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*Full Length Research Paper*

# Prevalence of seed-borne fungi in sorghum of different locations of Bangladesh

**S. M. M. Islam[1], M. M. I. Masum[2]* and M. G. A. Fakir[3]**

[1]Soil Microbiology Division, Bangladesh Rice Research Institute, Gazipur-1701 Bangladesh.
[2]Department of Plant Pathology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706 Bangladesh.
[3]Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh.

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**Fungi associated with sorghum (*Sorghum vulgare*) seeds collected from eight different locations viz. Jamalpur, Kushtia, Mymensingh, Pabna, Rajbari, Rajshahi, Savar and Sherpur of Bangladesh were detected by Blotter method. About 36% of the sorghum seeds were infected by different species of fungi obtained from the selected locations and nine different fungi identified in order of prevalence, were- *Curvularia lunata*, *Fusarium moniliforme*, *Alternaria tenuis*, *Bipolaris sorghicola*, *Colletotrichum graminicola*, *Botrytis cinerea*, *Aspergillus niger*, *Penicillium oxalicum* and *A. flavus*. Of all these fungi, the most predominant fungus was *C. lunata* (17.4%). The other predominant fungi were *F. moniliforme* (16.2%), *A. tenuis* (15.7%), *B. sorghicola* (11.4%), *C. graminicola* (11.3%) and *B. cinerea* (10.0%). The fungi varied in prevalence with respect to location of seed collection. No definite relationship between germination and seed-borne fungal infection was observed.**

**Key words:** Prevalence, seed-borne fungi, locations, sorghum.

## INTRODUCTION

Seed is the most important input for crop production. Pathogen free healthy seed is urgently needed for desired plant populations and good harvest. 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). Coincidentally important or devastating crop diseases are seed-borne and caused by fungi. It has also been demonstrated that seed-borne fungi are responsible for poor health of seeds in many crops (Neergaard, 1979).

Sorghum (*Sorghum vulgare*) is an important grain and fodder crop ranking fourth after paddy, wheat and maize in the world. The crop is used for feeding poultry, swine, cattle and horses and as human food. 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). Among more than 30 fungal diseases (USDA, 1960). Richardson (1990) listed 40 seed-borne fungal pathogens causing 32 the various factors responsible for the low yield of the crop, diseases play a vital role. Sorghum suffers from 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). A study conducted on the prevalence of fungi in sorghum seeds collected only from four locations of Bangladesh show that a good many fungi are associated with sorghum seeds and as many as eight of them are pathogenic to the crop (Karim, 2005). Thus, there is a need for studying the prevalence of fungi in sorghum seeds collected from more different sorghum growing areas of the country and development of suitable control measures for pathogenic fungi prevalent in sor-

*Corresponding author. E-mail: masum_ban@yahoo.com

**Table 1.** Total fungal infections recorded on seeds of sorghum collected from eight different locations in Bangladesh.

| Location | Number of seed-borne fungal infections |
|---|---|
| Jamalpur | 130 |
| Kushtia | 100 |
| Mymensingh | 185 |
| Pabna | 140 |
| Rajbari | 150 |
| Rajshahi | 135 |
| Savar | 155 |
| Sherpur | 145 |
| Total | 1140 |

ghum seeds.

## MATERIALS AND METHODS

The experiment was conducted at the Seed Pathology Centre (SPC), Bangladesh Agricultural University (BAU), Mymensingh during the period from March to October, 2006. Approximately 1 kg seeds of sorghum were collected for each sample collected from eight different locations (Jamalpur, Kushtia, Mymensingh, Pabna, Rajbari, Rajshahi, Savar and Sherpur) of Bangladesh.

The fungi associated with sorghum (*S. vulgare*) seeds were detected by Blotter method following the International Rules for Seed Testing Association (ISTA, 2001). In this method, three pieces of filter paper (Whatman No. 1) were soaked in sterilized water and placed at the bottom of 9 cm dia. plastic Petri dish. Four hundred seeds from each sample were taken randomly and then placed on the moist filter paper in sixteen Petri dishes at the rate of 25 seeds per plate. The Petri dishes with seeds were then incubated at 22 ± 2°C under 12/12 h alternating cycles of NUV light and darkness in the incubation room of the Seed Pathology Centre (SPC) for seven days. After incubation, the seeds were examined under the stereo-microscope (x 25) for recording the seed borne fungal infections grown on the incubated seeds. Where identification was difficult or doubtful under stereo microscope, the identification was confirmed by preparing slides and examining them under compound microscope.

