EFFECTS OF NITROGEN FERTILIZER RATES AND TIME OF APPLICATION ON THE GROWTH AND YIELD OF MAIZE (*Zea mays* L.) IN MINNA, NIGERIA

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ABSTRACT

The experiment was conducted during the raining season of 2017 at the Teaching and Research Farm of Department of Crop Production, Federal University of Technology Minna, GidanKwano Campus. The experiment was to determine the effect of nitrogen rates and time of application on the growth and yield of maize (Zea mays).The variety used was Oba Super 1and the fertilizer application was at the rate of 0 kg N/ha, 30 kg N/ha, 60 kg N/ha and 90 kg N/ha and was applied by split application. First application was at 2,3 and 4 week after sowing and the second application were at 5,6 and 7 WAS after sowing respectively. Data collected include plant height, number of leaves,and days to 50% tasselling, days to 50 % silking, number of cobs, cob length, cob weight and grain weight. The result indicated that application of nitrogen fertilizer at 2 and 4 weeks after sowing resulted in optimum growth and yield of maize in the study area.

Key words: Nitrogen,Oba Super 1, plant height, number of leaves and number of cobs,

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important crops all over the world and is often known as the king of cereals. The production of maize in developing regions is low as compared to developed countries. There are several reasons for this low productivity. Among them, mismanagement of plant nutrition is considered to be the major one. Hence, there is a need to improve this major component of production technology for getting higher maize production. Nitrogen (N) is the most important nutrient supplied to most non-legume crops, including corn. The most important role of N in the plant is its presence in the structure of protein and nucleic acids, which are the most important building and information substances of every cell. Despite the fact that maize productivity is relatively better than other major cereal crops, its current output is still far below its potential productivity. Nitrogen rate and time of application are among the major abiotic factors limiting the productivity of the crop. Nitrogen (N) management in maize production system is one of the main concerns since it is the most important and primary nutrient for growth and development of the crop.

Nitrogen is a major plant nutrient and plays an important role in the plant growth and development (Mariga *et al* 2000). Rate of nitrogen applications can enhance yield productivity and nutrient use efficiencies. Nitrogen availability to maize can be increased either with manual inoculation or with application of commercial nitrogen fertilizer. Corn is usually considered to have a high soil fertility requirement toachieve maximal yields (Paponov*et al*., 2005.

Uribelarreaet *al.*, 2009), and thus large quantities of N are required. Torbertet *al.* (2001) found that yield and yield components of maize increases by increasing of applied N rate. Halvorson *et al.* (2001) reported a significant increase in grain yield with rates up to 224 kg N /ha under irrigated conditions, while Mariga *et al.* (2005) observed that maize grain yield increased significantly with rates up to 120 kg N/ ha.

MATERIALS AND METHODS

The experiment was conducted during the raining season of 2017 at the Teaching and Research Farm of the Department of Crop Production, Federal University of Technology Minna, GidanKwano Campus. The study area is located at 6^0 33 E and longitude $9^0$37 N in the South Guinea Savanna zone of Nigeria. The soil type of study area is sandy clay loam. The land was first sprayed with a Glyphosphate to control the weeds, and left for 1week to allow the weeds to die off. The plot was cleared manually, ploughed and harrowed with a hoe prior to planting following the cultural practices. Maize seeds were sown (2 seeds per hole) at a depth of 2 cm. The seeds were planted at a spacing of 75 cm x 50 cm. Nitrogen fertilizer of 0 kg/ha, half doses of 30 kg/ha, 60 kg/ha and 90 kg/ha was applied at side placement 5cm away from the maize plant at 2 WAS, 3 WAS, 4 WAS, while the remaining doses was applied at 5 WAS, 6 WAS and 7 WAS to enhance growth. Manual weeding was done with the use of hoe at 3 WAS, 6 WAS, and 10 WAS after sowing. Data collected include plant height, number of leaves, days to 50% tasselling, days to 50 % silking, number of cobs, cob length, cob weight and grain weight. All data collected were subjected to statistical analysis using (ANOVA), where significant differences exist, means were separated using Duncan Multiple Range Testat 5% probability level.

