# Effect of Disease Managements on Disease Incidence, Seed Yield, Stick Yield and Fibre Yield Following Line Sowing Method in O-9897 Variety

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**Abstract**

The experiment was conducted in the field of Jute Agriculture Experimental Station (JAES), Manikgonj and Kishoregonj Regional Station (KRS), Kishoregonj of BJRI during the period April 2012 to January 2013. Two different disease management practices viz. Dithane M-45 and BAU-Biofungicide and Seeds having moisture content 9.5% were used for the present study. Disease management showed lowest disease incidence 3.13% and 2.11% 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 (339.24 kg $ha^{-1}$), fibre yield (4.03 t $ha^{-1}$) and stick yield (8.76 t $ha^{-1}$) were recorded under BAU- Biofungicide sprayed plants and lowest seed yield (297.47 kg $ha^{-1}$), fibre yield (1.95 t $ha^{-1}$) and stick yield (4.85 t $ha^{-1}$) were recorded under control treatment.

***Keywords:*** disease management, disease incidence, seed quality, yield

## Introduction

Jute is one of the major cash crops of Bangladesh. Its influence on ecology and economy is so intimate that it's the effects are significantly related to the agro-ecology and the socio-economic life of the people. Jute crop is also cultivated in different countries. The jute crop also greatly improves the soil fertility status by incorporating organic matter to the soil through decomposition of shaded 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; IJSG website, 2012-2013). 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 corchori* (Ikata and Yoshida, 1940), are respectively and 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 seedlings, spread of the diseases to standing crops and loss and deterioration of quality of fibre (Ahmed, 1966 and 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 targot 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* sp. 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 and Period

The experiments were conducted in the field of Jute Agriculture Experimental Station (JAES), Manikgonj and Kishoregonj Regional Station (KRS), Kishoregonj of Bangladesh Jute Research Institute (BJRI). The experiments were conducted during the period April 2012 to January 2013.

### Varieties Used

Seed of O-9897 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

i) Spraying of fungicide dithane M-45 (0.2%). Dithane M-45 (Mancozeb 80%) was sprayed at 2 g $L^{-1}$ (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 1$^{st}$ spraying. ii) Spraying of BAU-Biofungicide at 2% in water (Hossain, 2011b) BAU- Biofungicide was sprayed at 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 1$^{st}$ spraying and iii) Control (without spray)

### Experimental Design

The experiment was conducted following Randomized Block Design (RCBD) having three replications. The size of the unit plot was 10 $m^2$ (5x2 m) 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.

**Land Preparation**

The land was first opened on 13 March 2012 with a power tiller. Final land preparation was done by tractor drawn disk plough and thoroughly prepared with four ploughings and three cross ploughings followed by ladderings in order to level the soil. Weeds and stubbles were removed from the field. Finally, individual plots were prepared by using spades before sowing of seeds.

**Application of Fertilizers**

During final land preparation urea 60 kg $ha^{-1}$, triple super phosphate 50 kg $ha^{-1}$ and muriate of potash 25 kg $ha^{-1}$ were applied (Islam, 2009; Islam et al., 2008). After 15-20 days of seed germination first top dressing with the urea at 60 kg and again another 15 days later of first top dressing, the $2^{nd}$ top dressing was given with 60 kg $ha^{-1}$. 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 at 45 and 5 kg $ha^{-1}$ were applied (Islam, 2009; Islam et al., 2008).

**Sowing of Seeds**

Seeds were sown in line on 20 April, 2012 in Kishoregonj Regional Station (KRS), Kishoregonj and 2 May, 2012 in Jute Agriculture Experimental Station (JAES), Manikgonj. Row to row and plant to plant distance were maintained as 1M and 1M, respectively. The seed rate for O-9897 was 4 kg $ha^{-1}$.

