Effects of Cutting Length and Position on the Seed Yield and Quality of Tossa
Jute (*Corchorus olitorius* L.)

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Abstract

An experiment was conducted at the research field of Jute Research Regional Station of Bangladesh Jute Research Institute (BJRI) at Kishoreganj during August 2009 to January 2010 to assess the effect of cutting length and position of cutting on seed yield and quality of tossa jute (*Corchorus olitorius* L.). Three cutting lengths (15 cm, 20 cm and 25 cm) and three cutting positions (1\(^{st}\) top, 2\(^{nd}\) top and 3\(^{rd}\) top) were the treatments. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The highest seed yield (917 kg ha\(^{-1}\)) was obtained from 1\(^{st}\) top x 15 cm interaction and the lowest (811 kg ha\(^{-1}\)) was recorded in 3\(^{rd}\) top x 25 cm cutting length. The highest seed germination (89%), field emergence (87%) and accelerated ageing (73%) were recorded from 1\(^{st}\) top x 15 cm interaction and the lowest seed germination (83.00%), field emergence (81%) and accelerated ageing (72) were recorded in 3\(^{rd}\) top x 25 cm cutting length. The upper position of cutting produced the highest yield and best quality seeds.

Keywords: Cutting length, cutting position, yield, quality, jute seed.

1. Introduction

Jute (*Corchorus* sp.) is the principal fiber crop of Bangladesh. It accounts for 6% of the foreign currency earnings from exports (Islam, 2009). Jute is predominantly grown for fiber rather than seed production. Despite so much importance of jute fibre, very little attention has been given on its research mainly on seed production practices. Moreover, the country faces an acute shortage of jute seeds every year. Bangladesh requires 4000-4500 MT of jute seeds annually, whereas production by 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 mostly from India (Pulok *et al*., 2014).

Conventionally, farmers sow jute seeds during March-April for fibre production and a part of it is kept at the corner of the land for seed production. Remnant part of fibre crop in its long stay in the field experiences natural calamities like hail storm, diseases and insect pest infestations, which results in a bad harvest in respect to both quality and quantity of seeds.

Jute is a photosensitive and short-day plant. It is evident from earlier report that jute plants induce flowers later or do not flower at all below 14 or above hours of photoperiod. It
hastens flower, no matter whenever planted, on or subjected to short days of around 12 hours (Husain, 1977). However, if it is planted in June or later, the plants exhibit stunted growth and profuse branching and induce flowers prematurely at the juvenile stage of crop due to short photoperiodic effect.

Vegetative propagation of jute plants is an improved technique in which about 20-25 cm plant tops are taken off from normal fibre plants at harvested and are planted in puddled field in the months from June and July. Sohel et al. (2002) reported good survival and increased seed yield of jute through top cutting method. Besides, plant tops at harvest of fibre crop contribute nothing to fiber yield rather can be used for growing a second crop for seed production.

Yield and quality of seeds varied on the basis of position of top cutting due to growth hormone produce at the top of the plant (Pandey and Sinha, 2006). Seed production of jute crop is a great problem now a day. Farmers are not interested to grow jute seeds crop in traditional ways. Besides, modern varieties of C. olitorius jute produce very poor seed yields in traditional method. Though the late jute seed production technology developed by BJRI becomes promising, the sowing of late jute seed crop is usually hampered due to heavy rainfall. To avoid this situation, planting of top cuttings in the wetland during July to September may be an alternative way for quality seed production in the late season. However, information on appropriate cutting positions and lengths for seed production of jute is scarcely available. The present study was, therefore, conducted to determine the effects of cutting length and position on the seed yield and quality of jute.

