

COMPARATIVE STUDY OF SELECTED TOSSA JUTE VARIETIES (*Corchorus Olitorius*) IN RESPONSE TO THE PRESENCE OF FUNGI

F.U. Talukder^{1,4*}, M.S. Rahman², M.M. Mukul³ and S.M.A. Haque⁴

¹Rural Development Academy (RDA), Bogura, Bangladesh

²Entomology Department, Bangladesh Jute Research Institute, Dhaka, Bangladesh

³Breeding Division, Bangladesh Jute Research Institute, Dhaka, Bangladesh

⁴Plant Pathology Department, Bangladesh Jute Research Institute, Dhaka, Bangladesh

ABSTRACT

The purpose of this study was to observe the germination rate and fungal pathogens association in selected Tossa jute varieties. The experiment was conducted following Completely Randomized Design (CRD) with four replications. Truthfully labelled seeds (TLS) collected from four districts in Bangladesh, was used in the present study. The Highest germination rate (93.5%) and the lowest infection (31.25 pathogens/100 seed) were observed in BJRI Tossa Pat 5 (O-795) variety. BJRI Tossa Pat 4 (O-72) was observed as the most vulnerable against pathogen infection (121.25 pathogens/100 seed) and the showed lowest germination (83.25%). Regressions co-efficient (β) -0.82 was observed between germination (%) and total number of pathogens on seeds. Regression co-efficient (β) was -0.71 between moisture (%) and germination (%) of Tossa seeds. Regression co-efficient (β) was 0.65 between moisture (%) and total number of pathogens at Tossa jute seeds. For conducting the experiment, there was no limitation. From the study, it may be concluded that, seed-borne pathogenic fungi negatively affect the germination (%) of Tossa jute seed.

Keywords: Germination percentage, Moisture percentage, Pathogens, Tossa Jute

INTRODUCTION

Tossa jute (*Corchorus olitorius*) is an annual herbaceous plant under the Malvaceae family. It is grown as a source of fibre and vegetables of its mucilaginous edible leaves (Anonymous, 2018). Jute is mainly a fibre producing crop that is considered as the main cash crop of Bangladesh (Sarker et al., 2017). In the world market, 70% of jute fibre and jute product is supplied by Bangladesh (Hossain and Abdulla, 2015).

* Corresponding author: fakhiruddin155@gmail.com

But in Bangladesh, there is a serious scarcity of healthy jute seeds (Islam et al., 2015). Bangladesh earns a lot of foreign currencies by exporting jute and jute products. Among Jute exporting states, Bangladesh owns 2nd position as a solitary exporter and producer. The disease/pathogen is soil, air and seed borne in nature that constantly harms the crop preliminary from germination to maturity in both fiber seed crops (De, 2013). Seed is a vital source of primary inoculum, then infect through soil. Of the seed borne fungal diseases of jute, black band and stem rot caused by *Botryodiplodia theobromae* and *Macrophomina phaseolina*, respectively are commonly transmitted through seeds. In field condition, seed borne pathogens often make diseases on the plants. Subsequently, the pods or capsules are frequently affected which results unhealthy or infected seed production (Lecomte et al., 2016; Ali et al., 2015). Jute is affected by ten seed borne diseases. Black band, Stem rot, wilt and foot rot are responsible for spreading of the diseases to standing crops, seedling infections, damping off and seed rot which make degradation in the excellence of fiber (Rathod and Pawar, 2012) and cause extensive yield loss (Sarker and Sultana, 2017). Sharp decline of germination percentage is occurred with the increase of seed moisture content (Haque et al., 2016). Improvement of quality and increasing of yield is possible through appropriate practices of disease management (Sardrood and Goltapeh, 2018). The association of pathogens in seeds and moisture percentage of seeds might be affect the germination percentage. The primary objective of this study is to find out the co-relation between germination (%) and total number of pathogens association on Tossa jute seeds. Co-relation between germination (%) and moisture percentage of seeds will also be found out.

MATERIALS AND METHODS

The experiment was carried out in the Plant Pathology Lab, Bangladesh Jute Research Institute (BJRI).

