J. Agrofor. Environ. 2 (2): 9-13, 2008 ISSN 1995-6983

Nutritional status of edible jute leaves as influenced by different levels of potassium

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Abstract: Potassium is one of the most important essential nutrient elements and it can significantly influence the uptake of other nutrients by plant. Therefore, the field study was conducted to observe the influence of K on the nutritional status of edible leaves of two jute varieties *viz*. CVL-1 and O-9897 in the experimental field of the Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh from April to August, 2011. There were five levels of K *viz*. 0, 10, 20, 30 and 40 kg ha^{-1}. 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. Variety as well as different K levels exerted significant effect on protein, chlorophyll and nutrient contents of edible jute leaves. Maximum protein and nutrient contents were found in variety CVL-1 where as the highest chlorophyll content was obtained from the variety O-9897. Protein, chlorophyll and nutrient contents were increased with the increasing levels of K up to 30 kg ha^{-1} and then declined. The overall results suggest that K level @ 30 kg ha^{-1} can be applied for obtaining nutritious edible jute leaves of the variety CVL-1 under the agro-climatic condition of BAU farm.
Key words: Jute, Potassium, Nutrient content, Protein and Chlorophyll.

Introduction

Jute, an important and the largest natural fiber crop belonging to the genus *Corchorus*, family Tiliaceae, is an eco-friendly and the major cash crop of Bangladesh. Food and Agriculture Organization (FAO) has declared 2009 as the International Year for Natural Fiber which reflects the importance of this group of commodities to many countries. An information search review was done on jute leaf as vegetable and medicine. It was observed in different literatures that this green and leafy vegetable is rich in beta-carotene for good eyesight, iron for healthy red blood cells, calcium for strong bones and teeth, and vitamin C for smooth, clear skin, strong immune cells, and fast wound-healing. Vitamins A, C and E present in jute leaf/Saluyot "sponge-up" free radicals, jute leaves as vegetable contain an abundance of antioxidants that have been associated with protection from chronic diseases such as heart disease, cancer, diabetes, and hypertension as well as other medical conditions. Due to better performance in respect of yield and quality the mutant CM-18 has been registered as the first jute variety in Bangladesh for vegetable purpose in the name of *Binapatshak-1* in 2003. Fresh jute leaf has higher demand. Ayurvedics use the leaves for ascites, pain, piles, and tumors. Elsewhere, the leaves are used for cystitis, dysuria, fever, and gonorrhea. The cold infusion is said to restore the appetite and strength (Islam, 2010).

Potassium is one of the primary essential nutrients for plant growth and development. To get nutritious jute leaves, appropriate level of K is essential. An experiment was, therefore, initiated with five levels of K to study the nutritional status of two popular jute varieties *viz*. CVL-1 and O-9897 and to find out optimum level of K to obtain maximum nutrient content of edible leaves under the study.

Materials and Methods

An investigation was carried out at the experimental farm of the Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh during the period from April to August, 2011. Soil sample was collected and kept in a polyethylene bag for chemical analysis. The experiment was consisted of two factors: A. Variety of jute *viz*. CVL-1 and O-9897 B. Five different doses of K (0, 10, 20, 30, and 40 kg K ha^{-1}). Seeds were collected from the BADC, Mymensingh. There were 10 treatment combinations with variety and fertilizer. The experiment was laid out in RCBD with three replications. The unit plot size was 4 m × 2.5 m. The total number of unit plots was 30. The spaces between replication and between unit plots were 1m and 0.5 m, respectively. The treatments were randomly distributed. At the time of final land preparation, the land was fertilized @ 80, 20, 40 and 7 kg ha^{-1} of urea, triple superphosphate, gypsum and zinc sulphate, respectively. Muriate of potash was used as sources of K. Seeds were sown on April 30, 2011. After seed sowing weeding, gap filling, thinning, irrigation and pesticide application were performed as and when necessary throughout the growth period of the crop. Plant samples were collected from each of the plot after 35 days of sowing and divided into two parts. One part was kept fresh in the refrigerator until chlorophyll analysis and other part was dried in an oven at 60°C for about 72 hours. Then they were ground to pass through a 20-mesh sieve. The prepared samples were then put into polythene bag. Total N was determined by kjeldahl method. P, K, S, Ca, Mg and Fe contents were determined by standard methods (Jackson, 1973; Page *et al*., 1982; Ghosh *et al*., 1983; Tandon, 1995 and Singh *et al*., 1999) and chlorophyll by using the method of Anderson and Boardman (1964). Analysis of variance was done with the help of computer package program MSTAT according to Gomez and Gomez (1984) and adjudged the mean differences by LSD Test.

