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Research paper

Performance evaluation of maize (*Zea mays* L.) varieties for growth and yield as influenced by Urea and NPK fertilizers

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This field experiment was conducted during the 2021 cropping season at the Prince Abubakar Audu University Research and Demonstration farm, Anyigba in the Southern Guinea Savana Agro Ecological Zone of Nigeria to determine the performance of maize varieties under the influence of NPK 20:10:10 and Urea fertilizer application. A Randomized Complete Block Design (RCBD) was used with three replications. The treatment consisted of three NPK 20:10:10 levels (0, 60, 120), Urea (0, 60, 120) and two varieties [Samaz 52 (OPV) and Oba-super-6 (Hybrid)] respectively. Results obtained show that fertilizers application increased growth parameters such as; plant height, days to 1st and 50% flowering. However, Number of leaves/plant, number of spikes/plant and grain weight/cob was not significantly influenced by fertilizer application. There were varietal differences in number of spikes/tassel and threshing %. Oba-super-6 consistently produced taller plants, thicker stems, higher leaf area, more spike/tassels than OPV. Application of NPK 20:10:10 fertilizer at 120kg/ha significantly influence yield and some yield components such as cob length (13.84cm), threshing % (78.61) and final grain yield (4196.30kg/ha), number of grains/cob (355.85), leaf area at 4 and 6WAS (307.21 and 447.28cm) respectively than at the application of 60kg/ha and 0kg/ha. However, application of 120kg N/ha significantly influenced 100-seed weight (29.36). Oba-super-6 out yielded OPV in yield and its components. For the interactions studied, for days to emergence, all factors studied had no significant effect (P ≥ 0.05); for plant height, NPK x V, NPK x N, N x V was significant (P ≤ 0.05), for days to 1st, NPK x N and NPK x N x V was significant (P ≤ 0.05), for days to 50% flowering, NPK x V, N x V and NPK x N x V was significant (P ≤ 0.05). for threshing percent, only NPK x N was significant (P ≤ 0.05); for No. of grains/cob, NPK x N and NPK x N x V was significant (P ≤ 0.05); for 100-seed weight, all factors studied had no significant effect (P ≥ 0.05); for final grain weight, NPK x N and NPK x N x V was significant.

Key words: *urea, threshing percent, Days to emergence, Final Grain weight, 100-seed weight, variety and interaction*

INTRODUCTION

Maize crop (*Zea mays* L.) origin can be traced to the Meso American region. (Doebley, 2004) Maize is of the wild grass family origin called teosintes since 10,000 years ago (Schnable et al., 2009). The crop, an important cereal worldwide, is consumed as staple food and feed in developing countries. The botany of the plant makes it important for use as fodder and consumption as the grains are basically utilized as, meal domestically; it also forms some important industrial products (Ranum et al., 2014). It forms a primary component of livestock feed of high palatability to poultry, cattle, and pig farmers (Iken et al., 2002). Nigeria's Maize land hectarage has reportedly increased from 438,000 ha to 3.3 million ha over the period of 28years FAOSTAT (2011). However, maize production volume due to this increase cannot meet the demand of the populace. This can be related to low yield of an average of 1.4 t ha^{-1} which differs significantly from the global average yield of 5.5 t/ha and USA average of 9.5 t/ha (FAO, 2014). This low yield has been related to the poor soil fertility in Nigeria. Agbede et al. (2019) had reported the use of chemical fertilizer to increase crop yields. Nitrogen fertilizers being a major Nitrogen supplier may be used at different growing stages, it is a vital plant nutrient which significantly influences and strongly affects the synthesis and content of protein and production of grain. Maize optimum growth has been attributed to sufficient Nitrogen availability (Gallais & Hirel, 2004; Kogbe & Adediran, 2013). However, Adediran & Banjoko (2015) and Shanti et al. (1997) reported in their findings that the supply of N can be humanly regulated. Lemcoff & Loomis (1986) had reported that N-use influence expansion of leaf area, drooping of leaves, and consequently interception of light as these photosynthetic activities significantly affects leaf Nitrogen (Quantity of N per unit Leaf Area) (Muchow & Sinclair, 1994). Adequate supply of N has been reported to translate to rapid vegetative growth and a dark green colour of leaves of maize plants. However, excess or deficient N relative to P, K, and S may elongate periods of growth and retard maturity (Marti & Mills, 1991). Low soil moisture can be disastrous to the rapid growth during the early growth stage because depletion of soil moisture without making up prior to the grain-filling period may depress yield. Lower % corn water content has been reported with the use of 0.33tons of N ha^{-1} Common Nitrogen recommendations for in Nigeria include 75 kg Nitrogen per hectare according to Jones (1973). 150 kg N/ha for FARZ series Lucas (1981), yield increase up to 0.07, 0.14 and 0.21 tons N/ha according to Akintoye et al. (1999) has been reported in Ikenne, Mokwa & Kaduna respectively, in different cultivars. Regarding the influence of Nitrogen on dry matter distribution in maize, Olaniyan (2011) had reported dry matter partitioning was highest in stems and grains and least at tasseling among cultivars and N – levels. Several researchers have reported responses of grain yield of maize to N-fertilizer, Variety and Interaction of fertilizer and variety. However, the magnitude of these responses differs across experimental research and locations resulting from confounding influences of soil nitrogen, cultivars, and environmental influences (Yusuf personal communication, 2021). Therefore, this experiment seeks to; investigate the influence of NPK 20:10:10, Urea fertilizer, Variety and possible interactions on two maize cultivars in Anyigba environment of Kogi State, Nigeria.

MATERIALS AND METHODS

This field study was conducted during the rainy season of 2021 at the Prince Abubakar Audu University Student Research Farm, Anyigba, Kogi State, Nigeria, situated on latitude 7° 29' N and longitude 7° 11' E on elevation of 420 m above sea-level. Anyigba which is located within the Southern Guinea Savannah Ecological Zone of Nigeria. It is characterized by an average rainfall of about 180 mm mostly distributed between the months of April and October. Mean monthly minimum and maximum temperature of about 17° C and 36.2° C respectively. The soils generally are sandy to sandy-loam. Temperature shows some variation throughout the years. Mean Monthly temperature varies between 15.1° C and 31.3° C. (Metrological Station Data, 2019). Soil sample from the experimental location was obtained using tubular auger, bulked and analyzed for its physio-chemical properties at the Soil and Environmental Management Laboratory, Prince Abubakar Audu University, Anyigba (Table 1).