2. Materials and Methods

A field experiment was conducted at the Jute Research Regional Station, Kishoreganj, of Bangladesh during August/2009 to January/2010 to study the effect of cutting length and position on seed yield and quality of tossa jute. The soil was sandy loam to loam in texture which belongs to the Old Brahmaputra floodplain soils (AEZ 9). The type of land was high and soil pH was 6.4. The diurnal ranges of air temperature during the experimentation periods were 23.8°C to 35.0°C and 10.4°C to 28.0°C, respectively. Three types of cutting lengths e.g., 15cm, 20cm, 25cm and three types of top cutting position e.g., top (1st top), middle (2nd top), bottom (3rd top) position were used as plant materials in this experiment. The experiment was laid-out in a randomized complete block design (RCBD) with three replications.

The experimental plots were fertilized with urea, triple super phosphate (TSP), muriate of potash (MoP) and gypsum @ 200-50-60-95 kg ha⁻¹, respectively. All fertilizers except urea were applied during final land preparation. Urea was top dressed in three equal splits at 15, 30 and 45 days after sowing (DAS). Weeding was done by hand at 25 and 45 days after sowing (DAS). The crop was infested by mealy bug and white fly at the vegetative stage and those were effectively controlled by spraying Ripcord 10 EC @ 2ml L⁻¹ of water for three times at an interval of 10 days. No irrigation was applied while excess water was drained out as and when necessary. The crop was harvested at maturity (when 80% pods became brown). Plant survivalism⁻², plant height, primary branches plant⁻¹, secondary branches plant⁻¹ and capsules plant⁻¹, capsule length, capsule diameter, seed yield, stick yield, germination, field emergence and accelerating percent were recorded. The crop was harvested on 7-8 January in 2010 (180 DAT). After harvest the crop was dried for three days and then threshed by beating with a stick. Seeds were then cleaned and dried for another five days in the sun to bring seed moisture content to below 10%.

2.1. Germination test

Germination test was conducted following wait tissue paper method. One hundred seeds in four replications were placed on the moist tissue paper (Bashundhara kitchen towel) in petridish
The petridishes were kept in the germinator at 30 ±1°C. Daily counting of the germinating seedlings were done up to 8 days of seed setting. The number of normal seedlings was counted at 8 DAS and the germination percentage of seed was measured as:

\[
\text{Germination} \% = \frac{\text{Number of normal seedling}}{\text{Number of seed sown}} \times 100
\]

2.2. Accelerated ageing (AA) test
Accelerated ageing seed was done by taking 15 g seeds in accelerated ageing chamber and exposing the seeds to 41°C temperature and 100% RH for 72 hours. For conducting the AA test, seeds were weighed and placed on a screen tray (10.0×3.5×3.0 cm) which was inserted into an inner chamber (plastic box: 10.0 × 6.0 × 4.0 cm) containing 50 ml of water. The boxes were covered with lids and kept airtight. The inner chamber was placed into an accelerated ageing (outer) chamber. During the ageing period the seeds absorb moisture from the humid environment within the inner chamber and were stressed by high temperature and RH. After accelerated ageing, germination test of seeds was done using modified paper folding method (ISTA, 1999).

2.3. Field emergence (FE)
Field emergence was calculated according to Mollah (2014) using the following formula:

\[
\text{Field emergence} \% = \frac{\text{Number of normal seedling}}{\text{Number of seed sown}} \times 100
\]

2.4. Statistical analysis
Data were analyzed by using the Analysis of Variance Technique and differences among the treatment means were adjudged by Duncan’s Multiple Range Test (DMRT) (Gomez and Gomez, 1984) following a statistical computer package (MSTATC).

