Dhaka Univ. J. Biol. Sci. **25**(1): 9-17, 2016 (January)

# ESTIMATION OF INTERRELATIONSHIPS AMONG SOME QUALITY FACTORS OF JUTE SEEDS

MD. AL-MAMUN, S. SHAMSI AND M. A. BASHAR*

*Department of Botany, University of Dhaka, Dhaka 1000, Bangladesh*

*Key words*: Estimation, Interrelationship, Jute seed, Storage mycoflora, Quality factors

**Abstract**

The storage mycoflora associated with seeds of 21 accessions of *Corchorus capsularis* L. were isolated and identified. Blotter, Paper towel and Agar plate methods were used to isolate the fungi associated with seeds. A total of ten species of fungi *viz. Aspergillus flavus*, *A. fumigatus*, *A. niger*, *A. terreus*, *Curvularia lunata*, *Colletotrichum corchori*, *Fusarium oxysporum, Eurotium* sp., *Penicillium* sp. and *Rhizopus stolonifer* were isolated from the selected jute seeds. *Aspergillus* spp. and *Colletotrichum corchori* were predominant in most of the jute accessions. Accession No. A-3047 showed the highest fungal incidence and Accession Nos. A-3361, A-2734 and A-877 showed the lowest. Accession No. A-3361 showed the highest seed germination while Accession No. A-3309 showed the lowest. Mortality of seedling showed the highest in Accession No. A-3309 and the lowest in Accession No. A-3361. Physical purity of seed recorded the highest in Accession No. A-3361 and the lowest in Accession No. A-3309. There were negative correlation between percentage of fungi and percentage of germination and between percentage of fungi and physical purity of seeds. Positive correlation was observed between percentage of fungi and seedling mortality and between purity of seed and germination of seed.

## Introduction

Jute (*Corchorus capsularis* L. and *C. olitorius* L.) is the most important cash crop of Bangladesh and plays an important role in the economy of Bangladesh. Among the jute growing countries of the world, Bangladesh ranks second in respect of production[1-2]. Nearly 12 - 15% of the jute products are exported to about 20 countries of the world earning foreign exchange to the tune of Tk. 2000 crores per annum, and the trend is on the increase[3-4].

Like all other commercially important plants, one of the major bottlenecks of jute production is its constant exposure to different biotic and abiotic stresses. The severe yield loss of jute depends on certain factors of which diseases play a major role. In Bangladesh, yield loss due to diseases is about 8 - 20% depending on the severity of the diseases[5].

*Author for correspondence: <botanybashar@yahoo.com>

The first report of jute disease was made by Shaw from India and the disease was stem rot of jute which was confirmed by Sawada[6-7]. In 1940 Ikata and Yoshida from Japan reported Anthracnose disease of *Corchorus capsularis* L. caused by *Colletotrichum corchori*[8]. Rashid *et al.* (2007) reported that jute suffers from more than 12 different diseases of which 10 are known to be seed borne[9]. Among the fungal pathogens *Colletotrichum corchori, Botryodiplodia theobromae, Macrophomina phaseolina, Fusarium* spp., *Cercospora corchori* and *Corynespora cassiicola* are of major importance in causing different diseases and frequently transmitted through jute seeds[10]. *Macrophomina phaseolina* alone can cause up to 10% yield loss[11]. The seed borne fungi which are recorded are mostly of local varieties. But the government of Bangladesh always imports new varieties of seeds. The mycoflora of these varieties may be of new types. On the other hand the climate of Bangladesh is very much suitable for the growth of fungi. On the basis of the above facts, the present investigation was undertaken to achieve the aim of determining the seed borne fungi associated with some imported jute seeds.

Correlation is a measure of the relationship between two or more variables. Correlation coefficients can range from –1.00 to +1.00. The value of –1.00 represents a perfect negative correlation while a value of +1.00 represents a perfect positive correlation. A value of 0.00 represents a lack of correlation. Results of analysis of the interrelationships among quality factors i.e. storage mycoflora, seed germination, purity and seedling mortality gave valuable information about which steps of agro techniques of jute growing needs more attention to enhance best quality and quantity of yield.

