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Influence of Potassium on Yield and Nutrient Composition of Sugarcane

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ABSTRACT

An experiment was carried out at Sugarcane Research & Training Institute (SRTI) farm to study the effect of potassium on yield and nutrient composition of sugarcane. Potassium application showed no significant response to yield and little response to yield contributing characters. Luxury uptake of potassium was recorded which had no effect on yield. Mixed response was recorded in respect of phosphorus, calcium, magnesium and iron concentration. Insignificant difference was recorded in case of Nitrogen concentration in both stalk and leaves. Mixed reaction in case of Nitrogen, Phosphorus, Potassium, Calcium, Magnesium and Iron uptake was also recorded due to application of potassium.

INTRODUCTION

Sugarcane is a long duration exhaustive crop, removes large quantity of nutrients from soil. Potassium is one of the primary element and increase sugarcane yield through enhancing tillering and preventing lodging. A crop producing 100 tons of cane per hectare might remove above 370 kg potassium (Marachan, 1984) The critical level of potash in Bangladesh soil was reported to be about 0.2 me% (Anon., 1989). Potassium present in soils in varying amounts, and a small fraction of it become available to plants. Its deficiency causes marked chlorosis in lower leaves, and burn margins and tips.

Considering the importance of potassium fertilizer on the overall performance of sugarcane the present piece of research was undertaken to evaluate the effect of potash application under rainfed condition on yield, quality and the nutrient composition in sugarcane.

MATERIALS AND METHODS

The experiment was conducted at SRTI farm. The soil of the experimental farm belongs to High Ganges River Flood Plain (Agro-ecological zones-II) under Sara series. The texture of the soil being sandy clay loam and slightly alkaline in reaction. The chemical characteristics of the initial soil were pH 7.6, organic carbon 0.70%, total nitrogen 0.59%, available P-13 ppm, exchangeable K-0.20 me% and available sulphur 6.95 ppm. The experiment was laid down in randomized complete block design with three replications. The sugarcane variety Isd-18 was used as a test crop. The treatments and the sources of fertilizers were as follows :

$T_1 = N_{125}P_{125}S_{30}$kg ha^{-1}
$T_2 = T_1 + K_{80}$kg ha^{-1}
$T_3 = T_1 + K_{160}$ kg ha^{-1}
$T_4 = T_1 + K_{240}$kg ha^{-1} ($P = P_2O_5$ and $K = K_2O$)

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The sources of N, P_2O_5, K_2O and S were Urea, Triple Super Phosphate, Muriate of Potash and Gypsum respectively.

Soil samples were collected before planting for determination of initial status of soil. Plant samples such as leaves and stalks were also collected for determination of N, P, K, S, Ca, Mg and Fe levels.

Soil texture was determined by the hydrometer method, organic carbon by wet oxidation method, pH by a glass electrode meter and total N by macro kjeldahl method. Available P was determined using 0.5M $NaHCO_3$ extraction and spactrometry. Exchangeable K was determined by 1 M ammonium acetate extraction by flame photometry, available S was determined by turbidimetric spectophotometer method, Ca and Mg were determined titrimetrically by complexometric titration. Fe was determined by diacid extraction method. Data collected were analysed statistically. Correlation and regression studies were done between different nutrients constituents.

RESULTS AND DISCUSSION

Results obtained on different growth parameters have been presented in the Tables 1 and 2. The Table 1 shows that individual stalk weight significantly increased due to application of potassium fertilizer compared to control. The highest individual stalk weight was obtained when 160 kg potash ha^{-1} was applied. Significantly higher stalk diameter compared to control was also obtained due to application of 160 kg potash ha^{-1}. Significantly higher number of leaves obtained upto 160 kg ha^{-1}. than control. However, no significant effect of potassium application was recorded in respect of number of cane per clump as well as length of cane. It has been reported that application of potassium at the rate of 120-140 kg K_2O ha^{-1} in potash deficit area increased stalk length, diameter and weight (Anon., 1986). The table. 2 shows that potash application upto 240 kg K_2O ha^{-1} had no significant effect in respect of millable canes, yield of cane and sugar, and sucrose percentage. These results indicate that soil of experimental farm is rich in available potash. Similar results have also been reported elsewhere (Ahmed, 1979; Chapman, 1982). The present results also confirmed the findings of Chowdhury and Rahman (1986). They found no response of potassium application on sugar yield in the Ganges River Flood Plain area.

