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CRITICAL LEVEL OF ZINC FOR SOILS OF COIMBATORE DISTRICT

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ABSTRACT

Effect of zinc application on yield and the establishment of critical level of zinc in soil was studied in soils of Coimbatore district in Tamilnadu state. The yield of sorghum, cv CSH. 5 increased significantly by the application of zinc deficient soils. DTPA extractable zinc at 1.5 ppm was found to be critical level of zinc for calcareous soils of Coimbatore district with regard to sorghum crop.

Key words : Soil, Zinc, Critical level, Yield

Soil tests are largely emphirical procedures used in determining the nutrient status of soils and in predicting fertilizer requirements. A successful soil test procedure must extract all or proportionate part of available nutrients from a wide range of soils through rapid and accurate techniques. In addition, the amount of nutrients extracted should be calibrated with crop response when other nutrients or conditions are not limiting (Cox and Kamprath, 1972; Sanchez, 1976).

It has been observed that even if the threshold values for the available micronutrients in soils are lower than those generously described for response, no increase in yield is obtained. This shows that critical level of Zn in soils depends upon the nature of extractant, its pH, various chemical reactions in soils, kind of crop, texture, soil properties viz., level of lime, contents of other nutrients including major secondary and micronutrients and their interactions. So it is evident that there is a need for establishing critical level of Zn in the soils of intensive agricultural areas like Coimbatore district.

Hence to establish critical level of Zn in soil, a collaborative research project under ICAR-ACIAR programme on "Diagnosis of Nutritional Disorders in grain sorghum" was carried out in the soils of Coimbatore district.

MATERIALS AND METHODS

Surface soil samples (0-15 cm) varying in Zn status were collected from 15 different locations of Coimbatore district, Tamil Nadu state. These soils represent Inceptisol, Vertisol and Alfisol. Their physico-chemical properties were determined as detailed in Jackson (1973) and are given in Table 1. The soils were analysed for available Zn by extracting with 0.005 M. DTPA (Lindsay and Norvell, 1978).

The experiment was conducted in earthern pots lined with polythene sheet. Four kg of soil was filled in each pot. Six levels of Zn, 0, 1.25, 2.5, 5.0, 10 and 20 ppm were used and it was replicated thrice. Zinc was applied as $ZnSO_4$ $7H_2O$. A basal dose of N, P_2O_5 and K_2O at 18;18;16 ppm was applied through urea, diammonium phosphate and muriate of potash respectively to each pot. Eight

seeds of sorghum (variety CSH. 5) were sown in each pot. Afterwards only four plants were allowed to grow upto seven weeks. The top dressing of N @ 18 ppm was provided at four weeks after sowing so that the crop did not suffer from nitrogen.

After seven weeks period, the crop was harvested and the total dry matter yield was recorded after drying them at 65°C. Bray's per cent yield was calculated as detailed below :

$$\text{Bray's per cent yield} = \frac{\text{Yield at control}}{\text{Yield at 5 ppm level of zinc}} \times 100$$

The critical level of available Zn in soil was worked out by graphical as well as by statistical methods (Cate and Nelson, 1965 ; 1971).

RESULTS AND DISCUSSION

The soils were calcareous sandy loam to clay in texture and varied from neutral to alkaline in reaction.

Response : Six soils responded significantly to Zn application in terms of total dry matter production (Table 2). Highest and lowest yields were observed in soils of Krishnapuram and TNAU (EB) respectively.

Zinc application at 5 ppm has significantly increased total dry matter yield over control. Besides this, at highest level of Zn application (20 ppm), significant reduction in yield was also observed. This is ascribed to the toxic effect of Zn at higher levels.

It is observed that deficient soils at different levels of Zn recorded significantly higher yield. The response decreased as the Zn status of soils increased. Similar results have been reported earlier by Takkar *et al.* (1975) and Rathore *et al.* (1978).

Critical level : The amounts of Zn extracted by DTPA was correlated with Bray's per cent yield significently. Suitability of DTPA for extracting available Zn in soils has been reported to be useful by Lindsay and Norvell (1978) and Brown *et al.* (1971).

Critical level for DTPA extractable zinc in soils of Coimbatore district worked out to be 1.5 and 1.7 ppm for graphical and statistical methods respectively. Brown *et al.* (1971) found that DTPA extraction was one of the suitable methods for assessing soil zinc. Response could be predicted correctly upto 73 per cent for the critical level of 1.5 ppm Zn in the calcareous soils of Coimbatore district.

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REFERENCE

Brown, A. L., Quick, J. and Eddings, J.L. 1971 A comparison of analytical methods for soil zinc. *Proc. Soil Sci. Amer. 35*, 105-107.

