DIVERSITY OF SEED BORNE FUNGI ASSOCIATED WITH FOURTEEN VARIETIES OF STORAGE COTTON (*Gossypium hirsutum* L.) SEEDS

Khatun, A., S. Shamsi and M. A. Bashar

Mycology and Plant Pathology Laboratory, Department of Botany, University of Dhaka, Dhaka- 1000, Bangladesh

Abstract

Present paper deals with the occurrence and diversity of fungi on storage cotton (*Gossypium hirsutum* L.) seeds. 24 species of the fungi were found associated with the seeds of 14 varieties of cotton after 10 months of storage. The isolated fungi were *Aspergillus flavus* Link, *A. fumigatus* Fresenius, *A. niger* (Type 1 and Type 2) Van Tiegh, *A. ochraceus* K. Wilhelm, *A. nidulans* Eidam, *Aspergillus* sp.1, *Aspergillus* sp.2, *Aspergillus* sp.3, *Curvularia lunata* (Wakker) Boedijn, *Colletotrichum gloeosporioides* Penz & Sacc, *C. gossypii* Southw., *Chaetomium globosum* Kunze., *Fusarium nivale* (Fr.) Sorauer, *F. moniliforme* J. Shelden, *F. oxysporum* Schlechtendal, *F. fujikuroi* Nirenberg, *Mucor* sp. P. Micheli ex L., *Penicillium* sp.1 and sp.2 Link, *Rhizoctonia solani* Khun., *Rhizopus stolonifer* (Ehrenb.) Vuill., *Rhizomucor* Lucet & Costantin, *Syncephalastrum racemosum* Cohn and *Trichoderma viride* Pers. The association of fungi with cotton seeds was recorded within two months of harvest, after 6 and 10 months of storage. The association of fungi varied with duration of storage periods. *Aspergillus flavus, A. fumigatus, A. niger, Chaetomium globosum, Penicillium* sp.1 and *Rhizopus stolonifer* were found in all the examined varieties. These were the most predominant fungi in terms of prevalence with the increase of storage periods. The fungal association with the seeds of cotton also affected the germination, seedling mortality, height and vigor. The total association of fungi in cotton seeds was the highest in cotton variety CB10 (204) and the lowest in CB8 (71). On the other hand, the total fungal association of *Rhizopus stolonifer* was the highest (337) and *Colletotrichum gossypii* was the lowest (1).

Key words: Biodiversity, cotton seeds, fungi, germination, seedling height, seedling mortality, vigor index.

INTRODUCTION

Cotton is one of the most known and reliable fiber yielding as well as cash crops around the world. Its seeds are also used in oil production. It is harvested as seed cotton and ginned to separate seed and lint (Tripathi *et al.* 2014). Cotton is cultivated in more than seventy countries, which represents 2.5% of all cultivated land and grows mostly in the tropical and subtropical regions of the world. Pathogen free healthy seeds are prerequisites for healthy and high yield crop production of all agricultural products. The lack of high quality seeds and the prevalence of seed borne organisms are the main constraints of crop production.

Fungi are the largest group of the seed-borne pathogens due to their capacity of multiplication and survival in nature (Neergaard 1977, Richardson 1990, Machado and Langerak 2002). Cotton is generally propagated by seeds and these are potential harbor of numerous micro-fungi which may impair seed germination resulting in the production of abnormal seedlings. Most cotton diseases are transmitted through seeds which in most cases affect the quality of the fibre and seed. The seed borne pathogens may cause discoloration of seed and embryos, seed rot, seed necrosis, reduce germination and seedling damage (Khanzada *et al*. 2002, Jeyalakshmi *et al*. 1999, Eisa *et al*. 2007, Tomar *et al*. 2012). Cotton seeds in storage carry 'field' and 'storage' fungi. Most of the storage pathogens are *Penicillium*, *Aspergillus* and *Rhizopus*.

Lot of research has been done in home and abroad on cotton diseases and their control but information on storage seed borne mycoflora of cotton seeds is inadequate. Considering the importance of this crop present research work was undertaken to study the diversity of fungi in different varieties of cotton seeds in storage condition.

