YIELD AND QUALITY OF JUTE SEED AS INFLUENCED BY VARIETY AND SOWING DATE AT LATE SOWN CONDITION

IKRA HAQUE SHAMMI

INSTITUTE OF SEED TECHNOLOGY

SHER-E-BANGLA AGRICULTURAL UNIVERSITY

DHAKA-1207

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By

IKRA HAQUE SHAMMI
REGISTRATION NO: 14-05972

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Approved by:

_____	_____
Prof. Dr. A. K. M. Ruhul Amin	**Prof. Dr. Md. Abdullahil Baque**
Department of Agronomy	Department of Agronomy
SAU, Dhaka	SAU, Dhaka
Supervisor	**Co-Supervisor**

_____
Prof. Dr. Md. Ismail Hossain
Chairman
Examination Committee
&
Director
Institute of Seed Technology

INSTITUTE OF SEED TECHNOLOGY

Sher-e-Bangla Agricultural University

Sher-e-Bangla Nagar, Dhaka-1207

Phone: 9134789

CERTIFICATE

*This is to certify that the thesis entitled "**YIELD AND QUALITY OF JUTE SEED AS INFLUENCED BY VARIETY AND SOWING DATE AT LATE SOWN CONDITION**" submitted to the **Institute of Seed Technology**, Sher-E-Bangla Agricultural University, Dhaka, in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (MS)** in **Seed Technology**, embodies the results of a piece of bona fide research work carried out by **IKRA HAQUE SHAMMI**, REGISTRATION NO. **14-05972** under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.*

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

Dated: June, 2021

Place: Dhaka, Bangladesh

_____

Prof. Dr. A. K. M. Ruhul Amin
Department of Agronomy
Sher-e-Bangla Agricultural University, Dhaka-1207
Supervisor

DEDICATED TO MY BELOVED PARENTS WHO FIRST ENCOURAGED MY INTEREST IN THIS KIND OF THING

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The author

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LIST OF ACRONYMS

Full word	Abbribiation
Agro-Ecological Zone----------	AEZ
Percent ----------	%
Degree Celsius ----------	^{0}C
Bangladesh Jute Research Institute ----------	BJRI
Centimeter ----------	cm
Percentage of co-efficient of variance ----------	CV%
Cultivar ----------	cv.
Days after sowing ----------	DAS
And others ----------	et al.
Gypsum ----------	G
Gram (g) ----------	G
Per hectare ----------	ha-1
Hour ----------	Hr
Kilogram ----------	kg
Least Significant Difference ----------	LSD
Maximum ----------	Max
Milligram ----------	mg
Minimum ----------	Min
Millimeter ----------	mm
Muriate of Potash ----------	MP
Number ----------	No.
Nitrogen, Phosphorus and Potassium ----------	NPK
Non-significant ----------	NS
Sher-e-Bangla Agricultural University ----------	SAU
Ton ----------	T
Triple Super Phosphate ----------	TSP
Videlicet (namely) ----------	viz
Weight ----------	Wt.

YIELD AND QUALITY OF JUTE SEED AS INFLUENCED BY VARIETY AND SOWING DATE AT LATE SOWN CONDITION

ABSTRACT

The research work was conducted in the net house of the department of agronomy, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka during the period from July, 2019 to December, 2019 to study the yield and quality of jute seed as influenced by variety and sowing date at late sown condition. The two-factor experiment was laid out in the Randomized Complete Block Design RCBD (factorial) with three replications. Two factors viz. Factor A, four jute varieties; V_1 = BJRI Tossa Pat-8, V_2 = BJRI Tossa Pat-6, V_3 = BJRI Tossa Pat-5 and V_4 =O-9897; and Factor B; four sowing dates S_1 = July 7, S_2 = July 21, S_3 = August 7 and S_4 = August 21 were considered for the experiment. The result revealed that variety V_3 (BJRI Tossa Pat-5) showed the highest seed yield (1303.94 kgha^{-1}) which might be attributed to the highest number of pods plant^{-1}(27.78), number of seeds pod^{-1}(176.48) and weight of seeds pod^{-1} (0.40g). This variety also produced the tallest plant (171.63cm) and maximum number of branches plant^{-1} (3.73). Among the different sowing dates, crop sown at 7 August (S_3) showed the maximum seed yield (1203.74 kgha^{-1}) which might perhaps the highest number of pods plant^{-1} (24.75), pod length (6.76 cm), pod diameter (5.80 mm), number of seeds pod^{-1} (175.96), weight of seeds pod^{-1} (0.39 g) and weight of 1000 seed (1.79 g) in this treatment. Interaction of V_3S_3 (Variety BJRI Tossa Pat-5 with sowing date August 7) gave the highest seed yield (1390.2 kgha^{-1}) along with the highest number of pods plant^{-1} (29.98), pod diameter (6.26 mm) and number of seeds pod^{-1} (186.26). Considering seed quality, the interaction V_3S_3 also showed the highest germination (97.66%), seedling length (4.97 cm), oven dry weight of seedling (51.59 mg) and lowest electrical conductivity (8.17 dSm^{-1}). Considering the above result, it may be concluded that variety V_3 1303.94 kgha^{-1} and sowing date S_3 1203.74 kgha^{-1} and its interaction V_3S_3 1390.2 kgha^{-1} seems promising of jute seed production in late sown condition.

CHAPTER I

INTRODUCTION

Jute (*Corchorus* spp.) is now universally recognized that jute is the English version of the current Bengali word „Pat", a kind of fiber which is obtained from two species (annual and short day plants) of the genus *Corchorus* belonging to the family Tiliaceae. It is a common term used both for plants and the fiber obtained from the bark of the plants, *Corchorus capsularis* L. and *Corchorus olitorius* L. The fiber looks white and golden, bright silky and shining. Jute covers about 2.86% of total cropped area and it accounts for 6% of the foreign currency earnings from exports (Islam, 2009). In the year 2010-2011, 8.40 million bales of jute were produced in the country from 1.75 million acres of land (BBS, 2011). Jute is also the second most common natural cellulosic fiber in the world (Liu *et al*., 2010). Almost 85% of the world's jute cultivation is concentrated in the Ganges delta of Bangladesh and India (Das *et al*., 2011) the production of jute and allied fibers for cordage and sacking is a well-established industry in Bangladesh and in many Asian countries. India, Bangladesh and Thailand account for 90% of the world jute production (IJO, 2012). Bangladesh is the largest supplier of jute and jute goods in the international markets meeting nearly 95% of world raw jute demand and about 60% of jute goods demand (Rahman, 2010). Now an attempt is being made to popularize the jute plants also for making pulp in paper industries (Dastageer *et al*., 2011).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 ranks second in respect of production (Islam and Rahman, 2008). Bangladesh requires about 6000 tons of jute seed. Among this quantity Bangladesh produces a whole amount of *Corchorus capsularis* L. (white jute) seed but only very little amount of *Corchorus olitorius* L. (Tossa jute) seed. Bangladesh annually requires about 4000 metric tons of jute seed during the sowing period in which 2000 tons are Tossa seed (BJRI, 2004). Bangladesh requires 4000-4500 MT of jute seed annually where production in Bangladesh Agricultural Development Corporation (BADC) is only 800- 1000 MT. The farmers produce 400-600 MT. Rest of the demand is met up by importing from India (Pulok *et al*., 2014). A small portion of the required Tossa seed is produced in Bangladesh. Now jute fiber produced from 0.461 million hectares of land which covered 2.86 percent of total cropped area and produced 0.912 million tons of fiber (BBS, 2007). Jute is grown mainly in Bangladesh for fiber rather than for seed. Among the various factors related to good

production, seed quality plays the pivotal role. BJRI released an improved variety of high yielding and better quality fiber of C. *olitorius* L. In Jute, use of quality seeds of improved variety alone contributes 223.54 kg of extra fiber per hectare i.e. an increase of about 17 percent in fibe (Talukdar and Rahman, 1989). Conventional method of seed production successfully replaced by off or late season jute seed production technology. It is a rapid growing renewable biomass and photo-reactive crop with only 120 days harvesting period (Dempsey, 1975).

Global awareness on 'save the environment' increases the demand for jute. Jute and jute products not only retard ecological degradation but also conserve green environment and atmosphere as a whole (Ghosh *et al*., 2013, Mamun *et al*., 2017). Thus, jute is a crop having a lot of positive benefits in the establishment of a green economy, soil health and environment. The climate and soil of our country is highly congenial for jute cultivation. Presently, the area under jute and kenaf cultivation is about 8.0 - 8.2 lakh hectare with production 85-90 lakh bales. Of the jute cultivated area about 85% Tossa jute, 8% white jute and 7% is of kenaf (Saha, 2011). Quality jute seed of improved variety itself provides about 20% additional yield although there is an acute shortage of quality seed in every year (Hossain *et al*., 1994). Bangladesh requires about 5500-6000 tons of jute and kenaf seeds every year, of which only 10 - 15% is produced and distributed by the BADC (Ali *et al*., 2003). BADC is the only public sector of the country which produces and distributes jute and very few kenaf seeds to the growers in the late season for seed production of BJRI Tossa Pat 5 at different locations of Bangladesh.

For successful jute production, quality seeds are a prerequisite. Normal sowing time of *olitorius* jute is in the month of Last March-April for fibre production and August-September is the sowing time for seed production of *olitorius* jute but seed production during August-December-January known as late season jute seed production technique (Mollah *et al*., 2017). Conventional method of seed production successfully replaced by off or late season jute seed production technology. As a result, seed crops remain standing in the field for a short period of about four months instead of seven to eight months during the regular season. This technique is adopted to increase seed yield by checking vegetative growth of fiber plants (Chowdhury and Ali, 1962). Unfortunately the availability of good quality jute seed in our country is far below the total requirement. Farmers of the country often have to depend on market seed having poor quality. Hence, the production and quality of healthy jute seed as well as its quality storage is highly essential to ensure the higher yield of quality fiber in order to meet the challenging need for natural fiber. The farmers produce 400-600 MT. Nevertheless, the country has to largely rely on the farmers' seed and it faces acute scarcity of quality jute seed every year. During the devastating flood of 1988 almost all of the jute

seed crops were damaged. To recover that cataclysmic effect, jute seeds were planted in the month of September where, O-9897 provided excellent results. Earlier evidence also offered favorable opinions that late planting techniques produce higher seed yield (Hossain *et al*., 1994 and Khan *et al*., 1997). Appropriate methods have been developed to produce jute seeds. Therefore, the present review has evaluated the methods, phenology and yield and of production of the off-season jute seed.

These seed crops due to long stay in the field are affected by hailstorm, diseases and insect pests thus produce lower yield of poor quality seeds. Farmers are also very reluctant to grow jute seed. So, the country has been facing an acute shortage of quality jute seed in every village. To overcome jute seed problems and to ensure supply of required quality seeds, Bangladesh Jute Research Institute has been advocating late or off season seed production for higher seed yield and economic return, which to be sown in the month of August and September and harvested in December and January (Hossain *et al*., 1994). In the jute production system, water management includes application of irrigation and draining out the excess water needed from the jute fields. Irrigation is the artificial application of water to the crop field for its proper growth (Rahman *et al*., 1992). Farmers will pay due attention to the research findings about which they have some experiences and seem to be more economical. Jute growers are habituated to follow the technology or practice which has been developed through experiences and tradition and they are reluctant to change their practices (Azad, 1984). Jute is the prime fiber crop in Bangladesh although its productivity is much low due to varied reasons. One of the key reasons is the use of poor quality seed. High quality jute seed can be produced by sowing the crop in optimum time. Sowing time is one of the important production components and sowing before or after optimum date produces lower yield with poor seed quality. Sowing time is specifically important for late sown jute as it is short day photoperiod sensitive. The critical photoperiod of *Corchorus olitorius* L. is 12.5 hours although it may vary over the genotypes and other environmental parameters prevailing during the whole growing season. Extreme late sowing, short photoperiod hastens flowering, reduces seed maturation period and provides adverse effect upon seed quality. Because of late sowing, temperature below 15^0 C usually causes flower bud injury, restricts its number and effects on pod formation (Hossain *et al*., 1999). Further, high temperature convergent hastens maturity of seeds; pods turn brown and dry quickly before seeds attain proper physiological maturity. These plants produced more unfilled seeds with smaller seed size and low germination percentage. At extreme early sowing, the anthesis period is prolonged (Talukder and Akanda, 1994), but there is every possibility to damage the seed crop by natural hazards during

the rainy season. Seed quality of jute further depends on the harvesting stage of the crop. Harvesting the crop at an early stage makes relative losses due to threshing and gives enormous unfilled seeds. Besides, mature seeds store better than the immature seeds. Harvesting at a late stage may result in increased weather damage and losses due to scattering of seeds. Further, prevalence of weather damage is frequent in early planted crop, still, persistent foggy weather affects late jute seed crop and often contains pathogens and deteriorates health status of seed (Islam *et al*., 2007). As sowing time regulates the appropriate sowing dates, the present study was undertaken to optimize sowing date for higher seed yield of different genotypes of jute in late sown condition. Chaudhuri and Ali (1963) further suggested that jute crops should be planted in June or later so that plants remain stunted in growth, induce early flowers and produce higher seed yield.

Jute is the eco-friendly and important fiber crop among the world. Throughout the life cycle of jute from cultivation to usage, disposal is friendly to the environment and produces no toxic materials (Sarkar 2008). On average, Jute, of about 1 hectare land, absorbs 15 ton CO_2 and 11 ton O_2 from the atmosphere during 100 days of its life. Optimum sowing time plays a very important role for higher yield and quality seed. Sometimes farmers are using improved technologies for higher yield and quality seed.

