EFFECT OF DITHANE M-45 AND BAU BIOFUNGICIDE ON DISEASE INCIDENCE AND YIELD OF JUTE CV. CVL-1

*Saleh Md. A. Haque, **Ismail Hossain, ***Md. A. Rahman

*Plant Pathology Department, Pest Management Division, Jute Research Institute, Dhaka-120, Bangladesh.
**Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh.

ABSTRACT

The experiments were conducted in the field of Jute Agriculture Experimental Station (JAES), Manikgonj and Kishoregonj Regional Station (KRS), Kishoregonj of BJRI. The experiments were conducted during the period April 2012 to January 2013. Two different disease management practices viz. Dithane M-45 and BAU- Biofungicide were used for the present study. Disease management showed lowest disease incidence 1.98% and 1.87% at JAES and KRS, respectively with BAU- Biofungicide spraying and highest disease incidence 4.26% and 4.47% at JAES and KRS, respectively were recorded under control condition. The highest seed yield (588.35 kg/ha), fibre yield (4.12 ton/ha) and stick yield (9.33 ton/ha) were recorded under BAU- Biofungicide sprayed plant and lowest seed yield (378.45 kg/ha), fibre yield (2.21 ton/ha) and stick yield (5.43 ton/ha) under control treatment.

Keywords: Effect, disease management, disease incidence, seed quality, yield.

INTRODUCTION

Jute is one of the major cash crops of Bangladesh. Its influence is significantly related to the agro-ecology and the socio-economic life of the people. The jute crop also greatly improves the soil fertility status by incorporating organic matter to the soil through decomposition of shedded leaves and plant residues and helps in breaking plough-pans through its long taproots. Also, jute and jute goods have been recognized as being friendly to the environment. Jute is mostly grown in the Indo-Bangladesh region and in some countries of Southeast Asia. Among the jute growing countries of the world, Bangladesh was second position in respect of production (Islam, 2007). The land and climatic conditions of Bangladesh are congenial for the production of high quality jute. In Bangladesh, about 0.709 million hectares of land was under jute cultivation and the total yield was 8.40 million bales (BBS, 2011, http://www.jute.org/, 2012-13). As per Khandakar (1987), Bangladesh annually needs about 4000 metric tons of jute seeds of which only 12-15% is produced and supplied by the Bangladesh Agricultural Development Corporation (BADC). The rest of the seeds, about 85% or more of the requirement, are produced and managed by farmers’ (Hossain et al., 1994). Jute suffers from more than 13 different diseases (Fakir, 2001) and 10 of them are seed borne. Sowing of infected seeds may cause the death of seedlings and often plants escaping early infection succumb to death due to different diseases. Seed germination decreases with the increase of the seed borne infection. Seeds having higher seed borne infection results to significantly higher amount of disease development in the field. The rate of transmission of these pathogens from infected seeds to the growing plants and finally to the harvested seeds was relatively low (Fakir and Islam, 1990). Among the seed-borne fungal diseases, stem-rot, black-band, and anthracnose caused by Macrophomina phaseolina (Tassi, Goid.), Botryodiplodia theobromae and Colletotrichum cenchori (Ikata and Yoshida, 1940), respectively are frequently transmitted through jute seeds (Fazli and Ahmed, 1960; Ahmed, 1966; Fakir et al., 1991). Macrophomina phaseolina alone can cause 10% yield loss (Ahmed, 1968). Stem rot, black band, anthracnose, foot rot and wilt (Rhizoctonia solani) and leaf mosaic (virus) are responsible for seed rot, pre and post emergence damping off seedling, spread of the disease
to standing crops and loss and deterioration of quality of fibre (Ahmed, 1966; 1968; Ahmed and Islam, 1980; Biswas et al., 1985). Soft rot, foot rot and wilt caused by Sclerotium rolfsii and Rhizoctonia solani, respectively also cause considerable yield losses to the crop. Cercospora leaf spot and target spot caused by Cercospora chorchori and Corynespora cassicola, respectively, are not so important, though these two pathogens are frequently transmitted through jute seeds. The pathogens like Fusarium spp. (Fusarium semitectum and Fusarium oxysporum), Curvularia lunata and Phomopsis spp. are responsible for causing germination failure and seed rot (Fazli and Ahmed, 1960). Yield loss due to seed borne diseases of jute is 8-20% depending on the severity of jute diseases from year to year (Ahmed and Sultana, 1985). Infected jute seed fail to germinate or the young seedlings emerging from the infected seed die. Infection of jute seed causes germination failure, post emergence damping off and seedling blight (Fakir, 1989). Jute seedlings or growing plants produced in the field from the infected seeds and escaping early infection may often be infected at the later stages of their growth by the primary seed borne inocula grown and multiplied on the infected dead seeds and seedlings. Later on, these inocula may be transmitted to the healthy growing plants of the same or neighboring plants or even neighboring fields resulting to disease outbreak, often in epidemic form. Seed borne pathogens causing diseases on the growing jute plants in the field quite often attack the capsules or pods and subsequently infect the seed, resulting to production of infected or unhealthy seeds. Considering the above facts, the present study was carried out with the objective was to find out suitable disease management for quality jute seeds and fibre production.