MATERIALS AND METHODS

An investigation was conducted on the storage seeds of cotton. The seeds of fourteen varieties of cotton (CB 1 - CB 14) were collected from Cotton Research, Training and Seed multiplication Farm, Sreepur, Gazipur. Samples were collected after harvesting and kept in clean glass jar, and preserved at room temperature (ºC) for future use.

The fungi were isolated from the collected samples following the 'Tissue planting method' on Potato Dextrose Agar (PDA) medium (CAB 1968), Blotter method and Paper towel method (ISTA 1996). For the Tissue planting method, 300 seeds were washed in sterile water and then surface sterilized by 10% Chlorox. Then, they were transferred to sterilized blotting paper to remove the excess surface water. The seeds were placed in Petri plates containing sterilized PDA medium. The inoculated plates were incubated at 25 ± 2 °C for 5-7 days. The association of the fungi with cotton seeds was recorded thrice by this method within two months of harvest, after 6 and 10 months of storage.

The identification of the isolates was determined based on the morphological characteristics observed under a compound microscope following standard literature (Thom and Rapper 1945, Rapper and Thom 1949, Subramanian 1971, Barnett and Hunter 2000, Benoit and Mathur 1970, Booth 1971, Ellis 1971, 1976, Sutton 1980). Per cent frequency of occurrence of the fungi was calculated by adopting the formula of Spurr and Wetly (1972).

For the determination of germination, 300 seeds of each sample were taken and placed in 30 PDA plates. The plates were then incubated at room temperature (ºC) for seven days. Seeds producing both plumule and radical were considered as germinated seeds. Germination was recorded after seven days and expressed as percentage.

The seed quality, seedling mortality and seeding height of different varieties of cotton seeds were determined according to the method described by Shamsi and Khatun (2016). The seedling vigor index of different cotton varieties was recorded with the formula of Lee *et al*. (2008).

RESULTS AND DISCUSSION

Twenty four species of fungi belonging to 12 genera were found to be associated with the seeds of 14 varieties (CB 1- CB 14) of cotton. The isolated fungi were *Aspergillus flavus* Link, *A. fumigatus* Fresenius, *A. niger* (Type 1 and Type 2) Van Tiegh, *A. ochraceus* K. Wilhelm, *A. nidulans* Eidam, *Aspergillus* sp.1, *Aspergillus* sp.2, *Aspergillus* sp.3, *Curvularia lunata* (Wakker) Boedijn, *Colletotrichum gloeosporioides* Penz and Sacc, *C. gossypii* Southw., *Chaetomium globosum* Kunze., *Fusarium nivale* (Fr.) Sorauer, *F. moniliforme* J. Shelden, *F. oxysporum* Schlechtendal, *F. fujikuroi* Nirenberg, *Mucor* sp. P. Micheli ex L., *Penicillium* sp.1 and sp.2 Link, *Rhizoctonia solani* Khun., *Rhizopus stolonifer* (Ehrenb.) Vuill., *Rhizomucor* Lucet & Costantin, *Syncephalastrum racemosum* Cohn and *Trichoderma viride* Pers. (Figs. 1 and 2).

The fungi associated with cotton seeds within two months of harvest is presented in Table 1. Nineteen species of fungi belonging to 10 genera were associated with 14 varieties of cotton seeds. The isolated fungi were *Aspergillus flavus*, *A. fumigatus*, *A. niger* (Type 1), *A. niger* (Type 2), *Aspergillus* sp.1, 2 and 3, *Curvularia lunata*, *Colletotrichum gossypii*, *C. gloeosporioides*, *Chaetomium globosum*, *Fusarium oxysporum*, *F. nivale*, *F. fujikuroi*, *Mucor* sp., *Penicillium* sp.1 and 2, *Rhizopus stolonifer*, *Rhizoctonia solani* and *Trichoderma viride.* Prevalence of *A. niger* (Type 1) and *Aspergillus* sp.3 was highest (100%) in cotton variety CB12 and CB9, respectively, whereas prevalence of *C. lunata*, *C. gossypii*, *Mucor* sp. and *Penicillium* sp.2 were lowest (2%). The total association was the highest in CB12 (269) and the lowest in CB8 (61).