Therefore, keeping all the points in mind mentioned above, present review was undertaken to evaluate the yield and quality of jute seed as influenced by variety and sowing date at late sown condition with following objectives:

i. To know the varietal performance of producing quality seed in late sowing condition;
ii. To find out the appropriate date of sowing for higher yield and better quality of late season jute seed crop, and
iii. To investigate the interaction between variety and sowing date on seed yield and quality of *Corchorus olitorius* L. jute in late season sowing condition.

CHAPTER II

REVIEW OF LITERATURE

The quantity and quality of seeds produced can be maximized by sowing at periods of the year that favor the growth, development and yield performance of the plant. *Corchorus capsularis* L. and *Corchorus olitorius* L. Jute is a kind of fiber which is obtained from the two cultivated species of the genus *Corchorus* belonging to the family Tiliaceae.It plays an important role earning about 5-6% foreign exchange through exporting jute and jute goods. Normal sowing time of *olitorius* jute is in the month of April for fiber production and August-September is the sowing time for seed production of *olitorius* jute but seed production during August-December known as `late season jute seed production technique' Some of the important and informative works and research findings related to the sowing time and variety of jute done at home and abroad have been reviewed under the following headings:

2.1 Effect of different variety of jute on yield and quality components in late sowing seed production method

Islam *et al*. (2010) investigated the impact of the production season of jute seed, methods, techniques and related process for yield and their economical situation were selected as it was large concentration point in relation to production methods, yield and expenses in Bangladesh during the year 2009 at Agronomy Division, Bangladesh Jute Research Institute (BJRI), Dhaka. The study was used the direct seeding method. The result indicated that among three improved methods of seed production, stem/top cutting and the seedling transplanting methods were found complicated, labor intensive and much costly. On the other hand, direct seeding methods were easier and less costly. The average flowering days, pod maturation days and total field duration also varied significantly due to the planting dates in C. *olitorius* L. and C. *capsularis* L. Pest and diseases infestation found higher in traditional method for its long field duration. Lower infestation was observed in an improved method as this was practiced in dry and comparatively cool seasons. Net return as well as CRD was found to be higher in improved direct seeding method (1.86%), which was then followed by top/stem cutting (1.66%) and seedling transplanting method (1.41%). Therefore, it could be suggested that at farm level, the direct seeding method was better

as it was safer and appropriate for jute seed production in Bangladesh.

Alam and Haque (2019) conducted the study at four locations of Bangladesh (Manikgonj, Cumilla, Dinajpur and Joshore) to optimize sowing date for higher seed yield of jute in late sown condition during the year 2011-12 late jute seed growing season.The study was laid out in a randomized complete block design with three replications with three genotypes (O-72, O-3820 and Acc.4311) and three sowing dates (31 July, 15 August and 30 August).the findings showed that sowing of *olitorius* jute seed in the first fortnight of August is better for higher seed yield and stated that the genotypes, Acc.4311 was found superior in yield and other traits which can be incorporated into the genetic background of high quality genotypes in order to have good quality seeds and to limit seed deterioration which is very important under tropical climates.

Hossain *et al*. (2015) conducted an experiment at the Agronomy Division, Bangladesh Jute Research Institute, Dhaka, Bangladesh to determine the optimum sowing date of BJRI Tossa Pat 5 (O-795) for seed production at late season for the time period of 2010-2011 to 2012-2013 using RCBD design with three replications and the cultivar BJRI Tossa Pat 4 (O-72) was used as control with Five different sowing dates viz., 15 July, 30 July, 15 August, 30 August, and 15 September, were used as treatment. According to the study by date of sowing and variety differed significantly in all the locations studied. Also stated that BJRI Tossa Pat-5 produced the highest seed of 1045kgha^{-1} at Manikganj and 594.67kgha^{-1} at Dinajpur on 15 August sowing. On the other hand, seed yield of 973.33 kgha^{-1} was observed the highest in 30 July sowing at Monirampur location. The lowest seed yield and yield attributes were recorded sown on 15 September at all the locations.

The experiments were conducted by Haque *et al* (2015) in the Laboratory of Plant Pathology Department, Bangladesh Jute Research Institute (BJRI), Dhaka, Bangladesh during 15 January to 5 March 2010 to determine the status of farmers' seed management practices, seed quality and prevalence of seed borne pathogens in jute seeds. It was observed that 58% jute farmers' used O-9897 variety and two third of the farmers' used BADC seed and stored their seeds in earthen pot, gunny bag, tin pot, plastic pot, gunny bag lined with polythene, poly bag and cloth bag. Among five tiers, breeder seed showed best performance and farmers' and NGO's seeds showed the poorest performance in respect of moisture content, germination, vigor index, purity, 1000 seed weight and seed borne infection by fungal pathogens

Hossain *et al*. (1991) conducted a study to determine the effect of seedling transplantation of late sown jute crop on seed yield with four cultivars (CVL- 1, D- 154, O-4 and O-9897) in 1990 at Manikgonj, Rangpur, Faridpur, Comilla and Kishorgonj regional station of BJRI. Seedling were transplanted on September 1, 15 and 30 to the monsoon seed bed. The outcome indicates that the interaction effect between dates of transplanting and varieties of jute indicated that all the four varieties transplanted on September 1 and 15 produced higher seed yields. Variety O-9897 produced the highest seed yield (546 $kgha^{-1}$) over the other varieties.

A field experiment was conducted by Hossain *et al*. (1994) at Rangpur Station of BJRI with four varieties viz. CVL- 1, D-154, O-4 and O-9897 during 1992 to evaluate the feasibility of growing late jute seed crops through transplanting on three different transplanting dates. It also found that the variety O-9897 gave significantly the highest seed yield (630 $kgha^{-1}$) when the seedling was transplanted on 1st September.

A field experiment was conducted by Debnath *et al*. (2018) at Jute Research Regional Station, Faridpur at September, 2016 to January, 2017 with five varieties, viz O-9897, BJRI Tossa Pat 4 (O-72), BJRI Tossa Pat 5 (O-795), BJRI Tossa Pat 6 (O-3820) and JRO-524 to find out the seed production capacity and quality. The result revealed that the highest seed yield was obtained from O-9897 (557.56kg/ha) which were statistically identical with the seed yield of O-795, O-3820 and JRO-524 whereas O72 gave the lowest seed yield. Seed quality was highest at O-3820 with maximum normal seedlings percentage (79.67%) and minimum abnormal seedlings percentage (10.33%). Jute seed yield was significantly positively correlated with plant population. For highest amount of seed production O-9897 cultivation should be recommended and for best quality seed BJRI Tossa Pat 6 may be recommended to cultivate at Faridpur region.

Al-Mamun *et al*. (2017) examine this study at Hill Agricultural Research Station, Khagrachari (representing hilly areas), Agricultural Research Station, Satkhira and Jute Research Station, Patuakhali (representing saline areas) with seven varieties of jute and one variety of kenaf to find out the seed production potentiality in non-traditional areas. All varieties were sown in late July to mid-August in 2009 to 2011. At hilly station white jute varieties (BJRI Deshi Pat-6, CVL- 1 and BJRI Deshi Pat-5) performed better for seed production than Tossa jute and kenaf varieties. At saline station (both Satkhira and Patuakhali) kenaf variety HC-95 performed better for seed yield than white and Tossa jute varieties (O-9897, OM- 1, BJRI Tossa Pat-4 and BJRI Tossa Pat- 5). The kenaf variety (HC-95) produced the highest yield (0.86 ton/ha) in saline areas. Among the white jute varieties, BJRI Deshi Pat-5 gave the highest yield (0.66 ton/ha) and in case of Tossa

jute varieties, BJRI Tossa Pat-5 gave the highest seed yield (0.70 ton/ha).The study recommends that BJRI Deshi Pat-5 of white jute, BJRI Tossa Pat-5 and HC-95 of kenaf are considered as the best varieties for seed production in hilly and saline areas of Bangladesh, respectively.

Hossain and Wahab (1992) evaluated that improved seeds of C. *olitorius* under optimum management condition produced 32% higher yields respectively compared to local seeds under farmer's management conditions.

Joseph *et al*. (1984) carried out an investigation aimed to study the influences of field trials at Barrackpore, West Bengal with C. *capsularis* cv. JRC 212 and C. *olitorius* cv. JRO 632 and reported that, seed yield plant^{-1} was positively correlated with plant height, basal stem diameter, number of branches plant^{-1}, seed weight and pod number which made the greatest contribution to the yield.

A field experiment was conducted by Rahman *et al*. (1992) at Faridpur and Kishorgonj with O-9897 jute cultivar at four cultivars at four sowing dates (August 15 & 30 and September 15 & 30). Result revealed that August 15 sowing produced significantly the highest seed yield and gradually decreased with delayed sowing from August 15.

A study was undertaken by Hossain (1999) to determine the research on varietal suitability for late planting technique on seed yield productivity with C. olitorious (var. O-4, O-9897 and chaitali), C. *capsularis*(var. D-154, CVL- 1 and CVE-3), Hibiscus sabdariffa (var. HS-24) and H. cannabinus(var. HC-2). It was concluded that, all the varieties of C. *capsularis* (var. D-154, CVL-1 and CVE-3), C. *olitorius* (var. O-4, O-9897 and Chaitali) and H. cannabinus (var.HC-2) can be sown as a late season seed crop. But, H. sabdariffa (var. HS-24) should be grown as conventional practices for seed production.

Haque (1995) reported that Both C. *capsularis* and C. *olitorius* varieties show the varietal suitability on seed production under late planting technique. The author indicated that there were significant variations in seed yield among different varieties of jute sown as late seed crops. Among C. *olitorius* cv. O-9897, O-4 and Chaitali produced 1044, 891 and 811 kg seeds ha^{-1} respectively. Among C. *capsularis* varieties CVE-3 showed the highest seed yield potential (509kg^{-1}) followed by D-154 (473kg^{-1}) and CVL- 1 (416 kgha^{-1}). Although, differences in seed yield among C.*capsularis* varieties were statistically significant, all the studied varieties of C. *capsularis* gave significantly lower seed yield than those of C. *olitorius* varieties.

Sohel *et al*. (2002 and 2003) observed that jute seed obtained from top cutting method gave significantly higher percentage of germination and shoot length indicating its superiority over the conventional method. The variety O-9897 gave higher percentage of germination, speed of germination, root length and dry weight of root and shoot indicating its superiority attributes among the varieties. The interaction effect of the planting method and variety of different attributes differed significantly.

Islam *et al*. (2008) aimed to evaluate the influences of moisture content, germination, vigor, and coefficient of germination and their relationship of jute seeds collected from five different sources. Quality of jute seed was observed better in BJRI seeds followed by BADC than that of the other three seed sources. Higher initial moisture content subsequently reduced germination and vigor of farmers and market seeds. *Corchorus capsularis* L. seeds were bigger in size and had a higher seed weight than that of C. *olitorius* L. seeds. Moisture percent was higher in farmers and market seeds and lower in BJRI and BADC seeds. Germination percentages of both jute species have positive relationship with seed vigor. Seed vigor of both jute species have positive relationship with coefficient of germination.

2.2 Effect of sowing date on seed yield of *olitorius* jute in late season

A study was undertaken by Patra and Chowdhury *et al*. (2017) during the kharif season of two consecutive years 2014 and 2015 at West Bengal with the view to maximize the jute seed yield by manipulating certain non-monetary techniques like dates of sowing and topping associated with crop production. The study area belongs to humid and tropical climate characterized by a wet monsoon season (June to September) and a dry post monsoon season. The outcome can be concluded that higher jute seed yield can be obtained from the *capsularis* variety Bidhan pat-3 under rainfed condition in the red and laterite zone of West Bengal if the seeds are sown during the period of late June to mid-July along with topping at 45 DAS.

Agronomic research advances of jute crops in Bangladesh were stated for its large concentration points in relation to cultivation methods, climate and soil, cropping pattern etc. The high and medium high land where rain and flood water does not stand is suitable for Tossa jute cultivation. Jute requires a warm and humid climate with temperature. Rainfall ranges from 250mm to 270mm

for good growth and yield. Proper seed rate for plant population, growth and for maximum yield. Jute varieties are to be planted starting from 15 March, and will help incorporate Tossa jute into three crop patterns. To concern Hibiscus *cannabinus* L. varieties planting around 15 March to 30 April and H. *sabdarifa* L. varieties planting around 15 March to 15 May for optimum fiber yield. For seed production, the best time of seed sowing, in case of C. *capsularis* L. whole July and of C. *olitorious* L. within August 30, which give more seed yield (Islam and Ali *et al*. 2017).

