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Influence of different levels of potassium on yield and fibre strength of jute

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Abstract: Jute is an important fibre crop in Bangladesh. Potassium has beneficial effect not only in fibre yield but also effectively influence the fibre strength. We hypothesized that fibre yield and strength of jute could be influenced by variety and different K levels. Therefore, this field study was carried out to assess the effects of five different levels of K and two varieties on the yield and fibre strength of jute at the field laboratory of the Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh, during the period from April to August 2011. The K levels were 0, 10, 20, 30 and 40 kg ha^{-1} and the varieties were CVL-1 and O-9897. The land was fertilized as per experimental treatments along with the recommended doses of urea, TSP, gypsum and zinc sulphate to supply N, P, S and Zn, respectively. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Both variety and K levels significantly influenced the yield and yield attributes of jute. The highest values of yield contributing parameters, stick and fibre yield and fibre strength were obtained from the variety O-9897 compared to CVL-1. Plant height, bark and stick diameter, fresh bark and stick weight, fibre yield, stick yield and fibre strength were significantly influenced by the different levels of K. The highest values of most of the parameters were found from the plants fertilized with 30 kg K ha^{-1} for both varieties except fibre strength which was highest when K was applied @ 40 kg ha^{-1} and the lowest values of all the mentioned parameters were obtained from control. The overall results suggest that K @ 30 kg ha^{-1} can be applied for getting higher yield and quality of *C. olitorius cv.* O-9897 under the agroclimatic condition of BAU farm.
Key words: Jute, Potassium, Yield and Fibre strength.

Introduction

Jute has a great potential because of its fibre properties, industrial advantages and wide adaptation capacity. It was once known as the "Golden Fibre of Bangladesh" since it was the most important cash crop of the country**.** It is produced mainly from two commercially important varieties *viz*. *Corchorus olitorious* (*Tossa* jute) and *Corchorus capsularis* (*Deshi* jute) which have both economic and culinary values. It contributes significantly to the economy of Bangladesh and one of the major sources of foreign currency by exporting jute and jute goods (BJRI, 2008). The area and production of jute are declining day by day. Horizontal expansion of area under this crop is not possible. Vertical expansion is the only way to increase production. Increased yield with quality fibre and strong stick of jute is a highly desirable to be grown that would permit more expansion of it's cultivation in our country. Development of improved crop varieties including hybrids with high yielding potential and judicious application of fertilizers are some of the best option available to the agriculturist in order to break through the present yield ceiling of the modern varieties and to expedite a sustainable increase in jute production. The use of local cultivars is one of the most important reasons for low yield. Variety and appropriate nutrient management strategy are another important ways to increase jute yield.

Potassium is one of the primary as well as the third nutrient for plant growth and development since it is involved in main biochemical processes. Effects of K on yield and fibre quality were found in cotton (Cassman *et al.,* 1990; Sheng and Yang, 1963). Optimum K fertilization was suggested for jute production to obtain higher yield (Cabangbang and Zabate, 1978; Singh, 1992) and fibre quality. They stated that balancing N and P with adequate K improve length, strength and fineness of fibre in both cotton and fibre crops. However, Bennet *et al*. (1965) reported negative correlation between levels of K application and fibre quality of cotton. The objective of this study was, therefore, to study the response of jute to different levels of K fertilizations in terms of plant productivity, fibre quality and their interactions.

Materials and Methods

The experiment was carried out at the field laboratory of the Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh during the period from April to August, 2011. The field was medium high land and soil belongs to the Sonatola soil series under the AEZ of Old Brahmaputra Floodplain (AEZ-9). Soil sample was collected and kept in a polyethylene bag for chemical analysis. The experiment consisted of two factors: a) Variety of jute *viz*. CVL-1 and O-9897, b) Levels of K *viz*. 0, 10, 20, 30, and 40 kg ha^{-1}. Seeds were collected from Bangladesh Agricultural Development Corporation (BADC), Mymensingh. There were 10 treatment combinations with variety and levels of K. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The unit plot size was 4 m × 2.5 m. The spaces between replication and unit plots were 1m and 0.5 m, respectively. The treatments were randomly distributed. The land was ploughed six times with country plough followed by laddering. At the time of final land preparation, the land was fertilized with urea, TSP, gypsum and zinc sulphate @ 80, 20, 40 and 7 kg ha^{-1}, respectively. Muriate of potash was used as a source of K as per treatment. Seeds were sown on April 30, 2011. Weeding, gap filling, thinning, irrigation and pesticide application were done as and when necessary throughout the growth period of the crop.