Results and Discussion

Nutritional status of edible jute leaves:

Nitrogen content: The application of different levels of K, variety and their interactions significantly influenced N content of jute leaf. The highest N content (0.86%) was obtained in CVL-1 leaves than N content (0.77%) of O-9897 (Table 1). In the edible jute leaves N content varied from 0.63 to 0.99%. Maximum amount (0.99%) was observed in 30 kg K ha^{-1} treated unit and minimum (0.63%) was found in control treatment which was statistically different from other treatments. On the other hand K_{30} and K_{40} treatments were statistically identical (Table 2). Thus the results of our study is in agreement with the findings of Mondal *et al.* (2006) who obtained significantly higher N content from the plant treated with 33.33 K ha^{-1}. The highest N content (1.02%) was found in CVL-1 with the treatment of 30 kg K $ha^{-1}$and the lowest content was found in O-9897 with control treatment (Table 3).

Table 1. Effect of variety on the nutrient content of edible jute leaf

Variety	N (%)	P (mg 100 g^{-1})	K (mg 100 g^{-1})	S (mg 100 g^{-1})	Ca (mg 100 g^{-1})	Mg (mg 100 g^{-1})	Fe (mg 100 g^{-1})
CVL-1	0.86	111	444	209	323	595	7.07
O-9897	0.77	106	379	205	296	567	6.74
LSD	0.07	3.83	10.86	12.14	13.08	2.55	0.25
CV (%)	3.73	2.21	2.25	4.62	2.43	2.15	1.65

Table 2. Effect of different levels of K on the nutrient content of edible jute leaf

Treatments	N (%)	P (mg 100 g^{-1})	K (mg 100 g^{-1})	S (mg 100 g^{-1})	Ca (mg 100 g^{-1})	Mg (mg 100 g^{-1})	Fe (mg 100 g^{-1})
K_0	0.63	90	350	138	256	477	6.20
K_{10}	0.74	103	404	163	292	547	6.58
K_{20}	0.83	111	431	230	315	582	7.03
K_{30}	0.99	123	455	261	350	655	7.47
K_{40}	0.89	115	420	244	335	645	7.26
LSD	0.11	6.06	17.17	19.20	20.68	4.04	0.40
CV (%)	3.73	2.21	2.25	4.62	2.43	2.15	1.65

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 the nutrient content of edible jute leaf

Interaction	N (%)	P (mg 100 g^{-1})	K (mg 100 g^{-1})	S (mg 100 g^{-1})	Ca (mg 100 g^{-1})	Mg (mg 100 g^{-1})	Fe (mg 100 g^{-1})
CVL-1×K_0	0.65	90	390	130	265	492	6.45
CVL-1×K_{10}	0.78	105	430	167	298	558	6.79
CVL-1×K_{20}	0.88	114	464	235	329	589	7.21
CVL-1×K_{30}	1.02	127	488	268	372	672	7.56
CVL-1×K_{40}	0.95	119	452	246	352	667	7.33
O-9897×K_0	0.60	91	310	146	248	462	5.94
O-9897×K_{10}	0.70	102	379	160	287	537	6.36
O-9897×K_{20}	0.78	109	398	225	301	576	6.84
O-9897×K_{30}	0.96	120	422	254	329	639	7.38
O-9897×K_{40}	0.82	112	388	243	318	623	7.18
LSD	0.16	8.57	24.28	27.16	29.25	5.72	0.569
CV (%)	3.57	2.00	2.37	4.11	2.38	2.02	1.68

Phosphorus content: The effects of variety and levels of K were significant on P content of leaves. The highest P content of edible jute leaf per 100 g (111 mg) was obtained in CVL-1 and the lowest (106 mg) P content was from O-9897 (Table 1). Different K levels also significantly influenced P content of jute leaves. The highest value (123 mg 100 g^{-1}) was found in K_{30} which was identical to K_{40} (115 mg 100 g^{-1}) and the lowest from the control treatment (Table 2). The results of our study is nicely supported by the findings of Maitra *et al.* (2000) who observed maximum P content in jute leaves when K was applied @ 40 kg ha-1. The interaction effect of variety and level of potassium had no significant effect on P content. The highest P content (127 mg) was obtained from the interaction of CVL-1 with 30 kg K ha^{-1} and the lowest (90 mg 100 g^{-1}) from O-9897 and K_0 interaction (Table 3).