Kumar *et al*. (2013) conducted a field experiment at the experimental farm of Crop Research Station, Bahraich to evaluate the effect of sowing time on the productivity of both *olitorius* and *capsularis* jute seed under a uniform fertilizer dose. The data recorded at fortnightly intervals after 15 days of germination till harvest (180 days after sowing). Among three dates of sowing, 12th June recorded the highest value of yield attributing characters for both the species of jute and the growth parameters decreased significantly with further delay in sowing time. Thus it may be concluded that in eastern terai region sowing of jute for seed production should be completed within 12th June and latest by the 24th June for both *capsularis* and *olitorius* varieties

Ali *et al*. (2004) noticed that sowing date had a small effect on different seed variety, but had a massive impact on seed vigor. Quality of Tossa jute seed obtained from different sowing dates was evaluated by using germination test, speed of germination, seedling evaluation test, electrical conductivity and accelerated aging test. The seeds obtained from 5th October sowing showed the lowest germination percentage in both the varieties. Seedling growth of the variety OM- 1 was better than that of O-9897 and 5th October sowing produced the lowest seedling dry weight in both the varieties. Electrical conductivity of seeds of O-9897 was higher than seeds of OM- 1. In O-9897, it varied from 254 to 322 µs cm-1 and in OM- 1 it varied from 250 to 306 µs cm^{-1}. In general, the aging rate of OM- 1 was faster than O-9897. Jute seeds produced from September sowing were much better than that of other sowings and took 6 days of aging to end their lives. Among the three dates of September sowing, jute seeds obtained from 15th September were superior in terms of germ inability of aged seeds.

A field experiment was conducted by Rahman *et al*. (2016) at Jute Seed Production and Research Station, Bangladesh Jute Research Institute, Nashipur, Dinajpur, Bangladesh during August 2011 to January 2014 to study the time of sowing and seed quality in late season on the variety O-72. Jute variety O-72 was planted on six different dates starting from 10 August at 10 days interval to investigate the quality seed production at an optimum sowing time. Results indicated that seed yield potentiality gradually declined due to delay in sowing after 20 August. The crop sown on 10

and 20 August produced higher as 702 kg and 720 kg quality seeds per hectare respectively which would be highly profitable. The seeds obtained from 25 August showed the highest (85%) germination and high vigority (67%).

Hossain *et al*. (1999) conducted experiment on sowing time of late jute seed crop varied in different agro-ecological zones of Bangladesh. They reported that late sowing jute seed crops should not be done beyond the first week of September at Rangpur, middle of September at Jessore and end of September at Faridpur. Manikganj. Kishoreganj region of Bangladesh.

Hossain (1999) did an experiment with jute seed crops that planted earlier (March -April) are affected by the traumatic events through drought, hailstorm, and water stagnation. flood, disease and insect-pest infestation: The author further stated that jute seed crop planted under exorbitant short photoperiod hasten seed maturity, pods color turn brown quickly and the pods also become dried within short field period duration before the seeds attain proper physiological maturity and the seed lot gives enormous unfilled seeds to provide lower 1000 seed weight and lower germination percentage.

Rahman *et at.* (1989) observed a germination test with jute seeds obtained from plants of three sources viz., normal season plant. Top cuttings plants (direct seedbed). The results indicated that the quality of seed obtained from off-season jute crop was as good as the seeds obtained from the jute crop sown at optimum time.

Mishra and Nayak (1997) carried out an experiment during rainy season (kharif) 1989 and 1990 to study the effect of sowing and row spacing with or without clipping on seed production of Jute with Cure/zorns capsular cv. JRC 7447 and Corc/wrus oluonus cv. JEW 524 and reported that JRC 7447 significantly out yielded JRO 524 in terms of seed production. Sowing in early April and early May produced significantly higher seed yield in 1989, where the seed yield increased significantly in late sowing during mid-June in 1990. No significant effect for spacing and clipping had on seed yield.

Talukder (1984) performed a study with different indigenous and exotic varieties of jute to evaluate (heir response at different dates of sowing. As expected, accession number 492 and 1421 showed less sensitivity to photoperiod. Ascension 1563 flowered early in all sowing. With few exceptions fruit maturation time was longer in March 15 and April 30 sowing in case of Core/wins capsu/aris. Seed yield was highest in March 30 sowing for *Corchorus capsularis* accession.

A study was designed by Hossain *et al*. 1992) to investigate that Jute plants were grown for seed production in the off-season during August to November in the year 1987. The plants became gradually shortened as the plantings were delayed from August to November. The higher number and longer branches having bigger sized capsules with effective seeds per plant could be obtained when plantings were done before October, especially in case of *Corchorus capsularis*. Very short sized plants showing early flowering with fewer and smaller branches possessing smaller and/or unfertile capsules were observed when plantings were done beyond early October. The results show that the jute plants could be sown safely up to the end of September for effective seed production in the off-season.

Hossain *et al*. (1994) demarcated the last time of sowing of late jute seed crop for different agro-climatic regions of Bangladesh. According to his works sowing of late jute seed crop should not be done beyond the 1st week of September at Rangpur, middle of September at Jessore, and end of September at Faridpur, Manikgonj and Chandina (Comilla) regions.

Khan and Islam (1993) carried out an experiment at Kishorergonj regional station of BJRI to find out the best time of sowing for late season seed crop of jute (var. O-9897). Results indicated that August 30 sowing produced the highest seed yield (1086 kg/ ha) followed by August 15 sowing (1033 kg/ha). The sowing of October 15 produced the lowest seed yield (400 kg / ha).

Begum *et al*. (1992) conducted an experiment with D-154, CVL- 1, O-9897 and OM- 1 jute varieties to study sowing seeds at the middle of each month. For D-154 and CVL- 1, highest seed yields were obtained during sowing from March to June. Seed germination was maintained above 80 percent from January to August. For O-9897 and OM- 1, seed yield was the highest during April to July as seed germination was maintained close to 100 percent during April to October sowing.

Hossain and Iqbal (1992) noticed that less photosensitive variety O-9897 produced a higher seed yield of 546 kg ha^{-1} than those of D-154, CVL- 1 and O-4 varieties when seedlings were transplanted in September. Seedlings survival percentage was higher in O-9897 which possibly played a vital role towards higher seed yield. They further stated that the crops transplanted on 1 and 15 September produced significantly higher seed yield than the crop of 30 September.

Hossain *et al*. (1990) reported that late season jute seed crop gave maximum seed yield when planted on 5 September at Kishoreganj (1259 kg/ha), 25 August at Faridpur (815 kg/ha) and Jessore (556 kg/ha) and at Rangpur station (889 kg/ha) on 15 August.

Hossain *et al*. (1986) carried out an experiment to find out the best seeding time together with the proper dose of fertilizer for optimum seed production at JAMES, Manikganj in 1986. There were 36 treatment combinations composed of two cultivars (DCM-3221 and 0-9897), two spacing (30 cm × 10 cm and 30 cm × 15 cm), three dates of sowing viz., 15 June, 15 July and 30 July and three doses of fertilizer viz., 44-6-18, 66-9-27 and 88-12-36 $kgha^{-1}$ N-P-K, respectively. It was observed that there were significant differences in the seed yield due to varieties and sowing dates. But the spacing and fertilizer doses did not show significant differences in seed yield. The cultivar 0-9897 gave higher seed yield when sown in late with closer spacing and with low dose of N-P-K.

From the review of literature, it is clear that available information showed that most of the work has been done to focus seed yield and yield attributes of jute seed. Quality of jute seed was evaluated only by germination test although there are many other techniques available for quality test. The present study, therefore, would help to understand the effect of sowing dates at late season on the yield and quality of jute seed.

CHAPTER III

MATERIALS AND METHODS

The pot experiment was conducted at the experimental field of Sher-e-Bangla Agricultural University (SAU), Dhaka-1207 to study the yield and quality of jute seed as influenced by variety and sowing date at late sown condition. The details of the materials and methods i.e. location of experimental site, soil and climate condition of the experimental plot, materials used, design of the experiment, data collection and procedure of data analysis those were used or followed in this experiment have been presented below under the following headings:

3.1 Experiment period

The experiment was conducted during the period from July, 2019 to November, 2019 in kharif 2 season.

3.2 Site description

The study was conducted at the central research field of Sher-e-Bangla Agricultural University, Dhaka, under the Agro-ecological zone of Madhupur Tract, AEZ-28. The location of the site is 23º74' N latitude and 90º35' E longitude with an elevation of 8.2 meter from sea level. The location of the experimental field was presented in Appendix I. The land topography was medium high and the soil texture was silty clay with pH 5.8. The morphological, physical and chemical characteristics of the experimental soil have been presented in Appendix-II.

3.3 Climatic condition

The geographical location of the experimental site was under the subtropical climate that is characterized by heavy rainfall, high temperature and relatively long day period during “Kharif- 1” and scarce rainfall, low humidity, low temperature and short-day period during “Rabi” season. This climate is also characterized by three distinct seasons, namely the monsoon extending from

May to October, the winter or dry season from November to February and pre-monsoon period or hot season from March to April (Edris *et al*., 1979). The meteorological data in respect of temperature, total rainfall (mm) and relative humidity for the entire experimental period have been shown in Appendix III.

3.4 Soil

The soil of the experimental area belongs to "The Madhupur Tract", AEZ – 28 Tejgaon (FAO, 1988). Topsoil was silty clay in texture, olive-gray with common fine to medium distinct dark yellowish- brown mottles. Soil pH was 5.6, has organic carbon 0.45% and 2.64 meq/100 g soil, respectively. The experimental area was flat having available irrigation and drainage systems and above flood level. The selected plot was medium high land. The characteristics of the soil under the experimental plot were analyzed in the Soil Testing laboratory, SRDI, Khamarbari and the details were presented in Appendix II.

3.5 Planting Materials

The seeds of different Tossa jute varieties like BJRI Tossa Pat-8, BJRI Tossa Pat-6, BJRI Tossa Pat-5 and O-9897 were collected from Bangladesh Jute Research Institute (BJRI), Dhaka.

3.6 Treatments of the experiment

This was a two factors experiment.They were-

Factor A – Variety (4)

1. V_1 = BJRI Tossa Pat-8
2. V_2 = O-3820 (BJRI Tossa Pat-6)
3. V_3 = O-795 (BJRI Tossa Pat-5)
4. V_4 = O-9897

Factor B – Sowing date (4)

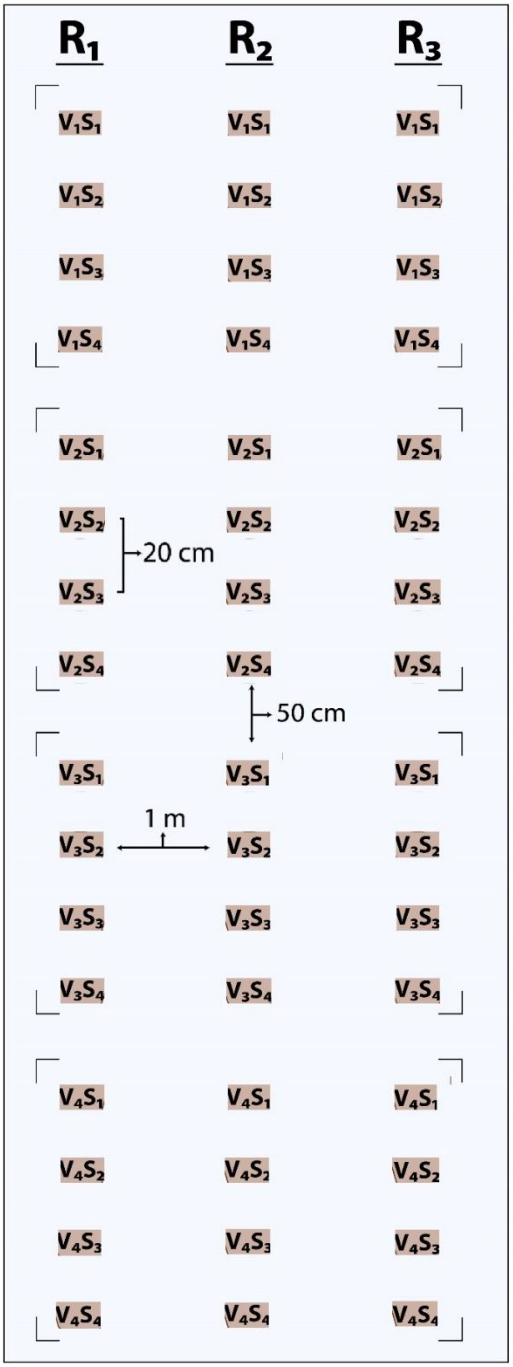
1. S_1 = Sowing at 7 July, 2019
2. S_2 = Sowing at 21 July, 2019.
3. S_3 = Sowing at 7August, 2019
4. S_4 = Sowing at 21 August, 2019

There were 16 (4×4) treatment combinations given below:

V_1S_1,V_1S_2,V_1S_3,V_1S_4,V_2S_1,V_2S_2,V_2S_3,V_2S_4,V_3S_1,V_3S_2, V_3S_3,V_3S_4, V_4S_1, V_4S_2, V_4S_3 and V_4S_4

3.7 Design and layout of the experiment

The two-factor experiment was laid out in the Randomized Complete Block Design RCBD (factorial) with three replications. The layout of the experiment is shown in Figure 1.



Layout

Pod to pod distance: 20 cm
Line to line distance: 1 m
Block to block distance: 50 cm
Experimental Design: RCBD

Treatment

Factor A - Varity (4)
V_1 : BJRI Tosha pat-8
V_2 : BJRI Tosha pat-6
V_3 : BJRI Tosha pat-5
V_4 : O-9897

Factor B - Sowing Date
S_1 : 7th July, 2019
S_2 : 21st July, 2019
S_3 : 7th August, 2019
S_4 : 21st August, 2019

Figure 1. Layout of the experimental field

3.8 Preparation of pot

Soil for pot preparation was collected from the experimental filed of Sher-e-Bangla Agricultural University farm. The collected soil was sun dried, crushed and sieved properly. The chemical fertilizer and cow dung were mixed properly before filling up of pot as per recommended dose. Each of the pot was filled up with 18 kg of soil. The size of the earthen pot was 22cm in diameter and 25 cm in height.