Fig. 1. Fungi associated with the seeds of different cotton varieties (CB1-CB14). **a**. *Aspergillus flavus*; **b**. *A. fumigatus*; **c.** *A. niger* (Type 2); **d**. *A. niger* (Type 1); **e.** *Aspergillus* sp.1; **f.** *Aspergillus* sp.2; **g**. *Aspergillus* sp.3; **h.** *A. ochraceus*; **i**. *A. nidulans*; **j.** *Chaetomium globosum*; **k.** *Colletotrichum gossypii*; **l**. *C. gloeosporioides*; **m**. *Curvularia lunata*; **n**. *Fuarium oxysporum*; **o.** *F. nivale*; **p.** *F. moniliforme*; **q.** *F. fujikuroi*; **r.** *Mucor* sp.; **s.** *Penicillium* sp.1; **t.** *Penicillium* sp.2; **u.** *Rhizopus stolonifer*; **v.** *Rhizoctonia solani*; **w.** *Rhizomucor* sp.; **x.** *Syncephalastrum racemosum*; and **y.** *Trichoderma viride*.

Table 2 represents the association of fungi with cotton seeds after six months of storage. The associated fungi were *Aspergillus flavus*, *A. fumigatus*, *A. niger* (Type 1 and 2), *Aspergillus* sp.1, 2 and 3, *A. ochraceus*, *Chaetomium globosum*, *Fusarium nivale*, *F. moniliforme*, *Penicillium* sp.1, *Mucor* sp., *Rhizopus stolonifer*, *Rhizoctonia solani* and *Syncephalastrum racemosum.* The frequency percentage of *R. stolonifer* was the highest (100%) in CB5 and CB10. On the other hand, the lowest (2%) was found in *Aspergillus* sp.1, *A. ochraceus*, *Penicillium* sp.1, *Chaetomium globosum* and *Syncephalastrum racemosum*. The total association was the highest in CB10 (208) and the lowest in CB8 (50).

The prevalence of fungi with the seeds of cotton after 10 months is presented in Table 3. The isolated fungi were *Aspergillus flavus*, *A. fumigatus*, *Aspergillus niger* (Type 1), *A. nidulans*, *A. ochraceus*, *Aspergillus* sp.2, *A.* sp.3, *Curvularia lunata*, *Chaetomium globosum*, *Fusarium nivale*, *Mucor* sp., *Penicillium* sp.1, *Rhizopus stolonifer*, *Rhizoctonia solani*, *Rhizomucor* sp. and *Trichoderma viride*. The frequency percentage of *Aspergillus* spp., *Chaetomium globosum*, *Rhizopus stolonifer* and *Penicillium* sp.1 gradually increased with the increase of storage period. The prevalence of *Aspergillus* sp.3 was the highest (100%) in CB10. *Aspergillus* sp. 2, *A. ochraceus*, *Curvularia lunata* and

Trichoderma viride was recorded the lowest (2%) in CB1, CB12 and CB6, respectively. The total association was the highest in CB10 (177) and the lowest in CB2 (53).

