World Journal of Agricultural Sciences 3 (3): 306-315, 2007
ISSN 1817-3047


# Effect of Physical and Chemical Seed Treatments on Leaf Spot (*Bipolaris sorokiniana*) and Yield of Wheat

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**Abstract:** Experiment was conducted at the Farm of Sher-e-Bangla Agricultural University, Dhaka during the period from December 2005 to April 2006 to study the effect of physical and chemical seed treatments on leaf spot (*Bipolaris sorokiniana*) and yield of wheat.There were ten treatments viz. farmer's stored seed ($T_1$), apparently healthy seed ($T_2$), farmer's stored seed treated with Vitavax-200 @ 0.4% ($T_3$), apparently healthy seed treated with Vitavax-200 @ 0.4% ($T_4$), farmer's stored seed washed with water ($T_5$), apparently healthy seed washed with water ($T_6$), farmer's stored seed treated with brine solution @ 2% ($T_7$), apparently healthy seed treated with brine solution @ 2% ($T_8$), washed farmer's stored seed treated with brine solution @ 2% ($T_9$) and washed apparently healthy seed treated with brine solution @ 2% ($T_{10}$). Physical and chemical seed treatments increased seed germination and suppressed the incidence of *Bipolaris sorokiniana* in the laboratory. The highest germination was counted 84.20% and 86.08% respectively at 10 and 15 DAS in the treatment $T_4$ and the lowest germination 49.84% and 55.54% at 10 and 15 DAS, respectively was recorded in the treatment $T_1$ that served as control. The lowest disease severity recorded at panicle initiation stage, flowering stage, milking stage and hard dough stage under the treatment $T_4$, which were 0.05, 0.19, 0.36 and 0.84, respectively. On the other hand the highest disease severity were recorded at panicle initiation stage, flowering stage, milking stage and hard dough stage under the treatment $T_1$, which were 0.55, 1.21, 1.69 and 2.52, respectively. The highest grain yield (3.5 t $ha^{-1}$) was obtained in treatment $T_4$, which was 75% increased over control ($T_1$). So, physically sorted apparently healthy seeds treated with Vitavax-200 may be recommended to suppress leaf spot (*Bipolaris sorokiniana*) with increasing grain yield of wheat.

**Key words:** Seed treatment · leaf spot · *Bipolaris sorokiniana* · wheat · yield

## INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops in the world. About two third of the world population use wheat as staple food [1]. It is cosidered the second most important cereal crop next to rice in Bangladesh. Though the crop has been introduced in 1961 in the country, its popularity has gained after 1975. Since initiation of HYV wheat expansion program in 1974, the area as well as yield has increased manifold [2]. Though the cultivated area, production and yield rate of wheat have been increasing dramatically during the last decade, the wheat production and yield rate in Bangladesh is too low (2.2 t $ha^{-1}$) in comparison to the other countries of the world like Japan, France, Germany and UK producing 3.76, 7.12, 7.28 and 8.00 t $ha^{-1}$, respectively [3].

There are many constraints responsible for low yield of wheat in Bangladesh. Among the different factors that affect the production of wheat, use of unhealthy or diseased seeds is one of the major constraints. Government and semi government organizations supply only 22.8 % of the total wheat seed required during 1998-1999 [4]. These seeds are treated as quality seeds in Bangladesh. The rest 77.2 % of the seeds produced traditionally by the farmers with no or little care even for purity and germination and remain out of scope of certification. As a result, a huge crop loss is incurred every year in wheat due to seed diseases in the country. Seed borne disease causes enormous losses to our crop [5]. Seed carries large number of destructive pathogens. Wheat is suffering from as many as 26 seed borne diseases [6]. Among the diseases, leaf spot caused by *Bipolaris sorokiniana* (Sacc. In sork.) is considered to be a threat to wheat cultivation all over the world [7]. In Bangladesh, the disease is also considered as a common and devastating one [8]. In Bangladesh yield loss in wheat due to leaf spot

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disease has been reported to be 20% in Sonalika, while 14% and 8% in Akbar and Kanchan, respectively [9]. In farmer's field, the yield loss was estimated 14.97% [10], where up to 29% yield reduction was estimated during 1991-1992 in Kanchan [11]. Rashid and Fakir [12] estimated yield reduction of wheat due to *Bipolaris sorokiniana* as high as 57.6% and 64.5% in cvs. Kanchan and Sonalika, respectively at maximum disease incidence.

Easy and economic way of controlling seed borne diseases may be the use of clean, healthy looking and washed seeds. It may play an important role to minimize disease incidence and reducing entry of pathogens to the field. In a preliminary study, it has been found that, cleaning and washing farmer's seed reduces seedling diseases up to 53.87% over unclean farmer's seed [13]. Seed cleaning and washing are easy and practically feasible method for our poor farmer's [14]. This technique does not require much effort and is an alternative method of avoiding chemical fungicides and thus environment will be save from pollution. Now a day's scientists are giving more emphasis on sustainable technology for agriculture. It would be possible when ecologically sound, economically viable, culturally appropriate and socially acceptable technology will be adopted. Therefore, the present study has been undertaken to determine the effect of physical and chemical seed treatments on leaf spot (*Bipolaris sorokiniana*) and grain yield of wheat.

