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RESPONSE TO APPLIED NPK, FARMYARD MANURE AND ZN ON GROWTH AND YIELD COMPONENTS OF BABY CORN MAIZE (*ZEA MAYS* L. *SACHARATA*)

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ABSTRACT A rainfed field experiment was conducted to study the influence of NPK, FYM and Zn application on baby corn maize (Zea mays L. sacharata). Treatments combinations consist of FYM, NPK and Zn which were combine in different ratios solely and in combinations. Parameters recorded were plant height, number of leaves, cob length and number of grains. Data collected were statistically analysed and results obtained indicated that the best result recorded was with the combination of 100% NPK (in a ratio of 120:60:60) + 100% FYM(10 t/ha) + 100% Zn (20 kg/ha). The outcome of the results revealed significant ($p<0.05$) effects due to treatments on all the parameters studied. The results presented therefore suggest that application of NPK at 100% along with FYM at 100% and Zinc at 100% would be highly beneficial for sustainable baby corn production and maintainance of soil fertility of the soils of the study area.

KEYWORDS : NPK, Farmyard Manure, Zn, Baby Corn Maize

Introduction

Nitrogen is vitally important for plant nutrition, growth and development. Nitrogen is an essential constituent of protein and is present in many other compounds that are of great physiological importance in plant metabolism. Nitrogen is called a basic constituent of life because it is required for all stages of plant growth and development since it is the essential element of both structural (cell membranes) and nonstructural (amino acids, enzymes, protein, nucleic acids and chlorophyll) components of plant (Seilsepour and Rashidi, 2011). Despite the fact that nitrogen is the most abundant gas in the earth's atmosphere (78%), it is the most deficient essential macronutrient element in cultivated soils of the world and most limiting for maize crop production (Jones, 1973; Rayar and Usman, 1985; Agbede, 2009). Availability of soil nitrogen in the nitrate form is most significant as far as maize cultivation is concerned since its uptake controls grain yield and protein quality, provides resistance to diseases and drought, and guarantees competition against weeds (Ibrahim, 2006; Agbede, 2009).

Phosphorus has a great role in energy storage and transfer and closely related to cell division and development of maize. Phosphorus is a constituent of nucleic acid, phytin and phospho-lipids. Phosphorus compound act as "energy currency" within plants. Due to biochemical functions of phosphours in the plant, the most important of which is the activation of enzymes participating in generating and transformation of energy as well as the synthesis of carbohydrates, proteins and fats, this component controls N metabolism (Potarzycki 2009).

Potassium play important role in formation of protein and chlorophyll and it provide much of osmotic "pull" that draw water into plant roots. Potassium produces strong stiff straw and reduces lodging in maize. Another important function of potassium is in plant-water relations where it regulates ionic balances within tissue cells. Potassium regulates the leaf stomata opening and subsequently the rate of transpiration and gas exchange. Plants also need K for the formation of sugars and starches, for the synthesis of proteins, and for cell division. It increases the oil content of pistachios and contributes to its cold hardiness (Beede *et al.,* 2011).

The application of farmyard manure besides supplying N, P and K after decomposition also make unavailable sources of plant nutrients such as bound phosphates, fixed micronutrients, and decomposed plant residues into slowly available forms which makes it easy for plants to absorb these nutrients. It is also a fact that optimum yield level of maize production can't be achieved by using only organic manures because of their low nutrient content and availability. Efficacy of organic sources to meet the nutrient requirement of crop is not as assured as mineral fertilizers, but the combined use of chemical fertilizers along with various organic fertilizer sources is capable of improving soil quality and higher crop productivity on long-term and sustainable basis. Chandrashekara *et al.* (2000) reported that highest productivity of crops in sustainable manner without deterioration of the soil and other natural resources would be achieved only by applying appropriate combination of different organic manures with recommended doses of inorganic fertilizers.

Zn(Zn) is a vital micronutrient necessary for plant growth. It affect the synthesis of protein in plants as such it is considered to be the most critical micronutrients (Cakmak *et al.*,1998). It is important in taking part in plant development due to the catalytic action it perform in metabolism especially in maize Cakmak (2000). Deficiency of Zn in corn affect young leaves in addition to delay in silking and tasseling (Kakade, 2009; Saddiq *et al., 2013*).

