Andhra Pradesh J Agril. Sci : 3(2): 139-143, 2017

OPTIMISATION OF NUTRIENT MANAGEMENT STRATEGY FOR ENHANCING THE GROWTH AND YIELD OF HYBRID MAIZE (*Zea mays* L.)

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Date of Receipt: 18-02-2017 Date of Acceptance: 24-03-2017

ABSTRACT

A field experiment was conducted durring *rabi,* 2015 to optimize the nutrient management strategy for enhancing the growth and yield of hybrid maize. The experiment was laid out in a randomized block design with nine treatments and replicated thrice. The treatments consisted of nine nutrient management practices viz., control; 100 per cent RDF (180-60-50 kg N, P_2O_5 and K_2O ha^{-1}); 125 per cent RDF; 150 per cent RDF; 100 per cent RDF + FYM @ 5 t ha^{-1}; 100 per cent RDF + 25 kg $ZnSO_4$ ha^{-1}; 100 per cent RDF + $ZnSO_4$ + $FeSO_4$ each @ 25 kg ha^{-1} ; 100 per cent RDF + sulphur @ 30 kg ha^{-1} + $ZnSO_4$ + $FeSO_4$ each @ 25 kg ha^{-1}; 100 per cent RDF + sulphur @ 30 kg ha^{-1} + foliar application of $ZnSO_4$ and $FeSO_4$ @ 0.5 per cent each at booting and silking. Application of recommended dose of fertilizers (180-60-50 kg N, P_2O_5 and K_2O ha^{-1}) supplemented with 30 kg S ha^{-1} along with foliar application of $ZnSO_4$ + $FeSO_4$ @ 0.5 per cent each at booting and silking recorded the highest stature of growth attributes of maize viz., plant height, leaf area index, dry matter production and yield in maize, which was significantly superior over the rest of the treatments tried. The lowest values of the above said growth parameters and yield were recorded with control.

KEYWORDS: High Maize, nutrient management, growth attributes, yield.

INTRODUCTION

Maize (*Zea mays* L.) is third most important cereal crop after rice and wheat in the world's agricultural economy, both as a food for human and as feed for livestock. It is known as "queen of cereals" because of its maximum yield potential (22 t ha^{-1}) among the cereals and expanded use in different agro industries. In India, it is grown over an area of 9.5 million hectares with a production of 23.3 million tonnes and productivity of 2452 kg ha^{-1}(DACNET, 2014). Maize is being a C_4 plant has a tremendous yield potential and responds well to growth resources. Despite the impressive strides in acreage and production for last two decades, the productivity of maize in India (2452 kg ha^{-1}) is far below the world average productivity (5490 kg ha^{-1}). Imbalance and inadequate nutrition was the prime reason attributed to low productivity and poor quality of newly evolved high yielding single cross hybrids in India.

Maize is a high nutrient demanding crop, which requires micronutrients along with major nutrients (Verma, 2011). The availability of nutrients such as nitrogen, phosphorus, potassium, sulphur, zinc and iron in balanced proportion in the soil is essential for improving the yield and quality of maize (Randhawa and Arora, 2000). Undoubtedly, the use of high analysis fertilizers must be accompanied by matching doses of zinc and iron applied at the right time through an appropriate mode (soil or foliar), for sustaining and improving the productivity besides quality in corn (Singh *et al.,* 2000).

MATERIAL AND METHODS

The experiment was conducted during *rabi*, 2015-16 at dryland farm of S.V. Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The soil was sandy loam in texture, neutral in soil reaction (pH 6.9), low in organic carbon (0.43%) available nitrogen (125.4 kg ha^{-1}), phosphorus (14.2 kg ha^{-1}), potassium (142.4 kg ha^{-1}), sulphur (12.5 kg ha^{-1}), zinc (1.02 kg ha^{-1}) and iron (2.80 kg ha^{-1}) content. The experiment was laid out in a randomized block design with nine treatments and replicated thrice. The treatments consisted of nine nutrient management practices viz., control; 100 per cent RDF (180-60-50 kg N, P_2O_5 and K_2O ha^{-1}); 125 per cent RDF; 150 per cent RDF; 100 per cent RDF + FYM @ 5 t ha^{-1}; 100 per cent RDF + 25 kg $ZnSO_4$ ha^{-1}; 100 per cent RDF + ZnSO4 + $FeSO_4$ each @ 25 kg ha^{-1} ; 100 per cent RDF + sulphur @ 30 kg ha^{-1} + $ZnSO_4$ + $FeSO_4$ each @ 25 kg ha^{-1}; 100 per cent RDF + sulphur @ 30 kg ha^{-1} + foliar application of $ZnSO_4$ and $FeSO_4$ @ 0.5 per cent each at booting and silking. Data

