



Prevalence of fungi associated with different parts of jute plant

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Abstract

Thirty three species of fungi were isolated from different parts of infected jute plants during the tenure of October 2008 to January 2016. The isolated fungi were *Alternaria alternata*, *Aspergillus flavus*, *A. fumigatus*, *A. niger*, *A. terreus*, *Cercospora corchori*, *Chalara sharminensis*, *Cladosporium cladosporioides*, *C. oxysporum*, *Curvularia lunata*, *Colletotrichum corchori*, *C. gloeosporioides*, *Corynespora cassiicola*, *Dendryphiella vinosa*, *Diplodia* sp., *Eurotium* sp., *Fusarium avenaceum*, *Fusarium graminearum*, *Fusarium* sp., *Gibberella zeae*, *Lasiodiplodia theobromae*, *Macrophomina phaseolina*, *Penicillium* sp., *Phoma* sp., *Phomopsis* sp., *Rhizopus stolonifer*, *Rhizoctonia solani*, *Sclerotium rolfsii*, *Stachybotrys* sp., *Torula* sp., *Trichothecium roseum* and *Ulocladium* sp. Prevalence of *C. corchori* with surface of capsule was highest 98.5 % in 2014. The lowest count was recorded 0.5% in case of *T. roseum* in 2011. Association of *Stachybotrys* sp. and *Ulocladium* sp. with jute seeds is new record.

Keywords: Prevalence, Fungi, jute plant, *Corchorus capsularis*

INTRODUCTION

The word 'jute' is probably coined from the word jhuta or jota an Oriya word. Jute is one of the most affordable natural fibers and is second only to cotton in amount produced and variety of uses of vegetable fibers. It falls into the bast fibre category (fiber collected from bast, the phloem of the plant, sometimes called the "skin") along with kenaf, industrial hemp, flax (linen), ramie, etc. The industrial term for jute fiber is raw jute. Jute is also called "the golden fiber" for its color and high cash value.

Jute is a long, soft, shiny vegetable fibre that can be spun into coarse, strong threads. It is produced from plants in the genus *Corchorus*, which was once classified with the family Tiliaceae, more recently with Malvaceae, and has now been reclassified as belonging to the family Sparrmanniaceae. The primary source of the fibre is

Corchorus olitorius, but it is considered inferior to *Corchorus capsularis*. "Jute" is the name of the plant or fiber that is used to make burlap, hessian or gunny cloth. Leafy vegetable is rich in beta-carotene for good eyesight, iron for healthy red blood cells, calcium for strong bones and teeth, and vitamin C for smooth, clear skin, strong immune cells, and fast wound-healing. Vitamins A, C and E present in jute leaf/saluyot "spongeup" free radicals, scooping them up before they can commit cellular sabotage. Jute leaf as vegetable contains an abundance of antioxidants that have been associated with protection from chronic diseases such as heart disease, cancer, diabetes, and hypertension as well as other medical conditions. Due to better performance in respect of yield and quality the mutant CM-18 has been registered as the first jute variety in Bangladesh for

vegetable purpose in the name of Binapatshak-1 in 2003. Fresh jute leaf has higher demand. Ayurvedics use the leaves for ascites, pain, piles, and tumors. Elsewhere the leaves are used for cystitis, dysuria, fever, and gonorrhoea. The cold infusion is said to restore the appetite and strength (Banglapedia 2009). Traditionally, jute has been used to manufacture packaging materials like hessian, sacking, ropes, twines, carpet backing cloth etc. Alternative and non-traditional use of jute are generally termed as Diversified Jute Products. Among the various diversified jute products, floor coverings, home textiles, technical textiles, geotextiles, jute nonwovens, jute reinforced composites, pulp and paper, particle boards, shopping bags, handicrafts, fashion accessories, apparels etc. have potential for wider use and application (diversified_prod.html). Bangladesh holds the 2nd position as a jute producer in the world with the average production of Jute 1.08 m ton/year. More than 85% of world production of jute is cultivated in the Ganges Delta and having the major portion of it; Bangladesh became the largest producer of raw jute or jute fiber in the world. For centuries, Bangladeshi jute had and still has demand in the international market for higher quality fibers. This fact makes Bangladesh the major exporter (80% + market share) of jute fiber in the world; while India has nominal dominance over export of raw jute fiber. Total average export earnings from jute and jute goods are US\$ 611 million (60 lakh bales)/year. Average export value of raw jute is US\$ 140 million (Bangladesh-business-jute.php).