MATERIALS AND METHODS

Experimental sites: The experiments were conducted in the field of Jute Agriculture Experimental Station (JAES), Manikgonj and Kishoregonj Regional Station (KRS), Kishoregonj of BJRI. Three sites of each station and each sites designed for three replications were considered for the experiments.

Variety Used: Seeds of Jute cv. CVL-1 was selected for this study.

Moisture Content of Seeds: Seeds having moisture content 9.5% (Khandakar and Bradbeer, 1983 and Bangladesh Gazette, 2010) was selected for field study.

Disease management in the Field: Spraying of fungicide Dithane M-45 (0.2%)

i) Spraying of BAU- Biofungicide @ 2% in water (Hossain, 2011b)

ii) Control (without spray)

Spraying of Dithane M-45: Dithane M-45 (Mancozeb 80%) was sprayed @ 2gm/L (0.2%) water as a preventive measure against the diseases of jute plants. Altogether, two sprays were done. The first spraying was done after disease occurred and the second spraying was done after 45 days of 1st spraying.

Spraying of BAU- Biofungicide: BAU- Biofungicide was sprayed @ 2% in water as a preventive measure against the diseases of jute plants. Altogether, two sprays were done. The first spraying was done after disease occurred and the second spraying was done after 45 days of 1st spraying.

Experimental Design: The experiments were conducted following Randomized Block Design (RCBD) having three replications. The size of the unit plot was 10m² (5m x 2m) and the distance between plots and replications were 1.0 m and 1.0 m, respectively.

Soil Characteristics and Nutrient Status: The soil characteristics and nutrient status of the two experimental stations (JAES, Manikgonj and KRS, Kishoregonj) are shown in Table 1.

Application of Fertilizers: During final land preparation Urea 60 kg, Triple Super Phosphate 50 kg and Muriate of Potash 25 kg per hectare were applied (Islam, 2009; Islam et.al, 2008). After 15-20 days of seed germination first top dressing with the urea @ 60 kg and again another 15 days later of first top dressing, the 2nd top dressing was given with 60 kg per hectare. Top dressing of urea was done very carefully so that it will not come in contact with the plant parts. To meet sulphur and zinc deficiency, gypsum and zinc oxide @ 45 kg and 5 kg per hectare were applied (Islam, 2009; Islam et.al., 2008).

Sowing of Seeds: Seeds were sown in line on 18 April, 2012 in Kishoregonj Regional Station (KRS), Kishoregonj and 30 April in Jute Agriculture Experimental Station (JAES), Manikgonj. Row to row and plant to plant distance were maintained as 1 m and 1 m, respectively. The seed rate for CVL-1 was 5 kg per hectare.