**Data collection**

Data on different parameters were collected: 1) Incidence of diseases (%), 2) Fibre yield per plant (g) and per hectare (t). Fibre was harvested at field duration of 120 days from the jute plants grown in different blocks. The crop was harvested after 120 days of sowing. After being harvested, bundles of plants were to leave in a heap in dry jute field for four days to make defoliation. 3) Stick yield per plant (g) and per hectare (t). Stick was harvested from the jute plants grown in different blocks. 4) Average number of branch per plant, 5) Average number of fruits per plant, 6) Seed yield per plant (g) and per hectare (kg). The ripening pods (65-75%) were harvested from the jute plants. Seeds were extracted from the harvested pods, dried and seed yield per plant and hectare were recorded.

**Statistical Analysis**

Data were analyzed statistically and treatments effects were compared by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

## Results and Discussion

**Disease Incidence in O-9897 at JAES and KRS, BJRI**

Altogether six seed borne fungal diseases (Seedling blight, Stem rot, Black band, Die back, Soft rot and Root knot) were recorded. Total as well as individual disease incidence varied independently of each other with respect to different types of storage containers, variety 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 condition. Resistance was found in Olitorius varieties against anthracnose and mosaic diseases (Ahmed, 1966). Before spraying highest total disease incidence (13.27%) and lowest total disease incidence (6.16%) were recorded at JAES and KRS, respectively. After spraying, the highest total disease incidence (5.08%) at JAES was recorded under control condition and the lowest total disease incidence (2.11%) at KRS was recorded under BAU- Biofungicide spraying (Table 2).

BAU- Biofungicide and Dithane M-45 have been recorded as superior means for controlling seed borne fungi as well as field fungi with higher seed yield and better improvement of seed quality as reported by Pradhan et al. (2012), Gurjar et al. (2004), Hossain and Hossain (2010, 2014), Hossain (2011a), Hossain and Sultana (2011), Shultana et al. (2009), Yeasmin et al. (2009), Mostafa (2009), Hossain and Sarker (2008), Agarwal and Singh (1974) and Islam and Biswas (1981). The present findings revealed that disease incidence was comparatively lower in case of using BAU- Biofungicide and Dithane M-45 spraying. Moreover, management of disease by BAU- Biofungicide increased yield with the decrease of total seed borne fungal pathogens.

**Table 1** Soil characteristics and nutrient status of the two experimental locations in 2012

| Experimental location | AEZ | Soil characteristics | | | Nutrient status | | | |
|---|---|---|---|---|---|---|---|---|
| | | Land type | Soil type | pH | OM (-----%----) | N | P (mg $kg^{-1}$) | K (cmol $kg^{-1}$) |
| Jute Agriculture Experimental Station (JAES), Manikgonj, BJRI | Active Plain Brahmaputra and Jamuna Flood (AEZ-7) | Medium land | Sandy and silty | 6.69 | 1.79 | 0.35 | 14.38 | 0.138 |
| Kishoregonj Regional Station (KRS), BJRI | Old Brahmaputra Flood Plain (AEZ-9) | Medium land | Loam | 6.11 | 1.24 | 0.39 | 14.98 | 0.15 |

**Table 2** Effect of disease managements on disease incidence in O-9897 at JAES and KRS, BJRI following line sowing method in the field.

