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Response of potassium on yield of different varieties of *kenaf* in southern region of Bangladesh

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ABSTRACT

An experiment was conducted at the Field Laboratory of the Department of Agronomy, Patuakhali Science and Technology University, Dumki, Patuakhali to identify the optimum level(s) of K fertilizer on the aspect of higher growth and greater yield of Kenaf (*Hibiscus cannabinus* L.) during the period from May to September, 2016. The experiment consisted of three varieties of Kenaf namely HC-2 (V_1), HC-3 (V_2) and HC-95 (V_3) and four treatments on K fertilizer viz. without K (K_0), 30 kg K ha^{-1} (K_{30}), 40 kg K ha^{-1} (K_{40}) and 50 kg K ha^{-1} (K_{50}). The two factors experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Obtained result of the present study revealed that all the characters of the study were affected significantly due to the effect of variety, K fertilizer and their combinations. In case of the effect of variety, HC-2 showed overall superior performance in respect of the plant height, number of internodes per plant, plant diameter, green weight with and without leaves, fiber weight fiber yield, stick weight and stick yield. However, the highest green weight with leaves and green weight without leaves were obtained from the variety HC-95, respectively. In case of the effect of K fertilizer, 40 kg K ha^{-1} showed the greater effect among the whole characters studied such as plant height, number of internodes per plant, plant diameter, green weight with and without leaves, fiber weight per plant, fiber yield, stick weight and stick yield whereas the poorest effect was obtained in without fertilizer or natural condition However, the highest green weight with leaves, green weight without leaves stick weight and stick yield were obtained from the 50 kg K ha^{-1}, respectively. In case of the effect of interaction, the highest stick weight and stick yield were obtained from the variety HC-95 grown under 50 kg K ha^{-1}. The above findings of the study it was found that the 40 kg K ha^{-1} was the most optimum level for remarkable production of Kenaf while most successful variety was HC-2 in the present study.

INTRODUCTION

Kenaf is one of the most potential annual crops planted throughout the world. It is a member of the Hibiscus family (Malvaceae) and indigenous to Africa. Kenaf is an annual fibre crop of tropical origin (Hamid, 2009). The name "kenaf" is of Persian origin and is used to signify both the tall annual plant (*Hibiscus cannabinus* L.) with large showy flowers, characteristic of the Mallow family, and the bast fibre obtained from the stem of that plant (Dempsey, 1975). The genus Hibiscus is widespread, comprising some 200 annual and perennial species. Kenaf is closely related to cotton (*Gossypium hirsutum* L.), okra (*Hibiscus esculentum* L.), and hollyhock (*Althaea rosea* L.) (Dempsey, 1975; Taylor, 2003). Kenaf is sometimes also referred to as Bimly, Bimlipatum, Jute and Deccan Hemp (Duke and duCellier, 1993).

In Bangladesh, the fibre from Kenaf is primarily mixed with bast fibre obtained from jute for making bags, sacks, twines, ropes, cordages and carpets (Maiti et al., 2010). Kenaf also produces more biomass in poor soil where even jute cannot be grown (Hiron et al., 2006). In the past decades, alternate use of Kenaf fibres has increased considerably in automobile interior construction and fibre composite products (Preusser, 2006). Kenaf biomass is also considered as a potential alternative for wood in the paper pulp industry in China, USA and European countries. Significantly, Kenaf plantation (if grown in high density) has been recorded to fix about twice the amount of CO_2 as compared to forest plantation thereby contributing to global and regional environment (Lam *et al*., 2003). Jute and allied fibres has also great importance in rural economy of Bangladesh. As one of the most economically important crops for food or non–wood fibre production, Kenaf is mainly used as a source of fibre for making ropes, sacks, canvas and carpets (Dempsey, 1975). Kenaf seed yield edible oil that is used for first class cooking oil and margarine production (Hossain, 2016).

