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Fibre Development of Jute (*Corchorus olitorius* L.) as Influenced by Row Distance and Nitrogen Fertilizer Rate

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A b s t r a c t

Appropriate nitrogen fertilizer rate and row distance are important agronomic practices for optimum fibre development of jute. A field experiment was conducted at the Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, University of Rajshahi, from April 2017 to September 2017 to evaluate the effect of row distance and nitrogen fertilizer (urea) rate on fibre development of jute. The experiment was set up using a split-plot experimental design, placing three different row distances- S_1 (20×5 cm), S_2 (25×5 cm) and S_3 (30×5 cm) in the main plot and three nitrogen fertilizer (urea) rates viz. N_1 (112 kg ha^{-1} or 75% of standard BJRI urea recommendation), N_2 (150 kg ha^{-1} or 100% of standard BJRI urea recommendation) and N_3 (187 kg ha^{-1} or 125% of standard BJRI urea recommendation) in the subplot. Except for experimental treatments, standard agronomic practices were maintained for all plots. The results indicated that a wide row distance (30cm) can effectively develop fibre area (1.88 mm, 2.48 mm, 2.84 mm, and 3.82 mm at 40, 60, and 80 DAS and harvest days, respectively) but not maintain higher fibre yield, stick yield, and biological yield because of lower planting density. Narrow row spacing (20 cm) allows for more plants per plot while increasing total fibre yield (2.33 t ha-^{1}), stick yield (5.35 t ha^{-1}) and biological yield (7.68 t ha^{-1}). Considering nitrogen fertilizer (urea) rates, maximum fibre yield (2.30 t ha^{-1}), stick yield (5.32 t ha^{-1}) and biological yield (7.62 t ha^{-1}) were found with a maximum fertilizer rate (187 kg ha^{-1}). From our observation, it can be suggested that 20 cm row spacing with 187 kg urea would be the best practice for jute production in the experimental area.

Keywords: Nitrogen fertilizer,Row distance and Fibre development.

Introduction

Jute (*Corchorus olitorius L.*) is an important fibre crop as well as one of the main cash crops in Bangladesh. It is considered the golden fibre of Bangladesh. It is one of the cheapest and the strongest of all natural fibres and is considered the fibre of the future. Jute is second only to cotton in the world's production of textile fibres. India, Bangladesh, China and Thailand are the leading producers of jute. Among the jute-growing countries of the world, Bangladesh ranks second in terms of production.

Jute grows abundantly in Bangladesh best quality in comparison with that of India (Zakaria and Syed, 2008). Total jute production for this year has been estimated at 82,46,797 bales, which is 9.10% higher than that of last year. It fetched Tk. 2,939.5 crore by exporting raw jute and jute products in this fiscal year (BBS, 2016-2017).

Bangladeshi scientist Professor Dr Maqsudul Alam has successfully decoded the jute plant genome, opening up a new vista in the development of a variety of the world's most adorned biodegradable natural fibre in 2010 (Islam *et al.,* 2017).

Bangladeshi Scientist Md. Mahbubul Islam has successfully produced Novocel wool from jute. The Novocel wool blanket is now popular among buyers in the home market. Polythene-made nursery pot has proved to be harmful. At the time of plantation of the sapling polythene nursery bags needed to be removed as it is not bio-degradable. But the jute nursery pot is bio-degradable and need not be removed. Bangladesh is trying to increase the non-traditional use of jute (Islam and Ali, 2018). Once jute was our main exporting goods. The golden days of those fibres have gone. Bangladesh earned huge foreign currency by exporting jute. Before the 70s, till ready-made garments appeared, we earned a fabulous sum of foreign currency from jute. After the country's independence, more than 80% of the total foreign currency in Bangladesh was earned from jute and jute-related goods. But after the '80s, the earning rate of foreign currency from the jute industry gradually declined. Owing to mismanagement and lack of foresight we have already lost our golden age of jute. The present condition of jute as a cash crop in Bangladesh is very miserable. Due to the reduction of market demand, cultivation area and production of jute reduced dramatically after 1990 (Akhter *et al*., 2016). To overcome this situation, the Government of Bangladesh takes several initiatives to increase the use of jute. Jute also holds an important position in the industrial sector of the economy of Bangladesh.

Bangladesh is the drainage basin of big rivers and being bestowed with alluvial soil and availability of non-stagnant water for jute retting has a distinct agroecological comparative advantage in the production of best quality fibre (Islam *et al.,* 2009).

Recently jute fibres are used in a wide range of diversified products: decorative fabrics, chic saris, salwar kameezes, soft luggage, footwear, greeting cards, moulded door panels and other innumerable useful consumer products. Supported by several technological developments today jute can be used to replace expensive fibres and scarce forest materials.

Considering jute exports, Bangladesh ranks first (2.99 t ha^{-1}) and shows the highest dry fibre yield (3.15t ha^{-1}) (Mukul *et al*.,2021). It is, therefore, necessary to understand physiological and anatomical characteristics as well as proper agronomic management practices related increase fibre yield. Bast fibre production is closely correlated with plant population and nitrogen uptake rates. Plant density is the function of the spacing between the rows and plants. Under various spacing, the plants manifest a remarkable capacity to exploit environments with varying competition stresses for moisture, light, nutrition and carbon dioxide and thus, the plant growth is affected accordingly. Plant density is an important yield contributing factor which can be manipulated in jute to obtain higher fibre production per unit area. The yield of many crops is known to be positively correlated with the number of plants per unit area in the field. If the number of plants is lower or higher than what is best, the final output is hurt. To require plant density, one of the major yield components of jute is optimum seed rate, resulting in proper spacing to maintain the uniformity of stand for better growth and development of the plant (Masum *et al*., 2011).

(Islam *et al.*, 2010) reported that four plant densities (348, 261, 323 and 174 thousand $acre^{-1}$) were arranged in different planting patterns of 45, 60, 67.5 cm and 90 sq cm $plant^{-1}$. Although there were no significant differences in yield between the treatments, higher densities of the population produced a higher yield. For example, among the sowing patterns, 15cm × 7.5cm had the highest yield followed by 22.5cm × 5cm and 10cm ×11.25cm. However, the 22.50cm row width displayed better performance compared to other row widths.

