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Seed Yield of Jute as Influenced by Plant Densities and Topping Practices

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ABSTRACT: Seed production in jute can be enhanced by adopting suitable agro-techniques. Among the various agro-techniques, plant density is an important yield contributing factor which can be changed to obtain higher yield in jute. Another important factor is topping which is (clipping of apical buds). An experiment was conducted during *kharif*, 2019 at Agricultural College Farm, Bapatla with 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)] in a randomized block design with factorial concept using JRO 524 (Navin) variety of jute in three replications. Results indicated that maximum leaf area index (LAI) and light interception 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. Among the plant densities, maximum canopy temperature was noticed with plant density of 83, 333 plants ha^{-1} (D_3) and lowest canopy temperature ($^{\circ}$C) was measured at a plant density of 2,22,222 plants ha^{-1} (D_2). The highest seed yield of jute was recorded with treatment (D_3) which was significantly superior over treatment (D_1). Topping at 45 DAS (T_3) recorded maximum seed yield. It was on par with topping at 30 DAS and 60 DAS which was significantly superior over no topping (T_1). However, maximum seed yield (2388 kg ha^{-1}) of jute was obtained in crop sown with (60 cm × 20 cm) with a density of 83, 333 plants ha^{-1} (D_3) and with Topping at 45 DAS (T_3).

Keywords: Jute, Plant density, Topping practices, Leaf area index,light interception and Canopy Temperature.

INTRODUCTION

Jute is a very important prospective fibre as well as cash crop of West Bengal. 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). Jute is the major textile fibre as well as raw material for non-traditional and value added non textile products. It 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. India is the largest producer of jute with 0.98 million hectares under cultivation with an annual production of 9.76 million bales during 2019-2020 (Ministry of Agriculture, Govt. of India). It has been reported that quality seeds of an improved variety can itself provide 20 percent additional yield of the crop (Hossain *et al*., 2009) over that obtained from the use of local seed.

West Bengal occupies 70% area under jute in the country but it is mainly grown for fibre purpose only. Non-availability of quality jute seed to the farmers at lower price and at proper time is one of the major constraints. They depend for seed on non-jute growing states like Maharashtra, Andhra Pradesh, Karnataka and Telangana where the weather conditions are congenial for quality 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. Among the agro-techniques, plant density is an important yield contributing factor which can be manipulated to obtain higher yield in jute. The number of plants per unit area is positively correlated with yield. Another important factor is topping (clipping of apical buds) and when the apical buds are clipped off at the appropriate stage, it breaks the apical dominance and induces development of lateral branches which increases the seed yield by producing a greater number of capsules pod^{-1} (Roy, 2013).

However, strategies for increasing the seed production of jute include growing of resistant varieties for water logging, improving technologies for topping practices, nutrient management, water management and proper method of sowing.

Consequently, there is need to develop a better management practice. With this background, the present study was conducted with the main objective to identify the best treatment for jute seed production among different plant densities and topping practices in Krishna – agro climatic zone of Andhra Pradesh.

MATERIAL AND METHODS

The experiment was conducted at Agricultural College Farm, Bapatla, Andhra Pradesh during *kharif* 2019. During the crop growth period, the weekly mean maximum temperatures ranged from 29.8 $^{\circ}$C to 35.4 $^{\circ}$C with an average of 31.7 $^{\circ}$C and the weekly mean minimum temperatures ranged from 20.0 $^{\circ}$C to 26.4 $^{\circ}$C with an average of 24.7 $^{\circ}$C. A total rainfall of 623.3 mm was received in 26 rainy days during the crop growth period. The soil of the experimental field was clay in texture, neutral in reaction, medium in organic carbon and low in available nitrogen, high in phosphorus and potassium. The experiment was laid out in randomized block design with factorial concept and replicated thrice with two factors *i.e.*, plant density and topping practices. The treatments included three plant densities i.e. 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 14th August, 2019. Recommended fertilizers@20kgN, 30kg P_2O_5 and 30kg K_2 Oha^{-1}. Light interception was measured by using quantum sensor. The readings were taken in the morning between 10 to 11.30 AM from upper, middle and lower leaves and expressed as mean light interception in lux units. Canopy temperature is measured with an infrared thermometer to infer transpiration rates and moisture stress in plants as opined by Tanner *et al.* (1996). Seed and stalk yield were taken using standard procedures from net plot area to which the yield of tagged plants were also added and expressed in kgha^{-1}.

