

ASSESSMENT OF YIELD AND YIELD ATTRIBUTES OF TOSSA JUTE AS AFFECTED BY VARIETY AND FIELD DURATION

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Abstract

A study was conducted at the Jute Research Sub-Station (JRSS), Tarabo, Narayanganj in 2022 to find out the suitable varieties and field duration for tossa jute (*Corchorus olitorius*) harvesting for better fibre and stick yield production. The treatment was assigned of tossa jute varieties (3) viz., BJRI Tossa pat-7, Robi-1 (BJRI Tossa pat-8) and Indian variety JRO-524 and four field durations viz. 90, 100, 110, and 120 days, respectively. A factorial RCBD design with three replications was used. Results showed that varieties and field duration significantly affected plant height, base diameter, fibre yield and stick yield. The var. JRO-524 had the highest fibre yield (2.30 tha^{-1}) than BJRI Tossa Pat-7 and Robi-1 (2.10 tha^{-1} and 2.25 tha^{-1} respectively) when harvested at 90 days after sowing (DAS). On the other hand, BJRI Tossa pat-7 and Robi-1 produced significantly higher fibre yields (3.20 tha^{-1} and 3.55 tha^{-1} ; 3.45 tha^{-1} and 3.80 tha^{-1} respectively) and stick yields (6.15 tha^{-1} , and 6.25 tha^{-1} ; 6.67 tha^{-1} , and 6.84 tha^{-1} respectively) at harvesting 110 and 120 DAS. The results showed that var. BJRI Tossa pat-7 and BJRI Tossa pat-8 could be a better fibre yield and stick yield production when it could be harvested at 120 DAS.

Introduction

Bangladesh's main cash crop is jute (*Corchorus spp.*). The term "jute" is frequently used to refer to the plant and the fibre made from the plant's bark. Jute have been produced by cultivating jute on an average of 7-8 lakh hectares of land with 80-90 bales (Haque *et al.*, 2020).

Tossa jute (*C. olitorius*) produce higher fibre than Deshi jute (*C. capsularis*). In our country, farmers generally cultivate JRO-524, as it can be harvested 90 days after sowing (DAS) (Alim *et al.*, 2021). The present study was taken to know the potentiality of high yielding varieties of Bangladesh Jute Research Institute (BJRI) viz. BJRI Tossa Pat-7 and Robi-1 (BJRI Tossa pat-8) compared to JRO-524. Farmers have little interest in growing BJRI Tossa pat-7 and BJRI Tossa pat-8 because of the lengthy vegetative season. On the other hand, the Indian variety JRO-524 has shorter vegetative period than the Bangladeshi variety (Islam *et al.*, 2019). Previous results showed that the latest breeding lines sown between the 30th of March and the 10th of April, significantly increased the yield of fibre, with corresponding yields of 3.11 and 3.04 tha^{-1} at Manikganj and 3.13 and 3.11 tha^{-1} at Jashore (Ferdous *et al.*, 2021). It was found that *C. capsularis* cv. JRC-321 was given 30, 45 or 60 kg K ha^{-1} and 0 or 10 kg B ha^{-1} harvesting at 80, 100 or 120 days after emergence (Maiti and Singh, 2019). At increased field duration 120 DAS resulted in fibre with a good balance of strength and fineness (Sarkar and Bandyopadhyay, 2000). Field duration played an important role in the fibre production of BJRI Desi Pat-10. The first week of April was taken for the sowing of seeds. The plants were harvested at various harvesting ages (90, 100, 110, and 120 days). The results showed that at 110 days of harvesting

age, the salt-tolerant cultivar BJRI Deshi Pat-10 produced the highest amount of fibre. (Jannatul *et al.*, 2023).

Tossa jute varieties such as BJRI Tossa Pat-7 and Robi-1 (BJRI Tossa pat-8). Robi-1 is the most promising Tossa variety for fibre production in BJRI. Field period can be an important factor for higher production. Thus, the present study was taken to determine the appropriate harvesting time for higher fibre production.