The crop was harvested on August 29, 2011 at 50% flowering stage. Ten plant samples were taken at random from each plot to study the yield contributing characters of jute. After harvesting, plants were made into small bundles and kept standing on the ground for 4 days for shedding of leaves prior to steeping. Bundles were steeped plot wise on September 5, 2011 in pond water for retting which was completed within 15 days after steeping. The fibres in the bark get loosened and separated from the woody stalk due to the removal of pectin's, gums and other mucilaginous substances. This was usually done by the combined action of water, temperature and microorganisms. Fibres were extracted by stripping and washed thoroughly in clean water, dried in the sun on bamboo bars, and weighed to get the fibre yield. Jute sticks were also dried and weighed. A

pressly instrument was used for the determination of fibre strength. Analysis of variance was done with the help of computer package program MSTAT according to Gomez and Gomez (1984) and adjudged the mean differences as Least Significant Difference Test (LSD).

Results and Discussion

Effects of variety and K on yield attributes, yield and fibre strength of jute

Plant height: The plant height was significantly affected by variety (Table 1). The tallest plant (375 cm) was recorded in O-9897 and the shortest plant (232 cm) was obtained from CVL-1. Variation in plant height might be due to the difference in their genetic make-up. The effect of different levels of K on plant height also showed significant variation (Table 2). The highest height (364 cm) was recorded from K_{30} and the lowest height from K_0. After K_{30}, the height declined at K_{40} (307 cm). Height increase may be due to the fact that K helped more nutrient uptake. The effect of interaction between variety and K level on plant height was significant. The highest plant height was recorded from the interaction O-9897×K_{30} (465 cm) and the lowest value (193 cm) was found in CVL-1K_0. Thus the findings of our study is supported by the findings of Mondal *et al.* (2007) who recorded the highest plant height of jute when applied FYM along with NPK fertilizers.

Table 1. Effect of variety on yield attributes and strength of jute

Variety	Plant height (cm)	Bark diameter (mm)	Stick diameter (mm)	Fresh bark wt. (t ha^{-1})	Fresh stick wt. (t ha^{-1})	Jute Strength (lb mg^{-1})
CVL-1	232	0.24	1.02	4.23	7.20	8.36
O-9897	375	0.33	1.55	6.82	10.74	9.23
LSD	12.78	0.04	0.05	0.35	0.54	0.24
CV (%)	5.07	5.45	4.02	6.42	4.55	3.32

Table 2. Effect of different levels of K on the yield attributes and strength of jute

Treatments	Plant height (cm)	Bark diameter (mm)	Stick diameter (mm)	Fresh bark wt. (t ha^{-1})	Fresh stick wt. (t ha^{-1})	Jute strength (lb mg^{-1})
K_0	254	0.23	1.25	3.63	7.32	6.46
K_{10}	285	0.27	1.26	4.95	8.45	8.21
K_{20}	310	0.29	1.28	5.38	8.84	8.94
K_{30}	364	0.37	1.39	7.62	10.57	9.83
K_{40}	307	0.28	1.26	6.05	9.67	10.55
LSD	20.20	0.06	0.09	0.55	0.86	0.38
CV (%)	5.07	5.45	4.02	6.42	4.55	3.32

K_0 = Control, K_{10} = 10 kg K ha^{-1}, K_{20} = 20 kg K ha^{-1}, K_{30} = 30 kg K ha^{-1}, K_{40} = 40 kg K ha^{-1}.

Table 3. Interaction effects of variety and K on yield attributes and strength of jute

Variety	Plant height (cm)	Bark diameter (mm)	Stick diameter (mm)	Fresh bark wt. (t ha^{-1})	Fresh stick wt. (t ha^{-1})	Jute strength (lb mg^{-1})
CVL-1×K_0	193	0.19	0.97	2.85	5.49	5.68
CVL-1×K_{10}	220	0.22	0.99	3.51	6.72	7.84
CVL-1×K_{20}	233	0.24	1.01	4.05	6.82	8.20
CVL-1×K_{30}	264	0.32	1.16	6.12	8.80	9.78
CVL-1×K_{40}	254	0.22	0.99	4.61	8.15	10.32
O-9897×K_0	315	0.27	1.52	4.40	9.14	7.24
O-9897×K_{10}	351	0.31	1.53	6.39	10.17	8.57
O-9897×K_{20}	387	0.33	1.55	6.71	10.86	9.68
O-9897×K_{30}	465	0.41	1.63	9.11	12.35	9.87
O-9897×K_{40}	359	0.33	1.53	7.48	11.19	10.78
LSD	29	0.09	0.13	0.78	1.22	0.54
CV (%)	5	5.17	3.80	5.72	3.95	2.59