Collection of jute seed samples

A total of 32 Tossa seed samples (*Corchorus olitorious*) were collected from four (4) selected district of Bangladesh (Kishoregonj, Rangpur, Cumilla, Manikgonj). Approximately 250 g seeds were collected for each and every sample. Seeds samples were kept in poly bags and stored at 5-7°C.

Varieties used in the study

- (i) V₁= O-4
- (ii) V₂= O-9897
- (iii) V₃= BJRI Tossa Pat 3 (OM-1)
- (iv) V₄= BJRI Tossa Pat 4 (O-72)
- (v) V₅= BJRI Tossa Pat 5 (O-795)
- (vi) V₆= BJRI Tossa Pat 6 (O-3820)
- (vii) V₇= JRO-524
- (viii) V₈= BJRI Tossa Pat 8 (Robi -1)

Germination test

For each variety, 400 Tossa jute seeds were selected randomly from the properly mixed seed sample (ISTA, 2017). The working seed samples (each having 400 seeds) were allocated into four (4) replications and consequently one replication contained 100 seeds. Again, 100 jute seeds were divided into four sub-replications and each sub-replication contained 25 jute seeds. It was ensured that each and every seed had enough space in Petri dish so that germination might not be hampered. Soaked in water, the filter papers were positioned at the bottom of plastic petridishes (having 9 cm diameter), afterward 25 seeds were positioned on the surface of the top filter paper. The seeds were germinated on the surface of top layer filter paper. Three layers of Whatman No-1 had been used at each Petri dish. 16 replicate petridishes were made by using 400 seeds (16 x 25=400). By compactly fixing the covers of the petri-dishes, evaporation losses of water were lessened. Inside into the incubator, the petridishes were sited maintaining 30°C temperature for 5 days (Islam et al., 2015). After incubation Seeds having radical and plumule that were calculated as germinated jute seeds. The results were articulated as percentage (%).

Seed moisture content

Seed moisture content was measured using high constant temp. oven dry method by following ISTA rules (2003). About 7-8 g of jute seeds were placed in aluminium dish and dried in oven at 130°C for 2 hours (until constant weight attained). Then the seed sample was cooled in a desecrator and weighed. After that, the moisture content was calculated using the following formula:

$$\text{Moisture content (\%)} = \frac{w_1 - w}{w_1 - w_2} \times 100$$

Here,

W_1 = Weight of seed plus aluminum dish with lid (before drying)

W = Weight of blank aluminum dish with lid

W_2 = Weight of seed plus aluminum dish with lid (after drying)

Identification of seed-borne fungi associated with jute seeds

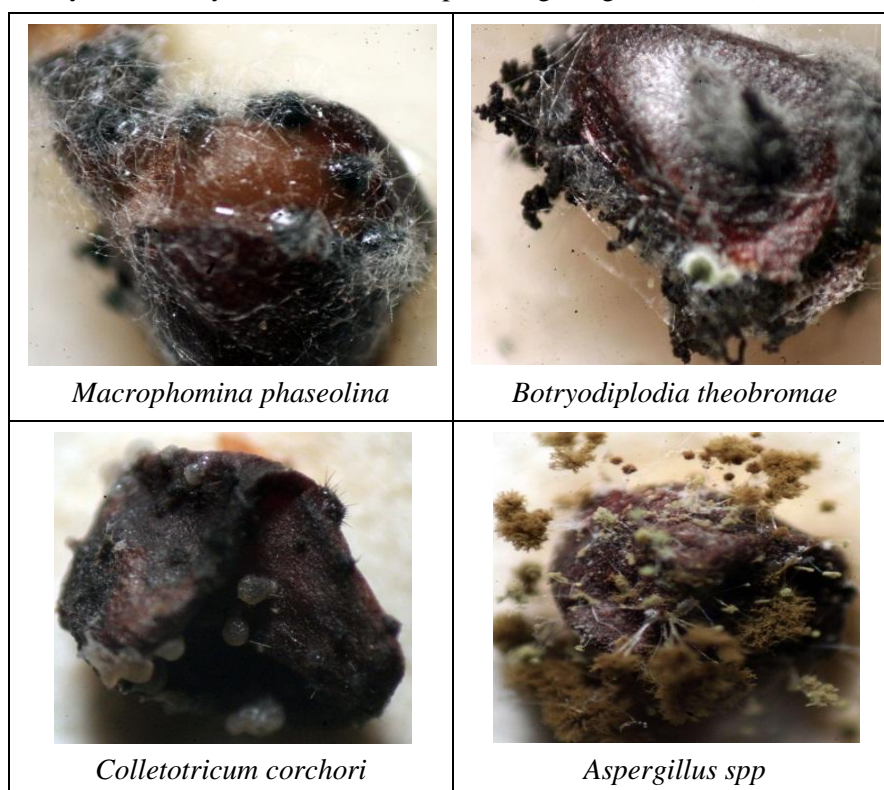
After 7 days of incubation of Tossa jute seeds on wet blot based on earlier reports (Mathur and Kongsdal, 2003; Ellis, 1993). All the Tossa jute seed samples were tested for the incidence of fungal pathogens imitates by the Blotter Paper Method following the International Rules for Seed Testing Association ISTA (2017).