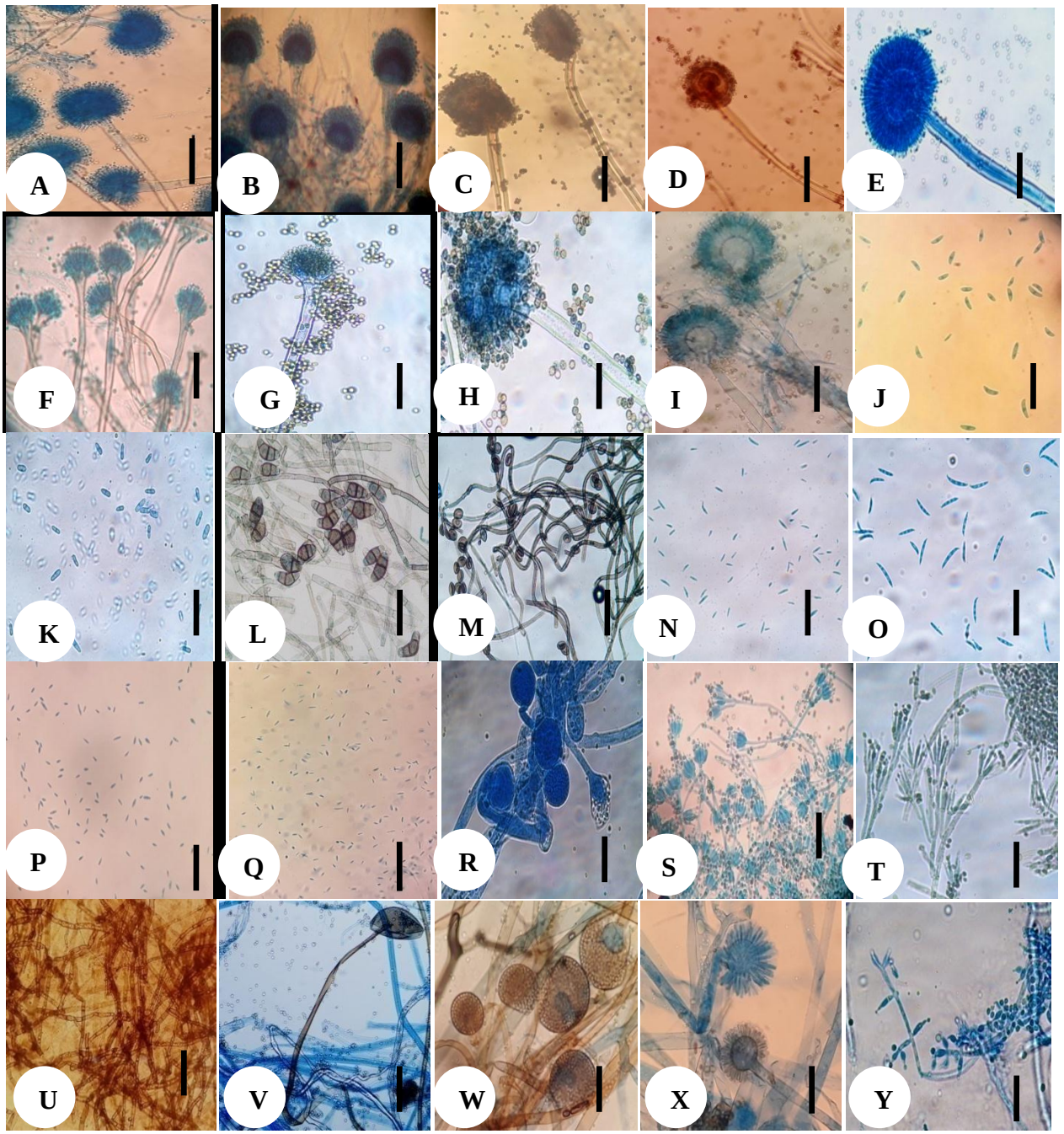

Fig. 2. Conidia, conidiophores and hyphae of different fungi associated with cotton seeds. **A**. *Aspergillus flavus*; **B.** *A. fumigatus*; **C.** *A. niger* (Type 1); **D.** *A. niger* (Type 2); **E.** *A. ochraceus*; **F**. *A. nidulans*; **G.** *Aspergillus* sp.1; **H.** *Aspergillus* sp.2; **I**. *Aspergillus* sp.3; **J**. *Colletotrichum gossypii*; **K.** *C. gloeosporioides*; **L**. *Curvularia lunata*; **M.** *Chaetomium globosum*; **N.** *Fusarium oxysporum*; **O**. *F. nivale*; **P.** *F. moniliforme*; **Q**. *F. fujikuroi*; **R.** *Mucor* sp.; **S.** *Penicillium* sp.1; **T.** *Penicillium* sp.2; **U.** *Rhizoctonia solani*; **V.** *Rhizopus stolonifer*; **W.** *Rhizomucor* sp.; **X**. *Syncephalastrum racemosum*; and **Y**. *Trichoderma viride* (Bar = 50 µm).

