SEED BORNE FUNGI OF JUTE AND ALLIED FIBER CROPS SEED AND THEIR TRANSMISSION FROM SEED TO SEEDLINGS

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CERTIFICATE

This is to certify that thesis entitled, "**SEED BORNE FUNGI OF JUTE AND ALLIED FIBRE CROPS SEED AND THEIR TRANSMISSION FROM SEED TO SEEDLINGS**" submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** IN **PLANT PATHOLOGY**, embodies the result of a piece of bona fide research work carried out by **LITON CHANDRO BARMAN**, **Registration No. 17-08199** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Dated: 15/10/19
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DEDICATED TO
MY
BELOVED PARENTS

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SEED BORNE FUNGI OF JUTE AND ALLIED FIBER CROPS SEED AND THEIR TRANSMISSION FROM SEED TO SEEDLINGS

ABSTRACT

The experiment was conducted at the Plant Pathology Laboratory and the net house of Plant Pathology Department, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka -1207 during June' 2018 to March' 2019. Nine fiber crops varieties were used for conducting the experiments viz., V_1 = Jute cvl-1, V_2 = BJRI deshi jute-5 (0-795), V_3 = BJRI deshi jute-6 (0-3820), V_4 = BJRI deshi jute-7 (BJC-2142), V_5 = BJRI deshi jute-8 (BJC-2197), V_6 = Kenaf (HC-2), V_7 = Kenaf (HC-95), V_8 = BJRI Kenaf-4 and V_9 = Mesta (HS-24). All seed samples were collected from Bangladesh Jute Research Institute (BJRI), Manik Mia Avenue, Dhaka. In Blotter method, the highest total number of seed borne fungi (7.00) was recorded in V_5 and five fungal genera (*C. corchori, Fusarium* spp., *Aspergillus* spp., *B. theobromae, M. phaseolina* and *Curvularia lunata*) were identified in jute and allied fiber crop varieties. In Water agar method, the highest total numbers of seed borne fungi (5.67 and 5.33) were recorded in V_4 and V_5, respectively and five fungal genera (*C. corchori, Curvularia lunata, Fusarium* spp., *Aspergillus* spp., and *M. phaseolina*) were identified. In Test tube method, the highest total number of seed borne fungi (2.00) was recorded in V_2; V_3 and V_4, respectively and 4 fungal genera (*C. corchori, Fusarium* spp., *Aspergillus* spp., *M. phaseolina*). In growing on test method, the highest total number of seed borne fungi (3.67) was recorded in V_5 and altogether four fungal genera (*C. corchori, Fusarium* spp., *Aspergillus* spp. and *B. theobromae*) were found. In this findings, the highest % seedling incidence (83.33%; 80% and 66.67%, respectively were found in control withurrt treatment) where the lowest results (24.14%; 21.43% and 42.86%, respectively) were found in Autostin treatment in case of severely infected 3 varieties of jute and allied fiber crops seed namely V_5; V_6 and V_9, respectively . For growth performance, the highest % germination (91.67%), root length (7.21 cm), shoot length (31.17 cm) and leaf number (17.21) was observed in the T_2V_5 treatment with Autostin and the lowest % germination (41.68 %), root length (3.33 cm), shoot length (13.70 cm) and leaf number (8.67) was observed in T_0V_9 with cntrol treatment.

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CHAPTER I

INTRODUCTION

Jute is a fiber crop belongs to genus *Corchorus* of the Tiliaceae family with two cultivated species- *Corchorus capsularis* L. and *C. olitorius* L. Fiber is extracted from the bark of the plants (Alim, 1978 and Dempsey, 1975). The young leaves of *C. olitorius* that have been introduced into Japan as a healthy vegetable are rich in vitamins, carotenoids, calcium, potassium and dietary fiber (Resources Council, Science and Technology Agency, Japan, 2000). Jute leaves are used as a food source in Asia, the Middle East, and parts of Africa. In addition adding a distinct flavor to food, jute leaves also have nutritional value, and they act as thickeners in soups, stews, and sauces. Jute leaves may also be called saluyot or ewedu, depending on the region of the world in which one is cooking. It is possible to grow jute for its fresh leaves in some parts of the world, and some specialty stores also stock it in fresh, frozen, or dried form, depending on their location and size (Calleja, 2010). There is some anti-ageing components present in jute leaf. It contains lipid, protein, crude fiber, carbohydrate, different vitamins and minerals and also have some medicinal values.

Jute is the eco-friendly and important fiber crop among the world. Entire life cycle of jute from cultivation to usage, disposal it is friendly to the environment and produces no toxic materials (Sarkar, 2008). Production of jute is concentrated mostly in Bangladesh (1,349,000 tons) and Bangladesh is the 2nd position in the world's. India is the 1st largest producer of jute (1,968,000 tons) but imported approximately 162,000 tonnes of raw fiber and 175,000 tones of jute products in 2011 (IJSG, 2014). The land and climatic conditions of Bangladesh are congenial for the production of high quality jute. In Bangladesh, about 7, 37, 770 hectares of land were under the jute cultivation, and 82, 46, 797 bales of jute with the yield rate at 11.178 bales/ha (BBS, 2017).

Jute does not cause any health hazards and environmental pollution. Traditionally jute has been used as a raw material for manufacturing of yarns and twines, hessian, burlap and bulk packaging. Jute is also used in making different kind of artistic handicrafts which are also getting popularity day by day at home and abroad. Jute has been closely attached with our cultures, society and economy in Bangladesh for centuries. A

considerable amount of foreign currency is still earned by the country through exporting jute and jute products.

Jute, kenaf, and mesta are the second most important natural fibers next to cotton. Jute grows under wide variation of climatic conditions and stress of tropic and subtropics.In Bangladesh, the major part of agricultural researches on jute, kenaf and mesta are being conducted by Bangladesh Jute Research Institute (BJRI).

In Bangladesh around 4 to 5 million small and subsistence farmers derive their livelihood from jute and allied Fiber (JAF) crops production while thousands of other workers and employed in its processing, handling ,and manufacturing Presently, the area under jute and kenaf cultivation is about 8.0 - 8.2 lakh hectare with production 85-90 lakh bales. Of the jute cultivated area about 85% tossa jute, 8% white jute and 7% is of kenaf (Saha, 2011).

Bangladesh requires about 5500-6000 tons jute and kenaf seeds in every year, of which only 10-15% is produced and distributed by the BADC (Ali *et al.,* 2003). BADC is the only public sector of the country which produces and distributes jute and very few kenaf seeds to the growers. BADC supplied only 12-15% of the total jute and allied fibers seed (Al-Mamun and Saha, 2017).

Jute suffers from a number of diseases. Among of the diseases of jute, 10 are known to be seed borne. Among the seed-borne fungal diseases, stem-rot, black band and anthracnose caused by *Macrophomina phaseolina, Botryodiplodia theobromae* and *Colletotrichum corchori,* respectively are frequently transmitted through jute seeds. Stem rot, black band, anthracnose, foot rot and wilt (*Rhizoctonia solani*) are responsible for seed rot, pre and post emergence damping off, seedling infections and spread of the diseases to standing crops causing considerable yield loss (Sarker and Sultana, 2017) and deterioration in the quality of fiber (Rathod and Pawar, 2012).

Seed-borne pathogens causing diseases on the growing jute plants in the field quite often attack the capsules or pods and subsequently infect the seeds, resulting in the production of infected or unhealthy seeds (Lecomte *et al.,* 2016; Ali *et al.,* 2015). *Colletotrichum corchori* is seed borne fungi and found only in *C. capsularis*. Other seed borne fungal pathogens of jute seeds are *Fusarium oxysporium, F. semitectum, Fusarium moniliformae, Curvularia lunata* and *Corynespora cassiicola* (Fakir and Islam,1990). These seed borne pathogens have been found to cause seed rot and infection to young seedlings. Besides, *Aspergillus, Penicillium* are frequently associated with stored jute

seeds and responsible for reduction in germination. The inocula of the seed borne pathogens from the infected seeds and seedlings are transmitted to the growing plants cause diseases in jute.

Therefore, proper disease control measure should be taken for the production of quality healthy jute seeds (Sarker *et al.,* 2016). Proper disease management practices can substantially improve the quality of jute and significantly increase the yield (Sardrood and Goltapeh, 2018; Sarker 2016). *Macrophomina phaseolina*, *Botryodiplodia theobromae* and *Colletotrichum corchori* can be transmitted from seed to plant to seed (Fakir*et al.,* 1993). Study on transmission of seed borne infection of three major seed borne fungal pathogens- *M. phaseolina*, *B. theobromae* and *C. corchori* in jute revealed that higher seed borne infection resulted in higher disease development in the field. Transmission of *C. corchori* from infected seeds to the harvested seeds through the growing plants is a great threat for jute cultivation (Fakir *et al.*, 1993).

Among the practices used, seed treatment is probably the cheapest and safest method of direct plant disease control (Ali *et al.,* 2015). In many countries regular practice of seed treatment is considered as an insurance against the building up of inoculants and has greatly reduced the yield loss and improves the quality in many crops (Islam *et al.* 2018, Haider *et al.,*2015), once chemical control of plant diseases was quite popular for reducing crop losses (Sarker *et al.,* 2015).

Few work regarding the seed health status of jute seeds of different tires and the transmission nature of *C. corchori* from seed to seedlings have been conducted by Fakir, *et al.* (1993) as Begum and Fakir (1991) in laboratory condition. But very few detail study on the transmission rate of *C. corchori* from seed to plant to seed has been conducted under field condition in the country. Keeping the view of the above facts and findings the present study was undertaken with the following objectives:

1. To identify the seed borne fungi associated with jute and allied fiber crops seed in different methods under laboratory condition.
2. To determine the rate of transmission of seed borne fungi from seed to seedling.
3. To manage the seed borne fungi associated with jute and allied fiber crops seed.

CHAPTER II

REVIEW OF LITERATURES

Considerable amount of research work has been conducted on jute seeds regarding seed borne pathogens and for controlling the various seed borne diseases in jute. But literature on the production of quality healthy jute seeds is rare in Bangladesh. Relevant literature available on fungal pathogens associated with jute seeds, seed treatments with chemicals, plants extracts/ botanicals and effect of sowing method on the production of quality healthy jute seeds and seed yield are reviewed and presented in this chapter.

2.1 Fungal pathogens associated with jute and allied fiber crop seeds

Shaw (1921) reported that black-band of jute caused by *Botryodiodiplodia theobromae* was seed borne. While working on the seed transmission of *Macrophomina phaseolina* in India, Rajan and Patel (1946) showed that pathogen was externally as well as internally seed borne in jute. Baxter (1960) reported that *M. phaseolina*, *Diplodia corchori* were the most predominant and important seed borne pathogens of jute. It has been demonstrated in Jute Agriculture Research Institute, Calcutta, India that the seed borne *Colletotrichum corchori* was responsible for the mortality of jute seedlings at high rate in the field (Anon, 1958).

Fazli and Ahmed (1960) found that fungal organisms associated with jute seeds were responsible for affecting viability and causing infections to seedlings. Among these *Macrophomina phaseolina*, *Diplodia corchori* and *Colletotrichum corchori* are mainly seed borne pathogens. Besides these pathogenic organisms, there are many saprophytes associated with jute seeds, which deteriorates the quality of jute seeds during storage. From India, Agarwal and Singh (1974) detected *Alternaria tenuis*, *Arthobotrytis* sp., *Cephalosporium* sp., *Curvularia lunata*, *Epicoccum* sp., *Fusarium moniliformae*, *Fusarium semitectum, Helminthosporium tetramera*, *Macrophomina phaseolina*, *Periconia* sp., *Trichothecium* sp., in seeds of four varieties of jute namely, JRC 212, JRC 321, JRO 632 and JRO 878.

While working on seed borne pathogens of jute at DGISP, Copenhagen, Miah (1974) found that in all the seed samples tested were heavily infected with different fungi. He detected forty-four fungal organisms in the jute seeds collected from Banglasesh. The

most predominant fungi encountered were *Ascochyta corchoricola*, *Botryodiplodia theobromae, Cercospora corchori*, *Colletotrichum* spp., *Corynespora cassicola*, *Macrophomina phaseolina*, and *Rhizoctonia solani*, *Colletotrichum corchori* was not found in *olitorius* jute seeds. He also reported that seed borne fungal organisms affect the seed germination and seedling survival.

At Bangladesh Agricultural University (BAU), Fakir (1977) recorded the presence of *Corynespora cassiicola* in 28 jute seed samples collected from Mymensingh, Pabna and Tangail districts of Bangladesh and found that the fungus was associated with the ungerminated seeds and pathogenic to young seedlings. Michail *et.al.,* (1977) also detected *Rhizoctonia solani* as seed borne fungal organisms in jute.

Analyses of health status of jute seeds were collected from Mymensingh district was conducted at BAU showed that rarely a seed was free from *Macrophomina phaseolina*, *Botryodiplodia theobromae*, *Colletotrichum corchori* and as high as 50.0 %, 75.0 % and 85.5% seed borne infection of *B. theobromae*, *C. corchori* and *M. phaseolina*, respectively, were observed in certain seed lots (Akanda, 1978).

Freire and Albuquerque (1978) observed that black spot caused by *Colletotrichum corchori* was a serious disease in jute in the Amazan region of Brazil. This pathogen was isolated from the depressed lesions found on the capsules. The pathogen was also detected in mycelial forms in the seeds.

Ahmed *et al*. (1980) tested 110 jute seed samples in the laboratory obtained from different stations of Bangladesh Jute Research Institute (BJRI) and reported that there were 20%, 37 % and 66% seed borne infections of *Macrophomina phaseolina*, *Botryodiplodia theobromae* and *Colletotrichum corchori* respectively in certain variety of jute at certain locality. Eight samples of D-154, 1 of CVE-3, 15 of CC –45, 10 of CVL-1 were not recommended for sowing as over 15% seeds were infected by these three major pathogens. Presence of *Corynespora*, *Cercospora, Myrothecium, Fusarium* and *Chaetomium* spp. were also detected.