Materials and Methods

The experiment was conducted at Jute Research Sub-Station (JRSS), Tarabo, Narayanganj in 2022. The experiment was designed in RCBD with three replications. The unit plot size was (4.0 x 2.5) m². Two high yielding varieties of Tossa:- viz. BJRI Tossa Pat-7 and Robi-1(BJRI Tossa pat-8) and one Indian Tossa variety JRO-524 were used as planting materials for the study. In the very first week of April, the crop had been sown. The seeds were sown on 1st April 2022 at the rate of 6 kg ha⁻¹ in 30 cm apart lines with hands. All the intercultural operations like thinning, weeding, irrigation, insect pest and disease management were done properly. The experimental fields were prepared through ploughing, harrowing and levelling several times; and fertilizers were applied @ Urea 100 kg, Triple Super Phosphate (TSP) 25 kg, Muriate of Potash (MoP) 80 kg and gypsum (sulphate) 40 kg per hectare of land. Few amounts of cow dung were previously supplied to add organic matter content to the soil. Half of the urea was applied at land preparation and the rest half was top dressed at 45 DAS. The plants were harvested at 90, 100, 110, and 120 DAS as part of the treatment. Plant height was recorded from 10 randomly selected plants from each plot. The effective plant height was considered from ground level to the top of the leaf at the vegetative phase at the harvest stage. Plant height data was measured by a meter scale and converted into cm. The base diameter of the plant was measured with a meter scale as the horizontal distance covered by the plant. The data were recorded from 10 selected plants at harvest and the mean value was counted and expressed in millimeters (mm). The fibres and sticks of each plot were taken after retting and then their weight was recorded and expressed in t ha⁻¹. The statistical analysis of all the gathered data was performed with the help of a computer statistical package named doe-bioresearch in R software. The Least Significant Difference (LSD) and T-test were used to determine the mean differences between the treatments at the 0.05 level. (Gomez and Gomez, 1984). Graphs were created with the help of ggplot2 in R software.

Results and Discussion

Performance of varieties on plant height

The three Tossa varieties had a considerable impact on plant height (Fig. 1). The box graph indicated that V₂ (2.99 m) represented the highest plant height. The smallest plant height was identified in V₃ (2.63 m), which is statistically comparable to V₁ (2.73m). A similar result was found by Hasan *et al.* (2018) in the southern part of Bangladesh BJRI Tossa pat-8 produced longer plant length over JRO-524.

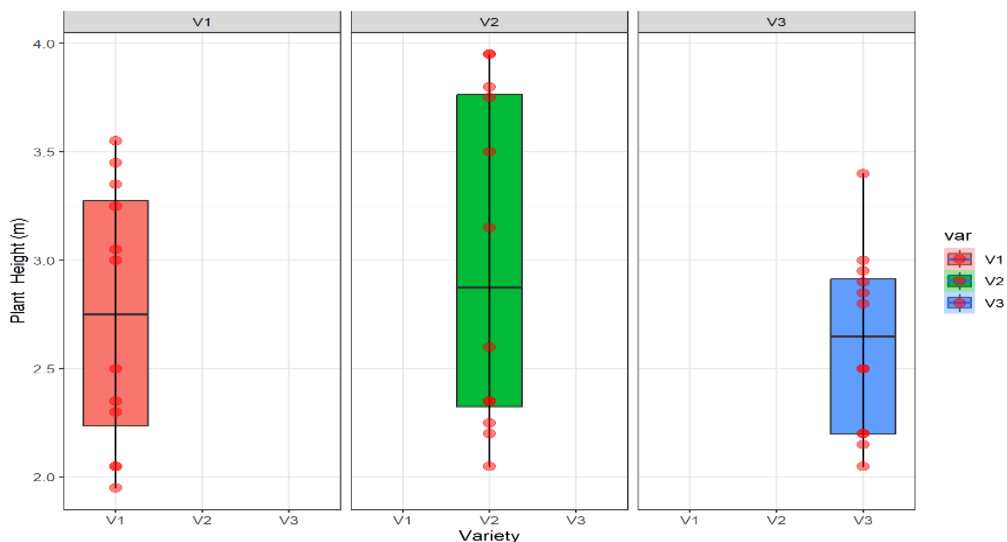


Fig. 1: Effect of variety on plant height. (V1= BJRI Tossa pat-7, V2= Robi-1(BJRI Tossa Pat-8) and V3= JRO-524).