Analysis of data

The experiment was carried out ensuing the Completely Randomized Design (CRD). Analysis of variance was evaluated and the mean differences were arbitrated by Duncan's Multiple Range Test (DMRT) following statistical procedure for agricultural research (Gomez and Gomez, 1984). Relationships between germinations of seeds and seed borne fungal pathogens were calculated by regression lines and equations.

RESULTS AND DISCUSSION

In this experiment, the association of seed borne pathogenic fungi in the Tossa jute seeds was analyzed and studied. The relationship between germination (%) of Tossa seeds and total number of pathogens on seeds, relationship between moisture (%) and germination (%) of Tossa seeds, and relationship between moisture (%) and total number of pathogens at Tossa jute seeds were determined. It was observed that the Tossa jute seeds are recurrently infected/affected by seed borne fungi. *Botryodiplodia theobromae* and *Macrophomina phaseolina* are transmitted from seed to plant to seed (Fakir et al., 1993). High humidity and rainfall at flowering stage is suitable for the seed-borne fungal infection in jute (Ghosh, 1999). The weather of Bangladesh is highly favorable for the outburst of fungi (Al-Mamun et al., 2016). Seed borne fungi is one of the major factors for lessening yield of jute crop. So, the inhibition of seed borne fungi bears extensive importance. From the study, it was observed the lowest pathogen infection (31.25 pathogens/100 seed) in BJRI Tossa Pat 5; leading to higher percentage of germination. BJRI Tossa Pat 4 (O-72) was found to be suitable for containing pathogens over its seed coat (121.25 pathogens/100 seed). BJRI Tossa Pat 5 (O-795) and BJRI Tossa Pat 6 (O-3820) provided almost similar type of germination percentage: 93.5 and 93.25%, respectively. O-4 variety showed minimum percentage of germination (83.25%).



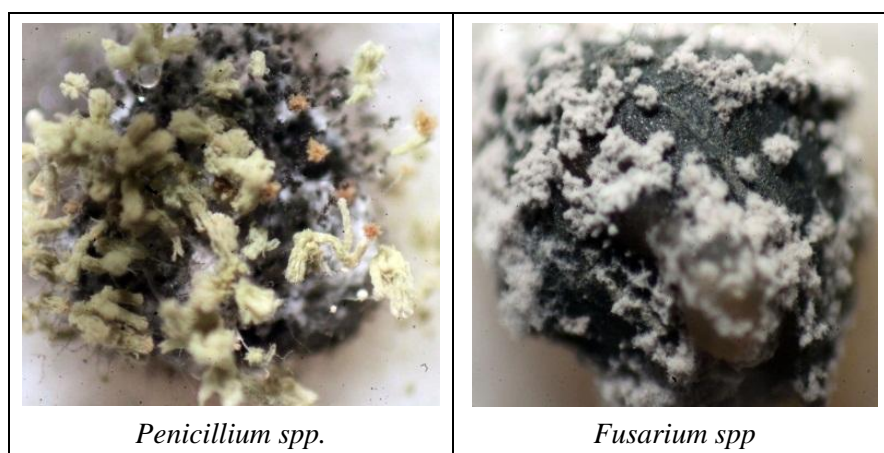


Plate 1. Growth of different types of seed borne fungal pathogens on jute seed under stereo- microscope (X 250)

Table 1. Germination percentages (%), pathogen association, moisture (%) in seed of tested Tossa jute varieties