| Seed treatment | Seedling blight | | Stem rot | | Black band | | Die back | | Soft rot | | Mosaic | | Root knot | | Total disease | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After |
| % Major disease incidence recorded in JAES | | | | | | | | | | | | | | | | |
| $T_1$ | 0.00 | 0.00 | 1.67 | 0.51 | 1.09 | 0.49 | 1.85b | 0.56b | 0.77b | 0.19) | 0.00 | 0.00) | 1.95 | 0.61 | 11.01b | 3.13a |
| | (0.71) | (0.71) | (1.47) | (1.00) | (1.26) | (0.99) | (1.53) | (1.03) | (1.13) | (0.83) | (0.71) | (0.71) | (1.57) | (1.05) | (3.39) | (1.91) |
| $T_2$ | 0.00 | 0.00 | 1.90 | 0.67 | 1.74 | 0.84 | 1.97 | 0.75ab | 0.95ab | 0.27 | 0.00 | 0.00 | 2.06 | 0.78 | 12.30 | 4.08ab |
| | (0.71) | (0.71) | (1.55) | (1.08) | (1.50) | (1.16) | (1.57) | (1.12) | (1.20) | (0.88) | (0.71) | (0.71) | (1.60) | (1.13) | (3.58) | (2.14) |
| $T_3$ | 0.00 | 0.00 | 1.98 | 0.76 | 2.09 | 1.05 | 2.16a | 1.10a | 1.21a | 0.35 | 0.00 | 0.00 | 2.15 | 1.05 | 13.27a | 5.08b |
| | (0.71) | (0.71) | (1.57) | (1.12) | (1.61) | (1.24) | (1.63) | (1.26) | (1.31) | (0.92) | (0.71) | (0.71) | (1.63) | (1.24) | (3.71) | (2.36) |
| Level of significance | NS | NS | NS | NS | NS | NS | 0.05 | 0.05 | 0.05 | NS | NS | NS | NS | NS | 0.05 | 0.05 |
| % Major disease incidence recorded in KRS | | | | | | | | | | | | | | | | |
| $T_1$ | 0.95 | 0.00 | 1.80 | 0.60b | 1.19 | 0.55 | 1.55b | 0.74 | 0.67 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 6.16c | 2.11 |
| | (1.20) | (0.71) | (1.52) | (1.05) | (1.30) | (1.02) | (1.43) | (1.11) | (1.08) | (0.85) | (0.71) | (0.71) | (0.71) | (0.71) | (2.58) | (1.62) |
| $T_2$ | 0.98 | 0.05 | 2.21 | 0.81ab | 1.31 | 0.61 | 2.34a | 0.86 | 0.92 | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 | 7.76b | 2.60 |
| | (1.22) | (0.74) | (1.65) | (1.14) | (1.35) | (1.05) | (1.69) | (1.17) | (1.19) | (0.88) | (0.71) | (0.71) | (0.71) | (0.71) | (2.87) | (1.76) |
| $T_3$ | 1.02 | 0.10 | 2.95 | 1.02b | 2.25 | 0.81 | 2.61a | 1.09 | 1.46 | 0.44 | 0.00 | 0.00 | 0.00 | 0.00 | 10.29a | 3.46 |
| | (1.23) | (0.77) | (1.86) | (1.23) | (1.66) | (1.14) | (1.76) | (1.26) | (1.40) | (0.97) | (0.71) | (0.71) | (0.71) | (0.71) | (3.28) | (1.99) |
| Level of significance | NS | NS | NS | 0.05 | NS | NS | 0.05 | NS | NS | NS | NS | NS | NS | NS | 0.05 | NS |

$T_1$= Spraying of BAU- Biofungicide (2%), $T_2$= Spraying of Dithane M-45 (0.2%), $T_3$ = 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

**Effect of Disease Managements on Fibre and Stick Yield per Plant and per Hectare in O-9897 at JAES and KRS, BJRI Following Line Sowing Method in the Field**

Different types of disease managements differed significantly in respect of fibre and stick yield in O-9897 grown at JAES and KRS of BJRI (Table 3). The highest fibre yield $plant^{-1}$ (11.67 g) and fibre yield $ha^{-1}$ (4.03 t) at JAES were recorded under BAU- Biofungicide sprayed plants. The lowest fibre yield $plant^{-1}$ (6.52 g) and fibre yield $ha^{-1}$ (1.95 t) at KRS were recorded under control condition. The highest mean fibre yield $plant^{-1}$ (10.27 g) and fibre yield $ha^{-1}$ (3.55 t) of two locations were recorded under BAU- Biofungicide sprayed plants. Highest stick yield $plant^{-1}$ (22.32 g) and stick yield $ha^{-1}$ (8.76 t) at JAES were recorded under BAU-Biofungicide sprayed plants. The lowest stick yield $plant^{-1}$ (18.36 g) and stick yield $ha^{-1}$ (4.85 t) at KRS were recorded under control condition. The highest mean stick yield $plant^{-1}$ (21.88 g) and stick yield $ha^{-1}$(8.32 t) of two locations were recorded under BAU- Biofungicide sprayed plants.