Effect of field duration on plant height

Field duration influenced significantly plant height (Fig. 2). The highest plant height (3.83m) was found at D4 which was statistically equivalent to D3. The smallest plant height was (2.18 m) found in D1 which was statistically similar to D2. The highest plant height was 75.68% greater than the lowest plant height found in D1. The result indicated that the plant height increased with the increase in field duration. The field duration of 120 DAS was given the highest plant height. Islam *et al.* (2019) found a positive increase in plant length with an increase in field duration up to 120DAS in Tossa jute production. Similarly, Debnath *et al.* (2018) reported that the increasing pattern of plant height was almost the same in case of variety BJRI Tossa pat-6 and BJRI Tossa pat-6 up to 90 DAS and after 90 DAS this parameter increase pattern remained sharper in case of variety BJRI Tossa pat-6 compare to BJRI Tossa pat-5 upto 120 DAS.

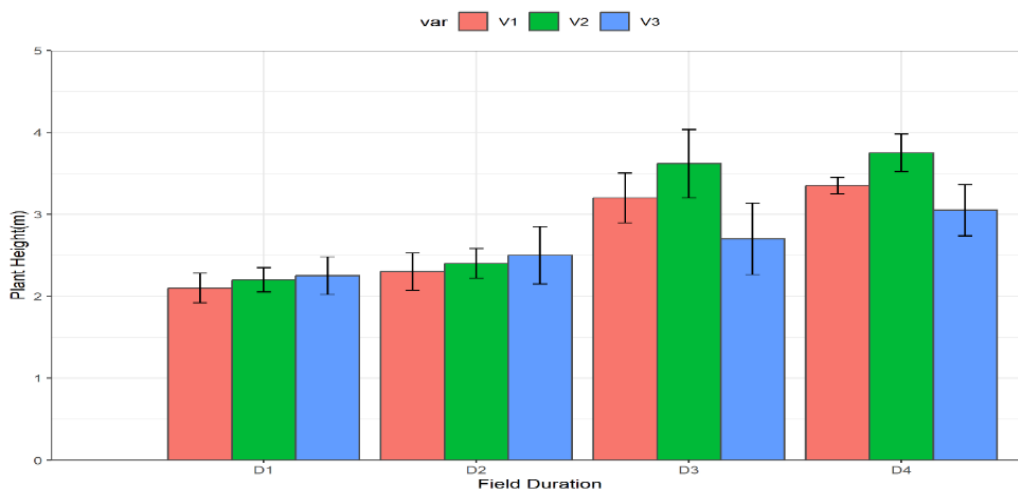


Fig. 2. Effect of field duration on plant height. D1= 90 DAS, D2= 100 DAS, D3= 110 DAS, D4= 120 DAS.

Interaction effect of variety and field duration on plant height

The interaction effect of varieties and field duration differ significantly (Table 1). The highest plant height (3.75 m) was found in the V2D4 treatment combination (BJRI Tossa Pat -8 at field duration 120 DAS) which was statistically comparable to V1D4 and V2D3. The second height value (3.62 m) was found from the V2D3 combination which was Statistically equivalent to V1D3 and V1D4. The lowest value (2.1 m) was found from the V1D1 treatment combination (BJRI Tossa Pat-7 at field duration 90 DAS) which was statistically similar to V1D2, V2D1, V2D2, V3D1 and V3D2). The height plant height found in the V2D4 treatment combination was 78.57% greater than the lowest value found in the V1D1 treatment combination. Islam *et al.* (1995) found similar results that field duration increased plant height by 3.70 m in 120 DAS in tossa jute production and Weng *et al.* (1990) also reported that there was a positive growth in tossa jute stem due to increasing field duration.