Ahmed and Sultana (1982) tested the jute seed health of a total number of 56 samples in the laboratory by PDA and Blotter method. The highest seed borne infection of *Botryodiplodia theobromae*, *Macrophomina phaseolina* and *Colletotrichum corchori* were found to be 7%, 7%, and 5% in samples of D-154 from Faridpur, CC-45 and CVL-

1 from Chitla, respectively. Ahmed and Sultana (1983) carried out a routine seed health test at BJRI to determine the percentage of infected seeds and to make recommendation for sowing. A total of 78 jute seed samples received from Tarabo, JAES, Monirampur, Faridpur, Chandina, Central station, Kishoregonj and from India were tested. Maximum infection of *Macrophomina phaseolina* (20%) was recorded in CVE-3 from Chandina. JRC- 4 from India yielded 19% of *Botryodiplodia theobromae*. There was 12 % infection of *Colletotrichum corchori* recorded in CC –45 from Kishoregonj.

Rangaswami (1984) described the fungus *Macrophomina phaseolina*, the causal organism of stem rot of jute. Under favorable condition, disease spreads and kills the seedlings. Often the diseases spread rapidly and cause damping-off of seedlings. Infection often spread from the basal stem to roots killing the plant. Pycnidia are formed on the infected roots and stem and in other rotting tissues. When infect the inflorescence, the capsules are discolored to black and infected seeds become discoloured and small. Akanda and Fakir (1985a) worked with 43 seed samples of *Corchorus capsularis* collected from various locations in Mymensingh district and found that three had pure infection of *Macrophomina phaseolina,* 12 had mixed infection of *Botryodiplodia theobromae* and *M. phaseolina* and 10 had mixed infection of *Colletotrichum corchori* and *M. phaseolina*. *M. phaseolina* was predominant species (39.6%) followed by *B. theobromae* (11.1%) and *C. corchori* (7.8%). Germination of seed samples varied from 20-68 %. Low germination percentage was recorded due to high prevalence of pathogens.

The Central Research Institute for Jute and Allied Fibers (CRIJAF) in India deals with white and tossa jute, mesta and kenaf CRIJAF, have yielded a number of varieties suitable for various situations and purposes. Early tossa and white jute varieties were developed. Varieties were also developed with higher yield and responsive to higher level of nitrogenous fertilizer. In this type of seeds, seed borne pathogens were found numberously. Researches are going on with jute based cropping sequence. CRIJAF has identified a variety of mesta which yields around 50-60 tons of bio-mass per hectare. A high yielding variety was developed with resistant to drought and lodging.

Fakir *et al.* (1988) recorded *Curvularia lunata* and *Fusarium* spp. (*F. oxysporum*, *F. semitectum*) in jute seeds during routine seed health analysis in Seed Pathology

Laboratory, BAU, Mymensingh. The two pathogens *C. lunata* and *Fusarium* spp. were encountered in 66.3 % and 95.5% seed samples, respectively collected from 80 selected farmers representing 10 villages under 5 unions of Sader Upazila, Mymensingh. The highest seed borne infection of *C. lunata* and *Fusarium* spp. was found to affect the health of jute seeds and the two fungi were associated with 60.0% and 75.0% ungerminated and rotted seeds, respectively. According to them, 10-15 % emerging radicals got infection by the three fungal pathogens.

Ahmed and Sultana (1985) analyzed 379 seed samples of jute collected from farmers" and markets of Sonargaon, Nabinagar and Jamalpur. Three important fungal pathogens namely, *Botryodiodiplodia theobromae*, *Colletotrichum corchori* and *Macrophomina phaseolina* which were commonly found in the collected seed samples. Of these three pathogens, highest percentage of seed borne infection was recorded in case of *C. corchori* (42%). As high as 35.0% seed borne infection of *M. phaseolina* was detected in seed sample obtained from Jamalpur market in 1984. Sultana and Ahmed (1985) at BJRI examined the health status of 82 jute seed samples collected from different experimental stations and recorded maximum infection of *Macrophomina phaseolina* (22%) in the sample CVE-3 collected from JAES. They also recorded the highest infection of *Botryodiplodia theobromae* in Dhabdhabey and *Colletotrichum corchori* (80%) in CVL-1 collected from Kishoregonj station.

Sultana and Ahmed (1986) tested 1137 seed samples obtained from different regional stations of BJRI for detection of seed borne pathogens under the projects "Survey on Jute Seed Quality". Maximum seed borne infection of *Macrophomina phaseolina* (20%), *Colletotrichum corchori* (20%) and *Botryodiplodia theobromae* (30%) were recorded in Dhabdhadey (central station) and D-154 (Nashipur and Chandina). Out of 77 seed samples of jute collected from five districts viz. Dhaka, Manikgonj, Comilla, Chittagong and Jamalpur during 1985-86 and 1986-87, altogether 12 different fungi were detected in jute seeds. The most predominant fungi encountered were *Colletotrichum. Corchori* (31.11%), *Sclerotium rolfsii* (23.93%),*Chaetomium* (10.04%),*Curvularia* (5.2%), *Trichoderma sp*. (3.7%) *and Macrophomina phaseolina* (3.22%). Most of the fungi were found to affect the rate of germination (Anon. 1987). Halder and Anwar (1988) isolated altogether 12 different genera of fungi from jute seeds collected from five south-eastern districts of Bangladesh. Of all the fungi encountered, *Colletotrichum corchori* and

Sclerotium rolfsii causal organisms of anthracnose and foot rot, respectively appeared to be the most predominant.

Sultana *et al.* (1988) tested 487 jute seed samples for health status, which included 159 breeder seed samples, 277 samples from IJO and 51 from Gene Bank accessions. They obtained maximum number of infection (30% each) with *Macrophomina phaseolina* and *Colletotrichum corchori* in local *capsularis* varieties from Gene Bank. CVL-1 from JAES had 22 % infected seeds followed by 21% in *C. corchori* from Kishoregonj. Fourteen samples including CVL-1 from JAES, D-154 and Dhabdhabey from Kishoregonj were not recommended for sowing as they had higher percentage of infected seeds. While conducting the Growing on test for determination of seed borne fungal pathogens in jute, Begum (1989) found that *Colletotrichum corchori*, *Botryodiplodia theobromae* and *Macrophomina phaseolina* caused germination failure, seed rot and produced disease symptoms on growing seedlings. According to the report, most seed rots were caused by each of the three pathogens. Among the three pathogens, *C. corchori* caused maximum seed rot and minimum seedling infections in sand culture.

Anon (1990) reported Plant Pathology Division of BJRI, Dhaka made a routine health test of jute seeds of two cultivated species (*Corchorus capsularis* and *Corchorus olitorius*) obtained from different research stations as well as from the contact growers and observed that the three major fungal pathogens are *Botryodiplodia theobromae*, *Colletotrichum corchori* and *Macrophomina phaseolina* causing black band, anthracnose and stem rot diseases, respectively were frequently seed transmitted. During the survey, the highest seed borne infection by *B. theobromae*, *C. corchori* and *M. phaseolina* were recorded as 30%, 37% and 51%, respectively.

Health analysis of traditional varieties of jute (*Corchorus capsularis*) seeds collected from 200 farmers of Mymensingh sadar thana revealed that all the seed samples were infected by one or more fungal pathogens. The pathogens encountered in jute seeds were *Botryodiplodia theobromae*, *Colletotrichum corchori*, *Curvularia lunata* , *Fusarium* spp. and *Macrophomina phaseolina*. Of these, *C. corchori* appeared to be the most predominant one occurring in 65 seed samples out of 80 and as high as 87% seed borne infection of the pathogen was recorded (Fakir *et al.,* 1990).

Fakir *et al.* (1991) found that there were six different seed borne diseases of jute caused by 10 different fungal organisms in Bangladesh. Of all these pathogens, *Botryodiplodia theobromae*, *Colletotrichum corchori* and *Macrophomina phaseolina* were responsible for causing black band, anthracnose and stem rot, respectively and most widely distributed in the country. Each of these three diseases had major effects on seed production.

Haider *et al.* (1992) studied seed samples of jute collected from 5 districts of Bangladesh were detected during 1985 and 1986 for the association of fungal pathogens by standard blotter and agar plate methods. Altogether, 12 genera were detected of which *Colletotrichum corchori*, *Sclerotium rolfsii* were found to be predominant. The percentage of occurrence of fungi varied markedly with respect to collection as well as with methods of detection.

Khan (1992) studied an experiment on the occurrence of seed borne fungal pathogens in jute at different stages of seed development and maturation using the cultivar "Deshi Pat" (*Corchorus capsularis* L.). Altogether, 9 different fungi viz. *Botryodiplodia theobromae*, *Cercospora corchori*, *Colletotrichum corchori*, *Curvularia lunata*, *Fusarium oxysporum*, *F. semitectum*, *F.* spp. and *Macrophomina phaseolina* were found to be associated with 1-3 weeks old growing pods. Of these, five fungi namely- *C. lunata*, *F. semitectum*, *F, oxysporum,F.* spp. and *M.phaseolina* were found to infect the developing seeds in the three weeks old growing pods. Eight fungi were recorded during 3-10 weeks period of seed development and maturation.

Khan and Fakir (1992) reported eight different seed-borne fungal pathogens were detected in seeds of a local jute cultivar "Deshi pat" (*Corchorus capsularis* L') during three to ten weeks period of seed development and maturation' They were *Botryodiplodia theobromae*, *Cercospora corchori*, *Colletotrichum corchori*, *Curvularia lunata*, *Fusarium oxysporum*, *Fusarium semitectum*, *Fusarium* sp., and *Macrophomina phaseolina*. Among these Fungi *C. lunata,F. oxysporurm*, *F. semitectum*, *Fusarium* sp and *M. phaseolina* were detected in seeds obtained from three weeks old young – growing pods. *B. theobromae, C. corchori*, *Curvularia lunata*, *F. oxyspurum*, *F. semitectum*, *Fusarium* sp.and *M. phaseolina* were found in developing seeds collected from five weeks old growing pods; while all the eight fungal pathogens were detected in

seeds of seven weeks old and ten weeks old pods. The occurrence of fungal infections detected in seeds at their different stages of development increased with increase of seed age.

Fakir *et al.* (1993) reported that transmission of the major seed borne diseases including stem rot caused by *Macrophomina phaseolina*, black band caused by *Botryodiplodia theobromae* and anthracnose caused by *Colletotrichum corchori*, from seed to plant to seed revealed that germination of the seeds was found to decrease with the increase of the seed borne infection and resulted significantly higher amount of disease development in the field. However, the rate of transmission of the three test pathogens from infected seeds to the growing plants and finally to the harvested seeds was relatively low.

Khan and Fakir (1993) reported that nine different pathogenic fungi namely *Botryodiplodia theobromae*, *Cercospora corchori*, *Colletotrichum corchori*, *Corynespora cassiicola*, *Curvularia lunata*, *F. oxysporum*, *F. semitectum*, *F.* spp. and *Macrophomina phaseolina* were detected in one week old growing jute capsules. *Cercospora corchori* was the most predominant (36.4%) fungus followed by *C. lunata* (29.4%). Only *C. lunata*, *F. oxysporum*, *F. semitectum*, *Fusarium*.sp.and *M.phaseolina* were found to infect the developing seeds of three weeks old capsules. Of these, *Fusarium* spp. (2.8%) were more frequently detected in developing seeds followed by *M. phaseolina* (1.8%). Sahu and Behera (1996) studied the surface and sub-surface fungal flora of jute (*Corchorus capsularis* and *C. olitorius*). Of the seed coat fungi, *Aspergillus* was the dominant species followed by *Penicillium*. The recorded endophytes were *M. phaseolina*, *F. oxysporum* ,*F. semitectum* and *S. rolfsii* (*Corticium rolfsii*).

Fakir (1998) conducted an experiment on the health status of jute (*Corchorus capsularis* var. local Deshi pat) seeds collected from 80 farmers representing 10 villages under 5 union of Mymensingh sadar district. He observed that no seed sample was completely free from pathogens. The pathogens encountered were *Botryodiplodia theobromae*, *Colletotrichum corchori*, *Curvularia lunata*, *Fusarium* spp. and *Macrophomina phaseolina*. Each of all the tested seed samples was infected by at least three fungal pathogens. Among these, *C. corchori* appeared to be the most prominent occurring in 65 seed samples out of 80 tested and as high as 87.0% seed borne infection of the pathogens was recorded. The pathogens associated with the seeds were found to cause seed rot/germination failure and seedling infection. Average germination of most of the seed

samples was below 80%, lower than the national germination standard. In general, low germination was related to high prevalence of seed borne infection of the pathogens. Seed borne infection of the three most destructive pathogens are *B. theobromae*, *C. corchori* and *M. phaseolina*, respectively responsible for causing black band, anthracnose, and stem rot of jute, were always much higher than the recommended national seed health standard fixed for these pathogens.

Fakir (2001) reported from a study that jute suffered from 12 different diseases. Of all these diseases, 10 were known to be seed borne. Among the seed borne diseases, except leaf mosaic (caused by virus), all other diseases were caused by fungal pathogens.

Islam *et al.* (2003) reported that inoculation with the pathogens was inoculated on 45, 55, 65 days age of the jute plants. Variety BJC-7370 and CVL-1 of jute had reaction with strains MS-6, MS-9, and CS-1 at every inoculation times. The gradual increase of inoculation affected the plants. As the time of inoculation increases the lesion size on stem decreases, the number of pods /plant, seeds/ plant and Seed germinations (%) increases and at the same time seed infections (%) decreases. MS-6 strain was found more virulent than MS-9 and CS-1 regarding pods /plant and seeds/ plant production, as well as seed germinations and infections (%).

