https://doi.org/10.29321/MAJ.10.A02581

Madras agric. J. 70 : (2): 88-91 February 1983

Effect Zinc, Copper and Phosphorus Fertilization the Content and Uptake of Nitrogen and Secondary Nutrients by Hybrid Maize

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The investigation revealed that the uptake of N, Ca, Mg and S increased due to application of Zn to maize. Copper fertilization decreased Ca and Mg and increased S content. Feeding of excessive P lowered the concentration of N, Ca, Mg and S in maize Plants.

Necessity of micronutrient application has been felt only after the introduction of high yielding varieties. Micronutrients interact among themselves as well with other nutrients thereby posing multiple problems in plant nutrition. Situation is further aggravated by heavy doses of phosphorus application owing to the demands of high yielding varieties. With a view to understand the influence of micronutrients on the uptake of nitrogen and other secondary nutrients by maize crop, the investigation was carried out on loamy sand soil of Gujarat State.

MATERIAL AND METHODS

A pot culture study was conducted by growing hybrid maize (Ganga-5) as test crop on 4 kg non-calcareous loamy sand soil of Anand, filled in polythene-lined earthen pots. Maize plants were allowed to grow for 46 days after germination. There were 27 treatment combinations of Zn, Cu and P each at 3 levels: 0, 5 and 10 ppm of Zn and Cu; and 50, 100 and 500 ppm of P_2O_5 with 3 replications. The $ZnSO_4 7H_2O$, $CuSO_4 . 5H_2O$ and KH_2PO_4 were used as sources of Zn, Cu and P respectively. A basal dose (120 ppm of N as ammonium sulphate was applied in 2 splits one at the time of sowing and the other 30 days after germination. Dummy pots were maintained under each treatment in order to know the moisture losses which was made up by irrigating the pots daily with glass distilled water to keep the moisture level at 60% of the field capacity. The plant samples were analysed for N, Ca, Mg and S by following the methods as detailed by Jackson (1958), Chang and Bray (1951) and Choudhary and Cornfield (1966) respectively.

RESULTS AND DISCUSSION

Dry matter yield was found to increase by Zn, Cu and P individually. Amongst the three, response to Zn application was of greater magnitude (Table 1). In general; the percentage increases in the yield were 49.3 by Zn, 10.6 by Cu, and 11.4 by P.

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The overall effect of Zn on N content in maize plant did not reach the level of significance (Table 2). Although Zn supplementation increased the yield (Hulagur *et al.*, 1975), practically there was no decrease in N content. Therefore, the dilution effect of increased growth was not felt on the protein content of maize plant as suggested by Verma (1968) and Motacha and Thomas (1968). There was significant effect of Zn on the uptake of N, corresponding to the increase in the level of Zn application. The combined effect of Zn, Cu and P was beneficial in increasing the yield (Hulagur *et al.*, 1975). Individual effect of Cu on N content was said to be non-significant. However, the uptake increased with increasing levels of Cu on account of higher dry matter production. Both, the content and uptake were improved significantly with the increase in level of P application indicating that sufficient P is required for protein synthesis in the maize plants. First and second order interaction effects affected both the constituents. The content ranged between 1.18 and 2.31 per cent while uptake varied from 139 to 339 mg/pot.

Application of Zn decreased the Ca content but increased its uptake while Ca content was affected significantly at each level of Zn, the favourable effect on uptake differed significantly only at lower levels. This increase in Ca uptake was because of influx for higher dry matter production. The pertinent review (Seatz *et al.*, 1959 and Banfi and Cavazzoni, 1963) on flax, sorghum and maize are on par with the present observations. Copper fertilization reduced the Ca content but no effect was seen on its uptake. Similarly, P decreased the Ca content but it was found to increase its uptake. The interaction effect of Zn, Cu and P varied the content between 0.61% ($Zn_2Cu_2P_2$) and 0.79% ($Zn_0Cu_1P_1$). It is indicated that two extreme combinations had a decreasing tendency with the increasing levels of Zn, Cu and P. The least uptake (53 mg/pot) was observed with $Zn_0Cu_0P_0$. When Zn level was increased either to Zn_1 or Zn_2, the uptake was almost 3 times of the minimum removal.

The concentration of Mg did not differ significantly because of Zn application although there was an increasing tendency. However, the significant increase in the uptake of Mg due to Zn fertilization is a confirmation of the observation made by Barrows *et al* (1960). Such an increase in Mg uptake could be attributed to substitution of Zn for Mg (Elgabaly, 1950). The disappearance of Zn deficiency with Mg addition (Lavollay, 1956) gives an additional support to the above hypothesis. The content and uptake of Mg were respectively in an order of linear relationship for decrease and increase with the levels of Cu. Addition of P, however, did not show regular pattern on the Mg content. The variation in the content was from 0.41 to 0.53 per cent while for the uptake range was between 35.1 and 110.9 mg/pot.