Table 1. Interaction effect of variety and field duration on plant height of Tossa jute

Treatments	Plant height (m)
V1 x D1	2.10f
V1 x D2	2.30ef
V1 x D3	3.20bc
V1 x D4	3.35abc
V2 x D1	2.20f
V2 x D2	2.40ef
V2 x D3	3.62ab
V2 x D 4	3.75a
V3 x D1	2.25ef
V3 x D2	2.50ef
V3 x D3	2.70de
V3 x D4	3.05cd
LSD(0.05)	0.48
CV (%)	10.16

V1 BJRI Tossa pat-7, V2= Robi-1(BJRI Tossa Pat-8), V3= JRO-524, D1= 90 DAS, D2= 100 DAS, D3= 110 DAS, D4= 120 DAS.

Performance of variety on base diameter

Different varieties had a significant effect on plant base diameter (Fig. 3).

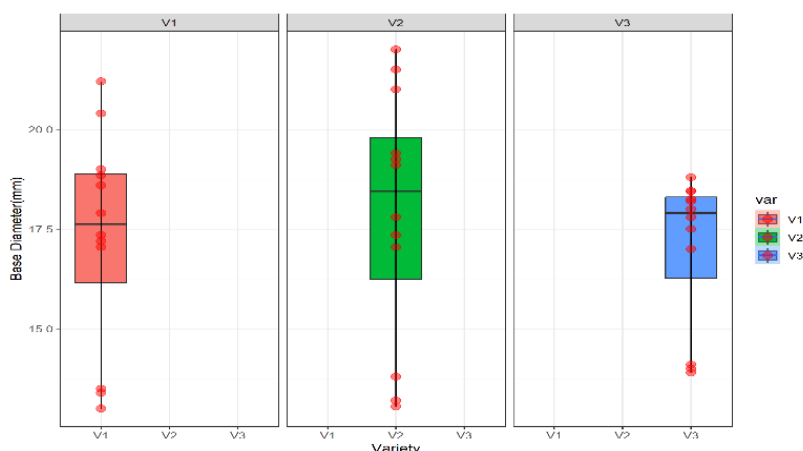


Fig. 3. Effect of Variety on jute base diameter. Legends: V1= BJRI Tossa pat-7, V2= Robi-1 (BJRI Tossa Pat-8) and V3= JRO-524.

The height base diameter (17.88 mm) was found from V₂, Robi-1(BJRI Tossa Pat-8). The smallest base diameter (17.03 mm) was found from V₃ (JRO-524) which was statistically identical to V₁ (BJRI Tossa Pat-7). Hsu and Chi (1976) reported that the basal diameter of tossa varieties had a great impact on fibre yield production and it was numerically greater in BJRI Tossa pat-6 and BJRI Tossa pat-7 than in JRO-524 (Ferdous *et al.*, 2020). It was reported that basal diameter was higher in BJRI high yielding varieties than those of Indian local varieties (Mukul *et al.*, 2021).

Effect of field duration on base diameter

Field duration had a great influence on the plant base diameter, as the field duration increased plant base diameter increased (Fig. 4). The highest base diameter (20.07 mm) was found from D₄ at 120 DAS. The second and third highest base diameter was found in D₂ and D₃ at 100 DAS and 110 DAS, respectively. The lowest value (13.55 mm) was found from D₁ (90 DAS). The results indicated that the longer field duration had a positive influence on plant base diameter. The highest base diameter found in D₄ was 48.11% greater than the lowest one found in D₁. Das *et al.*, (2014) reported the same results that tossa jute reached a maximum in breath length when it got the fuller length of field period of 120 DAS.

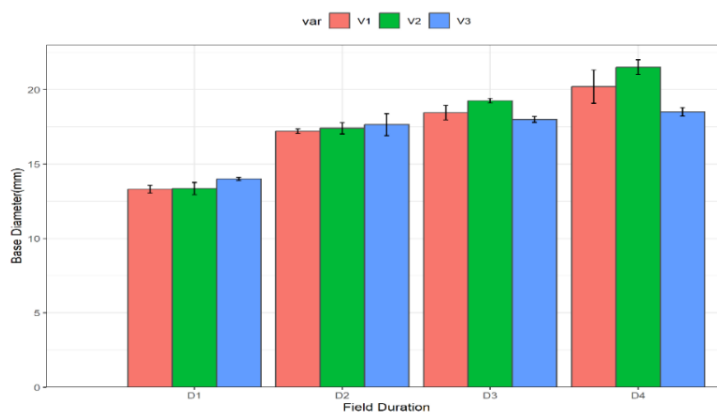


Fig. 4. Effect of field duration on plant base diameter. D₁= 90 DAS, D₂= 100 DAS, D₃= 110 DAS, D₄= 120 DAS