3.9 Fertilization

The rate of fertilizer for jute was 170, 85, 60, 85 and 28 kg ha^{-1} of urea, TSP, MOP, Gypsum and Zinc sulphate respectively. The rate of cow dung was 10 t ha^{-1}. All the chemical and organic fertilizer was applied as basal dose (during pot filling) except urea. Urea was applied in three equal split viz – $^1/_3$ at pot preparation, $^1/_3$ at days after sowing and rest $^1/_3$ at 45 days after sowing. Pot were fill up with soil one day before sowing.

3.10 Sowing of seeds

Seeds were sown in line on 7 July, 21 July, 7 August and 21 August 2019 in each pot as per treatment. Seeds were sown in lines continuously. There were two lines in each pot.

3.11 Intercultural operations

3.11.1 Irrigation and drainage system

Irrigations at the early stage of jute growth, seedling stage flowering stage and fruiting stage were provided. For germination of jute seed 18-20% soil moisture is required. Sometimes no irrigation was done because of the rainy season. Proper drainage system was also developed for draining out excess water.

3.11.2 Thinning

During plant growth period one thinning was done on 27 July, 11 August, 27 August and 10 September 2019, which was 20 days after sowing. Finally 10 plants were kept in each pot.

3.11.3 Weeding

Weeding's were done to keep the pots free from weeds which ultimately ensured better growth and development of jute seedlings. The newly emerged weeds were uprooted carefully.

3.11.4 Plant protection measures

During the entire growing period the crop was observed carefully to take protection measures. The crop was attacked by aphid and white mealy bugs. Malathion 57 EC was sprayed three times at the rate of 2 ml liter^{-1} at an interval of 15 days. Insecticides were sprayed on 25 August, 2019 and 20 September and 10 0ctober 2019 through the sowing lines.

3.11.5 Harvesting

The crop was harvested manually depending upon the maturity when 60-70% capsules/fruits of jute became brown in color. Data was taken between mid-November to mid-December. Five sample plants were collected from each pot for taking yield attributes data. For taking seed yield data, rest 5 plants were collected from each pot. The harvested crops were tied into bundles, properly tagged and carried to the threshing floor. The crop bundles were sun dried by spreading these on the threshing floor. The seeds were separated, cleaned and dried in the sun for 5 consecutive days for achieving safe moisture of seed.

3.12 Data collection

The data were recorded on the following parameters

a. Plant height (cm)
b. Fruiting branches plant^{-1}(no.)
c. Pod diameter (mm)
d. Pod length (cm)
e. Pods plant^{-1}(no.)
f. Seeds pod^{-1}(no.)
g. Weight of seed pod^{-1}(g)
h. Weight 1000 seed (g)

i. Seed yield (kg ha^{-1})

The pots wise sun-dried seeds were used for quality assessment. The seeds were set for standard germination test and the following data were taken----

a. Seedling length (cm)
b. Germination percentage
c. Oven dry weight of seedling (mg)
d. Electrical conductivity (dSm^{-1})

3.13 Procedure of recording data

It was done on the basis of following parameter-

3.13.1 Plant height

The height of five randomly collected plants from each pot was measured from ground level to the tip of the plant by a meter scale. The mean value was calculated as plant height.

3.13.2 Branches $plant^{-1}$

The number of primary branches $plant^{-1}$ was counted from five randomly sampled plants. It was done by counting the total number of branches of the five sampled plants then the average data were recorded.

3.13.3 Pod diameter (mm)

Ten pods from each pot were taken and the diameter was measured by using slide calipers. It was recorded in millimeters. The average value was calculated.

3.13.4 Pod length (cm)

Length of pod was measured by meter scale from ten pods and then average pod length was calculated in cm.

3.13.5 Pods plant^{-1}

Number of pods plant^{-1} was counted from the 5 selected plant samples and then the average pod number was calculated.

3.13.6 Seeds Pod^{-1}

Ten pods were selected from each pot and the seed numbers were counted carefully. The average number of seeds of 10 pods was calculated.

3.13.7 Weight of seed pod^{-1}

From each pot, 10 pods were selected and seeds were separated from the pods. The weight of the seed from 10 pods was measured by an electrical balance. The average value of the seeds of 10 pods was calculated to have seeds pods^{-1}. It was recorded in gram.

3.13.8 1000 seed weight

1000 seeds from each pot were counted and measured by an electrical balance. It was recorded in gram.

3.13.9 Seed yield (kgha^{-1})

Seed yield was measured from each pot. The weight was finally converted to kgha^{-1}

3.13.10 Seedling length

The length of five seedlings from each treatment was recorded at 10 DAS and the average value was calculated. Measurement was done using a meter scale and the unit was expressed in centimeters (cm).

3.13.11 Germination percentage

Seeds obtained from each treatment were placed in a petri dish which was full of sand. There were 25 seeds in each petri dish. The number of sprouted and germinated seeds was counted

daily commencing. Germination was recorded at 24 hours interval and continued up to 5th day. More than 2 mm long plumule and radicle was considered as germinated seed. The germination rate was calculated using the following formula (Islam, 2009):

$$\text{Rate of germination (\%)} = \frac{\text{Total number of germinated seeds}}{\text{Total seed placed for germination}} \times 100$$

3.13.12 Oven dry weight of seedling

Ten seedlings from each petri dish were collected randomly 10 days after sowing. Samples were put into envelope separately and placed in an oven maintained at 70∘C for 72 hours. The sample was then transferred into desiccators and allowed to cool down at room temperature. The average dry weight of the sample was taken and recorded in milligram (mg).

3.13.13 Electrical conductivity

Electrical conductivity test provides a quick decision about the seed quality. It is concern to deterioration process of seeds degradation of cell membranes and leakage out of the cells and also reduction of respiratory and biosynthetic activities (Delouche *et al*. 1973). The 2g seeds of each sample were taken in a conical flask containing 50ml deionized water and were incubated at 20∘C for 24 hours as per Ali *et al*. (2004) and Islam (2009). At the end of 24-hour soak period, water of the beaker containing seeds was decanted in order to separate the seeds. The electrical conductivity of the decanted water containing seed leachate was measured with EC meter (Model-CM-30 ET). It was recorded in dSm^{-1}

3.14 Statistical analysis

The recorded data on different parameters were statistically analyzed using MSTAT-C computer software program. The analysis of variance for the characters under study were performed by ‘F’ variance test. The differences between the pairs of treatment means were compared using least significant difference (LSD) test (Gomez and Gomez, 1984). The probability level used was 0.05 in all cases.

CHAPTER IV

RESULT AND DISCUSSION

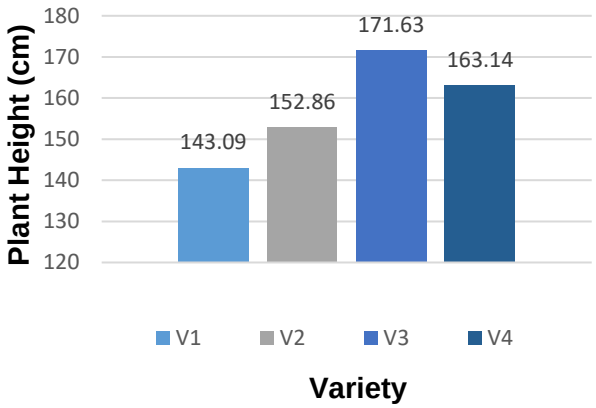
The experiment was conducted to study the yield and quality of jute seed as influenced by variety and sowing date at late sown condition. Data on phenological characters, yield attributes, yield and quality parameters of different jute varieties, their sowing date and their interaction were recorded. The results have been presented and discussed with the help of tables and graphs and possible interpretations given under the following headings:

4.1 Plant characters

4.1.1 Plant height

Effect of variety

Plant height is an important vegetative factor affecting seed yield and is a very essential parameter for plant growth and development. Plant height was significantly influenced by variety (Fig. 2). The tallest plant (171.63 cm) was recorded from the crops of V_3 (BJRI Tossa Pat-5) variety. The shortest plant (143.09 cm) was recorded from V_1 (BJRI Tossa Pat-8). Probably the genetic makeup of varieties was responsible for the variation in plant height. This result is in agreement with findings of Islam *et al*. (2010). They reported that variety had a significant influence on plant height.

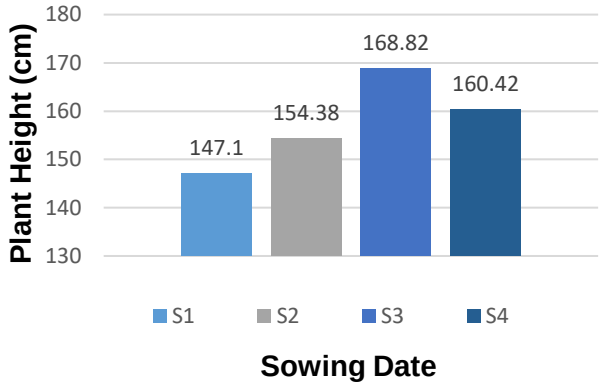


V_1=BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5), V_4 = O-9897

Figure 2. Effect of variety on plant height of jute seed crop in late sown condition ($LSD_{0.05}$ = 12.437)

Effect of sowing date

Sowing date exhibited a significant influence on plant height of jute in late sown condition (Figure 3). In case of sowing date, the tallest plant (168.82 cm) was found in S_3 treatment (August 7) whereas the shortest plant (147.10 cm) and (154.38 cm) were found in S_1 (July 7) and S_2 (July 21) treatment. S_4 (August 21) showed intermediate level. The plant height was increased gradually from July 21 through August 7 and later it was decreased in August 21.



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019, S_4: Sowing at 21 August 2019

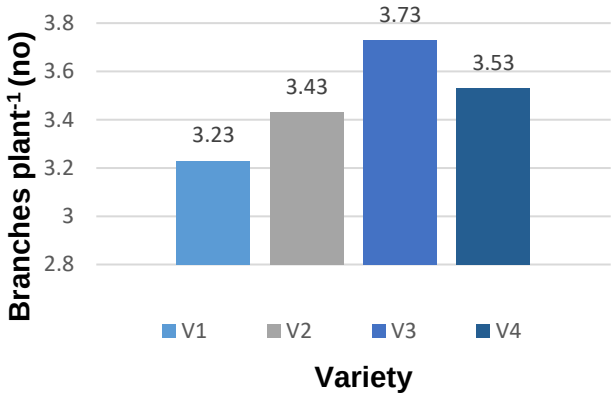
Figure 3. Effect of sowing date on plant height of jute seed crop in late sown condition ($LSD_{0.05}$ = 12.437)

Interaction effect of variety and sowing date

The significant variation was found due to interaction effect of variety and sowing date on plant height of jute at late sown condition (Table 1). The tallest plant (186.58cm) was found from a treatment combination of V_3S_3 which was statistically similar with the interactions of V_4S_3 (177.04 cm) and V_3S_4 (175.03 cm). The lowest plant height (135.24 cm) was found in V_1S_1 treatment which were statistically similar with V_1S_2 (140.92cm), V_1S_4 (145.38 cm) and V_2S_1 (142.81 cm)

4.1.2 Number of branches plant^{-1}

Effect of variety

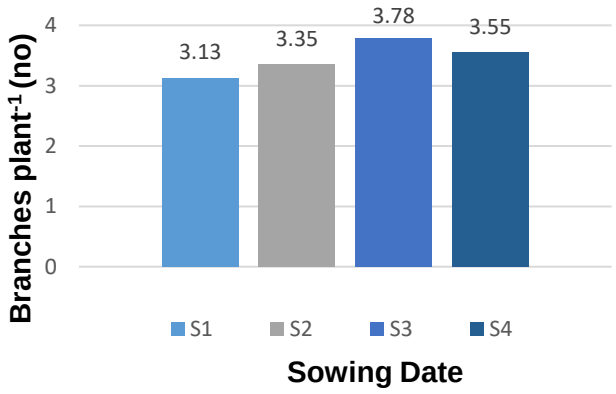


V_1=BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5), V_4 = O-9897

Figure 4. Effect of variety on number of branches plant^{-1} of jute seed crop in late sown condition ($LSD_{0.05}$ = 0.2573)

Different varieties of jute revealed a significant influence on the number of branches plant^{-1} at late sown condition. (Fig. 4). The maximum number of branches plant^{-1} (3.73)

was recorded from V_3 which was statistically similar with V_4 (3.53), whereas the minimum number of branches plant^{-1} (3.23) was found from V_1 treatment. Variations in number of branches plant^{-1} among the varieties may perhaps be the genetic characteristics of the varieties.



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019, S_4: Sowing at 21 August 2019

Figure 5. Effect of sowing date on number of branches plant^{-1} of jute seed crop in late sown condition ($LSD_{0.05}$ = 0.2573)

Effect of sowing date

There exhibited a significant difference among the sowing date in late sown condition of jute (Figure 5). Maximum number of branches plant^{-1} (3.78) was found in S_3 treatment which was statistically similar with S_4 treatment (3.55) and minimum number of branches plant^{-1} (3.13) was found in S_1 treatment.