Potassium content: The content of K in jute leaf was significantly influenced by variety. The highest K content (444 mg 100 g^{-1}) was found in CVL-1 and the lowest amount (379 mg 100 g^{-1}) was found in O-9897 (Table 1). Levels of K also significantly influenced it's content of leaves. K content linearly increased with the increased levels of K up to K_{30} and then decreased. Maximum K content (455 mg 100 g^{-1}) was observed in K_{30} treatment and minimum content (350 mg 100 g^{-1}) was found in control treatment (Table 2). A similar finding was observed by Khan and Islam (1961) who reported that application of 28 kg K_2O ha^{-1} significantly increased the K content of jute leaf. The interaction effect of varieties and levels of K had no significant effect. The highest value was obtained from CVL-1 at K_{30} and the lowest value from O-9897 at K_0 treatment.

Sulphur content: The content of S in jute leaf was statistically significant by the effect of variety. The highest S content (209 mg 100 g^{-1}) was obtained in CVL-1 and the lowest (205 mg 100 g^{-1}) was in O-9897 (Table 1). The effect of different K levels on S content of edible jute leaf was also significant. The highest S content (261 mg 100 g^{-1}) was found in K_{30} treatment and the lowest content (138 mg 100 g^{-1}) was found in control treatment (Table 2). The interaction of variety and levels of K on S content of jute leaf was not significant. The highest content (268 mg 100 g^{-1}) was found from the interaction K_{30} with CVL-1 and the lowest from K_0 with O-9897 (Table 3). From this result, it can be noted that the combined effect of variety and K increased sulphur content of jute leaf. A similar findings also reported by Rashid *et al.* (2008) in case of brinjal.

Calcium content: The effect of variety significantly influenced Ca content of edible jute leaf. The higher (323 mg 100 g^{-1}) Ca content was found in variety CVL-1 compared to the Ca content (296 mg 100 g^{-1}) of the variety O-9897. The content of Ca in Jute leaf varied significantly among different treatments of K. Maximum Ca content (350 mg 100 g^{-1}) was observed in K_{30} treatment and minimum (256 mg 100 g^{-1}) was found in control treatment (Table 2). The results of our study is in good agreement with the results of Mondal *et al.* (2006) who found significantly higher Ca content due K fertilization. The interaction of different levels of K and variety on Ca content was not significant. The highest (372 mg 100 g^{-1}) and lowest (265 mg 100 g^{-1}) values of Ca were found from CVL-1 at K_{30} and O-9897 at K_0 interaction, respectively.

Magnesium content: The effect of variety on Mg content was statistically significant at 1% level. Variety CVL-1 contained 595 mg Mg 100 g^{-1} jute leaf which was higher than the variety of O-9897 (567 mg 100 g^{-1}). The concentration of Mg in jute leaf varied significantly among the different treatments of K. The highest Mg content (655 mg 100 g^{-1}) was observed in K_{30} treatment and the lowest (477 mg 100 g^{-1}) was obtained in control treatment (Table 2). The result indicates that potassium fertilizer treated crops obtained the higher Mg content than control. Similar trend of finding was reported by Rashid (1999). The effect of interaction between variety and levels of K on Mg content in jute leaf was statistically significant. The highest Mg contents were recorded from variety CVL-1 at the treatment of K_{30} and K_{40} which was statistically identical (Table 3). The lowest (492 mg 100 g^{-1}) value was obtained from variety O-9897 with K_0 (Table 3).

