

INFLUENCE OF STARTER FERTILIZER (NPK) AND FOLIAR FERTILIZER (UREA) ON THE GROWTH AND YIELD OF MAIZE (*Zea mays*)

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Abstract

In order to help farmers become more knowledgeable about the optimum fertilizer to apply to maize during and after planting with the intent of increasing crop yield, this study aimed to ascertain the current level of knowledge among farmers on the effects of applying various fertilizers on maize. The experiment was conducted at the Teaching and Research farm of the Department of Agricultural Technology, Aquatech College of Agriculture and Technology, Ibadan, Oyo state. The experiment was arranged in a completely Randomized design (CRD) with three replicates. The factors used were starter (NPK 15:15:15), foliar (Urea) (25kg of urea in 1 liter of water) and a combination of starter and foliar. The data collected on growth parameters were plant height, stem girth, leaf length and grain yield and the data collected were subjected to analysis of variance (ANOVA). Significant means were separated using Least Significant Difference at $p \leq 0.05$. The result showed that the combination of foliar and starter fertilizers improved plant height, stem, leaf length, and yield. Starter, foliar, and control performed the worst. The combination of foliar and starter fertilizers significantly ($p \leq 0.05$) increased maize growth and yield, followed by starter only, foliar, and control. The combination treatments of foliar and starter fertilizer significantly ($p \leq 0.05$) increased maize growth yield, followed by starter only, compared to foliar and control. Therefore, foliar and starter fertilizers are thereby recommended as a source of nutrient for maize crop production and soil fertility improvement.

Keywords: Starter, Foliar, Urea, Growth, Yield, Maize and Fertilizer

INTRODUCTION

According to reports, maize is an important staple food crop not only in Nigeria but also in Africa (Olakojo *et al.*, 2005). It is a versatile crop that grows across a wide range of agro-ecological zones of Nigeria because of its high adaptability. The crop is one of the most important cereal crops in Nigeria because

of its economic value in addition to its ability to be cultivated. Maize is one of the major crops cultivated over the world, mainly in developing countries, with a varied range of consumed forms and utilizations.

Almost every tribe in Nigeria uses maize; the fresh cobs are boiled or roasted and eaten locally, and the dry grains are

mixed into flour and used to make a variety of dishes, including solid food known as "tuwo" and semi-solid food known as "pap." In Africa, maize ranks second in terms of overall production behind wheat and is the most significant grain in terms of yield per hectare. (Woomer *et al.*, 2008). In addition to being the primary ingredient in many industrial products, maize has enormous economic importance on a global scale for both human and animal use. The increase in agriculture production and the purity of industrial fertilizers have resulted in depletion of soil and reduction of micronutrients phyto availability therefore, the application of fertilizers has become an important bio fortification approach to increase mineral content, especially in cereal grains, that are relatively poor sources of mineral nutrients (Gomez-Galera *et al.*, 2010).

Maize has multifarious uses and the diversity of environments under which it grows. It therefore, unmatched by any other crop (Doswell *et al.*, 1996). Maize (*Zea mays*) is the most important grain in South Africa and is one of the most important crops in the milder subtropical and tropical regions of the world (FSSA, 2007). It is grown under diverse environmental conditions compared to other important grain crops such as wheat and rice (Du plessis, 2003; FSSA, 2007). Maize (*Zea mays*) is an important cereal crop which ranks third after wheat and rice in the world (David and Adams, 1985). Maize requires adequate supply of nutrients particularly Nitrogen, Phosphorus and potassium for good growth and high yield. Nitrogen and phosphorus are very essential for good vegetative growth grain development in maize production (Buresh *et al.*, 1997). The quantity required of these nutrients,

particularly nitrogen, depends on the pre-clearing vegetation, organic matter content, tillage method and light intensity (Kang, 1998). The practice of applying liquid fertilizer to plant leaves (foliar fertilizer) is recently done in Nigeria, and it is gradually gaining popularity among peasant farmers in many cultivated crops. This method of fertilizer application has been reported to increase the yield, and quality of crops such as Okro (Selvi and Perumal, 2000), soybean (Barge, 2001) and tomato (Alexander *et al.*, 2004) among others. Philip (2004) demonstrated that this technique apart from supplying the micronutrients, also acts as a catalyst in the uptake and of certain macronutrients.