**Materials and Methods**

The research work was undertaken with the collaboration of Genetic Resource and Seed Division of Bangladesh Jute Research Institute (BJRI) situated at Manik Mia Avenue, Farmgate, Dhaka 1207. Twenty one different accessions of seeds of *Corchorus capsularis* L. were taken from the Genetic Resource and Seed Division of BJRI.

For the study, 400 seeds were taken from each sample following Tissue Planting Method[12], Blotter Method[13] and Paper Towel Method. Blotter moist chambers were made by placing 3 layers of filter paper at the bottom of the Petri plate and covered with its upper part. Each Petri plate was moistened by adding distilled water and sterilized under 15 lb pressure, 120ºC temperature for 30 minutes in an autoclave. Seeds were surface sterilized with 10% chlorox for 3 minutes and washed three times with sterilized water and placed on the filter paper (inside the Petri plate) and kept in room condition.

In tissue planting method surface sterilized seeds as mentioned above were placed on sterilized potato dextrose agar medium in Petri plate. Each Petri plate contained 15 ml of PDA with 1 drop of lactic acid (0.03 ml) which was used to check the bacterial growth. Inoculated Petri plates were incubated for 5 - 7 days at 25 ± 2ºC.

Fungal population growing from the plated seed was sub-cultured and maintained on PDA slants. Percentage of infected seeds were calculated by the following formula[14]:

$$\text{Percentage of infected seed} = \frac{\text{Number of infected seed}}{\text{Total number of seeds}} \times 100$$

A total of 5 g seeds were taken from each working sample and examined for impurities which include inert matter, plant debris, sunken seed, other crop seed, sclerotium, etc. Purity percentage of seed was calculated by the following formula:

$$\text{Percentage of seed purity} = \frac{\text{Weight of pure seed}}{\text{Total weight of seeds}} \times 100$$

Microscopic details of the specimens were studied following standard techniques. Identification of the fungi were confirmed following relevant literature[15-18].

Interelationships among storage mycoflora, seed germination, purity and seedling mortality of different accessions of jute seeds were measured through correlation and regression analysis[19]. The results were statistically analyzed by t test following Steel and Torrie[19].

**Results and Discussion**

During this investigation a total of ten species of fungi *viz., Aspergillus flavus*, *A. fumigatus, A. niger, A. terreus, Colletotrichum corchori, Curvularia lunata*, *Eurotium* sp., *Fusarium oxysporum, Penicillium* sp. and *Rhizopus stolonifer* were identified (Table 1). Several studies also reported the association of these seed-borne fungi in jute (Rashid *et al.* 2007)[9]. Among these fungi *Aspergillus* spp. and *Colletotrichum corchori* were predominant in most of the jute accessions (Table 1). *Aspergillus terreus*, *Curvularia lunata* and *Penicillium* sp. were recorded only with a few accessions of jute seeds. Maximum of six species of fungi were found to be associated with Accession No. A-4710 (Table 1).

Per cent frequency of association of *Aspergillus fumigatus* was the highest (54.06%) and the lowest was in *Curvularia lunata* (0.15%) (Table 1). The per cent of seeds associated fungi ranged from 14 - 62 (Table 2). Maximum fungal association (62%) was recorded in Accession No. A-3047 and minimum (14%) in Accession Nos. A-3361, A-2734 and A-877 (Table 2). Mortality of seedling was recorded the highest in Accession No. A-3309 and the lowest in Accession No. A-3361 (Table 2). Accession No. A-3361 of jute seeds showed the highest seed germination (92%) while Accession No. A-3309 showed the lowest (25%) (Table 2). In contrast to the present study, Anon. (1983) observed seed germination (46 - 90%) on various tested seed samples of jute, having an average of 73.7%[21]. Rashid *et al*. (2007) reported the variation in jute seed germination based on seed source[9]. However,

