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Growth and yield of *Olitorius* jute at various plant densities and topping practices

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Abstract
A field trial was conducted during *kharif*, 2019 at Agricultural College Farm, Bapatla with the view to maximize the jute seed yield by manipulating certain non-monetary techniques associated with crop production like plant density and topping practices. The treatments comprised three plant densities [1.66 lakh plants ha^{-1} (D_1), 2.2 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)] which were laid out in a randomized block design with factorial concept in three replications with jute variety, JRO 524 (Navin). The results revealed that highest plant height and maximum leaf area index (LAI) of jute was obtained with 2,22,222 plants ha^{-1} (D_2) and with no topping practice(T_1) which was on par with 1,66,666 plants ha^{-1} (D_1) and was significantly superior over other plant density of 83,333 plants ha^{-1} (D_3) and topping practices *i.e.*T_2, T_3 and T_4. Sowing of jute with 2,22,222 plants ha^{-1} (D_2) took significantly less number of days for 50% flowering compared to density of 1,66,666 plants ha^{-1} (D_1) and 83,333 plants ha^{-1} (D_3). Maximum seed yield and stalk yield of jute was obtained with 83,333 plants ha^{-1} (D_3) and topping at 45 DAS (T_3).

Keywords: Jute, plant density, topping practices, leaf area index, yield

Introduction
Jute is the second most important commercial fibre yielding cash crop next to cotton. It is the major textile fibre as well as raw material for non-traditional and value added non textile products. Jute is one of the cheapest of all the textile fibres and is extensively used in the manufacture of packing material for agricultural and industrial products. It is also an important commercial crop of Assam, Bihar, Orissa and eastern Uttar Pradesh earning foreign exchange and supporting nearly 7 million small and marginal farmers and industrial employees (Kumar *et al*. 2010) [3]. This environment friendly natural fibre, jute has tremendous potential to sequester the atmospheric CO_2.One hectare of jute crop sequesters as high as 15 MT of CO_2 in 100 days, which is higher than that of several tree crops (Kumar *et al*. 2012) [4]. Non-availability of quality jute seed to the farmers at lower price and at proper time is one of the major constraints along with other edapho-climatological factors, non-adoption of line sowing, imbalanced fertilizer application and improper pest management practices. They depend for seed on non-jute growing states like Maharashtra, Andhra Pradesh, Karnataka and Telangana where the weather conditions are congenial for quality jute seed production. To minimize the hindrances towards getting higher jute seed production with uniform productivity across the growing zones the issues those are to be readily addressed include standardization of quality jute seed production technology. Seed production in jute can be enhanced by adopting suitable agro-techniques. Keeping these points in view, the present investigation was carried out to study the impact of plant density and topping on seed production in *olitorius* jute (*Corchorus olitorius* L.)" in Krishna – agro climatic zone of Andhra Pradesh.

Material and Methods
The experimental site was situated at an altitude of 5.49 m above mean sea level (MSL), 15^0 55'N latitude, 80^0 30' E longitude at Agricultural College Farm, Bapatla, which is about 8 km away from the Bay of Bengal in the Krishna Agro-climatic Zone of Andhra Pradesh. The soil is clay, having neutral pH, medium in organic C (0.68%), low in available N (196 kg ha) and medium in available P (24 kg ha) and high in available K (294.5 kg ha Climatologically, this area falls in the semi-arid tract with an annual rainfall of 623.3 mm. The experiment was laid out during, in a randomized block design with factorial concept and replicated thrice. Treatments were, plant density and topping practices, 1.66 lakh plants ha^{-1} (D_1), 2.2 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). Jute was sown on 14thAugust 2019. Recommended fertilizers @ 20 kg N, 30 kg P_2O_5 and 30 kg K_2O ha^{-1} were applied uniformly in the form of urea, single superphosphate and muriate of potash. Half of the nitrogen, entire quantity of phosphorus and potassium were applied basally. Remaining half of nitrogen was applied at 30 DAS. All recommended cultural practices and plant protection measures were followed throughout the crop growing season. Observations on growth parameters like plant height, leaf area index, days to 50% flowering and yield parameters like number of capsules/plants, number of seeds per capsule, test weight, seed yield and stalk yield were taken using standard procedures. Harvesting was done in month of December as per maturity of crop. The crop was threshed plot wise and seed yield obtained from net plot was converted into kg ha^{-1}.

