EFFECT OF ZINC FERTILIZATION ON GROWTH AND YIELD OF COCOYAM (*COLOCASIA SPP*) IN ANAMBRA EAST LOCAL GOVERNMENT AREA

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ABSTRACT

Two field experiments were conducted for two seasons (2007 and 2008) at the research farm of the National Root Crops Research Institute, Igbariam Sub-Station. The aim of the research was to assess the effect of zinc fertilizer (ZnO) on growth and yield of cocoyam. The experiment was a randomized complete block design (RCBD) replicated three times. Zinc fertilizer was applied at 5 levels 0, 3, 6, 9 and 12 kg ha^{-1}. The result showed that zinc fertilizer had no significant ($P<0.05$) effect on plant height, number of croms, cormels and tuber yield. Zinc rates at 12 kg ha^{-1} and 6 kg ha^{-1} gave the highest plant height of 76.1 cm and 103.2 cm in 2007 and 2008 cropping season respectively. Number of corms produced slightly increased with increasing rate of zinc up to 3 kg ha^{-1} and 9 kg ha^{-1} in 2007 and 2008 respectively. The failure of zinc fertilizer to influence cormel production may be related to the risk of phosphorus-induced zinc deficiency, which occurs when zinc is applied in combination with phosphorus fertilizer. However, in 2007 zinc rate at 12 kg ha^{-1} gave the highest tuber yield of 11.6 t ha^{-1} compared with tuber yield of 8.4 t ha^{-1} obtained at the same rate in the corresponding year. Hence, the lack of significance observed on plant height, number of corms, number of cormels and tuber yield of cocoyam in the study area may be attributed to the inherent characteristics of zinc oxide applied which is very slow in releasing nutrient to the test crop because its specific gravity surface decreased when it is applied to the soil.

INTRODUCTION

Cocoyam is the common name for two tuber crops *colocasia escuterita* and *xanthosoma*. Nigeria is the largest producer of cocoyam in the world with annual production of 5.49 million metric tonnes in 2006 (FAO, 2007), equivalent to 45.9% of the world production. Nigeria account for 57.1% area, and 72.2% total output of cocoyam in West Africa (Chukwu *et al*, 2008). It is cultivated in southeastern and southwestern parts of Nigeria (Ojiako, *et al*; 2007). It is a food security crop variously grown by resources poor farmers, especially women who often intercrop it with yam, maize, plantain, banana, vegetable and rice (Ikwelle, *et al*, 2007). Research has shown that the protein content of cocoyam is comparatively higher than those of other tuber crops. Obasi *et al;* (2012) also considered cocoyam as being nutritionally superior to yam and cassava. The starch granule of cocoyam is comparatively small and easily digestible and therefore considered to be a good carbohydrate source for person with gastrointestinal disorder and diabetics (Eleje, 1959). Appraisal of the constraints in cocoyam production indicates that poor soil fertility management and other factors have greatly reduced the yield of the crop over the years. Emphasis in soil fertility management for sustainable production has now shifted from soil inorganic fertilization in integrated nutrient management involving utilization of available micronutrient in a judicious and efficient way.

Since the application of inorganic fertilizer alone cannot sustain high crop yield, increasing interest is being directed towards the use of micronutrient (Zn in particular) as a means of increasing efficiency of crop production and improving returns to the farmers. Therefore, zinc is an essential element needed in balanced amount for normal growth of plant. CIAT (1988) reported that zinc applied at 12.5 kg ha^{-1} as zinc sulphate increased the yield of cassava in laterite soils. While in Columbia zinc sulphate applied at the rate of 20 kg ha^{-1} was required for maximum cassava growth and yield (Howeler *et al*; 1976). In south-eastern Nigeria, especially in Anambra East Local Government Area, the effect of zinc as a fertilizer source for cocoyam production has not been investigated. Therefore, the present investigation is sought to determine the effect of zinc fertilizer on growth and yield of cocoyam.