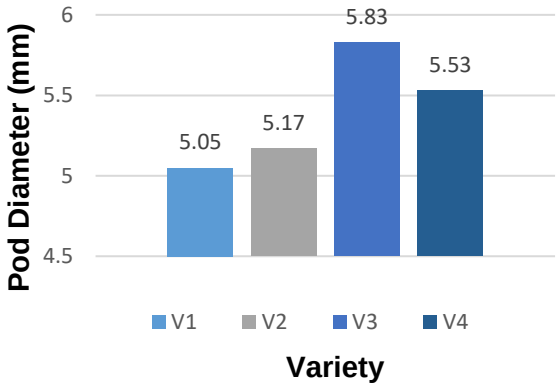
Interaction effect of variety and sowing date

Interaction effect of variety and sowing date demonstrated a significant influence at late sown condition of jute (Table 1). The highest number of branches plant^{-1} (4.1) was recorded from V_3S_3 treatment combination, while the minimum value (2.9) was recorded from V_1S_1 treatment. The lowest number of branches per plant also similar with V_1S_2 (3.10) and V_2S_1 (3.10).

4.1.3 Pod diameter

Effect of variety

Pod diameter is a crucial parameter and an important part of a crop plant because of its physiological role in photosynthetic activities. Pod diameter is directly related to the yield of jute variety. Effect of variety on pod diameter was found to be statistically significant at late sown condition (Fig. 6).



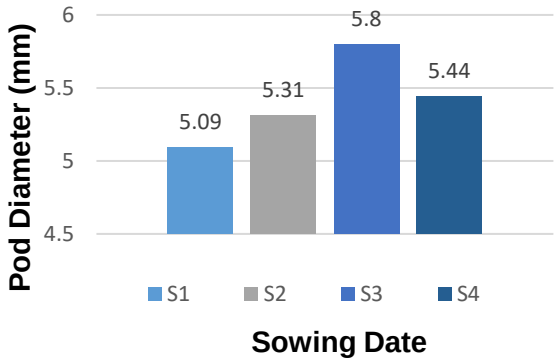
V_1=BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5) and V_4 = O-9897

Figure 6. Effect of variety on pod diameter of jute seed crop in late sown condition ($LSD_{0.05}$ = 0.1573)

However, the highest pod diameter (5.83 mm) was recorded from variety V_3 whereas the lowest (5.05mm) was found from variety V_1.

Effect of sowing date

Effect of sowing date on pod diameter was observed statistically significant at late sown condition (Fig. 7). The highest pod diameter (5.80 mm) was recorded from S_3 treatment, while the lowest pod diameter (5.09 mm) was measured from S_1 treatment, which was also statistically similar with S_2 (5.31mm) treatment.



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019 and S_4: Sowing at 21 August 2019

Figure 7. Effect of sowing date on pod diameter of jute seed crop in late sown condition ($LSD_{0.05}$ = 0.1573)

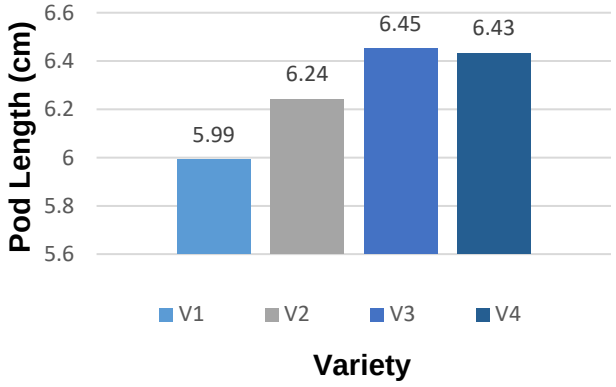
Interaction effect of variety and sowing date

Interaction effect of variety and sowing date had significant differences on pod diameter at late sown condition (Table 1). The result revealed that the maximum pod diameter (6.26 mm) was recorded from the V_3S_3 treatment combination. The lowest pod diameter (4.72 mm) was recorded from the V_1S_1 treatment combination which was statistically different from all other treatments. Greater pod diameter is very important as it determines seed size which regulates yield and quality of jute seed (AOSA, 1981)

4.1.4 Pod length

Effect of variety

Different jute varieties showed significant influence on pod length of jute at late sown condition (Figure 8). However, the highest pod length was found from V_3 (6.45cm) and that was lowest from V_1 (5.99cm).

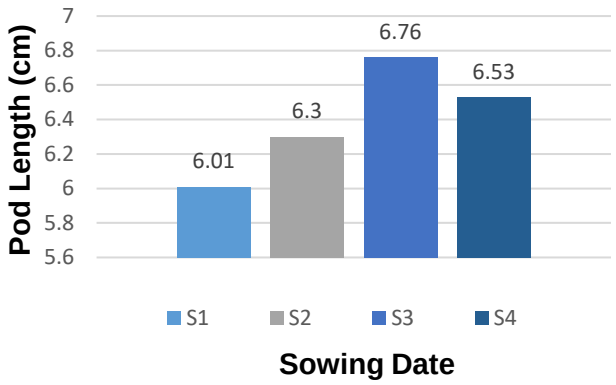


V_1= BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5) and V_4 = O-9897

Figure 8. Effect of variety on pod length of jute seed crop in late sown condition ($LSD_{0.05}$ =0.3359)

Effect of stage of sowing date

Considerable variation was found in terms of pod length as affected by different levels of sowing date (Figure 9). The figure indicated that the highest length of pod (6.76cm) was recorded from the treatment S_3 which was statistically identical with the treatment of S_4 (6.53cm) and the lowest length of pod (6.01cm) was recorded from the treatment S_1.



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019 and S_4: Sowing at 21 August 2019

Figure 9. Effect of sowing date on pod length of jute seed crop in late sown condition ($LSD_{0.05}$ = 0.3359)

Interaction effect of variety and sowing date

Significant variation was recorded due to the interaction effect of varieties and sowing date on pod length of late sown jute (Table 1). The result revealed that the highest pod length (7.26 cm) was recorded from the treatment combination of V_3S_3 which was statistically similar with the treatment combination V_3S_2 (6.95cm). The treatment combination V_1S_1, gave the lowest pod length (5.51 cm) which was statistically similar with the treatment combination of V_1S_2 (5.80cm).

Table 1. Plant characters of jute as influenced by variety and sowing date at late sown condition

Treatment	Plant height (cm)	Branches plant^{-1} (no)	Pod diameter (mm)	Pod length (cm)
$V_1 S_1$	135.24 h	2.90 h	4.72 h	5.51 j
$V_1 S_2$	140.92 gh	3.10 gh	4.97 g	5.80 ij
$V_1 S_3$	150.83 e-g	3.50 c-e	5.35 d	6.45 c-f
$V_1 S_4$	145.38 f-h	3.30 e-g	5.15 ef	6.18 f-h
$V_2 S_1$	142.81 gh	3.10 gh	4.95 g	5.86 hi
$V_2 S_2$	149.39 e-g	3.30 e-g	5.01 fg	6.10 g-i
$V_2 S_3$	163.81 cd	3.70 bc	5.72 b	6.60 c-e
$V_2 S_4$	155.41 d-f	3.50 c-e	5.3033 de	6.38 d-g
$V_3 S_1$	158.47 de	3.30 e-g	5.51 c	6.56 c-e
$V_3 S_2$	166.42 b-d	3.60 b-d	5.76 b	6.95 ab
$V_3 S_3$	186.58 a	4.10 a	6.26 a	7.26 a
$V_3 S_4$	175.03 a-c	3.80 b	5.80 b	6.67 b-d
$V_4 S_1$	149.89 e-g	3.20 fg	5.16 ef	6.10 g-i
$V_4 S_2$	158.77 de	3.40 d-f	5.41 cd	6.34 e-g
$V_4 S_3$	177.04 ab	3.80 b	5.86 b	6.72 bc
$V_4 S_4$	166.84 b-d	3.60 b-d	5.53 c	6.54 c-e
LSD $_{(0.05)}$	**12.437**	**0.2573**	**0.1573**	**0.3359**
CV	**7.10**	**12.3**	**3.78**	**3.16**

Here, V_1= BJRI Tossa Pat-8 S_1: Sowing at 7 July 2019

V_2 = O-3820 (BJRI Tossa Pat-6) S_2: Sowing at 21 July 2019

V_3 = O-795 (BJRI Tossa Pat-5) S_3: Sowing at 7August 2019

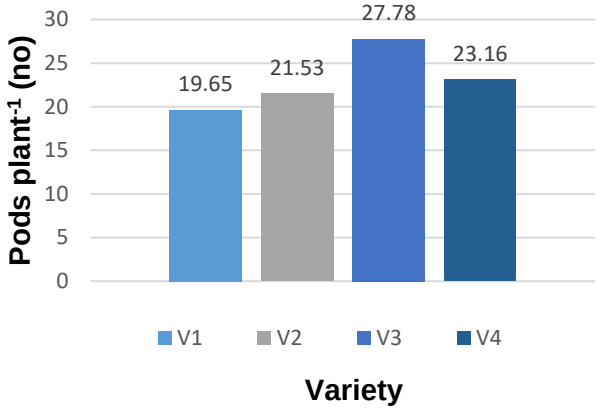
V_4 = O-9897 S_4: Sowing at 21 August 2019

4.2 Seed yield and yield contributing characters

4.2.1 Pods plant^{-1}

Effect of variety

Number of pods plant^{-1} was significantly affected due to varietal performance of jute under the present study (Figure 10). Results indicated that the maximum number of pods plant^{-1} (27.78) was recorded from variety V_3 whereas the minimum number of pods plant^{-1} (19.65) was found from variety V_1. The findings of the present study also accord with those of other authors (Talukder and Hossain, 1989) who reported that the number of branches of jute is the main reason for the increasing number of pods plant^{-1} of jute.

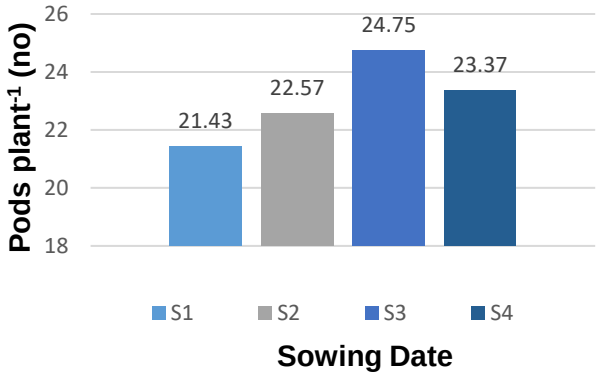


V_1=BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5) and V_4 = O-9897

Figure 10. Effect of variety on number of pods plant^{-1} of jute seed crop in late sown condition ($LSD_{0.05}$ = 0.5780)

Effect of sowing date

Number of pods plant^{-1} affected significantly due to different sowing date of jute in late sown condition (Figure 11). Results indicated that the highest number of pods plant^{-1} (24.75) was recorded from the treatment S_3 which is statistically similar to S_4 (23.37) and the lowest number of pods plant^{-1} (21.43) was recorded from the treatment, S_1.



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019 and S_4: Sowing at 21 August 2019

Figure 11. Effect of sowing date on number of pods plant^{-1} of jute seed crop in late sown condition ($LSD_{0.05}$ = 0.5780)

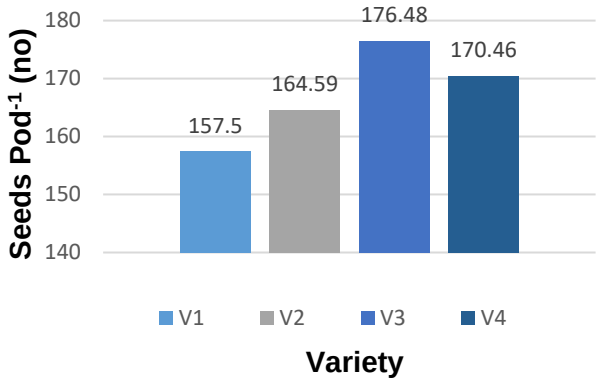
Interaction effect of variety and sowing date

Significant variation was recorded due to interaction effect of varieties and sowing date on number of pods plant^{-1} (Table 2). It was found from the table that the highest number of pods plant^{-1} (29.98) was recorded from the treatment combination, V_3S_3. The treatment combination, V_1S_1 gave the lowest number of pods plant^{-1} (18.40).

4.2.2 Seeds pod^{-1}

Effect of variety

The effect of variety on seeds pod^{-1} was significant due to jute varieties (Figure 12). It was found that the highest number of seeds per pod (176.48) was recorded from variety V_3 which was statistically similar with the treatment V_4 (170.46) and the lowest number of seeds pod^{-1} (157.50) was found from variety V_1.

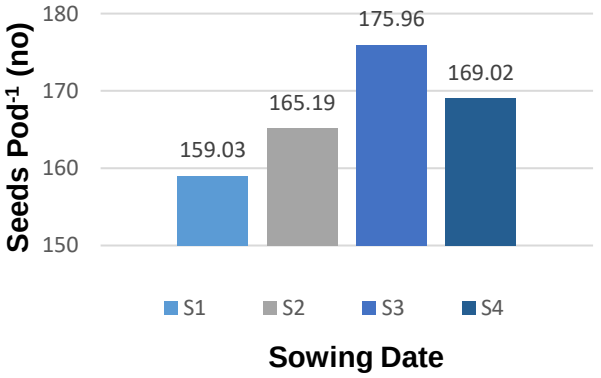


V_1=BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5) and V_4 = O-9897

Figure 12. Effect of variety on number of seeds pod^{-1} of jute seed crop in late sown condition ($LSD_{0.05}$ = 5.0386)

Effect of sowing date

Seeds pod^{-1} of jute differed significantly due to different sowing date (Figure 13). The maximum number of seeds pod^{-1} (175.96) was recorded from S_3, while the minimum number of seeds pod^{-1} (159.03) was counted from S_1.