Results and Discussion

Among the plant densities, significantly taller plants of jute was obtained with 2, 22,222 plants ha^{-1} (D_2) and it was on par with 1,66,666 plants ha^{-1} (D_1). The shortest plant height was observed with 83,333 plants ha^{-1} (D_3). Significantly highest plant height of jute was recorded from no topping (T_1) and it was significantly superior over remaining topping practices (Table 1). At higher plant densities, mutual shading might have increased the competition for sunlight in the community leading to elongation of internodes and encouraged the plant to grow tall and erect to capture more solar radiation. These results are in conformity with the findings of Parlawar *et al.* (2003) and Triveni (2010) [6, 10]. Maximum plant height was achieved without any topping practice. However, topping at 30 DAS recorded lowest plant height. This might be due to the reason that at initial stages of crop, growth was not, as no topping practices were tried. After 30 DAS, when the plants were subjected for topping, it must have got physical shock that reduced the growth considerably. Similar results were reported by Virdia (2011) and Patra *et al.* (2017) [11, 7].

A significant influence with plant densities only was observed with days to 50% flowering (Table 3). There was considerable increase in the number of days taken for days to 50% flowering from high plant density to low plant density of jute. Sowing of jute with 2,22,222 plants ha^{-1} (D_2) took significantly less number of days for 50% flowering compared to density of 1,66, 666 plants ha^{-1} ($D_{1)}$ and 83, 333 plants ha^{-1} (D_3). Crop sown at closer spacing (45 cm x 10 cm) reached the stage of 50 percent flowering earlier, followed by 30 cm x 20 cm and 60 cm x 20 cm spacing's probably due to abiotic stress created in high plant density at closer spacing and might have resulted in early transformation of vegetative phase into reproductive stage. Similar results were reported by Gaytan (2004) and Triveni (2010) [10].

The differences in leaf area index were non-significant among the topping practices tried at different growth stages of jute except at 75 DAS. Maximum leaf area index was noticed with high plant density of 2,22,222 plants ha^{-1} (D_2) which was on par with density of 1,66, 666 plants ha^{-1} ($D_{1)}$ (Table 2). Higher leaf area index was obtained without topping (T_1) which was significantly superior over other topping practices *i.e.*T_2, T_3 and T_4. Leaf area index (LAI) is the ratio of total leaf area and land area occupied by an individual plant and increment in spacing increases the area occupied by a single plant, which means more the spacing, less will be the leaf area index. Highest LAI was evident throughout the crop growth period in case of the closest spacing *i.e.*D_2 (45 cm x 10 cm) and LAI gradually decreased with the increment in spacing. In case of topping, no topping has given maximum LAI, which might be due to reason that topping increases number of lateral branches and this will be occupying more ground area, so LAI will decrease. These results are in accordance with the findings of Madakadze *et al*. (2007) and Das *et al.* (2018) [5, 1].

In case of test weight, there was significant influence with plant densities only. Both topping practices and interaction between plant densities and topping practices were found non-significant. Among the plant densities, significantly highest test weight was observed with 83, 333 plants ha^{-1} (D_3)and it was significantly superior over 2,22,222 plants ha^{-1} (D_2). However, it was on par with 1,66, 666 plants ha^{-1} ($D_{1)}$. Though test weight is a genetic character, the superiority of individual plant performance at wider spacing might be attributed to less plant competition for various nutrients, space, solar radiation etc. which finally led towards better growth and development of plants finally increased the test weight. Similar results were noticed by Tripathi *et al*. (2013) [9] and Sangeetha (2015) [8].