Baby corn is a delicious and nutritive vegetable and it is consumed as a natural food. It is very tasty, sweet and easy to consume because of its tenderness and sweetness with nutritive value addition. It provides carbohydrates, protein, fat, sugar, minerals and vitamins in palatable, wholesome, hygienic and digestible form. It is rich in phosphorus content (86 mg/100 g edible portion in comparison to 21 to 57 mg/100g phosphorus content in other commonly used vegetables). It is a low calorie vegetable having higher fiber content and without cholesterol. Besides nutritive advantage, it is also free from residual effect of pesticides as it is harvested within a week of tassel emergence and the young cob is wrapped up tightly with husk and well protected from insects and pests (Pradeep Kumar *et al.*, 2004).

MATERIALS AND METHODS

The experiment was carried out with baby corn (*Zea mays* L. *sacharata*) as the test crop in the Lower section of the Teaching and Research Farm of the Modibbo Adama University of Technology, Yola, Northeastern Nigeria located on Latitude 9° 16' N and Longitude 12° 35' E situated at 152m above sea level in the Northern Guinea Savannah agro-ecological zone of Nigeria. The experiment consisted of 4 treatments: Control (0%), NPK (120:60:60) at 0%, 50% and 100%; FYM at 0% and 100%; Zn at 0% and 100%. Treatments were applied solely and in combinations with three replications laidout in randomized block design. Plot sizes measured 4m x 5m with 1m between plots and 2m between replications. The treatments, T_x, schedules and combinations are as follows:-

$T^0 = L^0+F^0+Z^0$) [@0%NPK+@0% FYM+@0%Z];
$T_1 = L_0+F_0+Z_1$) [@0%NPK+@0% FYM+@100%Zn];
$T_2 = L_0+F_1+Z_0$) [@0%NPK+@100% FYM+@0%Zn];
$T_3 = L_0+F_1+Z_1$) [@0%NPK+@100% FYM+@100%Zn];
$T_4 = L_1+F_0+Z_0$) [@50%NPK+@0% FYM+@0%Zn];
$T_5 = L_1+F_0+Z_1$) [@50%NPK+@0% FYM+@100%Zn];
$T_6 = L_1+F_1+Z_0$) [@50%NPK+@100%FYM+@0%Zn];
$T_7 = L_1+F_1+Z_1$) [@50%NPK+@100%FYM+@100%Zn];
$T_8 = L_2+F_0+Z_0$) [@100%NPK+@0% FYM+@0%Zn];
$T_9 = L_2+F_0+Z_1$) [@100%NPK+@0% FYM+@100%Zn];
$T_{10} = L_2+F_1+Z_0$)[@100%NPK+@100% FYM+@0%Zn];
$T_{11} = L_2+F_1+Z_1$)[@100%NPK+@100% FYM+@100%Zn].

The parameters recorded in the study were plant height at 30, 60 and 90 DAS, number of leaves at 30, 60 and 90 DAS, cob length at 90 DAS, and number of grains per cob at 90 DAS.

RESULTS AND DISCUSSION

Physical and Chemical Properties of the Experimental Soil

The experimental soil is sandy clay loam in texture which is suitable for cultivation of the baby corn maize. Results of the chemical analysis (Table 1) indicate that the soil reaction of the study area is found to be slightly acidic, favorable for the cultivation of the baby corn maize. The low organic carbon content means low organic matter content which might not be unconnected to the scanty vegetation cover and high rate of organic matter decomposition in the area due to high temperature. This corroborates similar findings by Saddiq *et al.* (2013). The N, P, K and Zn contents of the soils fall within the very low to deficiency range. This therefore indicates that the soil will respond positively to application of N, P, K and Zn fertilizers in the soils and crop performance will be good. The addition of FYM is bound to improve the soil conditions and fertility status for sustainable productivity as reported by Ibrahim (2006).

Effects of NPK, FYM and Zn on plant height (cm) at 30, 60 and 90 DAS

The result presented on Table 2 recorded the effect of NPK, FYM and Zn on plant height at 30 60 and 90 DAS. The height of baby corn plant increased significantly and progressively with increase in levels of NPK, FYM and Zn fertilizers at 0.05% level of significance. The result indicated that at 30 DAS there was no significant effect of different treatment combinations on plant height whereas at 60 and 90 DAS there was a significant ($p<0.05$) effect of treatments combinations on plant height. Highest value of (182.53cm) at 90 DAS was recorded with the higher dose of NPK, FYM and Zn application (100% NPK +100% FYM +100% Zn) while the lowest value of 60.79cm was recorded with the control. The progressive increase in plant height with increase in treatments combinations levels could be as result of the effect of FYM which is capable of improving the water holding capacity of the soil thereby enhancing rapid uptake of nutrients in addition to supplying almost all the nutrients necessary for plant growth. Similarly, Singh (2003) observed that nitrogen promotes vegetative growth, cell elongation and expansion, while phosphorous is an important element for various metabolic activities and plant growth. Potassium is involved in meristematic growth, regulate translocation of photosyntates and action of several enzymes while Zn influences the activity of dehydrogenase enzyme.