The plant population is known to affect vegetative growth and reproductive development. The optimum plant population utilizes available moisture and nutrients from the soil more effectively and leads to better dry matter production, which can reflect crop yield. Nitrogen fertilizer is also important for fibre development and yield) (Saleem *et al*., 2020).

Plant Materials and Growth Conditions

The experiment was conducted at the Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, University of Rajshahi, Rajshahi during the period from April 2017 to September 2017, to study Jute fibre development as influenced by row distance and nitrogen fertilizer rate. This chapter talks about the things that were used and the steps that were taken during the experiment. A brief description of the experimental site, soil, Climate, experimental design, treatments, cultural operations, data collection, and statistical analysis are narrated under the following heads. The experimental field was situated on the western side of the Agronomy and Agricultural Extension Department. Geographically the experimental field was located at $24^{0}22'36''$ N latitude and $88^{0}38'\ 36''$E longitude at an elevation of 20m above sea level. The land of the experimental field was flat, well-drained and above flood level (Medium high land). The soil was sandy loam textured having a pH value of 8.1 composite soil sample was collected from 0-15cm depth of the experimental plot before applying any fertilizer and was analyzed for physical and chemical properties.

The experimental area has a subtropical climate with high temperatures, high humidity, and heavy rainfall with occasional gusty winds during the *Kharif* season (April-September) and rainfall with moderate temperatures during the *Kharif-1* season (April-September). During the experiment highest (353.4 mm) rainfall was observed in July, and average rainfall (123.8 mm) was found in the rest of the other months. Average minimum and maximum temperatures were found at 24° C and 37.72° C, respectively. The experimental area was previously cropped with maize *(Zea mays L.)* in the preceding *rabi* season. In the rabi season before the experiment, the area was used to grow maize.

Experimental treatments

The experiment was carried out with two factors. Factor- A: Row Spacing (three-row distances): S_1= 20 cm row distance, S_2= 25 cm row distance and S_3= 30 cm row distance and Factor - B: Nitrogen fertilizer rate (three rates): N_1= 112 kg N ha^{-1}, N_2= 150 kg N ha^{-1} and N_3= 187 kg N ha^{-1}. Thus, there were two factors, the first factor at three levels and the second factor at three levels, the total treatment combinations being 9 and replicated three times. A popular Tossa jute variety OM-1 released by The Bangladesh Jute Research Institute (BJRI) was used for the study. It is a high-yielding variety with a fibre yield potential of 34 to 36 q ha^{-1}. It exhibits resistance to premature flowering when sown from the 2nd week of March to the middle of May. It has field resistance to yellow mites and root rot. Fibre is easier to extract after retting. The experiment was laid out in a Split-Plot Experimental Design placing row distance in the main plot and fertilizer rates in the subplot. Three-row distances and three nitrogen fertilizer rates are combined into nine treatments and those were replicated three times. The total number of plots was 27, where each unit plot was 10 m^2 (5 m× 2 m). 1 m gap within the subplot and 2m gap within the main plots were maintained.

Crop cultivation and agronomic management

The land was first opened with a power tiller on 28 April 2017. Later on, the land was ploughed and cross-ploughed three times, followed by laddering. Repeatedly spading each plot of land until the soil had a good tilth and was ready to plant seeds. The weeds and stubbles were removed to clean the land. To supply water, drainage channels were made around the experimental plots. The following quantities of fertilizer were applied. Nitrogen was applied in the form of urea (46 % N) as per the treatments in 3splits *i.e.,* ½ at the time of sowing, ¼ at 20 DAS and ¼ at 45 DAS after the first and second wedding. A common dose of 60 kg P_2O_5 and 60 kg K_2O ha^{-1} was applied in the form of single superphosphate (SSP) and muriate of potash (MOP), respectively, at the time of sowing. Bold and healthy seeds were hand dibbled into the soil by adopting a spacing of 20 cm x 5 cm, 25 cm x 5 cm and 30 cm x 5 cm to obtain required planting densities of 200000, 160000 and 133333 plants ha^{-1}, respectively. Thinning was done to maintain the required plant population. Weeding was done manually at 20 and 45 DAS. Thereafter, the jute crop smothered the weeds, which did not necessitate weeding. Irrigation was given immediately after sowing for ensuring proper germination and plant stand. Subsequent irrigations were provided as and when required. The incidence of hairy caterpillars was observed during the crop growth period, which was controlled by spraying Diazinon 60 EC @ 1.5 ml/L twice at 30 and 45 DAS to protect the crop. The field was under constant observation. Crop production was satisfactory throughout the experiment. At maturity, the experimental crops were harvested plot-wise on 15 September 2017. Before harvesting, $1m^2$ plant samples were selected randomly and uprooted from each plot for data recording. The harvested crops from each plot were bundled separately, tagged and brought to the clean threshing floor. The same procedure was followed for the sample plant (5 plants from each plot). The data on the different parameters of jute were collected from randomly selected five plant samples collected from the middle portion of the plot ($1m^2$). Data on some morpho-physiological, yield and yield components were collected at the final harvest.

The data recorded were compiled and tabulated for statical analysis. The collected data were analyzed statistically using the statistical package "STATVIEW" (Gomez and Gomez, 1984). The mean differences were adjudged by Duncan's multiple range test (DMRT), (Steel and Torrie, 1960).

Results and Discussion

During our study, growth, yield contributing characters and yield of jute were evaluated. Jute plant height varied significantly depending on row distance **(Table 1).** Experimental results showed that the plant height varied significantly due to row space. The highest plant height (205.89 cm) was observed in S_1 which was reduced slightly by 1.99% in S_2, but significantly by 5.86% in S_3 (**Table 1**). Significant differences in plant heights were recorded due to different nitrogen fertilizer rates. The superior plant height (214.40 cm) was observed from the highest nitrogen levels (N_3), and it reduced significantly by 8.47% and 10.97% for N_2 and N_1, respectively (**Table 1**). Nitrogen induced exuberant vegetative growth and for this reason, a higher rate of nitrogen resulted in increased plant height in this experiment. The increase in plant height in response to higher levels of nitrogen conformed with the previous findings of (Indulekha 2012). Table 1 shows that the interaction between the distance between rows and the amount of nitrogen fertilizer had no big effect on the height of the plants. The longest plant height (219.28 cm) was obtained from the combination of S_1N_3 and the smallest plant height (185.62 cm) was found from the interaction of S_3N_1.

