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EFFECT OF FERTILIZER APPLICATION PERIODS ON THE GROWTH AND YIELD OF TWO HYBRID MAIZE (ZEA MAYS (L.) VARIETIES IN MUBI ADAMAWA STATE NIGERIA

Timon D, Zakawa N.N, Yusuf C.S and Richard G
Department of Botany Adamawa State University P.M.B 25 Mubi Adamawa State Nigeria

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ABSTRACT

A field experiment was conducted at the Teaching and Research Farm of Adamawa State University Mubi, during the 2017 rainy season to determine the effect of fertilizer application periods on the growth and yield of two hybrid maize varieties. The varieties were: OBA-98 and SAMMAZ-27. Fertilizer was applied twice for the first treatment, (NPK 15:15:15 2WAS+ Urea 46% 6WAS) was applied. For the second treatment (NPK 15:15:15 3WAS+ Urea 46% 7 WAS) at the rate of 240kg ha-1. The experiment was laid out in a Randomized Complete Block Design (RCBD) in three replicates. Data was collected on Plant height, days to 50% flowering, days to 50% tasselling, days to 50% silking, days to 90% maturity, ear length, number of rows per ear, Number of kernel per ear, 1000 kernel weight, seed yield per plot and grain yield (kg ha-1). The data collected was analyzed using MINITAB computer soft ware program, significant mean were separated by Duncan Multiple Range Test (DMRT) at $P<0.05$.The result showed significant difference at $p<0.05$ for number of kernel per ear and grain yield in kg ha-1 with OBA-98 having a better performance when (NPK 15:15:15 2WAS+ Urea 46% 6WAS) was applied. There was also varietal difference with respect to ear length, number of row per ear, seed yield per plot and grain yield in kg ha-1. Significant interaction was also observed between fertilizer application periods and varieties with respect to 1000 seed weight. Suggested that the response of the two hybrid varieties differ across the two fertilizer application periods, with OBA-98 produced the heaviest kernel weight when (NPK 15:15:15 2WAS+ Urea 46% 6WAS) was used. Therefore application of (NPK 15:15:15 2WAS+ Urea 46% 6WAS) is the most reliable period for fertilizer application in maize for yield enhancement most especially with OBA-98 hybrid maize in Mubi environment and optional for general use in agriculture

Keywords: Fertilizer, Hybrid maize, Application Periods, Growth, Yield.

1. INTRODUCTION

Maize (Zea mays (L.) is a member of the grass family Poaceae (Gramineae), a classification it shares with many other important agricultural crops, like wheat, rice, oats, sorghum, barley, and sugarcane. Maize is a widely cultivated crop in Nigeria, it require adequate and timely fertilizer application for growth and high grain yield.

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Its grain has high nutritive value containing 66.2% starch, 11.1% protein, 7.12% oil and 1.5% mineral. Moreover it contains 90 mg carotene, 1.8 mg niacin, 0.8 mg thiamine and 0.1mg riboflavin per 100g grain (Chowdhury and Islam 1993). It is used as a staple food by human being, also used as feed for livestock and raw material for industry (Harris et al., 2007).

Nigeria is the largest maize producer in Africa after South Africa with an estimated 10.79 million MT produced in 2014 (FAOSTAT, 2014). Despite this high production volume, Nigeria average maize yield is estimated around 1.8 MT/HA (FAOSTAT 2014) is one of the lowest among the 10 maize producers in Africa, it lag behind countries such as Egypt and South Africa where yield are 7.7 MT/HA respectively (FAOSTAT 2014).

The world-wide consumption of maize is more than 116 million tons, a testament to the fact that there is a high consumption of maize globally. In Sub-Saharan Africa, 50% of the population consumes maize while the entire African continent accounts for 30% of global Maize consumption. One would imagine that a continent that has a heavy maize consumption rate will be a major maize producer but on the contrary, Africa accounts for only 6.5% of the Global Maize production with Nigeria being the largest African Maize producer; her production is slightly over 10 million metric tons. However it is considerably small when compared to the USA's corn production about (384 million metric tons). If Africa produces very little and consumes so much, then it confirms to us that there is a heavy reliance on importation to bridge the production gap.

According to Kolawole and Joyce (2009), the low fertility status of most tropical soils hinders maize production as it has a strong exhausting effect on the soil. Adediran and Banjoko (2003) reported that there was decreased grain yield resulting from low application of NPK fertilizer.

Some of the factors that may be responsible for this low yield of maize in Nigeria include: high cost of farm input like fertilizer, and lack of adequate knowledge on the rate and timing of the first and second fertilizer application among others.

Bowyer, (2010) opined that fertilizers are compounds, which are used to produce an overall effective increase in crop yield, or they can be single nutrient which means they are used to replenish a single type of mineral that is lacking in the soil. Fertilizers have played a key role in helping farmers achieve their high level of production by providing essential plant nutrients which are indispensable for producing sufficient and healthy food for the world's expanding population (Khaskheli, 2011).