## MATERIALS AND METHODS

**Laboratory experiment:** The experiment was carried out in the Seed Health Laboratory, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. Wheat seeds of Kanchan variety were collected from a farmer named Md. Nurul Islam of Village Mahiarpur, Thana Mithapukur, District Rangpur, Bangladesh.

**Treatments:** There were ten treatments namely $T_1$ = Farmer's stored seed (control), $T_2$ = Apparently healthy seed, $T_3$ = Farmer's stored seed treated with vitavax-200 @ 0.4%, $T_4$ = Apparently healthy seed treated with vitavax-200 @ 0.4%, $T_5$ = Farmer's stored seed washed with water, $T_6$ = Apparently healthy seed washed with water, $T_7$ = Farmer's stored seed treated with brine solution @ 2%, $T_8$ = Apparently healthy seed treated with brine solution @ 2%, $T_9$ = Washed farmer's stored seed treated with brine solution @ 2%, $T_{10}$ = Washed apparently healthy seed treated with brine solution @ 2%.

**Preparation of the seed sample for different treatments:**
**Sorting of apparently healthy seeds:** Apparently healthy seeds were obtained by manual separation of seed contaminants, weed seeds, inert matter, other crop seeds, varietal mixture and black pointed seeds from the farmer stored seeds.

**Seed washing:** For washing 400 seeds were taken in conical flask and 100 ml of water was added into the flasks seeds. The seeds were then stirred for 10 minutes with a magnetic stirrer. The excess water was removed. The washing was done both for farmer's stored seeds and apparently healthy seeds.

**Seed treatment with brine solution:** At first 2% brine solution was prepared by mixing 2 g edible salt (NaCl) in 100 ml tap water and 400 seeds were soaked in the solution for 15 minutes. After treating seeds the excess water was removed and the seeds were air dried in the laboratory prior to sowing. The process was done for both of apparently healthy and farmer's stored seeds.

**Seed treatment with Vitavax-200:** 400 seeds were taken in a beaker and 0.4% Vitavax-200 (seed weight basis) was added in to the seeds and mixed thoroughly. Both apparently healthy seeds and farmer's stored seeds were treated with Vitavax-200 @ 0.4%.

**Seed health study:** Seed health study was done following the method of ISTA [15]. In this method, three layers of blotting paper (whatman filter paper No.1) soaked in water and were placed at the base of a 9 cm diameter plastic petridish and thereafter 25 seeds were placed on filter paper. The petridishes containing seeds were incubated at 20±2°C under alternating cycles of 12 h near ultraviolet (NUV) and darkness for 7 days. The incubated seeds were examined under stereo binocular microscope in order to record the incidence of *Bipolaris sorokiniana* that grew out of the seeds. For proper identification of fungi, temporary slides were also prepared from the fungal colony and examined under compound microscope and fungi were identified [16-18]. Germination % of the incubated seeds were also recorded.

**Field experiment**
**Experimental site and experimental period:** The experiment was conducted at Sher-e-Bangla Agricultural University Farm, Dhaka-1207 during the period from December 2005 to April 2006. The experimental field was located at 90°22′ E longitudes and 23°41′ N latitude at an altitude of 8.6 meters above the sea level. The soil of

the experimental field belongs to the Tejgaon series under the Agro Ecological Zone, Madhupur Tract (AEZ-28) and the general soil type is Shallow, Red Brown, Terrace Soils. The experiment was laid out in a Randomized Complete Block Design with three replications. The total number of plots was 30. The size of unit plot was 2 m × 1m. The distance maintained between two plots was 50 cm and between blocks was 1.0 m.

**Treatments:** The treatments were the same as described in Laboratory experiment. Seed sample for different treatments were prepared as of laboratory experiments. Sorting of apparently healthy seeds, seed washing and seed treatment with brine solution and Vitavax-200 were done following the method as described in laboratory experiment.

**Preparation of field:** A power tiller first opened the selected land on 1st December 2005; afterwards the land was ploughed and cross-ploughed several times followed by laddering to obtain a good tilth. Weeds and stubbles were removed and large clods were broken into smaller pieces to obtain a desirable tilth of soil for sowing of seeds. Finally, the land was leveled and the experimental plot was partitioned into unit plots. The field was fertilized at the rate of 220 kg urea, 180 kg TSP, 50 kg MP, 120 kg Gypsum and 10 tons cow dung per hectare [19]. Two third of Urea, full dose of TSP, MP, Gypsum and cow dung were applied at the time of final land preparation. Remaining one third of Urea was applied at 21 days after seed sowing. Wheat seeds variety Kanchan were used in this study. The source of seed collection was same as described in laboratory experiment.

**Sowing of seeds:** Wheat seeds were sown in the field on 10th December 2005 at the rate of 120 kg $ha^{-1}$. The seeds were sown in lines at a depth of 5 cm and covered by soil with the help of hand. The distance between lines was 20 cm in every plot.