The effect of row distance on the number of leaves of jute was not statistically significant at 20 DAS but it varied significantly at 40, 60 and 80 DAS (**Table 1**). The number of leaves was not viciously influenced by row spacing at 20 DAS and the maximum number of leaves per plant (7.64) was found in S_2 and the minimum number of leaves (7.07) was obtained at S_3. At 40 DAS, the maximum number of leaves per plant (19.86) was observed in S_3 and the minimum number of leaves (18.19) was in S_1. The number of leaves reduced significantly by 5.23% and 8.41% for S_2 and S_1 respectively. At 60 DAS, the maximum number of leaves per plant (53.33) was observed in S_3 which was reduced significantly by 14.14% and 30.09 % for S_2 and S_1 respectively. At 80 DAS, the maximum number of leaves per plant (89.62) was observed in S_3, which was reduced significantly by 12.33% and 23.16 % for S_2 and S_1 respectively. Data revealed that the number of leaves per plant decreased significantly with narrow (20cm) row space. In general, branching was influenced by interplant competition. Closer spacing resulted in more interplant competition for various resources and the number of leaves was affected adversely, whereas wider spacing facilitated the individual plant to develop properly because of more availability of sunlight, moisture and nutrients. These results were the following results reported by (Haque *et al.,* 2022) in jute.

The number of leaves per plant was also significantly influenced by nitrogen levels. It was evident from (**Table 1**) that an increase in levels of nitrogen increased the number of leaves per plant. The effect of nitrogen fertilizer on the number of leaves of jute was not statistically significant at 20 DAS. But it varied significantly at 40, 60 and 80 DAS. At 20 DAS, the maximum number of leaves per plant (7.52) was observed in N_1 and the minimum number of leaves (7.05) was in N_3. At 40 DAS, the maximum number of leaves per plant (19.69) was found in N3, which was reduced significantly by 4.62% and 6.65% for N_2 and

Table 1. Effect of row distance, nitrogen fertilizer rate and their interaction on plant height, number of leaf plant^{-1} and leaf area of jute.

Row distance	Plant height (cm)	Number of the leaf (plant^{-1})				Leaf area (LA) cm^2			
		20DAS	40 DAS	60 DAS	80 DAS	20 DAS	40 DAS	60 DAS	80 DAS
S_1	205.89 a	7.37	18.19b	37.28c	68.86c	140.19	456.61b	726.56c	1137.98c
S_2	201.78 a	7.64	18.82b	45.79b	78.57b	140.5	462.61b	749.29b	1145.59b
S_3	193.83 b	7.07	19.86a	53.33a	89.62a	143.23	479.46a	766.23a	1155.89a
LS	**0.05**	**NS**	**0.05**	**0.01**	**0.01**	**NS**	**0.01**	**0.01**	**0.01**
Nitrogen fertilizer rate									
N_1	190.88 b	7.52	18.38b	39.64c	70.94c	130.47	427.36c	730.47c	1127.19c
N_2	196.23 b	7.51	18.78b	45.22b	78.64b	146.01	474.41b	744.86b	1147.86b
N_3	214.40 a	7.05	19.69a	51.53a	87.47a	147.46	496.92a	766.75a	1164.41a
LS	**0.01**	**NS**	**0.05**	**0.01**	**0.01**	**NS**	**0.01**	**0.01**	**0.01**
Interaction									
S_1N_1	194.5	7.78	17.78	33.30e	61.3	125.4	411.11	707.25	1118.08
S_1N_2	203.91	6.89	17.92	37.89d	70.03	147.63	467.71	723.37	1136.75
S_1N_3	219.28	7.45	18.85	40.66d	75.26	147.56	491	749.04	1159.11
S_2N_1	192.5	7.44	18.48	40.41d	71.08	130.23	423.74	736.78	1127.16
S_2N_2	197.05	8.22	18.78	45.14c	77.47	143.02	470.67	745.37	1147.53
S_2N_3	215.79	7.26	19.19	51.82b	87.16	148.27	493.42	765.74	1162.07
S_3N_1	185.62	7.33	18.89	45.22c	80.45	135.78	447.22	747.38	1136.31
S_3N_2	187.72	7.44	19.64	52.64b	88.42	147.37	484.84	765.84	1159.31
S_3N_3	208.14	6.44	21.04	62.12a	100	146.55	506.33	785.48	1172.05
LS	**NS**	**NS**	**NS**	**0.05**	**NS**	**NS**	**NS**	**NS**	**NS**
CV%	**3.76**	**8.27**	**4.24**	**4.12**	**5.76**	**5.63**	**4.48**	**4.12**	**4.02**

Mean values in a column having the same letter (s) or without a letter do not differ significantly, whereas, with a dissimilar letter (s) differ significantly as per DMRT, NS= Non-significant, CV= Co-efficient of variation, LS= Level of significance, DAS= Days after sowing, S1= 20 cm, S2= 25 cm, S3= 30 cm, N1= 112 kg ha-1, N2= 150 kg ha-1, N3= 187 kg ha^{-1}.

Table 2. Effect of row distance, nitrogen fertilizer & their interaction rate on TDM &CGR on Jute

Row distance	Total Dry Matter (TDM) gm^{-2}				Crop Growth Rate (CGR) gm m² day		
	20 DAS	40 DAS	60 DAS	80 DAS	20-40 DAS	40-60 DAS	60-80 DAS
S_1	33.56	98.49a	383.89a	708.62a	3.61a	15.86a	19.67a
S_2	32.96	93.91b	306.56b	651.57b	2.77b	9.67b	15.68b
S_3	32.19	88.72c	276.50c	579.12c	2.02c	6.71c	10.81c
LS	NS	0.01	0.01	0.01	0.01	0.01	0.01
Nitrogen fertilizer rate							
N_1	32.36	85.34c	287.33c	605.01c	2.43c	9.53c	14.48
N_2	32.57	94.75b	318.06b	648.85b	2.87b	10.47b	15.19
N_3	33.78	101.04a	361.56a	685.47a	3.09a	12.23a	18.87
LS	NS	0.01	0.01	0.01	0.01	0.01	NS
Interaction Row distance× nitrogen rate							
S_1N_1	31.17	87.48	342.17	654.37	3.13	14.15	17.35
S_1N_2	34.17	100.05	379.33	708.78	3.66	15.52	18.3
S_1N_3	35.33	107.97	430.17	762.73	4.04	17.9	19.47
S_2N_1	34.17	85.93	280.67	611	2.35	8.85	15.01
S_2N_2	31.17	96.82	295.83	664.56	2.98	9.05	16.76
S_2N_3	33.56	98.98	343.17	679.17	2.97	11.09	15.27
S_3N_1	31.73	82.61	239.17	549.67	1.82	5.59	11.09
S_3N_2	32.39	87.39	279	573.2	1.96	6.84	10.51
S_3N_3	32.44	96.17	311.33	614.5	2.27	7.68	10.83
LS	NS	NS	NS	NS	NS	NS	NS
CV%	4.63	5.66	5.44	3.55	4.44	3.68	5.46