Table 1. Percentage of association of fungi with different varieties of cotton seeds within two months of harvest.

Name of fungi	Frequency percentage of fungi with different varieties of cotton seeds													
	CB 1	**CB 2**	**CB 3**	**CB 4**	**CB 5**	**CB 6**	**CB 7**	**CB 8**	**CB 9**	**CB 10**	**CB 11**	**CB 12**	**CB13**	**CB14**
Aspergillus flavus	4	-	12	16	-	36	8	3	-	12	4	23	3	3
Aspergillus fumigatus	12	26	6	10	18	-	-	18	-	16	3	10	-	-
Aspergillus niger (T 1)	28	10	16	8	16	4	34	4	6	8	34	100	52	96
Aspergillus niger (T 2)	-	-	-	-	10	-	-	4	-	-	20	48	50	24
Aspergillus sp. 1	8	-	4	-	6	-	-	-	-	-	-	-	-	-
Aspergillus sp. 2	-	-	-	-	-	-	86	-	-	4	-	-	-	-
Aspergillus sp. 3	-	-	-	34	-	-	44	-	100	86	-	-	-	-
Chaetomium globosum	-	-	-	-	-	-	-	-	-	20	-	-	-	-
Colletotrichum gloeosporioides	-	7	9	-	-	-	7	3	5	-	-	-	-	3
Colletotrichum gossypii	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Curvularia lunata	-	-	-	2	3	-	-	-	-	-	2	2	-	6
Fusarium fujikuroi	8	-	-	-	-	-	-	6	-	-	-	-	4	-
Fusarium oxysporum	-	-	-	-	-	-	-	-	-	-	-	6	-	-
Fusarium. nivale	-	14	4	5	-	7	-	8	-	6	3	-	3	3
Mucor sp.	-	-	-	-	-	-	-	-	-	2	-	8	4	8
Penicillium sp. 1	8	-	4	-	10	-	-	-	-	14	3	-	-	-
Penicillium sp. 2	-	4	-	-	-	-	-	4	-	-	-	-	2	8
Rhizoctonia solani	8	6	-	-	5	-	-	-	-	-	-	52	10	8
Rhizopus stolonifer	30	30	50	-	8	10	22	8	20	12	35	20	-	4
Trichoderma viride	-	4	4	24	12	12	10	4	6	-	-	-	3	-
Total fungi	**106**	**101**	**109**	**98**	**88**	**69**	**211**	**61**	**137**	**180**	**102**	**269**	**131**	**162**

- = No fungal growth; T= Type

Table 2. Frequency percentage of association of fungi with different varieties of cotton seeds after six months of storage.

Name of fungi	Frequency percentage of fungi with different varieties of cotton seeds													
	CB1	**CB2**	**CB3**	**CB4**	**CB5**	**CB6**	**CB7**	**CB8**	**CB9**	**CB10**	**CB11**	**CB12**	**CB13**	**CB14**
Aspergillus flavus	6	12	6	16	20	10	20	6	12	24	12	12	24	48
Aspergillus fumigatus	3	10	-	-	14	8	-	8	4	6	3	22	10	28
Aspergillus niger (T 1)	4	22	16	10	30	6	14	12	4	36	60	20	84	10
Aspergillus niger (T 2)	-	-	-	-	-	-	-	-	-	-	33	14	16	6
Aspergillus ochraceus	12	-	-	2	-	-	-	4	-	-	-	-	-	-
Aspergillus sp. 1	-	4	-	-	2	-	-	-	-	28	-	4	-	3
Aspergillus sp. 2	14	-	-	-	-	-	-	-	-	14	-	-	10	4
Aspergillus sp. 3	60	-	46	34	-	56	34	6	36	-	-	-	-	-
Chaetomium globosum	-	2	-	-	-	-	-	-	-	-	3	12	-	-
Fusarium moniliforme	4	-	-	-	3	-	-	-	-	-	5	-	-	-
Fusarium nivale	-	4	-	5	-	-	-	-	-	-	-	-	-	6
Mucor sp.	-	-	3	-	-	-	3	4	-	-	-	4	-	-
Penicillium sp. 1	10	8	-	6	4	6	-	10	-	-	2	2	-	3
Rhizoctonia solani	-	-	-	-	-	-	-	-	-	-	10	-	-	-
Rhizopus stolonifer	10	70	62	52	100	40	4	-	52	100	20	12	10	10
Syncephalastrum racemosum	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Total fungi	**124**	**132**	**133**	**125**	**173**	**126**	**75**	**50**	**108**	**208**	**148**	**102**	**154**	**117**

