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Yield and Economics of *Olitorius* Jute at Different Plant Densities and Topping Practices

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field trial was conducted in *olitorius* jute at Agricultural College Farm, Bapatla during *kharif*, 2019 with three plant densities and four topping practices. The trial was replicated thrice and RBD with factorial concept design was adopted. Olitorius jute sown at (60 cm x 20 cm) with a density of 83, 333 plants ha^{-1}(D_3) resulted in maximum seed and stalk yield together with increased gross and net returns and BC ratio which was significantly superior over (30 cm x 20 cm) with 1,66, 666 plants ha^{-1}(D_1).However, it was on par with (45 cm x 10 cm) 2,22,222 plants ha^{-1} (D_2). Topping at 45 DAS (T_3) resulted in highest seed yield, stalk yield, gross returns, net returns and B:C ratio and it was on par with topping at 30 DAS and 60 DAS, which was significantly superior over no topping (T_1).

Keywords: Jute; plant density; topping practices; gross returns; net returns; B:C ratio.

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1. INTRODUCTION

Jute, also referred to as "Golden Fibre," is the second-largest commercial fibre after cotton. One of the most significant commercial bast fibre crops, it plays a significant role in the Indian economy. Jute is also a significant cash crop in Assam, Bihar, Orissa, and Eastern Uttar Pradesh, providing employment for almost 7 million small and marginal farmers as well as industrial workers and generating foreign exchange [1]. Jute being cultivated in an area of 0.98 million hectares with a production of 09.76 million bales per year in 2019–2020, makes India as the world's top producer of jute [2]. "The main textile fibre and the primary source of raw materials for non-traditional and high-value non-textile products is jute. Jute grows on 70% of the country's land in West Bengal, primarily for fibre. They rely on Maharashtra, Andhra Pradesh, Karnataka, and Telang 6 ana, where the climate is conducive for the production of high-quality seeds".

The synthetic materials dominating the market have recently posed a serious threat to jute. One of the main constraints is the inability to provide farmers with high-quality jute seed at a reasonable price and at the appropriate time. Adoption of suitable agro-techniques can increase the seed output in jute in which plant density is the key determinant of seed yield in jute. Another crucial component is topping, which involves cutting off the apical buds at the right time to break the apical dominance and encourage the growth of lateral branches, which enhances the seed output by creating more capsules pod^{-1} (Roy, 2013). A trial on "Impact of plant density and topping on seed production in *olitorius* jute (*Corchorus olitorius* L.)" was undertaken in the Krishna agroclimatic zone of Andhra Pradesh due to the large potential for producing high-quality jute seed by using proper agro-techniques.

2. MATERIALS AND METHODS

The experiment was conducted at Agricultural College Farm, Bapatla, Andhra Pradesh during *kharif* 2019. "The experimental site is situated at an altitude of 05.49 m above mean sea level (MSL), 15^0 55'N latitude, 80^0 30' E longitude and about 08 km away from the Bay of Bengal in the Krishna Agro-climatic Zone of Andhra Pradesh, India. The soil is clay textured, with neutral pH, medium in organic carbon (0.68%), low in available Nitrogen (196 kg ha^{-1}), medium in available phosphorus (24 kg ha^{-1}) and high in available potassium (294.5 kg ha^{-1})". The experimental region lies in the semi-arid tract, and during the crop growing period, 26 rainy days resulted in a total rainfall of 623.3 mm. The trial was laid out in Randomized Block Design with factorial concept and replicated thrice with two factors *i.e*., plant density and topping practices. *i.e*., 1,66,666 lakh plants ha^{-1} (D_1), 2,2,222 lakh plants ha^{-1} (D_2) and 83,333 plants ha^{-1} (D_3) and four Topping practices T_1 (No topping), T_2 (topping at 30 DAS), T_3 (topping at 45 DAS) and T_4 (topping at 60 DAS). The jute crop was sown on 14.8.2019 Straight fertilizers in the form of urea, single superphosphate, and muriate of potash were used to apply the recommended fertilizers of 20 kg N, 30 kg P2O5, and 30 kg K_2O ha^{-1} consistently. The entire amount of phosphorus, potassium, and half of the nitrogen were applied basally. At 30 DAS, the remaining half of the nitrogen was applied. Throughout the crop's growing season, all advised cultural practices and plant protection techniques were followed. "Observation like drymatter accumulation, number of capsules per plants, number of seeds per capsule, seed yield and stalk yield were taken using standard procedures from five randomly selected tagged plants from each plot. Harvesting was done in month of December as per the treatments and maturity of crop, respectively. Threshing was done plot wise and the seed yield from the net plot was converted into kg ha^{-1} to which the yield from five tagged plants was also added.For calculating gross return, net return and B:C ratio prevalent market price for jute seed was taken as Rs. 120.00 kg^{-1}".

