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Full Length Research Paper

Effect of seed treatment practices in controlling of seed-borne fungi in sorghum

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An experiment was conducted to study the effectiveness in controlling seed borne fungi associated with sorghum seeds obtained from two locations at the Seed Pathology Centre (SPC), Bangladesh Agricultural University (BAU), Mymensingh. All the five seed treatment practices used viz. hot water treatment, garlic tablet, neem leaf extract, BAU- Biofungicide and Vitavax-200 reduced significantly the total seed-borne fungal infections as well as the population of individual six target pathogenic fungi- *Agrostis tenuis*, *Bipolaris sorghicola*, *Botrytis cinerea*, *Crinum graminicola*, *Curvularia lunata*, *Fusarium moniliforme*. Increased germination higher than the national standard (>80.0%) was also obtained in all the treatments over the untreated control. Vitavax-200 gave the best result in controlling seed-borne infection of all the individual target pathogenic fungi followed by garlic tablet, hot water treatment and neem leaf extract. Neem leaf extract gave over 90.0% reduction in seed-borne infection of *B. sorghicola* and *C. lunata* out of the six target pathogenic fungi. BAU-Biofungicide gave the lowest control of total seed-borne fungal infections (61.6 - 62.3%) as well as seed-borne infection of all the individual target pathogenic fungi (<80.0%).

Key words: Seed treatment practice, control, seed borne fungi, sorghum.

INTRODUCTION

Sorghum (*Sorghum vulgare*) is an important grain and fodder crop used for feeding poultry, swine, cattle and horses and as also as human food ranking fourth after paddy, wheat and maize in the world. In our country, 2000 metric tons of sorghum grains are produced annually from about 4000 ha of land and the average yield is 1.2 metric tons per hectare (BBS, 2005). Seed is the most important input for crop production. Many plant pathogens are seed-borne, which can cause enormous crop losses. In Bangladesh, out of 16% annual crop losses due to plant diseases, at least 10% loss is incurred due to seed-borne diseases (Fakir, 1983).

Among the various factors responsible for the low yield of the crop, diseases play a vital role. Sorghum suffers from more than 30 fungal diseases (USDA, 1960). Richardson (1990) listed 40 seed-borne fungal pathogens causing 32 different diseases in the crop. Important seed-borne fungal diseases recorded on sorghum are stalk rot (*Aspergillus niger*), target spot (*Bipolaris sorghicola*), stalk rot/anthracnose/red leaf (*Colletotrichum graminicola*), seed rot /stalk rot (*Fusarium moniliforme*), seedling blight/charcoal rot (*Macrophomina phaseolina*) and covered smut/grain smut (*Sphacelotheca sorghi*). In Bangladesh, limited works have been done on diseases and seed-borne fungi of sorghum (Karim, 2005; Talukdar, 1974). In order to control the seed-borne and soil- borne pathogens, farmers are generally use of various synthetic chemicals. The indiscriminate use of chemicals for controlling plant diseases resulted in environmental pollution, health hazard etc. and also farmers have to pay a high price. Moreover haphazard use of chemicals breaks down the natural ecological balance by killing the beneficial and/or antagonistic soil microbes. It is therefore, judicious to explore less expensive, less risky, non-chemical eco-friendly methods of seed treatment. Evidently, there is a need to increase the yield and improve the health and seed quality of the crop by controlling

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Table 1. Percent reduction in seed-borne infection of target pathogenic fungi recorded in sorghum seeds treated with five different treatments collected from Mymensingh.

Treatment	*Alternaria tenuis*	*Botrytis cinerea*	*Colletotrichum graminicola*	*Curvularia lunata*	*Fusarium moniliforme*
Hot water	94.1 b	90.9 b	93.3 b	93.3 b	88.5 b
Garlic tablet	94.1 b	90.1 b	90.6 c	96.5 a	88.5 b
Neem leaf extract	78.4 c	72.7 c	80.0 d	93.3 b	80.4 c
BAU-Biofungicide	58.8 d	70.1 c	64.0 e	65.3 c	54.0 d
Vitavax-200	100.0 a	100.0 a	100.0 a	96.6 a	92.3 a
Control [a]	8.5 e	5.5 d	7.5 f	15.0 d	8.7 e
CV (%)	0.93	1.10	1.00	0.83	1.03

seed-borne fungal pathogens. Among the different practices used, seed treatment is one of the cheapest and safest methods of direct control of seed-borne diseases by eliminating seed-borne inocula. Therefore treatment of sorghum seed by suitable measures before sowing is highly necessary in the country.