RESULTS

The result in Table 1 showed some physical and chemical properties of soil before sowing. The soil pH was 6.72. The textural classes of the soil were sandy clay loam. Available phosphorus of the soil analysed is moderate with a value of 8.73mgkg^{-1}. The organic carbon is low with value of 4.43 gkg^{-1}

Table 1. Some Physical and Chemical properties of soil before sowing

Parameters	values
Sand (g/kg)	732
Silt (g/kg)	63
Clay (g/kg)	205
Textural class	Sandy Clay Loam

pH in H_2O (1:2.5)	6.72
Total Nitrogen (g/kg)	0.56
Available P (mg/kg)	8.73
Organic Carbon (g/kg)	4.43
Exchangeable Bases (cmol/kg)	
Calcium	2.16
Magnesium	1.03
Potassium	0.14
Sodium	0.21
Exchangeable acidity	0.01
ECEC	3.55

Table 2 shows the effect ofthe rate and time of nitrogen fertilizer on plant height. The rate of nitrogen fertilizer and time of application shows that there was no statistical difference ($p>0.05$) in plant height at 3, 6 and 9 weeks after sowing.

Table 2. Effect rate and time of nitrogen fertilizer application on plant height (cm)

Treatment	Weeks after sowing		
	3WAS	6WAS	9WAS
Nitrogen Rate (KgN/ha)			
0	49.94a	93.12a	127.90a
30	47.52a	90.38a	125.29a
60	47.96a	94.47a	126.89a
90	47.56a	93.28a	130.21a
SE±	1.74	3.20	4.76
Time of Application(T)			
2 WAS	46.17a	92.93a	152.85a
3WAS	46.57a	89.88a	129.18a

4WAS	50.06a	95.63a	127.61a
SE±	1.45	2.60	4.10
N x T	NS	NS	NS

Means with the same latter(s) in a column are not significantly different at ($p > 0.05$) using LSD; NS= Not significant different at $p > 0.05$; WAS= Weeks after sowing

However the highest plant height was recorded (130.21cm) at 9 WAS where 90kg N/ha was applied while the lowest was observed where 30 kg N/ha (125.29cm) was applied. The highest plant height (152.85cm) was recorded where nitrogen fertilizer was applied at 2WAS while the least (127.61 cm) was obtained where nitrogen was applied at 4 WAS.

The result in table 3 revealed that the rate of Nitrogen fertilizer (N) application did not show any significant difference ($p>0.05$) on days to 50 % tasselling and days to 50 % silking. However, significant difference (($p<0.05$) was recorded on days to 50 % tasselling and days to 50 % silking as a result of time of nitrogen fertilizer application. The highest number of days (57) to 50 % tasselling was recorded where nitrogen fertilizer was applied at 2 and 4 WAS respectively, while the lowest (51) was observed where nitrogen fertilizer was appliedat 3 WAS. There was significant difference (($p<0.05$) on the time of nitrogen fertilizer application on days to 50 % silking. The application of nitrogen fertilizer at 2 WAS recorded highest number (69) of days to 50 % silking, while the least (59) was observed where nitrogen fertilizer was applied at 3 WAS.

Table 3. Effect of rate and time of nitrogen fertilizer application on days 50 % tasselling and silking

Treatment	Days to 50 % tasseling	Days to 50 % silking
Nitrogen Rate (kgN/ha)		
0	54a	65a
30	55a	65a
60	55a	63a
90	54a	62a
SE±	1.19	1.90
Time of application(T)		
2 WAS	57a	69a
3 WAS	51b	59c
4 WAS	57a	63b
SE±	0.64	
N x T	NS	NS

Means with the same latter(s) in a column are not significantly different at ($p > 0.05$) using LSD; NS= Not significant different at $p > 0.05$, WAS= Weeks After Sowing