Interaction effect of variety and field duration on base diameter

The highest base diameter (21.50 mm) was recorded from the V₂D₄ treatment combination at 120 DAS (Table 2).

Table 2. Interaction effect of variety and field duration on the base diameter of Tossa jute

Treatment	Base Diameter (mm)
V ₁ x D ₁	13.30g
V ₁ x D ₂	17.20f
V ₁ x D ₃	18.45d
V ₁ x D ₄	20.20b
V ₂ x D ₁	13.35g
V ₂ x D ₂	17.40ef
V ₂ x D ₃	19.25c
V ₂ x D ₄	21.50a
V ₃ x D ₁	14.00g
V ₃ x D ₂	17.65ef
V ₃ x D ₃	18.00de
V ₃ x D ₄	18.50d
LSD(0.05)	0.75
CV (%)	2.54

V₁ = BJRI Tossa pat-7, V₂ = Robi-1(BJRI Tossa Pat-8), V₃ = JRO-524, D₁ = 90 DAS, D₂ = 100 DAS, D₃ = 110 DAS, D₄ = 120 DAS

The second highest value was found in the V₁D₄ (BJRI Tossa pat-7 at 120 DAS field duration). The lowest base diameter (13.30 mm) was recorded in V₁D₁ which was statistically identical to V₂D₁ and V₃D₁ respectively. The highest basal diameter found in V₂D₄ was 61.65% greater than the lowest basal diameter found in V₁D₁. Weng *et al.* (1990) discovered that tossa jute produced higher basal diameter with increasing field duration as it had got more vegetative period with long days of sunlight. Similar results were also found by Ferdous *et al.* (2020) that tossa jute got a maximum basal diameter with a longer vegetative period of 120 DAS.

Performance of variety on fibre yield

Fibre yield had been differed significantly by the different varieties of Tossa jute (Fig 5). The highest fibre yield (3.00 t ha⁻¹) was found from V₂ (BJRI Tossa Pat-8) which was statistically similar to V₂ (BJRI Tossa Pat-7) and the lowest fibre yield (2.68 t ha⁻¹) was found from V₃ (JRO-524). BJRI Tossa pat-8 produced 11.94% higher than JRO-524. Ahmed *et al.* (2023) reported that BJRI Tossa pat-8 produced a higher fibre yield than JRO-524 and was highly significant. Plants with greater plant height had longer basal length resulting in increased fibre weight that ultimately improved the yield of the variety. Ferdous *et al.* (2021) reported similar results on fibre production for tossa jute.

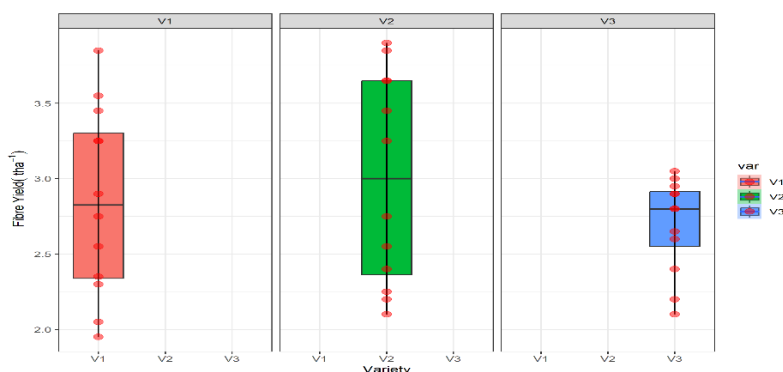


Fig. 5. Effect of variety on fibre yield, V₁= BJRI Tossa pat-7, V₂ = Robi-1(BJRI Tossa Pat-8) and V₃= JRO-524

Effect of field duration on fibre yield

The fibre yield of Tossa was significantly influenced by different field duration (Fig. 6).