MATERIALS AND METHODS

The study was carried out at the Seed Pathology Centre (SPC), Bangladesh Agricultural University (BAU), Mymensingh during the period from March to October, 2006. Out of eight different seed samples (Jamalpur, Kushtia, Mymensingh, Pabna, Rajbari, Rajshahi, Savar and Sherpur) of sorghum analyzed, two samples viz. Mymensingh having lowest germination (65.0%) and Sherpur having highest germination (82.5%), were selected for seed treatment study based on the germination and seed borne infections of fungal pathogens present in the seed samples, and six fungi (*Alternaria tenuis*, *B. sorghicola*, *Botrytis cinerea*, *C. graminicola*, *Curvularia lunata* and *F. moniliforme*) out of nine seed-borne fungi detected by Blotter method following the International Rules for Seed Testing Association (ISTA, 2001) were selected for the seed treatment study. Four hundred seeds for each sample were sown in 4 trays (100 seeds per tray) for germination test.

Five seed treatment practices used for controlling seed-borne infection of the target pathogenic fungi were - seed treatment with hot water; seed treatment with plant extracts (a) garlic tablet and (b) neem leaf extract; seed treatment with BAU bio-fungicide; and seed treatments with Vitavax-200. The modified method of hot water seed treatment prescribed by Freeman and Johnson (1909) was used in the present study. In hot water method the seeds were presoaked for 5 h in tap water, and then placed in hot water for 10 min at 55°C in a thermostatically controlled hot water bath. Garlic tablets collected from the IPM laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh were dissolved in sterile water for 15 min. For homogenous mixture, the solution was stirred. For preparation of the extracts, 25 g of the neem leaves were taken in a clean mortar and pestle and grounded without water. The pulverized plant tissues were squeezed through three folds of fine cloths and then the filtrate was used as an extract. The dilution doses of plant extract (seed: solution) used 1:1(w/v) were prepared adding sterile water to the filtrate. Then the seeds were dipped in the dilution doses for about 30 min. The seeds were treated with the single dose of BAU-Biofungicide @ 1:40 w/v (BAU-Biofungicide: seed) following the method of Hossain (2003) by moistening the seeds with rice broth. The dose of the Vitavax-200 (5,6 dithydro-2-methyl-1-4-oxathiin-3 carboxanilide) used was 0.3% of seed weight for 10 - 15 min for proper coating of the fungicide. Appropriate control was maintained in case of all the above mentioned five seed treatment practices used.

The seed-borne infection of fungal pathogens and the germination were recorded after 7 days and continued for 14 days. Data on these two parameters recorded on the 14th day of incubation were taken into final account. Data on both seed-borne infection of fungal pathogens and germination were expressed in percentages and the data were analyzed following the Completely Randomized Design (CRD).

RESULTS AND DISCUSSION

Effect of different seed treatment practices on seed-borne infections of the target

Pathogenic fungi

All the five seed treatment practices reduced significantly the seed-borne infection of the individual target pathogenic fungi (Tables 1 - 2 and Figures 1 - 2) and the total seed-borne infections of pathogenic fungi in the two test seed samples over the untreated control (Table 3 and Plate 1).