Maximum seed yield (2388 kg ha^{-1}) and stalk yield (6812 kg ha^{-1}) of jute were obtained in the crop sown at 60 cm x 20 cm with a density of 83, 333 plants ha^{-1} (D_3), which was significantly superior over 30 cm x 20 cm with 1,66, 666 plants ha^{-1}(D_1) and it was on par with 45 cm x 10 cm ha^{-1}(D_2).Topping at 45 DAS (T_3) recorded highest seed yield (2463 kg ha^{-1}) and stalk yield with 2, 22, 222 plants yield (6718 kg ha^{-1}), it was on par with topping at 30 DAS and 60 DAS.(Table 3). 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 dry matter 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*. (2013) [9], Ghosh and Das (2015) [2] and Patra *et al*. (2017) [7].

Table 1: Plant height of jute at different growth stages as influenced by plant densities and topping practices

Treatments	Plant height (cm)						
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	At Harvest
Plant density							
D_1: 30 cm x 20 cm (1,66,666 plantsha$^{-1)}$	29.0	135.7	185.9	255.7	258.3	262.0	267.0
D_2: 45 cm x 10 cm (2,22,222 plants ha^{-1})	44.5	143.6	233.0	262.0	267.1	271.1	279.0
D_3: 60 cm x 20 cm (83,333 plants ha^{-1})	27.8	130.0	159.0	226.0	255.3	260.0	265.0
S.Em±	4.77	13.39	20.13	23.26	23.91	22.51	25.52
CD (P=0.05)	13.9	NS	59.0	NS	NS	66.0	NS
Topping practices							
T_1: No topping	36.4	180.9	202.9	258.9	273.8	284.2	290.2

T_2: 30 DAS	30.5	110.7	178.2	241.3	249.9	259.9	262.9
T_3: 45 DAS	34.6	125.4	195.0	254.2	266.6	270.6	274.6
T_4: 60 DAS	33.6	128.9	194.4	237.2	256.0	262.0	269.0
S.Em±	5.51	15.46	23.25	26.86	27.61	25.99	29.47
CD (P=0.05)	NS	45.3	NS	78.7	80.9	NS	86.4
Interaction (D x T)							
S.Em±	9.54	26.78	40.26	46.52	47.82	45.02	51.04
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS
CV%	16.3	11.3	10.8	10.8	10.5	10.0	10.2

Table 2: Leaf area index of jute at different growth stages as influenced by plant densities and topping practices

Treatments	Leaf area index						
	30 DAS	**45 DAS**	**60 DAS**	**75 DAS**	**90 DAS**	**105 DAS**	**At Harvest**
Plant density							
D_1: 30 cm x 20 cm (1,66,666 plantsha$^{-1)}$	0.320	2.931	4.898	5.514	1.823	1.696	1.592
D_2: 45 cm x 10 cm (2,22,222 plants ha^{-1})	0.390	3.411	5.616	7.634	2.774	2.633	1.967
D_3: 60 cm x 20 cm (83,333 plants ha^{-1})	0.226	1.688	3.837	4.699	1.597	1.478	1.503
S.Em±	0.0342	0.3724	0.4745	0.6512	0.2662	0.2314	0.1132
CD (P=0.05)	0.099	1.104	1.377	1.925	0.774	0.668	0.332
Topping practices							
T_1: No topping	0.321	2.934	4.936	6.596	2.300	2.100	1.797
T_2: 30 DAS	0.316	2.714	4.734	5.621	2.210	1.981	1.528
T_3: 45 DAS	0.287	2.623	4.667	5.623	2.063	1.926	1.717
T_4: 60 DAS	0.324	2.721	4.823	5.901	2.200	2.000	1.800
S.Em±	0.0391	0.4324	0.5426	0.7536	0.3081	0.2625	0.1335
CD (P=0.05)	NS	NS	NS	2.214	NS	NS	NS
Interaction (D x T)							
S.Em±	0.0342	0.3742	0.4746	0.6582	0.2646	0.2348	0.2341
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS
CV%	12.4	16.1	11.2	12.6	14.6	13.4	7.7

Table 3: Days to 50% flowering, test weight, seed and stalk yield of jute as influence by plant densities and topping practices