Bark diameter: The bark diameter was significantly affected by variety and K levels. The highest (0.33 mm) diameter was obtained in O-9897 and the lowest diameter (0.24 mm) was from CVL-1 (Table 1). The highest (0.37 mm) bark diameter was found at 30 kg K ha^{-1} and the lowest (0.23 mm) from 0 kg K ha^{-1} (Table 2). Results revealed that bark diameter increased with the levels of K. The interaction effect of variety and level of K had no significant effect on this parameter. The highest value (0.41 mm) was obtained from O-9897×K_{30} and the lowest value from control (Table 3).

Stick diameter: Stick diameter followed similar pattern like bark diameter. The parameter had significant variation due to different variety and levels of K. The highest (1.55 mm) stick diameter was obtained from O-9897 and the lowest value (1.02 mm) in CVL-1 (Table 1). This result supported the result of Alam *et al.* (1994). Stick diameter was not significant due to levels of K. The highest (1.39 mm) diameter was obtained in 30 kg K ha^{-1} and the lowest (1.25 mm) was in control treatment (Table 2). The interaction of variety and levels of K on stick diameter of jute was not significant. The diameter ranged from 0.97 to 1.63 mm (Table 3).

Fresh bark weight: The fresh bark weight exhibited significant response due to different variety. The highest fresh weight of bark (6.82 t ha^{-1}) was obtained in O-9897 and the lowest (4.23 t ha^{-1}) from CVL-1. The variation in fresh weight of bark of Jute plant was significant with respect to levels of K. The highest fresh weight of bark (7.62 t ha^{-1}) was obtained in 30kg K ha^{-1} and the lowest weight (3.63 t ha^{-1}) from 0 kg K ha^{-1} (Table 2).The effect of interaction of variety and levels of K on fibre yield was not significant. The highest fresh weight (9.11 t ha^{-1}) was found in O-9897×K_{30} interaction and the lowest weight (2.85 t ha^{-1}) from control (Table 3). Application of K significantly increased the plant height and bark diameter this might be the reason of increased bark weight in K treated plats. The results of this study is in good agreement with results of Maitra *et al.* (2000) who observed increased bark weight due to K fertilization.

Fresh stick weight: The fresh weight of stick was significantly affected by variety. The highest (10.74 t ha^{-1}) weight of fresh stick was obtained from O-9897 and the lowest weight (7.20 t ha^{-1}) was from CVL-1 (Table 1). Fresh stick weight exhibited significant response to levels of K. The highest (10.57 t ha^{-1}) weight was obtained from 30 kg K ha^{-1} and the lowest (7.32 t ha^{-1}) was obtained at 0 kg K ha^{-1} (Table 2). The interaction effect of variety and levels of K had no significant effect on fresh stick weight of jute. The highest stick yield (12.35 t ha^{-1}) was obtained from O-9897 with K_{30} and the lowest yield (5.49 t ha^{-1}) from CVL-1 with K_0 interaction (Table 3).

Fibre yield: The fibre yield was significantly influenced by variety at 1% level of significance. The highest fibre yield (4.65 t ha^{-1}) was obtained from O-9897 and the lowest (2.23 t ha^{-1}) from CVL-1 (Fig. 1). The fibre yield exhibited significant response to levels of K. The highest fibre yield (4.65 t ha^{-1}) was obtained in 30 kg K ha^{-1} and the lowest (2.23 t ha^{-1}) was in 0 kg K ha^{-1} (Fig. 2). The trend of fibre yield increased due to increasing levels of K up to 30 kg K ha^{-1} and then declined at K_{40}. The findings of our study is nicely supported by the findings of Maitra *et al.* (2000) who recorded significantly higher fibre yield from the plant fertilized with K fertilizer. The interaction effect of variety and levels of K on fibre yield was not significant. The highest value (5.57 t ha^{-1}) was obtained from O-9897×K_{30} and the lowest (1.77 t ha^{-1}) from CVL-1×K_0 interactions.