Seed-borne infections of fungi observed under the stereo-microscope were identified by observing their growth characters on the incubated sorghum seeds in wet blotter. The fungi were identified to species level, following the keys of Chidambaram et al. (1973) and Mathur and Kongsdal (2003). Four hundred seeds were sown in 4 trays (100 seeds per tray) for germination test. Seed germination was recorded along with the seed-borne infection of fungal pathogens after seven days of incubation on wet filter paper in the blotter test.

Seed germination was recorded along with the seed-borne infection of fungal pathogens after seven days of incubation on wet filter paper in the blotter test. Germination was also determined with natural soil in plastic tray in the green house of the Seed Pathology Centre (SPC), BAU, Mymensingh. The soil was collected from the field laboratory of Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. Four hundred seeds were sown in 4 trays (100 seeds per tray) for germination test. Data on germination were recorded after 4, 7 and 14 days after sowing. But germination recorded on the 14$^{th}$ day was taken into final account. As there was little difference in germination recorded on wet blotter in Blotter test and in soil in plastic trays, germination determined in the Blotter test was taken into final account.

## RESULTS AND DISCUSSION

### Total seed-borne fungal infections

A total of 1140 seed-borne fungal infections were recorded from 3200 seeds obtained from eight different locations of Bangladesh viz. Jamalpur, Kushtia, Mymensingh, Pabna, Rajbari, Rajshahi, Savar and Sherpur. The total seed-borne fungal infections varied in prevalence considerably depending on the location of seed collection. The highest seed-borne fungal infection was observed at Mymensingh (185) followed by Savar (155) and Rajbari (150). The lowest number of fungal infection (100) was recorded at Kushtia (Table 1). The present study revealed that 36% of the sorghum seeds were infected by different species of fungi. This indicates that sorghum seeds are frequently infected by fungi. In an earlier study, Karim (2005) found 39% of the sorghum seeds infected by fungi obtained from four locations only. Still, the results of the two studies are more or less similar. This is probably because similar seed-borne fungi occur on sorghum in Bangladesh in the consecutive growing seasons.

### Fungi identified and their frequency of occurrence

Out of 1140 seed-borne fungal infections recorded in sorghum seeds obtained from eight different locations, nine species of fungi representing eight genera were identified (Table 2).

The identified fungi were- *Alternaria tenuis*, *Aspergillus flavus*, *Aspergillus niger*, *Bipolaris sorghicola*, *Botrytis cinerea*, *C. graminicola*, *Curvualria lunata*, *Fusarium moniliforme*, and *Penicillium oxalicum*. Of all these fungi, the most predominant fungus was *C. lunata* (17.4%). The other predominant fungi were *F. moniliforme* (16.2%), *A. tenuis* (15.7%), *B. sorghicola* (11.4%), *C. graminicola* (11.3%) and *B. cinerea* (10.0%). Each of these fungi constituted at least 10.0% of the total seed-borne fungal infections. *A. flavus* had the lowest occurrence (4.3%). Regarding percentage of seed yielding individual fungi, 6.2% of the seeds yielded *C. lunata* followed by *F. moniliforme* (5.8%) and *A. tenuis* (5.6%). All these fungi, except *A. flavus* were reported from the seeds of sorghum in the country by Karim (2005). Seven species of fungi detected in sorghum seeds obtained from different locations of Punjab, India were- *A. flavus*, *A. niger*, *A. tenuis*, *C. lunata*, *F. moniliforme*, *Helmintho-sporium* (*Bipolaris*) *sativum and Penicillium* spp. *F. moniliforme* was found to be the most devastating fungus in seed germination trials by Randhawa et al. (1998). So, the present findings are in agreeable with these reports.

**Table 2.** Frequency of occurrence of individual fungi recorded on sorghum seeds collected from eight locations.

| Fungi | Number of fungal infections | % of total infections [a] | % of total seed-borne fungal infections [b] |
|---|---|---|---|
| *Alternaria tenuis* [c] | 180 | 15.7 | 5.6 |
| *Aspergillus flavus* | 50 | 4.3 | 1.6 |
| *Aspergillus niger* | 102 | 8.9 | 3.2 |
| *Bipolaris sorghicola* [c] | 130 | 11.4 | 4.0 |
| *Botrytis cinerea* [c] | 110 | 10.0 | 3.4 |
| *Colletotrichum graminicola* [c] | 129 | 11.3 | 4.0 |
| *Curvularia lunata* [c] | 199 | 17.4 | 6.2 |
| *Fusarium moniliforme* [c] | 185 | 16.2 | 5.8 |
| *Penicillium oxalicum* | 70 | 6.1 | 2.2 |

[a]Percentage of total infection was calculated on the basis of 1140 fungal infections
[b]Percentage of the seed yielding of different fungi was calculated on the basis 3200 seeds
[c]Predominant fungus constituted at least 10.0% of the total seed-borne infection

## Prevalence of individual seed-borne fungi

The prevalence of total as well as individual infection of fungi recorded in sorghum seeds in the present study varied depending on the location of seed collection (Table 3). Similar variation in the prevalence of seed-borne fungi of sorghum with respect to location has been reported in the crop by Karim (2005). Thus, it indicates that the results of the present study are more or less consistent with the earlier work carried out by Karim (2005).

