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CRITICAL LEVEL OF ZINC IN SEMIARID SOILS OF COIMBATORE DISTRICT AND MAIZE PLANT

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Abstract

A greenhouse experiment results showed that Zn fertilisation at 5 ppm Zn was found to be effective in increasing the total dry matter production of maize crop. Evaluation of soil tests for available Zn with six extractants showed that 1.00 ppm of DTPA extractable - Zn can be used as a critical level for Zn in soils for delineating the soils of Coimbatore district. The DTPA method has significant correlation not only with Bray's per cent yield but also with actual yield, Zn content in leavs, and Zn content in leaf sheath and stem. Diagnostic criteria for Zn in plant revealed that 21 ppm Zn can be used as critical level for Zn in leaf of seven weeks old well established maize plant.

There is ever increasing demand for maize grain which is consumed directly as human food as well as used as a raw material for industrial needs like Glucose preparation and cattle feed etc. No systematic investigation has been done in establishing critical level of Zn in soils of Coimbatore district and maize plant. The present study was formulated in order to establish the critical level of Zn in soils and maize plant parts.

MATERIALS AND METHODS

Twenty surface soil samples (0-15 cm) representing a wide range in DTPA extractable Zn (0.26 to 3.90 ppm) were collected from the soils of Coimbatore district. p^H varying from 7.9 to 8.7 EC from 0.08 to 2.4 dSm^{-1}, organic matter from 1.4 to 2.84 per cent and available Zn from 0.26 to 3.9 ppm.

Four Kg of each soil was filled in polythene lined pots and treated with $ZnSO_4$ solution @ 0,2.5, 5.0 and 7.5 ppm.Zn. The treatments were replicated twice in a CRD. A basal dose of 120 ppm N (as urea), 80 ppm P_2O_5 (as diammonium phosphate) and 60 ppm K_2O (as muriate of potash) was applied in each pot. Four seeds of maize were sown in each pot and thinned to three plants after two weeks. For irrigating the pots, deionized water was used as and when required. The crop was harvested 49 days after sowing. The plants were separated into leaves, leaf sheath and stem (LSS) and the remaining parts such as whorl-cut and root. The dry matter of each plant part was weighed and added together to compute total dry matter of the plant.

The plant samples were washed in 0.1 N HCl to decontaminate metals on the surface of samples, dried, weighed, ground in a stainless steel mill and digested in a triacid mixture. Total Zn in the plant samples was determined by atomic absorption spectro photometry. Available Zn, in the soil samples, was determined by DTPA method (Lindsay and Norvell, 1978). The Bray's per cent yield was worked out at 5 ppm Zn level. The critical level of available Zn, in soils and plant parts, was determined by using graphical and statistical methods of cate and Nelson (1965 and 1971).

RESULTS AND DISCUSSION

Data in Table.1 show that application of Zn significantly increased the dry matter yield of maize. The dry matter yield in the control ranged from 2.02 to 39.52 g per pot as compared with 3.02 to 46.59 g per pot in the 5 ppm Zn treated pots. The Bray's per cent yield varied from 55.4 to 107.6. Zinc concentration of leaves and LSS ranged from 12 to 28 and 11 to 20 ppm respectively. The Zn uptake at optimum Zn (5 ppm) application in leaves and LSS varied from 16 to 244 and 22 to 329 µg per pot respectively. Simple correlation coefficients between DTPA-Zn and other variables showed significant positive correlation of DTPA-Zn with

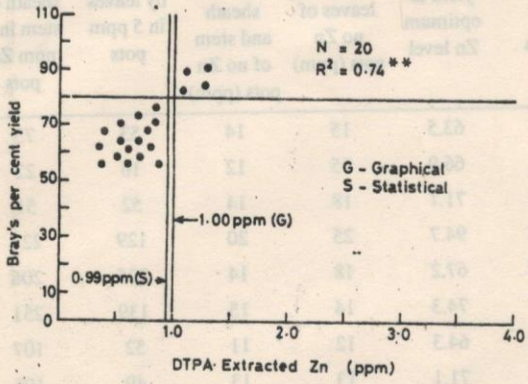

Fig.1. Relationship between soil available Zn and relative yield of maize

actual yield (r=0.659**), Bray's per cent yield (r=0.744**), Zn content in leaves (r=0.744**) and Zn content in LSS (r=0.685**). Also positive significant relationships were observed between Bray's per cent yield Vs Zn content in leaves (r=0.618*) and Zn content in LSS (r=0.546**). The correlations of DTPA-Zn with p^H (r=-0.145), organic matter (r=0.570**) and available-Cu (r=0.798**) were significant.