Foliar application of kinetin and indole acetic acid increased maize dry matter, grain yield, and chlorophyll content under salinity stress (Kaya *et al.*, 2010). Foliar application of ascorbic acid lowered drought stress in maize plants, increasing growth, biomass and photosynthetic activity (Noman *et al.*, 2015). Foliar fertilizers are concentrated solutions containing desired elements to be applied in minute amounts to the foliage of plants. This method seems to provide for rapid nutrient utilization and to enable correction plant stress and deficiency (Halvin *et al.*, 2005). Foliar fertilizer with micronutrients has been intensively used in the late years because this practice allows the application of minerals at the appropriate time during plant development (according to plant needs), it allows uniformity in nutrient distribution and increase in the nutrient absorption, and consequently it avoids losses in the environment, nowadays, the use of bioactive substances, such as chitosan, benzothiadiazole, glyphosate, salicylic acid and some phytohormones,

which can be applied concomitantly with the foliar fertilizer, have also shown promising results in influencing crop growth and development, playing a role on gene expression, plant defense metabolism, and in the mineral nutrient uptake (Ruiz-Garcia *et al.*, 2013).

Horticulturists have utilized foliar fertilizers to provide additional amounts of nutrients, plant hormones, photo-stimulants, and other beneficial substances. Starter fertilizer is frequently used to promote early growth and development in corn; it also somewhat improves early growth and development in soil that is warmer at later planting dates (Cromley *et al.*, 2006). Starter fertilizer has a major effect on the growth of maize especially (NPK) because the presence of nitrogen in excess promotes the growth and development of maize with abundant dark green (high chlorophyll II) of soft consistency. This research therefore assessed the effects of applying different fertilizer on maize growth and yield.

Methodology

Experimental Site

This research was carried out at the Teaching and Research farm of the Department of Agricultural Technology, Aquatech College of Agriculture and Technology, Ibadan, Oyo State, Nigeria (7.3482188°N, 3.8697708°E). The climate of the area is tropical with annual rainfall ranging from 1400-1500mm, while the average temperature is about 31.400 °C, and the relative humidity is about 65%.

Soil Sampling and Laboratory Analysis

Soil sample was taken at the depth of 10cm. Later, soil sample was taken for analysis for physical and chemical analysis at Institute of Agriculture

Research and Training (IAR&T) Apata, Ibadan.

Land Preparation

The trial site was ready for planting. Before planting corn on ridges, the area was cleared twice using a hoe and cutlass. In this study, a two-month-old early-maturing variety of maize was employed. The seeds were planted in the field with a 75-cm by-25-cm spacing after being acquired from the Institute of Agricultural Research and Training (IAR&T) in Apata Ibadan.

Experimental Design

The study used a Complete Randomized Design (CRD), with three replicates for each of the four treatments. There was a total of 12 plots in the experiment because there were 4 treatment combinations that were replicated 3 times. Two Weeks After Planting (2WAP) and Four Weeks After Planting (4WAP), NPK 15:15:15 was sprayed. Additionally, foliar fertilizer (urea) was administered at 4 and 6 weeks following planting, respectively (6WAP and 4WAP). The amount of foliar fertilizer used was 25 grams per liter of water. The plant used in the experiment was observed for the following factors: plant height (cm), stem girth (cm), leaf length (cm), yield weight (g), and yield number.

Data Analysis

Version 22.0 of the statistical package for the social sciences (SPSS) was used to analyze the data. Analysis of variance (ANOVA) was performed to assess differences in the means of the treatment groups based on the mean number of plant replicates for each group. Duncan Post Hoc analysis was used to perform multiple comparisons. At $p \leq 0.05$, statistical significance was established.

Results and Discussion

Effect of Different fertilizer on plant height of Maize (cm) at 2, 4, 6 and 8 weeks after planting (WAP)

The results showed there was no significantly difference across the

treatments groups from week 4 to week 8. Treatment group 1 (control) had the least plant height from week 4 to week 8 while treatment group 3 (starter and foliar) had the highest plant height at weeks 4 and 8 with treatment.

Table 1: Effect of different fertilizers on plant height of Maize (cm) at 2, 4, 6 and 8 weeks after planting

WEEKS	2WAP	4WAP	6WAP	8WAP
Control	4.30 ^a	16.00 ^a	69.97 ^a	95.67 ^a
Starter	4.10 ^a	35.77 ^c	157.67 ^b	210.00 ^b
Starter and Foliar	4.00 ^a	38.67 ^c	139.90 ^b	229.77 ^c
Foliar	4.00 ^a	28.50 ^b	81.67 ^a	162.00 ^b
F	0.034	24.242	4.180	17.177
P	0.991	0.000	0.047	0.001

Means with different superscripts are significantly different at $p \leq 0.05$

Effect of Different fertilizer on leaf length of Maize (cm) at 2, 4, 6 and 8 weeks after planting (WAP)

The mean leaf length was significantly different across the treatment groups from week 4 to week 8. Treatment group 3

(starter & foliar) had the highest leaf length from week 4 to week 8 while treatment groups 4, 2 and 1 (foliar, starter and control) had the least leaf at weeks 4, 6 and 8 respectively as shown in table below.

