



# Salt tolerance mechanism of sugarcane and management practices under sodic soil

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## ABSTRACT

A field experiment on sugarcane was conducted at Anbil Dharma lingam Agricultural College and Research Institute, Tiruchirapalli with the view to identify sodic tolerant variety and suitable amendment for sodic soil. Four sugarcane varieties viz., Co Si (Sc) 6, Co C (Sc) 86032, Co C (Sc) 23 and Co G (Sc) 5 and three amendments viz., pressmud @ 12.5 t ha<sup>-1</sup>, gypsum @ 4.8 t ha<sup>-1</sup> and bottom slag @ 15 t ha<sup>-1</sup> were studied along with the unamended control in the experiment were studied. The results revealed that sugarcane varieties Co G (Sc) 5 and Co C (Sc) 23 gave higher K<sup>+</sup>: Na<sup>+</sup> as compared to the Co Si (Sc) 6 and Co C (Sc) 86032 under sodic soil. The sugarcane varieties namely Co G (Sc) 5 and Co C (Sc) 23 were found to be superior for accumulating more K than the Na<sup>+</sup>, hence these might be considered suitable for growing under sodic soil.

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## Introduction

Sugarcane (*Saccharum officinarum* L.) is a major source of sucrose and therefore ubiquitous in cultivation. Although it is ranked as moderately salt-sensitive (Francoise and Maas, 1999), there are differences in salt resistance (Wahid *et al.*, 1997). Primary metabolism of sugarcane has been well studied under normal or sodic conditions; however, there is a lack of information on the biosynthesis and role of secondary metabolites in sugarcane under sodicity, although they accumulate in low levels under normal conditions (Franca *et al.*, 2001). It is assumed that accumulation of secondary metabolites enhances the sugarcane capacity for salt tolerance. Therefore, the aims of this study was to determine time course changes in the levels of some secondary metabolites and their physiological implications in salt tolerance of sugarcane.

## Materials and Methods

The field experiment was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirapalli during June 2007- May 2008 with the view to identify sodic tolerant variety and suitable amendment for sodic soil. Four sugarcane varieties viz., Co Si (Sc) 6, Co C (Sc) 86032, Co C (Sc) 23 and Co G (Sc) 5 were studied. The experimental soil was sandy loam in texture, belonging to Adavathur soil series, taxonomically termed as Vertic Ustropepts.

The soil was alkaline in reaction with pH 8.76 and EC of 0.32 dS m<sup>-1</sup> and was low in available nitrogen (224 kg ha<sup>-1</sup>), medium in available phosphorus and potassium (12.6, 210 kg ha<sup>-1</sup> respectively). The organic carbon content of the soil is medium with 0.65 per cent.

The exchangeable sodium percentage and cation exchange capacity was 38.3 and 19.6 c mol p<sup>(+)</sup> kg<sup>-1</sup> respectively. The experiment was laid out in Randomized block design with three replications.

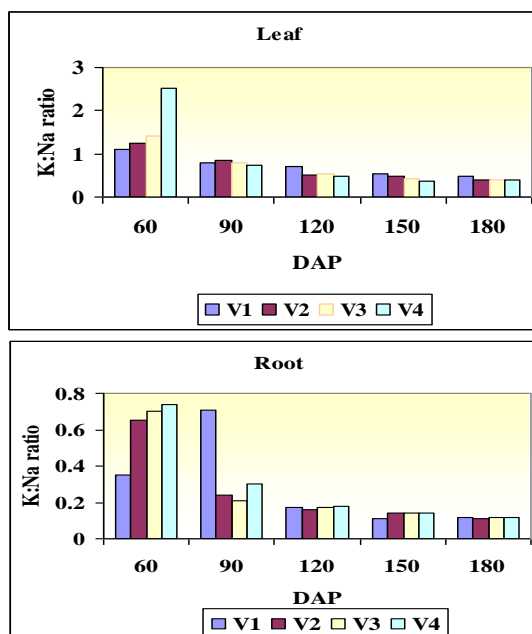
Destructive plant samples were collected at, 60, 90, 120, 150, and 180 days after planting. Samples were separated into different parts like leaf, sheath, stem and root. Samples were shade dried and oven dried at 60°C, then ground and stored in

labelled containers for chemical analyses. Wet digestion of a known quantity of plant material was carried out with 15 ml of triple acid (nitric acid, sulphuric acid and perchloric acid in the ratio of 9:2:1 respectively) mixture for K,Na estimation. The digested samples were made up to desired volume and used for the estimation of K,Na by using flame photometer.

