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Uptake of Major Nutrients in Above Ground Parts of Promising Mid Late Maturing Sugarcane Clones

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ABSTRACT

Ten mid late maturing promising sugarcane clones including three standards were evaluated for major nutrient uptake and use efficiency in ratoon crop grown in a clay soil (Typic Haplustert). Concentration of N, P and K in dry leaves, green tops and stem were determined and their uptake in the individual plant parts, total above ground parts and uptake of nutrients (kg) per tonne of cane produced were computed. Clones differed significantly in N, P and K uptake in dry leaves, green tops, stem and total above ground parts and kg nutrients to produce a tonne of cane. Total N uptake ranged from 50.19 kg/ha in Co 7219 to 84.24 kg/ha in Co 93014. The lowest uptake of N per tonne of cane was 0.812 kg in Co 93009 and the highest was 1.135 kg in Co 93016. Total P uptake varied from 16.09 kg/ha in Co 7219 to 32.01 kg/ha in Co 93009. Uptake of P per tonne of cane varied from 0.297 kg in Co 86032 to 0.449 kg in Co 93016. Total K uptake ranged form 94.80 kg/ha in Co 93010 to 240.03 kg/ha in Co 6304. The lowest and the highest K uptake to produce a tonne of cane were 1.50 kg in Co 93010 and 3.10 kg in Co 6304 respectively. Clones CoG 93076, Co 93010 and Co 93009 were identified for better NPK use efficiency.

Keywords: Sugarcane, NPK uptake, nutrient use efficiency

INTRODUCTION

A sugarcane clone for its wide acceptance must be an efficient utiliser of nutrients. Considerable variations are noted in the absorption and uptake of nutrients by sugarcane from the soil. Nutrient requirements of sugarcane can be determined based on the levels of the respective nutrient in select index tissues at specific ages of the crop (Lakshmikantham, 1983). Nasir *et al.*, (2000) reported that higher growth rate by sugarcane was mainly due to enhanced uptake of N, P, K and Ca. Vijay Kumar *et al.* (1999) reported that application of balanced dose of N, P and K produced the maximum cane yield. Karthikeyan *et al.* (2003) reported that by judicious combination of irrigation level and balanced fertilisation of K along with N and P, it was possible to increase the productivity of cane along with juice quality to ensure good economic return to the farmer. Morris *et al.* (2002) reported that P was an essential plant nutrient that contributed to optimum sugarcane yields. Thangavelu and Chiranjivi Rao (2002) reported that P uptake by dry leaves, green tops, stem and total above ground parts were associated positively and significantly with N and K uptake, yield of cane and sugar at the harvest. Identification of varieties with higher nutrient use efficiency will be useful to achieve higher productivity at lower level of nutrient supply. Hence, a study was taken up to evaluate the ratoon crop of mid late maturing sugarcane clones for nutrient use efficiency.

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MATERIALS AND METHODS

Ten selected promising mid late maturing sugarcane clones including three standards were ratooned in February, 1999 and field experiment was conducted with these ten varieties as treatments in RBD with a plot size of 8 rows of 6 m length at 90 cm apart. Treatments were replicated thrice. The sugarcane clones tested were Co 93009, Co 93010, Co 93014, Co 93016, Co 93021, Co 93024 and CoG 93076 along with three standards (Co 6304, Co 7219 and Co 86032). Recommended ratoon management practices (stubble shaving, off-barring and application of 140 kg N, 62.5 kg P_2O_5, and 60 kg K_2O/ha as basal and 140 kg N and 60 kg K_2O/ha as top dressing at 60 days) were followed for raising the crop in a clay soil (Typic Haplustert) of ECC Farm of Sugarcane Breeding Institute, Coimbatore. At maturity (12th month), crop was harvested and yield was recorded. From eight randomly harvested canes,

sub samples for dry leaves, green tops and stem were collected, dried at 80°C in an electric oven and powdered. Dry matter per cent of dry leaves, green tops and stem were determined. Biomass production (t/ha) of dry leaves, green tops and stem and total biomass production in above ground parts were determined. Powdered samples were digested with H_2SO_4 and H_2O_2 till the solution was colourless and made up to a known volume. Nitrogen in plant parts was estimated colorimetrically using Nessler's reagent for colour development, phosphorus colorimetrically by vanadomolybdo phosphoric yellow colour method and potassium using Flame photometer (Jackson, 1967). Nitrogen, phosphorus and potassium uptake in dry leaves, green tops and stem were computed by multiplying N, P and K per cent with biomass yield of respective plant parts. Total nitrogen, phosphorus and potassium uptake in above ground parts were summed up. Nutrient uptake (kg N, P and K) to produce a tonne of cane was computed by dividing total uptake of N, P and K by yield of cane.