The common and most destructive diseases of jute plant are stem rot of jute caused by *Macrophomina phaseolina*, black band of jute caused by *Lasiodiplodia theobromae*, anthracnose of jute caused by *Colletotrichum corchori* and soft rot of jute caused by *Sclerotium rolfsii*. Among the diseases of jute, stem rot alone cause 10% yield loss annually (Ahmed, 1968; Islam, 2003). Jute diseases and their pathogens were studied by Wadud and Ahmed (1962), Ahmed (1968), Akanda and Fakir (1985) Begum (1989), Islam *et al.* (2010) and Khan and Fakir (1993). Since 2008 to 2016, 200 jute samples were examined during practical classes of B. Sc. (Hons), Extra-departmental courses and M.S. classes in the Department of Botany, University Dhaka, Bangladesh. Present research has been undertaken to find out the prevalence and variation of fungal populations in jute plant.

MATERIALS AND METHODS

Stem leaf fruit and seed samples of jute plant (*Corchorus capsularis*) were collected from Manikgonj upazilla, Dhaka, Jute Research Institute, Dhaka and Botanic Garden, Curzon Hall Campus, Dhaka University, Dhaka

during the period of October 2008 to January 2016. Infected plant parts were cut into small pieces and placed on warm water in specimen cup for 10 minutes. Then fungal structures were scraped out with sterilized scalpel and placed on a clean slide with lectophenol and cotton blue. Fungal structures were spread with two needles and after placing cover glass it was examined under microscope for identification.

Side by side the fungi associated with the symptoms were isolated following tissue planting method on PDA medium and Blotter method (Shamsi *et al.* 2015). Identification of the isolates was determined following the standard literatures (Ellis 1971 and 1976; Barnett and Hunter 1998; Sutton 1980). Voucher specimens were preserved in the Herbarium, Mycology and Plant Pathology division, Department of Botany, University of Dhaka, Bangladesh.

RESULTS AND DISCUSSION

Jute plant is an excellent substrate for fungi and vulnerable to fungal attack. In the present investigation twelve types of symptoms were recorded on different parts of the jute samples. The typical symptoms were leaf spot, stem rot, black band, anthracnose and soft rot. In addition to typical symptoms, white effuse mycelial growth of *Fusarium graminearum*, pinkish mycelia growth of *F. avenaceum* and *Fusarium* sp. was recorded on stem. *Chalara sharminensis* was associated with infected stem of jute with pinkish areal mycelia growth of the respective fungus. Black velvety mycelial mat was formed on stem due to attack of *Torula* sp. Effuse olivaceous black mycelial growth was noticed on the fruit surface. *Alternaria alternata* and *Cercospora corchori* were associated with the fruit samples. *Gibberella zeae* and *A. alternata* showed blackish fungal colony inside the inner surface of fruits. Discolouration of seeds was also recorded. *Stachybotrys* sp. and *Ulocladium* sp. were isolated from the germinating discoloured jute seeds (Shamsi and Sultana 2008, 2010 and 2012).

A total of 33 species of fungi were isolated from different parts of the infected jute plants and seeds during the tenure of 2008 to 2016. The isolated fungi were *Alternaria alternata* (Fr.) Keisser, *Aspergillus flavus* Link ex Fries, *A. fumigatus* Fresenius, *A. niger* van Tieghem, *A. terreus*, *Cercospora corchori* Sawada, *Chalara sharminensis* Shamsi *et* Sultana sp. nov., *Cladosporium cladosporioides* (Fresen.) G.A. de Vries, *C. oxysporum* (Berk. and Curt.), *Curvularia lunata* (Wakker) Boedijn, *Colletotrichum corchori* Ikada and Tanaka, *C.*

gloeosporioides (Penz.) Penz. and Sacc., *Corynespora cassiicola* (Berk. & Curt.) Wei, *Dendryphiella vinosa* (Berk. & Curt.) Reisinger, *Diplodia* sp., *Eurotium* sp., *Fusarium avenaceum* (Corda ex Fr.) Sacc., *Fusarium graminearum* Schwabe, *Fusarium* sp., *Gibberella zeae* (Schw.) Petch, *Lasioidiplodia theobromae*,

Macrophomina phaseolina (Tassi) Goid, *Penicillium* sp., *Phoma* sp., *Phomopsis* sp., *Rhizopus stolonifer*, *Rhizoctonia solani* Kühn, *Sclerotium rolfsii* Sacc., *Stachybotrys* sp., *Torula* sp., *Trichothecium roseum* (Pers.) Link and *Ulocladium* sp.

