SHORT COMMUNICATION

CATIONS IN LEAF BLADES OF SUGARCANE GENETIC STOCKS AND THEIR RELATIONSHIP WITH LEAF NUTRIENTS AND YIELD

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Abstract

The sum of cations in leaf blades at grand growth period in 30 sugarcane varieties was examined. The differences in the sum of leaf cations among varieties and stages, and interaction between stage x variety were significant. H 50-7209 recorded the highest mean leaf cations (101.5 meqts) and Co 7712 the lowest (84.8 meqts). While Co 678 recorded the highest value of 107.6 meqts for leaf sum of cations at 4 months, Co 6806 had the lowest value of 78.4 at 7 months. For interaction between variety x stage, the difference between varieties in a stage ranged from 83.5 meqts / 100 g in Co 7712 to 107.6 in Co 678 at five months; 84.1 in Co 775 to 105.5 in H 50-7209 at six months and 83.2 in Co 62174 to 94.4 in Co 617 at seven months. While H 50-7209, Co 678, Co 853, Co 62101, Co 975, Co 62399, Co419, CP 44 - 101, Co 740 and Co 6304 showed high sum of cations, Co 7712, CoJ 64, CoC 671, Co 6806, Co 997, Co 775, Co 7204, Co 617, Co 7508 and NCo 310 recorded low sum of cations. With the increase in the age of the crop, the mean of 30 genetic stocks showed a decrease in the sum of cations from 96.3 meqts at 4 months to 87.6 meqts at 7 months. Leaf sum of cations had significant positive correlations with calcium, magnesium, sulphate, chloride, sodium and sum of anions at 4, 5, 6 and 7 months. There were significant positive associations between leaf potassium and leaf sum of cations at 5, 6 and 7 months. The correlations between leaf sum of cations at 4 and 5 months and cane yield at 10 and 12 months were positive and significant. The relationship of sum of cations with cane and sugar yield may serve as a tool to screen a large number of sugarcane seedlings at an early stage itself.

Key words: *Sugarcane, leaf blade, cations, leaf blade and sheath nutrients, cane yield, sugar yield*

Introduction

There must be a balance of cations and anions in the soil and in the plant at all times. When a plant absorbs a cation, it must also absorb an anion or else release another cation in exchange for the one absorbed (Thompson and Troach, 1975). The presence of plant mechanism which may be linked with nitrogen metabolism regulated the proportions of the sum of cations and the sum of anions taken up by the plant soil solutions (Cunningham, 1964). Dijkshooram *et al.,* (1963) reported that there was a mechanism to regulate cations- anions content value during the crop growth. Sugarcane is a heavy feeder and exhaustive crop, and its requirement of nutrients depends on varieties, soil type, irrigation, etc. (Singh *et al.,* 2008). Filho and Haag (1977) analyzed third leaf in 16 sugarcane varieties for N, P, K, Ca, Mg and S and observed that higher nutrient levels in the leaves did not always correspond to higher sugar production. Rakkiyappan *et al.* (1996) reported a positive association of total cations in leaf with yield of both cane and sugar. Sithanantham *et al.,* (1976) reported that spraying potassium increased N, K, Ca and Mg in leaf compared to control. Yield differences were found between varieties under the influence of salt as were differences in the uptake of K, Na, Ca and Mg which tended to increase with salt concentration

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(Anonymous, 1974). Chowdhury *et al* (2001) reported that increased sodium uptake decreased the potassium uptake in sugarcane. Gupta and Shukla (1970) noticed decrease in total N, Ca, Mg and Na due to potash manuring. Gumbs (1966) found a significant positive correlation between leaf sum of cations and cane yield under different combinations of NPK fertilizer doses. In this experiment, an attempt was made to study the sum of cations from the 4^{th} to 7^{th} month (grand growth stage) at monthly intervals in leaf number 3 - 6 of sugarcane.

