The Andhra Agric. J 66 (2): 355-358, 2019

Effect of Source and Method of Zinc Application on Growth and Yield of Maize (*Zea Mays* L.)

P Vijaya Durga, P Ravindra Babu, Ch Sujani Rao and M Martin Luther
Department of Soil Science and Agricultural Chemistry, Agricultural College, Bapatla, A.P.

ABSTRACT

A field experiment was conducted at Agricultural College Farm, Bapatla, on sandy loam soils during *kharif*, 2017 to know the response of source and method of zinc application on growth and yield of maize. The results of the experiment revealed that plant height, dry matter accumulation and yield (stover and kernel) were significantly influenced by the imposed treatments. The treatment receiving RDF+ seed priming with 2% $ZnSO_4$ and foliar application of 0.2% $ZnSO_4$ (T_7) recorded significant increase in stover and kernel yield (7379 and 6342 kg ha^{-1}, respectively) which was 43.9% and 53.8% increase over recommended dose of fertilizers (T_1). Significant increase in drymatter accumulation (13957 kg ha^{-1}) at harvest was recorded with T_7 (RDF+ seed priming with 2% $ZnSO_4$ and foliar application of 0.2% $ZnSO_4$). The highest plant height (239.9 cm) at harvest was recorded with T_7 which was on par with T_4 (RDF+ foliar application of 0.2% $ZnSO_4$) and significantly superior over T_1 (RDF).

Key words: *Drymatter accumulation and yield, Maize, Plant height,*

Maize is the third most important food grain after wheat and rice. It is cultivated as *kharif* and *rabi* crop in India in an area of 9.2 mha with a production of 24.2 mt and average productivity of 2632 kg ha^{-1}. Andhra Pradesh is one of the leading states with an area of 3.03 lakh hectares and producing 1.938 mt (www.indiastat.com 2014-2015).

In Indian context, more than 50% of the agricultural soils are zinc-deficient. The total area under zinc deficiency is about 10 m ha in India (Singh *et al*., 2005). It is estimated that nearly 50 percent of the world's important cereal growing soils have low levels of plant available Zn and around 30 percent of the world's population is affected by zinc deficiency (Alloway, 2009). Soil poor in available zinc is a serious qualitative and quantitative stress factor for crops. As a consequence, zinc is considered as the most yield-limiting micronutrient in some areas of the world (Fageria, 2010).

Under zinc deficiency conditions in soils, maize has low zinc concentration, usually below the critical level of 22 mg kg^{-1} (Singh *et al*., 2005) and shows white linear bands between the midrib and margin of leaves. In order to prevent this zinc deficiency stress, proper source and method of zinc application is advisable.

MATERIAL AND METHODS

A field experiment was conducted at Agricultural College Farm, Bapatla during *kharif*, 2017. The experimental soil is sandy loam in texture having pH 6.55, EC 0.16 dSm^{-1} , low organic carbon (3 g kg^{-1}), low available nitrogen (144 kg ha^{-1}), available phosphorus (22 kg P_2O_5 ha^{-1}) and medium available potassium (176 kg K_2O ha^{-1}). The experiment was laid out in a randomized block design with eight treatments and three replications. The recommended dose of phosphorus was applied two days before the date of sowing as basal through Single super phosphate (SSP) and nitrogen was applied in splits at basal, knee high and tasseling stages through urea. The recommended dose of potassium was supplied through muriate of potash. Zinc sulphate was supplied as per treatments on the day of sowing. The crop was sown on 31th July, 2017. The observations were recorded in five plants randomly selected in each treatment. The total rainfall received during the crop growth period was 664.7 mm. The crop was harvested on 4th November, 2018.

RESULTS AND DISCUSSION

The results of the present investigation revealed that plant height was significantly influenced by the imposed treatments at different stages of crop growth (Table.1). Significantly higher plant height (80.8 cm) at knee high stage was registered in T_6 (RDF+ seed priming @ 2% $ZnSO_4$ + soil application of 50 kg $ZnSO_4$ ha^{-1}) which was on par with T_8 (78.3cm), T_3 (77.8cm) and T_5 (76.9cm). The lowest plant height (64.7 cm) at knee high stage was recorded with T_1 (RDF). The increase of plant height in T_6, T_8, T_3 and T_5 at knee high stage might be due to soil application of zinc.

Table 1. Effect of source and method of zinc application on plant height (cm) at different stages of crop growth in maize.