However, the cultivation of Kenaf has a contribution in world economy. In Bangladesh the cultivation of Kenaf is not satisfactory, because most of the farmers are not familiar to cultivate it. The constraint of Kenaf cultivation is prevailing due to insufficient supply of quality seed and low yield of fibre. Besides, various biotic and abiotic factors adversely affected Kenaf growth in many countries. Therefore, Kenaf yield is decreased due to lack of stress tolerant varieties (Hossain, 2016). Considerable development has been done in research to meet the demands of high fibre yielding and disease resistant Kenaf in the recent decades (Bitzer, 2000). Abiotic stress include drought, salinity, extreme temperature, chemical toxicity and oxidative stress are serious threats to agriculture and the natural states of environment (Wang and Altman, 2003). The cultivated land is decreasing with the continuous increase of population of Bangladesh. Therefore, it is essential to utilize the lands of coastal zone which have high salinity. Furthermore, the crop is damaged by a series of environmental stresses during vegetative phase. Abiotic stress limits plant growth and significantly increases the negative effect on both quantity and quality of production (Mohsin, 2004). A vast area of land in Bangladesh is under salinity and drought condition and these abiotic factors are major problems to cultivate Kenaf. To overcome this problem, may be selecting the most suitable kenaf variety which will more productive under this area.

Potassium is considered as a major limiting factors in crop growth, development and finally economic yield. To grow kenaf the responses of plants to K fertilization is of considerable importance in agriculture. K limits growth and development of several crop species under field conditions, the precise mechanisms by the limitation occurs are complex and variable depending on varieties, developmental stage and environment. Limited K supply decreases rates of cell division, cell expansion and cell permeability. Photosynthesis, leaf production, and growth, plants and yield. Some reports suggest that K deficiency affects more strongly the leaf development than photosynthesis.

Also, about 25-40% of the outer bast stem (Alexopoulou et al., 2000). Potassium is one of the vital minerals for every major stage of protein synthesis. In all growth steps, potassium regulates the plant cells for the production of proteins and enzymes, and the production is impossible without an adequate amount of it. When potassium is a deficit, the plants are not making proteins even though there is an abundance of available nitrogen. Vast levels of available potassium improve the physical quality, illness resistance, and it increases crop yield and plays significant roles in enhancing crop quality.

MATERIALS AND METHODS

An experiment was conducted at the Agronomy Field Laboratory, Patuakhali Science and Technology University, Dumki, Patuakhali during May to September, 2016 with a view to investigate the of variety and level of potassium on the fibre yield of kenaf in coastal region of Bangladesh. The variety and treatments included in the experiment were i) three varieties viz. HC-2,HC-3 and HC-95 and ii) four potassium levels viz. 0 kg K ha^{-1}, 30 kg K ha^{-1}, 40 kg K ha^{-1}, and 50 kg K ha^{-1}. The experimental field located at 22º37’ N latitude and 89º10’ E longitude at Ganges Tidal Floodplains and falls under Agro-ecological Zone “AEZ 13”. The study locations also lie under Ganges Tidal Floodplain AEZ (AEZ No. 13). The seeds of HC-2, HC-3 and HC-95 were collected from the Bangladesh Jute Research Institute (BJRI), Khepupara, Patuakhali. Seeds were tested for germination before sowing and it was found 90% germination.The experimental plot was laid out in a randomized complete block design (RCBD) with three replications. The number of plots in the experiment was 36. The land was first ploughed on May 5, 2016 by disc plough. It was then harrowed again on 8 and 9 May to bring the soil in a good tilth condition. The clods of the land were hammered to make the soil into small pieces.

Weeds, stubbles and crop residues were cleaned from the land. Finally ploughed thoroughly with a power tiller and then laddering was done to obtain a desirable tilth and land preparation was done on as per layout of ex-perimental design. The fertilizers of urea, triple superphosphate (TSP) and sulphur were applied in the plots corresponding to 100, 25 and 10 kg ha^{-1}, respectively. The whole amount of TSP, MoP, Gypsum and ⅓ of Urea were applied as basal dose at the time of final land preparation. The remaining ⅔ of the urea was top dressed in splits at 30 days and 45 days after sowing. The collected seeds of Jute were line sown at May 12, 2016 @ 20 g plot^{-1} of each cultivar, respectively for getting proper population in the plot**.** Necessary intercultural operations were done as and when necessary.The crop was harvested on 22 September, 2016 when the crop reached at 50% flowering stage. Before harvesting 10 sample plants were taken at random from each plot to study the yield contributing characters of kenaf. After harvesting, the kenaf plants were made into small bundles and kept standing on the ground for 4 days for shedding of leaves prior to steeping. After shedding of the leaves, the kenaf bundles were steeped plot-wise on 26 September in pond water for retting. The retting was completed within 18 days after steeping. After proper retting, the fibres were extracted by stripping and were washed thoroughly in water. The extracted fibres were dried in the sun plot-wise on bamboo bars. Ten plants were selected randomly from each plot to note plant height (m),number of internode per plant,plant diameter (mm),green weight with leaf (kg),green weight without leaf (kg), fibre weight per plant(g),fibre yield (t ha^{-1}),stick weight per plant(g),stick yield(t ha^{-1}).