MATERIALS AND METHODS

Two field experiments were conducted during the successive seasons of 2007 and 2008 on a sandy loam soil at the research farm of the National Root Crops Research Institute Sub-Station Igbariam (Longitude 60^0 25^1E and latitude 46^0 14^1N) in Anambra East Local Government Area to study the effect of zinc fertilization on growth and yield of cocoyam. The land was cleared using a tractor mounted slasher, ploughed, disc harrowed and ridged. Pre-cropping soil samples were collected from the experimental sites before land preparation started. The pre-cropping composite soil samples were collected at the depth of 0 to 20 cm. the composite soil samples were air dried, crushed with a wooden roller and passed through a 2 mm sieve. The 2 mm sieved soils were further subjected to grinding using the mortar and pistle for the determination of organic carbon and nitrogen.

The experiment was a randomized complete block design (RCBD) with five treatments replicated three times. The treatments comprised five levels of zinc fertilizer at 0, 3, 6, 9 and 12 kg ha^{-1} as zinc oxide (ZnO). High yielding cocoyam (*colocasia*) variety, Ede ofe was used as the test crop. In 2007 the test crop was planted on 23rd May, while in 2008, it was planted on 7th May at 1 m x 0.5 m on a 5 m x 4 m plot using sett size of about 100 g. Weeding was carried out manually by hand hoeing at five weeks after planting (WAP) just after the emergence and subsequent two other weeding were carried out one month interval. Zinc fertilizer at various rates was applied directly to the soil in combination with a basal application of NPK fertilizer (15:15:15) at 400 kg ha^{-1} eight weeks after planting. Growth and yield parameters such as plant height, number of corms, number of cormels and tuber yield were recorded. Analysis of variance (ANOVA) was performed on data collected and treatments compared for significance using least significant difference, LSD, (Little and Hills, 1998).

RESULTS AND DISCUSSION

General characteristics of the soil

Nutrient resources in the soil determine its fertility status. This is because of the efficient utilization of the nutrients in the soil depends to a large extent on the suitability of the soil as a rooting medium and source of water. The physical and chemical properties of the soils before planting and at harvest are presented in (Table 1). The sand particle content before and after planting range from 64.40% to 70.08% with an average of 67.0%. While the silt content ranged from 14.0% to 17.0%. The clay content was 10% and it ranged from 6.70% to 16.0%. The pH of the soil was low, varied from moderately acidic to strongly acid 5.20 to 5.95. Organic carbon content of the soils were low 0.50 to 0.74%. Total nitrogen content was low and it ranged from 0.05% to 0.07%. However, the low nitrogen content could be related to an effective microbial degradation of organic matter resulting to low fertility characteristics of the soils of southeastern Nigeria.

Available phosphorus content of the soils was low 5.21 to 14.51 mg $kg^{-1.}$ The low organic matter found in the study sites may be attributed to low available P. Exchangeable calcium however dominates the other exchangeable cations. Calcium content ranged from 1.53 to 2.80 cmol kg^{-1}. Exchangeable magnesium was found low, 0.80 to 1.41 cmol kg^{-1}. The exchangeable potassium values were low 0.12

to 0.26 cmol kg^{-1}. The low exchangeable potassium may be attributed to soil loss through erosion which has been reported, resulting in deficiencies of exchangeable bases in the soil. (Mbagwu 1998).

Table 1: Some physical and chemical properties of soil before and after harvest

	Planting	Harvest	
Soil parameters	**2007**	**2007**	**2008**
Sand (%)	64.60	70.00	70.00
Silt (%)	28.70	17.00	14.00
Clay (%)	6.70	13.00	16.00
Texture	SL	SL	SL
pH	5.20	5.60	5.45
Organic C (%)	0.57	0.74	0.52
Total N (%)	0.07	0.06	0.05
Available P (mg kg^{-1})	5.27	5.21	14.51
Exchangeable bases (cmol kg^{-1})			
Ca " "	2.80	1.52	3.35
Mg " "	0.80	0.96	1.41
K- " "	0.12	0.26	0.12
Na " "	0.36	0.09	0.08
Exchangeable Acidity	1.12	0.17	0.18
ECEC cmol kg^{-1}	5.20	2.99	5.14

SL = Sandy loam

Effect of zinc fertilizer on plant height of cocoyam

Zinc fertilizer had no significant ($p<0.05$) effect on plant height of cocoyam is shown in (Table 2). The highest value (103.2 cm) was recorded by the treatment that received 6 kg Zn ha^{-1} in 2008 cropping season. The non response of zinc fertilizer to plant height of cocoyam may be attributed to the low organic matter content which was responsible for unavailability of zinc to the test crop.

