Response of Cassava (*Manihot esculenta* Crantz) to Zinc: Two Decades Experience in an Ultisol of Kerala, India

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INTRODUCTION

Among the tropical tuber crops, cassava is an annual root crop which provides food for 500 million people in the tropical and subtropical areas of the world. It has a strong competitive advantage because of its high biological efficiency (250 k cal ha^{-1} day^{-1}), yield potential, drought tolerance, wide adaptability to different climates and cropping systems, high starch extraction rate and its excellent physico- chemical characteristics. Cassava is highly responsive to manures and fertilizers including secondary and micronutrients. Among the micronutrients, Zn was found to be critical, and responses to Zn depend upon the soil and plant tissue critical levels. This paper describes the impact of fertilizer Zn under a long term fertilizer experiment at CTCRI since 1990, including evolution, standardisation and validation of fertilizer Zn recommendations for cassava.

METHODS

The experiment was conducted in a Plinthustult (laterite) of Kerala with 20 treatments replicated thrice in a RBD. Here, the treatments compared were T1 (Package of Practices Recommendation as NPK @100:50:100 kg ha^{-1} + FYM @12.5 t ha^{-1}), T2 (NPK@125:50:125 kg ha^{-1} + FYM @12.5 t ha^{-1}) and T3 (NPK@100:50:100 kg ha^{-1} + FYM @12.5 t ha^{-1}+ $ZnSO_4$ @12.5 kg ha^{-1}).Data on tuber yield, tuber quality parameters (starch and cyanogenic glucosides), soil DTPA extractable Zn and plant Zn concentrations (leaf, stem and tuber) were recorded in the variety H-1687. The rate of application of fertilizer Zn was standardised and validated in the 2 major cassava growing districts of Kerala.

RESULTS AND DISCUSSION

Response to Zn in the LTFE

There was no significant effect of Zn application on tuber yield, except during the first year, where the soil Zn status (0.35 mg kg^{-1}) was below the critical level (0.6 mg kg^{-1}). The lack of response in subsequent years may be due its level being above the critical limit. Tuber quality parameters were not significantly different. Application of Zn imparted significantly higher leaf and stem Zn without much effect on tuber Zn concentrations (Table 1). The soil Zn status was improved to a level (Figure 1) higher than the critical level as suggested by Tandon (1993) and was within the sufficiency range (1-5 mg kg^{-1}) (Howeler,1983).

Table 1. Effect of Zn on yield, quality, soil available Zn, plant Zn concentration (pooled mean over 20 years)

Treat No.	Tuber Yield	Tuber Quality		Soil Zn	Plant Zn concentrations		
		Cyanogenic glucosides	Starch		Leaf	Stem	Tuber
	(t ha^{-1})	(mg kg^{-1})	(%)	(µg g^{-1})	(mg kg^{-1})		
T1	26.13	63.6	20.8	1.46	64.1	27.01	19.7
T2	26.99	57.3	21.1	1.82	69.4	28.75	24.6
T3	25.73	52.2	22.6	2.99	8.24	35.92	24.8
CD (0.05)	NS	NS	NS	0.530	9.15	3.94	NS

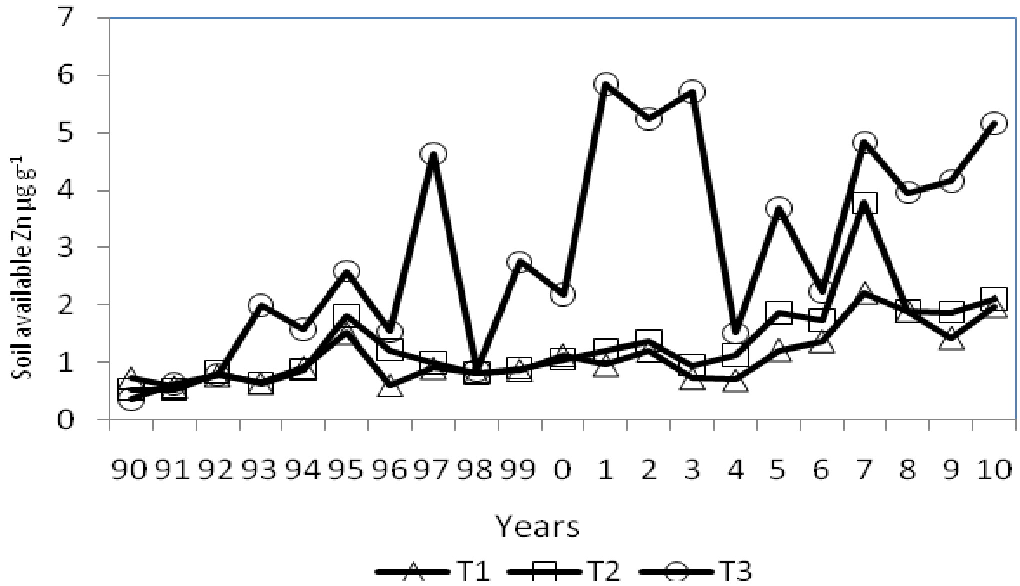

Figure 1. Soil Zn dynamics over a period of 20 years.

Evolution of Zn recommendation and its validation

The standard recommendation is Zn @ 2.62 kg ha^{-1} as $ZnSO_4$ @12.5 kg ha^{-1}. As the response was found diminishing, the dose of Zn (kg ha^{-1} $ZnSO_4$) was standardised based on soil available Zn status (mg kg^{-1}) (Susan John *et al.,* 2010) as <0.2-12.5, 0.2-0.3-10, 0.3-0.4-7.5, 0.4-0.6-5, >0.6-2.5.

The Zn status of cassava-growing soils of Kerala ranged from 0.62-2.84 mg kg^{-1}. The concentration of Zn in the youngest fully expanded leaf tissue at the 3-4 month stage (index leaf) was 44.7-70.1 mg kg^{-1} and this according to Howeler (1983) is sufficient for cassava (30-60 mg kg^{-1}). About 75% of the surveyed districts have sufficient Zn both in soil and in plant tissues.

The soil test based Zn recommendation tested in farmers' fields resulted in a benefit cost ratio of 1.75 with a significantly higher tuber yield of 42.19 t ha^{-1}, where the soil Zn status was between 0.19-0.85 mg kg^{-1}.

CONCLUSIONS

The study established that the need based application of Zn in the acid laterite soils of Kerala on the basis of soil and plant Zn concentration as beneficial to obtain substantial response in terms of yield, quality and benefit cost ratio.

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REFERENCES

Howeler, R.H. (1983) Analisis del tejido vegetal en el diagnostico de problems nutricionales de algunascultivos tropicals. Centro International de Agricultura Tropicale ISBN 84-89206-35-X, Cali, Colombia

Susan John K., Ravindran, C.S., Suja,G. and Prathapan,K. (2010) Soil test based fertilizer cum manurial recommendation for cassava growing soils of Kerala. *J. Root Crops*, 36(1):44-52

Tandon, H.L.S. (1993) Assessment of soil nutrient depletion. *Proceedings of FADIWAP Regional Seminar on Fertilization and the Environment*. Chingmai, Thailand, pp. 203-220