**Table 1. Occurrence and per cent frequency of fungi in different accessions of jute (*Corchorus capsularis* L.) seeds.**

| Sl. No. | Accession No. | *A. flavus* | *A. fumigatus* | *A. niger* | *A. terreus* | *Curvularia lunata* | *Colletotrichum corchori* | *Fusarium oxysporum* | *Penicillium* sp. | *Eurotium* sp. | *Rhizopus stolonifer* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | A–54 | - | 7 | 6 | - | - | - | 9 | - | - | - |
| 2. | A–3047 | 23 | 14 | 9 | - | - | - | 8 | - | - | 8 |
| 3. | A-879 | - | 30 | 6 | - | - | - | - | - | - | - |
| 4. | A-560 | 4 | 37 | - | - | - | - | - | - | - | 2 |
| 5. | A-4728 | - | 4 | 12 | - | - | 3 | - | - | - | - |
| 6. | A-2734 | 2 | - | 12 | - | - | - | - | - | - | - |
| 7. | A-2528 | - | 2 | 2 | - | - | 36 | 4 | 2 | - | - |
| 8. | A-651 | 8 | 29 | 6 | - | - | - | - | - | - | - |
| 9. | A-653 | 3 | 39 | - | - | - | - | - | - | - | - |
| 10. | A-4710 | 2 | 20 | 2 | 2 | - | 11 | - | 1 | - | - |
| 11. | A-3361 | - | - | 2 | - | - | 12 | - | - | - | - |
| 12. | A-1780 | - | 23 | - | - | - | 12 | - | - | - | - |
| 13. | A-3311 | - | 22 | 5 | - | - | 3 | - | - | - | - |
| 14. | A-3309 | 3 | - | 7 | - | - | 31 | - | - | - | - |
| 15. | A-3490 | 3 | 5 | - | - | - | 16 | - | - | - | 4 |
| 16. | A-660 | - | 46 | - | - | - | - | - | - | - | - |
| 17. | A-674 | 7 | 14 | 2 | - | - | - | - | - | - | - |
| 18. | A-877 | - | 5 | 2 | - | - | - | - | - | 2 | 7 |
| 19. | A-4683 | - | 24 | 2 | - | - | - | - | - | 2 | - |
| 20. | A-956 | - | 36 | - | - | - | - | - | - | - | - |
| 21. | A-4618 | 5 | 9 | - | - | 1 | - | - | - | - | - |
| | Total | 60 | 366 | 75 | 2 | 1 | 124 | 21 | 3 | 4 | 21 |
| | Per cent frequency | 8.86 | 54.06 | 11.1 | 0.3 | 0.15 | 18.32 | 3.10 | 0.44 | 0.59 | 3.10 |
| | Mean | 2.85 | 17.43 | 3.57 | 0.095 | 0.047 | 5.90 | 1 | 0.143 | 0.19 | 1 |

- = Indicates no fungal growth.

the differences in germination status might be due to differences in storage and handling. The prevalence of seed-borne infection is also responsible for lower germination (Fakir 1998)[20].

**Table 2. Effects of storage fungi on purity, germination and seedling mortality of different accessions of jute (*Corchorus capsularis* L.) seeds.**