## Results

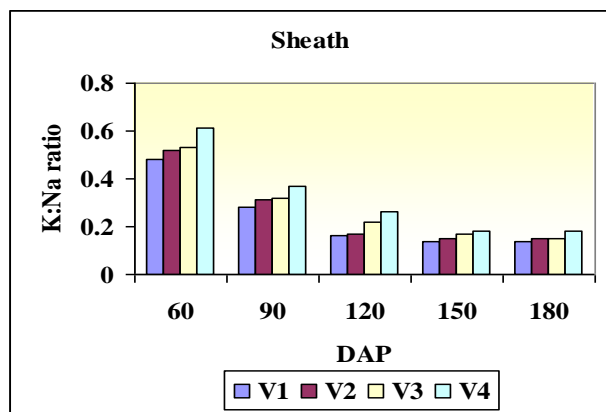
### K<sup>+</sup>: Na<sup>+</sup> ratio in different parts of plant (Table 1)

The mean K:Na ratio of different plant parts at different growth stages of sugarcane have shown higher K: Na ratios were associated with V<sub>4</sub> and T<sub>3</sub> in all plant parts and at all stages of sampling. However, the K: Na ratio was found to be narrowed with the advancement of crop growth in all parts of sugarcane irrespective of varieties and amendments. At later stages of crop growth *i.e.* 150 DAP and 180 DAP narrow K: Na ratios were observed in sheath and root than leaf and stem.



**Table 1. Performance of varieties and effect of amendments on K<sup>+</sup>: Na<sup>+</sup> ratio at different stages of sugarcane**

	Leaf					Stem					Sheath					Root				
	60	90	120	150	180	60	90	120	150	180	60	90	120	150	180	60	90	120	150	180
V <sub>1</sub>	1.10	0.79	0.70	0.54	0.49	1.08	0.42	0.34	0.25	0.22	0.48	0.28	0.16	0.14	0.14	0.35	0.71	0.17	0.11	0.12
V <sub>2</sub>	1.24	0.84	0.51	0.48	0.39	1.12	0.48	0.39	0.29	0.24	0.52	0.31	0.17	0.15	0.15	0.65	0.24	0.16	0.14	0.11
V <sub>3</sub>	1.41	0.79	0.55	0.42	0.40	1.17	0.42	0.41	0.28	0.24	0.53	0.32	0.22	0.17	0.15	0.70	0.21	0.17	0.14	0.12
V <sub>4</sub>	2.51	0.75	0.49	0.38	0.40	1.25	0.62	0.46	0.29	0.22	0.61	0.37	0.26	0.18	0.18	0.74	0.30	0.18	0.14	0.12
T <sub>1</sub>	1.06	0.62	0.47	0.52	0.38	0.96	0.53	0.37	0.27	0.25	0.45	0.26	0.18	0.13	0.14	0.33	0.21	0.18	0.12	0.10
T <sub>2</sub>	1.53	0.83	0.57	0.46	0.43	1.19	0.51	0.39	0.28	0.24	0.55	0.33	0.19	0.17	0.17	0.70	0.22	0.15	0.12	0.12
T <sub>3</sub>	2.07	0.91	0.71	0.40	0.48	1.36	0.45	0.47	0.30	0.18	0.61	0.37	0.24	0.18	0.18	0.84	0.26	0.20	0.19	0.14
T <sub>4</sub>	1.60	0.80	0.50	0.42	0.40	1.12	0.47	0.38	0.27	0.24	0.51	0.30	0.19	0.15	0.14	0.59	0.22	0.14	0.11	0.10



### Discussion

#### K<sup>+</sup>: Na<sup>+</sup> ratio in different parts of plant

The genotypic ability of tolerant varieties in accumulating potassium at higher concentration than susceptible one was observed. Similar results were found with Abdul Wahid (2006). K: Na ratio was found to be narrowed with the advancement of crop growth at all plant parts of sugarcane irrespective of amendments and varieties. At later stages of crop growth i.e., 150 DAP and 180 DAP narrow K:Na ratio were observed in sheath and root than leaf and stem. It revealed that the sodium was stored in sheath and root at later stages. Wider K: Na ratio in leaf at early stages could be used as an indicator of varieties

tolerance to sodicity. Gypsum application also showed wider K: Na ratios in leaf.

### Conclusion

This study strongly supports the hypothesis that K: Na ratio play significant physiological role in sugarcane sodicity tolerance. Wider K: Na ratio in leaf at early stages (60 DAP) and in sheath at all stages could be used as an indicator of varietal tolerance to sodicity. Such roles of these metabolites are confined to the compartment where they accumulate; accumulation of higher K is of key importance to in the tolerance of sodicity. Further research is imperative for broad spectrum understanding the roles of those K: Na ratio in various plant species under sodicity conditions.

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