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was recorded on plant height, leaf area index, dry matter production, seed yield, stover yield and harvest index. Leaf area index was calculated by dividing the total leaf area with the corresponding land area as suggested by Watson (1952). The oven dry weight of all the five plants was taken and dry matter production per hectare was worked out and expressed in kg ha^{-1}. Weather conditions indicated that the weather variables were within the cardinal range so as to enable the crop to reasonably express the effect of imposed treatments.

RESULTS AND DISCUSSION

Effect of nutrient management practices on growth attributes of Maize

The results of the present investigation have clearly brought out a noticeable trend of response to nutrient management practices in *rabi* maize (Table 1).

Application of recommended dose of fertilizers (180-60-50 kg NPK ha^{-1}) supplemented with 30 kg S ha^{-1} along with foliar application of $ZnSO_4$ + $FeSO_4$ @ 0.5 per cent each at booting and silking resulted in higher stature of growth attributes of maize viz., plant height, leaf area index, dry matter production, which was significantly superior over the rest of the treatments. The highest plant height might be due to role of nutrients in various physiological and biochemical processes contributing to the growth of the meristematic region (Cakmak *et al.,* 1989). The increase in plant height with application of zinc might be attributed to increase in intermodal distance (Ghaffari *et al.,* 2011). Higher leaf area index recorded was probably due to better absorption and translocation of foliar applied nutrients leading to delayed senescence and abscission. Foliar application of nutrients at the hour of the need enables the plants to maintain higher chlorophyll content, leaf area $plant^{-1}$, leaf area index which helps in decreasing the rate of senescence (Zayed *et al.,* 2011). As zinc is involved in the synthesis of IAA, which is a component of various enzymes, such as *Carbonic anhydrase* and *Alcoholic dehydrogenase*, which have a suggestive role in chlorophyll formation, photosynthesis and metabolic reactions in plants leading to higher leaf area index. The response to sulphur application might be due to synthesis of more chlorophyll and amino acids resulting in better utilization of carbohydrates from more protoplasm, resulting in increased leaf area (Jeet *et al.,* 2012). Higher dry matter production associated might be due to the significant role of NPK, sulphur, zinc and iron in better root and shoot development and which inturn increased dry matter production. The foliar application of zinc and iron was found to be more effective due to its higher uptake efficiency compared to soil application as they helps in increased photosynthetic efficiency by delaying leaf senescence. Enhanced growth of maize under balanced supply of nutrients has been undisputed fact and universally acceptable proportion as could be visualized from the research evidence (Kumar *et al.,* 2010).