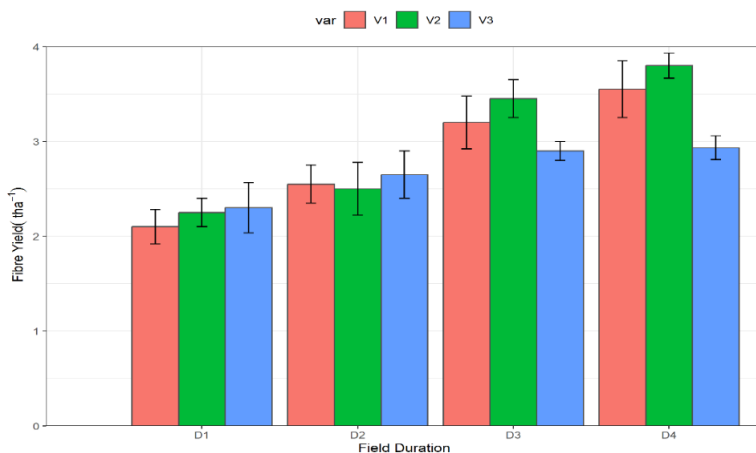


Fig. 6. Effect of field duration on fibre yield. D₁= 90 DAS, D₂= 100 DAS, D₃= 110 DAS, D₄= 120 DAS

The highest fibre yield (3.42 t ha⁻¹) was found from D4 at 120 DAS. The second and third fibre yield (3.18 tha⁻¹ and 2.57 tha⁻¹) were found from D3 and D2, respectively. The lowest fibre yield (2.22 t ha⁻¹) was found from D1 at 90 DAS. The highest fibre yield found from D4 was 54.05% greater than the lowest fibre yield found in D1. BJRI Tossa pat-8 produced the maximum number of plantm⁻², the tallest plant, maximum base diameter and largest leaf area at 120 DAS. Thus, BJRI Tossa pat-8 got superior on growth, yield and yield contributing traits as well as their sustainability (Rafiq *et al.*, 2020, Ferdous *et al.*, 2020).

Interaction effect of variety and field duration on fibre yield

The interaction effect of varieties of tossa jute and field duration was significant on fibre yield (Table 3).

Table 3. Interaction effect of variety and field duration on fibre yield and stick yield of Tossa jute

Treatment	Fibre yield (t ha ⁻¹)	Stick yield (t ha ⁻¹)
V1 x D1	2.10h	4.70c
V1 x D2	2.55efg	5.05c
V1 x D3	3.20bc	6.15b
V1 x D4	3.55ab	6.25ab
V2 x D1	2.25gh	4.80c
V2 x D2	2.50fg	5.10c
V2 x D3	3.45ab	6.67ab
V2 x D4	3.80a	6.84a
V3 x D1	2.30fgh	5.00c
V3 x D2	2.65def	5.15c
V3 x D3	2.90cde	5.17c
V3 x D4	2.93cd	5.20c
LSD(0.05)	0.38	0.63
CV (%)	4.81	6.78

V1= BJRI Tossa pat-7, V2 = Robi-1(BJRI Tossa Pat-8), V3= JRO-524, D1= 90 DAS, D2 = 100 DAS, D3 = 110 DAS, D4 = 120 DAS.

The highest fibre yield (3.80 t ha⁻¹) was produced in V2D4 (BJRI Tossa pat-8 at 120 DAS) which was statistically similar to V1D4 and V2D3, respectively. The second highest fibre yield (3.55 t ha⁻¹) was found in V1D4. However, there are no significant differences among V1D4, V1D3 and V2D3. The lowest fibre yield (2.10 t ha⁻¹) of this study was found in V1D1 (BJRI Tossa Pat-7 at 90 DAS) which was statistically similar to V2D1 and V3D1, respectively. The highest fibre yield found in the V2D4 was 80.95% higher than the lowest fibre yield found in the V1D1 treatment combination. The result showed that V3D1 and V3D2 gave numerically higher fibre yields than the V1D1, V1D2, V2D1 and V2D2, respectively. But fibre yield was decreased in V3D3 and V3D4 compared to V1D3, V1D4, V2D3 and V3D4 treatment combinations. This observation was agreed with Ferdous *et al.* (2021) who worked with tossa jute and reported that BJRI Tossa pat-8 jute produced higher fibre yield at 120 DAS than 90 DAS.