Table 2: Effect of different fertilizers on leaf length of Maize (cm) at 2, 4, 6 and 8 weeks after planting

WEEKS	2WAP	4WAP	6WAP	8WAP
Control	23.80 ^a	49.70 ^a	62.20 ^a	66.33 ^a
Starter	27.57 ^a	72.60 ^b	93.23 ^b	92.20 ^b
Starter and Foliar	28.07 ^a	78.67 ^b	99.07 ^b	95.67 ^b
Foliar	24.90 ^a	46.67 ^a	74.67 ^a	86.50 ^b
F	1.819	4.723	22.382	18.000
P	0.222	0.035	0.001	0.001

Means with different superscripts are significantly different at $p \leq 0.05$

Effect of Different fertilizer on stem girth of Maize at 2, 4, 6 and 8 weeks after planting (WAP)

In the table below, it was observed that the stem girth was significantly different across the treatment groups from week 4 and week 8. Treatment group 3 (starter and

foliar) had the highest stem girth at week 4 and week 8 while treatment groups 2 (starter) had the highest stem girth at weeks 6. Treatment group 1 (control) had the least stem girth from week 4 to week 8 as shown in table below.

Table 3: Effect of different fertilizers on stem girth of Maize 2, 4, 6 and 8 weeks after planting

WEEKS	2WAP	4WAP	6WAP	8WAP
Control	0.37 ^a	0.93 ^a	1.33 ^a	1.33 ^a
Starter	0.33 ^a	1.93 ^b	2.53 ^b	2.47 ^b
Starter and Foliar	0.30 ^a	2.03 ^b	2.43 ^b	2.50 ^b
Foliar	0.33 ^a	1.47 ^a	1.50 ^a	1.70 ^a
F	0.444	7.189	77.111	37.583
P	0.728	0.012	0.000	0.000

Means with different superscripts are significantly different at $p \leq 0.05$

Effects of Different fertilizers on Yield weight (g) and Yield number of Maize 4,6 and 8 weeks after planting (WAP)

In the table below, it observed the mean yield weight and yield number were significantly different across the treatment group. Treatment group 4 (foliar) had the

highest yield weight while treatment group1 (control) had the least yield weight. The yield number was least in the treatment group1 and 4 (control and foliar) while treatment group 3 (starter and foliar) had the highest yield number as shown in table 4.

Table 4: Effect of different fertilizers on yield weight (g) and yield number of Maize 4, 6 and 8 weeks after planting

	Weight	Number of Yield
Control	45.00 ^a	2.00 ^a
Starter	119.60 ^b	15.00 ^b
Starter and Foliar	104.06 ^b	17.00 ^b
Foliar	175.50 ^c	2.00 ^a
F	89.239	97.485
P	0.000*	0.000*

Means with different superscripts are significantly different at $p \leq 0.05$

Table 5: Results of Soil Analysis Test

Parameter	Soil Test Value
Soil (Texture)	Sandy Loam
pH (H2O)	6.42
Sand	37.52
Clay (%)	9.56
Silt	52.56
Exchange Bases (mol/kg)	
Calcium	2.29
Magnesium	0.72
Sodium	0.33
Potassium	0.55
Exchangeable CEC (mol/kg)	3.98
Exchangeable acidity (h+)	0.60
% Organic Carbon	3.51
% Total Nitrogen	0.26
(h+)	0.09
Micro Nutrient (mg/kg)	
Copper	1.73
Manganese	35.26
Iron	3.25
Available P (ppm)	2.80

Discussion

Effect of different Fertilizers on Maize Starter fertilizer (NPK) and foliar fertilizer (UREA) application significantly affected plant height and leaf in 4WAP to 8WAP. Plant height was increased with successive addition of starter and foliar (NPK and Urea) fertilizer on the plant. The height of plant is an important growth character directly linked with the productive potential of plants in terms of grains. An optimum plant height is claimed to be positively correlated with productivity of plant (Saeed *et al.*, 2001). The starter and foliar fertilizer (NPK and Urea) also increased the stem girth. The increase in stem girth is a reflection of retention of appreciable amounts of assimilates in stem for leaf production. The grain yields were significantly affected by starter and foliar fertilizer application. The pattern of response was very clear. Unfertilized plant control had the lowest yield. Compare to fertilizer

plant (Starter and Foliar) NPK and Urea that had the highest yield. Furthermore, the study revealed that the combination of starter and foliar fertilizer (NPK and Urea), contributed to the high yield of maize, plant height, stem girth and leaf length.

Conclusion and Recommendations

This experiment figured out that the combination of starter and foliar fertilizer had a great influence on the stem girth, height, leaf length and yield of plant. Thus, this fertilizer influences these parameters and gives the highest performance. It is therefore recommended that the combination of starter and foliar fertilizer (NPK and Urea) should be used in the production of maize since it had great influence on the growth and maize yield. Further research should be conducted to know if increase or decrease in the rate of application can influence the growth and yield of maize.

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