Islam *et al.* (2003) found that total seed borne infections were minimum in breeder seeds and that of maximum in farmer's seeds. Negative relationship between % germination and % total fungal pathogens were observed. Regression coefficient (β) were -0.95, -0.85, -0.78 and -0.82 in CVL-1, CVE-3, O-9897 and O-4, respectively which indicates for every 1% increase of seed borne infection there were corresponding decrease of 0.95, 0.85, 0.78 and 0.82%.

Islam and Fakir (2007) found that the poorest performance was observed in farmers seeds. Seven different pathogenic fungi – *Botryodiplodia theobromae*, *Colletotrichum corchori*, *Corynespora cassicola*, *Curvularia lunata*, *Fusarium moniliformae*, *F. semitectum* and *Macrophomina phaseolina* were detected in seeds of all seed classes. All seed quality parameters were comparatively better in breeder seeds than foundation seeds. As certified seeds had better performance than farmers seeds, so certified seeds should be used for fiber production at farm level and therefore, proper care should be taken in the production and storage of certified seeds.

Sultana *et al.* (2007) revealed that the germination percentage was more in laboratory conditions than that of field conditions. Seeds having higher seed borne infections caused significantly higher amount of diseases development in the field.

Pervin *et al.* (2012) observed that Breeder seeds had the best performance in all the seed quality attributes as compared to foundation, certified and farmers seeds. The lowest performance was observed in farmers‟ seeds. Seven different causal organisms of fungal disease *Botryodiplodia theobromae*, *Colletotrichum corchori*, *Corynespora cassicola*, *Curvularia lunata*, *Fusarium moniliformae*, *F. semitectum* and *Macrophomina phaseolina* were detected in seeds of all seed classes. All seed quality parameters were comparatively better in breeder seeds than foundation seeds. Certified seeds had better performance than farmers‟ seeds. So, certified seeds should be used for fibre production at farm level. Therefore, proper care should be taken in the production and storage of certified seeds.

Islam *et al.* (2010) collected Jute seeds from twenty locations of Sadar upazilla in Jamalpur district were studied for seed-borne fungal prevalence and it's control by plant extracts. Four hundred seeds of each sample were tested by dry inspection and blotter incubation method. Incidence of the seed-borne fungal pathogens and number of seeds sprouted were recorded. 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. Percent sprouting and percent seed borne infection of fungal pathogens were influenced by different plant extracts. Out of five extracts (Garlic clove, Allamanda leaf, Neem leaf, Tobacco leaf and Bishkatali leaf @ 1:1 and 1:2 concentration), garlic (*Alium sativum*) clove extract @ 1:1 and 1:2 concentrations were found most effective in controlling seed-borne fungal infections. Garlic clove extract @ 1:1. reduced highest fungal infection where as tobacco leaf extract @ 1:2, reduced lowest percentage of fungal infection.

CHAPTER III

MATERIALS AND METHODS

3.1. Experimental site

The experiment was conducted at seed pathology laboratory and the net house of Plant Pathology Department, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka during June-2018 to March-2019. The location of the experimental site was at 23^0 46' N latitude and 90^0 22'E longitudes with an elevation of 8.24 meter from sea level (Khan, 1997).

3.2. Experimental period

The experiments were conducted during June 2018 to March 2019.

3.3 Collection of seed sample

Altogether 9 seed samples were collected from Bangladesh Jute Research Institute (BJRI), Manik Mia aveneue, Dhaka-1207.Each seed samples were collected at the amount of 100g.

3.4. Jute and allied fiber crop varieties

The following fiber crops variety were used for conducting the experiments.

V_1 = Jute cvl-1
V_2 = BJRI deshi jute-5(0-795)
V_3 = BJRI deshi jute-6 (0-3820)
V_4 = BJRI deshi jute-7(BJC-2142)
V_5 = BJRI deshi jute-8(BJC-2197),
V_6 = Kenaf (HC-2)
V_7 = Kenaf (HC-95)
V_8 = BJRI Kenaf-4 and
V_9 = Mesta (HS-24).

3.5. Seed collection procedure

The collected seed samples were kept in plastic container. All the seed samples were labeled properly and preserved in refrigerator at 5^0C till the samples were used for conducting respective research. Working seed samples were taken from the preserved seed samples as per requirement. Total procedure was maintained following the Rules of ISTA (ISTA, 1999).

Seventy-five seeds were taken randomly from the seed sample (ISTA, 1999). The working samples were divided into three replications and thus one replication contained 25 seeds. The seeds were germinated on top of three layers of Whatman no.1 filter paper. The filter papers were soaked in water and placed at the bottom of 9-cm diameter plastic petri dish and thereafter 25 seeds were placed on the top of filter paper. Thus 75 seeds were placed in 3 replicated petri dishes. Evaporation of water was minimized by tightly fitting the lids of the petri dishes. The petri dishes were placed inside the incubator maintaining the temperature at 30^0C for five days. Seeds producing both plumule and radical after incubation were counted as germinating seeds. The result was expressed as percentage.

3.6 Detection of seed borne fungi

Seed samples were subjected to seed health analysis by Blotter method for detection of seed-borne fungi. In this method three layers of blotter papers (Whatman No.l) were soaked in sterile water and were placed at the bottom of nine cm diameter plastic petri dish. Thereafter, 25 seeds were placed in each plate for 5 varity of deshi jute, 3 varities of kenaf and one varity of mesta seeds. Each of the varieties of fiber crops seeds were placed in 3 replications. In this way, altogether 75 seeds for each samples were used. The petri dishes containing seeds were incubated at 22± 2^0C under alternating cycles of 12 hours near ultraviolet (NUV) light and darkness for 7 days. After incubation, the seeds were examined under stereo inocular microscope in order to record the incidence of seed borne infection of different fungi. The incidence of fungi was recorded and expressed in percentage.

3.7 Identification of fungi

The fungi grown out of the incubated seeds were examined under the stereo binocular microscope and were identified by observing their growth characters on the incubated seeds. In case of difficulty of identification, temporary slides were made and the fungi were identified to species level following the keys of Malone and Musket (1964), Ramnath *et al.* (1970), Booth (1971), Ellis (1971) and Mathur and Kongsdal (2003).

3.7.1 Blotter method

Seed health status was carried out by Blotter method to detect the seed borne pathogens associated with the jute and allied fiber crop seed samples. In this method, 75 seeds were randomly taken from each sample. The seeds were planted on water soaked three layered Whatmann No. 1 filter paper in plastic petri dishes. In each Petri dish, 25 seeds were placed at equal distance. All these petri dishes were incubated at 20 ± 2˚C under 12 hrs, alternate cycle of Near Ultra Violet (NUV) light and darkness. After 7 days of incubation, petri plates containing incubated seeds were observed under stereomicroscope for detecting seed borne pathogens on jute seed surface under stereomicroscope at 25x magnification. Where identification was difficult or doubtful under the stereo microscope, temporary slide was prepared and examined under the compound microscope and identified with the help of literature review and expert consultation. Number of germinated seeds was recorded along with the seed borne fungi after seven days of incubation. The results were expressed in percentage.

3.7.2 Agar plate method

Seed health status was also carried out by water agar method to detect the seed borne pathogens associated with the jute and allied fiber crop seed samples. In this method, 50 seeds were randomly taken from each sample. Seeds were dipped in 3% chlorox for 1 minute and washed 3 times and water agar media was prepared and placed in glass petri dishes in air laminar flow chamber. After solidifying the media, 25 seeds from each of the variety were placed at equal distance in the water agar plate in 2 replications. All these petri dishes were incubated at 20˚C ± 2˚C under 12 hrs, alternate cycle of Near Ultra Violet (NUV) light and darkness. After 7 days of incubation, petri plates containing incubated seeds were observed under stereo microscope for detecting seed borne

pathogens on jute and allied fiber seed surface under stereomicroscope at 25x magnification. Where identification was difficult or doubtful under the stereomicroscope, temporary slide was prepared and examined under the compound microscope and identified with the help of literature review and expert consultation. Number of germinated seeds was recorded along with the seed borne fungi after seven days of incubation. The results were expressed in percentage.

3.7.3 Test tube method

In this method, at first agar media was prepared and then placed in test tube at 1/3 of this test tube diameter in laminar air flow chamber. Only 1 seed was placed in the test tube from each variety of allied fiber crop seeds in 3 replications. All these test tube were incubated at 20˚C ± 2˚C under 12 hrs, alternate cycle of Near Ultra Violet (NUV) light and darkness. After 7 days of incubation, test tubes containing incubated seeds were observed under stereomicroscope for detecting seed borne pathogens on jute seed surface under stereomicroscope at 25x magnification. Where identification was difficult or doubtful under the stereomicroscope, temporary slide was prepared and examined under the compound microscope and identified with the help of literature review and expert consultation. Number of germinated seeds was recorded along with the seed borne fungi after seven days of incubation. The results were expressed in percentage.

3.7.4 Growing on test method

Growing on test was conducted in the net house of the Plant Pathology Department to determine the effect of fungi on germination and incidence of seedling diseases or infections. The test carried out by using sterilized sand in plastic trays. Sand was sterilized by 3% formaldehyde @ 200 ml/cft. The sand was covered with polythene sheet for 24 hours. After 24 hours the polythene sheet was removed and the sand was spread and allowed to open for seven days for evaporation of the formaldehyde gas. Thus, the sand was ready for sowing the seeds.

The tray was then filled with sterilized sand and moistened with water. Three trays were used for each seed sample of deshi jute, kenaf and mesta variety. 30 seeds were taken from each seed samples and 10 seeds were sown in a line in each tray for 3 replications of the three fiber crops-deshi jute, kenaf and mesta. Data on germination, normal seedlings, abnormal seedlings and diseased seedlings were recorded after 14 days of

sowing following the International Rules for Seed Testing (ISTA, 2001) with some modification. In the modification the diseased seedlings were separated from the abnormal seedlings and counted separately. The results were expressed in percentages.

3.8 Seed treatment

Based on the results of analysis of seed health test, one seed sample from the locations of local variety of jute (*Corchorus capsularis* L.) having high levels of infection by the major seed borne fungi, were selected for this study. Three treatment namely- *Trichoderma*, Autostin and Soil sterilization were tested at their recommended dose against the seed-borne fungal pathogens (Fakir and Ashrafujjaman, I989). Requisite amount of each fungicide and seeds from each sample were taken in a 250 ml Erlenmeyer flask and were shaken mechanically for 10 minutes for proper coating of the fungicides. Afier 24 hours, the efficacy of the Seed test fungicides was evaluated by comparing with an untreated control using the Standard Blotter Method (ISTA, I976).

3.9. Seedling incidence

Seedling incidence, which measures the extent of proportion of a disease was estimated by using the following formula (Agrios, 2005):

$$\text{Seedling incidence} = \frac{\text{Number of diseased seedling}}{\text{Number of total seedlings observed}} \times 100$$

3.9. Statistical analysis

Data were analyzed by MSTATC software and mean comparisons -Duncan's Multiple Range Test (DMRT).

CHAPTER IV

RESULTS

4.1 Fungi detection by blotter paper method

In this method, significant variation was found in germination of seeds, seed infection and seedling infection. These significant variations are shown in Table 1.

4.1.1 Germination of seeds

Germination of seeds varied from 87.33% to 97.67% depending on the fiber crop variety was shown in Table1. Germination of seeds varied significantly while the highest percentage of seed germination (97.67%) was recorded in V_7 (kenaf HC- 95) and it is identically similar with V_6, V_8, V_3 and the lowest percentage of seed germination (81.33%) was recorded in variety V_9 (Mesta HS-24).

4.1.2 Seed infection (%)

Seed infection varied from 46.67% to 3.33% depending on the jute and allied fiber crop varieties .Seed infection varied significantly while the highest percentage of seed infection(46.67%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8) and the lowest percentage of seed infection (3.33%) was recorded in V_7 Kenaf (HC-95) and V_8 (BJRI Kenaf-4), respectively.

4.1.3 Seedling infection (%)

Seedling infection varied significantly due to different fibre crop varieties. Result revealed that the highest percentage of seedling infection (36.67%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8) and the lowest percentage of seedling infection(0%) was recorded in fiber crop variety V_1(Jute cvl-1), V_3 (BJRI deshi jute-6), V_7Kenaf (HC-95) andV_8 (BJRI Kenaf-4), respectively.

4.1.4 Post emergence mortality (%)

Post emergence mortality of seedling was varied significantly due to different fiber crop varieties. Result revealed that at 5, 7 and 9 DAS, the highest percentage of post emergence mortality of seedling (10.00%, 16.67% and 36.67%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8) and the lowest percentage of post emergence mortality of seedling(0.00, 0.00 and 0.00) was recorded in V_1 (Jute cvl-1),

Table 1. Varietal reaction on germination, seed infection, seedling infection, post emergence mortality (%) in blotter paper method

Varieties	Germination (%)	Seed infection (%)	Seedling infection (%)	Post emergence mortality (%)		
				5 DAS	7 DAS	9 DAS
V_1	93.00b	10.00d	0.00c	0.00c	0.00e	0.00
V_2	92.00bc	6.67e	3.33b	3.33b	3.33d	3.33d
V_3	96.67a	10.00d	0.00c	0.00c	0.00e	0.00e
V_4	81.33e	6.67e	6.67b	0.00c	6.67b	10.67c
V_5	91.00c	46.67a	36.67a	10.00a	16.67a	36.67a
V_6	96.67a	20.00c	6.67b	3.33b	6.67c	10.00b
V_7	97.67a	3.33f	0.00c	3.33b	0.00e	3.33d
V_8	96.67a	3.33f	0.00c	0.00c	3.33d	3.33d
V_9	87.33d	33.33b	3.33b	0.00c	3.33d	6.67c
LS	**	**	*	*	*	**
$S\bar{x}$	0.951	1.859	4.649	3.597	1.600	1.670
CV (%)	3.48	12.53	15.43	13.23	21.43	21.33

Figures in a column having common letter(s) do not different from each other as adjusted by DMRT.

