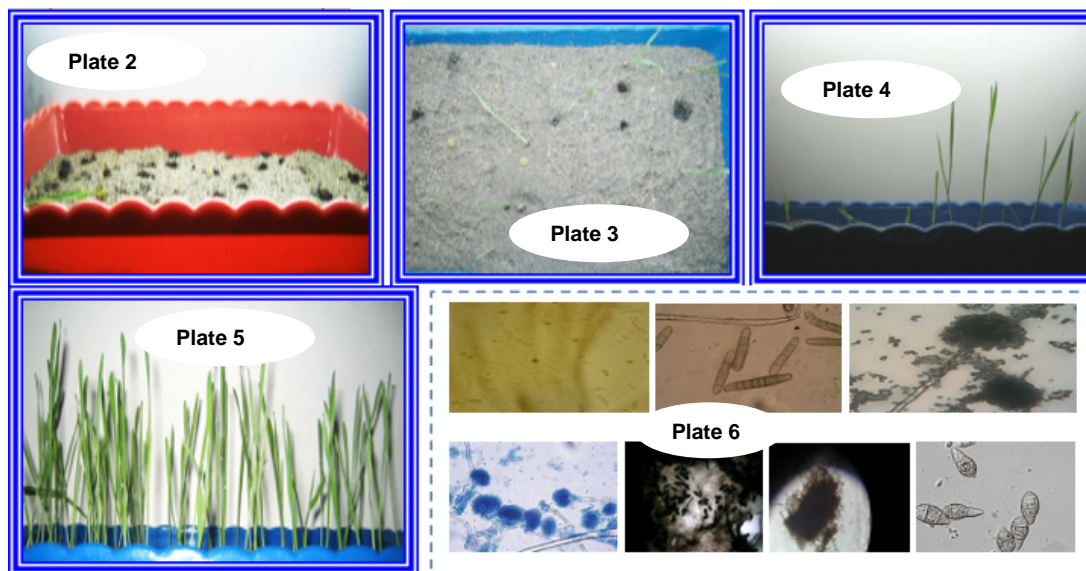


Fig. 5: Plate 2: Germination of infected seed, Plate 3: Germination of blast infected dead seeds, Plate 4: Germination of blast infected seedling, Plate 5: Germination of normal seedling, Plate 6. Conidia of detected fungi under stereo and compound microscope

3.2 ASSOCIATION OF SEED BORNE FUNGI IN DIFFERENT WHEAT VARIETIES

3.2.1 *Fusarium oxysporum*

The present 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 T₆ (BARI Gom26, 7.83%) which was statistically similar the treatment of T₄ (BARI Gom24, 6.58%) and T₃ (BARI Gom23, 6.50%). The lowest infection was found in the treatments of T₈ (BARI Gom 28, 1.17%) and T₉ (BARI Gom 29, 1.75%).

3.2.2 *Bipolaris sorokiniana*

The incidence of *Bipolaris sorokiniana* has been presented in table 1. From the study the highest incidence *Bipolaris sorokiniana* was found in the treatment of T₃ (BARI Gom23; 3.08%) that was statistically similar with T₅ (BARI Gom25, 2.50%) and T₄ (BARI Gom24; 2.58%). The lowest incidence was observed in the treatment of T₈ (BARI Gom28; .50%).

3.2.3 *Aspergillus sp.*

The incidence of *Aspergillus sp.* has been presented in table 1. It is observed that maximum percentage of *Aspergillus sp.* was associated with the treatment of T₆ (BARI Gom26; 7.83%). The minimum percentage in T₈ (BARI Gom 28; 1.16%), which was statistically similar to the T₉ (BARI Gom 29; 1.75%), T₂ (BARI Gom 22; 1.92%), T₇ (BARI Gom 27; 2.08%).

3.2.4 *Alternaria sp.*

The incidence of *Alternaria sp.* has been showed in table 1. The maximum association of *Alternaria sp* was observed in the treatments of T₆ (BARI Gom26; 10.33%) that was statistically similar with T₅ (BARI Gom25; 7.83%) and T₄ (BARI Gom24; 9.25%). The minimum incidence of *Alternaria sp* was in the T₈ (BARI Gom28; 2.00%).

3.2.5 *Rhizophus sp.*

The incidence of *Rhizopus sp.* has been presented in table 1. The maximum incidence of *Rhizopus sp.* was found in T₆ (BARI Gom26; 4.66%) that was similar with T₃ (BARI Gom23; 4.00%) and T₄ (BARI Gom24; 4.00%). The minimum *Rhizopus sp.* incidence was observed in T₇ (BARI Gom27; 1.25%) and T₈ (BARI Gom28; 1.25%).