Materials and methods

Thirteen early maturing and 17 late maturing varieties were planted in a simple rectangular 5 x 6 lattice design in two replications. Recommended cultural practices were followed to raise the crop in red sandy loam soil. Leaf samples (3 - 6 leaves, middle without midrib) collected at monthly intervals were dried at 80^oC, powdered and used in the determination of potassium, calcium, magnesium and sodium. One row each exclusively left for yield was harvested at 10 and 12 months age. Leaf samples were heated with H_2SO_4 and H_2O_2 until colourless solutions were obtained. Flame photometer method was followed for estimating potassium and sodium (Jackson, 1967). Calcium and Magnesium were determined by Eriochrome black T dye and EDTA. Calcium was determined using murexide indicator and EDTA. After deducting calcium from the above, magnesium was calculated (Vogel, 1975). Sum of cations was calculated by adding Ca, Mg, K and Na expressed in meqts (Gumbs, 1966).

Results and discussion

The sum of leaf cations of 30 genetic stocks at 4 to 7 months age are presented in Table 1. The differences in sum of leaf cations among varieties, stages and their interaction were significant. When the varietal mean of four stages was considered, H 50-7209 recorded the highest leaf cations (101.5 meqts) and Co 7712 the lowest (84.8 meqts). While Co 678 recorded the highest value of 107.6 meqts for leaf sum of cations at 4 months, Co 6806 had the lowest value of 78.4 at 7 months. With regard to the interaction of variety x stage, the differences among varieties in a stage ranged from 83.5 meqts / 100 g in Co 7712 to 107.6 in Co 678 at 5 months; 84.1 in Co 775 to 105.5 in H 50-7209 at 6 months; 83.2 in Co 62174 to 94.4 in Co 617 at 7 months. Chiranjivi Rao *et al.,* (1984) reported the range of leaf sum of cations from 55.4 to 127.3 meqts per 100 g dry matter. While the varieties H 50-7209, Co 678, Co 853, Co 62101, Co 975, Co 62399, Co 419, CP 44 - 101, Co 740 and Co 6304 showed high sum of cations, Co 7712, CoJ 64, CoC 671, Co 6806, Co 997, Co 775, Co 7204, Co 617, Co 7508 and NCo 310 recorded low sum of cations.

The interaction between variety x stage showed that in a variety, there was a decreasing trend as the stage of the crop advanced. The mean sum of cations of 30 genetic stocks showed a decrease with increase in the age of the crop (from 96.3 meqts at 4 months to 87.6 at 7 months). In Co 678, a high yielding variety, the total cations ranged from 107.6 meqts at four months to 93.0 meqts at 7 months. In the case of the low yielding variety Co 7712, the range was 83.5 at 4 months to 85.9 meqts at 5 months; and it decreased from 87.3 at 6 months to 82.6 meqts at 7 months.

Correlation coefficients of leaf sum of cations with leaf nutrients and yield of cane and sugar are presented in Table 2. Leaf sum of cations had significant positive correlations with calcium, magnesium, sulphate, chloride, sodium and sum of cations at 4, 5, 6 and 7 months. There were significant positive correlations between leaf potassium and leaf sum of cations at 5, 6 and 7 months. The correlations between leaf sum of cations at 4 and 5 months and cane yield at 10 and 12 months were positive and significant. While Gumbs (1966) found a significant positive correlation between yield of cane and sum of cations in leaves under different combinations of NPK, Chiranjivi Rao et al. (1984) reported a significant positive correlation between cane yield and sum of cations in a varietal trial. In addition, in the present study, a significant positive correlation was observed between leaf sum of cations at 4 months and sugar yield at 12 months ($r = 0.386$). However, the sum of cations was not at all influenced by leaf nitrogen, phosphate and silicon. The relationship of sum of cations with cane and sugar yield may serve as a tool to screen a large number of sugarcane seedlings at an early stage itself.

