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Effect of Levels and Time of Potassium application on Yield and Quality of Rainfed Sugarcane

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ABSTRACT

Field experiments were conducted on a calcarious alluvial sandy loam soil to study the effect of postassium levels (0, 50 and 100 kg/ha) and time of application (basal, half basal + half earthing up (June), half basal + half early October and half earthing up + half early October) on growth, yield and quality of rainfed sugarcane. There was significant increase in yield by K application. Cane yield and sucrose % juice increased significantly and fibre % decreased significantly upto 50 kg potash/ha. Commercial cane sugar (CCS/ha) followed almost similar trend. Potassium K application in two splits, half basal + half earthing up significantly improved sucrose % juice and CCS/ha. The K concentration significantly increased with increasing K level with its maximum value at grand growth and minimum at formative phase.

INTRODUCTION

Sugarcane is being grown as rainfed crop (60-70%) in subtropical regions where rainfall is uncertain and erratic. Potassium is an indispensable element and has been found most efficient in ameliorating crop losses under varied environmental conditions. Good supply of potash in soil helps in the reduction of transpiration by the cane crop resulting in water economy (Zende, 1984). Ascertaining the optimum K requirement and its time of application under the rainfed conditions to sugarcane to maintain proper growth, ensuring cane and sugar production are of great importance. Since systematic information on these aspects in rainfed sugarcane is scanty, an experiment was conducted to find out optimum level of potassium and its time of application to improve the productivity of rainfed sugarcane.

MATERIALS AND METHODS

The experiment was conducted at Pusa during cropping seasons of 1989-90 to 1991-92. The treatments consisted of 3 levels of potassium (0, 50,100 kg/ha), 4 times of application (basal, half basal + half earthing up in June, half basal+half early October, half earthing up +half early October) making altogether twelve treatment combinations. Factorial randomized block design was adopted with 3 replications. The sugarcane crop was fertilized with 90 kg N/ha and 37.4 kg P/ha and K as per treatments. Nitrogen was applied in 2 splits, 60 kg as basal and rest 30 kg at the time of earthing up (June). The mid-early variety BO 109 planted at 90 cm row spacing on 27 February, 1989; 21 February, 1990; 6 March, 1991, and harvested on 16

January, 1990; 25 January, 1991 and 5 February, 1992 respectively. The soil was sandy loam having 8.2 pH, 0.3% organic carbon, 185.5 kg available N, 9.95 kg available P and 110.82 kg available K/ha. The field capacity was 24.4, 24.3, 24.6 and 25.3 and 25.6% in 0-15, 15-30, 30-60 and 60-90 and 90-120 cm soil layer respectively and permanent wilting point in the corresponding layers was 10.4, 10.2, 10.1, 10.6 and 10.8%. Field capacity and permanent wilting point were determined by field method and pressure plate method, respectively. The total rainfall during establishment and formative phase was 43, 19.5 and 13.66 cm with number of rainy 15, 12 and 10 d having total rainfall of 148.8, 93.8 and 90.0 cm in first, second and third year respectively. Whole cane samples were taken at the time of harvest and analysed for total K and juice quality (Spencer and Meade, 1955) and commercial cane sugar was calculated. Fibre percentage of cane was determined with the help of "Rapi Pol Extractor" manufactured by Rivalgaon Sugar Farm Ltd, Ravalgaon (Maharashtra), India.

RESULTS AND DISCUSSION

Effect of K : Potassium application did not cause significant variation on most of the growth characters, although it favourably influenced tiller production, height and cane thickness (Table 1). Yield attributing characters i.e. cane weight and millable canes/ha were significantly influenced by K application. However, the difference between 50 and 100 kg potassium/ha failed to reach the level of significance. Absorption of K in sugarcane is most active after four months crop age and its beneficial effects resulted in more weight/cane and higher number of millable cane/ha. Yadav and Prasad (1989) reported similar results. Mortality % of tillers was also significantly lower due to potassium application since adequate K resulted in more turgid guard cells around stomatas. Further K deficiency affects the metabolism of plant photosynthesis and carbohydrate transport. Thus, owing to significant improvement in yield attributing characters and mortality % by K application, there was significant improvement in cane yield (Table 2). However, 50 and 100 kg potassium/ha did not differ significantly. The percentage increase in cane yield due to application of potassium over control ranged from 25.2 to 28.4. It was also evident that yield response was maximum at 50 kg potassium level (10.5 t/ha) and then decreased with increasing level of potash upto 100 kg (1.33 t/ha). Several workers (Sundra, 1985; Duraisamy *et al.* 1987 and Jafri *et al.* 1988) have reported similar results. Sucrose % juice was significantly improved by K application. Potassium forms a complex with sucrose and thereby holds sucrose in solution. The solubility of source increased as K level is increased (Clarke, 1981). A large number of workers (Verma and Singh, 1976; Sundra, 1985 and Duraisamy *et al.*, 1987) have also reported more sucrose % juice due to K application. Fibre % in cane decreased significantly with increasing level of K application as such there was lower fibre % and higher sucrose % with increased level of K application. Srivastava and Hunsigi (1978) also reported similar results. Due to improvement in cane yield and sucrose % juice by K application, commercial cane sugar/ha was also more at higher K level. The increase in CCS/ha by 100 and 50 kg potassium/ha over control was to the tune of 34.5 and