Of the five seed treatment practices, Vitavax-200 gave the best performance in controlling the seed-borne infection of all the individual target pathogenic fungi in two test samples, followed by garlic tablet, hot water treatment and neem leaf extract (Tables 1 - 2 and Plate 1 B, C, and D). Again, of the five treatments, BAU-Biofungicide gave the lowest control of seed-borne infection of all the individual test pathogens in two test seed samples compared to untreated control. Vitavax-200 completely eliminated the seed-borne infec-tions of *A. tenuis*, *B. cinerea* and *C. graminicola* from the infected seed samples of Mymensingh (Table 1 and Figure 1). The fungicide also completely controlled the seed-borne infections of *A. tenuis*, *C. graminicola* and *C. lunata* in Sherpur sample (Table 2 and Figure 2). As high as 98.2% control of seed-borne infection of *B. sorghicola* in Sherpur sample (Table 2 and Figure 2) and over 90.0% control of the seed-borne infection of *F. monili-forme* were also achieved in both seed samples by Vitavax-200 (Tables 1 - 2 and Figures 1 - 2). No report is available in the control of these seed-borne fungi in sor ghum with Vitavax-200. However, Shah

Table 2. Percent reduction in seed-borne infection of target pathogenic fungi recorded in sorghum seeds treated with five different treatments collected from Sherpur.

Treatment	*Alternaria tenuis*	*Bipolaris sorghicola*	*Colletotrichum graminicola*	*Curvularia lunata*	*Fusarium moniliforme*
Hot water	89.5 c	91.4 b	93.3 b	90.6 c	89.2 b
Garlic tablet	94.7 b	91.4 b	93.3 b	93.4 b	84.6 c
Neem leaf extract	73.6 d	91.4 b	86.6 c	90.5 c	76.9 d
BAU-Biofungicide	72.6 d	52.9 c	77.3 d	67.2 d	30.7 e
Vitavax-200	100.0 a	98.2 a	100.0 a	100.0 a	94.2 a
Control [a]	9.5 e	11.7 d	7.5 e	10.7 e	6.5 f
CV (%)	1.00	0.98	0.90	0.97	0.91

[a] % seed-borne infection of the target pathogenic fungi recorded in untreated seeds
Means followed by the same letter(s) in a column did not differ significantly at 1% level by DMRT
CV means coefficient of variation.

Table 3. Effect of five seed treatment in controlling total seed-borne infections of pathogenic fungi in sorghum seeds collected from two selected sample.

Treatment	Mymensingh		Sherpur	
	Total seed-borne infections of five target pathogenic fungi[a] (%)	Reduction of total seed-borne infections of target pathogenic fungi (%)	Total seed-borne infections of five target pathogenic fungi[b] (%)	Reduction of total seed-borne infections of target pathogenic fungi (%)
Hot water	3.5 d	92.2 b	4.2 d	90.8 b
Garlic tablet	3.9 d	91.3 b	3.7 d	91.9 b
Neem leaf extract	6.0 c	86.7 c	7.7 c	83.2 c
BAU-Biofungicide	17.0 b	62.3 d	17.6 b	61.6 d
Vitavax-200	1.0 e	97.7 a	0.7 e	98.4 a
Control	45.2 a	-	45.9 a	-
CV (%)	4.56	0.94	5.14	0.95

[a]Target fungi include *Alternaria tenuis*, *Botrytis cinerea*, *Colletotrichum graminicola*, *Curvularia lunata* and *Fusarium moniliforme*.
[b]Target fungi include *Alternaria tenuis*, *Bipolaris sorghicola*, *Colletotrichum graminicola*, *Curvularia lunata* and *Fusarium moniliforme*.
Means followed by the same letter(s) in a column did not differ significantly at 1% level by DMRT.
CV means coefficient of variation.

and Mariappan (1988) obtained 100% control of *S. sorghi* in sorghum seeds in India. Excellent performance of Vitavax-200 had also been demonstrated in controlling seed-borne patho-gens in cereal crop, especially wheat from different coun-tries of the world (Nene and Saxena, 1971; Sharma and Joshi, 1972; Guldhe et al., 1985; Moronova, 1991; Dey et al., 1992; Hyder-Ali and Fakir, 1993). In view of these facts, Vitavax-200 (0.3%) may be recommended for controlling seed-borne pathogenic fungi of sorghum.