RESULTS AND DISCUSSION

Nitrogen, phosphorus and potassium uptake by dry leaves, green tops, stem and total above ground parts and removal of N, P and K per tonne of cane at harvest are presented in Tables 1-3.

Nitrogen uptake in above ground parts

Sugarcane clones differed significantly in the nitrogen uptake by dry leaves, green tops, stem and total above ground parts and to produce a tonne of cane. The nitrogen uptake by dry leaves ranged from 11.30 kg/ha in Co 7219 to 21.47 kg/ha in Co 93014. The variation of nitrogen uptake by green tops was in between 16.49 kg/ha in CoG 93076 to 35.55 kg/ha in Co 93014 with a mean of 23.34 kg/ha. Nitrogen uptake in stem varied from 15.36 kg/ha in Co 93016 to 37.86 kg/ha in Co 93009 with a mean of 25.84 kg/ha. The clones recorded lower nitrogen uptake in stem were Co 93016 and Co 93010. Total nitrogen

Table 1: Uptake of nitrogen in above ground parts of ratoon crop of mid late maturing sugarcane clones

S. No.	Clones	N uptake (kg/ha)				N uptake per t of cane (kg)
		Dry leaves	Green tops	Stem	Total above ground parts	
1	Co 93009	18.90	26.89	37.86	83.65	0.812
2	Co 93010	18.41	24.17	18.73	61.31	0.969
3	Co 93014	21.47	35.55	27.28	84.30	1.085
4	Co 93016	12.24	22.85	15.36	50.44	1.135
5	Co 93021	16.16	26.04	23.05	65.25	1.117
6	Co 93024	20.26	21.97	25.37	67.60	1.053
7	CoG 93076	15.63	16.49	32.97	65.09	0.920
	Standards					
8	Co 6304	15.60	22.83	29.60	68.02	0.877
9	Co 7219	11.30	16.65	22.24	50.19	0.984
10	Co 86032	12.38	20.08	25.95	58.39	0.838
	Mean	16.32	23.34	25.84	65.46	0.978
	S.E.	0.19	0.43	0.25	0.49	0.007
	C.D.	0.56*	1.21*	0.75**	1.47**	0.021**

Table 2: Uptake of phosphorus in above ground parts of ratoon crop of mid late maturing sugarcane clones

S. No.	Clones	P uptake (kg/ha)				P uptake per t of cane (kg)
		Dry leaves	Green tops	Stem	Total above ground parts	
1	Co 93009	8.92	6.96	16.13	32.01	0.322
2	Co 93010	7.50	5.03	9.26	21.74	0.344
3	Co 93014	12.92	7.31	10.00	230.23	0.415
4	Co 93016	8.31	5.20	6.42	19.94	0.449
5	Co 93021	7.23	6.23	8.34	21.79	0.371
6	Co 93024	7.91	4.61	11.08	23.61	0.399
7	CoG 93076	6.81	5.08	11.21	23.11	0.312
	Standards					
8	Co 6304	8.32	5.74	11.88	25.95	0.334
9	Co 7219	6.88	3.31	6.78	16.99	0.334
10	Co 86032	5.15	4.26	11.11	20.52	0.297
	Mean	8.00	5.27	10.22	23.49	0.358
	S.E.	0.11	0.08	0.11	0.20	0.003
	C.D.	0.32*	0.23*	0.33**	0.59**	0.008*

Table 3: Uptake of potassium in above ground parts of ratoon crop of mid late maturing sugarcane clones