Table 1. Prevalence of fungi associated with capsule of jute plant during 2008 – 2016.

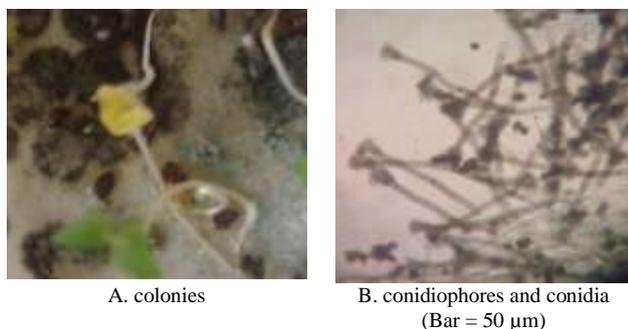
Name of fungi/ Plant parts	Frequency % of association of fungi								
	Years								
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Surface of capsule									
<i>Alternaria alternata</i>	20.1	10.0	5.5	15.3	12.6	21.1	11.7	19.4	17.6
<i>Cercospora corchori</i>	80.3	90.5	89.6	98.4	50.7	78.6	98.5	79.9	87.3
<i>Corynespora cassiicola</i>	20.2	13.3	5.5	-	-	-	-	-	-
<i>Cladosporium oxysporum</i>	33.3	3.3	25.3	10.3	19.3	16.6	11.5	17.1	6.5
<i>Curvularia lunata</i>	4.3	2.1	-	-	2.5	5.5	7.2	3.3	-
Inner surface of capsule									
<i>Alternaria alternata</i>	10.1	3.1	125	11.3	-	3.3	6.2	1.1	-
<i>Gibberella zeae</i>	5.8	3.7	-	-	-	-	-	-	-

“-“ = No fungal isolate

Description of newly associated fungal taxa with jute seedlings are given below:

Stachybotrys atra Corda (Plate 1. A-B)

Plate 1. *Stachybotrys* sp.



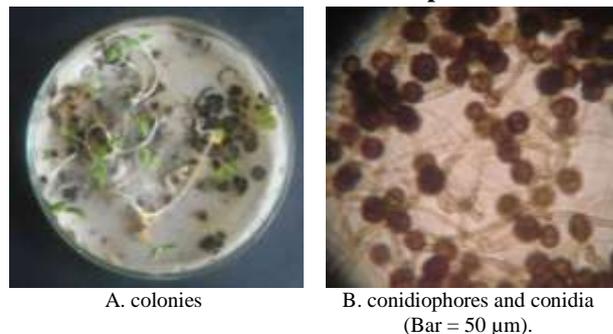
Colonies effuse, blackish-green on PDA medium at room temperature between 24-29° C and pH 6. Hyphae partly superficial and brown in colour. Conidiophores at first hyaline but soon becoming olivaceous brown to black and rough or covered with granules, especially towards the apex, mostly unbranched, up to 95 µm long, 3-5 µm wide. Phialides mostly 10-13 µm long, 5-7 µm wide in the

broadest part. Conidia broadly ellipsoidal to subspherical, dark, blackish-brown to black, 8-13 × 5-9 µm.

Specimen examined: On ten-day germinating seedlings of *Corchorus capsularis*. Seed collected from Botanic Garden, University of Dhaka, Dhaka.

Ulocladium Preuss (Plate 2. A- B)

Plate2. *Ulocladium* sp.



Colony black, mycelia brown, septate. Conidiophores pale golden brown, sometimes arising from clamydospores, conidia dark brown mostly muriform,

ovoid orellipsoida, echinulate, with 2-7 transverse and several longitudinal and oblique septa 12- 55 × 8-20 µm.

Specimen examined: On ten-day germinating seedlings of *Corchorus capsularis*. Seed collected from Botanic Garden, University of Dhaka, Dhaka.