RESULTS AND DISCUSSION

This chapter comprises the presentation of the results obtained from the experiment. The present study was determined on the aspect of the variation in morpho–physiological growth, yield and yield attributes of kenaf (*Hibiscus cannabinus* L.) as affected by kenaf varieties, different levels of K fertilizer and their combinations.

Effect of variety

The variety had significant influence on plant height, number of internodes per plant, plant diameter, green weight with and without leaves, fibre weight, fibre yield, stick weight and stick yield. The highest results of plant height (2.80m),, plant diameter (16.88mm), fibre weight (19.49), fibre yield(3.89 t ha^{-1}), stick weight (40.95g) and stick yield (6.53 t ha^{-1}) were obtained from HC-2 and number of internodes per plant (64.23),green weight with leaves (2.85kg) and green weight without leaves (2.47kg) were obtained from HC-95.

Table 1
Effect of variety on growth and yield characteristics of kenaf.

Variety	Plant height (m)	Number of internodes Plant^{-1}	Plant diameter (mm)	Green weight with leaf (kg)	Green weight without leaf(kg)	Fibre yield per plant (g)	Fibre yield (t ha^{-1})	Stick yield per plant (g)	Stick yield (t ha^{-1})
HC-2	2.80 a	61.60 b	16.88 a	2.81 b	2.41 b	19.49 a	3.89 a	40.95 a	6.53 a
HC-3	2.74 b	61.01 c	16.78 b	2.76 c	2.39 c	19.45 b	3.87 a	39.13 b	6.18 b
HC-95	2.73 b	64.23 a	16.76 c	2.85 a	2.47 a	19.23 c	3.84 c	38.90 c	6.13 c
Level of Sig.	**	**	**	**	**	**	**	**	**
CV (%)	6.67%	8.16%	8.05%	8.98%	9.36%	9.71%	4.44%	7.35%	8.34%

** = Significant at 1% level of probability, *= Significant at 5% level of probability
V_1=HC-2,V_2=HC-3 and V_3=HC-95

Table 2
Effect of potassium on growth and yield characteristics of kenaf.

Treatments	Plant height (m)	Number of internode plant^{-1}	Plant diameter (mm)	Green weight with leaf (kg)	Green weight without leaf (kg)	Fibre yield plant^{-1} (g)	Fibre yield (t ha^{-1})	Stick yield plant^{-1} (g)	Stick yield (t ha^{-1})
K_0	2.36 c	53.18 d	13.42 c	2.04 c	1.70 c	14.66 d	2.93 c	29.80 b	4.93 d
K_{30}	2.86 b	64.64 c	17.84 b	3.05 b	2.65 b	20.34 c	4.07 b	40.40 a	6.10 c
K_{40}	2.88 b	65.98 a	17.76 c	3.03 b	2.63 b	21.31 a	4.26 a	42.53 b	6.98 b
K_{50}	2.92a	65.33 b	18.21 a	3.11 a	2.70 a	21.26 b	4.23 a	45.91 a	7.12 a
Level of significance	**	**	**	**	**	**	**	**	**
CV (%)	6.67%	8.16%	8.05%	8.98%	9.36%	9.71%	4.44%	7.35%	8.34%

** = Significant at 1% level of probability, *= Significant at 5% level of probability
K_0=0 kg K ha^{-1}, K_{30}=30 kg K ha^{-1}, K_{40}=40 kg K ha^{-1}, K_{50}=50 kg K ha^{-1}

Table 3
Interaction effect of variety and potassium (K) on growth and yield parameters of kenaf.