Cox, F. R. and Kamprath E. J. 1972. Micronutrients tests pp 289-317. In : *Micronutrients in Agriculture* Eds. J. J. Mortvedt, P. M. Giordane and W. L. Lindsay. *Soil Sci. Soc. Amer.* Madison, Wisconsin.

Cate, R. B. and Nelson, L. A. 1965. A rapid method for the estimation of correlation of soil tests analysis with plant response data. *Int. Soil. Testing Series Tech. Bull No. 1.*

Table 2. Effect of Zn on total dry matter yield of sorghum-yield in g/pot (Mean of 3 replicatioes)

Var. CSH. 5 Period of growth : 7 weeks

Soil Numbers	Zinc levels (ppm)						Mean
	0	1.25	2.5	5.0	10.0	20.0	
1	11.6	13.4	18.4	16.2	12.4	8.2	13.4
2	28.2	27.7	19.8	32.2	30.1	25.6	27.3
3	17.4	22.5	25.2	22.3	27.9	15 2	21.8
4	46.0	46.6	51.9	47.4	33.0	34:6	43.3
5	16.7	18.6	20.0	18.3	12.6	6.3	15.4
6	13.4	16.8	15.7	19.8	21.7	27.3	19.1
7	12.6	14.7	14.9	14.0	10.4	9.5	12.7
8	5.4	6.8	12.7	9.3	5.3	5.6	7·5
9	16.0	19.6	20.3	20.9	23.2	20:8	20.1
10	15.6	17:2	17.6	16.7	18.0	13.9	17.3
11	13:6	10.1	13 6	13 9	9.0	8.7	11.5
12	19.8	22.8	16.1	18.1	18.0	20.6	19.2
13	13.0	13.2	11.4	15:7	13.5	14.3	13.5
14	22.3	18.7	19.2	16.9	20.4	20.7	19.7
15	14.1	12.8	11.5	11.3	10.6	10.5	11.3
Mean	17.7	18.8	19.8	19.5	17.7	16.5	

Statistical Analysis details

	C.D. (at 5%)
Zinc	0.65
Soils	1.01
Zinc x Soils	2.49

Cate, R. B: and Nelson, A. 1971. A simple statistical procedure for partioning soil test correlation data in two classes. *Soil Sci. Soc. Amer. Proc. 35* : 658-668.

Jackson, M. L. 1973. Soil Chemical Analysis. Prentice Hall of India (P) Ltd. New Delhi

Lindsay, W.L. and Norvell, W. A. 1978. Development of a DTPA soil test for zinc, iron, manganese and copper. *Soil Sci. Soc. Am. J.* 42 : 421-438.

Rathore, G. S., Gupta, C.P., Khamparia, R.S. and Sinha, S. B. 1978. Response of wheat of zinc application in alluvial soils of Morena district (Madhya Pradesh). *J. Indian Soc. Soil Sci. 26* : 59-62.

Sanchez, P. A. 1976. Properties aed management of soils in tropics. New York. Wiley p. 618.

Takkar, P. N., Mann, M. S. and Randhawa, N. S. 1975. Effect of direct and residual available zinc on yield, Zn concentrations and its uptake by wheat and groundnut crops. *J. Indian Soc. Soil Sci. 23* : 91-95.