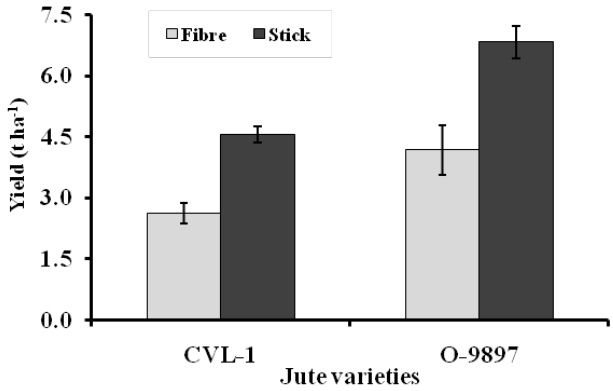

Fig. 1. Effect of variety on the fibre and stick yield of jute

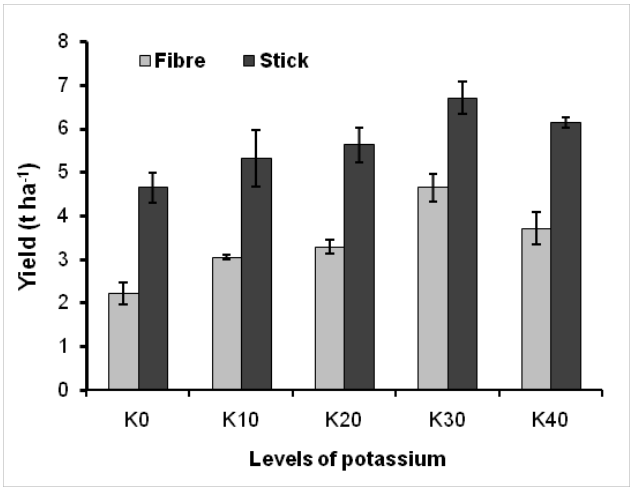

Fig. 2. Effect of different levels K on fibre and stick yield of jute

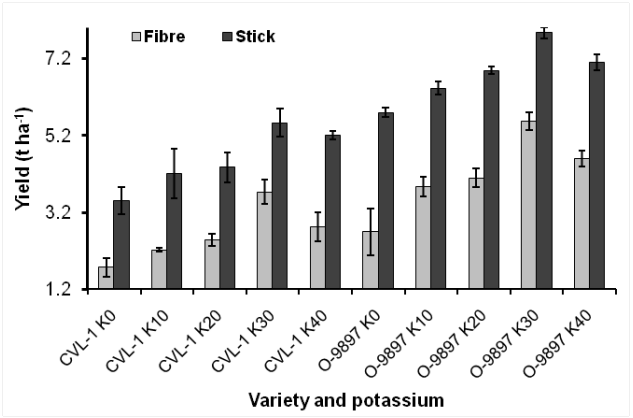

Fig. 3. Interaction effects of variety and K on fibre and stick yield of jute

Stick yield: The stick yield was also significantly affected by variety. O-9897 produced the highest stick yield (6.82 t ha^{-1}) and the lowest yield (4.56 t ha^{-1}) was obtained from

CVL-1. The yield of stick exhibited significant response to levels of K. The highest yield (6.70 t ha^{-1}) was obtained when 30 kg K ha^{-1} was applied and the lowest yield (4.65 t ha^{-1}) was from K_0 (Fig 2). From the result, it can be stated that K fertilizer increased the yield of stick. The effect of interaction of variety and levels of K on stick yield was not significant. The highest stick yield was obtained (7.87 t ha^{-1}) from O-9897×K_{30} interaction and the lowest (3.5 t ha^{-1}) from CVL-1×K_0 interaction (Table 3).

Jute strength: The effect of different levels of K and variety on jute strength was significant. The highest strength of jute fibre (9.23 lb mg^{-1}) was observed in variety O-9897 and the lowest (8.36 lb mg^{-1}) was in CVL-1 (Table 1). Maximum (10.55 lb mg^{-1}) fibre strength was measured at 40 kg K ha^{-1} which was statistically identical with (9.83 lb mg^{-1}) K_{30} and the lowest value (6.46 lb mg^{-1}) was found in the control treatment (Table 2). The result provided that constructive effect of K on fibre quality also influenced significantly (Cassman *et al*., 1990). The interaction of variety and levels of K had significant effect on the strength of jute fibre. The highest (10.78 lb mg^{-1}) fibre strength was recorded in variety O-9897 with 40 kg K ha^{-1} and the lowest (5.68 lb mg^{-1}) was from CVL-1 with 0 kg K ha^{-1} (Table 2). The result showed that higher amount of K fertilization contributed higher fibre strength, while K had discernible effects on fibre quality (Tatar *et al*., 2010).

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