Data collection: Data on different parameters were collected as shown below

1. Incidence of diseases (%)
2. Fibre yield per plant (gm)
3. Fibre yield per hectare (ton)  
4. Stick yield per plant (gm)  
5. Stick yield per hectare (ton)  
6. Average number of branches per plant  
7. Average number of fruits per plant  
8. Seed yield per plant (gm)  
9. Seed yield per hectare (kg)  

Some plots were kept un-harvested for seed production.  

Table 1. Soil characteristics (Quddus, 2009) and nutrient status of the two experimental locations in 2012.  

| Location                           | Agro Ecological Zones                  | Soil characteristics | Nutrient status |
|------------------------------------|----------------------------------------|----------------------|-----------------|
| Jute Agriculture                   | Active Brahmaputra and Jamuna Flood Plain (AEZ-7) | Medium land          |                |
| Experimental Station (JAES), Manikgonj, BJRI | Kishoregonj Regional Station (KRS), BJRI | Medium land          |                |
|                                    |                                        | Sandy and Silt       |                |
|                                    |                                        | Loam                 |                |
|                                    |                                        | pH                   |                |
|                                    |                                        | % OM                 |                |
|                                    |                                        | % N                  |                |
|                                    |                                        | P (ppm)              |                |
|                                    |                                        | K (meq/100)          |                |

**RESULTS**

**Disease incidence in CVL-1 at JAES and KRS, BJRI:**  
Altogether eight diseases (seedling blight, stem rot, black band, anthracnose, die back, soft rot, mosaic and root knot) of CVL-1 were recorded. Total as well as individual disease incidence varied independently of each other with respect to variety CVL-1 and locations (Table 2). Seedling blight was recorded before one month age of the plants. Seedling blight was not found at JAES and root knot was not found at KRS depending on soil characteristics and weather conditions. Before spraying, highest total disease incidence (19.65%) and lowest total disease incidence (12.17%) were recorded at KRS. After spraying, the highest total disease incidence (4.47%) at KRS was recorded under control treatment. Whereas the lowest total disease incidence (1.87%) at KRS was recorded with BAU-Biofungicide spraying.

**Effect of disease managements on number of branch and capsule per plant in CVL-1 at JAES and KRS, BJRI:**  
Different types of disease management strategies differed significantly in respect of number of branch and capsule per plant in CVL-1 grown at JAES and KRS of BJRI (Table 4). The highest branch (4.66) of CVL-1 was recorded with BAU-Biofungicide sprayed plants at JAES and highest capsule/plant (70.22) at KRS was recorded under BAU-Biofungicide sprayed plants. The lowest branch (3.25) and capsule/plant (47.12) at KRS were recorded both under control treatment. The highest mean branch (4.40) and capsule/plant (70.19) of two locations were recorded under BAU-Biofungicide sprayed plants. The lowest mean branch (3.48) and capsule/plant (47.97) of two locations were recorded under control condition.

**Effect of disease managements on fibre and stick yield per plant and per hectare in CVL-1 at JAES and KRS, BJRI:**  
Different types of disease management strategies differed significantly in respect of fibre and stick yield in CVL-1 grown at JAES and KRS of BJRI (Table 3). The highest fibre yield/plant (9.61 gm) and fibre yield/ha (4.12 ton) at JAES were recorded under BAU-Biofungicide sprayed plants. The lowest fibre yield/plant (8.43 gm) and fibre yield/ha (2.21 ton) at KRS were recorded under control condition. The highest mean fibre yield/plant (9.44 gm) and fibre yield/ha (3.70 ton) of two locations were recorded under BAU-Biofungicide sprayed plants. Highest stick yield/plant (21.89 gm) and stick yield/ha (9.33 ton) at JAES were recorded under BAU-Biofungicide sprayed plants. The lowest stick yield/plant (19.84 gm) and stick yield/ha (5.43 ton) at KRS were recorded under control treatment. The highest mean stick yield/plant (21.25 gm) and stick yield/ha (8.99 ton) of two locations were recorded under BAU-Biofungicide spraying plants.