Treatment	Knee high kg ha^{-1}	Tasseling kg ha^{-1}	Harvest kg ha^{-1}
T_1 : Recommended dose of fertilizers	64.7	172.3	184.8
T_2 : T_1 + Seed priming with 2% $ZnSO_4$ solution	68.9	177.2	188.7
T_3 : T_1 + Soil application of $ZnSO_4$ @ 50 kg ha^{-1}	77.8	208.5	213.8
T_4 : T_1 + Foliar application of 0.2% $ZnSO_4$	66.2	217.7	232.3
T_5 : T_1 + soil application of chelated Zn @ 10 kg ha^{-1}	76.9	201.6	211.8
T_6 : T_1 + Seed priming with 2% $ZnSO_4$ solution + Soil application of $ZnSO_4$ @ 50 kg ha^{-1}	80.8	212.7	219.1
T_7 : T_1 + Seed priming with 2% $ZnSO_4$ solution + Foliar application of 0.2% $ZnSO_4$	70.6	232.7	239.9
T_8 : T_1 + Seed priming with 2% $ZnSO_4$ solution + Soil application of chelated Zn @ 10kg ha^{-1}	78.3	210.6	218.4
SEm±	2.9	9.83	8.13
CD (p=0.05)	8.79	29.8	24.7
CV (%)	7.9	8.34	7.59

Table 2. Effect of source and method of application of zinc on dry matter accumulation (kg ha^{-1}) at different growth stages of maize.

Treatment	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}
T_1 : Recommended dose of fertilizers	714	3294	9417
T_2 : T_1 + Seed priming with 2% $ZnSO_4$ solution	738	3314	9659
T_3 : T_1 + Soil application of $ZnSO_4$ @ 50 kg ha^{-1}	797	3838	10906
T_4 : T_1 + Foliar application of 0.2% $ZnSO_4$	721	4293	12016
T_5 : T_1 + soil application of chelated Zn @ 10 kg ha^{-1}	792	3772	10669
T_6 : T_1 + Seed priming with 2% $ZnSO_4$ solution + Soil application of $ZnSO_4$ @ 50 kg ha^{-1}	857	4745	12805
T_7 : T_1 + Seed priming with 2% $ZnSO_4$ solution + Foliar application of 0.2% $ZnSO_4$	748	5267	13957
T_8 : T_1 + Seed priming with 2% $ZnSO_4$ solution + Soil application of chelated Zn @ 10kg ha^{-1}	820	4407	12332
SEm±	14.01	146.6	179.8
CD (p=0.05)	42.5	444.6	545.58
CV (%)	8.24	8.16	8.07

Table 3. Effect of source and method of zinc application on yield of maize.

Treatment	Kernal yield (kg ha^{-1})	Percent Increase over recommended	Stover yield (kg ha^{-1})	Percent Increase over recommended	Harvest index (%)
T_1	4126	-	5091		44.8
T_2	4370	5.90%	5122	0.60%	46
T_3	4920	19.20%	5786	13.60%	45.9
T_4	5393	31.00%	6223	22.20%	46.4
T_5	4847	17.50%	5621	10.40%	46.3
T_6	5867	42.20%	6898	35.40%	45.9
T_7	6342	53.80%	7329	53.80%	46.4
T_8	5479	32.70%	6556	28.80%	45.9
SEm±	154		141		1.73
CD (p = 0.05)	466		427		NS
CV (%)	7.89		8.15		6.52

At tasseling, significantly higher plant height (232.7 cm) was recorded with T_7 (RDF + seed priming with 2% $ZnSO_4$ and foliar application of 0.2% $ZnSO_4$) followed by T_4 (217.7 cm) (RDF+ foliar application of 0.2% $ZnSO_4$). Treatments T_6, T_8, T_4 and T_3 were on par with each other. Lowest plant height (172.3cm) was recorded in T_1 which was statistically on par with T_2 (177.2 cm). Plant height at tasseling stage was more influenced due to foliar application. At harvest, the highest plant height (239.9 cm) was recorded in T_7 which was on par with T_4 (232.3cm), T_6 (219.1 cm) and T_8 (218.4 cm) and the lowset was with T_1 (184.8 cm). The increase in plant height at tasseling and harvest stage of maize might be due to combined application of zinc as seed priming and foliar application i.e., greater absorption and availability of zinc. Similar results regarding plant height due to seed priming with zinc solution was reported by Arif *et al.* (2005), Ali *et al.* (2007) and Mohsin *et al.* (2014).

The drymatter accumulation at different stages was significantly influenced by imposed treatments at different stages of crop growth. (Table. 2). At knee high stage, all the treatments applied with zinc fertiliser to soil significantly increased the drymatter accumulation and the highest (857kg ha^{-1}) dry matter accumulation was registered with T_6 (RDF+ seed priming @ 2% $ZnSO_4$ and soil application of 50 kg $ZnSO_4$ ha^{-1}) which was on par with T_8 (820 kg ha^{-1}) and significantly superior to T_1 (RDF).