LS= Level of significance; $S\bar{x}$ = Standard error of mean; CV= Coefficient of variation,
*= Significant at 5% level of Probability; **= Significant at 1% level of Probability.
V1 = Jute cvl-1, V2 = BJRI deshi jute-5, V3 = BJRI deshi jute-6, V4 = BJRI deshi jute-7, V5 = BJRI deshi jute-8, V6 = Kenaf (HC-2), V7 = Kenaf (HC-95), V8 = BJRI Kenaf-4 and V9 = Mesta (HS-24).

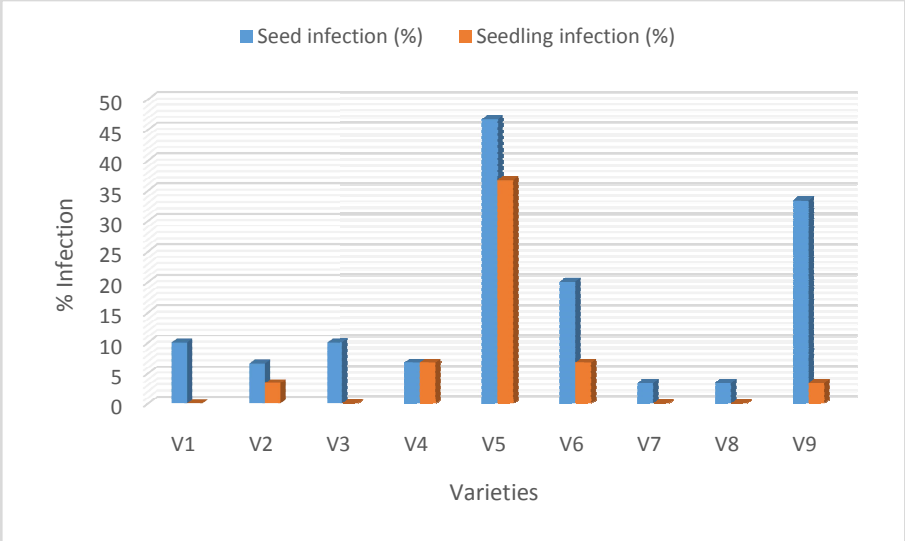


Figure 1 Varietal reaction on seed infection and seedling infection in blotter method.

4.1.5 Prevalence of seed borne fungi

Prevalence of total seed borne fungi detection were varied significantly depending on the seeds of different jute and allied fiber crops varieties. The prevalence of total seed borne fungi detection are shown in Table 2. The highest total number of seed borne fungi 7.00 were recorded in V_5 (BJRIdeshi jute-8), followed by V_9 (5.67), while the lowest total seed borne fungi 0.33 were recorded in seeds obtained from V_1 (cvl-1). Altogether five fungi genus (*Colletotrichum corchori, Fusarium* spp., *Aspergillus* spp., *Botryodiplodia theobromae, Macrophomina phaseolina*) were identified in nine fiber crops varieties. Of these, *Colletotrichum corchori* was the most predominant fungus recoded in V_4 (BJRI deshi jute-7), followed by V_5 (BJRI deshi jute-8), V_6 (Kenaf (HC-2)) and V_9 (Mesta (HS-24)) respectively.

Table 2. Varietal reaction on prevalence of seed borne fungi in blotter paper method

Varieties	Total fungi (no.)	Mean (%)				
		Colletotrichum corchori	***Botryodiplodia theobromae***	***Macrophomina phaseolina***	***Fusarium* spp.**	***Aspergillus* spp.**
V_1	0.33f	0.00f	0.00b	33.33a	0.00f	0.00f
V_2	3.00d	33.33b	11.11a	0.00c	22.22d	33.33c
V_3	1.67e	16.67e	0.00b	0.00c	0.00f	83.33a
V_4	4.67c	71.67a	0.00b	13.33b	8.33e	6.67e
V_5	7.00a	28.57c	0.00b	0.00c	38.10b	33.33c
V_6	0.67f	33.33b	0.00b	0.00c	33.33c	0.00f
V_7	1.67e	0.00f	0.00b	16.67b	33.33c	50.00b
V_8	0.67f	33.33b	0.00b	0.00c	0.00f	33.33c
V_9	5.67b	23.33d	0.00b	0.00c	53.33a	23.33d
LS	**	**	*	*	**	**
$S\bar{x}$	0.461	1.749	5.883	3.498	2.825	1.749
CV (%)	3.48	22.53	22.43	13.33	13.43	21.29

Figures in a column having common letter(s) do not different from each other as adjusted by DMRT.

LS= Level of significance; $S\bar{x}$ = Standard error of mean; CV= Coefficient of variation,
*= Significant at 5% level of Probability; **= Significant at 1% level of Probability.
V1 = Jute cvl-1, V2 = BJRI deshi jute-5, V3 = BJRI deshi jute-6, V4 = BJRI deshi jute-7, V5 = BJRI deshi jute-8, V6 = Kenaf (HC-2), V7 = Kenaf (HC-95), V8 = BJRI Kenaf-4 and V9 = Mesta (HS-24).

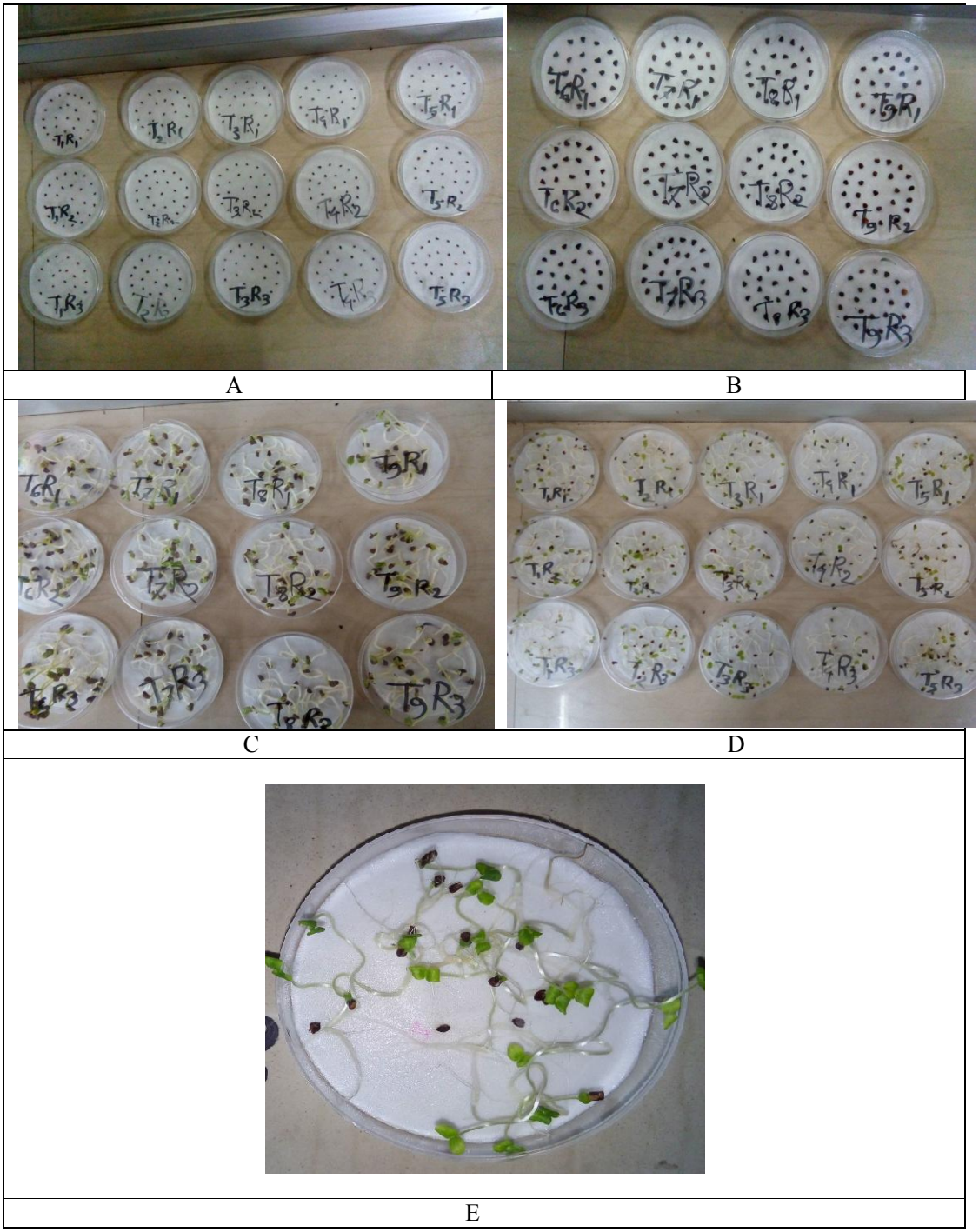


Plate1. Seed placement on blotter paper method A. deshi jute variety; B. kenaf and mesta variety and germinating seeds of C. deshi jute variety D. kenaf and mesta and E. showing the germinated seedlings of jute and allied fiber crop.

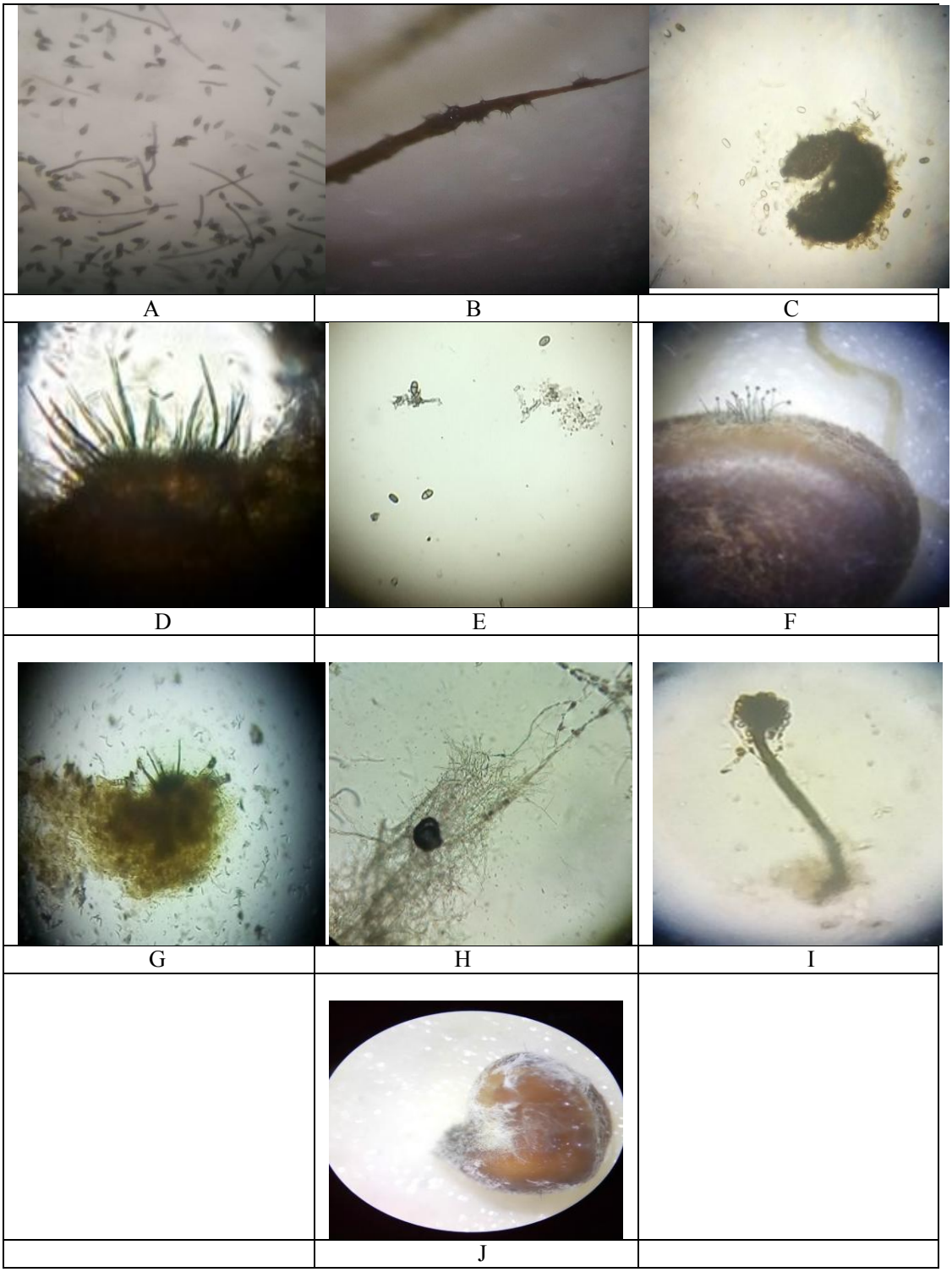


Plate-2.Compound microscopic view of A. *Carvularia lunata* C. *Macrophoomina phaseolina* D. black setae of *Colletotrichum corchori* E. *Botryodiplodia theobromae* G. conidia of *colletotrichum corchori* H. *Fusarium spp*. I. *Aspergillus niger* and stereo microscopic view of B. *Colletotrichum corchori* on seedling F. *Aspergillus niger* on seed J. *Fusarium spp*. on seed.

4.2 Fungi detection by agar plate method

In this method, significant variation was found in germination of seeds, seed infection and seedling infection. These significant variations are shown in Table 3

4.2.1 Germination of seeds

Germination of seeds varied from 92.00% to 77.00% depending on the fiber crop varieties. Germination of seeds varied significantly while the highest percentage of seed germination (92.00%) was recorded in fiber crop variety V_7 (kenaf (HC-95)) followed by V_3 and the lowest percentage of seed germination (77.00%) was recorded in V_6 (kenaf HC-2).