Mean values in a column having the same letter (s) or without a letter do not differ significantly, whereas, with a dissimilar letter (s) differ significantly as per DMRT, NS= Non-significant, CV= Co-efficient of variation, LS= Level of significance, DAS= Days after sowing, S1= 20 cm, S2= 25 cm, S3= 30 cm, N1= 112 kg ha-1, N2= 150 kg ha-1, N3= 187 kg ha^{-1}

N_1 respectively. At 60 DAS, a similar trend also occurred. The maximum number of leaves per plant (51.53) was found in N_3 which was reduced significantly by 12.25% and 23.07% forN_2 andN_1respectively. At 80 DAS, the maximum number of leaves per plant (87.47) was observed with N_3 which was reduced significantly by 10.09% and 18.89% for N_2 and N_1 respectively. Increased application of nitrogen might have increased the plant vigour during the vegetative phase, contributing to the higher production of branches and leaves per plant. Similar findings were also reported by (Mabala *et al*. (2018) in jute. No significant effects on the number of leaves were found in the interaction between row distance and nitrogen fertilizer at different growth stages except 60 DAS (**Table 1**). At 20 DAS, the maximum number of leaves per plant (8.22) was observed in S_2 N_2 and the lowest value (6.44) was obtained from S_3N_3. At 40 DAS, the maximum number of leaves per plant (21.04) was observed in S_3N_3 and the minimum number of the leaf (17.78) was observed in S_1N_1. At 60 DAS, the maximum number of leaves per plant (62.12) was observed in S_3N_3 which reduced significantly by 15.26%, 16.58%, 27.21%, 27.33%, 34.55%, 34.94%, 39.01% and 46.39% for S_3N_2, S_2N_3, S_3N_1, S_2N_2, S_1N_3, S_2N_1, S_1N_2 and S_1N_1 respectively. At 80 DAS, the maximum number of the leaf (100.00) was observed in S_3N_3, and the minimum value (61.30) was in S_1N_1.

The total leaf area (cm^2) did not differ significantly at 20 DAS but it was significantly influenced at 40, 60 and 80 DAS and in most of the cases maximum leaf area was observed in wide (30 cm) row space (**Table 1**). At 20 DAS, the maximum leaf area (143.23 cm^2) was observed in S_3 and the minimum leaf area (140.19 cm^2) was in S_1. At 40 DAS, the maximum leaf area (479.46 cm^2) was observed in S_3 which was reduced significantly by 3.51% and 4.77 % for S_2 and S_1, respectively compared with S_3. At 60 DAS, the maximum leaf area (766.23 cm^2) was observed in S_3, which reduced significantly for S_2 and S_1, respectively. At 80 DAS, the maximum leaf area (1155.89 cm^2) was observed in S_3 which reduced significantly for S_2 and S_1, respectively. Leaf area was significantly influenced due to nitrogen at 40, 60 and 80 DAS except at 20 DAS (Table 8). At 20 DAS, the highest leaf area (147.46 cm^2) was found in N_3 and the lowest (130.47 cm^2) was in N_1. At 40 DAS, it was detected that the highest leaf area (496.92 cm^2) was found in N_3, which was reduced significantly by 4.53% and 13.99% in N_2 and N_1, respectively. At 60 DAS, the highest LA (766.75 cm^2) was found in N_3, which reduced significantly for N_2 and N_1 respectively. At 80 DAS, the highest LA (1164.41 cm^2) was found in N_3 which reduced significantly for N_2 and N_1, respectively. (Ali *et al.,* 2016) observed a similar result. The interaction between row distance and nitrogen fertilizer rate had no significant effect on leaf area at different (20, 40, 60 and 80) DAS (**Table 1**). At 20 DAS, the highest leaf area (148.27cm^2) was observed in the interaction between S_2N_3 and the lowest leaf area (125.40 cm^2) was observed in S_1N_1. At 40 DAS, the highest leaf area (506.33cm^2) was observed in S_3N_3, and the lowest (411.11cm^2) was observed in S_1N_1. At 60 DAS, the highest LA (785.48cm^2) was recorded in S_3N_3, and the lowest (707.25cm^2) was recorded in S_1N_1. At 80 DAS, the highest LA (1172.05cm^2) was recorded in S_3N_3, and the lowest (1118.08cm^2) was recorded in S_1N_1.