Results on dry matter production have been shown in the Table 3. The table shows that potassium application have significant positive effect on dry matter production was recorded at 160 kg K_2O ha^{-1}. application. Potassium application significantly increased stalk and leaves dry matter without having significant effect on cane and sugar yield. This discripency is not clearly understood.

Results on nutrient composition and nutrient uptake of leaves and stalk have been presented in the Tables 4 and 5. It is seen from the table 4 that N level decreased significantly in leaves which indicates lower uptake of N due to application of potassium upto 160 kg K_2O ha^{-1}. However, N level increased in leaves upto control treatment when 240 kg K_2O ha^{-1} was applied. Significantly higheer N uptake was recorded in stalk tissues when applied 160 kg K_2O ha^{-1}. No influence was recorded in respect of phosphorus levels in both leaves and stalk tissues. This result disagree with the findings of Haque (1989) who reported higher level of phosphorus in stalks and lower in leaves tissues. Potash levels in both leaves and stalk was found significantly higher compared to untreated control. But this higher uptake of K didnot contribute to increase the yield of either sugar or cane. This is probably because of luxury consumption of K by the sugarcane plants. This view is supported by other workers (Humbert. 1986; Chowdhury and Rahman, 1986). Potassium application has no effect on S uptake and level in sugarcane leaves and stalk tissues. Identical Ca levels in leaves were recorded among treatments while the levels decreased in stalk tissues due to application of potash. But the level of Fe didnot changed due to potassium application.

The Table 5 shows that uptake of N and P significantly increased in stalk due to application of 160 kg K_2 ha^{-1}. Potash uptake was also increased in both leaves and stalks by the same treatment. No effect was recorded in S uptake in both leaf and stalk tissues. Insignificant difference in stalk tissues in respect of Ca uptake. Mg level was recorded identical in leaf tissues.

Table 1. Effect of potassium on no. of cane per clump, length of cane, weight of cane, diameter of cane stalk and total leaf no. per cane.

Treatments (K_2O kg ha^{-1})	No. of cane $clump^{-1}$	Length of cane (cm)	Weight of individual cane (kg)	Diameter of cane stalk (cm)	Total leaf no. $cane^{-1}$
K_0	6.0 ab*	302.0 bcd	0.96 f	1.86 b	30.0 b
K_{80}	5.0 b	300.0 cd	1.20 e	1.95 ab	32.0
K_{160}	6.0 ab	302.0 bcd	1.80 b	2.11 a	32.0 a
K_{240}	7.0 ab	302.7 abc	1.25 e	1.88 ab	30.0 b

* Figures accompanied by same letters are not significantly different at 5% level of significance as per DNMR test.

Table 2. Effect of K on yield of cane and sugar.

Treatments (K_2O kg ha^{-1})	No. of millable cane ($10^3 ha^{-1}$	Yield of cane ha-1 (TCH)	Recovery (%)	Yield of sugar ha-1 (TSH)
K_0	96.7c*	86.7 bc*	10.6 a	9.1 a
K_{80}	102.5 bc	100.2 bc	10.9 a	10.9 a
K_{160}	100.9 bc	96.5 bc	10.7 a	10.3 a
K_{240}	96.8 bc	94.8 bc	10.9 a	10.4 a

* Figures accompanied by same letters are not significantly different at 5% level as per DNMR test.

Table 3. Effect of K on dry matter production of sugarcane (MT ha^{-1}).

Treatments (K_2O kg ha^{-1})	Dry matter yield of cane stalk	Dry matter yield of cane leaves	Total dry I leaf Yield (TDM)
K_0	26.9 f*	2.0 c	28.9 f
K_{80}	34.6 d	2.4 d	37.0 d
K_{160}	45.6 c	2.1 e	47.7 c
K_{240}	31.7 e	2.1 c	33.8 e

* Figures accompained by same letters are not significantly different at 5% lefel of significance as per DNMR test.

Table 4. Effect of K on nutrient content of cane leaves and stalk (Oven dry basis).