30.3 percent respectively. The K concentration at formative, grand growth and maturity phase increased significantly due to application of K (Table 2) though its maximum value was obtained at 100 kg potassium/ha (1.86%) during grand growth phase (Aug-Sept.) owing to more uptake of K. The decrease in K concentration (0.89%) during maturity at the same level might be due to its translocation to other plant parts for physiological development. Potassium uptake was also significantly more due to its application, although the difference between 50 and 100 kg potassium was not significant.

Table 1. Effect of levels and time of potassium application on growth and yield attributes of rainfed sugarcane (Pooled data of 1989-90, 1990-91 and 1991-92).

Treatment	Germination (%)	Tillers at 120 d (000/ha)	Height (cm)	Cane girth (mm)	Weight/ Cane (g)	Mortality (%)	Millable cane ('000/ha)
Potassium levels (kg/ha)							
0	41.2	118.6	172	18.4	570	39.3	73.0
50	41.9	122.3	185	19.2	655	35.0	79.5
100	41.7	122.8	186	19.3	656	33.5	81.7
CD(P=0.05)	NS	NS	NS	NS	65.7	2.2	6.2
Time of K application							
Full basal	41.8	122.5	187	19.2	662	34.0	80.7
Half basal + half earthing up	41.8	122.2	188	19.4	672	32.0	83.1
Half basal +half early October	42.0	120.6	185	19.2	660	34.3	79.3
Half earthing up + half early October	42.0	123.0	184	18.9	636	37.2	77.3
CD (P=0.05)	NS	NS	NS	NS	NS	2.4	NS

Effect of time of K application : Time of K application had no significant effects on most of growth and development characters although plant height, unit weight and millable cane/ha were influenced when K was applied half basal + half earthing up followed by full basal than the treatments where K was applied at latter stages (Table 1). This was due to fact that even K was applied at planting it was available to growing plants as and when required. Mortality % was significantly lower in half basal + half earthing up (32.1%) than half earthing up + half early October (37.2%). Time of K application did not influence cane yield singnificantly, however, the yield was maximum in half basal + half earthing up and it was 13.2% higher than half earthing up + half early October (Table 2). Sucrose % juice (16.7) was significantly more in half basal + half earthing up over other treatments in the experiment. Sundra (1985) also found that juice quality improved due to split application of K.

Table 2. Potassium percentage in sheath, fibre %, cane yield and commercial cane sugar/ha as influenced by K levels and its time of application under rainfed conditions (Pooled data of 1989-90, 1990-91 and 1991-92).

Treatment	K percentage in sheath during growth phases			Fibre %	Yield (t/ha)	Sucrose (%) in juice	Commercial cane sugar (t/ha)	K uptake at harvest (kg/ha)
	Formative	Grand growth	Maturity					
Potassium levels (kg/ha)								
0	0.81	1.46	0.84	16.0	41.6	15.7	4.5	121.9
50	0.85	1.71	0.86	15.3	52.1	16.3	5.9	175.1
100	0.87	1.86	0.89	15.2	53.4	16.4	6.0	194.5
CD(P=0.05)	0.02	0.06	0.02	0.2	2.7	0.4	0.4	30.3
Time of K application								
Full basal	0.85	1.82	0.87	15.5	53.4	16.3	6.0	167.2
Half basal + half earthing up	0.84	1.88	0.88	15.2	55.7	16.7	6.4	182.0
Half basal + half early October	0.84	1.75	0.86	15.1	52.5	16.4	5.9	195.6
Half earthing up + half early October	0.82	1.70	0.86	15.3	49.2	16.2	5.5	187.3
CD(P=0.05)	0.02	0.04	NS	NS	NS	0.3	0.25	NS

Due to significant improvement in sucrose % juice and maximum yield in half basal + half earthing up, commercial cane sugar/ha was significantly higher in this treatment. The increase in CCS/ha in the treatment receiving K at half basal + half earthing up than full basal, half basal + half early October and half earthing up + half early October was to the tune of 7.92, 8.11 and 16.36% respectively. Potassium % in sheath was significantly higher during grand growth phase in half basal + half earthing up (1.88%) than other treatments, although it did not influence significantly at maturity phase.

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