Table 1. Physio-chemical Characteristics of the soil sample taken from the experimental site before the conduct of the experiment

Soil Characteristics	Depth (0-30cm)
Physical Characteristics	
Sand (%)	86.24
Silt (%)	2.61
Clay (%)	11.15
Soil textural Class	Sandy-Clay-Loam
Chemical Characteristics	
pH in H_2O (1:2:5)	6.13
Organic Carbon (%)	0.51
Organic Matter (%)	0.88
Total Nitrogen (%)	0.03
Available Phosphorus (mg/kg)	9.00
Exchangeable Cation (meg/100gm Soil)	
K^+	2.75
Mg^{2+}	1.97
Ca^{2+}	4.16
Na^+	0.95

The experimental site was ploughed, harrowed and ridged to a fine tilt using a tractor, the seed beds was made into ridges of three meters long and 0.75m from each other.

Treatment and experimental design

There were 18treatments which consisted of NPK 20:10:10 (at 0, 60, 120kg/ha), Urea (0, 60, 120kg/ha) and two varieties [Samaz 52 (OPV) and Oba-super-6 (Hybrid)] respectively combined (3x3x2 factorial combination). The experiment was laid out in a Randomized complete block design (RCBD) with three replications. A total number of 54plots was obtained. Each block was separated 1m apart while an inter plot spacing of 0.2m was adopted. Each replication was spaced 1.5m apart.

Treatments were assigned to each plot using a random number system to avoid being bias. Total land area used for the experiment measures 24m x 46.60m = 1118.40m^2 (0.11184ha) with each plot measuring 3x5m (15m^2) and containing 4ridges. Planting was done at a spacing of 0.2m x 075m. For optimal utilization of N, and reduced leaching, Urea and NPK 20:10:10 fertilizers were applied in split dose, first at 3 weeks after sowing (WAS) and the second dose applied at tasseling.

Cultural practices/data collection

The maize seeds were sown by precision planting method manually on ridges using a cutlass. Planting was done early June, 2021 after proper land preparation. After germination, thinning was done to achieve 2 plants/stand. Weeds were manually controlled by use of cutlass, hoe and hand picking methods. Caterpillar force was used in the control of army worms and stem borer at 100 – 150g a.i /ha. With the exception of days to emergence, three (3) plants per plot were tagged, and all measurements taken from the three plants were averaged. Data on growth and yield characters and yield such as number of leaves/plant, leaf area, length of cob/plant, threshing %, plant height, days to 1st and 50% flowering, number of spikes/tassel, number of grains/cob, 100-seed weight, and final grain weight were measured.

Analysis of data

Data obtained on growth and yield parameters were subjected to Analysis of Variance (ANOVA) using Statistical Analysis System (SAS). Significantly different treatment means ($P < 0.05$) were separated using the Fisher's Least Significant Difference (F-LSD) procedure with proper ranking (Snedecor & Cochran, 1967).

RESULTS AND DISCUSSION

Fertilizer application and variety of maize had no significant influence ($P \geq 0.05$) on days to emergence. The interaction of all factors studied had no significant influence ($P \geq 0.05$) on days to emergence as well (Table 2). This result is in opposition to Ahmadu (2014) who obtained significantly higher percent emergence, number of days to 50% tasseling and number of days to 50% silking, with close spacing. He also reported variation in the emergence count of two maize cultivars. Table 3 shows the Influence of NPK 20:10:10 and Urea fertilizer application on Plant height of maize varieties (*Zea mays L.*) In Anyigba, Kogi State. At 4, 6, and 8WAS, Application of 120kg/ha NPK 20:10:10 significantly produced ($P \leq 0.05$) taller plants followed by 60kg/ha NPK 20:10:10. At 6WAS, heights obtained when 60kg/ha and 120kg/ha of NPK 20:10:10 was applied were not significantly different ($P \geq 0.05$). However, mean height showed that 0kg/ha NPK 20:10:10 produced plants with the shortest height across all sampling periods. Urea application also produced the tallest plants as it performed better than NPK 20:10:10. 120kg N/ha consistently produced the tallest plant across all sampling periods, this was followed by 60kg N/ha. However, 0kg N/ha consistently produced the shortest plants under Urea fertilizer application. Mean heights of plants also conform with the result (Table 3). Variety significantly influenced plant height only at 6WAS as mean height and heights obtained at 4 and 8WAS showed no significant effect on variety. Oba-super-6 (Hybrid) produced taller plants than Samaz-52 (OPV). Interaction of NPK 20:10:10 x Urea was significant at 6 and 8WAS, interaction of Urea x Variety was significant only at 4 and 6WAS and interaction of NPK 20:10:10 x Variety was significant only at 8WAS. These interactions are presented in tables 4a – e. In Sharifai (2004) reported a significant increase in plant height exhibited by varieties TZPZ-SR and TZE COMP-3G over TZE-W variety, this was linked to application of N-fertilizer. Ayub et al. (2002) also reported increased plant height resulting from use of fertilizer in maize. These corroborate with Wajid et al. (2007) findings. This increase translates to the fact that nitrogen significantly improves vegetative growth in maize. similar results have been reported by Shah et al. (2005).Oba-super-6 (Hybrid) responded best to N-levels by producing the tallest plants (93.32cm) at 4WAS (Table 4a). However, this was not significantly different from those obtained with 60kg N/ha, the control plots and Samaz-52 (OPV) at 120kg N/ha. At 6WAS, 120kg/ha NPK 20:10:10 + 120kg N/ha produced that tallest plants (88.29cm), this is however not significantly different from heights obtained when 60kg/ha NPK 20:10:10 + 120kg N/ha, 60kg/ha NPK 20:10:10 + 60kg N/ha, 120kg/ha NPK 20:10:10 + 60kg N/ha, 0kg/ha NPK 20:10:10 + 120kg N/ha, 0kg/ha NPK 20:10:10 + 60kg N/ha, 120kg/ha NPK 20:10:10 + 0kg N/ha and 60kg/ha NPK 20:10:10 + 0kg N/ha respectively. Shortest plant was obtained from control plots for both NPK 20:10:10 and Urea fertilizers (Table 4b). This same pattern of response of NPK 20:10:10 x Urea was however observed at 8WAS (Table 4c). Oba-super-6 (Hybrid) and Samaz-52 (OPV) was found to have similar response to N-levels by producing plants whose heights were statistically at par (Table 4d) when 120kg N/ha, 60kg N/ha and 0kg N/ha was applied. These responses were however not statistically different from each other. This similar behavior was also observed with NPK 20:10:10 x Variety interaction (Table 4e). Control plots consistently gave the shortest plants for both varieties. This result correlates with those of Bashir et al. (2012) who obtained significant response of maize genotypes to urea fertilizer application. Significant results of most growth characters may be also an expression of the fact that micronutrients have played an essential role in various physiological and biochemical processes which include photosynthesis (as perceived in significant plant height and leaf area), carbohydrate metabolism (as perceived in high number if leaves produced), Ion homeostasis, Plant antioxidant capacity among others which influenced growth and yield (Taiz & Zeiger, 2010). Bashir et al. (2012) had also reported increase of Phosphorus and Potassium accumulation in leaves and grains of corn cultivars due to urea application. This is an outstanding attribute of high yielding crops. Ahmadu (2014) had also reported significant response of cultivar to plant height as Samaz – 29 was reportedly taller than Samaz – 28 with increased N-use up to 0.135 tons N/ha

