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Research Communication

Response of maize (*Zea mays*) to nitrogen and zinc fertilization

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ABSTRACT

Results of a field experiment conducted at Rajasthan College of Agriculture, Udaipur during *Kharif* 2011 in factorial randomized block design with four replications involving 12 treatment combinations (four nitrogen levels: 60, 80, 100 and 120 kg/ha and three zinc levels: 2.5, 5.0 and 7.5 kg/ha) revealed that application of N up to 100 kg/ha and Zn up to 5 kg/ ha in maize (*Zea mays* L.) significantly enhanced the plant height, dry matter accumulation, N and Zn uptake, yield characters, grain yield, harvest index, net returns and benefit cost ratio over their respective counter treatments. However, Zn uptake by maize was significantly improved up to 7.5 kg/ ha.

Key words: Maize, Nitrogen, Zinc

Maize is one of the most versatile and emerging crops due to its wider adaptibility and successful cultivation in diverse seasons and ecologies for various purposes. In India, maize is third important staple food crop but its sustainable higher productivity demands a good nutrient management. Among different essential nutrients, N is highly limiting in Indian soils that exerts a profound effect on plant growth and development owing to its metabolic and physiological roles. The beneficial effects of nitrogen on crop production are well documented however, nitrogen mining by crops for optimum productivity widely vary on account of different agro-climates, soils, cultivars, management practices and other factors. Among micronutrients, zinc deficiency appears to be the most wide spread due to intensive agriculture, use of high analysis fertilizers and limited/no zinc application by farmers. It is established fact that among field crops, maize is the most susceptible to zinc deficiency and is used as an indicator plant for zinc. Among cereals, maize ranks third in zinc demand after rice and wheat but studies on Zn in Sub-humid southern plain and Aravalli Hills in general and in interaction with N in particular; are meagre.

Therefore, an experiment was conducted during *Kharif*, 2011 at Instructional Farm of Rajasthan College of Agriculture, Udaipur (altitude: 579.5 m above mean sea level; location: 24°35' N and 74°42' E) involving 12 treatment combinations (four nitrogen levels: 60, 80, 100 and 120 kg/ha and three zinc levels: 2.5, 5.0 and 7.5 kg/ha) in factorial randomized block design with four replications. The soil of study site was clay loam, slightly alkaline, medium in available nitrogen (275.0 kg/ha), phosphorus (20.21 kg/ha) and potassium (280.5 kg/ha) and low in available zinc (0.49 ppm). Maize 'PEHM 2' which received 870.10 mm rains during the entire crop growing period was planted at 60 × 25 cm applying recommended package of practices.

Results revealed that application of 120 kg N/ha recorded the highest grain yield but variation in this regard was at par with 100 kg N/ha due to statistically at par variations in plant height, dry matter accumulation, grains/cob, seed index, N and Zn uptake and harvest index (Table 1). Application of 100 kg N/ ha was thus found to be the most suitable which recorded 17.13, 39.34; 20.38, 47.95; 18.32, 46.49; 10.92, 23.55; 7.35, 18.12; 6.57, 20.74; 3.86, 7.71 and 32.24, 89.12% higher grain yield, N uptake, Zn uptake, dry matter accumulation, grains/cob, seed index, harvest index and net return than 80 and 60 kg N/ha, respectively. Thus, it is clear that up to 100 kg N/ha in maize dry matter accumulation, yield characters and grain yield significantly varied at each incremental N dose of 20 kg/ha above N level of 60 kg/ha. Improvement in these parameters may be attributed due to fact that N is a constituent of amino acids, nucleic acid, chlorophyll etc that directly influence the conversion of solar radiation into biomass and various plant physiological processes that favourably affected the growth and development of maize.

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Table 1. Effect of nitrogen and zinc fertilization on growth, yield attributes, yield, nutrient uptake and economics of maize

Treatment	Plant height at harvest (cm)	Dry matter accumulation at harvest (g/plant)	Grains/cob	100-grains weight (g)	Grain yield (t/ha)	Harvest index (%)	Total nutrient uptake		Net returns (×10³ ₹/ha)	B:C ratio
							N (kg/ha)	Zn (g/ha)		
Nitrogen (kg/ha)										
60	218.5	127.4	309	18.8	2.11	35.0	51.1	169.3	10.6	1.64
80	234.9	141.9	340	21.3	2.51	36.3	62.8	209.6	15.2	1.90
100	251.5	157.4	365	22.7	2.94	37.7	75.6	248.0	20.1	2.18
120	262.8	167.7	374	23.3	3.08	37.8	81.2	265.2	21.7	2.26
SEm±	5.6	4.3	9	0.5	0.07	0.4	2.2	6.7	0.95	0.06
CD (P=0.05)	16.1	12.4	25	1.3	0.21	1.2	6.2	19.2	2.73	0.16
Zinc (kg/ha)										
2.5	229.9	138.3	331	20.78	2.38	35.9	59.5	189.8	13.9	1.84
5.0	244.7	150.6	352	21.69	2.72	37.0	69.3	227.5	17.7	2.04
7.5	251.2	156.9	358	22.10	2.87	37.3	74.3	251.8	19.1	2.10
SEm±	4.9	3.7	7	0.40	0.06	0.4	1.9	5.8	0.82	0.05
CD (P=0.05)	14.0	10.7	22	NS	0.18	1.1	5.4	16.6	2.37	0.14

Hammad *et al*. (2011) also reported a good response of maize to N under semi arid environment.

Application of 5.0 kg Zn/ha recorded significantly higher plant height, dry matter accumulation, nitrogen uptake, harvest index and grain yield than 2.5 kg Zn/ha but variations in grains/cob between 2.5 and 5.0 kg Zn/ha were statistically at par while there was no significant variation in seed index due to different levels of Zn. Zinc uptake by maize significantly varied at each incremental zinc level and the highest Zn uptake was recorded at 7.5 kg Zn/ha. This shows that zinc uptake is governed by yield and rate of Zn application. Application of 5.0 kg Zn/ ha recorded statistically at par with 7.5 kg Zn/ha in plant height, dry matter accumulation, harvest index, N uptake grain yield and net returns. Application of 5.0 kg Zn/ ha in maize was found suitable considering the input economy as it recorded 6.44, 8.89, 3.06, 16.47, 19.86, 14.29 and 27.34 per cent higher plant height, dry matter accumulation, harvest index, nitrogen uptake, zinc uptake, grain yield and net return than 2.5 kg Zn/ ha, respectively. Differences in different parameters under test due to different Zn levels may be attributed due to variations in crop requirement for Zn as well as different metabolic and physiological roles of Zn (catalyzing enzymes; transformation of carbohydrates, chlorophyll and protein synthesis). Hossain *et al.* (2011) also reported a good response of maize to zinc fertilization.

On the basis of these results, it can be concluded that application of 100 kg N and 5.0 kg Zn/ha in maize is needed on soils of Sub-humid southern plain and Aravalli Hills under rain-fed production system for harvesting higher and economically viable maize yields.

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