**Statistical Analysis:** Data were analysed statistically and treatments effects were compared by Duncan's Multiple Range Test (DMRT). Relation between seed borne fungal pathogens and germination was observed with regression equations. Relationships between disease severity and seed, fibre and stick yield were also observed by linear regression lines and equations (Gomez and Gomez, 1984).
Table 2. Dithane M-45 and BAU biofungicide on disease incidence in CVL at JAES and KRS, BJRI.

| Seed Treatment | Significance Level | % Major disease incidence recorded in JAES | % Major disease incidence recorded in KRS |
|----------------|-------------------|-------------------------------------------|-------------------------------------------|
|                |                   | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After |
| T1             |                   | 0.00   | 0.00  | 3.40   | 0.33  | 0.33   | 0.00  | 0.52   | 0.08  | 1.90   | 0.20  | 0.51   | 0.11  | 3.60   | 0.81  | 2.50   | 0.45  | 1.276  | 1.98  | 0.05   | 1.26  | 1.57   | 0.05   | 1.26  | 1.57   |
| T2             |                   | 0.71   | 0.71  | 1.97   | 0.91  | 0.91   | 0.71  | 1.01   | 0.76  | 1.55   | 0.84  | 1.00   | 0.78  | 2.02   | 1.14  | 1.73   | 0.07  | 3.64   | 1.57  | 0.05   | 1.26  | 1.57   | 0.05   | 1.26  | 1.57   |
| T3             |                   | 0.00   | 0.00  | 3.67   | 0.44  | 0.33   | 0.00  | 0.87   | 0.09  | 2.25   | 0.36  | 1.08   | 0.25  | 3.98   | 0.54  | 2.90   | 0.57  | 15.08  | 2.25  | 0.05   | 1.26  | 1.57   | 0.05   | 1.26  | 1.57   |
|                |                   | 0.71   | 0.71  | 2.04   | 0.97  | 0.91   | 0.71  | 1.17   | 0.77  | 1.66   | 0.93  | 1.26   | 0.87  | 2.12   | 1.02  | 1.84   | 1.03  | 3.95   | 1.66  | 0.05   | 1.26  | 1.57   | 0.05   | 1.26  | 1.57   |
|                |                   | 0.00   | 0.00  | 3.86   | 1.13  | 1.66   | 0.46  | 1.03   | 0.09  | 3.35   | 0.60  | 1.28   | 0.45  | 4.35   | 0.76  | 3.68   | 0.77  | 19.21  | 4.26  | 0.05   | 1.26  | 1.57   | 0.05   | 1.26  | 1.57   |
|                |                   | 0.71   | 0.71  | 2.09   | 1.28  | 1.47   | 0.98  | 1.24   | 0.77  | 1.96   | 1.05  | 1.33   | 0.97  | 2.20   | 1.12  | 2.04   | 1.13  | 4.44   | 2.18  | 0.05   | 1.26  | 1.57   | 0.05   | 1.26  | 1.57   |

T1 = Spraying of BAU- Biofungicide (2%), T2 = Spraying of Dithane M-45 (0.2%), T3 = Control (No spray), JAES = Jute Agriculture Experimental Station (JAES), Manikgonj, KRS = Kishoregonj Regional Station (KRS), BJRI, Figures in parentheses indicates the transformed value, Data in column having common letter(s) do not differ significantly at 5% level of significance. NS = Not Significant.

Table 3. Effect of disease managements on fibre and stick yield per plant and hectare in CVL-1 at JAES and KRS, BJRI.

| Treatments | Fibre yield (gm/plant) | Stick yield (gm/plant) | Fibre yield (t/ha) | Stick yield (t/ha) |
|------------|------------------------|------------------------|-------------------|-------------------|
|            | JAES | KRS | Mean | JAES | KRS | Mean | JAES | KRS | Mean | JAES | KRS | Mean | JAES | KRS | Mean |
| T1         | 9.61 | 9.26 | 9.44 | 21.89 | 20.60 | 21.25 | 4.12 a | 3.28 a | 3.70 | 9.33 a | 8.65 a | 8.99 a |
| T2         | 9.53 | 8.93 | 9.23 | 21.56 | 20.23 | 20.90 | 3.88 a | 2.99 a | 3.44 | 8.15 b | 7.35 b | 7.75 b |
| T3         | 9.33 | 8.43 | 8.88 | 20.39 | 19.84 | 20.12 | 3.08 b | 2.21 b | 2.65 | 5.91 c | 5.43 c | 5.67 c |