3.2.6 *Curvularia sp*

The incidence of *Curvularia sp.* has been illustrated in table 1. The minimum incidence of *Curvularia sp.* was recorded in the treatment of T₈ (BARI Gom28; 1.25%) that was similar with T₇ (BARI Gom27; 1.33%). The maximum incidence of these fungi was found in the treatment of T₄ (BARI Gom24; 7.25%).

3.2.7 *Magnaporthe oryzae triticum*

The incidence of *Magnaporthe oryzae triticum* has been presented in table 1. The highest incidence was observed in T₄ (BARI Gom24; 7.33%) that was statistically similar to T₃ (BARI Gom23; 6.83%). The lowest was in T₂ (BARI Gom22; 2.00%) which was statistically identical to T₈ (BARI Gom28; 2.28%).

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

| No. of variety | <i>Fusarium oxysporum</i> | <i>Bipolaris sorokiniana</i> | <i>Aspergillus sp</i> | <i>Alternaria sp</i> | <i>Rhizopus sp</i> | <i>Curvularia sp</i> | <i>Magnaporthe oryzae</i> |
|----------------|---------------------------|------------------------------|-----------------------|----------------------|--------------------|----------------------|---------------------------|
| 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

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 T₂ (BARI Gom22; 81.11%) that was statistically similar to T₇ (BARI Gom27; 67.78%), T₈ (BARI Gom28; 59.99%), T₉ (BARI Gom29; 66.67%). On the other hand the minimum data was recorded was for T₆ (BARI Gom26; 36.66%). In case of 7 DAS the highest germination percentage recorded at T₂ (BARI Gom22; 86.66%) followed by T₉ (BARI Gom29; 73.33%), T₈ (BARI Gom28; 71.11%), T₁ (BARI Gom19; 71.11%). The lowest was found in T₆ (BARI Gom26; 51.12%). At 14 DAS, statistically the maximum result was recorded in T₂ (BARI Gom22; 88.88%) and T₉ (BARI Gom29; 85.55%). The minimum was recorded in T₆ (BARI Gom26; 64.44%).

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.

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 T₆ (BARI Gom26; 43.33%) and the lowest disease incidence was recorded from T₈ (BARI Gom28; 15.33) which was statistically similar with T₂ (BARI Gom22; 17.33%). At 60 DAS, statistically significant variation was found in different plot. The highest disease incidence was recorded T₆ (BARI Gom26; 53.33%) and lowest in T₈ (BARI Gom28; 17.33%) that was similar with T₇ (BARI Gom27; 20.00%) and T₂ (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 T₆ (BARI Gom26; 66.667%) and the lowest was recorded from T₈ (BARI Gom28; 21.66%) that was statistically similar with T₂ (BARI Gom22; 24.33%).

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

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 T₆ (BARI Gom26; 53.33%) which was statistically similar to T₄ (BARI Gom24; 46.67%). Minimum blast severity was recorded at T₂ (BARI Gom22; 20.00%) that was statistically similar with T₈ (BARI Gom28; 23.33%) and T₉ (BARI Gom29; 25%). At 60 DAS highest severity was recorded in T₆ (BARI Gom26; 71.66%) that was statistically similar with T₄ (BARI Gom24; 63.33%) and lowest severity was recorded in T₈ (BARI Gom28; 28.33%). After T₂ (BARI Gom22; 30%), T₉ (BARI Gom29; 36.66%) significantly reduced blast severity at 60DAS. At 55 DAS, disease severity was minimum in T₈ (BARI Gom28; 30.00%). T₂ (BARI Gom22; 36.66%) showed statistically similar result with T₇ (BARI Gom27; 36.66%). On the other hand, Maximum severity was found in T₆ (BARI Gom26; 78.33%).

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 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 T₈ (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 T₈ (BARI Gom28, 19.73) resulted highest number of spikelets per panicle. It is also statistically similar to T₂ (BARI Gom22, 17.83). The lowest number of spikelets was recorded in T₆ (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).

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 T₈ (BARI Gom28, 47%) that was similar to T₂ (BARI Gom22, 46.33%) and the lowest data was recorded in T₆ (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 T₈ (BARI Gom28, 45.36 g) that was statistically similar to T₂ (BARI Gom22, 44.20 g). The lowest grain weight observed in T₃ (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 T₆ (BARI Gom26, 1.6-ton ha⁻¹) and maximum was found in T₈ (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).

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.

