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PRODUCTIVITY AND PROFITABILITY OF MAIZE (*Zea mays* L.) AS INFLUENCED BY HIGHER LEVELS OF NPK AND Zn NUTRITION

K. SATHISH BABU*, P. V. RAMESH BABU, M. SRINIVASA REDDY AND P. KAVITHA

Department Agronomy, Agricultural College, Mahanandi - 518 502, Andhra Pradesh, India.

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ABSTRACT

A field experiment was conducted at Agricultural College Farm, Mahanandi on sandy loam soils to know the response of maize to higher levels of NPK and Zn nutrition on yield attributes, yield and economics. The experiment was laid out in randomized block design with 10 treatments consisting of three higher levels of nutrients and six treatments of higher levels of nutrients in combination of Zinc and each treatment was replicated thrice. Result showed that application of 350-100-100 kg N-P_2O_5-K_2O ha^{-1} along with foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS (T_{10}) gave the highest cob length (19.79 cm), number of grains row^{-1} (39.70), grain weight cob^{-1} (216.39 g), test weight (323.00), grain yield (8734 kg ha^{-1}) and stover yield (11275 kg ha^{-1}) which in turn on par with T_9 (T_3 + Foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS and significantly superior over control (T_1). However, number of cobs $plant^{-1}$, number of grain rows cob^{-1} were not significantly influenced by higher levels of NPK and Zn nutrition. Highest gross returns (₹ 113537.67 ha^{-1}) and net returns (₹ 74114.67 ha^{-1}) were recorded with application of 350-100-100 kg N-P_2O_5-K_2O ha^{-1} along with foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS (T_{10}). The highest B:C ratio was obtained with application of 250-60-60 kg N-P_2O_5-K_2O ha^{-1} along with foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS (T_8).

KEYWORDS: Economics, Maize, Yield attributes, Yield.

INTRODUCTION

Maize (*Zea mays* L.) is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions and successful cultivation in diverse seasons and ecologies for various purposes. Globally, maize is known as ''Miracle crop'' because of its highest genetic yield potential than other cereals. Maize is the third most important cereal crop and cultivated in 160 countries on almost 150 m. ha and contributes to 36% (78.2 m. t) in the total grain production of the world. In India, maize is cultivated in an area of 9.23 m. ha with production of 23.67 m.t with an average yield of 2.56 t ha^{-1} (IIMR, 2016). In Andhra Pradesh, maize is cultivated in an area of 4.07 lakh ha with a production of 24.9 lakh t and an average yield of 6697 kg ha^{-1} (IIMR, 2016). The nutrient management is one of the most important factors that affect the growth and yield of maize. The recommendations presently made are based on the response of maize to nitrogen at constant levels of P and K and also farm level reports are available with response of the crop to foliar application of zinc irrespective of the availability of zinc in the soil. Since the crop is spreading to newer areas there is a need to find out the appropriate levels of nutrients and the response of crop to applied nutrition. Hence, an attempt is being made to study the response of maize to increased levels of N, P K and foliar application of Zn.

MATERIAL AND METHODS

A field experiment was conducted under irrigated conditions during *rabi* 2015-16 at Agricultural College Farm, Mahanandi, (Scares Rainfall Zone of A.P.) on sandy loam soils with slightly alkaline pH (7.98), low in organic carbon (0.46%), medium in available nitrogen (298 kg ha^{-1}) , high in available phosphorus (48kg ha^{-1}), available potassium (687 kg ha^{-1}) and sufficient in available zinc (1.32 ppm).Weather during the crop period is normal without any marked deviation from mean of the experimental site. The experiment was laid out in a randomized block design with ten treatments and replicated thrice. The treatment details are T_1: Control, T_2: 250-60-60 kg N-P_2O_5-K_2O ha^{-1}, T_3: 300-80-80 kg N-P_2O_5-K_2O ha^{-1}, T_4: 350-100-100 kg N-P_2O_5-K_2O ha^{-1}, T_5: T_2 + Foliar application of 0.2% $ZnSO_4$ at 15 DAS, T_6: T_3 + Foliar application of 0.2% $ZnSO_4$ at 15 DAS, T_7: T_4 + Foliar application of 0.2% $ZnSO_4$ at 15 DAS, T_8: T_2 + Foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS, T_9: T_3 + Foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS,

*Corresponding author, E-mail: msreenivas1974@gmail.com

T_{10}: T_4 + Foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS and crop was sown on ridges with 75 cm row spacining and 25 cm spacing between plants within the row. Maize hybrid 'P3396' was used in the study. The amount of nitrogen in the form of urea was applied in three splits i.e., at sowing, at knee height stage and remaining at tasseling stage and phosphorous and potash was applied through SSP and MOP as basal at the time of sowing and the foliar feedings of zinc was given at 15 and 25 DAS. All the nutrients were applied as per the treatments.Data on yeild attributes, yield were recorded and subjected to analysis ov variance(ANOVA) and economics worked out based on present price of product in market.

RESULTS AND DISCUSSION

The maximum values of yield attributes like, cob length (19.79 cm), number of grains row $^{-1}$ (39.70), grain weight cob^{-1} (216.39 g), test weight (323.00), were recorded with the treatment T_{10} (T_4 + Foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS) which was at par with the treatment T_9 (T_3 + Foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS) and signifiantly superior over T_1 (Control) (Table 1). However, the number of cobs pe plant and grain rows per cob were not singnifacantly influenced by different higher levels of nutrients. The increase in yield attributes due to application of influenced levels of N, P, K and foliar application of zinc, which resulted in higher chlorophyll content and this had apparently a positive effect on photosynthetic activity, synthesis of metabolites and growth regulatory substance, oxidation and metabolic activities and ultimately better growth and development of crop that led to increase in yield attributes of maize. These findings were in accordance with the research findings of Mohan Kumar *et al*. (2015), Nithin Krishna *et al*. (2015) and Manwar and Mankar (2015).