Nutrients	Samples	Nutrients (%)			
		Ko	K_{80}	K_{160}	K_{240}
N	Leaves	1.08 ab*	0.98 bc	0.95 c	1.06 a
	Stalk	0.57 b	0.57 b	0.65 a	0.60 b
P	Leaves	0.21 a	0.21 a	0.21 a	0.22 a
	Stalk	0.12 a	0.15 a	0.15 a	0.13 a
K	Leaves	1.00 b	1.41 a	1.56 a	1.40 a
	Stalk	0.66 c	0.87 b	0.88 b	0.93 a
S	Leaves	0.18 a	0.14 b	0.15 a	0.15 b
	Stalk	0.04 a	0.03 a	0.04 a	0.04 a
Ca	Leaves	0.73 a	0.76 a	0.80 a	0.75 a
	Stalk	0.80 a	0.70 b	0.73 b	0.60 c
Mg	Leaves	0.49 b	0.61 a	0.62 a	0.58 a
	Stalk	0.84 a	0.62 c	0.54 d	0.55 d
Fe	Leaves	0.019 a	0.023 a	0.023 a	0.018 a
	Stalk	0.021 b	0.022 b	0.020 b	0.030 a

* Figures accompanied by same letters are not significantly different at 5% level of significance as per DNMR test.

Table 5. Effect of K on nutrient uptake of cane leaves and stalk.

Nutrients uptake	Samples	Nutrients (%)			
		Ko	K_{80}	K_{160}	K_{240}
N	Leaves	20.0 ef*	24.0 cde	22.0 ef	21.0 def
	Stalk	153.0 d	197 S e	296.2 ab	189.2 c
P	Leaves	4.0 c	5.0 d	4.5 de	4.5 de
	Stalk	34.8 de	53.9 bc	68.3 a	41.0 a
K	Leaves	20.0 ef	34.4 bc	33.3 bc	28.6 de
	Stalk	182.1 c	299.0 d	394.0 b	325.1 d
S	Leaves	3.6 cd	3.4 cd	3.2 cde	3.0 de
	Stalk	14.1 cd	9.5 d	15.6 d	15.5 d
Ca	Leaves	14.7 f	18.6 d	17.0 de	15.5 ef
	Stalk	214.0 b	201.8 b	221.7 b	189.9 b
Mg	Leaves	13.0 cd	14.3 bc	13.2 cd	12.1 cd
	Stalk	225.8 d	203.1 de	256.5 c	190.1 c
Fe	Leaves	0.4 bc	0.6 a	0.5 ab	0.4 bc
	Stalk	6.5 abc	8.2 ab	5.0 bc	9.5 a

* Figures accompanied by the same letters are not significantly different at 5% level as per DNMR test

Statistical relationship among different nutrient constituents of sugarcane leaves and stalk due to application of potassium were studied and presented in the Figures 1-8. The relationship between nitrogen and phosphorus content of cane leaves showed positive significant (at 5% level) correlation r= 0.8007 (Figure 1). A highly significant positive correlation (r = 0.9623) exhibited between the uptake pattern of nitrogen content and sulphur content (Figure 2). Nitrogen and iron content was maintained a negative highly significant correlation r=0.9465 (Figure 3). A negatives significant (at 5% level) correlation was also observed between potassium as well as sulphur content (Figure 4). A highly significant (at 1% level) correlation (r=0.9763) was also found between the uptake pattern of potassium and magnesium content (Figure 5). Magnesium and sulphur content showed a negative highly significant (at 1% level) correlation (Figure 6). A negative correlation was also observed between potassium and calcium content of the stalk (Figure 7). The uptake pattern of potassium and magnesium content was found a negative highly significant (at 1% level) correlation (Figure 8).

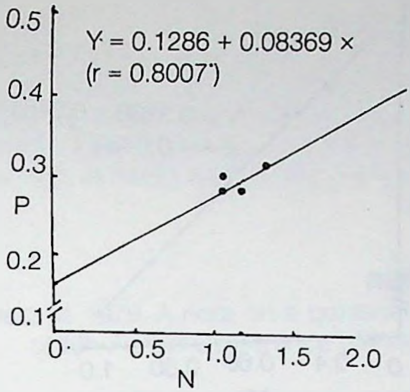


Figure 1.

Relationship Between Nitrogen Content (%) and Phosphorus Content of Cane Leaves.

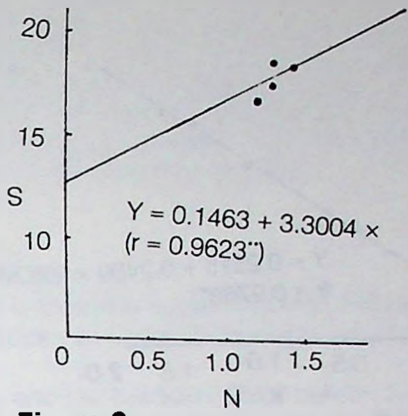


Figure 2.