Next to Vitavax-200, garlic tablet and hot water treat-ment gave almost equally good control of seed-borne infection of the individual target fungal pathogens in the two test seed samples. Over 90% reduction in infection of all the target pathogens, except *F. moniliforme* were obtained by these two treatments in both the seed sam-ple (Tables 1 - 2 and Figures 1 - 2). Garlic tablet and hot water treatment gave 84.6 - 89.2% control of *F. monili-forme* which was recorded in two test samples (Tables 1 - 2). Hot water and garlic tablet gave equally good control of *A. tenuis* (94.1%) and *F. moniliforme* (88.5%) in Mymensingh sample while the same two treatments gave equally good performance in controlling seed-borne infection of *B. sorghicola* (91.4%) and *C. graminicola* (93.3%) in Sherpur sample (Table 2). Garlic tablet had better performance in controlling seed-borne infection of *A. tenuis* in Sherpur sample (94.7%) and *C. lunata* in both the samples obtained from Mymen singh (96.5%) and Sherpur (93.4%) over hot water treatment (Tables 1 - 2). No report is available on the effect of seed treatment on seed-borne infection of fungi in sorghum with hot water and garlic tablet from the searched literature. How-

Table 4. Effect of five different seed treatments practices in germination recorded in two selected seed samples.

Treatment	Mymensingh[a]		Sherpur[b]	
	% germination	% germination increase	% germination	% germination increase
Hot water	82.0	27.1d	86.0	3.6 d
Garlic tablet	84.5	31.0 b	92.5	11.4 b
Neem leaf extract	83.5	29.4 c	90.5	9.0 c
BAU-Biofungicide	82.5	27.9 d	90.0	8.4 c
Vitavax-200	86.5	34.1 a	94.5	13.8 a
CV (%)		2.37		6.45

[a] Germination recorded in control was 64.5%
[b] Germination recorded in control was 83.0%
CV means Coefficient of Variation

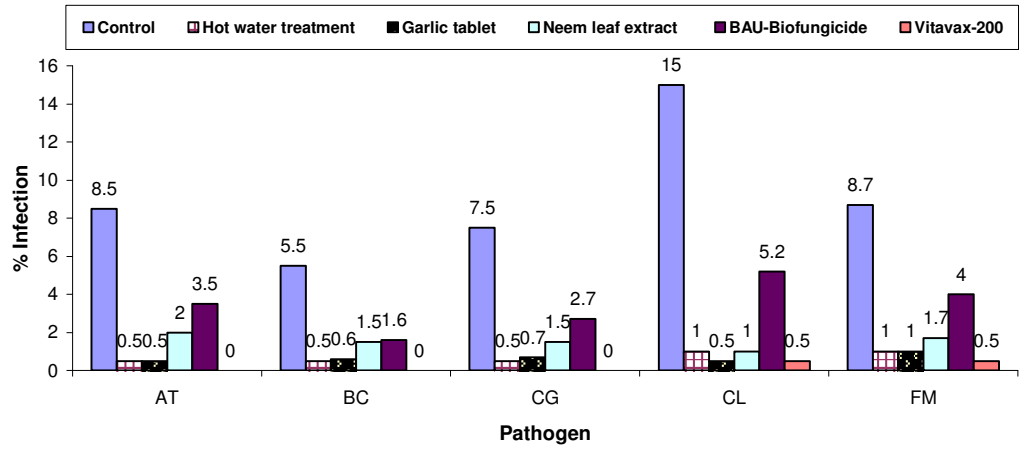

Figure 1. Effect of seed treatment in controlling five selected seed borne pathogens in sorghum collected from Mymensingh (AT = *Alternaria tenuis*, BC = *Botrytis cinerea*, CG = *Colletotrichum graminicola*, CL = *Curvularia lunata*, FM = *Fusarium moniliforme*).