**Table 3** Effect of disease managements on fibre and stick yield per plant and hectare in O-9897 at JAES and KRS, BJRI following line sowing method in the field.

| Treatment | JAES | KRS | Mean | JAES | KRS | Mean |
|---|---|---|---|---|---|---|
| | Fibre yield (g plant$^{-1}$) | | | Stick yield (g plant$^{-1}$) | | |
| $T_1$ | 11.67 a | 8.87 a | 10.27 a | 22.32 a | 21.44 a | 21.88 a |
| $T_2$ | 10.42 ab | 7.67 ab | 9.05 b | 20.16 b | 19.55 b | 19.86 b |
| $T_3$ | 9.67 b | 6.52 b | 8.10 c | 19.76 b | 18.36 c | 19.06 b |
| Level of significance | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Fibre yield (t ha$^{-1}$) | | | Stick yield (t ha$^{-1}$) | | |
| $T_1$ | 4.03 a | 3.07 a | 3.55 | 8.76 a | 7.87 a | 8.32 a |
| $T_2$ | 2.98 b | 2.99 a | 2.99 | 6.12 b | 6.53 b | 6.33 b |
| $T_3$ | 2.19 c | 1.95 b | 2.07 | 5.24 c | 4.85 c | 5.05 c |
| Level of significance | 0.05 | 0.05 | NS | 0.05 | 0.05 | 0.05 |

$T_1$= Spraying of BAU- Biofungicide (2%), $T_2$= Spraying of Dithane M-45 spray (0.2%), $T_3$ = 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

**Effect of Disease Managements on Number of Branch and Capsule per Plant in O-9897 at JAES and KRS, BJRI Following Line Sowing Method in the Field**

Different types of disease managements differed significantly in respect of number of branch and pod per plant in O-9897 grown at JAES and KRS of BJRI (Table 4). The highest number of branches (3.78) of O-9897 was recorded with BAU-Biofungicide sprayed plants at JAES and highest number of pods plant$^{-1}$ (25.13) at JAES was recorded under BAU- Biofungicide sprayed plants. The lowest number of branches (2.75) and pods plant$^{-1}$ (17.95) at KRS were recorded under control treatment. The highest mean branches (3.51) and pods plant$^{-1}$ (24.74) of two locations were recorded under BAU- Biofungicide sprayed plants. The lowest mean branches (2.89) and pods plant$^{-1}$ (18.23) of two locations were recorded under control condition.

**Effect of Disease Managements on Seed Yield per Plant and per Hectare in O-9897 at JAES and KRS, BJRI Following Line Sowing Method in the Field**

Different types of disease managements differed significantly in respect of seed yield in O-9897 grown at JAES and KRS of BJRI (Table 5). The highest seed yield plant$^{-1}$ (4.13 g) and seed yield ha$^{-1}$ (339.24 kg) at KRS were recorded under BAU-Biofungicide sprayed plants. The lowest seed yield plant$^{-1}$ (3.36 g) and seed yield ha$^{-1}$ (297.47 kg) at JAES were recorded in control treatment. The highest mean seed yield plant$^{-1}$ (4.07 g) and seed yield plant$^{-1}$ (4.07 g) and seed yield ha$^{-1}$ (337.40 kg) of both locations were recorded under Biofungicide sprayed condition. Ahmed (1966) reported that among the causal agents of jute diseases, fungal pathogens are the main group of organisms responsible for the loss of fibre yield. Ahmed (1968) also reported that three important diseases as Stem rot (*Macrophomina phaseolina*), Anthracnose (*Colletrotichum corchori*) and Leaf mosaic (virus) disease that deteriorated jute seed.