3. Results and Discussion
3.1. Cutting length on survivalist
Cutting length had significant effect on plant survivalist of jute seed production (Table 1). The highest plant survivalist (14.5) was recorded in 25 cm cutting length. It may be due to more node contain in this cutting. The lowest plant survivalist (12.7) was recorded in 20 cm cutting length. Cutting position also has significant effect on plant survivalist of jute seed production (Table 2). The highest plant survivalist (14.4) was recorded in 2nd top it may be due to more auxin produce in the upper part of cutting and 1st top may be vulnerable (Pandey and Sinha, 2006). The lowest plant population (12.8) was recorded in 3rd top. From cutting length and position interaction effect it was evident that in the highest plant population (15.4) was found in 3rd top x 25 cm followed by 2nd top x 20 cm (15.3). The lowest plant population (10.0) was found in 3rd top x 20 cm interaction (Table 5). Similar result was reported by BJRI (2005-06) and Zigene and Kassahun (2016).

3.2. Cutting length on plant height
Plant height is an important yield contributing character. Cutting length and position had significant effect on plant height. The highest plant height (1.33 m) was recorded at 25 cm cutting length and the lowest one (1.26 m) was in 20 cm cutting length followed by 1.29 m at 15 cm cutting length (Table 1). The highest plant height (1.35 m) was recorded in 1st top and the lowest plant height (1.26 m) was recorded in 2nd and 3rd top (Table 2). Interaction effect of cutting length and position shows that the highest plant height (1.38 m) was found in 1st top x 15 cm followed by 1st top x 25 cm. The lowest plant height (1.19 m) was found in 3rd top x 20 cm interaction (Table 5). Similar result was reported by BJRI (2005-06) and Zigene and Kassahun (2016).

3.3. Primary branch per plant
Primary branch in a jute plant is an important seed yield contributing character. Cutting length and position had significant effect on primary
branch per plant. The highest number of primary branch per plant (1.90) was recorded at 25 cm cutting followed by (1.80) in 20 cm cutting and the lowest one (1.60) was at 15 cm cutting (Table 1). Similarly the number of primary branch was the highest (1.93) in 3rd top, followed by (1.83) in 2nd top and the lowest one (1.53) was recorded in 1st top (Table 2). Interaction of cutting length and cutting position shows that the highest number of primary branch (2.3) was found in 3rd top x 25 cm cutting and the lowest (1.5) was found in 1st top x 15 cm, 1st top x 25 cm and 3rd top x 15 cm cutting (Table 5). Similar result was reported by Zigene and Kassahun (2016).

3.4. Secondary branch per plant

Number of secondary branch per plant was varied with cutting length and position.. The number of secondary branch per plant was the highest (3.47) in 20 cm cutting, followed by 3.38 cm in 15 cm cutting and the lowest one (3.25) was in 25 cm cutting (Table 1). The highest secondary branch (3.80) was recorded in 2nd top and the lowest secondary branch (3.06) was recorded in 1st top followed by 3.23 in 3rd top (Table 2). From cutting length and position interaction effect on the highest secondary branch (4.1) was found in 2nd top x 20 cm and the lowest secondary branch (2.8) was found in 1st top x 25 cm (Table 5).

3.5. Number of capsule per plant

Number of capsule per plant is an important seed yield contributing character in jute. Cutting length and position had significant effect on capsule number per plant. The highest number of capsule per plant (38) was recorded in 15 cm cutting and the lowest one (33) was in 20 cm cutting length (Table 1). For cutting position the highest number of capsule per plant (37) was recorded in 1st top and the lowest one (35) was recorded in 2nd top (Table 2). Interaction effect of cutting length and position revealed that the highest capsule per plant (41) in 1st top x 25 cm, followed by 2nd x 25 cm and the lowest one (33) was obtained in 3rd top x 15 cm (Table 5).

3.6. Capsule length and diameter

Capsule length and diameter are important seed yield contributing characters of jute. Cutting length and position had significant effect on capsule length and diameter. The highest capsule length (6.27 cm) and diameter (5.33 mm) was recorded in 15 cm cutting and the lowest capsule length (6.03 cm) and diameter (5.19 mm) was in 20 cm cutting (Table 1). The highest capsule length (6.20 cm) and diameter (5.32 mm) was recorded in 3rd top and the lowest capsule length (6.03 cm) and diameter (5.19 mm) was recorded in 3rd top (Table 2). Interaction of cutting length and position shows that the highest capsule length (6.33 cm) and diameter (5.39 mm) in 2nd top x 20 cm and the lowest capsule length (5.64 cm) and diameter (5.09 mm) was found in 3rd top x 20 cm (Table 5).