S. No.	Clones	K uptake (kg/ha)				K uptake per t of cane (kg)
		Dry leaves	Green tops	Stem	Total above ground parts	
1	Co 93009	44.44	61.61	110.03	216.08	2.17
2	Co 93010	24.09	41.36	29.35	94.80	1.50
3	Co 93014	45.81	74.50	133.80	254.11	2.83
4	Co 93016	27.51	39.31	52.18	119.00	2.68
5	Co 93021	61.17	6161	47.89	170.67	2.91
6	Co 93024	52.56	47.08	86.48	186.12	2.90
7	CoG 93076	47.35	57.29	66.46	171.10	2.42
	Standards					
8	Co 6304	46.06	68.61	125.37	240.03	3.10
9	Co 7219	36.14	26.31	54.35	116.79	2.29
10	Co 86032	23.95	39.67	139.42	203.05	2.92
	Mean	40.91	51.74	84.53	177.18	2.57
	S.E.	0.44	0.80	0.47	1.02	0.02
	C.D.	1.31**	2.38**	1.39**	3.03**	0.05**

uptake in above ground parts ranged from 50.19 kg/ha in Co 7219 to 84.24 kg/ha in Co 93014 with the mean of 65.14 kg/ha. Lower quantity of total N uptake was observed in Co 93016 and Co 93010. The lowest uptake of N per tonne of cane was 0.812 kg in Co 93009 and the highest N uptake to produce a tonne of cane was 1.135 kg in Co 93016 with the mean of 0.978 kg. Clones Co 93009 and CoG 93076 recorded lower quantity of N to produce a tonne of cane. Clones identified for better nitrogen use efficiency are Co 93009, CoG 93076 and Co 93010. Prasad *et al.* (1981) observed that 1.71 kg N was required to produce a tonne of cane.

Phosphorus uptake in above ground parts

Statistically significant differences were seen among sugarcane clones in phosphorus uptake by dry leaves, green tops, stem and total above ground parts and kg P uptake per tonne of cane. In dry leaves phosphorus uptake ranged from 5.15 kg/ha in Co 86032 to 12.92 kg/ha in Co 93014 with a mean of 8.00 kg/ha. Sugarcane clones recording lower quantity of phosphorus uptake in dry leaves were CoG 93076, Co 93021 and Co 93010. The phosphorus uptake by green tops varied from 3.31 kg/ha in Co 7219 to 7.31 kg/ha in Co 93014 with a mean of 5.27 kg/ha. Lower quantity of P uptake by green tops was observed in Co 93024, Co 93010 and CoG 93076, which were better than the standard Co 6304. Phosphorus uptake in stem had a range from 6.42 kg/ha in Co 93016 to 16.13 kg in Co 93009 with a mean of 10.22 kg/ha. Clones having lower quantity of P uptake in stem were Co 93016, Co 93021 and Co 93010. The total phosphorus uptake in above ground parts varied from 16.99 kg/ha in Co 7219 to 32.01 kg/ha in Co 93009 with a mean of 23.49 kg/ha. Clones Co 93016, Co 93010, Co 93021 and CoG 93076 recorded lower quantity of P uptake in above ground parts. Co 93016 was better than the standards Co 6304 and Co 86032 in P uptake in total above ground parts. Phosphorus uptake per tonne of cane ranged from 0.297 kg in Co 86032 to 0.449 kg in Co 93016 with the mean of 0.358 kg. Clones recording lower quantity of P to produce a tonne of cane were CoG 93076, Co 93009 and Co 93010. Thangavelu and Chiranjivi Rao (2002) reported that the highest P uptake by dry leaves was 22.4 kg/ha in Co 997 and the lowest was 5.8 kg/ha in CP 44-101. The highest value for total P uptake by above ground parts was 81.0 kg/ha in Co 7201 and the lowest was 24.2 in CP 44-101. Clones identified for better phosphorus use efficiency are Co 93010, CoG 93076, Co 93009 and Co 93021.