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019 and S_4: Sowing at 21 August 2019

Figure 13. Effect of sowing date on number of seeds pod^{-1} of jute seed crop in late sown condition ($LSD_{0.05}$ = 5.0386)

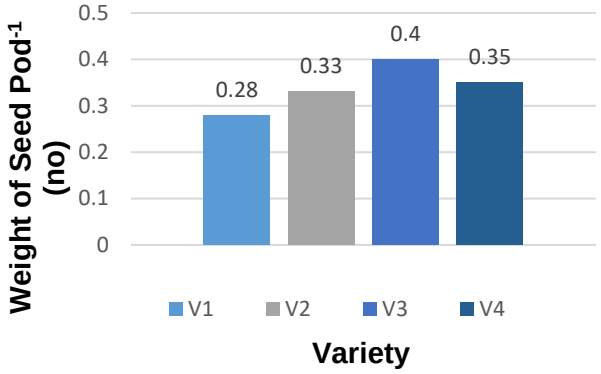
Interaction effect of variety and sowing date

The significant variation was found due to the interaction effect of varieties and sowing date on the number of seeds per pod of jute (Table 2). The maximum number of seeds pod^{-1}(186.26) was recorded from the treatment combination V_3S_3 which was statistically different from other treatment combinations. The minimum number of seeds per pod (148.34) was recorded from the treatment condition V_1S_1 which was also statistically different from other treatment combinations.

4.2.3 Weight of seed pod-1

Effect of variety

Significant effect was observed on weight of seed pod^{-1} due varietal difference of jute (Figure 14). The figure indicated that the highest weight of seed pod^{-1} (0.40g) was achieved from the variety V_3. The lowest weight of seed pod^{-1} (0.28g) was found from the variety, V_1.

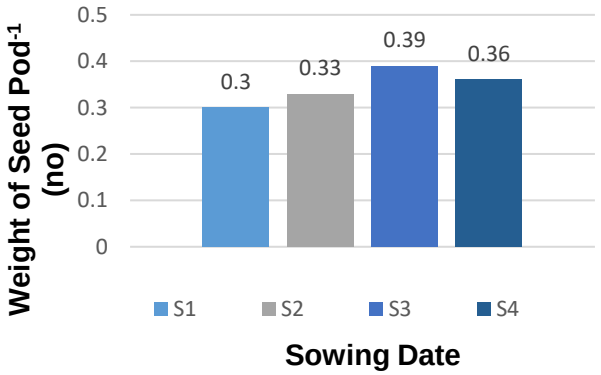


V_1=BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5) and V_4 = O-9897

Figure 14. Effect of variety on weight of seed pod^{-1} of jute seed crop in late sown condition ($LSD_{0.05}$ = 0.0222)

Effect of sowing date

Weight of seed pod^{-1} was significantly influence due to sowing date of jute in late sown condition (Figure 15). Results indicated that the maximum weight of seed pod^{-1} (0.39 g) was recorded from the treatment S_3 and the minimum weight of seed pod^{-1} (0.30 g) was recorded from the treatment S_1.



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019 and S_4: Sowing at 21 August 2019

Figure 15. Effect of sowing date on weight of seed pod^{-1} of jute seed crop in late sown condition ($LSD_{0.05}$ = 0.0222)

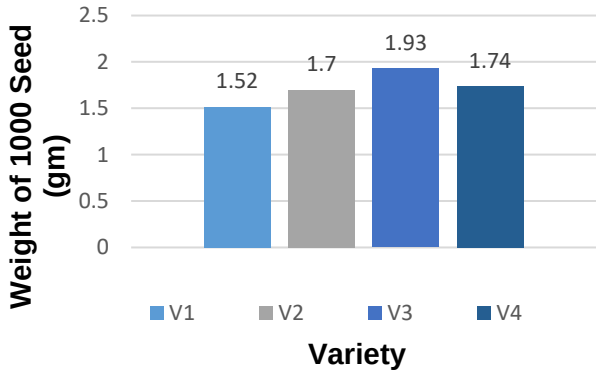
Interaction effect of variety and sowing date

Significant variation was recorded due to interaction effect of varieties and sowing date on weight of seed pod^{-1} (Table 2). The result revealed that the highest weight of seed pod^{-1} (0.44 g) was recorded from the treatment combination V_3S_3 which was statistically similar to the treatment combination V_3S_4 (0.42 g). The treatment combination V_1S_1, gave the lowest number of seed pod^{-1} (0.23 g) which was statistically different to other treatment combinations.

4.2.4 Weight of 1000 seed (g)

Effect of variety

Weight of 1000 seed was significantly influenced by varietal performance of jute in late sown condition (Figure 16). The highest weight of 1000 seed (1.93g) was achieved from the variety V_3 whereas the lowest weight of 1000 seed (1.52 g) was found from the variety V_1.

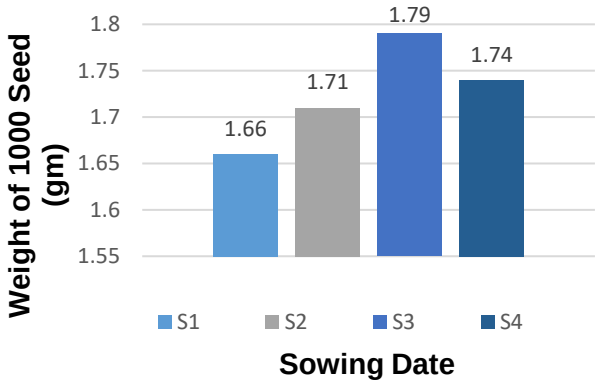


V_1=BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5) and V_4 = O-9897

Figure 16. Effect of variety on 1000 seed weight of jute seed crop in late sown condition ($LSD_{0.05}$ = 0.0623)

Effect of sowing date

There observed a significant variation on thousand seed weight of jute due to sowing date at late sown condition (Figure 17). Results revealed that the 1000 seed weight (1.79 g) was recorded from the treatment S_3. The lowest 1000 seed weight (1.66 g) was recorded from the treatment S_1.



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019 and S_4: Sowing at 21 August 2019

Figure 17. Effect of sowing date on 1000 seed weight of jute seed crop in late sown condition ($LSD_{0.05}$ = 0.0623)

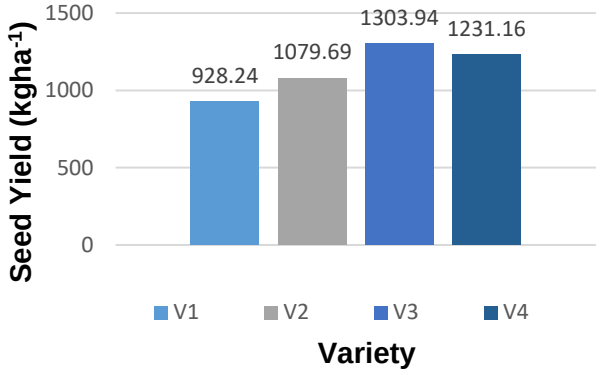
Interaction effect of variety and sowing date

Interaction effect of varieties and sowing date exhibited significant variation on 1000 seed weight in late sown jute (Table 2). It was revealed that the highest 1000 seed weight (1.98 g) was found from the treatment combination V_3S_3 which was statistically similar to the treatment combination of V_3S_2 and V_3S_4 where the 1000 seed weight was 1.92 g and 1.94 g respectively. The treatment combination, V_1S_1, gave the lowest 1000 seed weight (1.44 g) which was statistically similar to the treatment combination of V_1S_2, gave the 1000 seed weight (1.49 g)

4.2.5 Seed yield

Effect of variety

Seed yield (kgha^{-1}) was significantly influenced by varietal difference in late sown jute (Figure 18). It was recorded that the highest seed yield (1303.94 kgha^{-1}) was achieved from the variety V_3 whereas, the lowest seed yield (928.24 kgha^{-1}) was found from the variety V_1. The result revealed that variety V_3 out yields over variety V_1, V_2 and V_4 by producing seed yield.

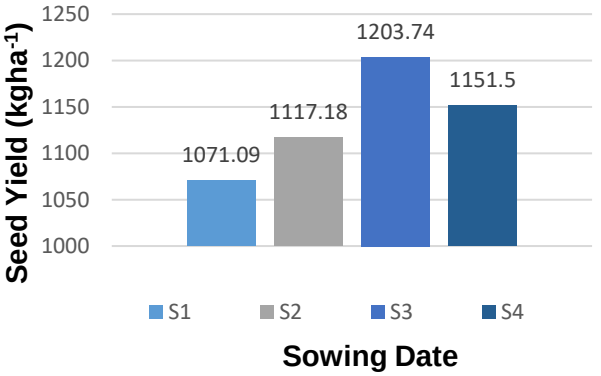


V_1=BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5) and V_4 = O-9897

Figure 18. Effect of variety on seed yield of jute seed crop in late sown condition ($LSD_{0.05}$ = 26.426)

Effect of sowing date

Significant variation was found in terms of seed yield kg ha^{-1} due to sowing date in late sown condition of jute (Figure 19). Results indicated that the highest seed yield (1203.74 kgha^{-1}) was recorded from the treatment S_3 and the lowest seed yield (1071.09 kgha^{-1}) was recorded from the treatment S_1. The result revealed that S_3 sowing date produce 12.38%, 7.75% and 4.54% higher yield than S_1, S_2 and S_4 sowing date, respectively.



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019 and S_4: Sowing at 21 August 2019

Figure 19. Effect of sowing date on seed yield of jute seed crop in late sown condition ($LSD_{0.05}$ = 26.426)

Interaction effect of variety and sowing date

Significant seed yield variation was recorded due to interaction effect of varieties and sowing date in jute (Table 2). It was found from the result that the highest seed yield (1390.2 kgha^{-1}) was recorded from the treatment combination V_3S_3 which was statistically different to the other treatment combinations. The treatment combination V_1S_1 gave the lowest seed yield (894.6 kgha^{-1}) which was statistically similar to the treatment combination V_1S_2 (920.2 kgha^{-1})

Table 2. Seed yield and yield contributing characters of jute as influenced by variety and sowing date at late sown condition of jute.

Treatment	Pods plant^{-1} (no.)	Seeds pod^{-1} (no.)	Weight of seed pod^{-1} (g)	Weight of 1000 seed (g)	Seed yield (kgha^{-1})
$V_1 S_1$	18.40 k	148.34 j	0.23 f	1.44 k	894.6 m
$V_1 S_2$	19.29 j	156.40 i	0.26 e	1.49 jk	920.2 lm
$V_1 S_3$	20.96 h	171.52 d-f	0.34 c	1.59 hi	964.9 k
$V_1 S_4$	19.96 i	160.42 hi	0.30 d	1.54 ij	933.2 l
$V_2 S_1$	20.15 i	157.64 hi	0.38 b	1.64 gh	992.1 j
$V_2 S_2$	21.03 h	161.62 h	0.31 d	1.66 fg	1072.9 i
$V_2 S_3$	23.22 e	172.37 de	0.38 b	1.78 cd	1151.5 g
$V_2 S_4$	21.72 g	166.73 fg	0.35 c	1.72 d-f	1102.2 h
$V_3 S_1$	25.31 d	167.93 ef	0.35 c	1.86 b	1221.1 de
$V_3 S_2$	27.32 c	174.47 cd	0.39 b	1.92 ab	1272.8 c
$V_3 S_3$	29.98 a	186.26 a	0.43 a	1.98 a	1390.2 a
$V_3 S_4$	28.47 b	177.88 bc	0.42 a	1.94 a	1331.7 b
$V_4 S_1$	21.86 g	162.19 gh	0.31 d	1.70 e-g	1176.6 fg
$V_4 S_2$	22.63 f	168.25 ef	0.34 c	1.75 c-e	1202.8 ef
$V_4 S_3$	24.84 d	180.36 b	0.39 b	1.79 c	1308.3 b
$V_4 S_4$	23.32 e	171.04 d-f	0.35 c	1.74 c-e	1239.0 d
LSD (0.05)	**0.5780**	**5.0386**	**0.0222**	**0.0623**	**26.426**
CV	**3.39**	**4.09**	**3.83**	**3.46**	**5.06**

Here, V_1= BJRI Tossa Pat-8; V_2 = O-3820 (BJRI Tossa Pat-6); V_3 = O-795 (BJRI Tossa Pat-5); V_4 = O-9897

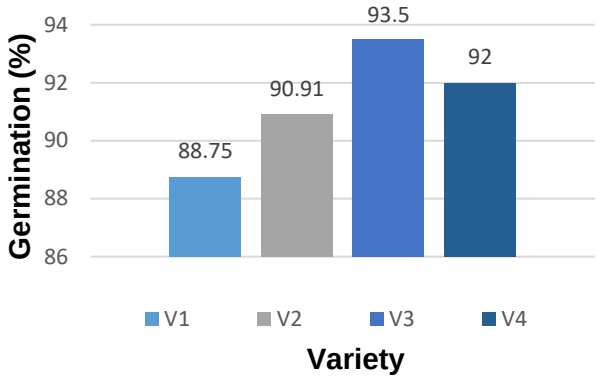
S_1: Sowing at 7 July 2019; S_2: Sowing at 21 July 2019; S_3: Sowing at 7August 2019; S_4: Sowing at 21 August 2019

4.3 Quality attributes

4.3.1 Germination percentage

Effect of variety

Seed germination was influenced by different varieties (Figure 20). It was found that the highest percent of seed germination (93.50) was found from the seeds produced in the V_3 variety. The lowest percent seed germination (88.75) was found from the variety, V_1.