The maximum grain yield (8734 kg ha^{-1}) and stover yield (11275 kg ha^{-1}) was recorded with the treatment that received 350-100-100 kg N-P_2O_5-K_2O ha^{-1} along with foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS (T_{10}) and significantly superior over the rest of the treatments tried in the study except the grain yield obtained with the treatments of T_9 (T_3 + Foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS) and T_7 (T_4 + Foliar application of 0.2% $ZnSO_4$ at 15 DAS). However harvest index (43.85) was significantly higher with the application of 350-100-100 kg N-P_2O_5-K_2O ha^{-1} along with foliar application of 0.2% $ZnSO_4$ at 15 DAS (T_7) and significantly superior over T_2 (250-60-60 kg N-P_2O_5-K_2O ha^{-1}) and Control (T_1) (Table 2). Highest grain, stover yield and harvest index might be due to better translocation of photosynthates from source to sink, higher growth attributing characters and higher yield attributing characters like cob length, number of grains per cob, grain weight cob^{-1} and test weight. These results were in conformity with the findings of Nandita Jena *et al*. (2013) and Manasa and Devaranavadagi (2015).

Table 1. Yield attributes of maize as influenced by higher levels of N, P, K and Zn

Treatments	Number of cobs plant^{-1}	Cob length (cm)	No. of grain rows cob^{-1}	No. of grains row^{-1}	Grain weight cob^{-1} (g)	Test weight (g)
T_1	1.00	13.21	15.73	22.59	84.82	238.67
T_2	1.07	18.30	15.93	34.80	165.86	299.00
T_3	1.07	19.22	16.27	36.03	177.53	303.33
T_4	1.20	18.90	16.47	37.12	187.56	307.33
T_5	1.07	18.52	16.00	35.67	173.93	305.00
T_6	1.07	19.47	16.33	38.00	191.66	308.67
T_7	1.13	19.42	16.49	38.50	198.58	313.00
T_8	1.13	18.98	16.27	37.33	187.35	308.67
T_9	1.13	19.56	16.53	38.67	201.92	316.67
T_{10}	1.20	19.79	16.87	39.70	216.39	323.00
S.Em±	0.05	0.82	0.35	0.67	6.26	9.97
CD (P=0.05)	NS	2.43	NS	2.89	18.60	20.95

Table 2. Grain, stover yield (kg ha^{-1}) and harvest index (%) of maize as influenced by higher levels of N, P, K and Zn

Treatments	Yield (kg ha^{-1})		Harvest index (%)
	Grain	Stover	
T_1	3211	4798	40.09
T_2	7311	10069	42.07
T_3	7957	10548	43.00
T_4	8290	10851	43.31
T_5	7891	10589	42.70
T_6	8216	10746	43.33
T_7	8531	10839	44.04
T_8	8113	10705	43.11
T_9	8480	10860	43.85
T_{10}	8734	11275	43.65
S.Em±	95	125	0.53
CD (P=0.05)	282	373	1.58

ECONOMICS

The highest gross returns and net returns (₹ 113537.67 ha^{-1} and ₹ 74114.67 ha^{-1}, respectively) was recorded with the treatment that received 350-100-100 kg N-P_2O_5-K_2O ha^{-1} along with foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS (T_{10}) and significantly superior over control (T_1). However, application of 250-60-60 kg N-P_2O_5-K_2O ha^{-1} along with foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS (T_8) resulted in significantly higher B: C ratio (1.99) and superior over the application of 250-60-60 kg N-P_2O_5-K_2O ha^{-1} alone (T_2) and control (T_1) (Table 3). These findings were in conformity with those of Rakesh Kumar *et al*. (2015) and Rizwan Patel *et al.* (2015).

CONCLUSION

From, the above investigation, it is clearly indicated that the higher level of nitrogen, phosphorus, potassium along with foliar application of Zn had significant influence in increasing the productivity and profitability of maize. The higher yield attributes and yield of maize was with the application of 350:100:100 kg NPK ha^{-1} alongwith foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS (T_{10}). However, the economic yield was obtained with the application of 250:60:60 kg NPK ha^{-1} alongwith foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS (T_8).

Table 3. Economics of maize as influenced by higher levels of N, P, K and Zn

Treatments	Cost of cultivation (₹ ha^{-1})	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B: C ratio
T_1	26425	41747.33	15322.33	0.58
T_2	33734	95047.33	61313.33	1.82
T_3	35778	103441.00	67663.00	1.89
T_4	37823	107770.00	69947.00	1.85
T_5	34534	102583.00	68049.00	1.97
T_6	36578	106808.00	70230.00	1.92
T_7	38623	110907.33	72284.33	1.87
T_8	35334	105464.67	70130.67	1.99
T_9	37378	110240.00	72862.00	1.95
T_{10}	39423	113537.67	74114.67	1.88
S.Em±	-	1233.74	1233.74	0.04
CD (P=0.05)	-	3665.77	3665.77	0.11

It is therefore concluded that the better yields can be acheieved in maize with the application of 250:60:60 kg NPK ha^{-1} alongwith foliar application of 0.2% $ZnSO_4$ at 15 and 25 DAS (T_8).

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