Interaction effect of variety and field duration on stick yield

Stick yield was significantly influenced by the interaction effect of variety and field duration (Table 3). The highest stick yield (6.84 t ha⁻¹) was found in V2D4 (BJRI Tossa Pat-8 at 120 DAS) which was statistically similar to V1D4 and V2D3, respectively. The second highest stick yield (6.67 tha⁻¹) was statistically comparable to V1D3 and V1D4. The lowest stick yield (4.70 t ha⁻¹) was found in the V1D1 treatment combination and there were no significant differences among V1D2, V2D1, V2D2, V3D1, V3D2, V3D3 and V3D4. BJRI Tossa pat-8 produced a 45.53% higher stick yield than the JRO-524. The result indicated that stick yield was higher in V3D1 and V3D2 than the V1D1, V1D2 and V2D1, V2D2. But V1D3, V1D4 and V2D3, V2D4 gave higher stick yields than V3D3 and

V3D4. Islam *et al.* (1995) indicated that BJRI Tossa pat-6 and BJRI Tossa pat-7 produced higher stick yield with longer plant height at 120 DAS and Hsu and Chi (1976) also claimed that tossa jute produced higher biomass in longer field duration at 115-120 DAS.

Performance of variety on stick yield

The stick yield of Tossa significantly differed with respect to varieties (Fig.7). V₂ (Robi-1) gave the highest stick yield (5.85 tha Table 3. Interaction effect of variety and field duration on fibre yield and stick yield of Tossa jute)

Treatment	Fibre yield (t ha ⁻¹)	Stick yield (t ha ⁻¹)
V ₁ x D ₁	2.10h	4.70c
V ₁ x D ₂	2.55efg	5.05c
V ₁ x D ₃	3.20bc	6.15b
V ₁ x D ₄	3.55ab	6.25ab
V ₂ x D ₁	2.25gh	4.80c
V ₂ x D ₂	2.50fg	5.10c
V ₂ x D ₃	3.45ab	6.67ab
V ₂ x D ₄	3.80a	6.84a
V ₃ x D ₁	2.30fgh	5.00c
V ₃ x D ₂	2.65def	5.15c
V ₃ x D ₃	2.90cde	5.17c
V ₃ x D ₄	2.93cd	5.20c
LSD(0.05)	0.38	0.63
CV (%)	4.81	6.78

V₁= BJRI Tossa pat-7, V₂ = Robi-1(BJRI Tossa Pat-8), V₃= JRO-524, D₁= 90 DAS, D₂ = 100 DAS, D₃ = 110 DAS, D₄ = 120 DAS.

and the second highest from V₁ (BJRI Tossa Pat-7) which was statistically similar to V₁. The lowest value (5.13 tha⁻¹) was found in the V₃ (JRO-524). The stick yield of BJRI Tossa pat-8 was 14.03% higher than JRO-524. Debnath *et al.* (2018) observed that BJRI Tossa pat-8 with longer plant height and basal diameter produced a higher stick yield. Das *et al.* (2014) found a similar result for stick yield.