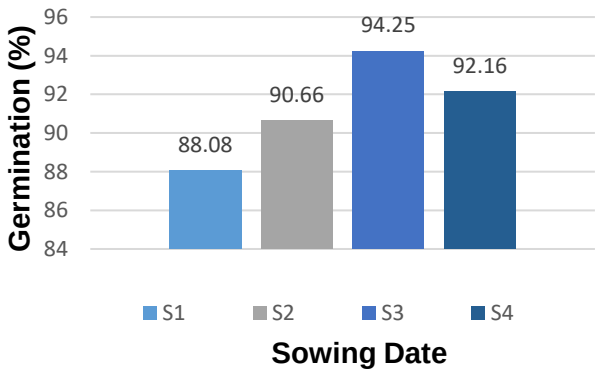


V_1=BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5) and V_4 = O-9897

Figure 20. Effect of variety on germination percentage of jute seed in late sown condition ($LSD_{0.05}$ = 0.6050)

Effect of sowing date

Effect of sowing date exerted significant variation on seed germination of jute in late sown condition (Figure 21). Results indicated that the highest percent of seed germination was recorded from seeds sown at of treatment S_3 (94.25) whereas the lowest percent of seed germination was recorded from the seeds of treatment S_1 (88.08). The present result confirmed with those of Bhattacharjee *et al.* (2000) who observed the germination of 55-65% matured jute seed at maximum level. This is agreement with Islam (2019).



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019 and S_4: Sowing at 21 August 2019

Figure 21. Effect of sowing date on germination percentage of jute seed in late sown condition ($LSD_{0.05}$ = 0.6050)

Interaction effect of variety and sowing date

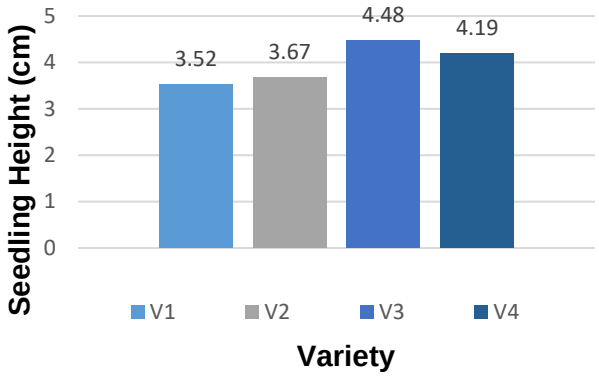
Significant variation was recorded on percent of seed germination due to interaction effect of varieties and sowing date at late sown condition (Table 3). It was found that the highest percent

of seed germination (97.66%) was recorded from the seeds obtained from combination V_3S_3.The lowest percent of seed germination (86.66%) was found from the seeds obtained from combination V_1S_1 which was statistically different to the other treatment combinations.

4.3.2 Seedling height

Effect of variety

Seedling length was significantly affected by the different varieties of jute seed in late sown condition (Figure 22). However, significantly the highest seedling length (4.48 cm) was found from variety V_3 and the lowest value (3.52cm) was recorded from V_1 variety.

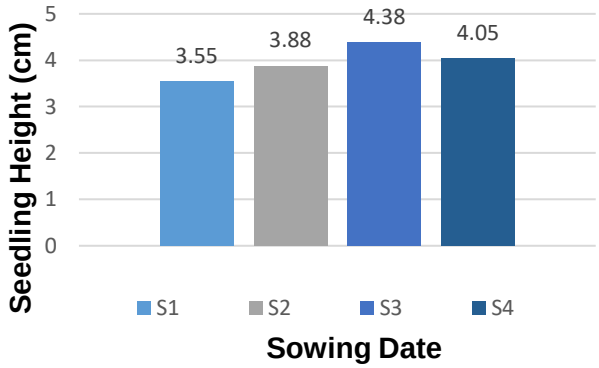


V_1 = BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5) and V_4 = O-9897

Figure 22. Effect of variety on seedling height of jute seed in late sown condition ($LSD_{0.05}$ =0.0931)

Effect of sowing date

Seedling length differed significantly due to sowing date of jute at late sown condition (Figure 23). The maximum seedling length (4.38cm) was recorded from the seeds obtained from S_3 and that of the lowest was recorded from S_1 (3.55cm).



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019 and S_4: Sowing at 21 August 2019

Figure 23. Effect of sowing date on seedling height of jute seed in late sown condition (LSD0.05 = 0.0931)

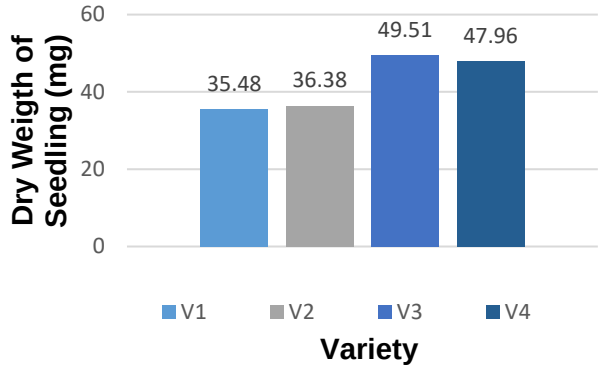
Interaction effect of variety and sowing date

The significant variation was found due to interaction effect of varieties and sowing date at late sown condition of jute (Table 3). The maximum seedling length (4.97cm) was recorded from the seeds achieved from the treatment combination of V_3S_3 which was statistically different to the other treatment combinations. The minimum seedling length (3.08 cm) was found from seeds that were obtained from the treatment combination of V_1S_1.

4.3.3 Dry weight of seedling

Effect of variety

Dry weight of seedling was affected significantly due to jute varieties (Figure 24). The maximum dry weight of seedling (49.51 mg) was recorded from the V_3 variety which was statistically similar to the variety V_4 (47.96 mg). The minimum dry weight of seedling (35.48 mg) was found from the seeds produced by the variety, V_1.

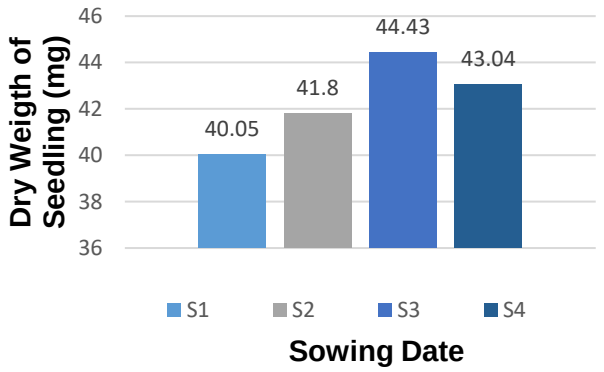


V_1=BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5) and V_4 = O-9897

Figure 24. Effect of variety on oven dry weight of seedling of jute seed in late sown condition ($LSD_{0.05}$ = 1.1513)

Effect of sowing date

Dry weight of seedling of jute exerted significant difference due to sowing date at late sown condition (Figure 25). The maximum dry weight of seedling (44.43mg) was recorded from the seeds obtained from S_3 sowing date which was statistically similar to the treatment S_4 (43.04 mg). The minimum dry weight of seedling (40.05 mg) was recorded from the seeds of S_1 treatment.



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019 and S_4: Sowing at 21 August 2019

Figure 25. Effect of sowing date on oven dry weight of seedling of jute seed in late sown condition ($LSD_{0.05}$ = 1.1513)

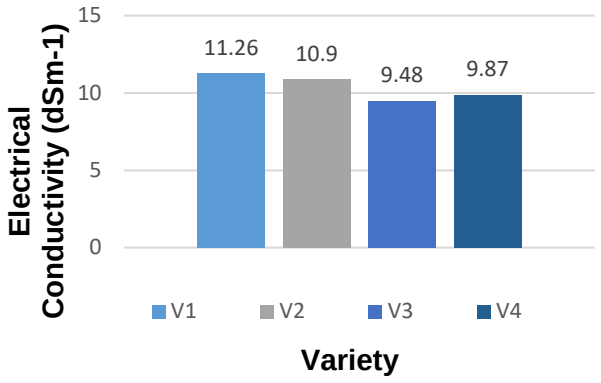
Interaction effect of variety and sowing date

Interaction effect of variety and sowing date exerted significant variation in dry weight of seedling of jute in late sown condition (Table 3). The maximum dry weight of seedling (51.59 mg) was recorded from seeds obtained from the treatment combination V_3S_3 which was statistically different to the other treatments whereas the minimum dry weight of seedling was recorded from V_1S_1 (33.34 mg) interaction.

4.3.4 Electrical conductivity

Effect of variety

Electrical conductivity test had also been applied to detect the difference among the seeds of jute variety at late sown condition. Effect of variety on electrical conductivity was found to be statistically significant (Fig. 26). The highest electrical conductivity (11.26 dSm^{-1}) was recorded from variety, V_1 and the lowest electrical conductivity (9.48 dSm^{-1}) was recorded from variety, V_3

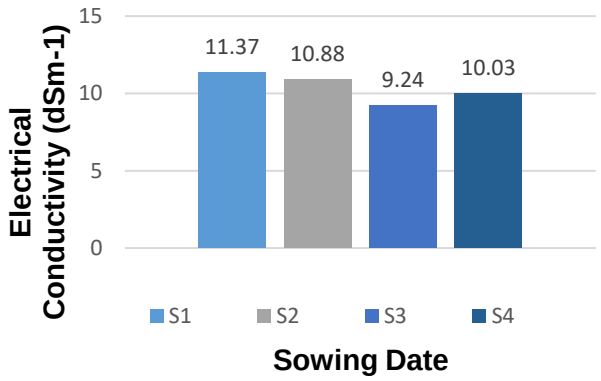


V_1=BJRI Tossa Pat-8, V_2 = O-3820 (BJRI Tossa Pat-6), V_3 = O-795 (BJRI Tossa Pat-5), V_4 = O-9897

Figure 26. Effect of variety on electrical conductivity of jute seed in late sown condition ($LSD_{0.05}$ = 0.3189)

Effect of sowing date

Effect of sowing date on electrical conductivity of jute seed was observed statistically significant at different sowing dates at late sown condition (Fig. 27). The highest electrical conductivity was recorded (11.37 dSm^{-1}) from S_1 treatment while the lowest electrical conductivity (9.24 dSm^{-1}) was measured from S_3 treatment.



S_1: Sowing at 7 July 2019, S_2: Sowing at 21 July 2019, S_3: Sowing at 7August 2019, S_4: Sowing at 21 August 2019

Figure 27. Effect of sowing date on electrical conductivity of jute seed in late sown condition ($LSD_{0.05}$ = 0.3189)

Interaction effect of variety and sowing date

Interaction effect of variety and sowing date at late sown condition had significant differences on electrical conductivity of jute seed (Table 3). The lowest electrical conductivity (8.17 dSm^{-1}) was recorded from the V_3S_3 treatment combination which was statistically different to the other treatment combinations. The highest electrical conductivity was recorded from the V_1S_1 (12.23 dSm^{-1}) treatment combinations. Which was statistically similar with V_1S_2 (11.88 dSm^{-1}) and V_2S_1 (11.83 dSm^{-1})

Table 3. Quality attributes of jute seed as influenced by variety and sowing date at late sown condition

Treatment	Germination percentage (%)	Seedling length (cm)	Oven dry weight of seedling (mg)	Electrical conductivity (dSm^{-1})
$V_1 S_1$	86.66 j	3.08 j	33.34 k	12.23 a
$V_1 S_2$	88.33 h	3.47 h	34.87 j	11.88 ab
$V_1 S_3$	90.33 f	3.93 f	37.53 fg	10.11 e-g
$V_1 S_4$	89.66 g	3.58 g	36.17 hi	10.83 cd
$V_2 S_1$	87.33 i	3.18 i	34.67 j	11.83 ab
$V_2 S_2$	90.66 f	3.53 gh	35.53 ij	11.35 bc
$V_2 S_3$	94.33 c	4.08 e	38.43 f	9.83 fg
$V_2 S_4$	91.33 e	3.87 f	36.87 gh	10.59 de
$V_3 S_1$	88.66 h	4.07 e	47.03 d	10.58 de
$V_3 S_2$	92.33 d	4.35 c	49.17 bc	10.07 e-g
$V_3 S_3$	97.66 a	4.97 a	51.59 a	8.17 j
$V_3 S_4$	95.33 b	4.52 b	50.23 b	9.13 hi
$V_4 S_1$	89.66 g	3.87 f	45.17 e	10.83 cd
$V_4 S_2$	91.32 e	4.15 de	47.63 d	10.23 d-f
$V_4 S_3$	94.66 c	4.53 b	50.17 b	8.83 i
$V_4 S_4$	92.32 d	4.21 d	48.87 c	9.57 gh
LSD (0.05)	**0.6050**	**0.0931**	**1.1513**	**0.3189**
CV	**1.59**	**5.50**	**5.66**	**3.76**

Here,

V_1= BJRI Tossa Pat-8

V_2 = O-3820 (BJRI Tossa Pat-6)

V_3 = O-795 (BJRI Tossa Pat-5)

V_4 = O-9897

S_1: Sowing at 7 July 2019

S_2: Sowing at 21 July 2019

S_3: Sowing at 7August 2019

S_4: Sowing at 21 August 2019

CHAPTER V

SUMMARY AND CONCLUSION

5.1 Summary

A pot experiment was conducted in the net house of the Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka during the period from July 2019 to December 2019 to determine the yield and quality of jute seed as influenced by variety and sowing date at late sown condition. Harvest of different pods completed within December, 2019 but seed processing and yield results were obtained in January, 2020. The experiment consisted of two factors viz. four jute varieties and four sowing dates. Four varieties namely V_1 (BJRI Tossa Pat-8), V_2 (BJRI Tossa Pat-6) and V_3 (BJRI Tossa Pat-5), V_4 (O-9897); and four sowing dates as S_1 (July 7), S_2 (July 21), S_3 (August 7) and S_4 (August 21) were used under the present study. The experiment consisted of 16 treatment combinations that were laid out in a Randomized complete Block Design RCBD (factorial) with three replications. Earthen pots were used in the experiment. At the time of harvest, plant characters, yield attributes, yield and seed quality data were taken. The collected data were statistically analyzed and the results have been summarized. In most cases, a variety of jute, different sowing dates and their combination data showed significant influence on yield contributing parameters, yield and seed quality attributes.