Efficient nitrogen use by maize permits use of appropriate source in an adequate amount, at proper timing and suitable application rate (Azeez and Adetunji 2007). By applying proper dose and suitable timing nitrogen use efficiency can be improved (Ferguson, (2002)

Studies have shown that application of balance fertilizer relating to time or period accelerates plant growth resulting in taller and greener plant, luxuriant growth and eventually high yield. Fishina et al. (2002), Zang et al. (2007).

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The high demand of maize for nitrogen and other major nutrients such as phosphorus and potassium makes it impossible to achieve high maize yield without fertilization (Kwaga 1994, Havlin et al., 2010). Therefore fertilizer dose of 120:60:60 N, P2O5 and K2Oha-1 has been recommended for maize production in Mubi agro ecology (Ewenzor et al., 1998). Even thou farmers in this area recognized the need to fertilized their crops to obtain better yield; the high cost of these fertilizers has made the commodity scarce and unaffordable by the local farmers. Consequently, they are unable to procure and apply the fertilizers as at when due. Information is scanty in published literatures on the decline in yield as a result of delay in fertilizer application on maize. Timing of Nitrogen application is also deliberated as the best managing strategy and is very crucial for maize production (Walsh, 2006). Therefore this research is carried out with the aim of investigating the effect of fertilizer application periods on the growth and yield of two commonly cultivated hybrid maize varieties in Mubi Adamawa state Nigeria.

2. MATERIALS AND METHODS

The research was carried out in the field at the Teaching and Research Farm of Adamawa State University Mubi latitude 10010' and 100 30' North of the Equator and between longitude 130 10' and 130 30' East of Greenwich meridian, altitude 696m above sea level during the 2017 rainy season. The soil of the area is broadly classified as alfisol (Brady and Weil, 1999). While the textural class of the trail site was clay loam with pH 6.23, total nitrogen 0.004gkg-1, available P 0.008mgkg-1, K 2.45 Cmol Kg-1 and ECC 2116.00 Cmolkg-1. The experiment was laid out in a Randomized Complete Block Design (RCDB) in three replicates, two hybrid maize varieties were used for the trail these were; V1 = OBA 98 and V2 = SAMMAZ 27. Fertilizer in form of NPK 15:15:15 was applied two weeks after sowing (2WAS) and Urea 46% six weeks after sowing (6 WAS) at the rate of 240 kg ha-1 this constitute the first treatment (T1). Fertilizer in form of NPK 15:15:15 was applied three weeks after sowing (3WAS) and Urea 46% seven weeks after sowing (7 WAS) at the rate of 240 kg ha-1 this constitute the second treatment (T1). The treatments combinations were as follows V1T1, V1T2, V2T1, V2T2.

Site Preparation

The land was cleared, disk plough harrow to provide a fine tilt, ridge was done manually Two seeds per hill were planted at a spacing of 25cm × 75cm within and between row respectively. Seedlings were later tined to one per hill at two weeks after sowing (2WAS). The parameters measured include: Days 50% to tasselling, Days 50% to silking, Number of ear per plant, Plant height at harvest, Days to 90% maturity, Number of rows per ear, ear length, Number of kernel per ear, 1000 kernel weight, Seed yield per plant, grain yield in kg ha-1

Determination Of Field Parameters

Days to 50% tasselling: - the number of days from sowing to when at least 50% of the total number of plant stand within a plot has tasseled.

Days to 50% silking: the number of days from sowing to when at least 50% of the total number of stand plant within a plot has silked.

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Days to 90% maturity: - the number of days from sowing to when at least 90% of the total number of stand within a plot has matured.

Number of ear per plant: the total number of ears in each plot was counted and divided by the number of plants in the respective plot to give the mean number of ear per plant.

Number of rows per ear: - five ear was tagged in each plot and the number of rows in each ear was counted and divided by the number of ear to obtained the mean number of row per ear.

Plant height (cm): At harvest five plants were tagged in each plot the height of each of the plant was measured from the base to the flag leaf. The mean plant height was used for data analysis

Ear length (cm) :- Five ears were tagged in each plot, the length of each of which was measured from the base to the tip, using a measuring tape. The mean ear length was used for the analysis.

Number of kernel per ear: the number of kernel was counted from five tagged ear per plot and divided by the number of ears to obtained the mean number of kernel per ear.

One thousand kernel weight (g): One thousand kernels were sampled from the whole grain lot per plot and weighed using electronic weighing balance in the laboratory.

Grain yield kg ha-1: Total grain was computed at 13% moisture contain (safe storage moisture content of maize according to AERLS, 1987). The whole grain harvested in each plot was weight and the weight was converted to the equivalent weight at 13% moisture content and then to kg ha-1 before the statistical analysis.