- = No fungal growth; T= Type

The results are in agreement with the findings of Mansoori and Hamdolahzadeh 1995), who isolated *Alternaria alternata*, *Aspergillus niger*, *Fusarium acuminatum*, *F. solani*, *Pythium ultimum*, *Rhizopus arrhizus* and *Rhizoctonia solani* from cotton seeds. *F. oxysporum* and *F. solani* were the

predominating species which gradually decreased with the increase of storage fungi like the species of *Aspergillus, Penicillium* and *Rhizopus*. *Aspergillus* sp. was the highest.

Table 3. Percentage of the association of fungi with different varieties of cotton seeds after ten months of storage.

Name of fungi	Frequency percentage of fungi with different varieties of cotton seeds													
	CB1	**CB2**	**CB3**	**CB4**	**CB5**	**CB6**	**CB7**	**CB8**	**CB 9**	**CB10**	**CB11**	**CB12**	**CB13**	**CB14**
Aspergillus flavus	2	7	24	9	12	-	4	25	10	3	8	12	17	24
Aspergillus nidulans	4	-	-	6	-	-	-	-	-	-	-	-	-	-
Aspergillus sp. 2	2	-	14	10	10	22	17	4	18	4	-	5	3	4
Aspergillus fumigatus	6	4	8	8	4	10	12	9	8	12	4	4	7	6
Aspergillus niger (T 1)	-	7	16	-	30	24	9	6	10	16	70	24	78	34
Aspergillus ochraceus	-	-	-	-	3	-	4	-	19	-	-	2	-	4
Aspergillus sp. 3	6	-	38	46	-	-	96	-	-	100	-	-	-	-
Chaetomium globosum	18	25	16	22	5	28	7	4	20	-	-	13	-	52
Curvularia lunata	-	-	-	-	-	2	-	3	-	-	-	-	-	-
Fusarium nivale	10	-	-	-	5	-	-	6	-	-	3	-	3	-
Mucor sp.	-	-	-	-	-	-	-	-	3	-	-	-	-	-
Penicillium sp. 1	30	-	4	14	10	10	14	25	4	32	-	36	15	38
Rhizoctonia solani	-	-	-	-	-	-	10	-	-	-	-	-	-	-
Rhizomucor sp.	-	-	-	-	-	-	-	-	3	-	-	-	-	-
Rhizopus stolonifer	-	10	-	11	12	-	-	-	45	10	100	21	20	10
Trichoderma viride	-	-	-	-	-	-	-	4		-	-	-	-	2
Total fungi	**83**	**53**	**120**	**126**	**117**	**116**	**173**	**96**	**139**	**177**	**185**	**119**	**148**	**174**