**Intercultural operations:** Intercultural operations like weeding, irrigation was done in order to maintain the normal hygienic condition of crop growth. Weeding was performed two times during the growing period of crop (one after 30 days and another 50 days of sowing). The experimental field was irrigated twice, first irrigation was done at 21 days after sowing and second irrigation was done at 60 days after sowing. Special care was taken to protect the crop from birds especially at sowing and germination stages and at the ripening stage of the crop.

**Recording of data:** Seedlings emergence % under field conditions was recorded at 10 and 15 days after sowing. Leaf spot severity of wheat was evaluated at four growth stages of plant viz. panicle initiation, flowering, milking and hard dough stage. The disease severity was recorded following rating scale as used by Hossain and Azad [8]. The rating of the disease reaction was done on the flag leaf, penultimate leaf and 3rd leaf from the top of the plant. The randomly selected 25 plants/plot were tagged for rating the disease severity and mean value were determined to get rating score of the material of each treatment. Data on yield and yield attributes were also recorded. The grading of seeds was done following the 0-5 rating scale of CIMMYT [20]. Data in respect of different growth and yield contributing characters were statistically analyzed and treatment means were compared following DMRT (Duncan's New Multiple Range Test).

## RESULTS AND DISCUSSION

### Laboratory experiment

**Germination of seed:** Significant variations among the treatments were observed in the percentage of seed germination (Table 1). The highest germination (97.10%) was counted in the treatment $T_4$ (apparently healthy seed treated with vitavax-200 @ 0.4%) and the lowest germination (82.57%) was counted in treatment $T_1$ (farmer's stored seed). The treatments T (apparently healthy seed), $T_4$ (apparently healthy seed treated with vitavax-200 @ 0.4%), $T_6$ (apparently healthy seed washed with water), $T_8$ (apparently healthy seed treated with brine solution @ 2%) and $T_{10}$ (washed apparently healthy seed treated with brine solution @ 2%) were statistically similar in respect of seed germination but they differed significantly from $T_1$ (farmer's stored seed). It reveals that farmer's stored seed have the lowest germination percentage. On the other hand physically or chemically treated apparently healthy seeds gave the highest germination percentage, which was due to separation of black pointed seeds, inert matter, weed seeds, as well as other crop seeds that might be contained fungi having role in inhibiting the germination of the seeds.

**Incidence of *Bipolaris sorokiniana*:** Different treatments differed significantly in respect of the pre-emergence incidence of seed borne *Bipolaris sorokiniana* that has shown in Table 1. The highest incidence of *Bipolaris sorokiniana* was counted (17.40%) under the treatment $T_1$ (farmer's stored seed) and the lowest incidence was counted (3.70%) under the treatment $T_{10}$ (washed

Table 1: Effect of physical and chemical seed treatments on germination and incidence of *Bipolaris sorokiniana* on wheat seeds under laboratory conditions

| Treatments* | Germination (%) | (%) seed yielding *Bipolaris sorokiniana* | (%) Reduction of *Bipolaris sorokiniana* over control |
|---|---|---|---|
| $T_1$ | 82.57 | 17.40 | -- |
| $T_2$ | 96.23 | 8.20 | 52.87 |
| $T_3$ | 83.83 | 5.43 | 68.69 |
| $T_4$ | 97.10 | 4.13 | 76.15 |
| $T_5$ | 83.83 | 10.33 | 40.56 |
| $T_6$ | 96.16 | 5.60 | 67.73 |
| $T_7$ | 82.93 | 5.67 | 67.34 |
| $T_8$ | 96.07 | 4.07 | 76.53 |
| $T_9$ | 83.57 | 4.67 | 73.08 |
| $T_{10}$ | 96.43 | 3.70 | 78.63 |
| $LSD_{(0.01)}$ | 1.31 | 1.43 | -- |

Table 2: Effect of physical and chemical seed treatments on germination, plant height, spike length and distance between the point of flag leaf initiation and base of ear of wheat under field conditions

| Treatments* | Germination (%) 10 DAS | Germination (%) 15 DAS | Plant height (cm) | Spike length (cm) | Distance between the point of flag leaf initiation and base of ear (cm) |
|---|---|---|---|---|---|
| $T_1$ | 49.84 | 55.54 | 64.80 | 13.02 | 13.20 |
| $T_2$ | 68.64 | 75.97 | 75.61 | 14.06 | 14.07 |
| $T_3$ | 82.32 | 83.92 | 83.62 | 14.32 | 14.32 |
| $T_4$ | 84.20 | 86.08 | 86.83 | 14.68 | 14.68 |
| $T_5$ | 57.58 | 65.08 | 66.82 | 13.32 | 13.72 |
| $T_6$ | 72.50 | 76.21 | 79.72 | 14.24 | 14.42 |
| $T_7$ | 52.50 | 56.28 | 72.48 | 13.56 | 13.76 |
| $T_8$ | 71.51 | 74.20 | 80.12 | 14.04 | 14.12 |
| $T_9$ | 54.21 | 66.28 | 70.16 | 13.52 | 13.80 |
| $T_{10}$ | 56.42 | 68.21 | 80.22 | 13.75 | 14.32 |
| $LSD_{(0.01)}$ | 6.22 | 6.95 | 6.32 | NS | NS |