Prevalence of fungi with different parts of jute plant is presented in Tables 1-4. Table 1 showed that five fungal species were isolated from surface of jute capsules. Frequency percentage of association of *C. corchori* was highest 98.5 in 2014. Two fungal species were isolated from inner surface of the capsule. Frequency percentage of association of *A. alternata* was highest 12.5 in 2010

and *G. zeae* was found 5.4 and 3.7 in the year 2008 and 2009, respectively. Thirteen fungal species were isolated from germinating seeds of jute. Frequency percentage of association of *A. fumigatus* was highest 41.1 in 2015. Lowest fungal count was recorded 3.2 % in *A. terreus* in the same year (Table 2). Table 3 showed that *C. corchori* was the exclusively fungus that was associated with leaf spot symptom of jute during the tenure of the study. Frequency percentage of association of the fungus was highest 21 in 2008 and it was lowest 12.4 in 2014. Different symptom types and associated fungi are presented in Table 4.

Table 2. Prevalence of fungi associated with germinating seeds of jute during 2008 – 2016.

Name of fungi	Years									
	2008	2009	2010	2011	2012	2013	2014	2015	2016	
<i>Alternaria alternata</i>	15.3	12.5	24.5	11.3	19.5	11.6	15.1	13.2	14.4	
<i>Aspergillus flavus</i>	12.3	14.5	18.1	11.2	13.3	12.5	3.2	6.5	19.2	
<i>A. Niger</i>	23.1	12.3	17.9	19.5	16.7	15.7	19.3	46.5	39.6	
<i>A. fumigatus</i>	16.8	3.6	6.9	11.9	9.7	29.5	37.6	41.1	43.2	
<i>A. terreus</i>	-	-	-	-	-	-	-	3.2	-	
<i>Colletotrichum corchori</i>	-	-	4.3	-	-	-	4.1	3.9	-	
<i>Eurotium sp.</i>	-	-	-	-	-	-	-	2.6	-	
<i>Curvularia lunata</i>	25.3	22.5	24.5	11.3	19.5	11.6	15.1	33.2	27.4	
<i>Penicillium sp.</i>	13.3	4.5	7.6	3.9	6.8	11.7	15.4	14.5	17.5	
<i>Fusarium spp.</i>	10.3	4.7	2.3	1.6	-	5.7	-	9.3	-	
<i>Rhizopus sp.</i>	3.5	-	5.7	3.1	6.1	13.2	14.2	31.5	30.0	
<i>Stackybotrys sp.</i>	-	-	-	-	-	-	-	-	35.0	
<i>Ulocladium sp.</i>	-	-	-	-	-	-	-	-	24.0	

“-“= No fungalisolate

Table 3. Prevalence of fungi associated with leaf spot symptom of jute during 2008 – 2016.

Name of fungi	Years									
	2008	2009	2010	2011	2012	2013	2014	2015	2016	
<i>Cercospora corchori</i>	21.0	13.3	15.4	16.2	20.0	24.0	12.4	16.5	-	

“-“= No fungal isolate

Four pycnidial fungi were associated with stem rot symptom of jute. Frequency percentage of association of *M. phaseolina* was highest 77.4 in 2009. *Lasiodiplodia theobromae* was associated with black band symptom on

stem. Frequency percentage of association of the fungus was highest 30.3 in 2011. Lowest fungal count was recorded 3.4 in 2016. *Colletotrichum corchori* and *C. gloeosporioides* were isolated from anthracnose symptom

on stem. Frequency percentage of association of *C. corchori* was highest 12.4 in 2010 and lowest was 1.0% in 2013. Frequency percentage of association *C. gloeosporioides* was highest 13.3 in 2010 and lowest was

1.1 % in 2015. *Sclerotium rolfsii* was isolated from soft rot symptom. Frequency percentage of association of the fungus was 20.9 in 2013. Lowest count of the fungus was 2.9 % in 2008.

Table 4. Prevalence of fungi associated with infected stem of jute plant during 2008 – 2016.