Significantly higher dry matter accumulation (5267 and 13957 kg ha^{-1}) at tasseling and harvest stages of maize was recorded with T_7 (RDF + seed priming @ 2% $ZnSO_4$ + foliar application of 0.2% $ZnSO_4$) followed by T_6 (4745 and 12805 kg ha^{-1}) and T_8 (4407 and 12332 kg ha^{-1}, respectively at tasseling and harvest) where T_6 and T_8 were on par with each other and significantly lower than T_7. The lowest dry matter accumulation (3294, 9417 kg ha^{-1}) was recorded with T_1 (RDF) at tasseling and harvest stages respectively. This increase might be due to the increased plant height with combined seed priming and foliar application of zinc sulphate and increased availability and direct absorption of zinc through foliar spray as reported by Mohsin *et al.* (2014) and Aruna *et al.* (2009).

The data (Table. 3) revealed that significantly higher (6342 and 7379 kg ha^{-1}) kernel and stover yield was recorded in T_7 (RDF+ seed priming @ 2% $ZnSO_4$ + foliar application of $ZnSO_4$ @ 0.2%) followed by T_6 (RDF+ seed priming @ 2% $ZnSO_4$ + soil application of 50 kg $ZnSO_4$ ha^{-1}) and T_8 (seed priming @ 2% $ZnSO_4$ + soil application of 10 kg chelated Zn ha^{-1}). However, T_6 and T_8 were on par with each other. The lowest (4126 and 5091 kg ha^{-1}) kernel and stover yield was registered in T_1 (RDF). In T_2, where seeds were primed with 2 % $ZnSO_4$ solution recorded an increase in kernel and stover yield (4370 and 5122 kg ha^{-1}) over recommended dose of fertilizers. However, T_2 and T_1 were on par with each other. The higher yields due to zinc fertilization was also attributed to the enhanced synthesis of carbohydrates and their transport to site of kernel production (Peddababu *et al.*, 2007). Seed priming with $ZnSO_4$ solution increased the yield which corroborate with the results of Harris *et al.* (2007) and Afzal *et al.* (2013). The increase in kernel yield due to zinc application might be attributed the to benefical effects of zinc on chlorophyll and auxin contents which influence photosynthesis. Also foliar application of zinc might have raised drymatter transformation from source to sink and thus significantly reflected in kernel yield (Zayed *et al.*, 2011). Similar results were reported by Mohsin *et al*. (2014)

LITERATURE CITED

Afzal S, Akbar N, Ahmad Z, Maqsood Q, Iqbal M.A and Aslam M R 2013 Role of seed priming with zinc in improving the hybrid maize (*Zea mays* L.) yield. *American-Eurasian Journal of Agricultural and Environmental Sciences*. 13 (3): 301-306.

Ali S, Arif M, Khan G A, Shah S S and Ali I 2007 Improving maize seed emergence and early seedling growth through water soaking. *Scientific Khyber*. 19: 173-177.

Alloway B J 2009 Soil factors associated with zinc deficiency in crops and humans. *Environmental Geochemistry and Health*. 31: 537–548.

Arif M, Ali S, Shah A, Javed N and Rashid A 2005 Seed priming maize for improving emergence and seedling growth. *Sarhad Journal of Agriculture.* 21 (4): 539-543.

Aruna M, Veeraraghavaiah R and Chandrasekhar K 2006 Productivity and quality of maize (*Zea mays* L.) as affected by foliar application of N and Zn at flowering. *The Andhra Agricultural Journal.* 53: 17-19.

Fageria N K 2010 Zinc in the use of nutrients in crop plants. CRC Press, Boca Raton, FL, 241–271.

Harris D, Rashid A, Miraj G, Arif M and Shah H 2007 On-farm seed priming with zinc sulphate solution- A cost effective way to increase the maize yields of resource- poor farmers. *Field Crops Research.* 102: 119-127.

http://www.indiastat.com. *Ministry of Agriculture, Government of India, 2015-16.*

Mohsin A U, Ahmad A U H, Farooq M and Ullah S 2014 Influence of Zinc application through seed treatment and foliar spray on growth, productivity and grain quality of hybrid maize. *The Journal of Animal and Plant Sciences*. 24 (5): 1494-1503.

Peddababu P, Shanthi M, Prasad B R and Minhas P S 2007 Effect of zinc in rice- blackgram cropping system in saline soils. *The Andhra Agricultural Journal*. 54(1-2): 47-50.

Singh B, Natesan S KA, Singh B K and Usha K 2005 Improving zinc efficiency of cereals under zinc deficiency. *Current Science*. 88: 36-44.

Zayed B A, Salem A K M and Sharkawy H M 2011 Effect of different micronutrient treatments on rice (*Oryza sativa* L.) growth and yield under saline soil conditions. *World Journal of Agricultural Sciences*. 7 (2): 179-184.

Received on 25.06.2018 and revised on 12.11.2018