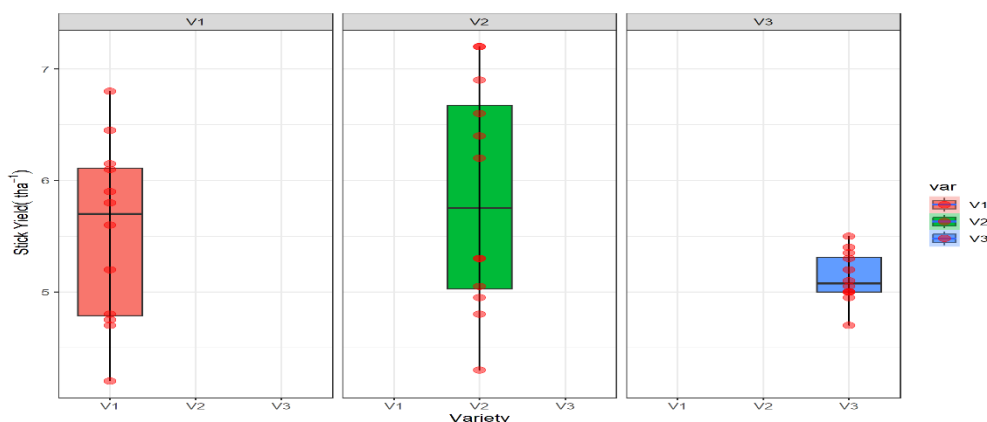


Fig. 7. Effect of variety on stick yield. V₁= BJRI Tossa pat-7, V₂= Robi-1(BJRI Tossa Pat-8) and V₃= JRO-524

Effect of field duration on stick yield

Field duration had a great impact on stick yield (Fig 8). The stick yield differed significantly due to different field durations. The highest stick yield (6.09 t ha^{-1}) was found from D₄ (120 DAS) which was statistically similar to D₃ (110 DAS). The lowest stick yield (4.83 t ha^{-1}) was found from D₁ (90 DAS) which was statistically identical to D₂ (100 DAS). The stick yield at 120 DAS was 26.08% higher than the stick yield at 90 DAS. Stick yield was increased with the increase in field duration (Islam *et al.*, 1995). Kamat *et al.* (2002) also found a similar result when working with hemp plants, reporting that it produced higher biomass at 60-70 DAS than at 30-40 DAS.

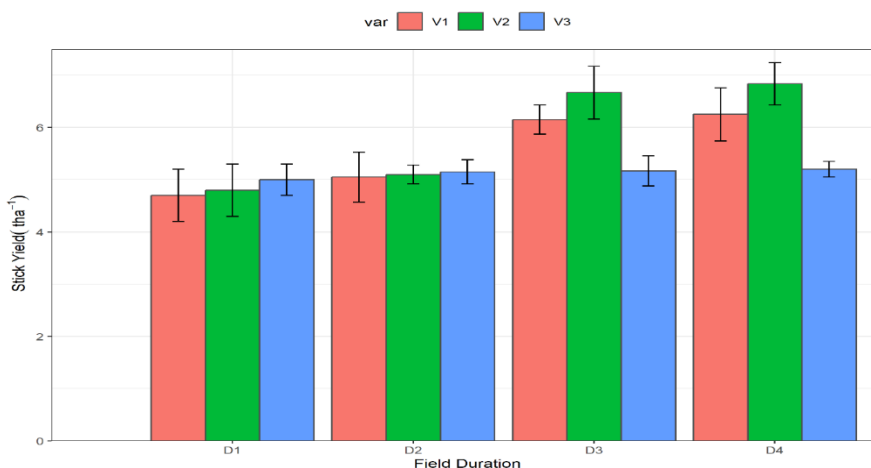


Fig. 8. Effect of field duration on stick yield. D₁= 90 DAS, D₂= 100 DAS, D₃= 110 DAS, D₄= 120 D

Conclusion

The varieties and field duration had a significant effect on plant height, base diameter, fibre yield and stick yield for tossa jute production. The outcomes of the present study concluded that BJRI Tossa Pat-7 and BJRI Tossa Pat-8 (Robi-1) gave lower fibre yield when harvested at 90–100 DAS compared to the popular Indian Tossa variety JRO-524. On the other hand, BJRI Tossa Pat-7 and BJRI Tossa Pat-8 (Robi-1) gave higher fibre yield when it was harvested at 110-120 DAS compared to JRO-524. The results concluded that BJRI Tossa pat-7 and BJRI Tossa pat-8 could be a better choice for fibre yield and stick yield production when it would be harvested at 120 DAS.

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