Variety	Germination (%)	Total no. of pathogens	Moisture (%) in seed
V ₁	84 cd	104 ab	10.44c
V ₂	92.5 a-c	41.5 d	10.36c
V ₃	84.75 b-d	91.5 a-c	12.48a
V ₄	83.25 d	121.25 a	12.29ab
V ₅	93.5 a	31.25 d	10.34c
V ₆	93.25 ab	65.75 b-d	10.19c
V ₇	85 a-d	64 b-d	11.23a-c
V ₈	87.25 a-d	57 cd	10.8bc
SE	4.2	21.44	0.8038
CV (%)	6.76	42.1	10.32

Relationship between germination (%) of Tossa seeds and total number of pathogens detected

Less than 80% germination of jute seed was occurred due to seed borne fungi associated with seeds, adverse situation in storage, inappropriate processing and careless handling of seeds (Meena et al., 2014; Lecomte et al., 2016). Fungal infection severely affected the germination of jute seed (Perello et al., 2013; Li et al., 2017; Chellappandian et al., 2018;). *Aspergillus spp.* were identified and frequently recorded in rotted/germinated jute seeds in wet blotter paper (Sheheli and Roy,

2014). Seed borne pathogen of jute e.g. *Fusarium oxysporum* causes germination failure/seed rot and seedling blight (Hossen et al., 2017). This is very similar to the result of present study. In figure 1, the relationship between total number of seed borne fungal pathogens and germination (%) of tested Tossa Jute varieties has been showed. Negative linear regression line has been observed between total number of seed borne fungal pathogens association and germination (%). Negative correlation was identified between total number of seed-borne fungal pathogens and germination (%) among tested Tossa varieties. Regressions co-efficient (β) was -0.82, which indicates that for every 1% increase of total fungal pathogens in Tossa jute varieties, there was corresponding decrease of 0.82% Tossa seed germination.

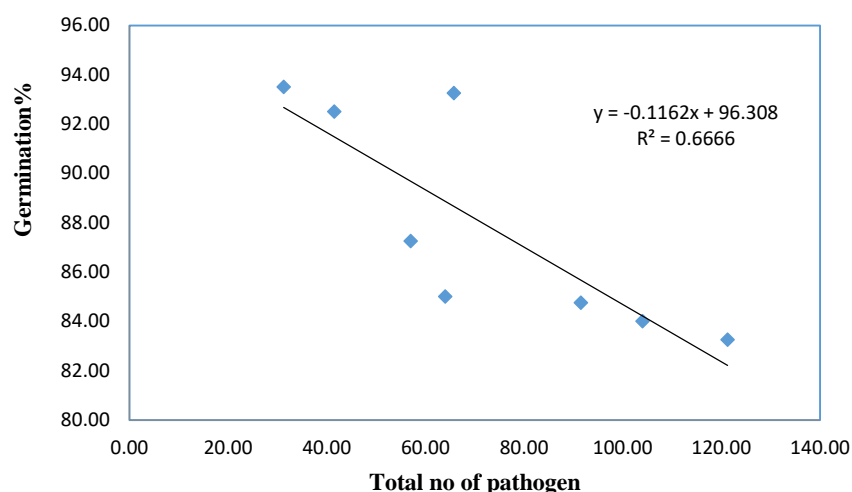


Figure 1. Relationship between total seed borne fungal pathogens association and germination (%) in Tossa Jute varieties

Relationship between moisture (%) and germination (%) of Tossa seeds

High humidity/rainfall at flowering stage is favorable for the seed-borne fungal infection (e.g. *Macrophomina phaseolina*) these made difficulties in jute seed production (Ghosh, 1999). In case of jute seed production, pod is affected by *Macrophomina phasolina* fungi which invade the inner part of the pod later and seed infection is caused (Sarkar et al., 2013). Moisture content (9.5%) is recommended for good quality of jute seeds (Haque et al., 2016). *Macrophomina phaseolina* can infect at any stage of growth of jute from germination to harvesting (Roy et al., 2008) and 10% yield loss was observed on an average. In case of severe infection *Macmhomina phaseolina*, 5-40% yield may be lessened in humid and hot weather (Mandal, 1990). In figure 2, relationship between moisture (%) and germination (%) of Tossa jute seeds has been presented. Between moisture (%) and germination (%),

negative correlations was found. Regression co-efficient (β) was (-)0.71 in regression equations between moisture (%) and germination (%) of Tossa seeds. This means for every 1% increase of moisture (%), there were corresponding decreases of 0.71% germination in Tossa jute seeds respectively.