Iron content: A significant influence of variety on Fe content of jute leaf was observed. Higher amount of Fe was found in CVL-1 variety (7.07 mg 100 g^{-1}) compared to the variety O-9897 (Table 1). The effect of different levels of K on Fe content of jute leaf was statistically significant (Table 4.2). The highest Fe content (7.47 mg 100 g^{-1}) was found in K_{30} and the lowest Fe content (6.20 mg 100 g^{-1}) was found in K_0 treatment. Andrews *et al.* (2000) reported that iron content was significantly higher in organic fruits and vegetables. The interaction effect of variety and levels of K had not significant on Fe content. From the result, the highest (7.56 mg 100 g^{-1}) Fe content was obtained from CVL-1 at K_{30} and the lowest (5.94 mg 100 g^{-1}) from O-9897 at K_0.

Protein content: Protein content was significantly influenced by variety. Higher protein content was estimated from CVL-1 variety compared to O-9897 variety. Similar trend of result was reported by James *et al.* (1983). Protein content in edible jute leaf varied significantly among different levels of K (Table 5). Maximum protein content (5.79%) was observed in K_{30} and minimum content (3.65%) was found in control. The interaction effect of variety and K level on protein content was not significant. The highest value (5.96%) was from CVL-1×K_{30} and the lowest content (3.51%) was found from O-9897×K_0 interactions (Table 6).

Table 4. Effect of variety on protein and chlorophyll contents of edible jute leaf

Variety	Protein (%)	Chlorophyll a (mg g^{-1})	Chlorophyll b (mg g^{-1})
CVL-1	5.00	0.07	0.12
O-9897	4.51	0.09	0.28
LSD	0.43	0.01	0.02
CV (%)	3.72	4.09	8.62

Table 5. Effect of K on protein and chlorophyll contents of edible jute leaf

Treatments	Protein (%)	Chlorophyll a (mg g^{-1})	Chlorophyll b (mg g^{-1})
K_0	3.65	0.05	0.14
K_{10}	4.32	0.08	0.19
K_{20}	4.86	0.09	0.21
K_{30}	5.79	0.10	0.24
K_{40}	5.17	0.09	0.23
LSD	0.68	0.01	0.03
CV (%)	3.72	4.09	8.62

Table 6. Interaction effects of variety and K on protein and chlorophyll contents of edible jute leaf.

Interaction	Protein (%)	Chlorophyll a (mg g^{-1})	Chlorophyll b (mg g^{-1})
CVL-1×K_0	3.80	0.04	0.09
CVL-1×K_{10}	4.56	0.08	0.10
CVL-1×K_{20}	5.16	0.07	0.12
CVL-1×K_{30}	5.96	0.10	0.15
CVL-1×K_{40}	5.54	0.07	0.14
O-9897×K_0	3.51	0.06	0.19
O-9897×K_{10}	4.09	0.09	0.28
O-9897×K_{20}	4.56	0.10	0.31
O-9897×K_{30}	5.61	0.10	0.33
O-9897×K_{40}	4.79	0.10	0.31
LSD	0.96	0.01	0.05
CV (%)	3.57	3.14	8.18

Chlorophyll a and b contents: The chlorophyll a and b contents in edible jute leaf were influenced significantly by variety. The highest chlorophyll a and b contents (0.09 and 0.28 mg g^{-1}) were found in variety O-9897 and variety CVL-1 contain (0.07 and 0.12 mg g^{-1}) Chlorophyll a and b which was the lowest than O-9897 (Table 4). The result in Table 5 indicated that chlorophyll content by jute leaf significantly influenced by different treatments. Chlorophyll content of a and b ranged from 0.05 to 0.09 mg g^{-1} and 0.14 to 0.23 mg g^{-1}, respectively. The highest amounts (0.10 and 0.24 mg g^{-1}) of chlorophyll a and b were obtained from K_{30} treatment and the lowest contents (0.05 and 0.14 mg g^{-1}) were recorded from (K_0) control treatment (Table 5). Hasan *et al.* (2000) conducted a field experiment and found that application of K had a significant influence on the chlorophyll content of jute leaf which was again proved by the findings of our study. The interaction of different levels of K and variety on chlorophyll a and b contents were not significant. But the highest and lowest ranges varied from chlorophyll a (0.10 to 0.04 mg g^{-1}) and chlorophyll b (0.33 to 0.09 mg g^{-1}) (Table 6).

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