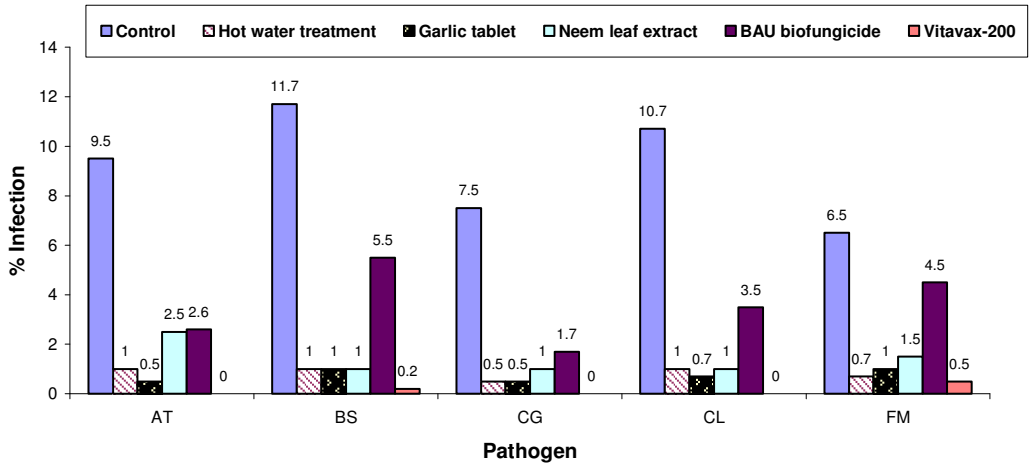

Figure 2. Effect of seed treatment in controlling five selected seed borne pathogens in sorghum collected from Sherpur (AT = *Alternaria tenuis*, BS = *Bipolaris sorghicola*, CG = *Colletotrichum graminicola*, CL = *Curvularia lunata*, FM = *Fusarium moniliforme*).

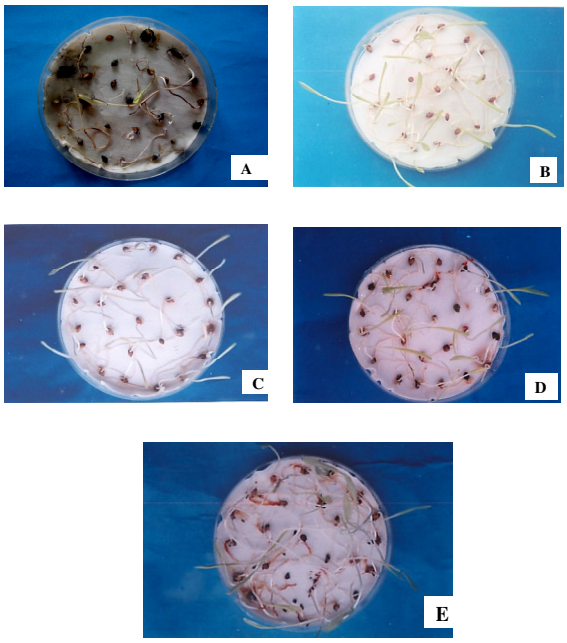

Plate 1. Effect of different seed treatment on germination increase and reduction of seed borne infection of fungi associated with sorghum seeds.
A. Huge growth of seed-borne fungi and lowest germination (Control).
B. Almost complete control of seed-borne fungal infection and highest germination increased (Vitavax-200).
C. Seed treated with garlic tablet showed very good control of seed-borne fungal infection with high germination increased (similar results were obtained with hot water treatment).
D. Seed treated with neem leaf extract showed good control of seed-borne fungal infection with moderate germination.
E. Seed treated with BAU-Biofungicide showed lowest control of seed-borne fungal infection with good germination.

ever, treatment of wheat seeds in hot water at 52 - 55°C for 10 min was found quite effective in con-trolling seed-borne infection of *A. tenuis*,*B. sorokiniana*, *C. lunata* and *Fusarium* spp. (Khaleduzzaman, 1996). But good control of seed-borne infection of *B. oryzae* in rice with garlic extract has been demonstrated by Alice and Rao (1987) in New Zealand and by Miah et al. (1990) in Bangladesh. Garlic extract was also found effective in controlling seed-borne patho-genic fungi such as *A. tenuis*, *B. sorokiniana*, *C. lunata* and *Fusarium* spp. in wheat by Hossain et al. (1993) and Khaleduzzaman (1996). Therefore, results of hot water treatment and garlic tablet in controlling selected seed-borne pathogenic fungi of sorghum obtained in the present study are more or less consistent with the findings observed in wheat and rice by other workers. Thus, the findings of the present seed treatment study show that garlic tablet and hot water treatment are quite suitable for controlling seed-borne fungal pathogens in sorghum.