Table 2. Days to Emergence of two maize varieties (*Zea mays L.*) as affected by NPK 20:10:10 and Urea fertilizer rates in Anyigba, Kogi State.

Treatments	Days to Emergence
NPK 20:10:10 (Kg/ha)	

0	5
60	5
120	5
F-LSD (0.05)	ns
Urea (Kg/ha)	
0	5
60	5
120	5
F-LSD (0.05)	ns
Variety (V)	
Oba-super-6 (Hybrid)	5
Samaz-52 (OPV)	5
F-LSD (0.05)	ns
Interactions	
NPK 20:10:10 x Urea	ns
NPK 20:10:10 x Variety	ns
Urea x Variety	ns
NPK20:10:10 x Urea x Variety	ns

ns = not significant at 5% level of test

to 50% flowering. Variety study shows that Oba-super-6 (Hybrid) gave the best results for both days to first and 50% flowering respectively. NPK 20:10:10 x Variety and NPK 20:10:10 x Urea x Variety was significant for both days to first and 50% flowering respectively. However, Urea x Variety was significant for only 50% flowering (Tables 6a – e). Significant influence of Fertilizers on days to first and 50% flowering has been reported by Namakka et al. (2009). Supporting these findings, Hussaini et al. (2001) found that N application up to 0.12 t/ha has reportedly delayed 50% tasseling, 50% silking. N-fertilizers improves meristematic and physiological activities thus delaying the process of development and synthesis of more assimilate which come to initiate early flowering of the crop as against the characteristic deficiency symptoms associated with lower level of N, which will hasten growth and development Baba (2002) and Mani (2004) respectively. NPK 20:10:10 x Variety interaction on days to first shows that Oba-super-6 (Hybrid) responded well to NPK 20:10:10 as it flowers earlier than its counterpart. However, this response was not significantly different at the three stages

Table 3. Heights of two maize varieties (*Zea mays L.*) as affected by NPK 20:10:10 and Urea fertilizer rates in Anyigba, Kogi State

	Sampling Periods (Weeks After Sowing)			
Treatments	**4**	**6**	**8**	**Mean**
NPK 20:10:10 (kg/ha)				
0	48.37_b	70.63_b	135.02_b	84.67_b
60	48.57_b	78.71_a	140.48_b	89.25_b
120	54.34_a	87.21_a	157.80_a	99.78_a
F-LSD (0.05)	05.23	10.43	15.80	10.48
Urea (N kg/ha)				
0	43.68_c	73.64_b	136.70b	84.67b
60	50.10_b	77.30_b	142.55ab	89.98b
120	57.50_a	89.31_a	157.40a	101.40a
F-LSD (0.05)	05.23	10.43	15.80	10.48
Variety (V)				
Oba-super-6 (Hybrid)	49.67	97.33b	144.34	97.11
Samaz-52 (OPV)	51.18	80.41a	142.80	91.46
F-LSD (0.05)	ns	10.43	ns	ns
Interactions				
NPK 20:10:10 x Urea	ns	*	*	
NPK 20:10:10 x Variety	ns	ns	*	
Urea x Variety	*	*	ns	
NPK 20:10:10 x Urea X Variety	ns	ns	ns	

Means followed by the same letter(s) within a sampling period are statistically not significant at 0.05 level of probability using N-DMRT

ns = not significant at 5% level of test

** = significant at 5% level of test*

Number of days to first and 50% flowering was found to be significantly influenced by fertilizer (NPK 20:10:10 and Urea), Variety and Interactions (Table 5). 120kg NPK 20:10:10 influenced first flowering ahead of other application rates, this was however, not different from the results obtained when 60kg NPK 20:10:10 was applied. Control plot for NPK 20:10:10 gave the least result. NPK 20:10:10 did not influence days to 50% flowering (Table 5). However, N-levels were significant for both days to first flowering and days to 50% flowering. 120kg N/ha performed best. However, results obtained with 120 kg N/ha and 60kg N/ha was statistically at par for days first flowering while that of 60kg N/ha and control plots for N-levels was also statistically at par for days of NPK 20:10:10 application. Samaz-52 (OPV) consistently gave the least result (Table 6a). Similar results were obtained with mean days to 50% flowering (table 5). Interaction of N-level x Varieties (table 6c) revealed that Oba-super-6 (Hybrid) responded well to 120kg N/ha. This was however not significantly different from the response at 60kg N/ha and Control plots respectively. Samaz-52 (OPV) gave the least response to N-levels on days to 50% flowering.

Table 4a. Interactions of Maize Varieties and Urea fertilizer rates on mean the heights of the crops at 4WAS in Anyigba, during 2021 rainy season

	Urea [N-Levels ($Kgha^{-1}$)]		
Varieties	0	60	120

Oba-super-6 (Hybrid)	85.49^{ab}	87.32^{ab}	93.32^{a}
Samaz-52 (OPV)	77.01^{b}	78.86^{b}	84.86^{ab}
C.V	15.94%		

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT.