*A. tenuis* was prevalent in all the eight seed samples. The highest occurrence of the fungus was recorded in the seed sample collected from Kushtia (10.6%), followed by Savar (10.2%). The lowest count of the fungus was observed in Jamalpur and Rajbari samples (4.6%). The highest occurrence of *A. flavus* was noted in Mymensingh sample (10.0%) followed by Savar (6.3%); while the lowest record of the fungus was encountered at Jamalpur and Kushtia (4.5%). Seed samples of Rajbari, Rajshahi and Sherpur were found completely free from *A. flavus*. *A. niger* was obtained in all the seed samples, except Pabna. The maximum incidence of the fungus was recorded in seed sample of Jamalpur (7.5%), followed by Mymensingh and Rajshahi (6.5%); while the minimum count of the fungus was encountered at Kushtia and Rajbari (3.0%). The highest count of *B. sorghicola* was recorded in seed sample of Savar (14.0%), followed by Sherpur (9.4%); while the lowest occurrence of the fungus was detected at Pabna (4.4%). No *B. sorghicola* was observed in the seed sample of Jamalpur and Mymensingh. The highest seed-borne infection of *B. cinerea* was observed in seed sample of Jamalpur (12.4%), followed by Rajbari (11.0%); while the lowest record of the fungus was encountered in Mymensingh and Rajshahi samples (3.5%). The fungus could not be detected in seed samples of Kushtia, Sherpur and Pabna. *C. graminicola* was observed in six samples out of eight. The maximum occurrence of the fungus was recorded in Sherpur sample (6.4%), followed by Mymensingh (5.6%); whereas the minimum count of the fungus was observed at Rajshahi (3.4%). The fungus could not be detected in the seed samples of Rajbari and Savar. *C. lunata* was prevalent in all the eight seed samples. The highest seed-borne infection of the fungus was obtained in the sample of Pabna (14.5%), followed by Mymensingh (14.0%); whereas the lowest count of the fungus was observed at Rajshahi (3.5%). *F. moniliforme* was recorded in all the seed samples, except Jamalpur. The highest occurrence of the fungus was recorded in Rajbari (14.7%), followed by Savar (7.5%); whereas the lowest record of the fungus was obtained at Rajshahi (3.5%). *P. oxalicum* was observed in six samples out of eight. The maximum occurrence of the fungus was obtained in the seed sample of Jamalpur (6.6%), followed by Mymensingh (4.5%). The minimum record of the fungus was encountered at Pabna (2.5%). No *P. oxalicum* was detected in seed samples of Rajbari and Rajshahi.

## Germination

Germination of eight seed samples obtained from eight different locations varied significantly from 65.0 - 82.5% depending on the locations of seed collection. Highest germination was recorded in seed sample obtained from Sherpur (82.5%), followed by Rajshahi (80.5%) and Jamalpur (76.5%); while the lowest germination was encountered in the sample collected from Mymensingh (65.0%), followed by Rajbari (70.0%) (Table 4). Germination failure recorded in all the eight seed samples were always lower than the total seed-borne fungal infections observed. But no definite relationship between germination failure and total seed-borne fungal infections was observed. The highest germination failure was recorded at Mymensingh (35.0%); while the highest seed-borne fungal infection was observed with the seed sample of Savar (64.3%). Similarly, the lowest germination failure