3. DATA ANALYSES

The data collected were subjected to two way analysis of variance (ANOVA) using MINITAB computer software program, significant means were separated using Duncan Multiple Range Test (DMRT) at $p < 0.05$.

4. RESULTS

Effect of fertilizer application periods on plant height, days to 50% flowering, days to 50% Silking and days to 90% maturity

The Analysis of variance (ANOVA) showed no significant difference in the fertilizer application periods at $P<0.05$ for Plant height, Days to 50% tasselling, Days to 50% silking and days to 90% maturity at $p<0.05$. (Table1). The two varieties i.e. OBA 98 and SAMMAZ 27 does not show differences for Plant height, Days to 50% tasselling, Days to 50% silking and days to 90% maturity with respect to the fertilizer application periods (Table 1). There was no significant interaction between the fertilizer application period and the two hybrid varieties for plant height, days to 50% tasselling, days to 50% silking and days to 90% maturity (Table 1).

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Effect of fertilizer application periods on ear length, number of rows per ear, number of kernel per ear, 1000 kernel weight

The analysis of variance showed significant difference at $p<0.05$ in the fertilizer application periods for number of kernel per ear, with the application of NPK 2WAS+ Urea 6WAS produced the highest number of kernel per ear of 406.00 while the fertilizer application periods of NPK 3WAS+ Urea 7WAS produced the least kernel per ear of 329.00. Comb length, number of rows per comb, and 1000 kernel weight was not significantly different with respect to the fertilizer application periods (Table 2).

There was significant variation between the varieties with respect to ear length and number of kernel per ear at $p<0.05$. OBA 98 had the ear length of 13.47cm while SAMMAZ 27 had the shortest ear length of 10.07cm. Consequently, OBA 98 had highest number of kernel per cob of 401.33 when NPK 2WAS+ Urea 6WAS, while SAMMAZ 27 had the least number of kernels per comb of 333.67 over the same fertilizer application period (Table 2).

The interaction between the fertilizer application period and varieties were significant for one thousand kernel weight while ear length, number of rows ear, number of kernel per ear showed no significant interaction between fertilizer application period and varieties at $P<0.05$. (Table 2)

Effect of fertilizer application periods on Seed yield per plot and Grain yield kg ha-1

The Analysis of variance showed no significant difference between the fertilizer application periods for seed yield per plot at $p<0.05$. However the grain yield in Kg ha-1 showed high significant difference across the fertilizer application period, with the fertilizer application of NPK 2WAS+ Urea 6WAS produced the highest grain yield of 852.92kg ha-1 while the fertilizer application period of NPK 3WAS+ Urea 7WAS recorded the lowest grain yield of 772.20 kg/ha. There was significant variation in seed yield per plot, and grain yield in kg ha-1 produced by the two varieties, with OBA 98 produced the highest seed yield per plot and grain yield in kg ha-1 of 914.67 and 696.37 respectively while SAMMAZ 27 produced lowest seed yield per plot and grain yield of 486.17 and 655.75 respectively.

There was no significant interaction between varieties and fertilizer application periods for seed yield per and grain yield per plot and Grain yield Kgha-1.

Table 1: Effect of fertilizer application periods on plant height, days to 50% flowering, days to 50% silking and days to 90% maturity

TREATMENTS	Plant Height	Days to 50% tasselling	Days to 50% silking	Days to 90% maturity
Fertilizer application period				

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2 and 6 WAS (T_1)	186.20[a]	52.17[a]	60.00[a]	69.00[a]
3 and 7 WAS(T_2)	175.58[a]	52.83[a]	59.67[a]	73.67[a]
Significance	NS	NS	NS	NS
S.E±	16.60	1.29	1.22	8.31
Varieties				
OBA 98 (V_1)	178.65[a]	52.50[a]	60.17[a]	69.00$_a$
SAMMAZ 27(V_2)	183.13[a]	52.50[a]	69.50[a]	73.67[a]
Significance	NS	NS	NS	NS
S.E±	16.60	1.29	1.22	8.31
Interaction				
Fertilizer * Varieties	NS	NS	NS	NS
CV%	5.08	1.57	0.96	16.99

Mean followed by the same superscript within the same column and treatment are not significantly different at P≤ 0.05 (DMRT)

*=Significant at P≤ 0.05 **= significant at P≤ 0.01 NS = Not significant

S.E= Standard error of mean, CV= Coefficient of variability WAS=Weeks after sowing

Table 2: Effect of fertilizer application periods on Comb length, No. of rows per comb, number of kernel per comb, 1000 kernel weight.