3. RESULTS AND DISCUSSION

3.1 Drymatter Accumulation

Maximum drymatter accumulation was obtained with a plant density of 83,333plantsha^{-1}(D_3) and it was on par with a plant density of 2.22 lakh plants ha^{-1}(D_2). Lowest drymatter accumulation was noticed in 1.66 lakh plants ha^1(D_1). This might be because more per plant accumulation of drymatter at a wider spacing at 60 cm x 20 cm and also due to more vigour and less competition from neighboring plants. These results are in accordance with the findings of Sangeetha [3] and Das et al. [4]. Among the topping techniques, highest drymatter accumulation was obtained with topping at 45 DAS (T_3) which was significantly superior over T_1 treatment. It was on

par with topping at 30 DAS (T_2) and topping at 60 DAS (T_4). Topping at initial stages (30 DAS) or at later stages (60 DAS) might not have favored the jute crop in increasing the branches whereas topping at (45 DAS) might have led to more branches leading to more drymatter accumulation. These results corroborate the findings of Das et al. [4].

3.2 Yield Attributes

Number of capsules per plant and number of seeds per capsule were found to be significantly influenced by plant densities only. More number of capsules per plant and number of seeds per capsule were noticed with a plant density of 83, 333 plants ha^{-1} (D_3) which was significantly superior over remaining two plant densities *i.e.,*2.22 lakh plants ha^{-1}(D_2) and 1.66 lakh plants ha^{-1}(D_1). The enhancement in number of capsules per plant under the influence of wider spacing might be due to production of more number of primary and secondary branches $plant^{-1}$ at the same spacing which might have resulted resulted in increasing in capsule weight per plant due to more capsules per plant. Wider spacings may result in better performance from individual plants since there is less competition for sunlight, nutrients, and other resources. It ultimately contributed to the plant's improved growth and development and an increase in the number of branches per plant, number of capsules per plant and finally increase in number of seeds per capsule. The results are in close conformity with the findings of Tripathi et al. [5] and Nirmal Kumar et al. [6].

3.3 Seed and Stalk Yield

"Maximum seed yield of 2388 kg ha^{-1} and stalk yield of 6812 kg ha^{-1} in jute was achieved in crop with a density of 83, 333 plants ha^{-1}(D_3), which was significantly superior over 1,66, 666 plants ha^{-1}(D_1) and it was on par with 2,22,222 plants ha^{-1}(D_2). Topping at 45 DAS, registered highest seed yield (2463 kg ha^{-1}) and stalk yield (6718 kg ha^{-1}), which was found to be on par with topping at 30 DAS and 60 DAS, and was significantly superior over no topping . In wider spacing, less competition between plants and more availability of various resources lead to maximum yield, topping at appropriate stage *i.e.*, 45 DAS lead to increase in various yield attributes along with more branches per plant accumulating more drymatter and finally resulting in more yield when compared to no topping and topping at 60 DAS". These results are in tune with the findings of Tripathi et al. [5], Ghosh and Das [7] and Patra et al. [8].

3.4 Economics

The highest gross returns, net returns and BC ratio were obtained with (D_3) 83, 333 plants ha^{-1} followed by (D_2) 2.22 lakh plants $ha^{-1}$and the lowest gross returns, net returns and BC ratio were noticed from crop sown with 1.66 lakh plants ha^{-1}. Among the topping practices, maximum gross returns, net returns and BC ratio were obtained with topping at 45 DAS (T_3) followed by T_2 and T_1. Lowest gross returns, net returns and returns per rupee invested were obtained with no topping (T_1) (Table 2). "At wider spacing with topping, the number of branches,