T1 = Spraying of BAU- Biofungicide (2%), T2 = Spraying of Dithane M-45 spray (0.2%), T3 = Control (Untreated), JAES = Jute Agriculture Experimental Station (JAES), Manikgonj, KRS = Kishoregonj Regional Station (KRS), BJRI, Data in column having common letter(s) do not differ significantly at 5% level of significance. NS = Not Significant.
Table 4. Effect of disease managements on number of branch and capsule per plant in CVL-1 at JAES and KRS, BJRI.

| Treatments | Number of branch/plant | Number of capsule/plant |
|------------|------------------------|-------------------------|
|            | JAES | KRS | Mean | JAES | KRS | Mean |
| T1         | 4.66 a | 4.13 a | 4.40 | 70.16 a | 70.22 a | 70.19 a |
| T2         | 4.03 ab | 3.75 ab | 3.89 | 66.83 a | 66.13 a | 66.48 a |
| T3         | 3.70 b | 3.25 b | 3.48 | 48.82 b | 47.12 b | 47.97 b |
| Significance Level | 0.05 | 0.05 | NS | 0.05 | 0.05 | 0.05 |

T1 = Spraying of BAU- Biofungicide (2%), T2 = Spraying of Dithane M-45 spray (0.2%), T3 = Control (Untreated), JAES = Jute Agriculture Experimental Station (JAES), Manikgonj, KRS = Kishoregonj Regional Station (KRS), BJRI. Data in column having common letter(s) do not differ significantly at 5% level of significance. NS = Not Significant.

**Interaction effect among the locations and disease managements on disease incidence, seed yield, stick yield and fibre yield:** Interaction effect of locations with different types of disease managements differed significantly for disease incidence, fibre yield, stick yield, number of branch, number of capsule and seed yield (Table 6). After spraying, interaction effect of KRS and BAU- Biofungicide sprayed plants resulted lower seed borne infection (1.87%) and highest disease incidence (4.47%) was encountered in interaction effect among KRS and control condition. Interaction effect between locations and different types of disease managements on fibre yield/ha were found significant. The highest result was found in L1XT1 (9.33 ton) followed by L1XT2 (8.65 ton). The lowest result was found in L1XT3 (5.91 ton) preceded by L1XT4 (4.66). Interaction effect between locations and different types of disease managements on seed yield/ha were found significant. But there was no significant differences among L1XT1 (588.35 kg) and L1XT2 (567.34 kg). Again there was no significant variation among L1XT3 (506.26 kg) and L1XT4 (488.37 kg). The highest result was found in L1XT1 (558.35 kg) followed by L1XT2 (567.34 kg). The lowest result was found in L1XT3 (480.35 kg) preceded by L1XT4 (432.29 kg).

Table 5. Effect of disease managements on seed yield per plant and per hectare in CVL-1 at JAES and KRS, BJRI.

| Treatments | Seed yield (gm/plant) | Seed yield (kg/ha) |
|------------|----------------------|-------------------|
|            | JAES | KRS | Mean | JAES | KRS | Mean |
| T1         | 4.49 a | 4.13 | 4.31 | 508.35 a | 506.26 a | 547.31 a |
| T2         | 4.22 ab | 3.90 | 4.06 | 567.34 a | 488.37 a | 527.86 a |
| T3         | 3.82 b | 3.74 | 3.78 | 432.29 b | 378.45 b | 405.37 b |
| Significance Level | 0.05 | NS | NS | 0.05 | 0.05 | 0.05 |

T1 = Spraying of BAU- Biofungicide (2%), T2 = Spraying of Dithane M-45 spray (0.2%), T3 = Control (Untreated), JAES = Jute Agriculture Experimental Station (JAES), Manikgonj, KRS = Kishoregonj Regional Station (KRS), BJRI. Data in column having common letter(s) do not differ significantly at 5% level of significance. NS = Not Significant.