Effect of nutrient management practices on yield of Maize

Seed Yield

Seed yield of maize was significantly influenced by various nutrient management practices (Table 1).The highest seed yield (5307 kg ha^{-1}) of maize was recorded with foliar application of $ZnSO_4$ and $FeSO_4$ @ 0.5 per cent each at booting and silking + 30 kg sulphur ha^{-1} along with 100 per cent RDF, which was significantly superior over the rest of the nutrient management practices tried, which resulted in 41.7 per cent higher seed yield over 100 per cent RDF. Seed yield of maize is a function of growth and yield attributes, which is significantly higher with these nutrient management practices. Application of 150 per cent RDF , 125 per cent RDF (T_3), FYM @ 5 t ha^{-1} or $ZnSO_4$ and $FeSO_4$ each @ 25 kg ha^{-1} or $ZnSO_4$ and $FeSO_4$ each @ 25 kg + sulphur 30 kg ha^{-1} along with 100 per cent RDF were the next best treatments, which were comparable among themselves. The comparatively lower yields recorded with soil application of zinc and iron along with RDF and sulphur over the foliar application of zinc and iron along with RDF and sulphur might be due to combination of leaching, fixation and volatalization (Ghaffari *et al*., 2011). The yield recorded with soil application of 25 kg $ZnSO_4$ ha^{-1} along with 100 per cent RDF was comparable with 100 per cent RDF and significantly superior over control. Foliar application of ZnSO4 and $FeSO_4$ @ 0.5 per cent each at booting and silking + 30 kg Sulphur ha^{-1} along with 100 per cent RDF (T_9) resulted in 12.7 per cent higher seed yield over soil application of 25 kg each $ZnSO_4$ and FeSO4 + 30 kg S ha^{-1} along with 100 per cent RDF.

The favourable effect of foliar application of zinc might be attributed to its direct influence on auxin production, which inturn enable the plant to produce more dry matter and consequently enhanced the partitioning of photosynthates towards newly formed sink, which resulted in early bloom, prolonged flowering period, which inturn

Table 1. Growth attributes and yield of maize as influenced by different nutrient management practices

Treatments	Plant height (cm)	Leaf area index	Dry matter production (kg ha^{-1})	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)
T_1 : Control	120.6	1.46	3515	404	1541	20.77
T_2 : 100 per cent RDF (180-60-50 kg N, P_2O_5 and K_2O ha^{-1})	160.0	1.80	8373	3744	4229	46.95
T_3 : 125 per cent RDF	185.5	2.46	9988	4567	5068	47.40
T_4 : 150 per cent RDF	190.0	2.62	10340	4880	5550	46.94
T_5 : 100 per cent RDF + FYM@5 t h^{-1}	178.7	2.38	9765	4484	4989	47.22
T_6 : 100 per cent RDF + $ZnSO_4$@ 25 kg ha^{-1}	164.0	2.02	8950	4027	4528	46.53
T_7 : 100 per cent RDF + $ZnSO_4$ and $FeSO_4$ each @ 25 kg ha^{-1}	181.6	2.37	9856	4535	5049	47.32
T_8 : 100 per cent RDF + + $ZnSO_4$ and $FeSO_4$ each @ 25 kg ha^{-1} + Sulphur @ 30 kg ha^{-1}	185.9	2.50	10300	4708	5127	47.86
T_9 : 100 per cent RDF ++ Sulphur @ 30 kg ha^{-1} + Foliar application of $ZnSO_4$ and $FeSO_4$ @ 0.5 per cent each at booting and silking	205.2	3.10	11298	5307	5555	48.85
SEm±	4.87	0.09	198	138	140	0.28
CD (P=0.05)	14.6	0.27	593	415	420	0.90

resulted in more number of seeds and higher seed weight cob-1, which is a direct function of yield leading to higher seed yield (Mostafavi, 2012). The lowest seed yield (404 kg ha^{-1}) in control without application of fertilizer could be because of the deflated stature of growth parameters and finally lower yields due to the deficiency of N, P, K, Zn, Fe and sulphur as the experimental soil was poor in available nitrogen, phosphorus, potassium, zinc, iron and sulphur.

Stover Yield

Among all the nutrient management practices, the highest stover yield of maize (5568 kg ha^{-1}) was recorded with foliar application of $ZnSO_4$ and $FeSO_4$ @ 0.5 per cent each at booting and silking + 30 kg S ha^{-1} along with 100 per cent RDF, which was however comparable with application of 150% RDF and significantly superior over rest of the nutrient management tried. Stover yield of maize was the interplay effect of plant height and dry matter accumulation and both the parameters were found to be the highest with 150 per cent RDF and foliar spray of $ZnSO_4$ and $FeSO_4$ @ 0.5% each at booting and silkig along with 30 kg S ha^{-1} and 100 per cent RDF. This might be due to increased availability of essential plant nutrients from the enhanced level of nutrients applied to the crop in and balanced supply of nutrients. Enhanced stover yield was the outcome of the positive and synergistic interaction between the nutrient supply and growth stature of maize as reflected in enhanced growth parameters with supply of highest dose of NPK or optimum dose of NPK with foliar application zinc and iron along with sulphur (Jyothi *et al*., 2015). The increase in grain and stover yield was due to role of zinc in metabolism of plants as an activator of several enzymes, which inturn may directly or indirectly affect the synthesis of carbohydrates and protein (Narwal *et al*., 1993). The lowest stover yield (1541 kg ha^{-1}) was recorded with control due to poor vegetative growth as a result of non supply of nutrients.