The data recorded on dry matter accumulation by jute at 20, 40, 60 and 80 were presented in (**Table 2)**. Total dry matter of jute varied significantly due to row spacing at 40, 60 and 80 DAS but did not vary at 20 DAS, and in most of the cases, the highest total dry matter was observed in a narrow (20 cm) row space. At 20 DAS, the highest TDM (33.56 gm^{-2}) was observed in S_1 and the lowest (32.19 gm^{-2}) was in S_3. At 40 DAS, the highest TDM (98.49 gm^{-2}) was observed in S_1 and the lowest (88.72 gm^{-2}) was in S_3. TDM was reduced significantly by4.65% and 9.92% in S_2 and S_3, respectively, compared with S_1. At 60 DAS, the highest TDM (383.89 gm^{-2}) was obtained with S_1, which was reduced significantly by 20.14% and 27.97% for S_2 and S_3, respectively. At 80 DAS, maximum TDM (708.62 gm^{-2}) was observed at S_1, which was reduced significantly by 8.05% and 18.27% for S_2 and S_3, respectively. Dry matter accumulation decreased with an increase in spacing. Dry matter accumulation in the narrow spacing of (20 cm) was significantly superior at (25 cm) and (30 cm), respectively. The maximum dry matter accumulation at higher planting density (S_1) was due to more number of plants per unit area, which enhanced plant height. Similar observations of higher dry matter per plant at higher planting densities compared to lower planting densities were also reported by Mishra and Misra (1996) and Sarkar and Sinha (2002).The effect of nitrogen fertilizer on the total dry matter (TDM) of jute was not statistically significant at 20 DAS, but it varied significantly at 40, 60 and 80 DAS (**Table 2**). TDM increased progressively with an increase in nitrogen fertilizer, and the values were found to be highest for maximum urea application at all growth stages.At 20 DAS, the highest TDM (33.78 gm^{-2}) was observed in N_3, and the lowest (32.36 gm^{-2}) was in N_1.At 40 DAS, the highest TDM (101.04 gm^{-2}) was observed in N_3 and the lowest (85.34gm^{-2}) was in N_1. TDM was reduced significantly by 6.23% and 15.54% in N_2 and N_3, respectively. At 60 DAS, the highest TDM (361.56 gm^{-2}) was obtained with N_3, which was reduced significantly by 12.03% and 20.53% for N_2 and N_1, respectively.At 80 DAS, the highest TDM (685.47 gm^{-2}) was found with N_3, which was reduced significantly by 5.34% and 11.74% for N_2 and N_1, respectively. These results are in line with the findings of (Babalad *et al*., 2021). Due to the interaction of row spacing and nitrogen fertilizer rate, TDM was non-significantly influenced at all growth stages (**Table 2**). At 20 DAS, the highest TDM (35.33 gm^{-2}) was observed in S_1N_3, and the lowest value (31.17 gm^{-2}) was obtained in S_1N_1 and S_2N_2. At 40 DAS, the highest TDM (107.97 gm^{-2}) was observed in S_1N_3, and the lowest value (82.61 gm^{-2}) was observed in S_3N_1. At 60 DAS, the highest TDM (430.17 gm^{-2}) was observed in S_1N_3 and the lowest (239.17 gm^{-2}) in S_3N_1. At 80 DAS, the highest TDM (762.73 gm^{-2}) was observed in S_1N_3 and the lowest (549.67 gm^{-2}) in S_3N_1. From the above narration, it can be told that the total dry matter production was slow at the initial stage, but it accelerated in the latter stages according to row space and nitrogen fertilizer rate. This result conforms with that of Indulekha (2012). Results showed that at 20-40, 40-60 and 60-80 DAS, row spacing significantly affected crop growth rate (**Table 2**). The results showed that the crop growth rate increased with the age of the plant. At 20-40 DAS, a significant difference was found in CGR due to the row space of the jute. The highest CGR (3.61 $gm^{-2}day^{-1}$) was observed in S_1, which was reduced significantly by 23.27% and 44.04% for S_2 and S_3, respectively. At 40-60 DAS, the highest CGR (15.86 $gm^{-2}day^{-1}$) was observed in S_1, which was reduced significantly by 39.02% and 57.69% for S_2 and S_3, respectively. At 60-80 DAS, the highest CGR (19.67 $gm^{-2}day^{-1}$) was observed in S_1, which was reduced significantly by 20.28% and 45.04% in S_2 and S_3, respectively. Nitrogen significantly affected the crop growth rate at 20-40 and 40-60 DAS except at 60-80 DAS (**Table 2**). At 20-40, DAS, the highest CGR (3.09 $gm^{-2}day^{-1}$) was obtained in N_3, and the lowest (2.43 $gm^{-2}day^{-1}$) was found in N_1. CGR reduced significantly by 7.12% and 21.36% for N_2 and N_1, respectively. At 40-60 DAS, the highest CGR (12.23 $gm^{-2}day^{-1}$) was observed in N_3, which was reduced significantly by 14.39% and 22.08% for N_2 and N_1, respectively. At 60-80 DAS, no significant difference was found in CGR due to nitrogen rate. Despite no significant variation, numerically, the highest CGR (18.87 $gm^{-2}day^{-1}$) was observed in N_3, and the lowest value (14.48 gm^{-2} day^{-1}) was obtained from N_1. The interaction between row distance and nitrogen did not significantly affect CGR at 20-40, 40-60 and 60-80 DAS. The highest CGR was found in the interaction of S_1N_3 (4.04, 17.90 and 19.47$gm^{-2}day^{-1}$) and the lowest was in S_3N_1 (1.82 and 5.59)$gm^{-2}day^{-1}$ at 20-40, 40-60 respectively and 10.51$gm^{-2}day^{-1}$ was found in S_3N_2 at 60-80 DAS (**Table 2**).