Effects of NPK, FYM and Zn on number of leaf per plant at 30, 60 & 90 DAS

Results presented in Table 3 indicate that there was no significant effect of NPK, FYM and Zn treatments on number of leaves at 30 DAS. However, there was a significant ($p<0.05\%$) effect at 60 and 90 DAS on number of leaves with increased in treatment dose application. Highest number of leaves (13.92 and 14.96) at 60 DAS and 90 DAS were recorded with full doses of NPK, FYM and Zn (100% NPK +100% FYM+100% Zn) which is based on the recommended dose for baby corn maize in the soils of the study area. The increase in the number of leaves could be attributed to the increased dose of nitrogen which is furnished from both the inorganic and the organic sources. This gradually accelerates the plant's photosynthetic activities thereby promoting growth and production of more leaves. Similar findings were also reported by various authors: Meena *et al*. (2011); Akmal *et al*. (2010) and Keteku *et al*. (2016).

Effects of NPK, FYM and Zn on Cob length (cm) and number of grains per cob

Results presented in Table 4 reveal that the highest cob length (18.23cm) of baby corn was recorded with full doses of NPK, FYM and Zn application (100% NPK +100% FYM +100% Zn) which is (120kg/ha: 60kg/ha: 60kg/ha), while the lowest length (11.01cm) was recorded with the control. The reasons for increase in cob length could be as result of increased uptake of nutrients due to higher nutrient availabilty which favors more tissue growth. Similar observation was reported by Yadav *et al*. (2015) and Mona (2015).

Effects of NPK, FYM and Zn on Number of Grains Per Cob at 90 DAS

Results presented on Table 5 show that the maximum number of grains per cob (357.92) was recorded with combined application of NPK, FYM and Zn fertilizers while the lowest (256.69) were recorded with the control. The number of grain as shown increased steadily as the combination of the treatments were increased. The increase in number of grain is as a result of the combined influence and interactions between Zn and other nutrients especially nitrogen which promotes many physiological aspect of growth and yield. Similar observation was reported by Portarzyki and Grzebis (2009) and Saddiq *et al.,* (2013) that the application of Zn to maize crop increased grain yield per cob and the cob length.

CONCLUSION AND RECOMMENDATION

The result of the study shows that the soil is inherently low in N, P, K and Zn deficient in almost all the nutrients therefore it should be expected that application of nutrients to the soils will provide a promising result. Also it is advisable to add organic manure to the soils base on the outcome of this research as it indicate that farmyard manure contributed greatly in enhancing baby corn's growth and yield. The findings of this work therefore justifies to recommend combined application of NPK and FYM with Zn because it is highly beneficial for a sustainable yield increase.

Table 1: Physical and Chemical Properties of the Experimental Soil

Properties		**Value**	**393.70**
Sand (g kg-1)			241.30
Silt (g kg-1)			365.00
Clay (g kg-1)			Sandy Clay loam
Textural class			
Bulk density (g cm-3)		1.53	
Basic Infiltration rate (mm hr-1)	17.14		
pH (Water)			6.10
pH (0.01M CaCl2)		5.63	
Electric Conductivity (dS m-1)	1.82	6.40	
Organic Carbon (g/kg)		11.01	
Organic Matter (g/kg)		0.80	
Total N (g/kg)		2.04	
Available P (mg/kg)			0.58
Zn (mg/kg)		0.14	
Sodium (Na+)		0.44	
Potassium (K+)		2.25	
Calcium (Ca2+)		0.53	
Magnesium (Mg2+)			
Effective Cation Exchange Capacity (ECEC)	3.86		