NS = Non significant

* $T_1$ =Farmer's stored seed (control), $T_2$= Apparently healthy seed, $T_3$= Farmer's stored seed treated with vitavax-200 @ 0.4%, $T_4$ = Apparently healthy seed treated with vitavax-200 @ 0.4%, $T_5$ = Farmer's stored seed washed with water, $T_6$= Apparently healthy seed washed with water, $T_7$ = Farmer's stored seed treated with brine solution @ 2%, $T_8$ = Apparently healthy seed treated with brine solution @ 2%, $T_9$ = Washed farmer's stored seed treated with brine solution @ 2%, $T_{10}$ = Washed apparently healthy seed treated with brine solution @ 2%

apparently healthy seed treated with brine solution @ 2%). The treatment $T_{10}$ reduced 78.63% incidence of *Bipolaris sorokiniana* over control $T_1$ (farmer's stored seed). The findings of the present study corroborates with the findings of Hasan [14]. In a similar type of experiment with rice, he reported that highest incidence of *Bipolaris oryzae* (3.5%) was found in discoloured and diseased seeds. He also reported that seeds became free from *Bipolaris oryzae* when washed with brine solution or seed cleaning followed by washing in normal water. Siddique [21] reported that seed cleaning by bamboo sieve reduced the prevalence of seed borne pathogens of wheat and increased seed germination and vigor index of the crop.

**Field experiment**

**Field Plant emergence and plant growth parameters:** The emergence of wheat seedling was counted at 10 and 15 days after sowing (DAS) of seeds. Significant variation in percentage of field emergence at 10 DAS and 15 DAS among the treatments were found and are shown in Table 2. The germination percentage varied from 49.84% to 84.20% at 10 DAS and 55.54% to 86.08% at 15 DAS among the treatments. The highest germination was counted 84.20% and 86.08% at 10 and 15 DAS respectively, under the treatment $T_4$ (apparently healthy seed treated with vitavax-200 @ 0.4%) and this was statistically similar to the treatment $T_3$ (Farmer's stored seed treated with vitavax-200 @ 0.4%) where germination

Table 3: Effect of physical and chemical seed treatments on leaf spot severity of wheat at panicle initiation and flowering stage

| | Disease severity at panicle initiation stage | | | | Disease severity at flowering stage | | | |
|---|---|---|---|---|---|---|---|---|
| Treatments* | Flag leaf | Penultimate leaf | 3rd leaf | Average | Flag leaf | Penultimate leaf | 3rd leaf | Average |
| $T_1$ | 0.15 | 0.42 | 1.08 | 0.55 | 0.52 | 1.03 | 2.09 | 1.21 |
| $T_2$ | 0.07 | 0.21 | 0.66 | 0.31 | 0.16 | 0.60 | 1.28 | 0.68 |
| $T_3$ | 0.02 | 0.06 | 0.18 | 0.09 | 0.08 | 0.18 | 0.54 | 0.26 |
| $T_4$ | 0.01 | 0.04 | 0.12 | 0.05 | 0.04 | 0.12 | 0.42 | 0.19 |
| $T_5$ | 0.06 | 0.18 | 0.54 | 0.26 | 0.15 | 0.54 | 1.18 | 0.62 |
| $T_6$ | 0.10 | 0.31 | 0.80 | 0.40 | 0.24 | 0.66 | 1.50 | 0.80 |
| $T_7$ | 0.08 | 0.25 | 0.68 | 0.34 | 0.16 | 0.60 | 1.42 | 0.72 |
| $T_8$ | 0.06 | 0.18 | 0.49 | 0.24 | 0.10 | 0.51 | 1.08 | 0.56 |
| $T_9$ | 0. 07 | 0.21 | 0.65 | 0.31 | 0.12 | 0.56 | 1.40 | 0.69 |
| $T_{10}$ | 0.06 | 0.17 | 0.48 | 0.24 | 0.09 | 0.49 | 1.06 | 0.54 |
| $LSD_{(0.01)}$ | 0.02 | 0.01 | 0.05 | 0.02 | 0.02 | 0.05 | 0.12 | 0.02 |

* $T_1$ =Farmer's stored seed (control), $T_2$ = Apparently healthy seed, $T_3$ = Farmer's stored seed treated with vitavax-200 @ 0.4%, $T_4$ = Apparently healthy seed treated with vitavax-200 @ 0.4%, $T_5$ = Farmer's stored seed washed with water, $T_6$ = Apparently healthy seed washed with water, $T_7$ = Farmer's stored seed treated with brine solution @ 2%, $T_8$= Apparently healthy seed treated with brine solution @ 2%, $T_{9}$ Washed farmer's stored seed treated with brine solution @ 2%, $T_{10}$ = Washed apparently healthy seed treated with brine solution @ 2%

was counted 82.32% and 83.92% at 10 DAS and 15 DAS, respectively. On the other hand the lowest germination (49.84% and 55.54% at 10 and 15 DAS, respectively) was recorded in the treatment $T_1$ (farmer's stored seed). Seed cleaning (apparently healthy seed) followed by washing also gave higher germination percentage. This result indicates that pathogenic fungal associations with the seed lot and lack of proper storage facilities have profound effect on germination. The findings of the present study corroborates with the study of Hasan [14]. He reported that physically sorted seed (apparently healthy seeds) showed higher germination (75%) than farmer's stored seed. The findings of the present study also corroborates with the study of Uddin [22] who observed that germination percentage was higher in physically sorted seeds over control (untreated seeds). Brine solution treated seed exhibited statistically similar germination percentage to that of untreated control. The findings of the present study corroborates with the study of Hasan [14].