Table 4b. Interactions of NPK 20:10:10 and Urea fertilizer rates on the heights of maize crops at 6 WAS in Anyigba, during 2021 rainy season

	Urea [N- levels (kgha^{-1})]		
NPK 20:10:10 (kg $^{-1}$)	0	60	120
0	72.14^{b}	76.18^{ab}	80.43^{ab}
60	73.97^{ab}	78.01^{ab}	82.26^{ab}
120	79.97^{ab}	84.01^{ab}	88.29^{a}
C.V	15.89%		

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT

Table 4c. Interactions of NPK 20:10:10 and Urea fertilizer rates on the heights of maize crops at 8 WAS in Anyigba, during 2021 rainy season

	Urea [N - levels (kgha^{-1})]		
NPK 20:10:10 (kg $^{-1}$)	0	60	120
0	135.86^{b}	138.59^{b}	147.25^{ab}
60	138.79^{b}	141.52^{ab}	150.20^{ab}
120	146.21^{ab}	148.94^{ab}	157.60^{a}
C.V	13.11%		

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT

Table 4d. Interactions of Maize varieties and Nitrogen fertilizer(Urea) rates on mean heights of the crops at 6WAS in Anyigba, during 2021 rainy season

	Urea [N-Levels (kgha^{-1})]		
Varieties	0	60	120
Oba-super-6 (Hybrid)	46.68^{b}	49.89^{ab}	53.59^{a}
Samaz-52 (OPV)	47.43^{b}	50.64^{ab}	54.34^{a}
C.V	16.56%		

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT

Table 4e. Interactions of NPK 20:10:10 and Variety on the heights of maize crops at 8 WAS in Anyigba, during 2021 rainy season

	NPK 20:10:10 (kgha^{-1})		
Varieties	0	60	120
Oba-super-6 (Hybrid)	139.68^{ab}	142.41^{ab}	151.07^{a}
Samaz-52 (OPV)	138.91^{b}	141.64^{ab}	150.3^{a}
C.V	17.86%		

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT

Table 5. Days to 1st and 50% flowering of two varieties of Maize (*Zea mays L.*) as affected by NPK 20:10:10 and Urea fertilizer rates in Anyigba, Kogi State

Treatments	**Days to 1st flowering**	**Days to 50% flowering**
NPK 20:10:10 (kg/ha)		
0	44.00b	54.22
60	44.17ab	54.33
120	45.11a	54.72
F-LSD $_{(0.05)}$	1.03	ns
Urea (N kg/ha)		
0	43.17b	53.22b
60	44.33a	54.06b
120	44.87a	55.89a
F-LSD $_{(0.05)}$	1.03	1.45
Variety (V)		
Oba-super-6 **(Hybrid)**	48.78a	57.70a
Samaz-52 (OPV)	40.07b	51.15b
F-LSD $_{(0.05)}$	1.03	1.45
Interactions		
NPK 20:10:10 x **Urea**	ns	ns
NPK 20:10:10 x Variety	*	*
Urea x Variety	ns	*
NPK 20:10:10 x Urea x Variety	*	*

Means followed by the same letter(s) within a sampling period are statistically not significant at 0.05 level of probability using N-DMRT

ns = not significant at 5% level of test

** = significant at 5% level of test*

Although this was statistically at par with other combined fertilizer levels (Table 6d). Similarly, Samaz-52 (OPV) responded poorly to the combination of NPK 20:10:10 at 0, 60 and 120kg/ha and Urea at 0, 60 and 120kg N/ha at it gave the least result expected (Table 6d).

Table 6a. Interactions of Maize Varieties and NPK 20:10:10 fertilizer rates on mean days to 1st flowering in Anyigba, during 2021 rainy season

	NPK 20:10:10 (kg/ha)		
Varieties	0	60	120
Oba-super-6 (Hybrid)	46.39^{a}	46.48^{a}	46.95^{a}
Samaz-52 (OPV)	42.04^{b}	42.12^{b}	42.59^{b}
C.V (%)	4.14		

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT

Table 6b. Interactions of maize varieties and NPK fertilizer rates on mean days to 50% flowering in Anyigba, during 2021 rainy season

	NPK 20:10:10 (kg/ha)		
Varieties	0	60	120
Oba-super-6 (Hybrid)	54.46^{ab}	56.02^{a}	56.21^{a}
Samaz-52 (OPV)	52.69^{b}	52.74^{b}	52.94^{b}
C.V (%)	4.18		

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT

(Table 6b)Interactions of NPK 20:10:10, Nitrogen fertilizer (Urea) and Varieties was found to influence days to 1st flowering and 50% flowering. Combined effect of 120kg N/ha Urea and 120kg NPK 20:10:10 gave the highest result for Oba-super-6 (Hybrid).

Table 6c. Interactions of Maize Varieties and Nitrogen fertilizer rates on 50% flowering in Anyigba, during 2021 rainy season

	Urea N-levels (kgha-1)		
Varieties	0	60	120
Oba-super-6 (Hybrid)	55.46^{ab}	55.88^{a}	56.80^{a}
Samaz-52 (OPV)	52.19^{b}	52.61^{b}	53.52^{ab}
C.V (%)	4.95		

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT

This result is in line with that of Olowoboko et al. (2017) who reported a significant increase in number of leaves of maize only at 4 WAP he established that nitrogen rates of 90 kg ha^{-1}, 120 kg ha^{-1} and 150 kg N ha^{-1} significantly increased number of leaves than the control. Ayub et al. (2002) also established that combined N and P use improved fresh biomass yield, maize height, number of leaves, stem girth and leaf area as growth is mostly supported with 0.12ton N/ha. Wajid et al. (2007) also reported an increase in leaf numbers on evaluating maize cultivars under nitrogen levels. Namakka (2002) findings supported this with increased leaves

Table 6d. Interactions of NPK 20:10:10, Nitrogen fertilizer (Urea) and Varieties of Maize on Days to 1st flowering in Anyigba, during 2021 rainy season