4.2.2 Seed infection (%)

Seed infection varied from 33.33% to 6.67% depending on the jute and allied fiber crop varieties .Seed infection varied significantly while the highest percentage of seed infection(33.33%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8) followed by V_2,V_6 and the lowest percentage of seed infection (6.67%) was recorded in fiber crop variety V_7 (kenaf (HC-95)).

4.2.3 Seedling infection (%)

Seedling infection varied significantly due to different fiber crop varieties. Result revealed that the highest percentage of seedling infection (16.67%) was recorded in fiber crop variety V_2 (BJRI deshi pat-5)followed by V_9 and the lowest percentage of seedling infection (0.00%) was recorded in fiber crop variety V_7(kenaf (HC-95)) and V_8 (BJRI Kenaf-4), respectively.

4.2.4 Post emergence mortality (%)

Post emergence mortality of seedling was varied significantly due to different fiber crop varieties. Result showed that at 5, 7 and 9 DAS, the highest percentage of post emergence mortality of seedling (10.00%, 16.67% and 16.67%) was recorded in fiber crop variety V_5 (BJRI deshi jute-7) and the lowest percentage of post emergence mortality of seedling (0.00%, 0.00% and 3.33%) was recorded in fiber crop variety V_7 (Kenaf (HC-95))

Table 3. Varietal reaction on germination, seed infection, seedling infection, post emergence mortality (%) in agar plate method.

Varieties	Germination (%)	Seed infection (%)	Seedling infection (%)	Post emergence mortality (%)		
				5 DAS	7 DAS	9 DAS
V_1	86.33b	16.67c	0.00e	6.67b	6.67c	6.67d
V_2	87.00b	30.00a	16.67a	3.33c	6.67c	10.00c
V_3	90.33a	6.67d	10.00bc	3.33c	6.67c	10.00c
V_4	80.33c	26.67ab	3.33de	0.00d	6.67c	6.67d
V_5	86.33b	33.33a	10.00bc	10.00a	16.67a	16.67a
V_6	77.00d	30.00a	6.67cd	0.00d	6.67c	10.00c
V_7	92.00a	6.67d	0.00e	0.00d	0.00d	3.33e
V_8	85.67b	20.00bc	0.00e	0.00d	6.67c	6.67d
V_9	86.67b	16.67c	13.33ab	3.33c	10.00b	13.33b
LS	*	**	**	**	**	**
S $\bar{x}$	1.518	4.653	3.102	1.551	1.551	1.749
CV (%)	7.86	12.54	17.53	21.54	12.54	21.43

Figures in a column having common letter(s) do not different from each other as adjusted by DMRT.

LS= Level of significance; S $\bar{x}$ = Standard error of mean; CV= Coefficient of variation,
*= Significant at 5% level of Probability; **= Significant at 1% level of Probability.
V1 = Jute cvl-1, V2 = BJRI deshi jute-5, V3 = BJRI deshi jute-6, V4 = BJRI deshi jute-7, V5 = BJRI deshi jute-8, V6 = Kenaf (HC-2), V7 = Kenaf (HC-95), V8 = BJRI Kenaf-4 and V9 = Mesta (HS-24).

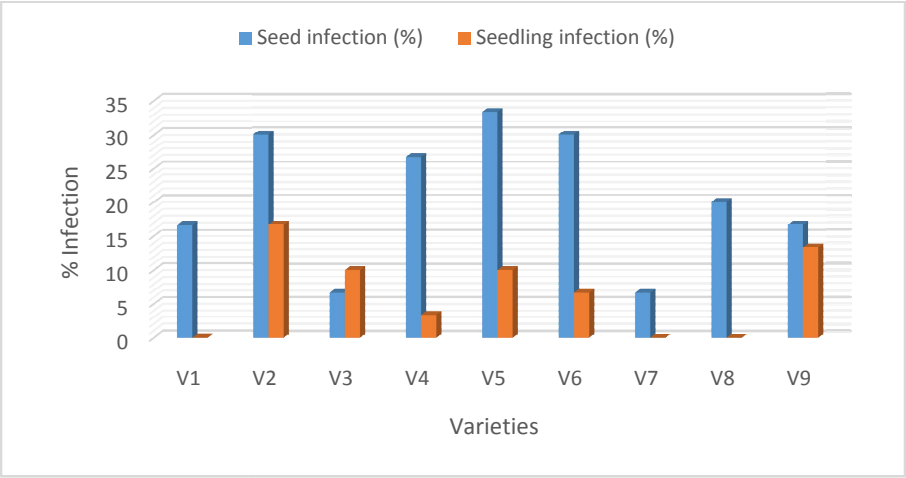


Figure 2 Varietal reactions on seed infection and seedling infection in agar plate method.

4.2.5 Prevalence of seed-borne fungi

Prevalence of total seed borne fungi detection were varied significantly depending on the seeds of jute and allied fiber crop varieties in Table 4. The highest total number of seed borne fungi (5.67%) were recorded in V_2 (BJRI deshi jute-5) which was statistically similar with V_4 (BJRI deshi jute-7) and V_5 (BJRI deshi jute-8) respectively, followed by V6 (4.33%), while the lowest total seed borne fungi (1.00) were recorded in seeds obtained from V_7 (Kenaf (HC-95)). Altogether six fungi genus (*Colletotrichum corchori, Curvularia lunata, Fusarium* spp., *Aspergillus* spp., *Macrophomina phaseolina* and *Botryodiplodia theobromae*) were identified in nine fiber crops varieties. Of these, *Colletotrichum corchori* was the most predominant fungus recorded in variety V_5 (BJRI deshi jute-8).

Table 4. Varietal reaction on prevalence of seed-borne fungi in agar plate method

Varieties	Total fungi (no.)	Mean (%)				
		Colletotrichum corchori	***Curvularia lunata***	***Macrophomina phaseolina***	***Fusarium* spp.**	***Aspergillus* spp.**
V_1	3.33c	8.33d	0.00b	0.00b	72.22a	19.44f
V_2	5.67a	34.44b	0.00b	0.00b	35.56d	30.00e
V_3	2.33d	27.78c	0.00b	0.00b	27.78e	44.44c
V_4	5.67a	35.56b	0.00b	5.56a	28.89e	30.00e
V_5	5.33a	43.33a	0.00b	0.00b	51.11c	5.56h
V_6	4.33b	8.33d	6.67a	0.00b	46.67c	38.33d
V_7	1.00e	0.00e	0.00b	0.00b	33.33d	66.67a
V_8	2.67cd	0.00e	0.00b	0.00b	50.00c	50.00b
V_9	2.67cd	22.22c	0.00b	0.00b	66.67b	11.11g
LS	**	**	*	*	**	**
$S\bar{x}$	0.437	2.806	1.551	2.484	3.102	2.102
CV (%)	14.23	24.40	42.35	13.54	35.45	32.34

Figures in a column having common letter(s) do not different from each other as adjusted by DMRT.

LS= Level of significance; $S\bar{x}$ = Standard error of mean; CV= Coefficient of variation,
*= Significant at 5% level of Probability, **= Significant at 1% level of Probability.
V1 = Jute cvl-1, V2 = BJRIdeshi jute-5, V3 = BJRIdeshi jute-6, V4 = BJRIdeshi jute-7, V5 = BJRIdeshi jute-8, V6 = Kenaf (HC-2), V7 = Kenaf (HC-95), V8 = BJRI Kenaf-4 and V9 = Mesta (HS-24).

Plate3. Seed germination of deshi jute variety kenaf and mesta variety in agar plate method.

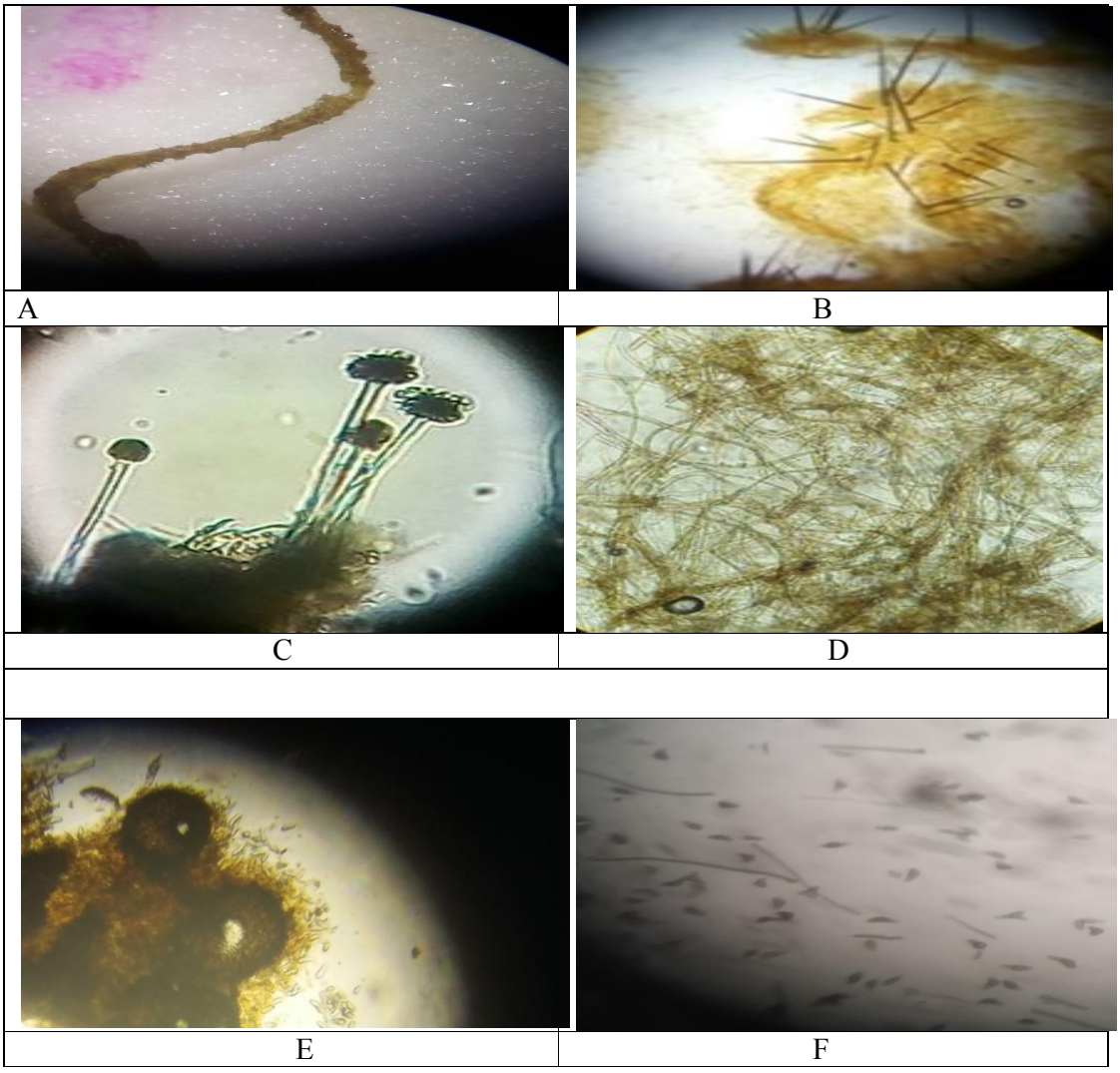


Plate 4.Stereo microscopic view of A. *Colletotrichum corrchori* in seedling and compound microscopic view of B. setae of *Colletotrichum lunata* C.*Aspergillus niger* D.*Fusarium* spp. E. *Macrophomina phaseolina* F.*Curvularia lunata*

4.3 Fungi detection by test tube method

In this method, significant variations were found in germination of seeds, seed infection and seedling infection. These significant variations are shown in Table 5.

4.3.1 Germination of seeds

Germination of seeds varied from 100% to 86.67% depending on the fiber crop variety. Germination of seeds varied significantly while the highest percentage of seed germination (100%) was recorded in fiber crop variety V_1(Jute cvl-1), V_3 (BJRI deshi jute-6) and V_4 (BJRI deshi jute-7), respectively and the lowest percentage of seed germination (86.67%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8).

4.3.2 Seed infection (%)

Seed infection varied from 93.33% to 0.00% depending on the jute and allied fiber crop varieties .Seed infection varied significantly while the highest percentage of seed infection (93.33 %) was recorded in fiber crop variety V_5 (BJRI deshi jute-8) and V_6 (Kenaf (HC-2)), respectively and the lowest percentage of seed infection (0%) was recorded in fiber crop variety V_3 (BJRI deshi jute-6) and V_4 (BJRI deshi jute-7).

4.3.3 Seedling infection (%)

Seedling infection varied significantly due to different fiber crop varieties. Result revealed that the highest percentage of seedling infection (100%) was recorded in fiber crop varietyV_4 (BJRI jute-7) and V_5 (BJRI deshi jute-8), respectively and the lowest percentage of seedling infection (86.67%) was recorded in fiber crop variety V_3 (BJRI deshi jute-6).

4.3.4 Post emergence mortality (%)

Post emergence mortality of seedling was varied significantly due to different jute and allied fiber crop varieties. Result revealed that at 5, 7 and 9 DAS, the highest percentage of post emergence mortality of seedling (90%, 93.33% and 100%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8) and the lowest percentage of post emergence mortality of seedling (73.33%, 83.33% and 86.67%) was recorded in fiber crop variety V_7 (Kenaf (HC-95)).