It was found that the highest plant height (171.63 cm) and maximum number of branch plants^{-1} (3.73) were recorded from the variety V_3 (BJRI Tossa Pat-5). The lowest plant height (143.09 cm) and minimum number of branch plants^{-1} (3.23) were found from the variety V_1 (BJRI Tossa Pat-8). The maximum pod length (6.45cm) and the highest pod diameter (5.83 mm) were recorded from the variety V_3 (BJRI Tossa Pat-5). The highest pod length (6.76 cm) and the highest pod diameter (5.80mm) were found from S_3 (August 7). Likewise, the lowest pod length (6.01 cm) and the lowest pod diameter (5.09 mm) was found from S_1 (July 7).

In case of the combination of both variety and sowing date at late sown condition, the tallest plant (186.58 cm) was found from the treatment combination V_3S_3, maximum number of branch plant^{-1} (4.10) was found from V_3S_3 treatment, the maximum pod length (7.26 cm) was recorded from the

treatment combination V_3S_3 and the highest pod diameter (6.26 mm) was found from V_3S_3 treatment. Likewise, the shortest plant (135.24 cm) and the lowest number of branch plant^{-1} (2.9) were found from the treatment combination, V_1S_1. The lowest pod length (5.51 cm) was found from V_1S_1 treatment and the lowest pod diameter (4.72 mm) was found from V_1S_1 treatment.

In case of yield attributes and yield contributing parameter, significant variation was found for all the parameter. Among the varieties, the highest number of pods plant^{-1} (27.78), the highest number of seeds pod^{-1} (176.48), the highest weight of seeds pod^{-1} (0.40g) and the highest seed yield (1303.94 kgha^{-1}) were found from V_3 (BJRI Tossa Pat-5) variety. Maximum weight of a thousand seeds (1.93 g) was found from V_3 (BJRI Tossa Pat-5) variety. The lowest number of pod plant^{-1} (19.65), minimum weight of seeds pod^{-1} (0.28 g) and the lowest seed yield (928.24 kg ha^{-1}) was found from the variety V_1 (BJRI Tossa Pat-8). Minimum number of seeds pod^{-1} (157.50) was found from V_1 (BJRI Tossa Pat-8) variety and minimum weight of thousand seed (1.52 g) was found from V_1 (BJRI Tossa Pat-8) variety.

Among the sowing dates, the highest number of pods plant^{-1} (24.75), the highest number of seed pod^{-1} (175.96), the highest weight of seed pod^{-1} (0.39 g), maximum weight of thousand seed (1.79 g) and maximum seed yield (1203.74 kgha^{-1}) were found from S_3 sowing date (August 7). On the other hand, the lowest number of pod plant^{-1} (21.43), the lowest number of seed pod^{-1} (159.03), the lowest weight of seed pod^{-1} (0.30 g), minimum weight of thousand seed (1.66 g) and minimum seed yield (1071.09 kgha^{-1}) was found from S_1 (July 7) sowing date.

Data were collected among the combined effect of variety and sowing date at late sown condition. The highest number of pod plant^{-1} (29.98), the highest number of seeds pod^{-1} (186.26) and the highest seed yield (1390.2 kgha^{-1}) were found from the treatment combination, V_3S_3 and the highest weight of seed pod^{-1} (0.44g) and maximum thousand seed weight (1.98 g) was found from the combination, V_3S_3.The lowest number of pod plant^{-1} (18.40) and the lowest number of seed pod^{-1} (148.34) were found from the treatment combination V_1S_1. Again, minimum weight of seed pod^{-1} (0.23 g) and minimum seed yield (894.6 kgha^{-1}) were obtained from V_1S_1 treatment combination and minimum weight of thousand seed (1.44 g) was found from treatment combination V_1S_1.

The highest seed germination (93.50%) was found from the V_3 (BJRI Tossa Pat-5) variety. The highest oven dry weight of seedling (49.51 mg) was found from the variety V_3 (BJRI Tossa Pat-5). The lowest seed germination (88.75%) and the minimum dry weight of seedling (35.48mg)

was found from the variety V_1 (BJRI Tossa Pat-8).The highest seedling height (4.48cm) was found from the V_3 (BJRI Tossa Pat-5) variety. The lowest electrical conductivity (9.48 dsm^{-1}) was found from the variety V_3 (BJRI Tossa Pat-5).The lowest seedling height (3.52 cm) and the highest electrical conductivity (11.26 dsm^{-1}) was found from the variety V_1 (BJRI Tossa Pat-8).

Considering sowing date, seeds obtained from the treatment M3 (August 7) showed the highest seed germination (94.25%), the highest seedling length (4.38cm) and maximum oven dry weight of seedling (44.43 mg). S_1 (July 7) showed the lowest seed germination (88.08%), the lowest seedling height (3.55 cm) and minimum oven dry weight of seedling (40.05). The lowest electrical conductivity (9.24 dSm^{-1}) was found from the S_3 (August 7) where the highest electrical conductivity (11.37 dSm^{-1}) was found from S_1 (July 7) In case of seeds produced from different combined treatment of variety and sowing date the highest seed germination (97.66%), the highest seedling length (4.97 cm), highest oven dry weight of seedling (51.59 mg) and the lowest electrical conductivity (8.17 dSm^{-1}) were identified from the treatment combination V_3S_3 combination. The lowest oven dry weight of seedling (33.34 mg), the lowest seed germination (88.66%), the lowest seedling height (3.08 cm) were found from V_1S_1 treatment, where the highest electrical conductivity (12.23 dSm^{-1}) was found from V_1S_1 treatment.

5.2 Conclusion

From the above findings the following conclusion could be made:

- V_3 (BJRI Tossa Pat-5) variety showed the best performance in respect of seed yield and quality contributing parameters in late sown condition.
- Sowing date S_3 (August 7) gave the best results regarding yield, yield contributing parameters and seed quality in late sowing.
- Variety V_3 (BJRI Tossa Pat-5) along with sowing date S_3 (August 7) showed the best results considering yield contributing parameters and yield at late sown condition.
- Variety V_3 (BJRI Tossa Pat-5) along with sowing date S_3 (August 7) showed the best results regarding seed quality at late sown condition.

5.3 Recommendation

This was a single year and single location experiment. So, for wider validity of the result, the following recommendation could be made:

• Further study is needed in field level at different Agro-ecological zones (AEZ) of Bangladesh for regional adaptability and other performance.

• Other cultivars or varieties may be studied in the further program with more treatments for accuracy of the results obtained from the present experiment.

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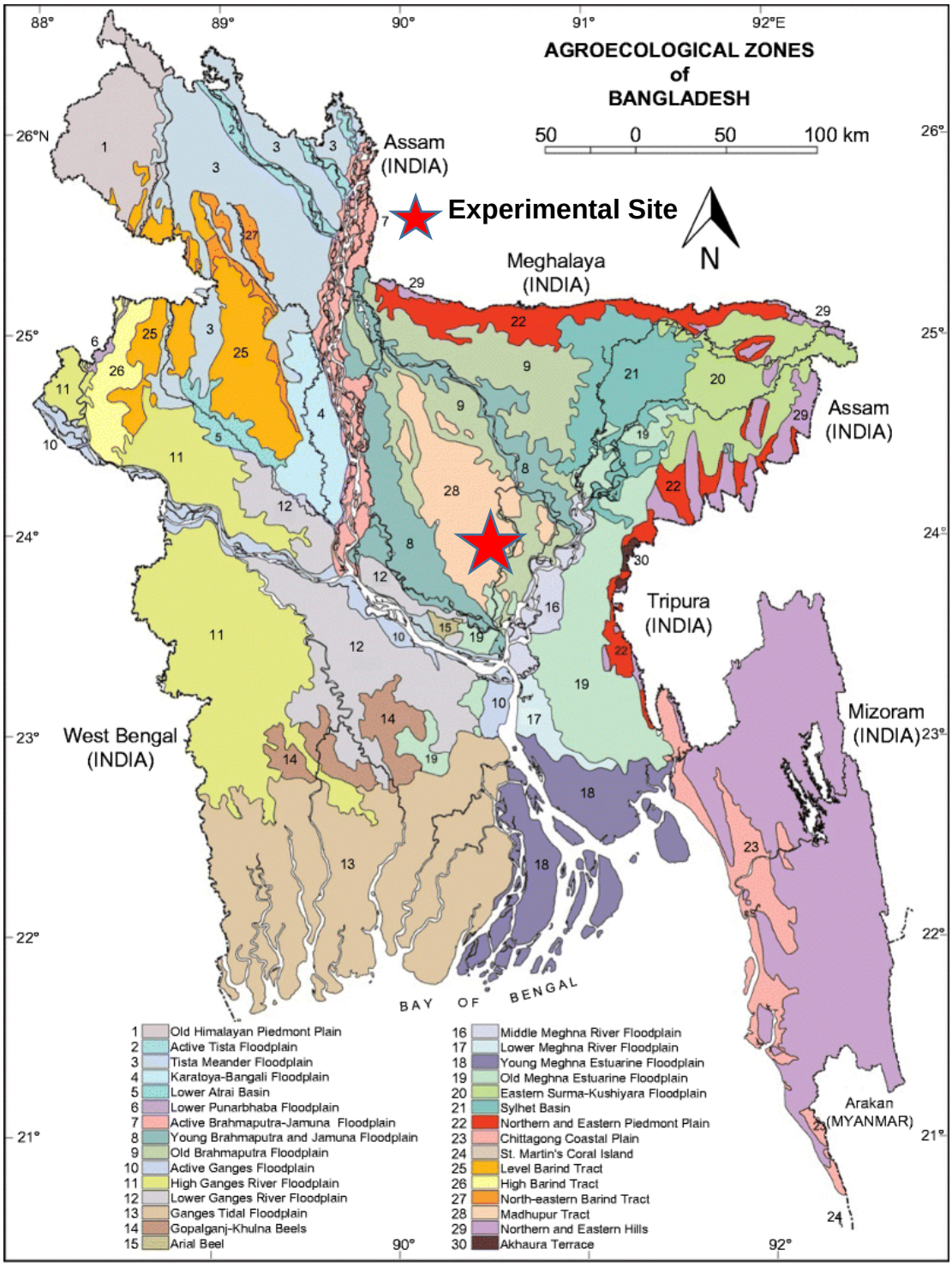
APPENDICES

Appendix I. Experimental location on the map of Agro-ecological zones of Bangladesh



Appendix II. Characteristics of soil of experimental field

A. Morphological characteristics of soil of the experimental field

Morphological features	Characteristics
Location	Sher-e-Bangla Agricultural University Research Farm, Dhaka
AEZ	AEZ-28, Modhupur Tract
General Soil Type	Deep Red Brown Terrace Soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled
Flood level	Above flood leveled
Drainage	Well drained
Cropping pattern	Not applicable

B. The initial physical and chemical characteristics of soil of the experimental site (0 - 15 cm depth)

Physical characteristics	
Constituents	**Percent**
Sand	27
Silt	43
Clay	30
Textural class	Silty Clay Loam (ISSS)
Chemical characteristics	
Soil characters	**Value**
pH	5.8
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total nitrogen (%)	0.03
Available P (ppm)	20
Exchangeable K (me/100 g soil)	0.01
Available S (ppm)	45
CEC meq/100g soil	2.64

Source: Soil Resource and Development Institute (SRDI), Farmgate, Dhaka

Appendix III. Monthly average temperature, relative humidity and total rainfall of the experimental site during the period from July 2019 to December 2019.

Month	Air temperature (^{0}C)		R. H. (%	Total rainfall (mm)
	Maximum	Minimum		
July,19	31.5	26.1	83	375.4
August,19	32.3	26.5	82	292.7
September,19	32	25.6	83	340.2
October,19	29.15	18.24	78	174.6
November,19	25.85	16.06	73	31.3
December,19	22.6	13.2	73	12.3

Source: Bangladesh Metrological Department (Climate and weather division) Agargaon, Dhaka

Appendix: Some pictorial view of the experiment.

Plate 1. Seedling stage in the pot.

Plate 2. Four different sowing stage of jute varieties.

Plate 3. Thinning.

Plate 4. Flowering stage.

Plate 5. Fruiting stage.

Plate 6. Variety (BJRI Tossa Pat-5)

Plate 7. Seedling of different variety.

Plate 8. Seedling of different variety.

Plate 8. Signboard of the experiment.