	Oba-super-6 (Hybrid)			Samaz-52 (OPV)		
NPK 20:10:10 (kgha^{-1})	N_0 (0 kgha^{-1})	N_1(60 kgha^{-1})	N_2(120 kgha^{-1})	N_0(0 kgha^{-1})	N_1(60 kgha^{-1})	N_2(120 kgha^{-1})
0	45.32^{ab}	45.37^{ab}	45.69^{ab}	42.41^{b}	42.47^{b}	42.78^{b}
60	45.70^{ab}	45.76^{ab}	46.07^{a}	42.80^{b}	42.86^{b}	43.17^{b}
120	45.88^{ab}	45.94^{ab}	46.25^{a}	42.98^{b}	43.04^{b}	43.35^{b}
C.V(%)			**4.18**			

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT

Table 6e. Interactions of NPK, Nitrogen fertilizer and varieties of maize on days to 50% flowering in Anyigba, during 2021 rainy season

	Oba-super-6 (Hybrid)			Samaz-52 (OPV)		
NPK 20:10:10 (kgha^{-1})	N_0 (0 kgha^{-1})	N_1(60 kgha^{-1})	N_2(120 kgha^{-1})	N_0(0 kgha^{-1})	N_1(60 kgha^{-1})	N_2(120 kgha^{-1})
0	55.05^{ab}	55.08^{ab}	55.21^{ab}	52.86^{b}	52.90^{b}	53.03^{ab}
60	55.33^{ab}	55.36^{ab}	55.49^{ab}	53.14^{ab}	53.18^{ab}	53.31^{ab}
120	55.94^{ab}	55.70^{ab}	56.10^{a}	53.75^{ab}	53.79^{ab}	53.92^{ab}
C.V(%)	**5.03**					

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT

In the same manner, responses of both Oba-super-6 (Hybrid) and Samaz-52 (OPV) were statistically at par with each other at the three levels of application respectively (Table 6e). Table 7 shows the Influence of NPK 20:10:10 and Urea fertilizer application levels on Number of Leaves of two varieties of Maize (*Zea mays L.*). In Anyigba, Kogi State at 4, 6, and 8WAS. NPK 20:10:10 was significant only at 6WAS as 120kg/ha of NPK 20:10:10 produced plants with more leaves. However, this was not significantly different from the number of leaves produced at 60kh/ha NPK 20:10:10 application. At 4 and 8WAS, application of NPK 20:10:10 did not influence ($P \geq 0.05$) the number of leaves produced. N-levels significantly influenced the number of leaves produced. Application of 120kg N/ha produced plants with the highest number of leaves at 6 and 8WAS respectively. However, number of leaves produced at 120kg N/ha and 60kg N/ha were significantly not different at 6WAS while number of leaves produced at 60kg N/ha and 0kg N/ha was significantly not different at 8WAS respectively. While variety had no significant effect on the Number of leaves produced, interaction studies showed that NPK 20:10:10 x Urea interaction was significant at 4 and 6WAS, likewise Urea x Variety interaction and NPK 20:10:10 x Urea x Variety was significant at 4 and 6WAS respectively. Interaction effects on number of leaves are represented in Tables 8a – 8f.

numbers, leaf size and dry matter among other characters due to increased N-assimilation in maize crop. At 4WAS, application of 120kg/ha NPK 20:10:10 + 120kg N/ha gave plants with the highest number of leaves (7.40). This was not significantly different from those obtained with 60kg N/ha + 120kg NPK 20:10:10 (7.25), 120kg N/ha + 60kg NPK 20:10:10 (7.22) and 0kg N/ha + 120kg NPK 20:10:10 (7.22) respectively (table 8a). Similar result was obtained at 6WAS, as application of 120kg/ha NPK 20:10:10 + 120kg N/ha gave plants with the highest number of leaves (12.75). However, 0kg NPK 20:10:10 + 60kg N/ha and 0kg N/ha + 60kg NPK 20:10:10 produced plants with the least number of leaves respectively (Table 8b). Urea x Variety interaction at 4 and 6WAS revealed that Samaz-52 (OPV) responded better to N-levels than Oba-super-6 (Hybrid). 120kg N/ha produced plants with the highest numbers of leaves at 4 and 6WAS (7.36 and 11.35) respectively (Tables 8c and 8d). This was however not significantly different from those obtained with 0 and 60kg N/ha. Oba-super-6 (Hybrid) consistently produced plants with the least number of leaves (Tables 8c and 8d). Similarly, Samaz-52 (OPV) responded better to combine rates of NPK 20:10:10 and N-levels than Oba-super-6 (Hybrid).

Table 7. Number of leaves of two Maize varieties (*Zea mays L.*) as affected by NPK 20:10:10 and Urea fertilizer application levels in Anyigba, Kogi State

Treatments	Sampling Periods (Weeks After Sowing)		
	4WAS	6WAS	8WAS
NPK 20:10:10 (kg/ha)			
0	7.02	8.60b	9.20
60	7.07	9.11a	11.11
120	7.44	12.10a	12.30
F-LSD (0.05)	ns	3.44	ns
Urea (N kg/ha)			
0	7.00	8.30b	9.46b
60	7.07	10.31a	10.07b
120	7.37	13.40a	12.40a
F-LSD (0.05)	ns	3.41	2.00
Variety (V)			
Oba-super-6 (Hybrid)	7.05	8.11	11.22
Samaz-52 (OPV)	7.37	9.31	10.63
F-LSD (0.05)	ns	ns	ns
Interactions			
NPK 20:10:10 x **Urea**	*	*	ns
NPK 20:10:10 x **Variety**	ns	ns	ns
Urea x Variety	*	*	ns
NPK 20:10:10 x Urea x Variety	*	*	ns

Means followed by the same letter(s) within a sampling period are statistically not significant at 0.05 level of probability using N-DMRT
ns = not significant at 5% level of test
** = significant at 5% level of test*