3.7. Number of seed per capsule

The highest number of seed per capsule (153) was recorded in 15 cm cutting and the lowest seed per capsule (145) was in 20 cm cutting length (Table 1). The highest number of seed per capsule (154) was recorded in 2nd top and the lowest number of seed per capsule (145) was recorded in 3rd top (Table 2). From cutting length and position interaction effect on the highest number of seed per capsule (156) was found in 2nd top x 20 cm followed by 155 in 3rd x 15 cm, 154 in 2nd x 15 cm and the lowest number of seed per capsule (137) was found in 3rd top x 20 cm (Table 5). Similar result was reported by BJRI (2005-06).

3.8. Seed and stick yield

Seed and stick yields are the ultimate goal of jute seed production. Cutting length and position has significant effect on seed yield and stick yield. The highest seed yield (798 kg/ha) and stick yield (3387 kg/ha) was recorded in 25 cm cutting length and the lowest seed yield (744 kg/ha) and stick yield (2848 kg/ha) was in 20 cm cutting length (Table 1). The highest seed yield (827 kg/ha) and stick yield (3338 kg/ha) was recorded in 1st top and the lowest seed yield (727 kg/ha) and stick yield (2901 kg/ha) was recorded in 3rd top (Table 2).
Table 1. Effect of cutting length on the seed yield and yield attributes of jute

| Length of cutting (cm) | Plant survivalist/m² (no.) | Plant height (m) | Primary branches/plant (no.) | Secondary branches/plant (no.) | Capsule s/ Plant (no.) | Length of capsule (cm) | Dia. Of capsule (mm) | Seed/capsule (no.) | Seed yield (kg/ha) | Stick yield (kg/ha) |
|-----------------------|---------------------------|------------------|-------------------------------|------------------|-----------------------|----------------------|---------------------|------------------|----------------|------------------|
| 15                    | 13.3b                     | 1.29b            | 1.60c                         | 3.38b             | 36b                   | 6.27a                | 5.33a               | 153a             | 785b           | 2918b            |
| 20                    | 12.7c                     | 1.26b            | 1.80b                         | 3.47a             | 33c                   | 6.03c                | 5.19b               | 145c             | 744c           | 2848c            |
| 25                    | 14.5a                     | 1.33a            | 1.90a                         | 3.25c             | 38a                   | 6.10b                | 5.20b               | 147b             | 798a           | 3387a            |
| LSD(5%)               | 0.16                      | 0.03             | 0.03                          | 0.03              | 0.03                  | 0.03                 | 1.17                | 0.49             | 3.49           |                  |
| CV(%)                 | 1.21                      | 1.58             | 1.29                          | 0.80              | 0.19                  | 0.50                 | 0.79                | 0.06             | 0.11           |                  |

Table 2. Effect of cutting position on the seed yield and yield attributes of jute

| Position of cutting | Plant survivalist/m² (no.) | Plant height (m) | Primary branches/plant (no.) | Secondary branches/plant (no.) | Capsule s/ Plant (no.) | Length of capsule (cm) | Dia. Of capsule (mm) | Seed/capsule (no.) | Seed yield (kg/ha) | Stick yield (kg/ha) |
|---------------------|---------------------------|------------------|-------------------------------|------------------|-----------------------|----------------------|---------------------|------------------|----------------|------------------|
| 1st top             | 13.3b                     | 1.35a            | 1.53c                         | 3.06c             | 37a                   | 6.18a                | 5.22b               | 147b             | 827a           | 3338a            |
| 2nd top             | 14.4a                     | 1.26b            | 1.83b                         | 3.80a             | 35b                   | 6.20a                | 5.32a               | 154a             | 772b           | 2912b            |
| 3rd top             | 12.8c                     | 1.26b            | 1.93a                         | 3.23b             | 35b                   | 6.03b                | 5.19b               | 145c             | 727c           | 2901b            |
| LSD(5%)             | 0.16                      | 0.03             | 0.03                          | 0.03              | 0.03                  | 0.03                 | 1.17                | 0.49             | 3.49           |                  |
| CV(%)               | 1.21                      | 1.58             | 1.29                          | 0.80              | 0.19                  | 0.50                 | 0.79                | 0.06             | 0.11           |                  |