Significant variation in plant height among the treatments was observed and shown in Table 2. Plant height varied from 64.80 to 86.83 cm. The highest Plant height (86.83 cm) was recorded under the treatment $T_4$ treatment (apparently healthy seed treated with vitavax-200 @ 0.4%), which was statistically identical to the treatment $T_3$ (farmer's stored seed treated with vitavax-200 @ 0.4%), $T_8$ (apparently healthy seed treated with brine solution @ 2%) and $T_{10}$ (washed apparently healthy seed treated with brine solution @ 2%). On the other hand the lowest plant height (64.80 cm) was recorded in the treatment $T_1$ (farmer's stored seed) that was statistically similar to the treatment $T_5$ (farmer's stored seed washed with water) and $T_9$ (Washed farmer's stored seed treated with brine solution @ 2%). The findings of the present study keep in with the findings of Hasan [14]. He reported that the highest plant height (117.8cm) was observed in farmer's seed washed with brine solution (20%) followed by farmer's cleaned seed and farmer's cleaned and washed seed of rice (BR 11) at BAU farm.

The spike length did not show any significant variation among the treatments (Table 2). The spike length varies from 13.02 to 14.68 cm that was not statistically significant. The highest spike length was found 14.68 cm in $T_4$ treatment (apparently healthy seed treated with vitavax-200 @ 0.4%). On the contrary, the lowest spike length (13.02 cm) was recorded in the treatment $T_1$ (farmer's stored seed). Chemically treated seed gave the maximum spike length that might be take place due to chemically treated seed could be free from seed borne pathogens which influence the development of wheat spike. Considering the length between panicle initiation and point of spike, no significant variation was found among the treatments (Table 2). The highest distance between the point of flag leaf initiation and base of ear (14.68 cm) was recorded in the treatment $T_4$ (apparently healthy seed treated with vitavax-200 @ 0.4%) and the lowest distance between the point of flag leaf initiation and base of ear (13.20 cm) was recorded in the treatment $T_1$ (farmer's stored seed).

Table 4: Effect of physical and chemical seed treatments on leaf spot severity of wheat at milking and hard dough stage

| | Disease severity at milking stage | | | | Disease severity at hard dough stage | | | |
|---|---|---|---|---|---|---|---|---|
| Treatments* | Flag leaf | Penultimate leaf | 3rd leaf | Average | Flag leaf | Penultimate leaf | 3rd leaf | Average |
| $T_1$ | 0.76 | 1.50 | 2.82 | 1.69 | 1.48 | 2.56 | 3.54 | 2.52 |
| $T_2$ | 0.38 | 0.88 | 1.96 | 1.07 | 0.70 | 1.68 | 2.50 | 1.62 |
| $T_3$ | 0.18 | 0.52 | 0.98 | 0.56 | 0.44 | 0.88 | 1.96 | 1.09 |
| $T_4$ | 0.08 | 0.28 | 0.72 | 0.36 | 0.28 | 0.72 | 1.52 | 0.84 |
| $T_5$ | 0.66 | 1.32 | 2.21 | 1.39 | 1.04 | 2.06 | 3.10 | 2.06 |
| $T_6$ | 0.32 | 0.76 | 1.68 | 0.92 | 0.62 | 1.48 | 2.40 | 1.50 |
| $T_7$ | 0.54 | 1.27 | 2.10 | 1.30 | 0.75 | 1.82 | 2.80 | 1.79 |
| $T_8$ | 0.30 | 0.70 | 1.70 | 0.90 | 0.60 | 1.60 | 2.38 | 1.52 |
| $T_9$ | 0.44 | 1.21 | 2.02 | 1.22 | 0.52 | 1.70 | 2.86 | 1.69 |
| $T_{10}$ | 0.32 | 0.72 | 1.80 | 0.94 | 0.42 | 1.32 | 2.32 | 1.35 |
| $LSD_{(0.01)}$ | 0.05 | 0.09 | 0.16 | 0.02 | 0.08 | 0.22 | 0.38 | 0.05 |

* $T_1$ =Farmer's stored seed (control), $T_2$ = Apparently healthy seed, $T_3$= Farmer's stored seed treated with vitavax-200 @ 0.4%, $T_4$ Apparently healthy seed treated with vitavax-200 @ 0.4%, $T_5$ = Farmer's stored seed washed with water, $T_6$ = Apparently healthy seed washed with water, $T_7$ = Farmer's stored seed treated with brine solution @ 2%, $T_8$ Apparently healthy seed treated with brine solution @ 2%, $T_9$ =Washed farmer's stored seed treated with brine solution @ 2%, $T_{10}$ = Washed apparently healthy seed treated with brine solution @ 2%