Pradhan et al. (2012), Gurjar et al. (2004), Bhuiyan et al. (2006), Hossain and Hossain (2014), Hossain (2011a, 2009), Islam (2009) and Mostafa (2009) similarly reported that BAU- Biofungicide (2%) was found to control the seed borne pathogens and also increased the yields (seed and fibre). The low yield in control was related to high prevalence of seed borne fungal infections. Similar result was also reported by Biswas et al. (1985). Debnath et al. (2012) reported that BAU-Biofungicide treated seed also show the higher vigor of the seed, highest germination and lowest disease incidence.

Ahmed (1966) reported that seed and fibre yield and quality decreased if seed borne fungal pathogens increased. He also reported that among the causal agents of jute diseases, fungal pathogens were the main group of organisms responsible for the loss of fibre yield. Gurjar et al. (2004), Debnath et al. (2012) Hossain (2003),

**Table 4** Effect of disease managements on number of branch and capsule per plant in O-9897 at JAES and KRS, BJRI following line sowing method in the field.

| Treatment | Number of branch (No. plant$^{-1}$) | | | Number of capsule (No. plant$^{-1}$) | | |
|---|---|---|---|---|---|---|
| | JAES | KRS | Mean | JAES | KRS | Mean |
| $T_1$ | 3.78 | 3.24 | 3.51 | 25.13 a | 24.34 a | 24.74 a |
| $T_2$ | 3.26 | 3.01 | 3.14 | 20.25 b | 20.04 b | 20.15 b |
| $T_3$ | 3.02 | 2.75 | 2.89 | 18.50 c | 17.95 c | 18.23 c |
| Level of significance | NS | NS | NS | 0.05 | 0.05 | 0.05 |

$T_1$= Spraying of BAU- Biofungicide (2%), $T_2$= Spraying of Dithane M-45 spray (0.2%), $T_3$ = 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 5** Effect of disease managements on seed yield per plant and per hectare in O-9897 at JAES and KRS, BJRI following line sowing method in the field

| Treatment | Seed yield (g plant$^{-1}$) | | | Seed yield (g ha$^{-1}$) | | |
|---|---|---|---|---|---|---|
| | JAES | KRS | Mean | JAES | KRS | Mean |
| $T_1$ | 4.01 | 4.13 | 4.07 | 25.13 a | 335.56 a | 339.24 a |
| $T_2$ | 3.68 | 3.85 | 3.77 | 20.25 b | 315.25 ab | 317.17 ab |
| $T_3$ | 3.36 | 3.40 | 3.38 | 18.50 c | 297.47 b | 302.22 b |
| Level of significance | NS | NS | NS | 0.05 | 0.05 | 0.05 |

$T_1$= Spraying of BAU- Biofungicide (2%), $T_2$= Spraying of Dithane M-45 spray (0.2%), $T_3$ = 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

Hossain and Sultana (2011), Hossain and Hossain (2010), Shultana et al. (2009), Yeasmin et al. (2009), Mostafa (2009) and Hossain and Sarker (2008) reported that yield was increased in BAU-Biofungicide sprayed field.

**Interaction Effect among the Locations and Disease Managements on Disease Incidence, Seed Yield, Stick Yield and Fibre Yield at Line Sowing Method in the Field**

Interaction effect of locations with different types of disease managements differed significantly for disease incidence, fibre yield, stick yield, number of branch, number of pod and seed yield (Table 6). After spraying, interaction effect of KRS and BAU-Biofungicide sprayed plants resulted lower seed borne infection (2.11%) and highest disease incidence (5.08%) was encountered in interaction effect among JAES and control condition. Interaction effect between locations and different types of disease managements on fibre yield ha$^{-1}$ were found significant. But there was no significant differences among $L_1xT_2$ (2.98 t), $L_2xT_1$ (3.07 t) and $L_2xT_2$ (2.99 t). Again there was no significant variation among $L_1xT_3$ (2.19 t) and $L_2xT_3$ (1.95 t). The highest result was found in $L_1xT_1$ (4.03 t) followed by $L_2xT_1$ (3.07 t).