**DISCUSSION**

In field experiment, two disease practices viz. spraying of BAU- Biofungicide and Dithane M-45 and moisture content (9.5% moisture) were used for this study. Field experiments were conducted at two different locations- Jute Agriculture Experimental Station (JAES), Manikgonj and Kishoregonj Regional Station (KRS), Kishoregonj of Bangladesh Jute Research Institute. Under field condition, effects of BAU- Biofungicide and Dithane M-45 on disease incidence and production of quality healthy seeds were studied. Disease incidence occurred minimum in both the jute varieties at JAES and KRS by BAU- Biofungicide spraying. After spraying, the highest total disease incidences 4.26% and 4.47% were recorded under control condition and the lowest total disease incidences 1.98% and 1.87% were recorded when BAU- Biofungicide sprayed in the field at JAES and KRS, respectively.
Table 6. Interaction effect among the locations and disease managements in CVL-1 variety on disease incidence, seed yield, stick yield and fibre yield.

| Interaction | DI (%) | FY (gm/P) | SY (gm/P) | FY (t/ha) | SY (t/ha) | branch /plant | capsule /plant | Seed (gm/P) | Seed (kg/ha) |
|-------------|--------|-----------|-----------|-----------|-----------|---------------|----------------|-------------|--------------|
|             | Before | After     |           |           |           |               |                |             |              |
| L₁ X T₁     | 12.76  | 1.98 bc   | 9.61 a    | 21.89 a   | 4.12 a    | 9.33 a        | 4.66 a         | 70.16 a     | 4.49         |
| L₁ X T₂     | 15.08  | 2.25 bc   | 9.53 ab   | 21.56 ab  | 3.88 ab   | 8.15 c        | 4.03 b         | 66.83 a     | 4.22         |
| L₁ X T₃     | 19.21  | 4.26 a    | 9.33 ab   | 20.39 bc  | 3.08 c    | 5.91 e        | 3.70 bc        | 48.82 b     | 3.82         |
| L₂ X T₁     | 12.17  | 1.87 c    | 9.26 ab   | 20.60 bc  | 3.28 bc   | 8.65 b        | 4.13 b         | 70.22 a     | 4.13         |
| L₂ X T₂     | 13.56  | 2.70 b    | 8.93 bc   | 20.23 c   | 2.99 c    | 7.35 d        | 3.75 bc        | 66.13 a     | 3.90         |
| L₂ X T₃     | 19.65  | 4.47 a    | 8.43 c    | 19.84 c   | 2.21 d    | 5.43 f        | 3.25 c         | 47.12 b     | 3.74         |

Significance Level: 0.05 NS 0.05 NS 0.05 NS 0.05 NS 0.05 NS

L₁= JAES, Manikgonj, BJRI, L₂ = KRS, Kishoregonj, BJRI, T₁= Spraying of BAU- Biofungicide (2%), T₂= Spraying of Dithane M₄₅ (0.2%), T₃ = Control (No spray). Data in column having common letter(s) do not differ significantly at 5% level of significance. NS = No significant, FY = Fibre yield, SY = Stick yield.

From the data, it is observed that disease incidence, seed yield, stick yield and fibre yield were found to decrease with the increase of seed borne infection of fungal pathogens. Ahmed (1966) reported that among the causal agents of jute diseases, fungal pathogens were the main group of organisms responsible for the loss of fibre yield. Hossain and Sultana (2011), Hossain and Hossain (2010) and Mostafa (2009) reported that yield was increased in BAU- Biofungicide sprayed field.

Therefore, the following conclusion may be drawn for quality seed and fibre production from the findings of this study:

- BAU- Biofungicide (2% in water) can successfully used as spraying agent to avoid Dithane M₄₅ or other chemical fungicides for the production of quality healthy jute seeds with higher seed and fibre yield.
- Fibre and seed yield were found to decrease with the increase of seed borne infection of fungal pathogens.