Relationship Between Nitrogen Content (%) and Sulphur Content (%) of Cane Leaves.

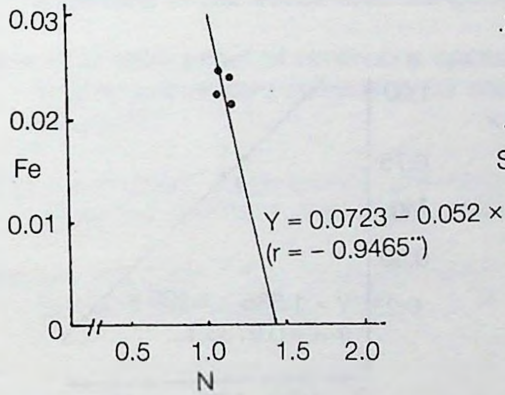


Figure 3.

Relationship Between Nitrogen Content (%) and Iron Content (%) of Cane Leaves.

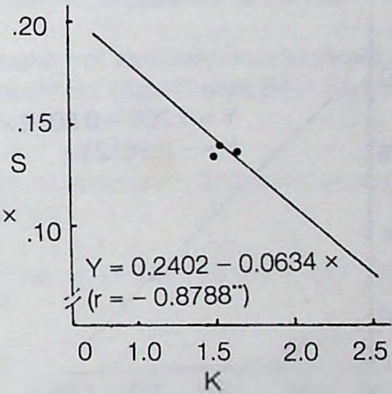


Figure 4.

Relationship Between Potassium Content (%) and Sulphur Content of Cane Leaves.

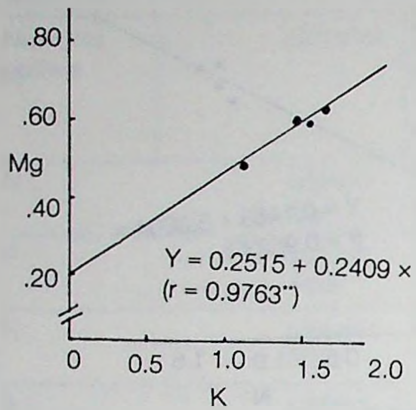


Figure 5.

Relationship between Potassium Content (%) and Magnesium Content (%) of Cane Leaves.

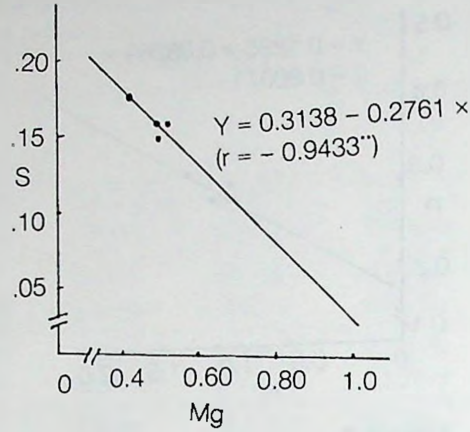


Figure 6.

Relationship between sulphur Content (%) and Magnesium Content (%) of Cane Leaves.

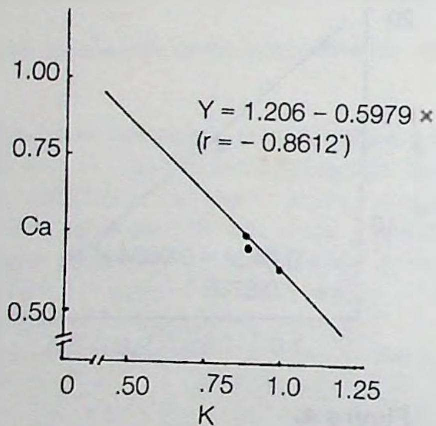
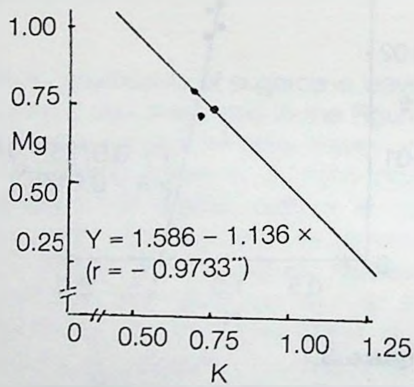


Figure 7.

Relationship between Potassium Content (%) and Calcium content (%) of Cane Leaves.



Relationship Between Potassium Content (%) and Magnesium content of Cane Leaves.

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