**Table 3.** Fungi associated with sorghum seed samples collected from eight different locations.

| Location of collection | % seed-borne fungi [a] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Alternaria tenuis* | *Aspergillus Flavus* | *Aspergillus niger* | *Bipolaris sorghicola* | *Botrytis cinerea* | *Colletotrichum graminicola* | *Curvualria lunata* | *Fusarium moniliforme* | *Penicillium oxalicum* |
| Jamalpur | 4.6 c | 4.5 c | 7.5 a | 0.0 e | 12.4 a | 4.7 bc | 8.6 b | 0.0 d | 6.6 a |
| Kushtia | 10.6 a | 4.5 c | 3.0 d | 6.5 c | 0.0 e | 3.5 d | 5.0c | 3.6 c | 3.0 c |
| Mymensingh | 8.8 b | 10.0 a | 6.5 ab | 0.0 e | 3.5 d | 5.6 ab | 14.0 a | 6.5b | 4.5 b |
| Pabna | 8.5 b | 4.7 c | 0.0 e | 4.4 d | 0.0 e | 3.5 d | 14.5 a | 6.5 b | 2.5 c |
| Rajbari | 4.6 c | 0.0 d | 3.0 d | 7.5 c | 11.0 b | 0.0 e | 3.9 cd | 14.7 a | 0.0 d |
| Rajshahi | 8.0 b | 0.0 d | 6.5 ab | 6.4 c | 3.5 d | 3.4 d | 3.5 d | 3.5 c | 0.0 d |
| Savar | 10.2 a | 6.3 b | 5.0 c | 14.0 a | 8.6 c | 0.0 e | 8.7 b | 7.5 b | 4.0 bc |
| Sherpur | 8.0b | 0.0 d | 6.0 bc | 9.4b | 0.0 e | 6.4 a | 9.5 b | 4.0 c | 3.5 bc |
| CV (%) | 8.57 | 14.02 | 14.13 | 9.62 | 11.45 | 17.82 | 7.56 | 11.90 | 19.97 |

**Table 4.** Germination recorded in sorghum seed sample collected from eight different locations.

| Location | % Germination [a] |
|---|---|
| Jamalpur | 76.5 c |
| Kushtia | 72.0 d |
| Mymensingh | 65.0 f |
| Pabna | 75.5 c |
| Rajbari | 70.0 e |
| Rajshahi | 80.5 b |
| Savar | 72.0 d |
| Sherpur | 82.5 a |
| CV (%) | 1.21 |

[a]Data based on 400 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

was found at Sherpur (17.5%), but the lowest seed-borne infection was recorded at Rajshahi (34.8%) (Table 5). While analyzing the relationship between germination failure and the occurrence of total seed-borne infection of pathogenic fungi, it was observed that the highest or the lowest germination failure was not related with the highest or the lowest incidence of seed-borne fungal infections (Table 5). This indicates that no definite or direct relationship existed between germination and seed-borne fungal infections present in sorghum seeds.

## Summary and Conclusion

Prevalence of seed-borne fungi of sorghum (*S. vulgare*) collected from eight different locations of Bangladesh viz. Jamalpur, Kushtia, Mymensingh, Pabna, Rajbari, Rajshahi, Savar and Sherpur was determined by Blotter method in the Seed Pathology Centre (SPC), Bangladesh Agricultural University (BAU), Mymensingh. A total of 1140 seed-borne fungal infections were recorded from 3200 sorghum seeds. Out of total seed-borne fungal infections, nine different fungi, representing eight genera were identified. The fungi in order to prevalence were – *C. lunata*, *F. moniliforme*, *A. tenuis*, *B. sorghicola*, *C. graminicola*, *B. cinerea*, *A. niger*, *P. oxalicum* and *A. flavus*. Out of nine fungi, *A. tenuis*, *B. sorghicola*, *B. cinerea*, *C. graminicola*, *C. lunata* and *F. moniliforme* were the predominant fungi, each constituting at least 10.0% of the total seed-borne fungal infections. Of the predominant fungi, *C. lunata* was the most predominant, constituting 17.4% of the total fungal infection. The prevalence of total population of fungal infections and the individual fungi detected in seeds of the crop varied significantly with respect to locations of seed collection. Germination recorded in seeds obtained from different locations varied significantly from 82.0 - 94.5%. No definite relationship between germination and seed-borne fungal infection was observed. The phenomenon suggests that fungi along with other factor(s) might have contributed to failure of seed germination.

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**Table 5.** Relationship between germination failure and total seed-borne fungal infections in sorghum.

| Location | % Germination failure [a] | %Total seed-borne fungal infections [a] |
|---|---|---|
| Jamalpur | 23.5 d | 48.9 c |
| Kushtia | 28.0 c | 39.7 f |
| Mymensingh | 35.0 a | 59.4 b |
| Pabna | 24.5 d | 44.6 e |
| Rajbari | 30.0 b | 44.7 e |
| Rajshahi | 19.5 e | 34.8 g |
| Savar | 28.0 c | 64.3 a |
| Sherpur | 17.5 f | 46.8 d |
| CV (%) | 2.58 | 1.29 |

[a]Data based on 400 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

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