The lowest result was found in $L_2xT_3$ (1.95 t) preceded by $L_1xT_3$ (2.19 t). Interaction effect between locations and different types of disease managements on stick yield ha$^{-1}$ were found significant. But there was no significant differences among $L_1xT_1$ (8.76 t) and $L_2xT_1$ (7.87 t). The highest result was found in $L_1xT_1$ (8.76 t) followed by $L_2xT_1$ (7.87 t).

The lowest result was found in $L_2xT_3$ (4.85 t) preceded by $L_1xT_3$ (5.24 t). Interaction effect between locations and different types of disease managements on seed yieldha$^{-1}$were found significant. But there was no significant differences among $L_1xT_1$ (335.56 kg) and $L_2xT_1$ (339.24 kg). Again there was no significant variation among

**Table 6** Interaction effect among the locations and disease managements in O-9897 variety on disease incidence, seed yield, stick yield and fibre yield following line sowing method in the field.

| Interaction among the locations and disease managements | Percent disease incidence | | Fibre yield | | Stick yield | | Branch Capsule | | Seed yield | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | (g plant$^{-1}$) | (t ha$^{-1}$) | (g plant$^{-1}$) | (t ha$^{-1}$) | (-----No. plant$^{-1}$----) | | (g plant$^{-1}$) | (kg ha$^{-1}$) |
| $L_1$ X $T_1$ | 11.01 b | 3.13 bc | 11.67 a | 4.03 a | 22.32 a | 8.76 a | 3.78 a | 25.13 a | 4.01 | 335.56 ab |
| $L_1$ X $T_2$ | 12.30 a | 4.08 ab | 10.42 ab | 2.98 b | 20.16 c | 6.12 bc | 3.26 ab | 20.25 b | 3.68 | 315.25 c |
| $L_1$ X $T_3$ | 13.27 a | 5.08 a | 9.67 bc | 2.19 c | 19.76 c | 5.24 cd | 3.02 ab | 18.50 c | 3.36 | 297.47 c |
| $L_2$ X $T_1$ | 6.16 d | 2.11 c | 8.87 cd | 3.07 b | 21.44 b | 7.87 a | 3.24 ab | 24.34 a | 4.13 | 339.24 a |
| $L_2$ X $T_2$ | 7.76 c | 2.60 bc | 7.67 de | 2.99 b | 19.55 c | 6.53 b | 3.01 ab | 20.04 b | 3.85 | 317.17 bc |
| $L_2$ X $T_3$ | 10.29 b | 3.46 bc | 6.52 e | 1.95 c | 18.36 d | 4.85 d | 2.75 b | 17.95 c | 3.40 | 302.22 c |
| Level of significance | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | NS | 0.05 |

$L_1$= JAES, Manikgonj, BJRI, $L_2$ = KRS, Kishoregonj, BJRI
$T_1$= Spraying of BAU- Biofungicide (2%), $T_2$= Spraying of Dithane M-45 (0.2%), $T_3$ = Control (No spray)
Data in column having common letter(s) do not differ significantly at 5% level of significance.
NS = No significant

$L_1xT_2$ (315.25 kg), $L_1xT_3$ (297.47 kg) and $L_2xT_3$ (302.22 kg). The highest result was found in $L_2xT_1$ (339.24 kg) followed by $L_1xT_1$ (335.56 kg). The lowest result was found in $L_1xT_3$ (297.47 kg) preceded by $L_2xT_3$ (302.22 kg).

## Conclusion

Therefore, the following conclusion may be drawn for quality seed and fibre production from the findings of this study: 1) BAU- Biofungicide (2% in water) can successfully used as spraying agent to avoid Dithane M- 45 or other chemical fungicides for the production of quality healthy jute seeds with higher seed and fibre yield. 2) 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 increase the quality and yield of the jute seed and fibre in the field.

## Acknowledgments

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.

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Manuscript received 19September2014, accepted 31 March 2016