The stem diameter of jute varied significantly due to row space at 40, 60 and 80 DAS, and in most of the cases, the highest stem diameter per plant was observed in wide (30 cm) row space (**Table 3**). At 40 DAS, the highest stem diameter (6.48 mm) was observed in S_3, and the lowest (6.04 mm) was in S_1. Stem diameter reduced significantly by 4.47% and 6.79% for S_2 and S_1, respectively compared with S_3. At 60 DAS, the highest stem diameter (8.67 mm) was observed in S_3 which was reduced significantly by 3.23% and 6.69% for S_2 and S_1 respectively. At 80 DAS, the highest stem diameter (9.05 mm) was observed in S_3, which was reduced slightly by 4.31% in S_2 but significantly by 8.95% in S_1. Nitrogen fertiliser's effect on jute's stem diameter was statistically significant at 40, 60 and 80 DAS. Stem diameter increased progressively with an increase in nitrogen fertilizer and the values were found highest for maximum urea application at all growth stages (**Table 3**). At 40 DAS, the highest stem diameter (6.49 mm) was observed in N_3 and the lowest (5.90 mm) was in N_1. Stem diameter reduced slightly (2.62%) in N_2, but significantly (9.09%) in N_1. At 60 DAS, the highest stem diameter (8.71 mm) was observed in N_3, which was reduced significantly by 3.44% and 7.58% for N_2 and N_1, respectively. At 80 DAS, the highest stem diameter (9.15 mm) was observed in N_3, which was reduced significantly by 5.46% and 10.81% for N_2 and N_1, respectively. The interaction between row distance and nitrogen fertilizer rate had no significant effect on stem diameter at different (40, 60 and 80) DAS (**Table 3**). At 40 DAS, the highest stem diameter (6.87 mm) was observed in S_3N_3 and the lowest value (5.69 mm) was obtained in S_1N_1. At 60 DAS, the highest value (9.16 mm) was observed in S_3N_3, and the lowest value (7.86 mm) was observed in S_1N_1. At 80 DAS, the highest value (9.83 mm) was observed in S_3N_3 and the lowest (7.98 mm) in S_1N_1. The Fibre area of jute per plant did not differ significantly at 40 DAS but was significantly influenced at 60 and 80 DAS and in most cases, the highest fibre area per plant was observed in wide (30 cm) row space (**Table 3**). At 40 DAS, the highest fibre area (1.88 mm) was observed in S_3, and the lowest (1.75 mm) was in S_1. At 60 DAS, the highest fibre area (2.48 mm) was observed in S_3, which was reduced significantly by 8.06% and 11.69% for S_2 and S_1, respectively. At 80 DAS, the highest fibre area (2.84 mm) was observed in S_3, which was reduced significantly by 7.39% and 23.24% for S_2 and S_1, respectively. The Fibre area of jute varied significantly depending on different nitrogen fertilizer rates at 40, 60 and 80 DAS (**Table 3**). At 40 DAS, the highest fibre area (1.95 mm) was recorded in N_3, which reduced slightly (6.15%) at N_2, but significantly (14.87%) at N_1. At 60 DAS, the highest fibre area (2.53 mm) was observed in N_3, which was reduced significantly by 11.46 and 13.83 % for N_2 and N_3, respectively. At 80 DAS, the highest fibre area (9.15 mm) was observed in N_3, which was reduced significantly by 5.46 and 10.82 % for N_2 and N_3, respectively. The interaction between row space and nitrogen fertilizer rate had no significant effect on fibre area at 40 and 60 DAS But was significant at 80 DAS (**Table 3**). At 40 DAS, the highest fibre area (2.11 mm) was observed in S_3N_3, and the lowest value (1.65 mm) was obtained in S_3N_1. At 60 DAS, the highest value (2.57 mm) was observed in S_3N_3, and the lowest value (1.99 mm) was observed in S_1N_1. At 80 DAS, the highest value (3.19 mm) was observed in S_3N_3 and the lowest (2.09 mm) in S_1N_1. Fibre area reduced slightly 4.08% in S_2N_3 but significantly 14.73%, 16.30%, 17.87%, 28.84%, 31.97%, 31.97% and 34.48%

Table 3. Effect of row distance, nitrogen fertilizer rate and their interaction on Stem diameter, Fibre area and yield components of jute.

Row distance	Stem diameter (mm)				Fibre area (mm)				Fibre yield (t/ha)	Stick yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
	40 DAS	60 DAS	80 DAS	100 DAS	40 DAS	60 DAS	80 DAS	100 DAS				
S_1	6.04 b	8.09 c	8.24 b	12.19 b	1.75	2.19 b	2.18 c	3.21 c	2.33 a	5.35 a	7.68 a	30.33
S_2	6.19 b	8.39 b	8.66ab	12.78 b	1.82	2.28 b	2.63 b	3.64 b	2.22 b	5.02 b	7.24 b	30.69
S_3	6.48 a	8.67 a	9.05 a	14.14 a	1.88	2.48 a	2.84 a	3.92 a	2.07 c	4.78 b	6.84 c	30.16
LS	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**NS**
Nitrogen fertilizer rate												
N_1	5.90 b	8.05 c	8.15 c	12.19 b	1.66 b	2.18 b	2.29 c	3.21 c	2.07 b	4.80c	6.87 c	30.12
N_2	6.32 a	8.41 b	8.65 b	12.78 b	1.83 ab	2.24 b	2.52 b	3.64 b	2.24 a	5.03 b	7.27 b	30.81
N_3	6.49 a	8.70 a	9.15 a	14.14 a	1.95 a	2.53 a	2.84 a	3.92 a	2.30 a	5.32a	7.62 a	30.24
LS	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**NS**
Interaction												
S_1N_1	5.69	7.86	7.98	11.56	1.68	1.99	2.09 c	3.14	2.16	5.15	7.3	29.53
S_1N_2	6.17	8.09	8.21	12.17	1.74	2.09	2.17 c	3.46	2.38	5.31	7.69	30.97
S_1N_3	6.27	8.34	8.53	13.99	1.82	2.5	2.27 c	3.67	2.45	5.59	8.04	30.48
S_2N_1	5.91	8.09	8.2	12.26	1.66	2.13	2.17 c	3.17	2.11	4.7	6.81	30.96
S_2N_2	6.33	8.47	8.69	12.69	1.86	2.19	2.67 b	3.52	2.26	4.99	7.26	31.17
S_2N_3	6.33	8.62	9.08	14.14	1.93	2.52	3.06 a	3.86	2.29	5.37	7.66	29.94
S_3N_1	6.1	8.18	8.28	12.77	1.65	2.43	2.62 b	3.31	1.94	4.56	6.5	29.86
S_3N_2	6.46	8.68	9.04	13.49	1.88	2.44	2.72 b	3.94	2.09	4.78	6.86	30.3
S_3N_3	6.87	9.16	9.83	14.29	2.11	2.57	3.19 a	4.22	2.17	4.99	7.17	30.31
LS	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
CV%	**10.32**	**2.62**	**3.85**	**4.36**	**9.68**	**5.2**	**5.25**	**3.96**	**3.95**	**2.85**	**5.2**	**4.41**

Mean values in a column having the same letter (s) or without a letter do not differ significantly, whereas, those with the dissimilar letter (s) differ significantly as per DMRT. NS= Non-significant, CV= Co-efficient of variation, LS= Level of significance. S1=20 cm,S2=25 cm, S3=30 cm , N1= 112 kg/ha, N2=150 kg/ha, N3= 187 kg/ha.