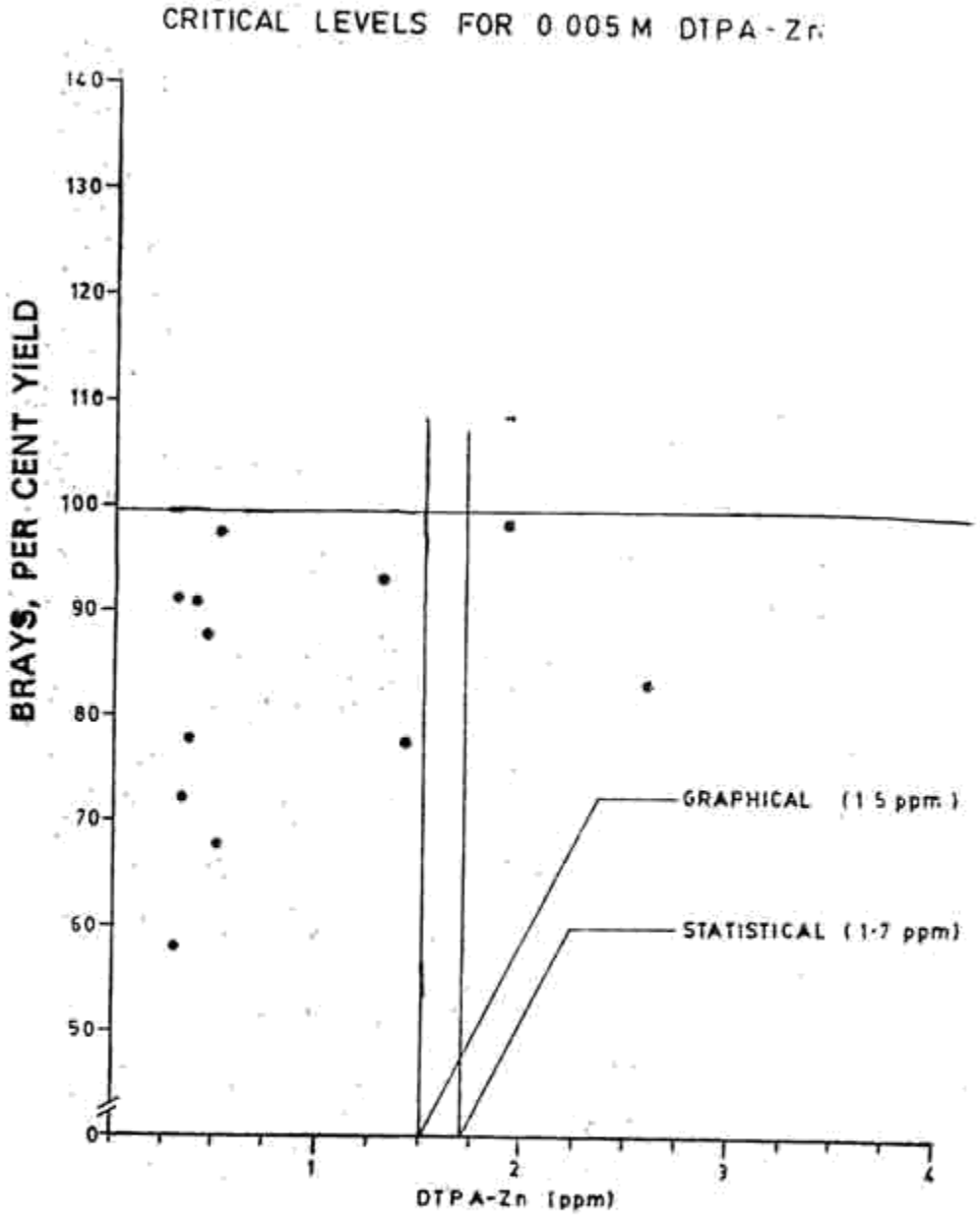
CRITICAL LEVELS FOR 0 005 M DTPA - Zn
BRAYS, PER CENT YIELD
140
130
120
110
100
90
80
70
60
50
0
1
2
3
4
DTPA-Zn (ppm)
GRAPHICAL (1 5 ppm)
STATISTICAL (1·7 ppm)

Table 1. Physio chemical properties and Initial soil and Bray's per cent yield

S. No.	Location	Soil type	Soil series	Soil order	pH	E.C.m mhos/cm	$CaCO_3$ %	DTPA Zn (ppm)	Bray's per cent yield
1.	Sengalipalayam	D Fine loam	Nyl	Alfisol	8.4	0.8	7.9	0.32	71.6
2.	Idayarpalayam	D Fine loam	Smy	Alfisol	8.2	0.3	6.9	0.44	87.6
3.	Chinnathadagam	D Fine loam	Smy	Alfisol	8.5	0.3	5.6	0.38	78.0
4.	Krishnapuram	D Clay	Pyk	Inceptisol	8.1	1.0	3.2	0.50	97.0
5.	Appanaickenpatty	D Fine loam	Dpt	Vertisol	8.2	2.0	2.9	0.40	91.0
6.	Kalianna Pudur	D Fine loam	Nyl	Alfisol	8.6	0.3	5.1	0.48	87.6
7.	Idigarai	D Sandy loam	Pfh	Alfisol	7.9	0.8	5.7	0.32	90.0
8.	TNAU. E.B. 76	D Clay	Pyk	Inceptisol	8.4	0.9	10.1	0.56	58.1
9.	TNAU C. F.	M Clay	Nyl	Alfisol	7.4	1.0	4.2	1.50	76.6
10.	Thekkuppalayam	M Clay	Pyk	Inceptisol	8.4	0.3	6.2	1.30	93.4
11.	TNAU E. B. NA. 1	M Clay	Pyk	Inceptisol	7.9	0.9	10.2	1.90	97.8
12.	TNAU MBS	M Sandy loam	Pth	Alfisol	8.0	0.2	4.2	1.90	109.4
13.	N. G. Pudur	A Clay	Plm	Vertisol	7.8	0.8	10.5	2.60	82.8
14.	U. Palayam	A Loam	Smy	Alfisol	7.5	0.7	7.1	3.00	131.9
15.	Bhavanisager	A Loam	Igr	Alfisol	8.2	0.2	Nil	4.50	124.8

D - Deficient in Zn M - Medium in Zn A - Adequate in Zn