RESULTS AND DISCUSSION

A. Leaf area index

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). 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 × 10 cm) and LAI gradually decreased with the increment in spacing.

Table 1: Leaf area index of *olitorius* jute at different growth stages as influenced by plant density 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 × 20 cm (1,66,666 plants ha^{-1})	0.320	2.931	4.898	5.514	1.823	1.696	1.592
D_2: 45 cm × 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 × 20 cm (83,333 plants ha^{-1})	0.226	1.688	3.837	4.699	1.597	1.478	1.503
SEm±	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
SEm±	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 × T)							
SEm±	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

In case of topping practices, no topping has given maximum LAI, which might be due to the 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).

B. Light Interception

Maximum light interception was observed from plant density D_2 which was significantly superior over D_3. It was on par with treatment D_1. Among the topping practices, maximum light interception was recorded from no topping (T_1) which was significantly superior over the other topping practices. Interaction between plant densities and topping practices also were non-significant. Light interception is dependent on leaf area index (LAI). The highest LAI was evident throughout the crop growing period in case of the closest spacing *i.e.* D_2 (45 cm × 10 cm) and LAI gradually decreased with the increment in spacing, at closer spacing D_2 *i.e.* (45 cm × 10 cm) light interception increased.

In case of topping practices, light interception was more with no topping (T_1), where LAI was more. However, when topping was done at different stages, there was increase in lateral branches leading to less LAI and less light interception. Hence, with no topping practice light interception was more. The results are in accordance with the findings of Das *et al.* (2018).

Table 2: Light interception of *olitorius* jute at different growth stages as influenced by plant density and topping practices.

Treatments	Light interception (Lux)						
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	At HARVEST
Plant density							
D_1: 30 cm × 20 cm (1,66,666 plants ha^{-1})	3222.9	4539.6	4274.9	4766.2	3227.9	2073.2	1220.0
D_2: 45 cm × 10 cm (2,22,222 plants ha^{-1})	3483 .4	4606.5	4385.6	5372.6	3483.4	1936.7	1748.5
D_3: 60 cm × 20 cm (83,333 plants ha^{-1})	2497.1	4080.4	4236.5	4971.0	2503.8	1779.8	943.5
SEm±	376.14	442.56	304.23	603.95	377.02	148.82	174.84
CD (P=0.05)	1103.0	NS	NS	NS	1105.6	NS	512.7
Topping practices							
T_1: No topping	3688.9	5922.2	5214.4	6936.0	3693.3	2415.8	1572.8
T_2: 30 DAS	2991.9	3991.9	4134.8	4850.9	3004.1	1784.0	1083.6
T_3: 45 DAS	3049.8	3816.5	3965.2	3560.2	3055.3	1514.8	1072.9
T_4: 60 DAS	3127.1	3904.8	4264.2	4862.1	3135.9	1852.7	1610.9
SEm±	434.33	511.03	351.30	697.38	435.34	171.85	201.88
CD (P=0.05)	NS	1498.6	1030.2	2045.1	NS	503.9	NS
Interaction (D × T)							
SEm±	752.28	885.13	608.47	1207.9	754.04	297.65	349.67
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS
CV%	13.5	11.6	8.2	14.0	13.5	8.9	16.0

C. Canopy Temperature (°C)

Canopy Temperature (°C) of jute measured at different growth stages was significantly influenced by plant densities, while the topping practices could not alter canopy temperature (°C) to a statistically perceptible level. Among the plant densities, maximum canopy temperature was noticed with plant density of 83, 333 plants ha^{-1} (D_3) and lowest canopy temperature (°C) was measured at a plant density of 2,22,222 plants ha^{-1} (D_2). Under moderate plant density there was a lower mean daily temperature compared to normal plant density. It was due to the fact that under the high plant density, competition for nutrients, space, solar radiation occurs which finally lead to abiotic stress created in plant system and cause cooling of plant leaf canopy temperature compared to surrounding temperature. These results are in accordance with the findings of Zheng *et al*. (2014).