Table 2: Effects of NPK, FYM and Zn on Plant Height (cm) at 30, 60 and 90 DAS

Treatments	**Combinations**	**30 DAS**	**60 DAS**	**90 DAS**
T_0	$\mathbf{L_0+F_0+Z_0}$	60.79	127.93	128.59
T_1	$\mathbf{L_0+F_0+Z_1}$	63.98	130.91	131.37
T_2	$\mathbf{L_0+F_1+Z_0}$	66.89	133.01	133.67
T_3	$\mathbf{L_0+F_1+Z_1}$	68.58	136.26	136.55
T_4	$\mathbf{L_1+F_0+Z_0}$	69.85	139.06	139.58
T_5	$\mathbf{L_1+F_0+Z_1}$	71.18	142.32	141.97
T_6	$\mathbf{L_1+F_1+Z_0}$	76.87	144.22	144.90
T_7	$\mathbf{L_1+F_1+Z_1}$	83.78	150.68	152.11
T_8	$\mathbf{L_2+F_0+Z_0}$	89.38	164.17	164.58
T_9	$\mathbf{L_2+F_0+Z_1}$	91.57	169.35	169.84
T_{10}	$\mathbf{L_2+F_1+Z_0}$	95.11	176.42	177.20
T_{11}	$\mathbf{L_2+F_1+Z_1}$	98.13	181.48	182.53
Interaction (Lx F x Z)	F – test	NS	S	S
	S. Ed. (±)	1.40	0.51	0.47
	C. D. at 5%	2.85	1.03	0.96

Table 3: Effects of NPK, FYM and Zn on Number of Leaves Per Plants at 30, 60 and 90 DAS

Treatments	**Combinations**	**30 DAS**	**60 DAS**	**90 DAS**
T_0	$L_0+F_0+Z_0$	3.72	6.59	6.92
T_1	$L_0+F_0+Z_1$	4.27	6.93	7.36
T_2	$L_0+F_1+Z_0$	4.61	7.70	7.92
T_3	$L_0+F_1+Z_1$	4.83	7.92	8.25
T_4	$L_1+F_0+Z_0$	5.05	8.36	8.47
T_5	$L_1+F_0+Z_1$	5.94	8.70	8.80
T_6	$L_1+F_1+Z_0$	6.39	9.25	9.36
T_7	$L_1+F_1+Z_1$	6.83	9.92	10.03
T_8	$L_2+F_0+Z_0$	7.39	10.59	10.81
T_9	$L_2+F_0+Z_1$	7.61	11.36	11.58
T_{10}	$L_2+F_1+Z_0$	8.27	12.25	12.58
T_{11}	$L_2+F_1+Z_1$	8.72	13.92	14.69

Interaction (Lx F x Z)	F – test	NS	S	S
	S. Ed. (±)	0.19	0.22	0.07
	C. D. at 5%	0.38	0.44	0.15

Table 4: Effects of NPK, FYM and Zn on length of cob (cm) at 30 DAS

Treatment	Combination	Length of Cob (cm)
T_0	$L_0+F_0+Z_0$	11.01
T_1	$L_0+F_0+Z_1$	12.00
T_2	$L_0+F_1+Z_0$	13.41
T_3	$L_0+F_1+Z_1$	14.02
T_4	$L_1+F_0+Z_0$	14.42
T_5	$L_1+F_0+Z_1$	15.45
T_6	$L_1+F_1+Z_0$	15.76
T_7	$L_1+F_1+Z_1$	16.70
T_8	$L_2+F_0+Z_0$	16.90
T_9	$L_2+F_0+Z_1$	17.12
T_{10}	$L_2+F_1+Z_0$	17.61
T_{11}	$L_2+F_1+Z_1$	18.23
Interaction (Lx F x Z)	F – test	S
	S. Ed. (±)	0.0096
	C. D. at 5%	0.0047

Table 5: Effects of NPK, FYM and Zn on Number of Grains Per Cob at 90 DAS

Treatments	Combinations	Number of grain per cob
T_0	$L_0+F_0+Z_0$	245.69
T_1	$L_0+F_0+Z_1$	250.58
T_2	$L_0+F_1+Z_0$	254.91
T_3	$L_0+F_1+Z_1$	255.36
T_4	$L_1+F_0+Z_0$	264.91
T_5	$L_1+F_0+Z_1$	266.58
T_6	$L_1+F_1+Z_0$	276.25
T_7	$L_1+F_1+Z_1$	292.03
T_8	$L_2+F_0+Z_0$	302.58
T_9	$L_2+F_0+Z_1$	322.69
T_{10}	$L_2+F_1+Z_0$	335.69
T_{11}	$L_2+F_1+Z_1$	357.92
Interaction (Lx F x Z)	F - test	S
	S. Ed. (±)	1.24
	C. D. at 5%	2.51

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