Treatments	Days to 50% flowering	Test weight (g)	Seed yield (Kg ha^{-1})	Stalk yield (Kg ha^{-1})
Plant density				
D_1: 30 cm x 20 cm (1,66,666 plantsha^{-1})	57	2.7	1699	5048
D_2: 45 cm x 10 cm (2,22,222 plants ha^{-1})	55	2.6	2200	6134
D_3: 60 cm x 20 cm (83,333 plants ha^{-1})	65	2.8	2388	6812
S.Em±	8.1	0.05	144.6	387.5
CD (P=0.05)	24	0.14	424	1136
Topping practices				
T_1: No topping	65	2.7	1824	5324
T_2: 30 DAS	67	2.8	2196	6077
T_3: 45 DAS	66	2.7	2463	6718
T_4: 60 DAS	65	2.7	1900	5873
S.Em±	9.4	0.06	167.0	447.4
CD (P=0.05)	NS	NS	489	1312
Interaction (D x T)				
S.Em±	16.3	0.10	289.3	775.07
CD (P=0.05)	NS	NS	NS	NS
CV%	14.3	2.0	7.9	7.5

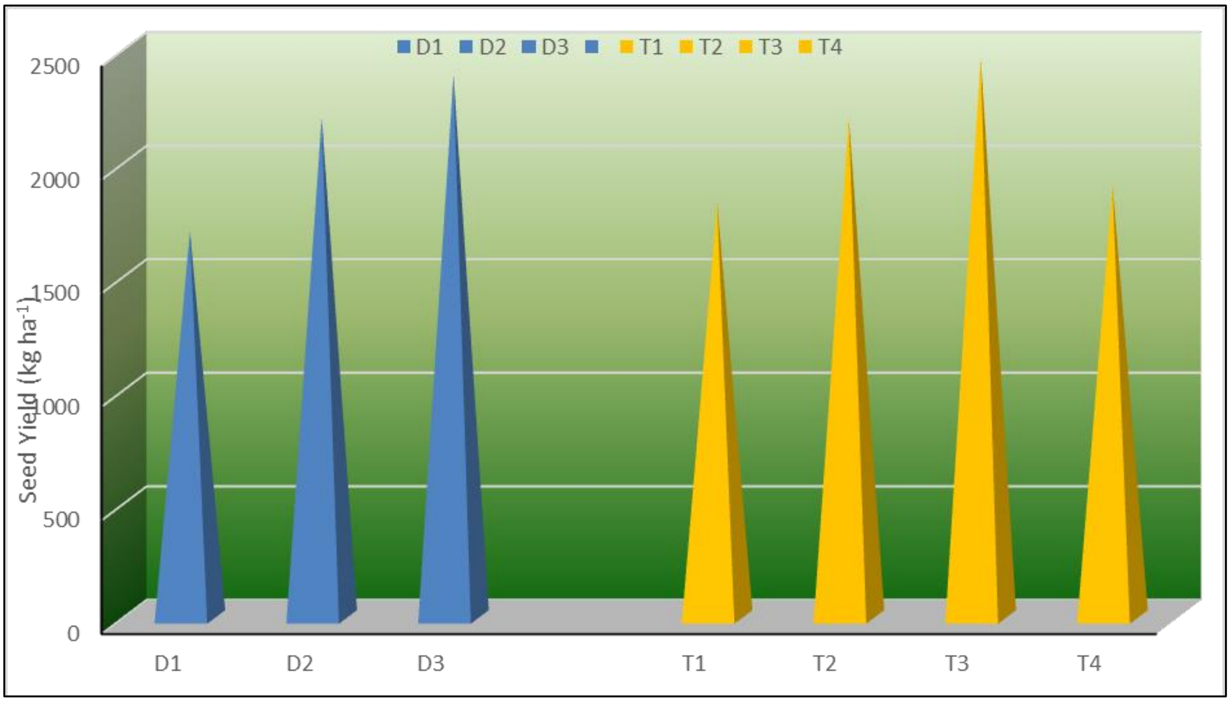

Fig 1: Seed yield of jute as influenced by plant densities and topping practices

Conclusion

There is a scope to improve total seed yield in jute by the adjustment of plant density and topping at appropriate stage of growth. Plant density of 83,333 plants ha^{-1}and with topping at 45 DAS could be recommended for enhancement of total seed yield in *olitorius* jute in Krishna – agro climatic zone of Andhra Pradesh.

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