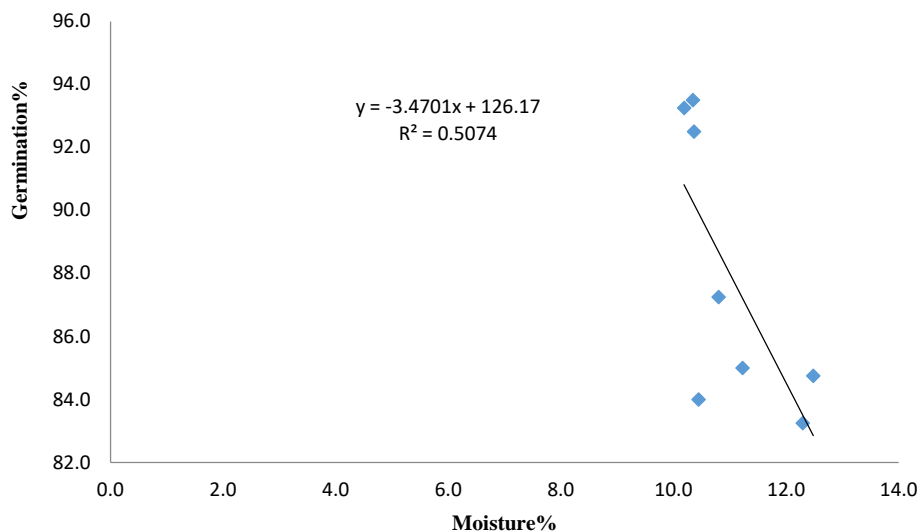


Figure 2. Relationship between moisture (%) and germination (%) of Tossa jute seeds

Relationship between moisture (%) and total number of pathogens at Tossa jute seeds

Macrophomina phaseolina, *Botryodiplodia theobromae*, *Fusarium oxysporum* and *Colletotricum corchori* have been found in the seed samples of Tossa jute and all these fungi at different stages of their maturation and development were reported to be seed borne in Tossa jute (Agarwal and Singh, 1974; Akanda and Fakir, 1985; Fakir et al., 1991;). To find out the amount of damage in jute fibre crop by every of these fungi independently, advanced research on field trial of this Tossa jute seeds is required. In figure 3, Relationship between moisture (%) and total number of pathogens at Tossa jute seeds has been presented. Between moisture (%) and total number of pathogens, positive correlations was found. Regression co-efficient (β) was 0.65 in regression equations between moisture (%) and total number of pathogens at Tossa seeds. This means for every 1% increase of moisture (%), there were corresponding increases of 0.65% total number of pathogens in Tossa jute seeds.

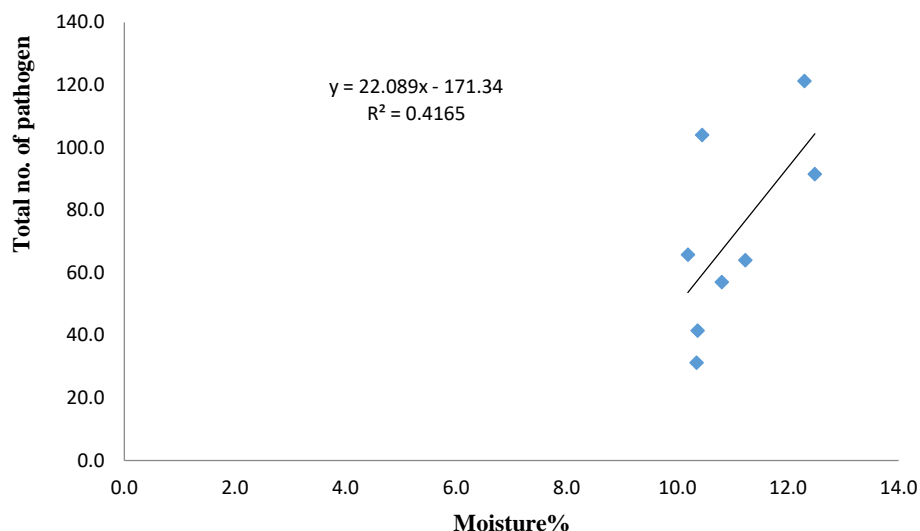


Figure 3. Relationship between moisture (%) and total number of pathogens at Tossa jute varieties