So, the following recommendation may be drawn for quality seed and fibre production from the findings of this study:

- Foliar spray of BAU- Biofungicide enhance the quality and yield of the jute seed and fibre in the field.

ACKNOWLEDGEMENT

The author first expresses his deep gratitude and gratefulness to his creator, the all mighty Allah for his kindness and giving ability to conduct and carry out this research work. Bangladesh Agricultural Research Council (BARC), Dhaka-1207 offered a NATP scholarship to study the research work with financial assistance. The author really grateful and indebted to BARC for this support.

LITERATURE CITED

Ahmed, N. and K. Sultana. 1985. Survey on the production and quality of jute seeds at Farm level. Ann. Rep. BJRI, Dhaka. 296-323.
Ahmed, N. and N. Islam. 1980. Correlation between jute seed infections recorded in the laboratory with the incidence diseases in the field. Ann. Rep. BJRI: 129-130.

Ahmed, Q. A. 1966. Problems in jute plant pathology. Jute and Jute fabrics Pakistan, July: 184-186.

Ahmed, Q. A. 1968. Diseases of jute in East Pakistan, Jute and Jute Fab. Pak. 7:147-151.

Bangladesh Gazette (Additional). December 20, 2010. 12.

BBS, 2011. Statistical Year Book of Bangladesh. Bangladesh Bureau of Statistics, Planning Ministry, Dhaka.

Biswas, A. C., M. A. Taher, M. Asaduzzaman, K. Sultana and A. K. M. Eshaque. 1985. Loss of yield and quality of jute fibre due to prevalence of stem rot, Bangladesh J. Plant Pathol. 1(1): 61-62.

Fakir, G. A. 2001. An annotated list of seed borne diseases in Bangladesh. Seed Pathology Laboratory, Dept. Plant Path. BAU, Mymensingh. 7-8.

Fakir, G. A. and M. R. Islam. 1990. Survey on the health status of jute and rice seeds of farmers of Sadar Upazilla, Mymensingh, BAURES progress.4: 42-47.

Fakir, G. A. 1989. Seed health test in seed quality control and seed certification. Seed Path. Lab. Pub. No. 4:11.

Fakir, G. A., M.A. Sarder, A. Gaffar and M. U. Ahmed. 1991. An annotated list of important disorders of important crop plants of Bangladesh. Pl. Quarantine Rev. Prog. Sponsored by the Ministry of Agriculture in coordination with CIDA and DANIDA. 107.

Fazli, S. F. I. and Q. A. Ahmed. 1960. Fungus organisms associated with jute seeds and their effect on germinating seeds and seedlings. Agric. Pakistan. 11: 298-306.

Gomez, A. K. and A. A. Gomez. 1984. Statistical Procedures for Agric. Res. Second Edn. Intl. Rice Res. Inst. Manila, Philippines. 680.

Hossain, I. 2003. Use of BAU- Biofungicide to control seed borne diseases of vegetables and pulses. Agril. Technologies Bangladesh Agricultural University, Mymensingh. 18.

Hossain, I. 2007. About jute seed research. R.S. printing press, Kalwalapara, Mirpur-1, Dhaka-1216. 1.

Hossain, I. 2009. Jute seed technology. College gate binding and printing, Dhaka-1207. 89-97.

Hossain, I. and M. R. Islam. 2008. Hand book on Agricultural technology of jute, kenaf and mesta crops. Bulbul printers, Dhaka-1203. 27-28.

Khandakar, A. L. 1987. Jute seed at farm level. Bangladesh Agric. Res. Coun., Dhaka. 1-77.

Khandakar, A. L. and J. W. Bradbeer. 1983. Jute Seed Quality. Agric. Econ. and Social Sci. Prog. Bangladesh Agric. Res. Coun., Dhaka. 1-92.

Mostafa, G. 2009. Effect of BAU- Biofungicide in comparison with Bavistin and Amistar for controlling diseases of soybean variety G2. An M. S. Thesis submitted to the Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh.

Quddus, M. A. 2009. Crop production growth in different agro-ecological zones of Bangladesh. J. Bangladesh Agril. Univ. 7(2): 351–360.