	Name of fungi/ symptom Frequency % of association of fungi								
	Years								
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Stem rot of jute									
<i>Macrophomina phaseolina</i>	61.0	77.4	23.5	20.6	26.9	37.8	36.5	32.8	12.3
<i>Phomopsis</i> sp.	60.3	55.7	38.2	30.3	12.5	15.8	35.1	40.3	4.5
<i>Phoma</i> sp.	21.3	6.7	13.4	17.5	9.0	14.2	3.5	7.5	-
<i>Diplodia</i> sp.	14.5	10.3	4.5	7.8	2.1	-	-	-	-
Black band of jute									
<i>Lasidiplodia theobromae</i>	26.4	19.8	18.6	30.3	29.0	21.1	15.7	12.3	3.4
Anthracnose									
<i>Colletotrichum corchori</i>	5.9	10.5	12.4	1.1	3.3	1.0	1.3	2.7	-
<i>C.gloeosporioides</i>	3.9	12.6	13.3	9.8	3.9	3.8	2.1	1.1	-
Soft rot of jute									
<i>Sclerotium rolfsii</i>	2.9	16.0	5.9	3.3	6.9	20.9	13.1	9.9	-
Stem near soil Surface									
<i>Rhizoclonia solani</i>	1.1	3.2	2.3	1.1	1.1	13.5	3.1	1.1	-
Black mycelia growth on stem									
<i>Alternaria alternata</i>	8.7	16.3	11.7	8.9	12.4	2.4	4.4	17.8	4.5
<i>Cercospora corchori</i>	3.1	1.1	1.5	-	-	-	1.5	-	-
<i>Cladosporium cladosporioides</i>	33.3	15.5	16.4	19.1	20.0	10.3	6.9	8.2	4.7
<i>C. oxysporum</i>	35.5	23.4	29.6	27.2	14.9	31.7	31.5	23.0	21.0
<i>Corynespora cassiicola</i>	10.5	12.3	1.5	1.5	3.2	-	-	6.7	-
<i>Curvularia lunata</i>	31.5	20.1	16.7	2.3	19.7	6.9	14.5	23.0	10.8
<i>Dendriphiella</i> sp.	6.5	10.0	8.9	-	-	-	9.5	5.6	-
<i>Drechslera</i> sp.	5.6	2.3	1.9	-	-	-	-	-	-
Pinkish mycelial growth on stem									
<i>Fusarium avenaceum</i>	5.7	5.9	-	1.9	8.7	30.5	2.7	1.9	-
<i>Fusarium</i> sp.	10.4	9.8	16.4	1.9	6.8	18.5	7.9	12.5	-
<i>Trichothecium roseum</i>	5.9	6.9	1.1	0.5	-	-	-	-	-
White mycelial growth on stem									
<i>Fusarium graminearum</i>	40.5	23.4	5.9	1.1	3.2	1.6	-	-	-
Pinkish aerial mycelial growth on stem									
<i>Chalara sharminensis</i>	23.0	-	-	-	-	-	-	-	-
Black velvet y mycelial growth on stem									
<i>Torula</i> sp.	4.9	-	1.1	-	-	-	-	-	-

“= No fungal isolate

Rhizotonia solani was isolated from infected stem near soil surface. Frequency percentage of association of fungus was 13.5 in 2013. Lowest count of the fungus was 1.1% in 2008, 2011, 2012 and 2015.

Nine fungal species were recovered from black mycelia growth on jute stem. Frequency percentage of association of *C. oxysporum* was highest 33.5 in 2008. Lowest fungal count was recorded 1.5% in *C. cassicola* in 2010 and 2011. Pinkish mycelia growth on the stem showed presence of *F. avenaceum*, *Fusarium* sp. and *T. roseum*. *Fusarium graminearum* was isolated from white mycelia growth on stem. *Chalara sharminensis* was recovered from infected stem of jute with pinkish areal mycelia growth of the respective fungus. Symptom showing black velvety mycelia growth on stem produced excellent fruiting structures of *Torula* sp.

Islam *et al.* (2010) reported the different seed-borne fungi such as *Macrophomina phaseolina*, *Botryodiplodia theobromae*, *Colletotrichum corchori*, *Fusarium* sp., *Cercospora corchori* and *Curvularia lunata* were found predominantly associated with the jute seeds.

Wadud and Ahmed (1962) reported wilting disease of jute (*Corchorus olitorius* L.). Fungal organisms isolated from these diseased plants were *Botryodiplodia theobromae* Patouill Griff. & Maubl., *Fusarium solani* (Mart.) App. & Woll., *Glomerella cingulata* (Stoneman) Spauld. & H. Schrenk, *Macrophomina phaseoli* (Maubl.) Ashby and *Rhizoctonia solani* Kühn. *Glomerella cingulata* was the most predominant organism in the wilted jute plants.

The results of the present investigation indicate that about 33 fungal species are associated with different parts of jute plant. Gradually new fungal species are invading jute plants. This may be due to location of sampling field, change in jute varieties as well as change of climate. Moreover, association of species of *Stachybotrys* and *Ulocladium* are new addition to jute mycoflora.

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