The highest number of leaves was obtained with Samaz-52 (OPV) at the combined rate of 120kg NPK 20:10:10 + 120kg N/ha. This was however not significantly different from those obtained with combined rate of 60kg N/ha + 60 kg NPK 20:10:10 and control plots respectively (Table 8e). In the same manner, numbers of leaves obtained with Oba-super-6 (Hybrid) at all rates of combination were statistically at par (P≥0.05) (Table 8e). Similar interaction behavior was observed at 6WAS (Table 8f). Table 9 shows the Influence of NPK 20:10:10 and Urea fertilizer application levels on Leaf Area (cm^2) of two varieties of maize (*Zea mays L.*) In Anyigba, Kogi State at 4, 6, and 8WAS. Application of 120kg/ha NPK 20:10:10 produced plants with broader leaves and high leaf area followed by 60kg/ha NPK 20:10:10 at 4 and 6WAS. However, control plots produced plants with the least leaf area. Application NPK 20:10:10 did not significantly influence leaf area at 8WAS. Similarly, 120kg N/ha produced plants with the highest Leaf Area at 4 and 6WAS, this was not significantly different from leaf areas produced at 60kg N/ha. Control plots for N-levels consistently produced plants with the least leaf area. Application Urea fertilizer did not significantly increase leaf area at 8WAS. Variety however did not significantly influence Leaf Area at 4 and 8WAS. However, NPK 20:10:10 x Variety was significant at 8WAS, Urea x Variety was significant at 4, 6 and 8WAS, NPK 20:10:10 x Urea X Variety was significant at 6WAS respectively (table 9). Interaction studies are presented in Tables 9a – 9e.

Table 8a. Interactions of NPK and Nitrogen fertilizer application levels on mean number of leaves of maize crops at 4WAS in Anyigba, during 2021 rainy season

NPK 20:10:10 (kgha^{-1})	Urea [N - levels (kgha^{-1})]		
	0	60	120
0	7.01^{b}	7.04^{b}	7.19^{b}
60	7.03^{b}	7.07^{b}	7.22^{ab}
120	7.22^{ab}	7.25^{ab}	7.40^{a}
	LSD = 0.20		

Means followed by the same letter(s) within a sampling period are not significantly different at 5% level of probability using N-DMRT

Table 8b. Interactions of NPK and Nitrogen fertilizer application levels on mean number of leaves of maize crops at 6WAS in Anyigba, during 2021 rainy season

NPK 20:10:10 (kgha^{-1})	Urea [N - levels (kgha^{-1})]		
	0	60	120
0	8.40^{bc}	9.45^{bc}	11.00^{ab}
60	8.70^{c}	9.71^{bc}	11.25^{ab}
120	10.20^{bc}	11.20^{ab}	12.75^{a}
	LSD = 2.50		

Means followed by the same letter(s) within a sampling period are not significantly different at 5% level of probability using N-DMRT

Table 8c. Interactions of two maize varieties and nitrogen fertilizer application levels on mean number of leaves of maize crops at 4WAS in Anyigba, during 2021 rainy season

Variety	Urea [N - levels (kgha^{-1})]		
	0	60	120
Oba-super-6 (Hybrid)	7.02^{b}	7.06^{b}	7.21^{ab}
Samaz-52 (OPV)	7.17^{ab}	7.21^{ab}	7.36^{a}
	LSD = 0.20		

Means followed by the same letter(s) within a sampling period are not significantly different at 5% level of probability using N-DMRT (Table 8c).

Table 8d. Interactions of two maize varieties and nitrogen fertilizer application levels on mean number of leaves of maize crops at 6WAS in Anyigba, during 2021 rainy season

Variety	Urea [N - levels (kgha^{-1})]		
	0	60	120
Oba-super-6 (Hybrid)	8.20^{b}	9.21^{ab}	10.75^{ab}
Samaz-52 (OPV)	8.80^{ab}	9.81^{ab}	11.35^{a}
	LSD = 2.90		

Means followed by the same letter(s) within a sampling period are not significantly different at 5% level of probability using N-DMRT (Table 8d).

Several authors have reported increase in growth characters of maize with the application of Nitrogen fertilizers. Improved maize characters obtained from this experiment supports Ahmadu (2014) findings who reported that application of 90

Table 8e. Interactions of NPK, Nitrogen fertilizer and varieties of maize on mean number of leaves of maize crop at 4WAS in Anyigba, during 2021 rainy season

NPK 20:10:10 ($kgha^{-1}$)	Oba-super-6 (Hybrid)			Samaz-52 (OPV)		
	N_0 (0 $kgha^{-1}$)	N_1(60 $kgha^{-1}$)	N_2(120 $kgha^{-1}$)	N_0(0 $kgha^{-1}$)	N_1(60 $kgha^{-1}$)	N_2(120 $kgha^{-1}$)
0	7.02^{b}	7.04^{b}	7.14^{ab}	7.12^{ab}	7.14^{ab}	7.24^{ab}
60	7.04^{b}	7.06^{b}	7.16^{ab}	7.14^{ab}	7.16^{ab}	7.26^{ab}
120	7.16^{ab}	7.18^{ab}	7.28^{ab}	7.26^{ab}	7.28^{ab}	7.38^{a}
	LSD = 0.28					

Means followed by the same letter(s) within a sampling period are not significantly different at 5% level of probability using N-DMRT

Table 8f. Interactions of NPK, Nitrogen fertilizer and varieties of maize on mean number of leaves of maize crops at 6WAS in Anyigba, during 2021 rainy season

NPK 20:10:10 ($kgha^{-1}$)	Oba-super-6 (Hybrid)			Samaz-52 (OPV)		
	N_0 (0 $kgha^{-1}$)	N_1(60 $kgha^{-1}$)	N_2(120 $kgha^{-1}$)	N_0(0 $kgha^{-1}$)	N_1(60 $kgha^{-1}$)	N_2(120 $kgha^{-1}$)
0	8.00^{c}	9.00^{bc}	10.03^{abc}	8.73^{bc}	9.40^{abc}	10.43^{abc}
60	8.50^{bc}	9.17^{abc}	10.10^{abc}	8.90^{bc}	9.57^{abc}	10.60^{abc}
120	9.50^{abc}	10.17^{abc}	11.20^{ab}	9.90^{abc}	10.57^{abc}	11.60^{a}
	LSD = 2.50					