**Leaf spot severity:** Leaf spot severity at panicle initiation stage and flowering stage was recorded on flag leaf, penultimate leaf and 3rd leaf of wheat and found to have statistically significant variations (Table 3). The lowest disease severities were recorded in the treatment $T_4$ (apparently healthy seed treated with vitavax-200 @ 0.4%), which was 0.01, 0.04 and 0.12 at flag leaf, penultimate leaf and 3rd leaf, respectively in panicle initiation stage. On the other hand the highest disease severities were obtained under the treatment $T_1$, which was 0.15, 0.42 and 1.08 on flag leaf, penultimate leaf and 3rd leaf of wheat, respectively. The lowest disease severities in flowering stage were recorded in the treatment $T_4$, which was 0.04, 0.12 and 0.42 on flag leaf, penultimate leaf and 3rd leaf, respectively. On the other hand the highest disease severities were obtained under the treatment $T_1$ (farmer's stored seed).

Similar trend of leaf spot severity was obtained in milking and hard dough stages among the different physical and chemical treatments used (Table 4). The lowest disease severity at milking stage was recorded in the treatment $T_4$, which was 0.08, 0.28 and 0.72 on flag leaf, penultimate leaf and 3rd leaf, respectively. On the other hand, the highest disease severity was obtained under the treatment $T_1$. The lowest disease severity at hard dough stage was recorded in the treatment $T_4$ and the highest disease severities were obtained under the treatment $T_1$. It was found that the farmer's stored seed ($T_1$) always resulted significantly highest leaf spot severity of wheat at panicle initiation stage, flowering stage, milking stage and hard dough stage, whereas the treatment $T_4$ (apparently healthy seed treated with Vitavax-200 @ 0.4%) resulted minimum disease severity. All the treatments significantly reduced lower leaf spot severity over control ($T_1$). From the present study it has been found that apparently healthy seed treated with Vitavax-200, brine solution and washing in water resulted the lower disease severity. The findings of the present study are supported by Hasan [14]. He reported that seed cleaning and washing reduced the disease severity of rice over farmer's stored seed. The findings of the present study also corroborates with the findings of Hossain and Asad-ud-Doullah [13]. They reported that cleaning and washing of farmer's stored seed of rice reduced the seedling diseases up to 53.87% over the unclean farmer's stored seed. Uddin [22] found the highest reduction of fungal flora in case of chemical treatment followed by garlic extract, brine solution, hot water treated and physically sorted seed of lentil.

**Yield and yield attributes:** Considering the number of spikelets/ear different seed treatments did not differ significantly (Table 5). The lowest number of spikelets/ear (19.17) was recorded in the treatment $T_1$ and the highest number (20.10) was recorded in the treatment $T_8$ (apparently healthy seed treated with brine solution @ 2%).The lowest number of healthy spikelets/ear (17.96) was recorded in the treatment $T_1$ and the highest number (20.04) was recorded in the treatment $T_4$. The highest number of diseased spikelets/ear (1.21) was recorded at the treatment $T_1$. On the other hand the lowest number of diseased spikelets/ear (0.04) was recorded in the treatment.

Table 5: Effect of physical and chemical seed treatments on number of spikelets / ear, number of healthy spikelets / ear and number of diseased spikelets/ ear of wheat

| Treatments* | Number of spikelets / ear | Number of healthy spikelets / ear | Number of diseased spikelets/ ear |
|---|---|---|---|
| $T_1$ | 19.17 | 17.96 | 1.21 |
| $T_2$ | 19.64 | 19.40 | 0.24 |
| $T_3$ | 19.96 | 19.84 | 0.12 |
| $T_4$ | 20.08 | 20.04 | 0.04 |
| $T_5$ | 19.23 | 18.65 | 0.58 |
| $T_6$ | 19.78 | 19.56 | 0.22 |
| $T_7$ | 19.18 | 18.82 | 0.36 |
| $T_8$ | 20.10 | 19.92 | 0.18 |
| $T_9$ | 19.49 | 19.21 | 0.28 |
| $T_{10}$ | 19.60 | 19.36 | 0.24 |
| $LSD_{(0.01)}$ | NS | NS | 0.07 |

Table 6: Effect of physical and chemical seed treatments on grain formation and grain weight of wheat

| Treatments* | Number of grains / ear | Number of diseased grains/ ear | Weight of grains/ ear (g) | Weight of healthy grains/ ear (g) | Weight of diseased grains / ear (g) |
|---|---|---|---|---|---|
| $T_1$ | 33.03 | 3.03 | 1.45 | 1.29 | 0.16 |
| $T_2$ | 38.24 | 1.20 | 1.60 | 1.54 | 0.06 |
| $T_3$ | 39.75 | 0.51 | 1.67 | 1.63 | 0.04 |
| $T_4$ | 40.60 | 0.28 | 1.78 | 1.75 | 0.03 |
| $T_5$ | 36.83 | 1.61 | 1.52 | 1.44 | 0.08 |
| $T_6$ | 39.31 | 0.97 | 1.65 | 1.55 | 0.06 |
| $T_7$ | 35.77 | 1.09 | 1.67 | 1.60 | 0.07 |
| $T_8$ | 39.34 | 0.82 | 1.71 | 1.65 | 0.06 |
| $T_9$ | 36.87 | 1.24 | 1.65 | 1.58 | 0.07 |
| $T_{10}$ | 37.62 | 0.80 | 1.73 | 1.68 | 0.05 |
| $LSD_{(0.01)}$ | 1.52 | 0.18 | NS | NS | 0.02 |