Harvest Index

The highest harvest index in maize was recorded with foliar application of $ZnSO_4$ and $FeSO_4$ @ 0.5% each at booting and silking + 30 kg S ha^{-1} along with 100 per cent RDF, which was significantly superior over rest of the nutrient management practices tried (Table 1). This might be due to better absorption and translocation of nutrients (N, P, K and S including zinc and iron) in balanced proportions, where foliar application coincides with the peak crop demand and thereby maintenance of better source sink relationship owing to higher harvest index. The lowest harvest index was recorded with control might be due to poor source sink relationship owing to inadequate nutrient supply.

LITERATURE CITED

Cakmak, I., Marschner, H and Bangerth, F. 1989. Effect of zinc nutritional status on growth, protein metabolism and levels of indole-3 acetic acid other phytohormones in bean (*Phaseolous vulgaris* L.). *Journal of Experimental Botany*. 40: 405.

DACNET. 2014. Directorate of Economics and Statistics, DAC, Ministry of Agriculture, Government of India, New Delhi.http://eands.dacnet.nic.in/ stateData_12-13Year.htm

Ghaffari, A., Ali, A., Tahir, M., Waseem, M., Ayub, M., Iqbal, A and Mohsin, A.U. 2011. Influence of integrated nutrients on growth, yield and quality of maize (Zea mays L.). *American Journal of Plant Sciences*. 2: 63-69

Jeet, S., Singh, J.P., Kumar, R., Prasad, R.K., Kumar, P., Kumari, A and Prakash, P. 2012. Effect of nitrogen and sulphur levels on yield, economics and quality of QPM hybrids under dryland condition of Eastern Uttar Pradesh, India. *Journal of Agricultural Sciences*. 4 (9): 31-38.

Jyothi, K.J., Ramana, A.V and Murthy, K.V.R. 2015. Nutrient uptake and post-harvest soil nutrient status of rabi maize as affected by different nutrients levels. *Journal of Soils and Crop*. 25 (2). 253-258.

Kumar, A.S., Chidanandappa, H.M and Babu, M.V.S. 2010. Effect of different souces of zinc on growth, yield and uptake of nutrient by maize crop (*Zea mays* L.). *Mysore Journal of Agricultural Sciences*. 44 (1): 92-99.

Mostafavi, K. 2012. Grain yield and yield components of soybean upon application of different micronutrient foliar fertilizers at different growth stages. *International Journal of Agriculture Research and Review*. 2 (4): 389-394.

Narwal, R.P., Singh, Mahendra, Singh, J.P., Dahiya, D.J and Singh, M. 1993. Cadmium-zinc interaction in maize grown on sewer water irrigated soil. *Arid Soil Research and Rehabilitation*. 7 (2): 125-131.

Randhawa, P.S and Arora, C.L. 2000. Phosphorus – sulphur interaction effects on dry matter yield and nutrient uptake by wheat. *Journal of Indian Society of Soil Science*. 48 (3): 536-540.

Singh, A., Vyas, A.K and Singh, A.K. 2000. Effect of nitrogen and zinc application on growth, yield and net returns of maize (Zea mays L.). *Annals of Agricultural Research*. 21 (2): 296-297.

Verma, N.K. 2011. Integrated nutrient management in winter maize (*Zea mays* L.) sown at different dates. *Journal of Plant Breeding and Crop Science*. 3 (8): 161-167.

Watson, D.J. 1952. The physiological basis for variation in yield. *Advances in Agronomy*. 6: 103–109.

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