Means followed by the same letter(s) within a sampling period are not significantly different at 5% level of probability using N-DMRT

kg N ha^{-1} gave significantly higher leaf area index, dry matter, net assimilation rate, flag leaf area than other levels (0, 45 and 135 kg N ha^{-1}). This result corroborates with Olowoboko et al. (2017) who reported that N-application rate of 120 $kgha^{-1}$ increased leaf area by 96 %. Hussaini et al. (2001) reported similar findings. Increased Leaf area may result from the supply of N which affects both leaf area expansion and drooping, and consequently crop photosynthetic activity (Muchow & Sinclair, 1994; Lemcoff & Loomis, 1986). NPK 20:10:10 x Variety interactions at 8WAS shows that Oba-super-6 (Hybrid) responded more to NPK 20:10:10 application at 120kg/ha by producing plants with the highest leaf area expansion (394.18cm^2) (Table 10a). This was however not significantly different from the leaf area obtained when 60kg/ha NPK 20:10:10 was applied. Samaz-52 (OPV) responded in a similar manner as control plots for both varieties produced plants with the least Leaf area. Similar observation was made with Urea x Variety at 4WAS. Although Oba-super-6 (Hybrid) responded higher numerically (288.00) to N-levels than its counterpart, this is however not significantly different from its counterpart (280.93). Other response at 0 and 60kg/ha N-application are statistically at par (table 9). Similar observation for was also made with Urea x Variety at 6WAS and 8WAS (tables 10c and 10d).

NPK 20:10:10 x Urea X Variety shows that Oba-super-6 (Hybrid) responded well to the combined application of NPK 20:10:10 + Urea by producing plants with the highest Leaf Area (450.08cm^2). This was not significantly different from other combined rates of NPK 20:10:10 and Urea fertilizer. Samaz-52 (OPV) responded in a similar manner (Table 9). Positive interaction effect on all growth characters reflect a genotypic difference at varying levels of urea and NPK 20:10:10 application, as both maize cultivars had displayed varying potential to extract N, sufficient from both nutrient source.

Table 9. Leaf Area (cm^2) of two maize varieties (*Zea mays L.*) as influenced by NPK 20:10:10 and Urea fertilizer application levels in Anyigba, Kogi State.

	Sampling Periods (Weeks After Sowing)		
Treatment	**4WAS**	**6WAS**	**8WAS**
NPK 20:10:10 (kg/ha)			
0	257.21b	367.14b	350.87
60	260.70b	386.96b	389.02
120	307.21a	447.28a	416.72
F-LSD (0.05)	17.21	50.58	ns
Urea (N kg/ha)			
0	265.21b	273.60b	350.22
60	276.58ab	401.69a	374.60
120	293.74a	420.82a	431.73
F-LSD (0.05)	17.21	50.58	ns
Variety (V)			
Oba-super-6 (Hybrid)	282.27	482.16a	371.64
Samaz-52 (OPV)	268.13	317.15b	364.43
F-LSD (0.05)	ns	50.58	ns
Interactions			
NPK 20:10:10 x Urea	ns	ns	ns
NPK 20:10:10 x Variety	ns	ns	*
Urea x Variety	*	*	*
NPK 20:10:10 x Urea X Variety	ns	*	ns

Means followed by the same letter(s) within a sampling period are statistically not significant at 0.05 level of probability using N-DMRT

ns = not significant at 5% level of test

** = significant at 5% level of test*

Table 10a. Interactions of two maize varieties and NPK fertilizer application levels on mean leaf area (cm^2) of maize crops at 8WAS in Anyigba, during 2021 rainy season

	NPK 20:10:10 ($kgha^{-1}$)		
Variety	0	60	120
Oba-super-6 (Hybrid)	361.25^{b}	380.33^{ab}	394.18^{a}
Samaz-52 (OPV)	357.65^{b}	376.72^{ab}	390.53^{ab}
LSD = 25.60			

Means followed by the same letter(s) within a sampling period are statistically not significant at 0.05 level of probability using N-DMRT (Table 10a)

Table 10b. Interactions of two maize varieties and nitrogen fertilizer application levels on mean leaf area (cm^2) of maize crops at 4WAS in Anyigba, during 2021 rainy season

	Urea [N - levels ($kgha^{-1}$)]		
Variety	0	60	120
Oba-super-6 (Hybrid)	273.74^{a}	277.42^{a}	288.00^{a}
Samaz-52 (OPV)	266.67^{b}	272.35^{a}	280.93^{a}
LSD = 18.00			

Means followed by the same letter(s) within a sampling period are statistically not significant at 0.05 level of probability using N-DMRT (Table 10b)

Table 10c. Interactions of two maize varieties and nitrogen fertilizer application levels on mean leaf area (cm^2) of maize crops at 6WAS in Anyigba, during 2021 rainy season

	Urea [N - levels ($kgha^{-1}$)]		
Variety	0	60	120
Oba-super-6 (Hybrid)	377.88^{ab}	441.92^{a}	451.49^{a}
Samaz-52 (OPV)	295.37^{b}	359.42^{ab}	368.98^{ab}
LSD = 142.11			

Means followed by the same letter(s) within a sampling period are statistically not significant at 0.05 level of probability using N-DMRT (Table 10c)

Table 10d. Interactions of two maize varieties and nitrogen fertilizer application levels on mean leaf area (cm^2) of maize crops at 8WAS in Anyigba, during 2021 rainy season

	Urea [N - levels ($kgha^{-1}$)]		
Variety	0	60	120
Oba-super-6 (Hybrid)	360.93^{b}	373.12^{ab}	401.68^{a}
Samaz-52 (OPV)	357.32^{b}	369.51^{b}	398.08^{ab}
LSD = 30.50			

Means followed by the same letter(s) within a sampling period are statistically not significant at 0.05 level of probability using N-DMRT(Table 10d)

Table 10e. Interactions of NPK, Nitrogen fertilizer and maize varieties on mean leaf area of maize crop at 6WAS in Anyigba, during 2021 rainy season

NPK 20:10:10 ($kgha^{-1}$)	Oba-super-6 (Hybrid)			Samaz-52 (OPV)		
	N_0 (0 $kgha^{-1}$)	N_1(60 $kgha^{-1}$)	N_2(120 $kgha^{-1}$)	N_0(0 $kgha^{-1}$)	N_1(60 $kgha^{-1}$)	N_2(120 $kgha^{-1}$)
0	374.30^{ab}	416.99^{ab}	423.37^{ab}	319.29^{b}	361.99^{ab}	368.37^{ab}
60	380.90^{ab}	423.60^{ab}	429.98^{ab}	325.90^{ab}	368.60^{ab}	374.97^{ab}
120	401.01^{ab}	443.71^{ab}	450.08^{a}	346.01^{ab}	388.70^{ab}	395.08^{ab}
LSD = 125.00						