The effect of Zn levels exerted significant increase on S uptake but not the content. The copper at the

highest level influenced significant removel of S. Its content decreased but uptake remained unaffected by P treatments. In general, S content varied between 0.11 and 0.19% while uptake ranged between 14.4 and 29.7 mg/pot, Thus balanced application of nutrients is desirable for better nourishment and higher dry matter production of maize plants.

REFERENCES

BANFI, G. and V. CAVAZZONI, 1963. The effect of zinc in unbalanced nutrient solutions on maize during its early vegetative stage. *Agrochimica* 7: 314-22.

BARROWS, H. L., M. S. NEFF and N. GAMMON, Jr.1960. Effect of soil type on mobility of zinc in the soil and its availability from zinc sulphate to tung. *Soil Sci. Soc. Amer. Proc.* 24 : 367-72.

CHENG, K. L. and R. H. BRAY 1951. Determination of Ca and Mg in soil and plant material. *Soil Sci.* 72 : 449-58.

CHOUDHARY, I. A. and A. H. CORNFIELD. 1966. The determination of total S in soils and plant materials, *Analyst*, 91 : 449-58.

ELGABALY, M. M. 1960. Mechanism of Zn fixation by colloidal clays and related minerals .. *Soil Sci.* 69 : 167-74.

HULAGUR B. F., R. T. DANGARWALA and B.V. MEHTA. 1975. Effect of zinc, copper and phosphorus on the yield and composition of hybrid maize grown in loamy sand *J. Indian Soc. Soil Sci.* 23 : 83-90.

JACKSON, M. L. 1958. Soil Chemical analysis *Prentice Hall Inc.* Englewood cliffs, N. J U. S. A.

LAVOLLAY, J. 1956, Principles and conditions of use of essential trace elements in agriculture, Read from *C. A.* 50 : 10960.

MOTACHA, J. E. and G. W. THOMAS. 1968 Grain sorghum response to zinc and iron on a Texas black land soil. *Sorghum News lettere II* : 113.

SEATZ, L. F. A. J. STERGERS and J. C. KRAMER. 1959. Crop response to zinc fertilization as influenced by time and phosphorus application. *Agron. J. 51* : 457-59.

VERMA, M. L. 1968. Effect of application of micronutrients on uptake of major and minor elements by maize. *J. Indian Soc. Soil Sci.* *16* : 351-354.

Table-1 : Dry matter yield of maize (g/pot) under different levels of Zn, Cu and P.

Treat ment	Cu_0			Cu_1			Cu_2			Mean values		
	Zn_0	Zn_1	Zn_2	Zn_0	Zn_1	Zn_2	Zn_0	Zn_1	Zn_2	P	Zn	Cu
P_1	14.7	17.2	16.2	14.5	16.6	16.4	15.4	20.1	18.5	16.6	13.4	16.9
P_2	14.4	17.1	19.2	14.9	18.5	20.2	13 8	19.9	21.0	17.7	19.5	17.4
P_3	11.4	19.1	22.6	12.8	21.7	20.7	8 5	25.2	24.7	18.5	19.9	18.7

C. D. @ 5% Zn: 0. 7, P : 0.7, Cu: 7, Zn X Cu=1.0; Cu X P : N. S.; Zn X Cu X P : 2.1

Table : 2. Nitrogen content and uptake by maize under different levels of Zn, Cu and P.

Levels	Cu_0			Cu_1			Cu_2			Mean values		
	Zn_0	Zn_1	Zn_2	zn_0	zn_1	zn_2	zn_0	xn_1	zn_2	P	zn	Cu
						Condent (per cent)						
P_1	1.68	1.79	1.86	1.74	1.78	1.79	1 60	1.63	1.73	1.73	1.58	1.57
P_2	1.26	1.61	1.62	1.30	1.53	1.62	1.88	1.42	1.47	1.52	1.56	1.55
P_3	1.21	1.48	1.23	1.18	1.46	1.55	2.31	1.34	1.18	1.48	1.60	1.65
						Uptake (mg/pot)						
P_1	241	308	302	257	285	294	244	329	321	287	207	266
P_2	181	275	311	194	284	328	260	283	310	270	301	371
P_3	139	282	352	151	321	322	192	339	292	266	315	286

		Zn	Cu	P	Zn X Cu	Zn X P	Zn X P
C. D. @ 5%	Content	N. S.	N. S.	0.04	0.06	0.06	0.06	0.10
	Uptake	6.0	6.0	6.0	10.0	10.0	10.0	18