Table 1. Sum of cations (meqts/ 100 g) in leaves of sugarcane genetic stocks at grand growth stage

S. No.	Varieties	Age in months				Varietal mean
		4	5	6	7	
1	Co 775	96.196.1	93.9	84.1	87.2	90.3
2	Co 997	92.5	90.4	91.6	84.3	89.7
3	Co 62174	96.1	96.3	93.0	83.2	92.2
4	Co 6806	93.8	91.5	85.8	78.4	87.4
5	Co 7201	95.0	96.7	95.6	85.1	93.1
6	Co 7204	95.0	95.3	89.9	83.6	91.0
7	Co 7304	94.8	100.1	97.1	86.1	94.5
8	Co 7704	94.5	92.8	89.7	91.1	92.0
9	Co 7712	83.5	85.9	87.3	82.6	84.8
10	CoJ 64	88.5	86.8	85.3	81.0	85.4
11	CoC 671	91.2	87.6	85.3	83.5	86.9
12	CoA 7601	96.4	82.4	93.1	90.7	93.2
13	Co 975	103.5	97.4	96.4	86.6	96.0
14	Co 419	102.3	100.1	92.0	88.2	95.7
15	Co 617	90.1	93.0	86.8	94.4	91.1
16	Co 678	107.6	100.6	96.3	93.0	99.4
17	Co 740	98.9	99.0	91.2	91.0	95.0
18	Co 853	101.9	102.8	100.4	88.2	98.3
19	Co 1148	101.9	102.8	100.4	88.2	98.3
20	Co 62101	105.3	98.9	98.6	90.2	98.2
21	Co 62101	96.7	98.8	96.2	87.0	94.7
22	Co 62399	96.6	98.2	95.1	93.5	95.7
23	Co 6304	96.8	96.5	93.0	92.7	94.8
24	Co 7508	92.2	95.6	91.1	85.4	91.1
25	Co 7717	95.6	97.0	89.3	84.9	91.7
26	B 37172	99.5	96.6	87.6	88.7	93.1
27	CP 44 - 101	98.4	95.0	97.7	91.3	95.6
28	H 50 - 7209	105.5	107.6	105.5	87.3	101.5
29	NCo 310	92.7	94.5	92.7	86.2	91.5
30	POJ 2878	95.3	93.0	91.9	88.8	92.4
	Stage mean	96.3	95.5	92.3	87.6	
	Varieties (V)		Stages (S)		V/S	S/V
S.Em	0.7		2.6		2.6	3.4
C.D	3.2*		7.5**		5.2*	6.9*

** Significant at 1.0 % level; * Significant at 5.0 % level

Acknowledgements

The author is thankful to Dr. N. Balasundaram, former Director and Dr. N. Vijayan Nair, Director, Sugarcane Breeding Institute, Coimbatore - 641 007 for their encouragement and affording facilities.

Table 2. Correlation coefficients (*r*) of leaf sum of cations with nutrients and yield of cane and sugar

Characters	Age in months			
	4	5	6	7
Nitrogen	0.166	0.221	-0.102	0.045
Phosphate	-0.163	0.113	0.173	0.059
Potassium	0.158	0.377*	0.370*	0.422*
Calcium	0.585***	0.657***	0.813***	0.478**
Magnesium	0.704***	0.729***	0.777***	0.722**
Sulphate	0.597***	0.655***	0.448*	0518**
Chloride	0.637***	0.678***	0.453*	0.612***
Sodium	0.719***	0.479**	0.606***	0.681***
Silicon	0.119	0.211	0.354	0.165
Sum of anions	0.617***	0.634***	0.511**	0.584***
Cane yield - 10 months	0.419*	0.363*	0.119	0.085
Sugar yield -10 months	0.336	0.314	0.036	0.152
Cane yield - 12 months	0.424*	0.404*	0.094	0.087
Sugar yield - 12 months	0.386*	0.346	0.044	0.081

*** Correlation coefficient r = 0.572; significant at 0.1 % level
** Correlation coefficient r = 0.463; significant at 1.0 % level
* Correlation coefficient r = 0.361; significant at 5.0 % level

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