The rate and time of nitrogen fertilizer application on number of cobs, cob length, cob weight and grain weight (Table 4) showed that the rate of nitrogen fertilizer application had no significant effect number of cobs, cob length, cob weight, and grain weight. The time of nitrogen fertilizer application showed no significant difference ($p>0.05$) on number of cobs. However, the time of nitrogen fertilizer application showed significant difference ($p<0.05$) on cob length, cob weight and grain weight. The application of nitrogen fertilizer at 4 WAS recorded highest number of cob length (13.78 cm), cob weight (0.50 kg) and grain weight (0.38 kg) respectively

Table 4. Effect of rate and time of nitrogen fertilizer application on number of cobs, cob length, cob weight and grain weight.

Treatment	Number of cobs per plot	Cob length(cm)	Cob weight(kg)	Grain weight(kg)
Nitrogen Rate (kgN,ha)				
0	5.0a	12.20a	0.43a	0.32a
30	5.0a	11.89a	0.41a	0.31a
60	5.0a	13.01a	0.44a	0.25a
90	5.0a	12.00a	0.40a	0.31a
SE±	0.00	0.81	0.42	0.29
Time ofapplication				
2 WAS	5.0a	11.85b	0.39b	0.27b
3 WAS	5.0a	11.17b	0.36b	0.24b
4 WAS	5.0a	13.78a	0.50a	0.38a
SE±	0.00	0.61	0.92	0.29
N x T	NS	NS	NS	NS

Means with the same latter(s) in a column are not significantly different at ($p > 0.05$) using LSD., NS= Not significant different at $p > 0.05$; WAS= Weeks After Sowing

DISCUSSION

The result in this study showed that there was no significant difference in the rate of application of Nitrogen fertilizer on plant height at 0 Kg N/ha, 30 kg N/ha,60 kg N/ha and 90 kg N/ ha, however, the highest plant height was recorded at 9WAS when 90 kg N/ha was applied. This is in agreement with(Ferreit*aet al.*, 2001) which demonstrates a positive correlation in plant height, chemical composition and with accumulation of protein and nutrients.

There was no significant difference in the time and rate of application of nitrogen fertilizer in plant height and number of leaves throughout the growth period of maize. This agreed with the findings of Torbert *et al* (2001) that stated that the greatest Nitrogen efficiency is directly linked to the time of application, because very early and late applications will be poorly used by plants. The timing of application directly influences Nitrogen utilization by maize plants. This statement is linked to the findings by Silva *et al.* (2005). There was a significant difference in the time of application of Nitrogen fertilizer on cob length, cob weight and grain weight at 2 weeks and 4 weeks after planting. This result is an agreement with the findings of Sangoi*et al.* (2011) and Balbitone*t al.*, (2005) who observed variability in grain yield and yield components among

maize varieties. Souza *et al.* (2014), who reported similar results studying the relation among maize characters and grain yield. The days to 50 % tasselling and days to 50 % silking was significantly affected by time of nitrogen fertilizer application. However, days to 50 % tasselling and days to 50 % silking was not statistically affected. Pre-anthesis uptake is necessary in order to accumulate N in the vegetative sink for later remobilization to the ear. Post-silking uptake supplements remobilized N and prevents excessive N relocation from the vegetative sinks to the ear, which is essential for maintenance of appropriate N partitioning between grain and stover to maintain photosynthesis and grain yield formation. Post-silking uptake is also critical to many physiological processes, including spikelet differentiation and kernel formation (Andrade *et al.*, 2000; Paponov *et al.*, 2005).

CONCLUSION

The result obtained from the study showed that the rate of application of Nitrogen fertilizer (N) showed no significant difference in plant height, number of leaves. However, there was significant difference in the time of N fertilizer application on days to 50 % tasselling and days to 50 % silkingat 2 weeks and 4 weeks after sowing .The result from this study shows that application of Nitrogen fertilizer at 2 and 4 weeks after sowing is sustainable for maize production in the study area.

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