CONCLUSION

Germination (%) and total number of pathogens association on Tossa jute seeds was negatively co-related. The jute variety namely. BJRI Tossa pat 4 (O-72) was evident with the lowest germination rate and maximum fungal presence on seed. BJRI Tossa pat 5 (O-795) was evident with the highest germination rate and the lowest fungal association.

ACKNOWLEDGMENT

Authors are grateful to Plant Pathology Department, Bangladesh Jute Research Institute, Dhaka for laboratory analysis.

REFERENCES

- Agarwal, V.K. and Singh, O.V. (1974). Seed borne fungi of jute and their control. *Indian Phytopathology*, 27(4): 651-652.
- Ahmed, K.M. and Reddy, R.C. (1993). A pictorial guide to the identification of seed borne fungi of Sorghum, Pearl millet, Finger millet, Chick pea, Pigeon pea and Ground nut. Information Bull. No. 34, ICRISAT, Hyderabad, India.
- Akanda, M.A.M. and Fakir, G.A. (1985). Prevalence of major seed-borne pathogens of jute. *Bangladesh Journal of Plant Pathology*, 1(1): 76.

- Ali, M.A., Islam, M.S., Sarker, M.N.I. and Bari, M.A. (2015). Study on biology of red pumpkin beetle in sweet gourd plants. *International Journal of Applied Research Journal*, 2: 1-4.
- Al-Mamun, M., Shamsi, S. and Bashir, M.A. (2016). Estimation of interrelationships among some quality factors of jute seeds. *Dhaka university Journal of Biological Sciences*, 25(1): 9-17.
- Anonymous, (2018). The Editors of Encyclopaedia Britannica. Tossa jute. Encyclopædia Britannica. <https://doi.org/10.1093/ww/9780199540884.013.u172122>.
- Chellappandian, M., Vasantha-Srinivasan, P., Senthil-Nathan, S., Karthi, S., Thanigaivel, A., Ponsankar, A. and Hunter, W.B. (2018). Botanical essential oils and uses as mosquitocides and repellents against Dengue. *Environment International*, 113: 214-230.
- De, R.K. (2013). Effect of date of sowing on the incidence of stem rot of jute (*Corchorus olitorius* L.) caused by *Macrophomina phaseolina*. *Journal of Mycopathological Research*, 51(2): 251-257.
- Ellis, M.B. (1993). Demataceous hyphomycetes. CAB, International Wallingford Oxen. 0X10BDE UK. Pp. 95-98.
- Fakir, G.A., Sarder, M.A., Gaffer, A. and Ahmad, M.U. (1991). An annotated list of important disorders of important crop plants of Bangladesh. Plant Quarantine Review Prog. Sponsored by Ministry of Agriculture in Co-ordination with CIDA and DANIDA.
- Fakir, G.A., Islam, M.R. and Islam, F. (1993). Transmission of three major seed-borne fungal pathogens from seed to plant to seed in jute (*Corchorus capsularis* L.). Proceedings of 5th Biennial Conference of Bangladesh Phytopathological Society. Pp. 87.
- Ghosh, T. (199). Cooperation but with caution. In: Jute and allied fibres – Agriculture and processing (Editors: P. Palit, S. Pathak and D.P. Singh). Central Research Institute for Jute and Allied Fibres (CRIJAF). Key note address: xi-xiv.
- Gomez, K.A. and Gomez, A.A. (1984). Statistical procedure of agricultural research. International Rice Research Institute, Manila, Philippines.
- Haque, S. M.A., Hossain, I. and Khokon, M.A.R. (2016). Effect of storage condition on seed quality and health in jute O-9897. *American Journal of Agricultural Research*, 1(4): 1-31.
- Hossain, M.M. and Abdulla, F. (2015). Jute Production in Bangladesh: A Time Series Analysis. *Journal of Mathematics and Statistics*, 11: 93-98.
- Hossen, M.T., Sohag, M.A.S. and Monjil, M.S. (2017). Comparative efficacy of garlic, BAU-Biofungicide, Bavistin and Tilt on seed borne fungal flora in chilli. *Bangladesh Journal of Agricultural University*, 15: 41-46.
- Islam, M.S., Ali, M.A. and Sarker, M.N.I. (2015). Efficacy of medicinal plants against seed borne fungi of wheat seeds. *International Journal of Natural and Social Sciences*, 2: 48-52.
- ISTA. (2003). International Rules for Seed Testing, (2003). Zurich, Switzerland, ISTA.