4. DISCUSSION

The collected seed samples viz., BARI Gom19, BARI Gom22, BARI Gom23, BARI Gom24, BARI Gom25, BARI Gom26, BARI Gom27, BARI Gom28, BARI Gom29 and BARI Gom30 collected from the Regional Agricultural Research Station (RARS), Jessore. The moisture content of the sample seeds of the varieties measured and it showed that 4 samples had moisture content more than 12% but remaining 6 samples had less than 12% moisture content. Germination percentages of the seeds were tested under the laboratory condition. Percent germination was varied from 90% to 69%. Healthy seedling percentage of the collected seeds was tested under the laboratory condition. The seedling percentage was varied from treatment to treatment. From the study 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. In this experiment ten wheat varieties were tested against blast disease to find out the resistant variety controlling the pathogen. In the field *Magnaporthe oryzae* affected seeds were sown to observe incidence and severity of blast disease. From the results of the field experiment it was established that some of the varieties have effectiveness against blast.

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. Urashima *et al.*, (2009) 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). Along with the all yield contributing characters yield was assessed and compared within the varieties. 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.

REFERENCES

1. FAO 2016: World food situation: FAO cereal supply and demand brief. FAO, Rome, Italy.
2. BBS (Bangladesh Bureau of Statistics) 2015: Statistical year book of Bangladesh. Ministry of Planning, Government of people's Republic of Bangladesh.
3. BBS (Bangladesh Bureau of Statistics) 2016: Statistical year book of Bangladesh. Ministry of Planning, Government of people's Republic of Bangladesh.
4. Godfray HC, Beddington JR, Crute IR, Haddad L, Lawrence D, Muir JF, Pretty J, Robinson S, Thomas SM, Toulmin C 2010: "Food security: The challenge of feeding 9 billion people". *Science* **327** (5967) 812.
5. Enikuomhin OA 2005: Seed abnormalities and associated mycoflora of rain-fed wheat (*Triticum aestivum* L.) in South Western Nigeria. *African Journal of Biotechnology* **4**(7) 672-675.
6. Hasan MM, Chowdhury SP, Alam S, Hossain B, Alam MS 2005: Antifungal effects of plant extracts on seed-borne fungi of wheat seed regarding seed germination, seedling healthy and vigor index. *Pakistan Journal of Biological Science* **8**(9) 1284-1289.
7. Couch B, Kohn L 2002: A multilocus gene genealogy concordant with host preference indicates segregation of a new species, *Magnaporthe oryzae*, from *M. grisea*. *Mycologia* **94** 683–693.
8. Murakami J, Tosa Y, Kataoka T, Tomita R, Kawasaki J, Chuma I, Sesumi Y, Kusaba M, Nakayashiki H, Matama S 2000: Analysis of host species specificity of *Magnaporthe grisea* toward wheat using a genetic cross between isolates from wheat and foxtail millet. *Phytopathology* **90**(10) 1060–1067
9. Farman M, Peterson GL, Chen L, Starnes JH, Valent B, Bachi P, Murdock L, Hershman DE, Pedley KF, Fernandes JMC, Bavaresco J 2017: The *Lolium* pathotype of *Magnaporthe oryzae* recovered from a single blasted wheat plant in the United States. *Plant Disease* **101** 684– 692.
10. Islam MT, Croll D, Gladioux P, Soanes DM, Persoons A, Bhattacharjee P, Hossain MS, 2016: Emergence of wheat blast in Bangladesh was caused by a South American lineage of *Magnaporthe oryzae*. *BMC Biology* **14**(1) 84.
11. Goulart ACP, Sousa PG, Urashima AS 2007: Damages in wheat caused by infection of *Pyricularia grisea*. *Summa Phytopathology* **33** 358–363.

12. Urashima AS, Galbieri R, Stabili A 2005: DNA fingerprinting and sexual characterization revealed two distinct populations of *Magnaporthe oryzae* in wheat blast from Brazil. *Czech Journal of Plant Breeding* **41** 238-245.
13. Goulart ACP, Paiva FA 1992: Wheat yield losses due to *Pyricularia oryzae* in the 1988–91 periods in Mato Grosso do Sul (Abstr.). *Fitopatologia Brasileira* **17** 171.
14. Ceresini PC, Maciel JL, Kohn L, Levy M, McDonald BA 2011: A `de novo` origin for the wheat-adapted populations of *Magnaporthe oryzae* in Southern Brazil and levels of gene flow 20 years after the first epidemics. *Phytopathology* **101** 221.
15. Haque MS, Rahman ML, Malek MA 1994: Effect of fungicides and number of sprays on cercospora leaf spot of mungbean. *Bangladesh journal of Plant Pathology* **10** 3-4
16. Gomez and Gomez 1984: *Statistical procedures for agricultural research*. Jhon Wiely and Sons, New York.
17. Cruz CD, Kiyuna J, Bockus WW, Baldelomar DF, Todd TC, Stack JP, Valent B 2015: *Magnaporthe oryzae* conidia on basal wheat leaves as a potential source of wheat blast inoculum. *Plant Pathology* **64**(6) 1491-1498.