Table 5. Varietal reaction on germination, seed infection, seedling infection, post emergence mortality (%) on test tube method

Varieties	Germination (%)	Seed infection (%)	Seedling infection (%)	Post emergence mortality (%)		
				5 DAS	7 DAS	9 DAS
V_1	100.00a	60.00c	93.33b	83.33c	96.67a	96.67b
V_2	93.33c	40.00d	93.33b	80.00d	93.33a	93.33c
V_3	100.00a	0.00e	86.67c	80.00d	90.00b	90.00d
V_4	100.00a	0.00e	100.00a	83.67b	86.33c	100.00a
V_5	86.67d	93.33a	100.00a	90.00a	93.33a	100.00a
V_6	93.33c	93.33a	93.33b	80.00d	86.67b	93.33c
V_7	93.33c	83.33b	93.33b	73.33f	83.33c	86.67e
V_8	96.67b	86.67b	93.33b	66.67g	86.67b	86.67e
V_9	96.67b	86.67b	90.00b	76.67e	93.33a	96.67b
LS	*	**	*	*	*	*
$S\bar{x}$	1.457	3.116	1.551	1.551	3.102	1.484
CV (%)	6.98	11.93	11.80	20.36	16.43	13.54

Figures in a column having common letter(s) do not different from each other as adjusted by DMRT.

LS= Level of significance; $S\bar{x}$ = Standard error of mean; CV= Coefficient of variation,
*= Significant at 5% level of Probability, **= Significant at 1% level of Probability.
V1 = Jute cvl-1, V2 = BJRIdeshi jute-5, V3 = BJRI deshi jute-6, V4 = BJRI deshi jute-7, V5 = BJRI deshi jute-8, V6 = Kenaf (HC-2), V7 = Kenaf (HC-95), V8 = BJRI Kenaf-4 and V9 = Mesta (HS-24).

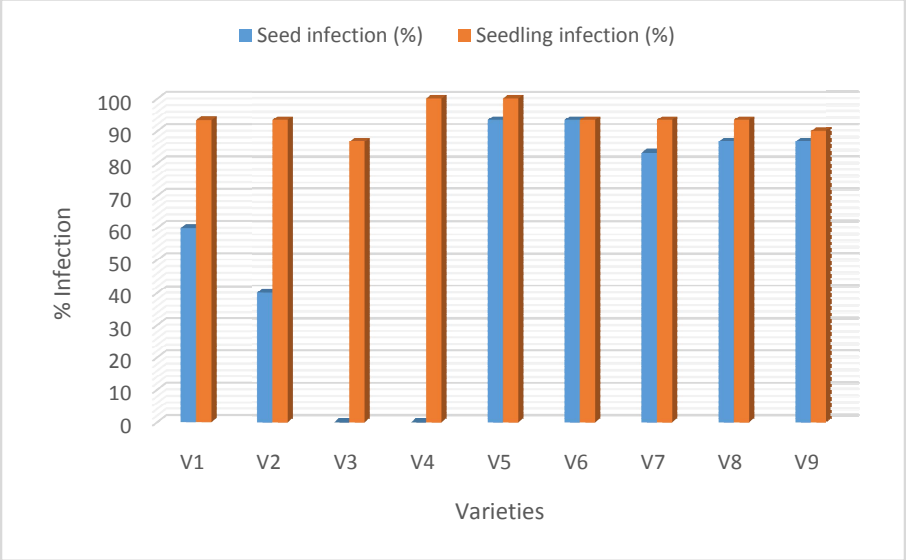


Figure 3.Varietal reaction on seed infection and seedling infection of test tube method

4.3.5 Prevalence of seed-borne fungi

Prevalence of total seed-borne fungi detection ware varied significantly depending on the seeds of jute and allied fiber crops varieties. The highest total number of seed borne fungi (2.00%) were recorded in V_2 (BJRI deshi jute-5), V_3 (BJRI deshi jute-6) and V_4 (BJRI deshi jute-7) while the lowest total seed borne fungi (1.33%) were recorded in seeds obtained from V_7 (BJRI Kenaf-4) and V_8 (BJRI kenaf-4), respectively. Altogether four fungi genus (*Colletotrichum corchori, Fusarium* spp., *Aspergillus* spp., *Macrophomina phaseolina*) were identified in nine fiber crops varieties. Of these, *Colletotrichum corchori* was the most predominant fungus recorded in variety V_5 (BJRI deshi jute-8).

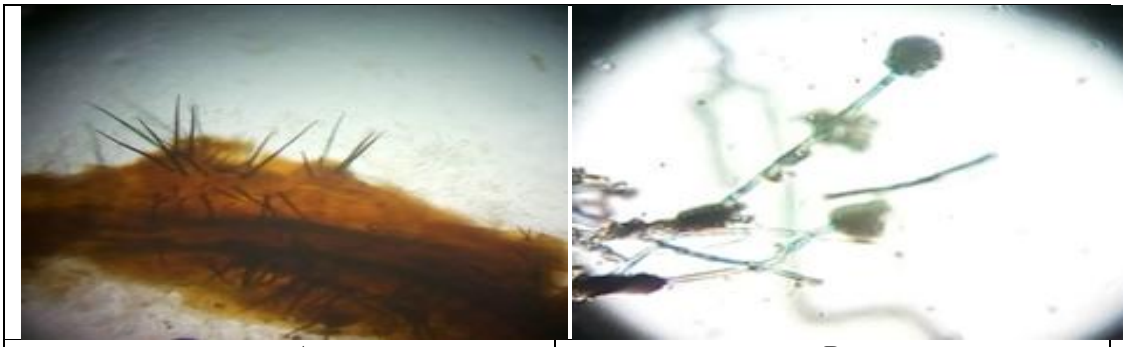
Table 6. Varietal reaction on prevalence of seed-borne fungi on test tube method

Varieties	Total fungi (no.)	Mean (%)			
		Colletotrichum corchori	***Macrophomina phaseolina***	***Fusarium* spp.**	***Aspergillus* spp.**
V_1	1.67b	16.67d	0.00c	33.33c	50.00b
V_2	2.00a	16.67dd	33.33b	50.00b	0.00d
V_3	2.00a	16.67d	0.00	33.33c	50.00b
V_4	2.00a	33.33c	16.67a	33.33c	16.67c
V_5	1.67b	83.33a	0.00c	33.33	0.00d
V_6	1.67b	0.00e	0.00c	33.33c	66.67a
V_7	1.33c	0.00e	0.00c	83.33a	16.67c
V_8	1.33c	0.00e	16.67a	83.33a	0.00d
V_9	1.67b	50.00b	0.00c	33.33c	16.67c
LS	*	**	*	**	**
$S\bar{x}$	0.108	5.786	7.191	2.975	2.067
CV (%)	6.12	31.23	22.54	22.32	21.56

Figures in a column having common letter(s) do not different from each other as adjusted by DMRT.

LS= Level of significance; $S\bar{x}$ = Standard error of mean; CV= Coefficient of variation,
*= Significant at 5% level of Probability, **= Significant at 1% level of Probability.
V1 = Jute cvl-1, V2 = BJRI deshi jute-5, V3 = BJRIdeshi jute-6, V4 = BJRI deshi jute-7, V5 = BJRI deshi jute-8, V6 = Kenaf (HC-2), V7 = Kenaf (HC-95), V8 = BJRI Kenaf-4 and V9 = Mesta (HS-24).

Plate5. Germination of seedlings of A. cvl-1 B. BJRI deshi jute-5 C. BJRI deshi jute-8 D. BJRI deshi jute -7 E. BJRI deshi jute-6 F. kenaf (HC-2) G. Kenaf (HC-95) H. BJRI kenaf -4 (HC-3) I. mesta (HS-24**)**



A B

C D

Plate6. Compound microscopic view of A. setae of *Colletotrichum corchori* B. *Aspergillus niger* C. *Fusarium spp*. and D. *Macrophomina phaseolina* in test tube method

4.4 Fungi detection by growing on test method

In this method, significant variations were found in germination of seeds, seed infection and seedling infection. These significant variations are shown in Table 7.

4.4.1 Germination of seeds

Germination of seeds varied from 84% to 24% depending on the jute and allied fiber crop variety. Germination of seeds varied significantly while the highest percentage of seed germination (84%) was recorded in fiber crop variety V_7 (Kenaf (HC-95)) and the lowest percentage of seed germination (24%) was recorded in V_9 (Mesta (HS-24)).

4.4.2 Seed infection (%)

Seed infection varied from 66.67% to 6.67% depending on the jute and allied fiber crop varieties .Seed infection varied significantly while the highest percentage of seed infection(66.67%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8) and the lowest percentage of seed infection (6.67%) was recorded in fiber crop variety V_7 (Kenaf (HC-95)).

4.4.3 Seedling infection (%)

Seedling infection varied significantly due to different jute and allied fiber crop varieties. Result revealed that the highest percentage of seedling infection (40%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8) and the lowest percentage of seedling infection (20%) was recorded in fiber crop variety V_8 (BJRI Kenaf-4).

4.4.4 Post emergence mortality (%)

Post emergence mortality of seedling was varied significantly due to different jute and allied fiber crop varieties. Result showed that at 5, 7 and 9 DAS, the highest percentage of post emergence mortality of seedling (20%, 23.33% and 40%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8) and the lowest percentage of post emergence mortality of seedling(0%, 13.33% and 20%) was recorded in fiber crop variety V_8 (BJRI Kenaf-4).

Table 7. Varietal reaction on germination, seed infection, seedling infection, post emergence mortality (%) on growing on test method

Varieties	Germination (%)	Seed infection (%)	Seedling infection (%)	Post emergence mortality (%)		
				5 DAS	7 DAS	9 DAS
V_1	75.00c	20.00b	33.33b	13.33b	23.33a	36.67b
V_2	68.67d	20.00b	23.33d	6.67d	20.00b	23.33e
V_3	81.00ab	10.00cd	23.33d	10.00c	13.33d	16.67g
V_4	66.33d	16.67bc	26.67c	6.67d	20.00b	26.67d
V_5	77.33bc	66.67a	40.00a	20.00a	23.33a	40.00a
V_6	67.33d	23.33b	33.33b	10.00c	23.33a	33.33c
V_7	84.00a	6.67d	26.67c	3.33e	20.00b	26.67d
V_8	75.33c	16.67bc	20.00e	0.00f	13.33d	20.00f
V_9	24.00e	10.00cd	23.33d	10.00c	16.67c	23.33e
LS	*	**	**	**	**	*
$S\bar{x}$	2.500	3.469	1.283	1.283	1.095	1.749
CV (%)	4.53	20.38	18.23	68.47	45.45	22.54

Figures in a column having common letter(s) do not different from each other as adjusted by DMRT.

LS= Level of significance; $S\bar{x}$ = Standard error of mean; CV= Coefficient of variation, *= Significant at 5% level of Probability, **= Significant at 1% level of Probability.
V_1 = Jute cvl-1, V_2 = BJRI deshi jute-5, V_3 = BJRI deshi jute-6, V_4 = BJRI deshi jute-7, V_5 = BJRI deshi jute-8, V_6 = Kenaf (HC-2), V_7 = Kenaf (HC-95), V_8 = BJRI Kenaf-4 and V_9 = Mesta (HS-24).

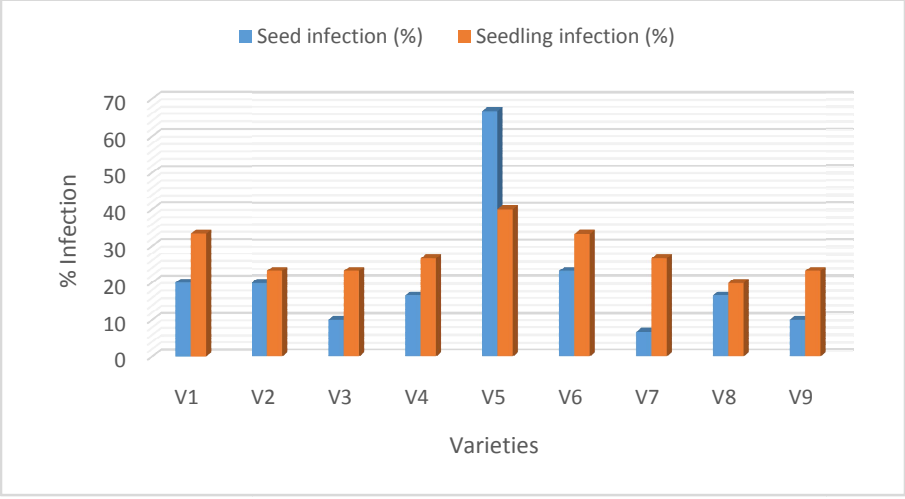


Figure 4.Varietal reaction on seed infection and seedling infection of growing on test Method.

4.4.5 Prevalence of seed-borne fungi

Prevalence of total seed borne fungi detection ware varied significantly depending on the seeds of jute and allied fiber crop varieties. The highest total number of seed borne fungi (3.67) were recorded in V_5 (BJRI deshi jute-8) while the lowest total seed borne fungi (1.67) were recorded in seeds obtained from V_4 (BJRI deshi jute-7). Altogether four fungi genus (*Colletotrichum corchori, Fusarium* spp., *Aspergillus* spp. and *Botryodiplodia theobromae*) were identified in nine fiber crops varieties. Of these, *Colletotrichum corchori* was the most predominant fungus recoded in variety V_5 (BJRI deshi jute-8).

Table 8. Varietal reaction on prevalence of seed-borne fungi on growing on test method

Varieties	Total fungi (no.)	Mean (%)		
		Botryodiplodia theobromae	***Colletotrichum corchori***	***Fusarium* spp.**
V_1	2.67d	0.00b	44.44	50.00b
V_2	3.33b	0.00b	33.33d	50.00b
V_3	2.33e	0.00b	50.00b	50.00b
V_4	1.67f	11.11 a	11.11f	77.78a
V_5	3.67a	0.00b	63.89a	19.44e
V_6	2.67d	0.00b	38.89c	27.78d
V_7	2.67d	0.00b	11.11f	50.00b
V_8	2.67d	0.00b	0.00	38.89c
V_9	3.00c	0.00b	16.67e	27.78d
LS	*	*	**	**
$S\bar{x}$	0.103	4.747	2.510	2.961
CV (%)	3.54	6.43	60.43	21.33

Figures in a column having common letter (s) does not different from each other as adjusted by DMRT.