NS = Non significant

* $T_1$ =Farmer's stored seed (control), $T_2$ = Apparently healthy seed, $T_3$ = Farmer's stored seed treated with vitavax-200 @ 0.4%, $T_4$ = Apparently healthy seed treated with vitavax-200 @ 0.4%, $T_5$ = Farmer's stored seed washed with water, $T_6$ = Apparently healthy seed washed with water, $T_7$ = Farmer's stored seed treated with brine solution @ 2%, $T_8$ = Apparently healthy seed treated with brine solution @ 2%, $T_9$ = Washed farmer's stored seed treated with brine solution @ 2%, $T_{10}$ = Washed apparently healthy seed treated with brine solution @ 2%

Data in Table (6) showed that the number of grains/ear, number of healthy grains/ear ( not shown in the Table) and number of diseased grains/ear varied significantly in respect of different physical and chemical seed treatments. Number of grains/ear ranged from 33.03 to 40.60 where the highest and lowest counts were made under the treatments $T_4$ and $T_1$ respectively. The treatments $T_3$, $T_4$, $T_6$ and $T_8$ resulted statistically similar effect in producing grains/ear. All the treatments differed significantly from the treatment $T_1$ (farmer's stored seed) in producing number of grains/ear. The highest number of diseased grains/ear (3.03) was recorded in the treatment $T_1$, which was followed by $T_5$ treatment (farmer's stored seed washed with water). On the other hand the lowest number of diseased grains/ear (0.28) was recorded in the treatment $T_4$ that was statistically identical to the treatment $T_3$. The weight of grains/ear and healthy grains/ear was not significant among the treatments. But the lowest weight of healthy grain/ear (1.29 g) was recorded in the treatment $T_1$. On the other way the highest weight of healthy grains/ear (1.75 g) was recorded in the treatment $T_4$. The highest weight of diseased grains/ear (0.16 g) was recorded in the treatment $T_1$ (farmer's stored seed), which was followed by $T_5$ treatment (farmer's stored seed washed with water). On the other hand the lowest weight of diseased grains/ear (0.03 g) was recorded in the treatment $T_4$ that was followed by $T_3$ (farmer's stored seed treated with vitavax-200 @ 0.4%). The findings of the present study supported by Hasan [14]. He reported that seed cleaning, washing and treated with brine solution increased number of grains/ear and healthy grains/ear of rice over farmer's

Table 7: Effect of physical and chemical seed treatments on number of grains/ear of different grades of wheat

| | Grading of seeds (0-5 scale)** | | | | | |
|---|---|---|---|---|---|---|
| Treatments* | 0 | 1 | 2 | 3 | 4 | 5 |
| $T_1$ | 30.00 | 0.80 | 0.60 | 0.40 | 0.30 | 0.93 |
| $T_2$ | 37.04 | 0.60 | 0.20 | 0.00 | 0.10 | 0.30 |
| $T_3$ | 39.25 | 0.40 | 0.10 | 0.00 | 0.01 | 0.00 |
| $T_4$ | 40.32 | 0.20 | 0.00 | 0.00 | 0.08 | 0.00 |
| $T_5$ | 35.22 | 0.45 | 0.40 | 0.30 | 0.12 | 0.34 |
| $T_6$ | 38.34 | 0.52 | 0.12 | 0.12 | 0.00 | 0.21 |
| $T_7$ | 34.68b | 0.50b | 0.20 | 0.09 | 0.00 | 0.30 |
| $T_8$ | 38.52 | 0.40 | 0.20 | 0.00 | 0.00 | 0.22 |
| $T_9$ | 35.63 | 0.60 | 0.32 | 0.12 | 0.00 | 0.20 |
| $T_{10}$ | 36.82 | 0.40 | 0.10 | 0.00 | 0.12 | 0.18 |
| $LSD_{(0.01)}$ | 5.08 | 0.10 | 0.06 | 0.05 | 0.05 | 0.10 |

Table 8: Effect of physical and chemical seed treatments on 1000 seed weight and yield of wheat.

| Treatments* | 1000- seed weight (g) | Straw yield (t $ha^{-1}$) | Grain yield (t $ha^{-1}$) | % Grain yield increased over control |
|---|---|---|---|---|
| $T_1$ | 29.22 | 4.00 | 2.00 | -- |
| $T_2$ | 33.82 | 5.50 | 3.00 | 50.00 |
| $T_3$ | 35.24 | 6.16 | 3.41 | 70.50 |
| $T_4$ | 36.17 | 6.00 | 3.50 | 75.00 |
| $T_5$ | 31.26 | 4.70 | 2.50 | 25.00 |
| $T_6$ | 34.32 | 5.90 | 2.91 | 45.50 |
| $T_7$ | 32.08 | 5.25 | 2.75 | 37.50 |
| $T_8$ | 33.80 | 5.70 | 3.00 | 50.00 |
| $T_9$ | 32.68 | 5.51 | 2.72 | 36.00 |
| $T_{10}$ | 34.27 | 5.75 | 2.95 | 47.50 |
| $LSD_{(0.01)}$ | NS | 0.58 | 0.37 | - |