Table 3. Effect of cutting length on the seed quality of jute

| Length of cutting (cm) | Germination (%) | Accelerated Ageing (%) | Field Emergence (%) |
|-----------------------|-----------------|------------------------|---------------------|
| 15                    | 86.00a          | 72.00a                 | 84.00a              |
| 20                    | 86.00a          | 71.33a                 | 84.00a              |
| 25                    | 85.00a          | 72.00a                 | 83.00a              |
| LSD(5%)               | 2.23            | 1.67                   | 1.66                |
| CV(%)                 | 3.10            | 2.77                   | 2.36                |
Table 4. Effect of cutting position on the seed quality attributes of jute

| Position of cutting | Germination (%) | A. Ageing (%) | Field Emergence (%) |
|---------------------|----------------|--------------|---------------------|
| 1\textsuperscript{st} top | 87.67 a | 72.00 a | 85.67 a |
| 2\textsuperscript{nd} top | 85.33 b | 72.33 a | 83.33 ab |
| 3\textsuperscript{rd} top | 84.00 b | 71.00 a | 82.00 b |
| LSD(5\%) | 2.23 | 1.67 | 1.66 |
| CV(\%) | 3.10 | 2.77 | 2.36 |

Table 5. Interaction effect of cutting position and length on the seed yield and yield attributes of jute

| Treatment | Plant survivalist /m\textsuperscript{2} (no.) | Plant height (m) | Primary branches /plant (no.) | Secondary branches /plant (no.) | Capsules / Plant (no.) | Length of capsule (cm) | Dia. of capsule (mm) | Seed/capsule (no.) | Seed yield (kg/ha) | Stick yield (kg/ha) |
|-----------|------------------------------------------|----------------|-----------------------------|-------------------------------|----------------------|-----------------------|---------------------|------------------|------------------|---------------------|
| 1\textsuperscript{st} topx15 | 13.9c | 1.38a | 1.5f | 3.3e | 37d | 6.21b | 5.40a | 151b | 917a | 3638b |
| 1\textsuperscript{st} topx20 | 12.8e | 1.30bc | 1.6e | 3.1g | 33g | 6.13c | 5.09d | 142d | 805d | 3194c |
| 1\textsuperscript{st} topx25 | 13.2d | 1.37a | 1.5f | 2.8h | 41a | 6.19b | 5.16c | 147c | 761e | 3183d |
| 2\textsuperscript{nd} topx15 | 13.0de | 1.23de | 1.8d | 3.7b | 38c | 6.31a | 5.31b | 154a | 733f | 2655f |
| 2\textsuperscript{nd} topx20 | 15.3a | 1.28bcd | 1.8d | 4.1a | 34e | 6.33a | 5.39a | 156a | 761e | 2905e |
| 2\textsuperscript{nd} topx25 | 14.9b | 1.28bcd | 1.9c | 3.6c | 33f | 5.95d | 5.27b | 151b | 822b | 3177d |
| 3\textsuperscript{rd} topx15 | 12.9e | 1.25cd | 1.5f | 3.1g | 33f | 6.28a | 5.29b | 155a | 705g | 2461g |
| 3\textsuperscript{rd} topx20 | 10.0f | 1.19e | 2.0b | 3.2f | 33f | 5.64e | 5.09d | 137e | 666h | 2444h |
| 3\textsuperscript{rd} topx25 | 15.4a | 1.33ab | 2.3a | 3.4d | 40.6b | 6.17bc | 5.18c | 142d | 811c | 3800a |
| LSD (5\%) | 0.28 | 0.05 | 0.05 | 0.11 | 0.05 | 0.05 | 2.03 | 0.86 | 6.05 |
| CV(\%) | 1.21 | 1.58 | 1.29 | 0.80 | 0.19 | 0.50 | 0.48 | 0.79 | 0.06 | 0.11 |
Table 6. Interaction effect of cutting position and length on the seed quality of jute