LS= Level of significance; $S\bar{x}$ = Standard error of mean; CV= Coefficient of variation,
*= Significant at 5% level of Probability, **= Significant at 1% level of Probability.
V1 = Jute cvl-1, V2 = BJRI deshi jute-5, V3 = BJRI deshi jute-6, V4 = BJRI deshi jute-7, V5 = BJRI deshi jute-8, V6 = Kenaf (HC-2), V7 = Kenaf (HC-95), V8 = BJRI Kenaf-4 and V9 = Mesta (HS-24).

A

Plate7. Seed germination of 9 different jute and allied fiber crop seeds in 3 replications in growing on test method

4.5 Identification of seed borne fungi associated with jute and allied fiber crop seeds

In this research work, four methods were conducted to identify the seed borne fungi associated with jute and allied fiber crop seeds. These method are called blotter paper method, water agar plate method, test tube method and growing on test method (tray method). After 7 days of incubation of seeds on wet blotting paper the yielded fungi were detected and then identified by the standard methods. The yielded fungi were *Macrophomina phaseolina*, *Botryodiplodia theobromae*, *Colletotrichum corchori*, *Curvularia Iunata*, *Fusarium* sp., *Aspergillus* spp., *Penicillium* spp. and *Rhizopus* spp. Among them only the major ones were taken into account in this experiment (Plate l; 8). The characteristics of identified fungi have been described below:

Colletotrichum corchori

Acervuli, either single or in groups, were present on the ungeminated seeds and/or infected emerged seedlings. The acervuli were cushion like and dark brown to black in colour with long dark brown to black, pointed setae. The acervuli were found to be coalesced in a continuous growth of spore masses with exposed dark pointed tips of setae all over the seed. Such growth of acervuli was noticed on the infected part of seed and emerging radicle. The conidia were hyaline, sickle shaped or curved (Plate no. 2;4 ;6).

Macrophomina phaseolina

The seeds were covered with light brown to ashy grey loose mycelium. Innumerable black, flask shaped, rough walled pycnidia mostly in stroma were found to be grown all over the seed. The pycnidia were mostly embeded in the seed coat. The observed pycnidio spores were unicellular, oblong and hyaline (Plate no.2, 4 and 6).

Botryodiplodia theobromae

Profuse, loose, greyish green mycelial growth covering the entire seed surface was observed. Mycelial growth often spread to the surface of the blotter, pycnidia, either single or in stroma, appeared almost completely embeded in the seed coat. The observed pycnidio spores were oblong in shape. Brownish in colour, thick walled and two celled (Plate no.2).

***Fusarium* sp.**

Profuse, loose, whitish mycelial growth was usually found on the incubated seed under stereomicroscope. Mycelium was well developed and hyaline. Sickle shaped, septate, 4-6 celled, hyaline macro conidia were observed (Plate no. 2, 4 and 6).

Curvularia lunata

On seed shiny velvety-black, fluffy growth on the colony surface. Septate, dematiaceous hyphae producing brown, geniculate conidiophores (Plate no. 2 and 4).

Comparison of total fungi in different methods

Among all fiber crop varieties, V_5 variety showed highest fungal infection which were found in blotter method (7.00) followed by variety V_9. The lowest fungal infection in case of all methods in variety V_8.

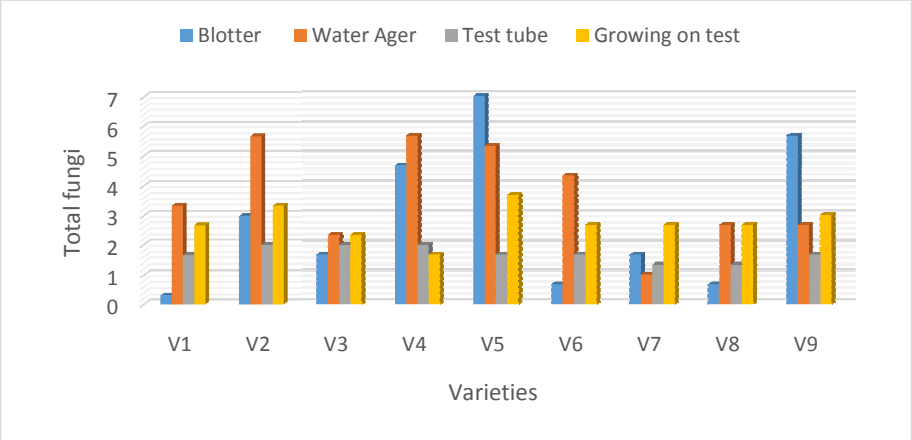


Figure 5. Comparison of total fungi in different methods

4.6 Management of seed borne diseases by different treatments in pot

Seedling incidence

Seedling incidence was identified by visual basis, observing the typical symptoms of diseases. The seedling incidence (%) is shown in (Table-9).In this findings, the highest % seedling incidence (83.33%; 80% and 66.67%, respectively) were found in control condition where the lowest result (24.14%; 21.43% and 42.86%, respectively) were found in Autostin treatment in case of severely infected 3 varieties of jute and allied fiber crops seed namely V_5 (BJRI deshi jute-8); V_6 kenaf (HC-2) and V_9 -mesta (HS-24), respectively. .

Table 9. Effect of different treatments on seedling incidence (%) among three varieties of fiber crop in pot

Treatments	% Seedling incidence		
	V_5	V_6	V_9
Trichoderma	52.17	55.56	60
Autostin	24.14	21.43	42.86
Soil sterilization	50	75	60
Control	83.33	80	66.67
LS	**	**	**
S $\bar{x}$	0.990	0.830	0.850
CV(%)	2.87	2.86	2.87

Figures in a column having common letter(s) do not different from each other as adjusted by DMRT.

LS= Level of significance; S $\bar{x}$ = Standard error of mean; CV= Coefficient of variation,
**= Significant at 1% level of Probability.
V_5 = BJRI deshi jute-8, V_6 = Kenaf (HC-2) and V_9 = Mesta (HS-24).

4.7 Effect of different treatments on growth performance

In this research work, 9 varieties of jute and allied fiber crops were used to determine the seed borne fungi. For determining these fungi, 4 methods were conducted. In these methods many pathogens were found like *Botryodiplodia theobromae Colletotrichum corchori, Macrophomina phaseolina, Fusarium* spp*., Aspergillus* spp. in 9 jute and allied fiber crop varieties. Among these 9 jute and allied fiber crop varieties, 3 varieties are infected severely by pathogens, especially by *Colletotrichum corchori* fungi. These 3 varieties V_5-BJRI deshi jute-8 from deshi jute variety; V_6-kenaf (HC-2) from kenaf variety; V_9-mesta (HS-24) from mesta variety) were taken to determine the effect of different treatments on controlling the seed borne fungi (*Colletotrichum corchori*).

4.7.1 % Germination

The combined effect between different level of treatments and allied fiber crops variety showed significant effect on % germination (Table 10). The highest % germination (91.67 %) was observed in the T_2V_5 (BJRI deshi jute-8) treatment with Autostin and the lowest % germination (41.68 %)was observed T_0V_9 (Mesta (HS-24)) with no treatment.

4.7.2 Root length

The interaction effect between different level of treatment and fiber crops variety showed significant effect on root length (Table 10). The highest root length (7.21) was observed in the T_2V_5 (BJRI deshi jute-8) treatment with Autostin and the lowest root length (3.33 cm) was observed T_0V_9 -Mesta (HS-24) with no treatment.

4.7.3 Shoot length

Interaction effect between different level of treatment and fiber crops variety showed significant effect on shoot length (Table 10). The highest shoot length (31.17 cm) was observed in the T_2V_5 (BJRI deshi jute-8) treatment with Autostin and the lowest shoot length (13.70 cm) was observed T_0V_9 (Mesta (HS-24)) with no treatment.

4.7.4 Leaf number

Interaction effect between different level of treatments and fiber crops variety showed significant effect on leaf number (Table-10). The highest leaf number (17.21) was observed in the T_2V_5 (BJRI deshi jute-8) treatment with Autostin and the lowest leaf number(8.67) was observed T_0V_9 (Mesta (HS-24)) with no treatment.

Table10. Combined effect of different varieties and treatments on % germination, root length (cm), shoot length (cm) and leaf number of different jute and allied fiber crops varieties

Varieties	Treatment	%Germination	Leaf number	Root length (cm)	Shoot length (cm)
V_5	T_0	51.32e	10.47f	4.38ef	18.96g
	T_1	81.58b	15.31b	6.41b	27.41b
	T_2	91.67 a	17.21a	7.21a	31.17a
	T_3	71.50c	13.42cd	5.62c	24.31d
V_6	T_0	45.22g	9.57gh	3.43g	15.72h
	T_1	73.87c	12.77d	5.06d	22.99e
	T_2	83.00b	14.35bc	5.68c	25.83c
	T_3	64.74d	11.19ef	4.43ef	20.15f
V_9	T_0	41.68h	8.67h	3.33g	13.70j
	T_1	66.45d	11.70e	4.58e	19.55fg
	T_2	74.67c	13.15d	5.15d	21.97e
	T_3	58.24e	10.26fg	4.02f	17.13i
LS		**	**	**	**
$S\bar{x}$		1.728	0.557	0.244	0.616
CV (%)		2.87	5.06	5.53	3.18

Figures in a column having common letter(s) do not different from each other as adjusted by DMRT.

LS= Level of significance; $S\bar{x}$ = Standard error of mean; CV= Coefficient of variation,
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V1 = Jute cvl-1, V2 = BJRIdeshi jute-5, V3 = BJRI deshi jute-6, V4 = BJRI deshi jute-7, V5 = BJRI deshi jute-8, V6 = Kenaf (HC-2), V7 = Kenaf (HC-95), V8 = BJRI Kenaf-4 and V9 = Mesta (HS-24).

A

B

Plate 8. Different treatment used for controlling seed borne fungi associated with jute and allied fiber crops seed A. initial stage B. later stage

CHAPTER V

DISCUSSION

Jute is a fiber crop belongs to genus *Corchorus* of the Tiliaceae family with two cultivated species- *Corchorus capsularis* L. and *C. olitorius* L. Fiber is extracted from the bark of the plants (Alim, 1978 and Dempsey, 1975). The young leaves of *C. olitorius* that have been introduced into Japan as a healthy vegetable are rich in vitamins, carotenoids, calcium, potassium and dietary fiber (Resources Council, Science and Technology Agency, Japan, 2000).Kenaf and mesta respectively belongs to the Malvaceae family notable for both its economic and horticultural importance. This jute and allied fiber crops have a great influence on socio-economic importance in Bangladesh. Bangladesh supplies about 70% jute and fiber crops and related product to the global market (Hossain *et al*., 2015). But these jute and allied fiber crop varieties are infected severely by many seed borne pathogens that can impact on jute and fiber production. Jute and fiber crop suffers from a number of diseases. All of the diseases of jute and fiber 10 are known to be seed borne pathogens. Among the seed-borne fungal diseases, stem-rot, black band and anthracnose caused by *Macrophomina phaseolina, Botryodiplodia theobromae* and *Colletotrichum corchori* respectively are frequently transmitted through jute seeds.

In this research work, 9 varieties of different jute and allied fiber crops seed (5 from BJRI deshi jute; 3 from kenaf and 1 from mesta) were taken to conduct this research. This research work was done to manage the seed borne fungi associated with different jute and allied fiber crops seed.

Almost 5 types of seed borne fungi were identified in all the tested methods namely blotter paper method, agar plate method, test tube method and growing on test method during experiment.

In blotter paper method, germination of seeds varied from 87.33% to 97.67% depending on the fiber crop variety. The highest total number of seed borne fungi (7.00) were recorded in V_5 (BJRI deshi jute-8), and 5 fungal genera such as *Colletotrichum corchori, Botryodiplodia theobromae, Macrophomina phaseolina, Fusarium* spp., and *Aspergillus* spp., were identified among nine fiber crops varieties. Of these, *Colletotrichum corchori* was the most predominant fungus recoded in variety V_4 (BJRI deshi jute-8), V_5 (Kenaf HC-2) and V_9 (Mesta HS-24), respectively. Similarly Haider *et al.* (1992) studied seed samples of jute collected from 5 districts of Bangladesh were detected during 1985 and

1986 for the association of fungal pathogens by blotter and agar plate methods. Altogether, 12 genera were detected of which *Colletotrichum corchori*, *Sclerotium rolfsii* were found to be predominant. The percentage of occurrence of fungi varied markedly with respect to collection as well as with methods of detection.

In agar plate method, germination of seeds varied from 92.00% to 77.00% depending on the fiber crop variety. The highest total number of seed borne fungi (5.67 and 5.33) were recorded in V_4 (BJRI deshi jute-7) and V_5 (BJRI deshi jute-8), respectfully and five fungal genera viz. *Colletotrichum corchori, Macrophomina phaseolina, Curvularia lunata, Fusarium* spp. and *Aspergillus* spp. were identified. Of these, *Colletotrichum corchori* was the most predominant fungus recorded in variety V_5 (BJRI deshi jute-8) and V_6 (Kenaf HC-2), respectively. Several researchers also done seed borne fungi in fibre crops. Haider *et al.* (1992) studied seed samples of jute collected from different districts of Bangladesh were detected during for the association of fungal pathogens by agar plate method. Altogether, different genera mostly (*Colletotrichum corchori, Curvularia lunata, Fusarium* spp., *Aspergillus* spp. and *Macrophomina phaseolina, Sclerotium rolfsii*) were detected of which *Colletotrichum corchori* were found to be predominant. The percentage of occurrence of fungi varied markedly with respect to collection as well as with methods of detection.