Potassium uptake in above ground parts

Sugarcane clones differed significantly in the uptake of potassium by dry leaves, green tops, stem and total above ground parts and potassium per tonne of cane. Potassium uptake in dry leaves ranged from 23.95 kg/ha in Co 86032 to 61.17 kg/ha in Co 93021 with the mean of 40.91 kg/ha. Clones that recorded lower K uptake in dry leaves were Co 93010 and Co 93016. In case of green tops, K uptake varied from 26.31 kg/ha in Co 7219 to 74.50 kg/ha in Co 93014 with a mean of 51.37 kg/ha. Clones Co 93016, Co 93010 and Co 93024 had lower quantity of K uptake in green tops. Potassium uptake in stem ranged from 29.35 kg/ha in Co 93010 to 139.42 kg/ha in Co 86032 with a mean of 84.53 kg/ha. Lower quantity K uptake in stem was seen in Co 93010, Co 93021, Co 93016 and CoG 93076. The variation of K uptake in total above ground parts was from 94.80 kg/ha in Co 93010 to 240.03 kg/ha in Co 6304 with the mean of 173.73 kg/ha. Sugarcane clones having lower amounts of K uptake in above ground parts were Co 93010 and Co 93016. The lowest and the highest potassium uptake to produce a tonne of cane were 1.50 kg in Co 93010 and 3.10 kg in Co 6304 with the mean of 2.57 kg. Clones recording lower quantity of K uptake per tonne of cane were Co 93010, Co 93009 and CoG 93076. Kisselman (1969) reported that the cane yield 160 to 180 tonnes per ha removed 250 to 350 kg K in various growing regions. Clones identified for better potassium

use efficiency are Co 93009, Co 93010, Co 93016 and CoG 93076. Over all, clones CoG 93076, Co 93010 and Co 93009 were identified for better NPK use efficiency in the present study.

CONCLUSION

1. Clones differed significantly in N, P and K uptake by dry leaves, green tops, stem and total above ground parts and nutrient per tonne of cane.
2. Clones identified for better nitrogen use efficiency are Co 93009, CoG 93076 and Co 93010.
3. Clones identified for better phosphorus use efficiency are Co 93010, CoG 93076, Co 93009 and Co 93021.
4. Clones Co 93009, Co 93010, Co 93016, Co 93009 and CoG 93076 were identified for better potassium use efficiency.
5. Overall, clones CoG 93076, Co 93010 and Co 93009 were identified for better N, P and K use efficiency.

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REFERENCES

Jackson, M.L. (1967). Soil Chemical Analysis. Asia Publishing House, Madras.

Karthikeyan, P.K., Bansal, S.K., Dhakshinamoorthy, M and Krishnasamy, R. (2003). Effect of potassium fertilization on cane yield, juice quality and economics of sugarcane grown on farmers' fields of Tamil Nadu, Fertilizer News, **48(10):** 31-38

Kisselman, E. (1969). Know how to produce more sugarcane. Ernst. Butterberg. Verlag. Munich from Husz, G.S. 1972. Sugarcane cultivation and fertilization. Ruhistickstoff,

A.G. Bochum West Germany Lakshmikantham, M. (1983). Technology in Sugarcane Growing. Andhra Pradesh Agricultural University, Hyderabad, Second Edn. 259 Morris, D.R., Gluz, B., Powel, G., Deren, C.M., Snyder, G.H., Perdoma, G.H. and Ulloa, M.F. 2002. Sugarcane leaf P diagnosis in organic soils. Sugarcane International Sep/Oct, 37

Nasir, N.M., Qureshi, R.H., Aslam, M and Akhtar, J.I. (2000). Screening of sugarcane lines selected through hydroponic studies in naturally salt affected field. Pak. Sug. J. 15(4): 2-10.

Prasad, B., Prasad, C.R., Misra, G.K., Verma, S.N.P and Rai, Y. (1981). Fertilizer requirement for different targets of sugarcane based on soil test values in calcareous soils of Bihar. Indian Sug. Crops J. **8(3):** 18-20

Thangavelu, S. and Chiranjivi Rao, K. (2002). Phosphorus uptake of some sugarcane genetic stocks and its association with uptake of other nutrients and yield of cane and sugar. Indian Sug. **52:** 499-506

Vijay Kumar, K., Verma, K.S. and Guomeet Talwar. (1999). Effect of integrated fertilizer use on cane yield and juice quality of sugarcane. Co-operative Sug. **30(7):** 669-674