Variety* Potassium	Plant height (m)	Number of internode per plant	Plant diameter (mm)	Green weight with leaf (kg)	Green weight without leaf (kg)	Fiber yield per plant (g)	Fiber yield (t ha$^{-1)}$	Stick yield per plant (g)	Stick yield (t ha^{-1})
V_1K_0	2.31 h	49.40 e	13.67 d	2.21 c	1.83 c	14.77 d	2.95 d	30.53 d	5.03 b
V_1K_{30}	3.19 a	66.40 abc	18.93 a	3.05 ab	2.65 ab	20.00 c	4 c	41.53 b	6.23 ab
V_1K_{40}	2.98 bc	68.00 ab	17.20 bc	2.91 b	2.50 b	21.03 abc	4.2 abc	43.13 b	7.03 ab
V_1K_{50}	2.72 ef	62.60 c	17.73 abc	3.08 ab	2.67 ab	22.13 ab	4.42 ab	48.60 a	7.83 a
V_2K_0	2.42 gh	55.00 d	13.40 d	1.94 d	1.62 c	14.53 d	2.9 d	29.87 d	4.86 b
V_2K_{30}	2.85 cde	61.33 c	16.93 c	2.95 ab	2.57 ab	20.83 abc	4.16 abc	38.20 c	5.96 ab
V_2K_{40}	2.79 de	64.40 bc	18.27 abc	3.10 ab	2.70 ab	22.40 a	4.48 a	41.87 b	6.50 ab
V_2K_{50}	2.91 cd	63.33 bc	18.53 ab	3.05 ab	2.65 ab	20.07 c	4.01 c	46.60 b	7.40 ab
V_3K_0	2.34 h	55.13 d	13.20 d	1.97 cd	1.65 c	14.67 d	2.93 d	29.00 d	4.90 b
V_3K_{30}	2.56 fg	66.20 abc	17.67 abc	3.16 ab	2.74 a	20.20 c	4.04 c	41.47 b	6.10 ab
V_3K_{40}	2.88 cde	65.53 abc	17.83 abc	3.10 ab	2.71 ab	20.50 bc	4.1 bc	42.60 b	7.40 ab
V_3K_{50}	3.14 ab	70.07 a	18.37 ab	3.19 a	2.78 a	21.57 abc	4.31 abc	42.53 b	6.13 ab
Level of significance	**	*	*	**	**	*	*	*	*
CV (%)	6.67%	8.16%	8.05%	8.98%	9.36%	9.71%	4.44%	7.35%	8.34%

** = Significant at 1% level of probability, *= Significant at 5% level of probability

Effect of potassium (K)

In case of the effect of K fertilizer, all the characters had statistically significant and found significant increase in increasing level of K. The potassium had significant influence on plant height, number of internodes per plant, plant diameter, green weight with and without leaves, fibre weight, fibre yield, stick weight and stick yield. The highest plant height (2.92m),plant diameter (18.21mm), green weight with leaves (3.11 kg) and green weight without leaves (2.70kg) , stick weight (45.91g) and stick yield (7.12 t ha^{-1}) were obtained from 50 kg K ha^{-1} and number of internodes per plant (65.98), fibre weight plant^{-1}(21.31g), fibre yield (4.26 t ha^{-1}) were obtained from the treatment when 40 kg ha^{-1} potassium fertilizer was applied.

Interaction effect of variety and potassium

The effect of interaction of variety and level of potassium had significant influence on plant height, number of internodes per plant, plant diameter,green weight with and without leaves, fibre weight per ten plants, fibre yield, stick weight per ten plants and stick yield. The highest values of fibre yield were obtained from HC-3 variety with 40 kg K ha^{-1}.

CONCLUSION

The results of the present experiment showed that the HC-3 was better than the other two varieties for fiber yield production. On the other hand, 40 kg K ha^{-1} proved to be better fiber yield than any other lower and higher level of potassium. Therefore, it can be inferred that the results of this study that kenaf can produce the highest fibre yield from a combination of variety HC-3 with 40 kg K ha^{-1} under conditions of the present experiment. Further studies are necessary to confirm the present findings.

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