NS = Non significant

* $T_1$ =Farmer's stored seed (control), $T_2$ = Apparently healthy seed, $T_3$ = Farmer's stored seed treated with vitavax-200 @ 0.4%, $T_4$ = Apparently healthy seed treated with vitavax-200 @ 0.4%, $T_5$ = Farmer's stored seed washed with water, $T_6$ = Apparently healthy seed washed with water, $T_7$ = Farmer's stored seed treated with brine solution @ 2%, $T_8$ = Apparently healthy seed treated with brine solution @ 2%, $T_9$ = Washed farmer's stored seed treated with brine solution @ 2%, $T_{10}$ = Washed apparently healthy seed treated with brine solution @ 2%

stored seed. The findings of the present study also corroborates with the findings of Rahman *et al.* [23]. They reported that seed treated with Vitavax-200 and manually sorted seed produced the highest number of healthy seed.

A significant variation was recorded in respect of number of grains/ear of different grades (Table 7). The highest (40.32) grade-0 (healthy) seeds were recorded in the treatment $T_4$ while the lowest (30.00) was recorded in the treatment $T_1$. The highest number of grade-1 seed (0.80) was recorded in the treatment $T_1$ and the lowest (0.20) was recorded in the treatment $T_4$ which was followed by $T_3$ and $T_8$. In case of grade-2 grains/ear the highest counts (0.60) were recorded in the treatment $T_1$ (farmer's stored seed) and the lowest (0.00), which was recorded in the treatment $T_4$. Considering grade-3 grains/ear it was found that the highest infected seed (0.40) was recorded in the treatment $T_1$ and the lowest infected seed (0.00) was recorded in the treatment $T_4$. In grade-4 grains/ear the highest counts (0.30) was recorded in the treatment $T_1$ and the lowest (0.08) was recorded in the treatment $T_3$ (farmer's stored seed treated with vitavax-200 @ 0.4%). In case of grade-5 grains/ear the highest infected seed (0.93) was recorded in the treatment $T_1$ and the lowest infected seed (0.00), was recorded in the treatment $T_4$ and $T_3$.

1000-seed w Weight of 1000-seeds did not differ significantly among the treatments under the present trail. (Table 8). The 1000-seed weight of wheat varied from 29.22 g to 36.17 g where the highest weight was recorded in the treatment $T_4$. On the contrary the lowest weight of 1000- seed was recorded in the treatment $T_1$. Considering the straw yield of wheat per hectare a significant variation

was recorded among the treatments (Table 8). Straw yield under the treatment varied from 4.00 to 6.16 t $ha^{-1}$. The highest straw yield was recorded in the treatment $T_3$ that was statistically identical to the treatment $T_4$. On the other hand the lowest straw yield (4.00 t $ha^{-1}$) was recorded in the treatment $T_1$ that was followed by $T_2$, $T_8$, $T_9$ and $T_{10}$. The highest grain yield (3.5 t $ha^{-1}$) was recorded in $T_4$ that was statistically similar to the treatment $T_3$ and the lowest grain yield (2.0 t $ha^{-1}$) was recorded in $T_1$ (farmer's stored seed). It was found that seed sorting, washing and seed treatment with brine solution and Vitavax-200 increased grain yield over the control ($T_1$). It was also observed that grain yield was increased by 50, 70.50, 75, 25, 45.50, 37.50, 50, 36 and 47.50% for the treatments $T_2$, $T_3$, $T_4$, $T_5$, $T_6$, $T_7$, $T_8$, $T_9$ and $T_{10}$, respectively. The findings of the present study corroborates with the findings of Hasan [14]. He reported that grain yield of rice was increased by 24.39, 23.18, 32.93 and 28.05% for the treatments, farmer's cleaned seed, farmer's seed washed with water, farmer's seed washed with brine solution (20% NaCI) and farmer's cleaned and washed with water, respectively. The findings of the present study also corroborates with the findings of Hossein [24]. He reported that farmer's clean seed, washed farmer's seed, washed clean seed and seed treated with Vitavax-200 increased grain yield by 16.62, 16.45, 23.39 and 26.60%, respectively over farmer's stored seed of rice (cv. BR11). The present study are in accordance with the study of Gworgwor *et al.* [25]. They reported that brine (NaCl) treated sorghum seeds gave higher yield than that of untreated control.

## CONCLUSIONS

Farmer's stored wheat seed is not up to the mark and it can be improved by means of physical and chemical treatments. This study focused on the importance of seed sorting seed washing and seed treatment for controlling seed borne *Bipolaris sorokiniana* as seed borne fungus and the causal of well as leaf spot of wheat in the field. Seed sorting and washing techniques are easy, economic and will be accepted by the farmer. But to obtain better yield physically sorted apparently healthy seeds treated with Vitavax-200 may be advised to the farmer befor sowing.

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