Although neem leaf extract was less effective compared to Vitavax-200, garlic tablet, and hot water treatment in controlling most of the target pathogenic fungi, the treatment was quite effective in reducing *B. sorghicola* (91.4%) in Sherpur sample (Table 2) and *C. lunata* in both the samples (90.5 - 3.3%) (Tables 1 - 2). Khaleduzzaman (1996) obtained 73.0 - 86.3% control of seed-borne infection of *A. tenuis*, *B. sorokiniana*, *C. lunata* and *Fusarium* spp. in wheat by seed treatment with neem leaf extract. Thus based on findings of the present study, neem leaf extract appears to be better in controlling seed-borne infection of some specific fungi like *C. lunata* and *B. sorghicola*. Therefore, neem leaf extract may be advocated for controlling seed-borne infection of *C. lunata* and *B. sorghicola* in sorghum based on proper seed health test.

Highest reduction of the total seed-borne infections of the target pathogenic fungi was obtained with Vitavax-200 (97.7%), followed by hot water treatment (92.2%), garlic tablet (91.3%) and neem leaf extract (86.7%) in Mymensingh sample (Table 3). Incase of Sherpur sample, highest reduction of the total seed-borne pathogenic fungi were observed in Vitavax-200 (98.4%), followed by garlic tablet (91.9%), hot water treatment (90.8%) and neem leaf exract (83.2%) (Table 3). BAU-Biofungicide gave the lowest control of the total seed-borne fungal infections in both the samples obtained from Mymensingh and Sherpur (Table 3).

Effect of five seed treatment practices on germination

Germination was found to increase in both the samples with all the treatments (Plate 1 and Table 4). Increase in germination recorded in the seed treatment study varied depending on the seed treatment practices and initial germination of the test seed samples. Rate of increase in germination was higher in the seed samples of Mymensingh where initial germination was low (64.5%) compared to Sherpur sample which had higher initial germination (83.0%). In Mymensingh seed sample, the highest increase in germination was recorded in seeds treated with Vitavax-200 (34.1%), followed by garlic tablet (31.0%) and neem leaf extract (29.4%), while the lowest increase was observed in seeds treated with hot water (27.1%), followed by BAU-Biofungicide (27.9%). Similar trend of increase in germination, though low, was observed in Sherpur sample. The BAU-Biofungicide has not been used for controlling seed-borne fungal pathogens of sorghum. Shamsuzzaman et al. (2003) reported that BAU-Biofungicide (*Trichoderma harzianum*) increased germination of sweet gourds up to 13% over control (untreated) in tray method. Hannan (2005) was observed 81.33, 77.50 and 85.33% germination of BAU-Biofungicide treated seeds of lentil, chickpea and grass-pea, respectively over control (untreated). Although this bio-control agent gave fairly good increase in germination,

due to its less efficacy in controlling seed-borne fungal infection cannot be advocated for its use as seed treating agent for the crop.

Summary and Conclusion

All the five seed treatment practices used viz. hot water treatment, garlic tablet, neem leaf extract, BAU- Biofungicide and Vitavax-200 reduced significantly the total seed-borne fungal infections as well as the population of individual six target pathogenic fungi- *A. tenuis*, *B. sorghicola*, *B. cinerea*, *C. graminicola*, *C. lunata* and *F. moniliforme*. Increased germination higher than the national standard (>80.0%) was also obtained in all the treatments over the untreated control. Of the five seed treatment practices, Vitavax-200 gave the best result in controlling seed-borne infection of all the individual target pathogenic fungi followed by garlic tablet, hot water treatment and neem leaf extract. The fungicide also gave the highest increase in germination. Garlic tablet and hot water treatment gave almost equally very good control of all the target fungal pathogens reducing more than 90.0% seed-borne infection, except *F. moniliforme* which had 84.6 - 89.2% reduction of seed-borne infection. Neem leaf extract gave over 90.0% reduction in seed-borne infection of *B. sorghicola* and *C. lunata* out of the six target pathogenic fungi. It also gave fairly good control of *C. graminicola* and *F. moniliforme* reducing 80.0 - 86.6% seed-borne infection. BAU-Biofungicide gave the lowest control of total seed-borne fungal infections (61.6 - 62.3%) as well as seed-borne infection of all the individual target pathogenic fungi (<80.0%). Based on the present seed treatment study, it may be concluded that among the five seed treatment practices, Vitavax-200 may be recommended for treatment practices in controlling seed-borne fungal pathogens of sorghum seeds. But the chemical should be used with caution as it is costly, hazardous to health and environment. Garlic tablet and hot water treatment may also be advocated for control of seed-borne fungal pathogens in sorghum as they are cheap, environment friendly and non hazardous to human and animal health. The eco-friendly and non hazardous neem leaf extract seed treatment practice may also be recommended for control of specific seed-borne pathogen, *C. lunata* and *B. sorghicola* in the crop.