- ISTA. (2017). Rules proposals for the international rules for seed testing. International Seed Testing Association (ISTA), Bassersdorf. <https://doi.org/10.15258/istarules.2015.f>
- Lecomte, C., Alabouvette, C., Edel-Hermann, V., Robert, F. and Steinberg, C. (2016). Biological Control of Ornamental Plant Diseases Caused by *Fusarium oxysporum*: A Review. *Biological Control*, 101: 17-30.
- Li, X.Z., Song, M.L., Yao, X., Chai, Q., Simpson, W.R., Li, C.J. and Nan, Z.B. (2017). The effect of seed-borne fungi and *Epichloe* endophyte on seed germination and biomass of *Elymus sibiricus*. *Frontiers in Microbiology*, 8: 1-8.
- Mandal, R.K. (1990). Jute diseases and their control. In: *Proceedings of National Workshop cum Training on Jute, Mesta, Sunn hemp and Ramie*. Central Research Institute for Jute and Allied Fibres, Barrackpore, West Bengal, India. <https://doi.org/10.18311/jbc/2019/22708>.
- Mathur, S.B. and Kongsdal, O. (2003). Common laboratory seed health testing methods for detecting fungi. DGISP for developing countries, Thorvaldsanvej 57, DK-1871 Frederiksberg c, Copenhagen, Denmark.
- Meena, P.N., Roy, A., Gotyal, B.S., Mitra, S. and Satpathy, S. (2014). Eco-friendly management of major diseases in Jute (*Corchorus olitorius* L.). *Journal of Applied and Natural Science*, 6: 541-544.
- Perello, A., Gruhlke, M. and Slusarenko, A.J. (2013). Effect of garlic extract on seed germination, seedling health, and vigour of pathogen-infested wheat. *Journal of Plant Protection Research*, 53: 317-323.
- Rathod, L.R. and Pawar, P.V. (2012). Antimicrobial activity of medicinal plant to control seed borne pathogen of soybean. *Current Botany*, 3: 10-12.
- Roy, A., De, R.K. and Ghosh, S.K. (2008). Diseases of bast fibre crops and their management in jute and allied fibres In: Karmakar, P.G., Hazara, S.K., Subramanian T.R., Mandal, R.K., Sinha, M.K. and Sen, H.S (Eds.). *Updates Production Technology*, Central Research Institute for Jute and Allied Fibres, Barrackpore, West Bengal, India <https://doi.org/10.18311/jbc/2019/22708>.
- Sardrood, B.P. and Goltapeh, E.M. (2018). Effect of Agricultural Chemicals and Organic Amendments on Biological Control Fungi. In: *Sustainable Agriculture Reviews* (Editor: E. Lichtfouse). Vol. 12, Springer, Berlin. Pp. 217-359.
- Sarkar, S.K., Biswas, C., De, R.K. and Satpathy, S. (2013). Diseases of jute and their management. Bulletin No. 9/2013. Published by Central Institute for Jute and Allied Fibres, Barrackpore, West Bengal, India.
- Sarker, M.N.I. and Sultana, A. (2017). An investigation into the status of riverbank (Char) women dwellers in Bangladesh. *International Journal of Rural Development, Environment and Health Research*, 1: 86-92.
- Sarker, M.N.I., Barman, S.C., Islam, M. and Islam, R. (2017). Role of lemon (*Citrus Limon*) production on livelihoods of rural people in Bangladesh. *Journal of Agricultural Economics and Rural Development*, 2: 167-175.
- Sheheli, S. and Roy, B. (2014). Constraints and opportunities of raw jute production: A household level analysis in Bangladesh. *Progressive Agriculture*, 25: 38-46.