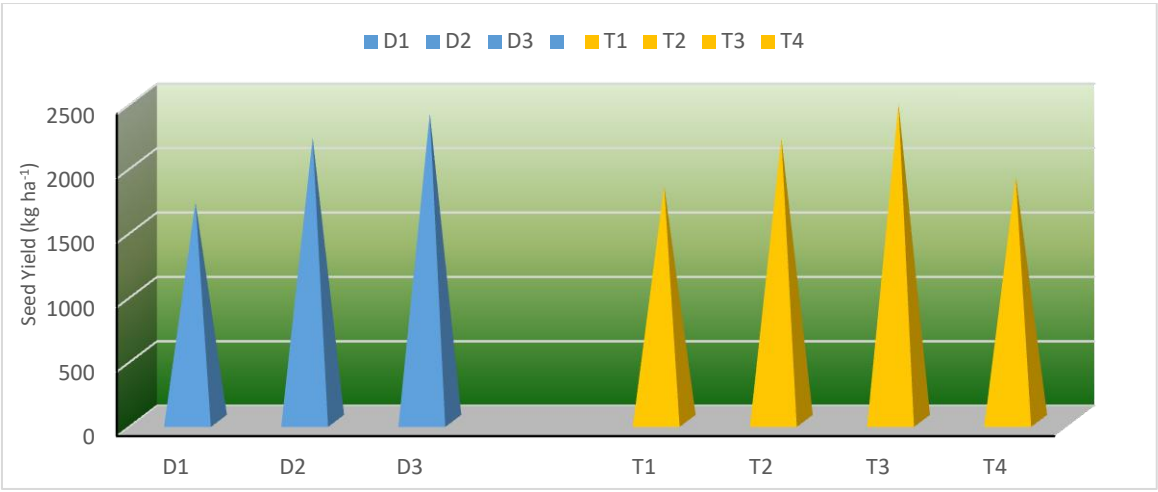

Fig. 1. Seed yield (kg ha^{-1}) of jute (*Corchorus olitorius*) as influenced by plant density and topping practices

Table 1. Drymatter accumulation (at harvest), number of capsules plant$^{-1,}$ number of seeds capsule^{-1}, Seed yield and Stalk yield of *olitorius* jute as influenced by plant density and topping practices

Treatments	Drymatter accumulation at harvest (kg ha^{-1})	Number of capsules plant^{-1}	Number of seeds capsule^{-1}	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})
Plant density					
D_1: 30 cm x 20 cm (1,66,666 plants ha^{-1})	6810	40.6	124.0	1699	5048
D_2: 45 cm x 10 cm (2,22,222 plants ha^{-1})	8335	35.0	109.6	2200	6134
D_3: 60 cm x 20 cm (83,333 plants ha^{-1})	9413	70.4	166.4	2388	6812
SEm±	434.1	3.00	11.28	144.6	387.5
CD (P=0.05)	1273	8.8	33.1	424	1136
Topping practices					
T_1: No topping	7172	44.9	127.2	1824	5324
T_2: 30 DAS	8292	49.4	135.2	2196	6077
T_3: 45 DAS	9286	51.1	140.1	2463	6718
T_4: 60 DAS	8021	49.2	130.8	1900	5873
SEm±	501.3	3.47	13.03	167.0	447.4
CD (P=0.05)	1470	NS	NS	489	1312
Interaction (D x T)					
SEm±	868.3	6.01	22.56	289.3	775.07
CD (P=0.05)	NS	NS	NS	NS	NS
CV%	6.1	7.1	9.8	7.9	7.5

Table 2. Gross returns (Rs ha^{-1}), Net returns (Rs ha^{-1}) and B: C Ratio of *olitorius* jute as influenced by plant density and topping practices

Treatments	Gross Returns (Rs ha^{-1})	Net Returns (Rs ha^{-1})	B: C Ratio
Plant density			
D_1: 30 cm x 20 cm (1,66,666 plants ha^{-1})	75550	48493	1.8
D_2: 45 cm x 10 cm (2,22,222 plants ha^{-1})	97544	69887	2.5
D_3: 60 cm x 20 cm (83,333 plants ha^{-1})	106010	79553	3.0
SEm±	6204.5	6204.5	0.23
CD (P=0.05)	18195	18195	0.6
Topping practices			
T_1: No topping	81066	55584	2.2
T_2: 30 DAS	97321	70339	2.6
T_3: 45 DAS	109094	81512	2.9
T_4: 60 DAS	84658	56476	2.0
SEm±	7164.3	7164.3	0.26
CD (P=0.05)	21010	21010	0.7
Interaction(D x T)			
SEm±	6204.6	6204.5	0.23
CD (P=0.05)	18195	18195	0.6
CV%	7.7	10.8	11.0

increased leading to more drymatter accumulation, more number of capsule per plant and increased number of seeds per plant which finally resulted in increasing the seed yield which lead to increased gross returns, net returns and BC ratio". These results are in agreement with the findings of Das et al. [4] and Pushpa [9].

4. CONCLUSION

The present experiment well highlighted the Yieldand economics of Olitorius jute at different plant densities and topping practices from the result we conclude that Olitorius jute sown at (60 cm x 20 cm) with a density of 83, 333 plants ha-1(D3) resulted in maximum seed and stalk yield together with increased gross and net returns and BC ratio which was significantly superior over (30 cm x 20 cm) with 1,66, 666 plants ha-1(D1).However, it was on par with (45 cm x 10 cm) 2,22,222 plants ha-1 (D2). Topping at 45 DAS (T3) resulted in highest seed yield, stalk yield, gross returns, net returns and B:C ratio and it was on par with topping at 30 DAS and 60 DAS, which was significantly superior over no topping (T1).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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