CRITICAL LEVEL OF Zn IN SOILS : The critical level of DTPA extractable Zn was calculated by plotting Bray's per cent yield against DTPA-Zn according to the method of Cate and Nelson (1965). A value of 1.00 ppm Zn was critical for soil Zn(Figure.1). A soil was considered as non-responsive to Zn where the Bray's per cent yield was more than 90. All the soils, except S_{13} and S_{19}, testing below 1.00 ppm in available Zn responded to the Zn application.

The most commonly used graphical procedure of Cate and Nelson (1965) suffers from human bias in drawing partition line particularly the one parallel to Y axis. In order to rectify this error, the data were subjectd to statistical method of Cate and Nelson (1971) for the determination of critical level of Zn. The critical level calculated by the statistical method was 0.99 ppm DTPA-Zn in soils under

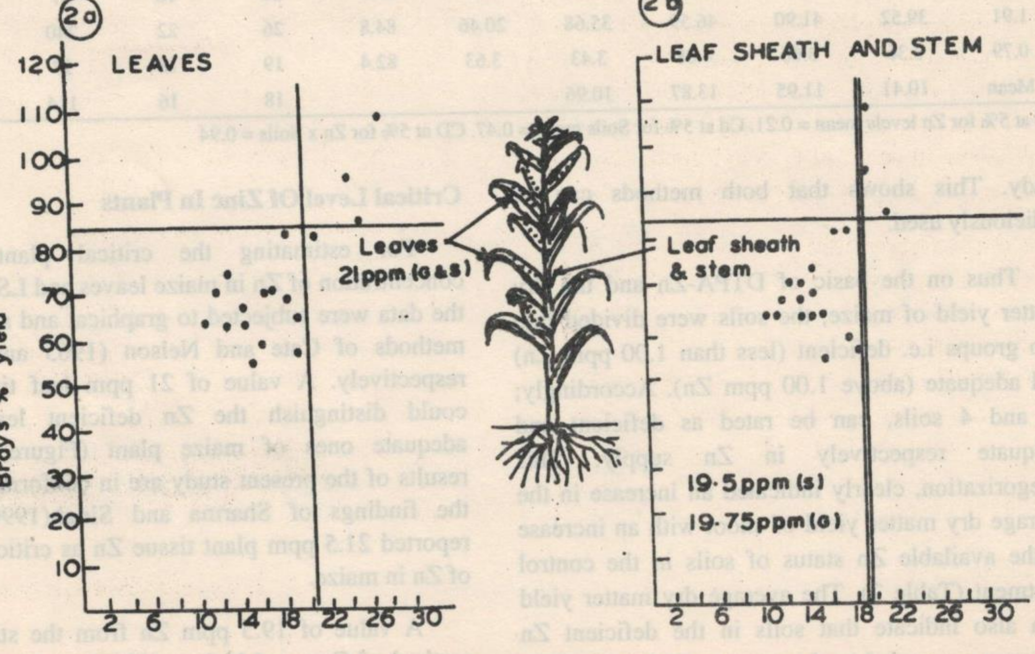

Fig.2 Critical level of Zinc in maize plant

Table.1. Effect of Zinc application on dry matter yield, zinc concent and its uptake by maize

DTPA Extractable Soil Zn (ppm)	Dry matter yield g pot -1 Zinc levels (ppm) C	2.5	5.0	7.5	Mean	Bray's % yield at optimum Zn level	Zn Content in leaves of no Zn pots (ppm)	Zn Content in leaf sheath and stem of no Zn pots (ppm)	Zn uptake by leaves in 5 ppm pots	Zn upake by leaf sheath of stem in 5 ppm Zn pots
0.53	5.89	6.77	9.27	8.78	7.68	63.5	15	14	53	73
0.40	2.02	2.49	3.02	2.24	2.44	66.9	15	12	16	22
0.60	3.59	4.48	5.05	4.50	4.40	71.1	18	14	52	51
3.90	22.22	21.52	22.40	18.13	20.82	94.7	25	20	129	221
0.73	19.38	21.82	28.85	17.15	21.95	67.2	18	14	225	206
0.86	20.88	23.43	28.12	25.60	24.51	74.3	14	15	139	251
0.26	6.55	8.61	10.18	6.85	8.04	64.3	12	11	52	107
0.60	6.78	12.60	9.54	7.39	9.07	71.1	13	13	49	103
0.53	10.38	14.93	16.29	12.80	13.60	63.7	15	12	117	127
0.73	5.89	7.75	10.47	10.46	8.64	56.3	20	19	129	182
0.46	4.71	5.45	7.36	4.56	5.53	64.4	18	15	72	88
0.79	9.55	10.52	16.24	10.57	11.72	58.8	17	18	182	247
1.12	14.29	14.82	17.48	15.18	15.44	81.8	22	17	194	202
1.91	28.34	26.08	26.34	22.09	25.71	107.6	28	20	244	329
0.40	3.27	4.63	5.90	4.55	4.59	55.4	16	16	42	94
0.73	12.84	16.32	18.69	15.22	15.77	68.7	19	15	182	244
0.60	6.35	7.42	9.88	6.46	7.54	64.3	14	15	55	114
0.86	3.28	4.81	5.07	4.87	4.51	64.7	20	16	57	61
1.91	39.52	41.90	46.59	35.68	20.46	84.8	26	22	240	259
0.79	3.36	3.66	4.08	3.43	3.63	82.4	19	18	27	37
Mean	10.41	11.95	13.87	10.96			18	16	114	151