- = No fungal growth; T= Type

Table 4 shows that twenty four species of fungi were found to be associated with fourteen varieties of cotton seeds. *Aspergillus flavus, A. fumigatus, A. niger, Chaetomium globosum, Penicillium* sp.1 and *Rhizopus stolonifer* were found in all varieties examined and frequency percentage of the association of these fungi were also higher. These were the most predominant fungi in terms of prevalence. These six predominant fungi varied in prevalence with respect to variety and time duration, whereas *Colletotrichum gossypii, Fusarium oxysporum, Syncephalastrum racemosum* and *Rhizomucor* sp. were exclusively isolated from only one variety. The frequency percentages of these fungi were very low. The total association of fungi in cotton seeds was the highest in CB10 (204) and the lowest in CB8 (71). On the other hand, the total association of *Rhizopus stolonifer* was the highest (337) and *Colletotrichum gossypii* was the lowest (1). *Alternaria tenuis, Aspergillus flavus, A. niger, A. fumigatus, Fusarium moniliforme* and *Rhizopus nigricans* were also reported predominant in the cotton seeds of Bangladesh by Lutfunnessa and Shamsi (2011).

The quality percentage and humidity of different varieties of cotton seeds are presented in Table 5. The study revealed that, in respect of purity, all the cotton varieties individually did not follow the standard of CDB (Anon. 2016-2017), but the mean value followed the standard. In respect of other seeds and non seeds, they have followed the standard. The maximum purity percentage was 99.92 in CB13 and the minimum was 97.08 in CB12. On the other hand, the maximum other seed percentage was 0.91 in CB12 and minimum was 0.0%. The maximum non or abio seed percentage was 1.0 in CB5 and minimum percentage was 0.10 in CB13. Maximum humidity percentage was 11.3 in CB12 and minimum in CB5 (10). All these factors followed the standard of CDB rules (Anon. 2016-2017).

Table 6 shows the germination, seedling mortality, seedling height and vigor index of 14 varieties of cotton seeds. The germination percentage of seeds was the highest in CB 10 (93) and the lowest in CB4 (80). The percentage of seedling mortality was the highest in CB11 (50.30) and the lowest in CB7

(16.05). The length of shoot was the highest in CB 2 (19.8 mm) and the lowest in CB 4 (9.0 mm) whereas root length was the highest in CB 5 (4.6 mm) and the lowest in CB 9 (3.0 mm). The vigor index was the highest in CB10 (2064.6) and the lowest in CB4 (952.0).

Table 4. Average per cent incidence of fungi with 14 varieties of cotton seeds after 10 months of storage.

Name of fungi	Frequency percentage of fungi with different varieties of cotton seeds														Total fungi
	CB 1	CB2	CB 3	CB4	CB 5	CB6	CB7	CB8	CB9	CB10	CB11	CB12	CB13	CB14	
Aspergillus flavus	4	6	14	14	11	16	20	12	7	13	8	16	15	25	181
A. fumigatus	7	14	5	6	12	6	4	12	6	11	6	12	6	12	119
A. nidulans	2	-	-	3	-	-	-	-	-	-	-	-	-	-	5
A. niger (T 1)	11	13	16	6	25	12	19	8	7	20	55	48	72	47	359
A. niger (T 2)	-	-	-	-	4	-	-	2	-	-	18	21	22	10	77
A. ochraceus	4	-	-	2	1	-	2	2	6	-	-	2	-	2	21
Aspergillus sp. 1	3	2	2	-	3	-	-	-	-	10	-	2	-	1	23
Aspergillus sp. 2	5	-	5	3	3	7	6	2	6	9	-	5	5	3	53
Aspergillus sp. 3	22	-	28	38	-	19	58	2	45	74	-	-	-	-	286
Chaetomium globosum	6	9	6	8	2	9	3	2	7	7	2	8	2	18	89
Colletotrichum gloeosporioides	-	3	3	-	-	-	2	1	2	-	-	-	-	1	12
C. gossypii	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Curvularia lunata	-	-	-	1	1	1	-	1	-	-	1	2	-	2	9
Fusarium fujikuroi	3	-	-	-	-	-	-	2	-	-	-	-	2	-	7
F. moniliforme	2	-	-	-	3	-	-	-	-	-	3	-	-	-	8
F. nivale	3	6	2	3	2	3	-	5	2	2	3	-	2	3	36
F. oxysporum	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4
Mucor sp.	-	-	1	-	-	-	-	2	2	2	-	4	2	3	16
Penicillium sp. 1	18	3	2	7	5	6	5	12	2	16	2	13	5	14	110
Penicillium sp. 2	-	2	-	-	-	-	-	2	-	-	-	-	2	3	9
Rhizoctonia solani	3	2	-	-	2	-	3	-	-	-	5	17	4	3	39
Rhizomucor sp.	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2
Rhizopus stolonifer	14	37	38	21	40	17	9	3	39	41	52	18	3	5	337
Syncephalastrum racemosum	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Trichoderma viride	-	2	2	8	4	4	3	3	2	-	-	-	1	1	31
Total fungi	**109**	**99**	**124**	**125**	**118**	**101**	**128**	**71**	**133**	**204**	**155**	**172**	**143**	**153**	