in S_3N_2, S_2N_2, S_3N_1, S_1N_3, S_2N_1,S_1N_2 and S_1N_1, respectively compared with S_3N_3. The stem diameter of the jute varied significantly due to row distance (**Table 3**). The maximum stem diameter (13.52 mm) was observed in wide row space (S_3), which was reduced slightly by 3.62% in S_2, but significantly by 7.03 % in S_1. Different nitrogen levels had significant variations in terms of the Stem diameter of jute. Stem diameter progressively increased with increasing levels of nitrogen. The results presented in (**Table 3**) exhibited that the highest (14.14 mm) stem diameter was obtained at the highest nitrogen levels (N_3) and which were reduced significantly by 9.62% and 13.79% for N_2 and N_1, respectively. No significant interaction was found between row space and nitrogen fertilizer rate on the stem diameter of the jute (**Table 3**). The highest stem diameter (14.29 mm) was observed in the combination of S_3N_3, and the lowest (11.56 mm) was in S_1N_1. The Fibre area of the jute was significantly influenced by row space (**Table 3**). The highest fibre area (3.82 mm) was observed from S_3, reduced significantly by 7.85% and 10.47% for S_2 and S_1, respectively. The Fibre area of jute increased significantly with the increasing level of nitrogen fertilizer (**Table 3**). The highest fibre area (3.92 mm) was observed in N_3, and the lowest (3.21 mm) was in N_1. Fibre area reduced significantly by 7.14% and 18.11% for N_2 and N_1, respectively. The interaction between row space and nitrogen fertilizer rate had no significant effect on fibre area (Table 3). The highest fibre area (4.22 mm) was obtained from the combination of S_3N_3, and the lowest fibre area (3.14 mm) was found from the interaction of S_1N_1. The fibre yield increased significantly in narrow row distances with increasing planting densities (**Table 3**). The highest fibre yield (2.33 t ha^{-1}) was obtained from S_1, reduced significantly by 4.72% and 11.16% for S_2 and S_3, respectively. The decrease in fibre yield from closer spacing to wider spacing is mainly attributed to the higher plant number coupled with enhanced plant height obtained at closer spacing. Though the individual plant fibre area was higher at wider spacing, it could not compensate for the loss in fibre yield due to less number of plants per unit area. There was a significant variation in fibre yield due to different nitrogen levels (**Table 3**). It was observed that the fibre yield gradually increased with increasing levels of nitrogen. The highest fibre yield (2.30 t ha^{-1}) was obtained in N_3, which was reduced slightly by 2.61% in N_2, but significantly by 10.00% in N_1, which indicated that increasing levels of nitrogen increased fibre yield.

So increasing nitrogen level increased all yield contributing characters which in terms increased fibre yield. The significant increase in fibre yield owing to nitrogen application was also reported by (Zaman *et al*.,2021). Fibre yield was not significantly affected by the interaction between row space nitrogen fertilizer rate (**Table 3**). The highest fibre yield (2.45 t ha^{-1}) was found in the combination of S_1N_3 and the lowest fibre yield (1.94 t ha^{-1}) was found in the combination of S_3N_1. The stick yield increased significantly in narrow (20cm) row spaces with increasing planting densities (**Table 3**). The highest stick yield (5.35 t ha^{-1}) was observed from S_1, which was reduced significantly by 6.17% and 10.65% for S_2 and S_3, respectively.

The decrease in stick yield from closer spacing to wider spacing is mainly attributed to the higher plant number coupled with enhanced plant height obtained at closer spacing. Though the individual plant weight was higher at wider spacing, it could not compensate for the loss in stick yield due to less number of plants per unit area. The reduction in stick yield with an increase in spacing or decrease in plant density was in agreement with the results of (Dwibedi*et al*.,2021)

A progressive and significant increase in stick yield was observed with each successive increase in nitrogen dose (**Table 3**). The highest stick yield (5.32 t ha^{-1}) was recorded in N_3, which was reduced significantly by 5.45% and 9.77% in N_2 and N_1, respectively, indicating that increasing nitrogen levels increased stick yield. These results are in corroboration the findings of (Rawal *et al.*, 2015). Stick yield was not significantly affected by the interaction between row space and nitrogen fertilizer (**Table 3**). The highest stick yield (5.59 t ha^{-1}) was found in the combination of S_1N_3 and the lowest stick yield (4.56 t ha^{-1}) was found in the combination of S_3N_1. The biological yield of the jute plant showed significant variations (**Table 3**). The maximum value was shown by S_1 (7.68 t ha^{-1}) reduced significantly by 5.73% and 10.94% in S_2 and S_3, respectively. Remarkable differences were observed in biological yield for different nitrogen fertilizer rates (**Table 3).** The highest biological yield (7.62 t ha^{-1}) was recorded in N_3, which was reduced significantly by 4.59% and 9.84% for N_2 and N_1, respectively. The biological yield was not significantly affected by the interaction between row space, and nitrogen fertilizer rate (**Table 3**) revealing that the highest biological yield (8.04 t ha^{-1}) was found in the combination of S_1N_3 and the lowest biological yield (6.50 t ha^{-1}) was found in the combination of S_3N_1. The harvest index was not significantly differed due to row space **(Table 3).** Numerically the maximum harvest index (30.69%) was found in S_2, and the minimum harvest index (30.16%) was obtained in S_3. (Dong *et al.,*2012) also observed that the harvest index was not varied due to spacing. Different nitrogen fertilizer rates significantly affected the harvest index (**Table 3**). Numerically the highest harvest index (30.81%) was obtained in N_2, and the lowest (30.12%) was in N_1. The harvest index was not significantly differed due to the interaction of row space and nitrogen fertilizer. Numerically, the highest harvest index (31.17%) was produced from the S_2N_2 combination and the lowest harvest index (29.53%) was produced from the S_1N_1 treatment combination (**Table 3**).

Conclusion

The results shows that row space affected the plant height, total dry matter and crop growth rate significantly and the taller plants (205.89 cm), highest TDM (708.62 gm^{-2}), CGR (19.67 gm^{-2} day^{-1}), fibre yield (2.33 t ha^{-1}), stick yield (5.35 t ha^{-1}) and biological yield (7.68 t ha^{-1}) were produced at narrow row space (20cm). Whereas, maximum number of leaves (89.62), leaf area (1155.89 cm^2), canopy cover (71.62%), stem diameter (13.52mm) and fibre area (3.82 mm) were achieved with wide row space (30 cm).

Considering nitrogen fertilizer rates, highest value for plant height (214.40 cm), TDM (685.47gm^{-2}), CGR (18.87gm^{-2} day^{-1}), number of leaves (87.47), leaf area (1164.41 cm^2), canopy cover (67.39%), stem diameter (14.14 mm), fibre area (3.92 mm), fibre yield (2.30 t ha^{-1}),stick yield (5.32 t ha^{-1}) and biological yield (7.62 t ha^{-1}) were recorded with application of 187 kg ha^{-1}.