| Treatment      | Germination (%) | Accelerated Ageing (%) | Field Emergence (%) |
|----------------|----------------|------------------------|---------------------|
| 1<sup>st</sup> top x 15 | 89a            | 73a                    | 87a                 |
| 2<sup>nd</sup> top x 15 | 86abc         | 72a                    | 84abcd              |
| 3<sup>rd</sup> top x 15 | 88ab           | 71a                    | 86ab                |
| 1<sup>st</sup> top x 20  | 85abc          | 72a                    | 83bcd               |
| 2<sup>nd</sup> top x 20  | 87abc          | 72a                    | 85abc               |
| 3<sup>rd</sup> top x 20  | 84bc           | 73a                    | 82cd                |
| 1<sup>st</sup> top x 25  | 84bc           | 71a                    | 82cd                |
| 2<sup>nd</sup> top x 25  | 85abc          | 70a                    | 83bcd               |
| 3<sup>rd</sup> top x 25  | 83c            | 72a                    | 81d                 |
| LSD (5%)        | 3.87           | 2.89                   | 2.88                |
| CV (%)          | 3.10           | 2.77                   | 2.36                |

From cutting length and position interaction effect on the highest seed yield (917 kg/ha) was found in 1<sup>st</sup> top x 15 cm and stick yield (3800 kg/ha) was found in 3<sup>rd</sup> top x 25 cm and the lowest seed yield (666 kg/ha) and stick yield (2444 kg/ha) was found in 3<sup>rd</sup> top x 20 cm (Table 5). Similar result was reported by BJRI (2005-06).

3.7 Germination

Germination percent, the most important quality parameter of jute seed was not affected significantly by cutting length but affected significantly by cutting position. The highest seed germination (87.67) was recorded in 1<sup>st</sup> top position, followed by 85.33 in 2<sup>nd</sup> top position and the lowest one was (84.00) recorded in 3<sup>rd</sup> top (Table 4). Interaction effect of cutting length and position shows that the highest germination percent was 89.00% in 1<sup>st</sup> top x 15 cm and the lowest one was 83.00% in 3<sup>rd</sup> top x 25 cm.

3.8 Ageing

Seed ageing percent was not affected significantly by cutting length, cutting position and cutting length x cutting position interaction but affected significantly by cutting position (Table 3, 4, 6).

3.9 Field emergence

Field emergence percent was not influenced significantly by cutting length but affected significantly by cutting position. The highest field emergence (85.67) was recorded in 1<sup>st</sup> top position. The lowest germination (82.00) was recorded in 3<sup>rd</sup> top position (Table 4). Germination affected significantly on cutting length x position interaction. The highest field emergence percent (87.00) was recorded in 1<sup>st</sup> top x 15 cm interaction and the lowest (81.00) was recorded in 3<sup>rd</sup> top x 25 cm interaction (Table 6).

4. Conclusions

The highest yield and quality seeds were obtained from 1<sup>st</sup> top x 15 cm interaction and the lowest seed yield and quality was found from 3<sup>rd</sup> x 20 cm interaction. The upper position of cutting produced the highest yield and best quality seeds. It may be concluded that decreasing cutting position is the cause of reduced yield and quality of jute seed.

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