CD at 5% for Zn levels mean = 0.21. Cd at 5% for Soils mean = 0.47. CD at 5% for Zn x Soils = 0.94

study. This shows that both methods can be judiciously used.

Thus on the basic of DTPA-Zn and the dry matter yield of maize, the soils were divided into two groups i.e. deficient (less than 1.00 ppm Zn) and adequate (above 1.00 ppm Zn). Accordingly; 16 and 4 soils, can be rated as deficient and adequate respectively in Zn supply. This categorization, clearly indicated an increase in the average dry matter yield of shoot with an increase in the available Zn status of soils in the control treatment (Table 2). The average dry matter yield data also indicate that soils in the deficient Zn category responded to the extent of 54 per cent to the application of Zn at 5 ppm level.

Critical Level Of Zinc In Plants

For estimating the critical plant tissue concentration of Zn in maize leaves and LSS, again the data were subjected to graphical and statistical methods of Cate and Nelson (1965 and 1971) respectively. A value of 21 ppm leaf tissue Zn could distinguish the Zn deficient leaf from adequate ones of maize plant (Figure.2). The results of the present study are in conformity with the findings of Sharma and Singh(1990) who reported 21.5 ppm plant tissue Zn as critical level of Zn in maize.

A value of 19.5 ppm Zn from the statistical method of Cate and Nelson (1971) can be used as critical level for Zn in LSS (leaf sheath and stem)

Table 2. Response of maize to Zn application in relation to critical Zn content in soils

Zn status of Soils (ppm)	DTPA Zn (ppm)	No of soils	Average dry matter yield of shoot (g/pot) Levels of applied Zn (ppm)				Percentage of soils responding to Zn	Per cent response on dry matter yield at 2.5 ppm Zn		5.0 ppm Zn		7.5 ppm Zn	
			0	2.5	5.0	7.5		Range	Mean	Range	Mean	Range	Mean
< 1.00 Deficient	0.26 to 0.86	16	7.80	9.73	11.75	9.13	100	9 to 86	28	21 to 80	54	2 to 78	24
>1.00 (Adequate)	1.12 to 3.90	4	26.10	26.08	28.20	22.77	50	4 to 6 -3 to -8	5.0* -6	1 to 22 -7	-8*	-10 to -22	-17

A soil was classified responsive to Zn application where per cent response in dry matter yield was more than 24 per cent.
* Two soils, (S13 and S19) containing available Zn above critical level (1.00 ppm), have resulted in positive response but not attained the minimum per cent response (24%) on dry matter yield.

of plant in diagnosing Zn deficiency in the above parts of maize plant.

Thus the present study lays emphasis on Zn fertilizations of maize on the basis of critical levels of Zn in soils and maize plants.

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SOIL TEST BASED FERTILIZER PRESCRIPTION FOR SORGHUM

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ABSTRACT

The nutrient requirement in kg per quintal of grain, per cent contribution of a particular nutrient from soil, fertilizer and organics have been worked out and given for sorghum along with fertilizer prescription equation. The validity of these equation was test verified at different locations in the farmers' fields. The results of these experiments indicate that it is possible to target the yield upto 50 Q ha^{-1} in sorghum.

Increased utilization of high yielding varieties demand higher fertilizer requirement. The general blanket recommendation could not account for the effect of soil nutrients in meeting palnt need. The fertilizer recommendation based on the soil test is well recognised in agricultural production (Velayutham *et al.*, 1985), which gives prescription for a yield target through fertilizer adjustment equation. Hence, an attempt was made to summarize the basis information obtained for prescription based fertilizer recommendation for sorghum.

MATERIALS AND METHODS

Soil test crop response field experiment was conducted with Sorghum Co-25 as a test crop at Agricultural Research Station, Bhavanisagar in a red, non-calcareous soil of Irugur series. The experiment comprised four equal "strips" in which a gradient crop of maize - UMC 5 was grown by applying a graded doses of N,P and K fertilizers so as to get a wide range in soil fertility (Ramamoorthy *et al* ., 1967). After the harvest of the gradient crop, the test crop of sorghum CO-25 was raised in the same field by dividing each strip