| Sl. No. | Accession No. | Purity (%) | Germination (%) (7th day) | Mortality (%) (after 7 days) | Associated fungi (%) |
|---|---|---|---|---|---|
| 1. | A–54 | 99 | 80 | 2.50 | 22 |
| 2. | A–3047 | 97 | 62 | 11.3 | 62 |
| 2. | A-879 | 98 | 76 | 5.26 | 36 |
| 4. | A-560 | 98 | 71 | 7.04 | 43 |
| 5. | A-4728 | 98 | 68 | 2.94 | 19 |
| 6. | A-2734 | 98 | 84 | 5.57 | 14 |
| 7. | A-2528 | 99 | 78 | 7.69 | 46 |
| 8. | A-651 | 97 | 72 | 6.94 | 43 |
| 9. | A-653 | 99 | 78 | 7.69 | 42 |
| 10. | A-4710 | 98 | 65 | 6.15 | 38 |
| 11. | A-3361 | 99 | 92 | 2.17 | 14 |
| 12. | A-1780 | 98 | 65 | 4.61 | 35 |
| 13. | A-3311 | 99 | 75 | 5.33 | 30 |
| 14. | A-3309 | 94 | 25 | 16.0 | 41 |
| 15. | A-3490 | 97 | 46 | 8.69 | 28 |
| 16. | A-660 | 95 | 35 | 11.4 | 46 |
| 17. | A-674 | 99 | 84 | 3.57 | 23 |
| 18. | A-877 | 99 | 76 | 5.26 | 14 |
| 19. | A-4683 | 99 | 77 | 10.38 | 28 |
| 20. | A-956 | 94 | 26 | 7.69 | 38 |
| 21. | A-4618 | 97 | 53 | 7.54 | 15 |

In this study it has been estimated some interrelationships between the quality factor through correlation and regression analysis which is very much important in controlling seed quality. Significant relationship has been estimated in all the cases (Figs 1 - 4).

Fig. 1 shows the relationship between percentage of fungi and percentage of germination and negative correlation between the two variables. From Fig. 1 it is evident that the regression line gives a downward sloping curve, which means that the germination of seeds decrease when the percentage of fungi increases or the germination of seed increases when the percentage of fungi decreases. In the present study, the correlation co-efficient value between percentage of fungi and percentage of germination was –0.360 (Table 3).

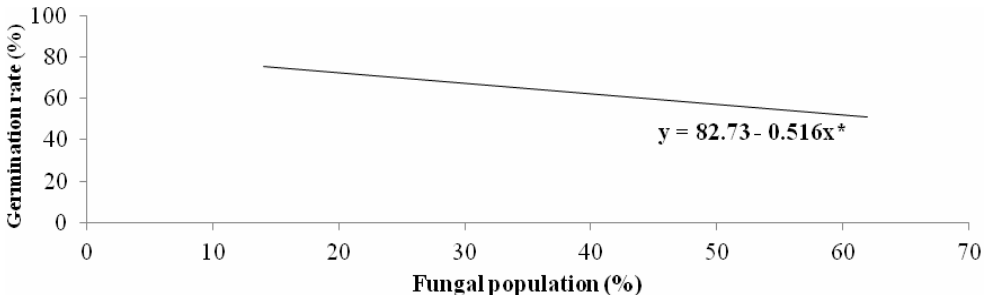


Fig. 1. Regression line between fungal populations (%) and germination rate (%).

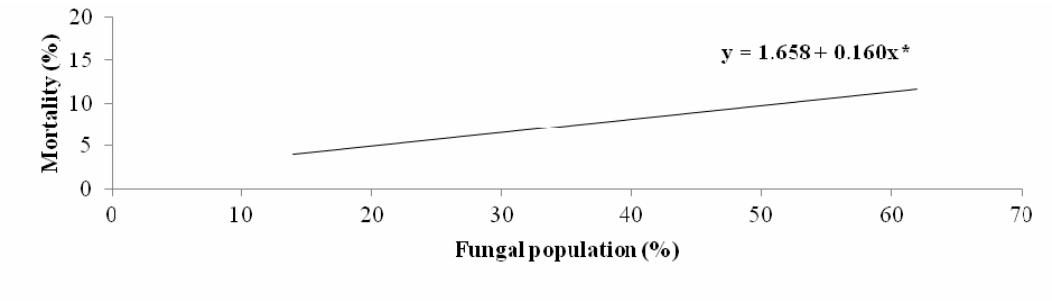


Fig. 2. Regression line between fungal populations (%) and seedling mortality (%).