TREATMENTS	Cob Length	No. Of rows per ear	No. Of kernel per ear	1000 kernel weight(g)
Fertilizer application period				
2 and 6 WAS (T_1)	11.47[a]	14.10[a]	406.00[a]	155.83[a]
3 and 7 WAS(T_2)	12.07[a]	14.07[a]	329.00[b]	144.76[a]
Significance	NS	NS	*	NS
S.E±	1.05	0.79	44.70	12.12

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Varieties				
OBA 98(V_1)	13.47[a]	14.37[a]	401.33[a]	152.28[a]
SAMMAZ 27(V_2)	10.07[b]	13.80[a]	333.67[b]	148.32[a]
Significance	**	NS	*	NS
S.E±	1.05	0.79	44.70	12.12
Interaction				
Fertilizer* Variety	NS	NS	NS	**
CV%	10.56	7.02	7.02	3.98

Mean followed by the same superscript within the same column and treatment are not significantly different at $P \leq 0.05$ (DMRT)

*=Significant at $P \leq 0.05$ **= significant at $P \leq 0.01$ NS = Not significant

S.E. Standard error of mean CV. Coefficient of variability WAS=Weeks after sowing

Table 3: Effect of fertilizer application periods on Seed yield per plot and Grain yield kg ha-1

TREATMENTS	Seed yield per plot (g)	Grain yield (Kgha^{-1})
Fertilizer application period		
2 and 6 WAS (T_1)	708.93[a]	852.92[a]
3 and 7 WAS(T_2)	691.90[a]	772.20[b]
Significance	NS	**
S.E±	30.49	30.49
Varieties		
OBA 98(V_1)	914.67[a]	696.37[a]
SAMMAZ 27(V_2)	486.17[b]	655.75[b]
Significance	**	**
S.E±	30.49	30.49
Interaction		
Fertilizer* Variety	NS	NS

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CV%	8.17	0.50

Mean followed by the same superscript within the same column and treatment are not significantly different at P≤ 0.05 (DMRT)

*=Significant at P≤ 0.05 **= significant at P≤ 0.01 NS = Not significant

S.E. Standard error of mean CV. Coefficient of variability WAS=Weeks after sowing

5. DISCUSSION

The Analysis of variance (ANOVA) showed no significant difference in the fertilizer application periods for Plant height, Days to 50% tasselling, Days to 50% silking and days to 90% maturity, suggest that these characters were not affected by the fertilizer application periods since all the hybrid maize attainded the same height at maturity, silked, tasseled and matured at the same time in both varieties. Interaction was not significant between fertilizer application periods and varieties for plant height, Days to 50% tasselling, Days to 50% silking and days to 90% maturity, suggest that the varieties responds is same across the fertilizer application periods for those characters.

Fertilizer application period has significantly affected number of kernel per ear. The application of NPK 2WAS+ Urea 6WAS at the rate of 240kg ha-1 has been found to be the best time and rate for fertilizer application which can help increase the number of kernel per ear in OBA- 98 than in SAMMAZ- 27.

The two varieties also showed variation with respect to the number of ear produced, suggests application of NPK 2WAS+ Urea 6WAS gives the highest number of ear in OBA-98 compared with SAMMAZ-27.Therefore OBA-98 responds better than SAMMAZ-27 for application of NPK 2WAS+ Urea 6WAS. The high significant interaction observed between the varieties and fertilizer application period for 1000 kernel weight is an indication that the two varieties respond differently to the different fertilizer application periods used in this study. And therefore suggest that both the genotype and the environment have contributed to the phenotypic responds of the varieties with respect to 1000 kernel weight.

Ear length showed variation among the two varieties with OBA-98 produced the longest ear, this may probably be due to genetic differences between the two varieties and not necessarily the fertilizer application periods. High significant difference observed between fertilizer application periods for grain yield in kg ha-1, with the application of NPK 2WAS+ Urea 6WAS produced the highest grain yield. This suggests that applying fertilizer NPK 2WAS+ Urea 6WAS will help boost the yield of maize as observed in this study. Several researchers has reported early fertilizer application enhanced the yield of maize for example, Kwaga, 2014 reported basal application of fertilizer 4 WAS and 8WAS lead to higher grain yield in maize. Precious and Namo, 2015 also reported that the mean number of leaves per plant, leaf area index, plant height, number of rows per ear, ear weight, kernel weight, and total grain yield significantly increased when fertilizer was applied two weeks after sowing

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The two varieties also showed significant variation for seed yield per plot and grain yield in kg/ha with OBA-98 performed better than SAMMAZ-27 in those characters. Therefore applying NPK 2WAS+ Urea 6WAS will give better yield with OBA- 98.

6. CONCLUSION

Applying (NPK 15:15:15) at the rate of 240kg ha-1 2 WAS and urea 46% 6 WAS has been found to be the best rate period for fertilizer application which can help boost the yield of maize most preferably with OBA-98 hybrid maize variety in Mubi environment.

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