The interaction between row distance and nitrogen rate was not significant for plant height, TDM, CGR, number of leaves, leaf area, canopy cover, stem diameter and fibre area at all stages. But number of leaves and fibre area were significant at 60 and 80 DAS respectively. In other case, the interaction effect showed marginal effect on all the yield and yield contributing characters. Apparently, the highest fibre yield (2.45 t ha^{-1}), stick yield (5.59 t ha^{-1}) and biological yield (8.04 t ha^{-1}) were found in the combination of S_1N_3 i.e. narrow row space with higher nitrogen fertilizer while the lowest fibre yield (1.94 t ha^{-1}), stick yield (4.56 t ha^{-1}) and biological yield (6.50 t ha^{-1}) were observed in the combination of S_3N_1 i.e. wide row space with lower level of nitrogen.

A significant yield improvement was observed with narrow row space (20cm) over wide space (30cm). With each increase in urea application from 112 to 187 kg ha^{-1}, growth and yield attributes increased linearly and the highest value was obtained with the application of 187 kg N ha^{-1} which was statistically identical to 150 kg N ha^{-1}.

Therefore, the farmers can be suggested to use the above mentioned treatment combination for maximizing their yield of jute. However, the experiment should be repeated at different climatic zones of Bangladesh for further confirmation of the result.

Conflict of interest

Threre is no conflict of interest among the authors.

References

Akhter, S., Sarker, J. R. and Das, K. R. 2016. Growth and Trend area, Production and Yield of Major Crops in Bangladesh. *Intl. J. of Econ., Fin. and Manage. Sci.*4(1): 20-25.

Ali, S. M., Haque, M. M., Hossain, M. S., Hussain, M. M., & Islam, M. N. (2016). Changes in Chemical Composition of Jute Seed as Influenced by Nitrogen and Phosphorus Fertilizers. *Bangladesh Agronomy Journal*, *19*(2), 29-38.

Babalad, H. B., Guggari, A. K., &Pattanashetti, V. A. (2021). Response of mesta (Hibiscus spp.) genotypes to stages of harvesting under rainfed conditions.

BBS (Bangladesh Bureau of Statistics). (2016-2017). Statistical Yearbook of Bangladesh. Bangladesh Bureau of Statistics, Planning Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

Dwibedi, S., Behera, B., Dwibedi, S. K., & Behera, S. D. (2021). Productivity and profitability of seed dhaincha (Sesbaniacannabina)+ relay yard long bean (Vigna unguiculata subsp. sesquipedalis) under different date of planting and row spacing. *Indian Journal of Agronomy*, *66*(1), 112-117.

Dong, H., Li, W., Eneji, A. E., & Zhang, D. (2012). Nitrogen rate and plant density effects on yield and late-season leaf senescence of cotton raised on a saline field. *Field Crops Research*, *126*, 137-144.

Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedures for Agricultural Research (2nd edn.). John Wiley and Sons. New York. U.S.A. pp. 97-115, 199-209.

Indulekha, V. P. 2012. Planting density and nitrogen influence on seed yield of jute (*Corchorus olitorius* L.). M.Sc.(Agric.) Thesis, Acharya N G Ranga Agricultural University, Hyderabad, India.

Islam, M. M. and Ali, M. S. 2018.Economic Importance of Jute in Bangladesh: Production, Research Achievements and Diversification. *Intl. J. of Econ. Theory and Appl.* Vol. 4, No.6, 2017, pp. 45-57.

Islam, M. M., Begum, S., Alam, A. K. M. M., Ahmed, I. and Ali, A. 2009. Study the impact of climatic changes on jute production in Bangladesh. *Bangladesh J. Prog. Sci. & Tech*. 7(1): 153-156.

ISLAM, M. S. (2010). Submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University. Dhaka, In partial fulfilment of the requirements for the degree of.

Islam, M. S., Islam, M. M., Alam, M. M. and Alam, M. 2017. Comparative genomics of two jute species and insight into fibro biogenesis. Vol.3, 16223.

Mabala, M. H. R. (2018). *Availability and utilization of indigenous leafy vegetables (ILVs) found in Limpopo Province and the response of a selected ILV to planting density and nitrogen fertilizer rate* (Doctoral dissertation).

Mukul, M.M., Akter, N., Islam, M.M., Bhuiyan, M.S.H., Mostofa, M.G., Ghosh, R.K., Saha, C.K. and Ali, M.A., (2021). Morpho-phenetical study of high yielding tossa jute variety BJRI Tossa Pat 7 (MG-1) for bastfibre yield and qualities. *Heliyon*, *7*(10), e08129.

Masum, S. M., Ali, M. H., Islam, M. S., & Sultana, S. (2011). Influence of plant spacing and post emergence herbicide on the yield of white jute (Corchorus capsularis). *hand*, *18*(16), 5.

Mishra, M. and Misra, A. 1996.Effect of fertilizer, weed control methods and row spacings in white jute (*Corchorus capsularis*). *Indian J. of Agron*. 41(3): 462-464.

Rawal, S., Mehta, A. K., Thakral, S. K., & Kumar, M. (2015). Effect of nitrogen and phosphorus levels on growth, yield attributes and yield of Bt cotton. *Cotton Res. Dev*, *29*(1), 76-78.

Saleem, M.H., Ali, S., Rehman, M., Rana, M.S., Rizwan, M., Kamran, M., Imran, M., Riaz, M., Soliman, M.H., Elkelish, A. and Liu, L.,. (2020). Influence of phosphorus on copper phytoextraction via modulating cellular organelles in two jute (Corchorus capsularis L.) varieties grown in a copper mining soil of Hubei Province, China. *Chemosphere*, *248*, 126032.

Steel, R. G. D. and Torrie, J. H. 1960. Principles and procedures of statistics. McGraw Hall, New York, USA. pp. 377-380.

Zakaria, A. and Sayed, A. N. 2008. Jute microbiological and Biochemical Research. *Plant Tissue Cul*

Zaman, I.,Ali, M., Shahzad, K., Tahir, M.S., Matloob, A., Ahmad, W., Alamri S., Khurshid, M.R., Qureshi, M.M., Wasaya, A. and Baig, K.S. (2021). Effect of plant spacings on growth, physiology, yield and fiber quality attributes of cotton genotypes under nitrogen fertilization. *Agronomy*, *11*(12), 2589.

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