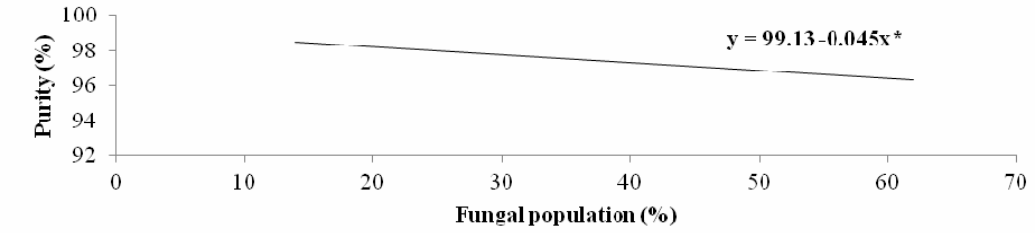


Fig. 3. Regression line between fungal populations (%) and physical purity (%).

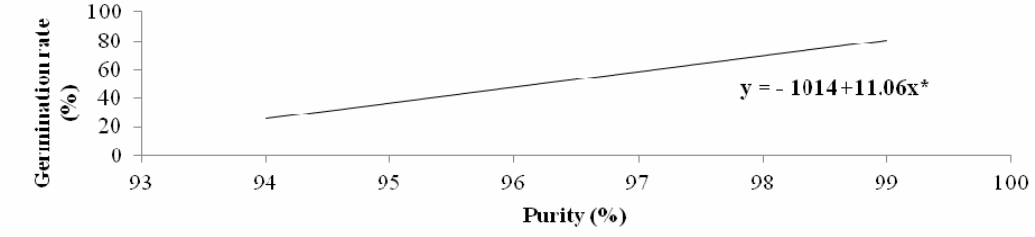


Fig. 4. Regression line between percentage of purity and percentage of germination.

Fig. 2 shows the relationship between percentage of fungi and seedling mortality and positive correlation between the two variables. Here regression line gives an upward sloping curve which means that both the variables change in the same direction i.e. the mortality of seed increases when the percentage of fungi increases. The correlation co-efficient value between percentage of fungi and seedling mortality was +0.618 (Table 3).

Fig. 3 shows the relationship between percentage of fungi and physical purity of seeds and negative correlation between the two variables. In this case the regression line gives a downward sloping curve which indicates that the percentage of fungi decreases when purity of seed increases and vice versa. The correlation co-efficient value between percentage of fungi and physical purity of seeds was –0.375 (Table 3). This value does not match with the value (+0.05) reported by Anon. (1883)[21].

Fig. 4 shows the relationship between purity of seed and germination of seed and positive correlation between the two variables. Here regression line gives an upward sloping curve which means that both the variables change in the same direction i.e. the germination increases when the purity of seed increases or the germination decreases when the purity of seed decreases. The correlation co-efficient value between purity and germination of seed was +0.934 (Table 3).

**Table 3. Correlation co-efficient between some quality factors of jute (*C. capsularis*) seeds.**

| Quality factors | Correlation co-efficient (r) |
|---|---|
| Fungal populations (%) and germination rate (%) | –0.360 |
| Fungal populations (%) and seedling mortality (%) | 0.618 |
| Fungal populations (%) and physical purity (%) | –0.375 |
| Physical purity (%) and germination rate (%) | 0.934 |

The present investigation revealed that, the jute accessions with the lowest fungal incidence showed the highest seed germination and again the jute accessions with the lowest fungal incidence showed the lowest mortality of seedling. Accession No. A-3361 was superior from the other accessions as it showed highest physical purity of seed (99%), highest seed germination (92%), lowest fungal incidence (14%) and lowest mortality of seedling (2.17%) (Table 2). Therefore, Accession No. A-3361 can be recommended by Bangladesh Jute Research Institute as suitable jute variety for cultivation to the farmer's level.

**Acknowledgement**

The first author (MAM) gratefully acknowledges the Ministry of Science and Technology, People's Republic of Bangladesh, for providing financial assistance to the research work in the form of the NST fellowship programme.