- = No fungal growth; T= Type

Storage fungi deteriorate the quality and quantity of seeds in storage. The fungal population of 14 varieties of cotton seeds was extensively studied up to 10 months of storage. The occurrence and abundance of fungi were different with duration of storage period. The association of *A. nidulans*, *Colletotrichum gossypii*, *Fusarium nivale*, *Rhizomucor* sp., and *Syncephalastrum racemosum* with cotton seeds is new addition to the field of Mycology and Plant Pathology in Bangladesh. These findings clearly exhibited the diversity of the fungi on different varieties of cotton seeds.

Table 5. Percentage of pure seeds, other seeds, abio seeds and humidity of different varieties of cotton seeds.

Name of Cotton Varieties	Pure seed (%)	Other seed (%)	Abio or non seed (%)	Humidity (%)
CB1	99.55	0.0	0.79	10.9
CB2	98.78	0.03	0.61	10.6
CB3	99.0	0.0	0.54	11.2
CB4	98.45	0.0	0.95	10.5
CB5	99.91	0.0	1.0	10.0
CB6	97.47	0.0	0.56	10.7
CB7	98.77	0.0	0.40	10.7
CB8	98.41	0.1	0.82	10.4
CB9	98.39	0.0	0.89	10.8
CB10	99.80	0.0	0.90	10.6
CB11	97.91	0.0	0.49	10.7
CB12	97.08	0.91	0.91	11.3
CB13	99.92	0.10	0.10	11.2
CB14	98.19	0.49	0.49	11.2
Mean	98.69	0.12	0.67	10.78

Cotton for its extra quality fiber secures an important position amongst the fiber crops. But, the seeds of cotton in the storage condition become more susceptible to fungal infection resulting in the lowering seed germination and deterioration in storage.

Table 6. Effects of seed borne fungi on germination, seedling mortality, seedling height and vigor of cotton seeds.

Name of varieties	% Germination (5^{th} day)	% Mortality (7^{th} day)	Seedling height (5^{th} day)		Vigor index
			Root (mm)	Shoot (mm)	
CB 1	82	25.39	4.4	15.0	1590.8
CB 2	83	27.71	3.1	19.8	1892.4
CB 3	85	35.29	3.2	11.3	1232.5
CB 4	80	31.25	2.9	9.0	952.0
CB 5	81	33.33	4.6	16.6	17717.2
CB 6	87	43.93	2.3	10.3	1096.2
CB 7	81	16.05	3.8	16.3	1628.1
CB 8	92	23.91	3.9	13.2	1573.2
CB 9	81	45.89	3.0	12.9	1287.9
CB10	93	26.88	3.7	18.5	2064.6
CB11	92	50.30	3.8	17.4	1950.4
CB12	84	21.43	3.5	14.9	1545.6
CB13	83	22.98	3.7	15.0	1552.1
CB14	91	47.88	4.5	17.8	2029.3

A damage seed will produce an abnormal seedling. The findings suggest that there is a need for proper storage of cotton seeds to minimize the fungal growth. There is also a clear need to increase public awareness on the aspects related to seed health and to develop suitable management practices for improving the quality of the seeds. Present findings will be helpful for designing the management of the mycoflora of cotton in storage.

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