D. Seed yield

Maximum seed yield (2388 kg ha^{-1}) and stalk yield (6812 kg ha^{-1}) of jute was obtained in crop sown with (60 cm × 20 cm) with a density of 83, 333 plants ha^{-1} (D_3), which was significantly superior over 30 cm × 20 cm with 1,66, 666 plants ha^{-1} (D_1) and it was on par with 45 cm × 10 cm ha^{-1}(D_2). Topping at 45 DAS (T_3) recorded highest seed yield (2463 kg ha^{-1}) and stalk yield (6718 kg ha^{-1}), it was on par with topping at 30 DAS and 60 DAS, which was significantly superior over no topping (T_1). 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.

Table 3: Canopy temperature of *olitorius* jute at different growth stages as influenced by plant density and topping practices.

Treatments	Canopy temperature (°C)						
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	At HARVEST
Plant density							
D_1: 30 cm × 20 cm (1,66,666 plants ha^{-1})	27.2	27.4	28.4	30.4	29.9	27.0	27.2
D_2: 45 cm × 10 cm (2,22,222 plants ha^{-1})	25.4	25.5	28.0	27.6	27.9	25.5	25.4
D_3: 60 cm × 20 cm (83,333 plants ha^{-1})	35.6	36.0	40.3	40.9	39.9	36.0	35.6
SEm±	2.84	3.04	3.51	3.73	3.36	2.93	2.84
CD (P=0.05)	8.3	8.9	10.2	10.9	9.8	8.6	8.3
Topping practices							
T_1: No topping	26.2	29.6	30.4	29.3	29.9	29.1	26.2
T_2: 30 DAS	33.8	29.8	39.1	39.4	38.7	29.8	30.6
T_3: 45 DAS	28.7	28.9	30.0	31.1	30.5	30.0	30.4
T_4: 60 DAS	28.9	30.1	30.3	31.9	31.3	30.1	28.9
SEm±	3.28	3.51	4.05	4.31	3.88	3.39	3.28
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS
Interaction(D x T)							
SEm±	5.69	6.07	7.01	7.46	6.72	5.87	5.69
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS
CV%	11.2	11.8	12.4	13.0	11.9	11.5	11.2

Table 4: Seed yield and Stalk yield (kg ha^{-1}) of *olitorius* jute as influenced by plant density and topping practices.

Treatments	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})
Plant density		
D_1: 30 cm × 20 cm (1,66,666 plants ha^{-1})	6134	5048
D_2: 45 cm × 10 cm (2,22,222 plants ha^{-1})	6812	6134
D_3: 60 cm × 20 cm (83,333 plants ha^{-1})	387.5	6812
SEm±	1136	387.5
CD (P=0.05)	424	1136
Topping practices		
T_1: No topping	1824	5324
T_2: 30 DAS	2196	6077
T_3: 45 DAS	2463	6718
T_4: 60 DAS	1900	5873
SEm±	167.0	447.4
CD (P=0.05)	489	1312
Interaction(D x T)		
SEm±	289.3	775.07
CD (P=0.05)	NS	NS
CV%	7.9	7.5

These results are in tune with the findings of Tripathi *et al*. (2013), Ghosh and Das (2015) and Patra *et al*., (2017).

CONCLUSION

By adjusting the plant density and topping practices, the seed yield of *olitorius* jute could be increased in coastal Andhra Pradesh.

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