## References


1. Islam MM and MM Rahman 2008. *Hand Book on Agricultural Technologies on Jute, Kenaf and Mesta Crops*. Bangladesh Jute Research Institute (BJRI), Dhaka. p. 2.
2. Sadi S 2007. *Pat Hotter Nepotthe (Factors Behind the Destruction of Jute).* Vol. **1**, Dhaka Printers, Dhaka, Bangladesh,
3. Hossain MA, SA Mannan, K Sultana and AL Khandakar 1994. Survey on the constrains of quality jute seed at farm level. Agril. Support Service Project (GOB/WORLD BANK/ODA), Dhaka, Bangladesh.
4. Basu A, M Ghosh, R Meyer, W Powell, SL Basak and SK Sen 2004. Analysis of genetic diversity of jute determined by means of SSR markers and AFLP profiling. Crop Sci. **44**: 678-685.
5. Ahmed N and K Sultana 1985. Survey on the production and quality jute seed at farm level. Annual Report, Bangladesh Jute Research Institute, Dhaka. pp. 296-323.
6. Shaw FJF 1912. Morphology and parasitism of *Rhizoctonia*. Mem. Dept. Agri. India, Bot. Ser. **4**(6).
7. Sawada K 1916. A new stem-rot disease of jute plant caused by *Macrophomina corchori*. Nov. (Japanese). Formosa Agric. Expt. Sta. Bull. **107**.
8. Ikata S and M Yoshida 1940. A new anthracnose of jute plant. Ann. Phytopath. Soc. Japan **10**: 141-149.
9. Rahsid MM, MMR Khan, MA Hossain and MM Hossain 2007. Management of seed borne fungi of jute in Mymensingh region. Bangladesh J. Crop Sci. **18**(1): 209-214.
10. Fakir GA 2001. An annotated list of seed borne diseases in Bangladesh. Seed Pathology Laboratory, Dept. of Plant Pathology, BAU, Mymensingh. pp. 7-8.
11. Ahmed QA 1968. Diseases of jute in East Pakistan. Jute and Jute Fabrics **7**: 147-151.
12. CAB (Commonwealth Agricultural Bureau) 1968. Plant Pathologist's Pocket Book. 1st ed., The Commonwealth Mycological Institute, England. pp. 267.
13. ISTA 1966. International rules for seed testing. Proc. Int. Seed Test. Ass. **31**: 1-152.
14. Spurr HW Jr and RE Welty 1972. Incidence of tobacco leaf mycoflora in relation to brown spot disease and fungicidal treatment. Phytopathology **62**: 916-920.
15. Barnett HL and SB Hunter 2000. *Illustrated Genera of Imperfect Fungi.* 4th ed., Burgess Publ. Co. Minneapolis. pp. 185.
16. Ellis MB 1976. *More Dematiaceous Hyphomycetes.* The Commonwealth Mycological Institute, England. pp. 326-328.
17. Ellis MB 1971. *Dematiaceous Hyphomycetes.* The Commonwealth Mycological Institute, England. pp. 608.
18. Sutton BC 1980. *The Coelomycetes. Fungi Imperfecti with Pycnidia, Acervuli and Stroma.* The Commonwealth Mycological Institute, England. pp. 696.
19. Steel RGD and JH Torrie 1960. *Principles and Procedures of Statistics*. Mc Graw-Hill Book Co., New York, pp. xvi + 481.

20. Fakir GA 1998. Health status of farmers jute seeds: progress and prospect of seed pathological research in Bangladesh. 1st International Workshop on Seed Pathology, Department of Plant Pathology, BAU, Mymensingh, Bangladesh.

21. Anonymous 1983. Study of fungi associated with jute seed from Bangladesh. M. Sc. Thesis, Department of Botany, Dhaka University, Dhaka. pp. 59.

*(Manuscript received on 3 August, 2015; revised on 12 January, 2016)*