Table 2: Effect of zinc fertilizer on plant height (cm) of cocoyam

	2007	**2008**
Zinc rates (kg ha^{-1})	**Plant height (cm)**	**Plant height (cm)**
0	77.5	98.3
3	75.9	97.3
6	73.9	103.2
9	75.0	102.8
12	76.1	99.5
Mean	75.7	100.2
LSD (0.05)	ns	ns

ns = Not significant at 5% probability level

Effect of zinc fertilizer on corm number

Corm of cocoyam is considered an important part that contributed to the yield of cocoyam. However, it could vary substantially over different varieties and can be influenced by agronomic practices such as applied nutrient. In this study as shown in (Table 3) zinc applied to cocoyam on both years had no significant ($p < 0.05$) effect on number of corm produced. Number of corm slightly increased with increasing zinc rates up to 3 kg ha^{-1} and 9 kg $ha-^{1}$ in 2007 and 2008 respectively. However, further increases in zinc rates resulted in decline in number of corm produced. The non response of zinc fertilizer on number of corm of cocoyam produced may be attributed to the inherent characteristics of zinc applied (zinc oxide) which is very slow in releasing nutrient to the crop because of the specific gravity surface of zinc oxide which decreases when it is applied to the soil.

Table 3: Effect of zinc fertilizer on cormel number

Zinc rates ($kg\ ha^{-1}$)	2007 Number of corm	2008 Number of corm
0	32	23
3	34	24
6	31	25
9	31	27
12	28	25
Mean	31	25
LSD (0.05)	ns	ns

ns = Not significant at 5% probability level

Effect of zinc fertilizer on number of cormel of cocoyam

The effect of zinc fertilizer on number of cormel of cocoyam is shown in (Table 4). The result revealed that there was no significant ($p < 0.05$) effect of zinc fertilizer on number of cormels of cocoyam produced. The failure of applied zinc to influence cormel production in acid tropical soils such as soils of Anambra East Local Government Area may be related to the risk of phosphorus –induced zinc deficiency which is likely to occur when zinc is applied in combination with phosphorus fertilizer. This findings agrees with Marschiner (1993) who reported that in general, crop uptake of zinc decreases sharply often beyond a level which can be attributed to dilution effects due to growth enhancement with an increase in soil content or supply of fertilizer phosphorus.

Table 4: Effect of zinc fertilizer on number of cormel of cocoyam

Zinc rates ($kg\ ha^{-1}$)	2007 Number of cormel	2008 Number of cormel
0	440	584
3	417	567
6	408	598
9	400	551
12	446	542
Mean	422	568
LSD (0.05)	ns	ns

ns = Not significant at 5% probability level

Effect of zinc fertilizer on tuber yield ($t\ ha^{-1}$) of cocoyam

The result of zinc fertilizer on tuber yield ($t\ ha^{-1}$) of cocoyam is shown on (Table 5). In both years the effect of zinc on tuber yield was not significant. However, in 2007, cropping season zinc rate at 12 $kg\ ha^{-1}$ gave the highest tuber yield of 11.4 $t\ ha^{-1}$ compared with tuber yield of 10.6 $t\ ha^{-1}$ obtained with the absolute control (0 $kg\ Zn\ ha^{-1}$). In the corresponding year (2008), tuber yield increase progressively from the absolute control (0 $kg\ Zn\ ha^{-1}$) to 6 $kg\ Zn\ ha^{-1}$. Further increase in zinc rate depressed tuber yield.

Table 5: Effect of zinc fertilizer on tuber yield (t ha^{-1}) of cocoyam

Zinc rates (kg ha^{-1})	2007 Tuber yield (t ha^{-1})	2008 Tuber yield (t ha^{-1})
0	10.6	9.5
3	10.8	10.2
6	9.8	11.6
9	10.3	9.4
12	11.4	8.4
Mean	10.6	9.8
LSD (0.05)	ns	ns

ns = Not significant at 5% probability level

CONCLUSION

The non response of zinc fertilizer to growth and yield of cocoyam may be attributed to the inherent characteristics of zinc oxide which is very slow in releasing nutrient to the test crop.

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