In test tube method, germination of seeds varied from 100% to 86.67% depending on the fiber crop variety. The highest total number of seed borne fungi (2.00) were recorded in V_2 (BJRI deshi jute-5), V_3 (BJRI deshi jute-6) and V_4 (BJRI deshi jute-7), respectively while the lowest total seed borne fungi (1.33) were recorded in seeds obtained from V_7 (BJRI Kenaf-4) and V_8 (BJRI kenaf-4), respectively. Altogether four fungi genus (*Colletotrichum corchori, Fusarium* spp., *Aspergillus* spp., *Macrophomina phaseolina*) were identified in nine fiber crops varieties. Among these, *Colletotrichum corchori* was the most predominant fungus recorded in variety V_5(BJRI deshi jute-8).Similarly, a research work was done by Nazmul Hasan (2013) under the study on health quality of jute seeds and transformation behavior of *colletotrichum corchori* from seed to plant to seed, under dept. of Plant Pathology, SAU, Dhaka-1207. In this work, *Colletotrichum corchori* was found predominantly and revealed that % germination, % post emergence infection, % germination failure and % seedling infection varied significantly.

In growing on test method, germination of seeds varied from 84.00% to 67.33% depending on the fiber crop variety. The highest total number of seed borne fungi (3.67) were recorded in V_5 (BJRI deshi jute-8) while the lowest total seed borne fungi (1.67) were recorded in seeds obtained from V_4 (BJRI deshi jute-7). Altogether four fungi genus (*Colletotrichum corchori, Fusarium* spp., *Aspergillus* spp. and *Botryodiplodia theobromae*) were identified in nine fiber crops varieties. Among these, *Colletotrichum corchori* was the most predominant fungus recorded in variety V_5 (BJRI deshi jute-8).

Fakir *et al.* (1991) found that there were six different seed borne diseases of jute caused by 10 different fungal organisms in Bangladesh. Of all these pathogens, *Botryodiplodia theobromae*, *Colletotrichum corchori* and *Macrophomina phaseolina* were responsible for causing black band, anthracnose and stem rot, respectively and most widely distributed in the country. Each of these three diseases had major effects on seed production. Fakir *et al.* (1993) reported that transmission of the major seed borne diseases including stem rot caused by *Macrophomina phaseolina*, black band caused by *Botryodiplodia theobromae* and anthracnose caused by *Colletotrichum corchori*, from seed to seedlings, revealed that germination of the seeds was found to decrease with the increase of the seed borne infection and resulted significantly higher amount of disease development .Post emergence mortality of seedling was varied significantly due to different fiber crop varieties. Result revealed that at 5, 7 and 9 DAS, the highest percentage of post emergence mortality of seedling (20.00%, 23.33% and 40.00%) was recorded in fiber crop variety V_5 (BJRI deshi jute-7) and the lowest percentage of post emergence mortality of seedling (0%, 13.33% and 20%) was recorded in fiber crop variety V_8 (BJRI Kenaf-4). Similar work was done by F. Begum and Bhuiyan M. K. A. (2003) under integrated control of seedling mortality of lentil caused by *Sclerotium rolfsii* in BSMRAU, Gazipur.

From these findings, among the deshi jute varieties, V_5(BJRI deshi jute-8); V_6 kenaf (HC-2) from 4 kenaf varieties and one variety V_9 mesta (HS-24) from mesta variety were infected severely by seed borne pathogens. To control these pathogens, these severely infected 3 varieties were selected. In this case, using of *Trichoderma* formulation and Autostin with seeds and soil sterilization was done following to the control the seed borne fungi.

It was observed that Autostin showed the best performance for controlling seed borne disease followed by *Trichoderma* formulation treatment and soil sterilization. The lowest seedling incidence (24.14%; 21.43; and 42.86% respectively) was observed in Autostin treatment followed by *Trichoderma* and the highest seedling incidence (83.33%; 80% and 66.67%, respectively) was observed in. From this finding, it is proved that Autostin is the best treatment to control seed borne pathogens of jute and allied fiber crops seed. Sultan *et al*., (2007) reported that seeds having higher disease infections caused significantly higher amount of diseases development which supports this findings.

Among these treatments, Autostin showed the highest % germination and growth promotion characters viz. leaf number, root length and shoot length of seeds while the lowest value was observed in control condition. By considering highest value of % germination, root length, shoot length and leaf number in case of different varieties of jute and allied fiber seeds were in Autostin showed best performance among others. V_5 and lowest in V_9 which was analyzed by DMRT at 5% and 1% level of probability.

The interaction between different variety and treatments on % germination, root length (cm), shoot length (cm) and leaf number was recorded the highest value in $T_2V_5$and lowest value in T_0V_9which was analyzed by DMRT at 5% and 1% level of probability.

CHAPTER VI

SUMMARY AND CONCLUSION

The experiment was conducted at seed pathology laboratory and the net house of Plant Pathology department, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka during june 2018 to March 2019. Nine fiber crops variety was used for conducting the experiments viz., V_1 = Jute cvl-1, V_2 = BJRI deshi jute-5, V_3 = BJRI deshi jute-6, V_4 = BJRI deshi jute-7, V_5 = BJRI deshi jute-8, V_6 = Kenaf (HC-2), V_7 = Kenaf (HC-95), V_8 = BJRI Kenaf-4 and V_9 = Mesta (HS-24). All seed samples were collected from Bangladesh Jute Research Institute (BJRI), Dhaka. Laboratory experiment data were analyzed following Completely Randomized Design (CRD).Analysis of variance was done and mean comparisons among the treatments were compared by DMRT at 5% and 1% level of probability.

In blotter method, germination of seeds varied from 87.33% to 97.67% depending on the fiber crop variety. The highest percentage of seed and seedling infection (36.67% and 46.67%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8) and also the highest percentage of post emergence mortality of seedling (10.00%, 16.67% and 36.67%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8). The highest total number of seed borne fungi (7.00) were recorded in V_5 (BJRI deshi jute-8), and five fungi genus (*Colletotrichum corchori, Fusarium* spp., *Aspergillus* spp., *Botryodiplodia theobromae, Macrophomina phaseolina,* and *Curvularia lunata*) were identified in nine fiber crops varieties.

In water Agar method, germination of seeds varied from 92.00% to 77.00% depending on the fiber crop variety. Seed and seedling infection varied significantly while the highest percentage of seed and seedling infection (33.33% and 16.67%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8) and V_2 (BJRI deshi jute-5), respectively. The highest percentage of post emergence mortality of seedling (10.00%, 16.67% and 16.67%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8). The highest total number of seed borne fungi (5.67 and 5.33) were recorded in V_4 (BJRI deshi jute-8) and V_5 (BJRI deshi jute-8)and five fungi genus (*Colletotrichum corchori, Curvularia lunata, Fusarium* spp., *Aspergillus* spp., and *Macrophomina phaseolina*) were identified.

In test tube method, germination of seeds varied from 100% to 93.33% depending on the fiber crop variety. Seed and seedling infection varied significantly while the highest

percentage of seed infection and seedling infection (93.33 % and 100%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8). At 5, 7 and 9 DAS, the highest percentage of post emergence mortality of seedling (90%, 93.33% and 100%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8). The highest total number of seed borne fungi (2.00) were recorded in V_2 (BJRI deshi jute-5), V_3 (BJRI deshi jute-6) and V_4 (BJRI deshi jute-7) while the lowest total seed borne fungi (1.33) were recorded in seeds obtained from V_8 (BJRI Kenaf-4) and V_9 (Mesta (HS-24)) and four fungi genus (*Colletotrichum corchori, Fusarium* spp., *Aspergillus* spp., *Macrophomina phaseolina*).

In growing on test method, germination of seeds varied from 84% to 67.33% depending on the fiber crop variety. Seed and seedling infection varied significantly while the highest percentage of seed infection (66.67% and 40%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8). At 5, 7 and 9 DAS, the highest percentage of post emergence mortality of seedling (20%, 23.33% and 40%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8). The highest total number of seed borne fungi (3.67) were recorded in V_5 (BJRI deshi jute-8) and Altogether four fungi genus (*Colletotrichum corchori, Fusarium* spp., *Aspergillus* spp. and *Botryodiplodia theobromae*).

For growth performance the highest % germination (91.67 %), root length (7.21 cm), shoot length (31.17 cm) and leaf number (17.21) was observed in the T_2V_5 (BJRI deshi jute-8) treatment with Autostin and the lowest % germination (41.68 %), root length (3.33) cm , shoot length (13.70) cm and leaf number (8.67) was observed T_0V_9 (Mesta (HS-24) with no treatment.

From this study, it was observed many seed borne fungi. Seed borne fungi are a threat to the health of jute and allied fiber crop seeds. Seed treatment may be a unique technique applicable in this regard as it reduces or eliminates seed borne fungi and also increased germination. But the study in laboratory experiment is not sufficiently enough. This emphasizes the need of undertaking further comprehensive research with more varieties and treatments and field study for its confirmation.

On the basis of the findings of this research work, the following conclusions may be included-

- In blotter method, germination of seeds varied from 81.33% to 97.67% depending on the fiber crop varieties. The highest percentage of seed and

Seedling infection (46.67% and 36.67%) was recorded in jute variety V_5 (BJRI deshi jute-7). The highest total number of seed borne fungi (7.00) were recorded in V_5 (BJRI deshi jute-8) and five fungi genus (*Colletotrichum corchori, Fusarium* spp., *Aspergillus* spp., *Botryodiplodia theobromae, Macrophomina phaseolina, Curvularia lunata*) were identified in nine jute and allied fiber crops varieties.

- In agar plate method, germination of seeds varied from 92% to 77% depending on the fiber crop varieties .The highest percentage of post emergence mortality of seedling (10%, 16.67% and 16.67%) was recorded in fiber crop variety V_5 (BJRI deshi jute-8).The highest total number of seed borne fungi (5.67 and 5.33) were recorded in V_4 (BJRI deshi jute-7) and V_5 (BJRI deshi jute-8), respectively and five fungi genus (*Colletotrichum corchori, Curvularia lunata, Fusarium* spp., *Aspergillus* spp., and *Macrophomina phaseolina*) were identified.
- In test tube method, germination of seeds varied from 100% to 93.33% depending on the fiber crop variety. The highest total number of seed borne fungi (2.00) were recorded in V_2 (BJRI deshi jute-5); V_3 (BJRI deshi jute-6) and V_4 (BJRI deshi jute-7), respectively and four fungi genus (*Colletotrichum corchori, Fusarium* spp., *Aspergillus* spp., *Macrophomina phaseolina*. were identified.
- In growing on test method, seed and seedling infection varied significantly while the highest percentage of seed infection (66.67% and 40%) were recorded in fiber crop variety V_5 (BJRI deshi jute-8).The highest total number of seed borne fungi (3.67) were recorded in V_5 (BJRI deshi jute-8) and Altogether four fungi genus (*Colletotrichum corchori, Fusarium* spp., *Aspergillus* spp. and *Botryodiplodia theobromae*) were found.
- In this findings, the highest % seedling incidence (83.33%; 80% and 66.67%, respectively) were found in control condition where the lowest results (24.14%; 21.43% and 42.86%, respectively) were found in Autostin treatment in case of severely infected 3 varieties of jute and allied fiber crops seed namely V_5(BJRI deshi jute-8); V_6 kenaf (HC-2) and V_9 mesta (HS-24), respectively .

- For growth performance the highest % germination (91.67 %), root length (7.21), shoot length (31.17 cm) and leaf number (17.21) was observed in the T_2V_5 (BJRI deshi jute-8) treatment with autostin and the lowest % germination (41.68 %), root length (3.33 cm) , shoot length (13.70 cm) and leaf number (8.67) was observed T_0V_9 -Mesta (HS-24) with no treatment.

From the above findings, it is revealed that Autostin gave the best performance followed by the *Trichoderma* treatment and soil sterilization in order to manage the seed borne fungi associated with jute and allied fiber crop seeds.

CHAPTER VII
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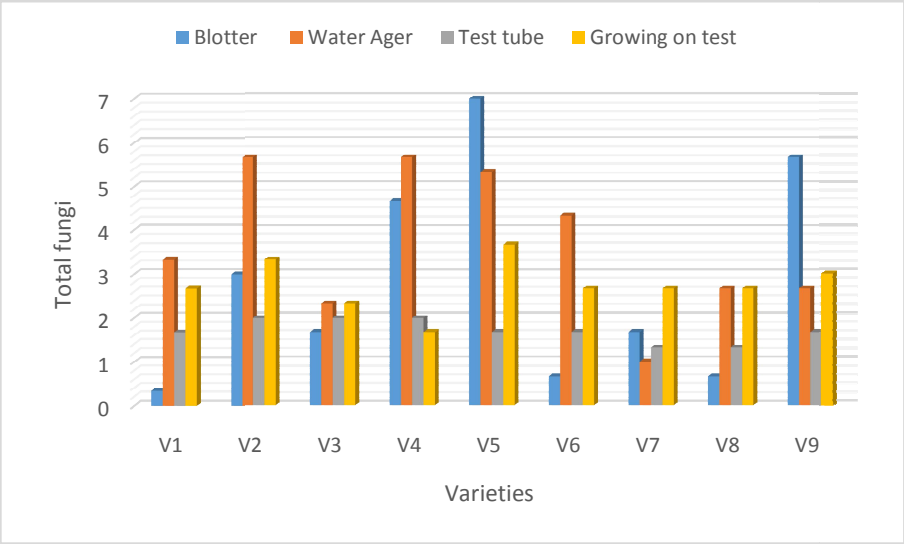
APPENDICES

APPENDIX I: Comparison of different methods on the effect of fiber crop varieties on total fungi



APPENDIX II: Disease incidence, which measures the extent of proportion of a disease was estimated by using the following formula (Agrios, 2005):

$$\text{Seedling incidence} = \frac{\text{Number of diseased seedlings}}{\text{Number of total seedlings observed}} \times 100$$

Treatments	% Seedling incidence		
	V5(BJRI deshi jute-8)	V6 kenaf (HC-2)	V9 Mesta(HS-24)
Trichoderma	52.17	55.56	60
Autostin	24.14	21.43	42.86
Soil sterilization	50	75	60
Control	83.33	80	66.67