REFERENCES

Alice D, Rao AV (1987). Antifungal effects of plant extracts on *Drechslera oryzae* in rice. Int. Rice Res. Newsl. 12(2): 28.

BBS (2005). Bangladesh Bureau of Statistics, Ministry of Planning. Govt. of Bangladesh. p. 21.

Dey TK, Chowdhury N, Ayub A, Goswami BK (1992). Black point of wheat occurrence, effect of fungicidal seed treatment on germination and quality characters. Bangladesh J. Bot. 21(1): 27-32.

Fakir GA (1983). Teaching, Research and Training Activities on Seed Pathology in Bangladesh. Seed Sci. Technol. 11: 1345-1352.

Guldhe SM, Raut JG, Wangikar PD (1985). Control of loose smut infection in wheat by physical and chemical methods of seed treatment. PKV Res. J. 9(1): 56-58.

Hannan MA (2005). Integrated Management of Foot Rot of Lentil, Chickpea and Grasspea. M. S. Thesis. Department of Plant Pathology. Bangladesh Agricultural University, Mymensingh, Bangladesh. p. 114.

Hossain I, Ashrafuzzaman H, Khan MHH (1993). Biocontrol of *Rhizoctonia solani* and *Bipolaris sorokiniana*. BAU. Res. Prog. 7: 264-269.

Hossain MI (2003). Effect of Activator in Composting and Manuring for Management of Seedling Diseases of Common Bean MS. Thesis. Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh. p. 73.

Hyder A, Fakir GA (1993). Control of seed borne fungi of wheat with fungicides. Bangladesh J. Bot. 22(2): 135-141.

ISTA (International Seed Testing Association) (2001). International Rules for Seed Testing. Rules Amendments. Seed Sci. Technol. 29: 1-127.

Karim M (2005). Prevelance of fungi associated with seeds of some minor cereals. An M.S. Thesis. Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. p. 97.

Khaleduzzaman M (1996). Control of seed-borne infection by seed treatmetn in wheat (*Triticum aestivum* L.). M.S. thesis. Dept. of Plant Pathology. Bangladesh Agricultural University, Mymensingh. p. 82.

Miah AT, Ahmed MU, Sharma NR, Ali A, Miah SA (1990). Antifungal activity of some plant extracts. Bangladesh J. Botany. 19(1): 5-20.

Moronova GV (1991). The effectiveness of spring wheat seed treatment. Nauchno-Tekhnicheskii Bull. No. 5: 20-24.

Nene YL, Saxena SC (1971). Present status of research on fungicidal control of wheat rusts and loose smut in India. Second International Symposium, I. A. R. I., New Delhi, India. 10: 83.

Richardson MJ (1990). An Annotated list of seed-borne disease. 4th ed. The Internal Seed Testing Association, Switzerland. p.186, 263, 340.

Shah SE, Mariappan V (1988). Efficacy of new fungicides in the control of sorghum smut in the field. Pesticides. 22(10): 41-42.

Shamsuzzaman S, Islam MA, Hossian I (2003). *Trochoderma* culture and germination of sweet gourd seed. . Bangladesh J. Seed Sci. Tech. 7(1, 2): 91-95.

Sharma RC, Joshi LM (1972). Controlling the hill bunt, Indian Fmg. 22: 31-32.

Talukdar MJ (1974). Palnt Disease in Bangladesh. Bangladesh J. Agri. Res. 1(1): 1-65.

USDA (1960). Index of Plant Disease in the United States. Agricultural hand book. 165: 187-211.