Means followed by the same letter(s) within a sampling period are not significantly different at 5% level of probability using N-DMRT (Table 10e)

However, a positive interaction between urea and nutrient uptake may offer an opportunity for considerable savings towards the cost of urea fertilizer. This is reported by Bashir et al. (2012). Number of Spikes/Tassel, Grain Weight/Cob and Cob Length of two varieties of maize planted in Anyigba environment of Kogi State were significantly influenced by NPK 20:10:10 and Urea fertilizer application levels (table 10). NPK 20:10:10 had no significant influence ($P \geq 0.05$) on

Number of spikes/tassel and grain weight/cob. However, cob length was significantly influenced as 120kg NPK 20:10:10 produced the longest cobs (13.84cm) followed by 60kg NPK 20:10:10 (13.32cm).

Control plots had the lowest cob length (12.92cm). N-levels had no significant influence on number of spikes/tassel and cob length respectively. However, 120kg N/ha produced the highest grain weight/cob (97.35g) which was not significantly

Table 11. Number of Spikes/Tassel, Grain Weight/Cob and Cob Length of two maize varieties (*Zea mays L.*) as Influenced by NPK 20:10:10 and Urea fertilizer application rates in Anyigba, Kogi State

Treatments	Number of Spikes/Tassel	Grain Weight/Cob (g)	Cob Length (cm)
NPK 20:10:10 (kg/ha)			
0	16.61	78.34	12.92c
60	16.37	79.08	13.32b
120	15.74	95.87	13.84a
F-LSD $_{(0.05)}$	ns	ns	0.50
Urea (N kg/ha)			
0	15.68	73.71b	13.01
60	15.79	82.28ab	13.10
120	17.24	97.35a	13.98
F-LSD $_{(0.05)}$	ns	18.31	ns
Variety (V)			
Oba-super-6 (Hybrid)	17.38	82.71	13.60
Samaz-52 (OPV)	15.10	86.16	13.13
F-LSD $_{(0.05)}$	1.61	ns	ns
Interactions			
NPK 20:10:10 x Urea	ns	ns	ns
NPK 20:10:10 x Variety	*	ns	ns
Urea x Variety	ns	*	ns
NPK 20:10:10 x Urea x Variety	ns	*	ns

Means followed by the same letter(s) within a sampling period are statistically not significant at 0.05 level of probability using N-DMRT, ns = not significant at 5% level of test, * = significant at 5% level of test

Table 12a. Interactions of two maize varieties and NPK 20:10:10 fertilizer application rates on mean spikes/tassel in Anyigba, during 2021 rainy season

Variety	NPK 20:10:10		
	0	60	120
Oba-super-6 (Hybrid)	16.99^{a}	16.87^{a}	16.56^{ab}
Samaz-52 (OPV)	15.85^{ab}	15.73^{ab}	15.42^{b}
	LSD = 1.30		

Means followed by the same letter(s) within a sampling period are not significantly different at 5% level of probability using N-DMRT

Table 12b. Interactions of two maize varieties and Nitrogen fertilizer application levels on grain weight produced per cob in Anyigba, during 2021 rainy season

Variety	Urea [N - levels (kgha^{-1})]		
	0	60	120
Oba-super-6 (Hybrid)	78.21^{b}	82.49^{ab}	90.03^{ab}
Samaz-52 (OPV)	79.93^{b}	84.22^{ab}	91.75^{a}
	LSD = 10.50		

Means followed by the same letter(s) within a sampling period are not significantly different at 5% level of probability using N-DMRT

Table 12c. Interactions of NPK, Nitrogen fertilizer and varieties of maize on grain weight (g) produced per cob in Anyigba, during 2021 rainy season

	Oba-super-6 (Hybrid)			Samaz-52 (OPV)		
NPK 20:10:10 (kgha^{-1})	N_0 (0 kgha^{-1})	N_1(60 kgha^{-1})	N_2(120 kgha^{-1})	N_0(0 kgha^{-1})	N_1(60 kgha^{-1})	N_2(120 kgha^{-1})
0	78.25^{b}	81.11^{b}	86.13^{ab}	79.40^{b}	82.26^{b}	87.28^{ab}
60	78.50^{b}	81.35^{b}	86.38^{ab}	79.65^{b}	82.50^{b}	87.53^{ab}
120	84.09^{ab}	86.95^{ab}	91.97^{ab}	85.24^{ab}	88.10^{ab}	93.12^{a}
	LSD = 10.41					

Means followed by the same letter(s) within a sampling period are not significantly different at 5% level of probability using N-DMRT

different for 60kg N/ha (82.28g), control plots had the least grain weight/cob (73.71g). Variety was only significant for spikes/tassel as Oba-super-6 (Hybrid) had the highest number of spikes/tassel as compared with its counterpart (Table 11).

Application of 120kg NPK 20:10:10 produced the highest threshing % (78.61%), number of grains/cob (355.85) and 100-seed weight (28.73) and final grain weight/ha (4,196.30kg) respectively, followed by 60kg NPK 20:10:10. Although, control plots consistently produced the least results

Table 13. Influence of NPK 20:10:10 and Urea fertilizer application on some yield component and final grain yield of two maize varieties (*Zea mays L.*) In Anyigba, Kogi State

	Yield Characters			
Treatments	**Threshing Percent (%)**	**No. of Grains Per cob**	**100-Seed Weight**	**Final Grain Weight (kgha^{-1})**
NPK 20:10:10 (kg/ha)				
0	76.61b	297.83b	26.62b	3,240.74b
60	77.44ab	306.50b	26.73b	3,244.42b
120	78.61a	355.85a	28.73a	4,196.30a
F-LSD $_{(0.05)}$	1.30	45.54	2.00	735.10
Urea (N kg/ha)				
0	77.28	297.83bc	25.02b	2,600.00b
60	77.50	312.72ab	27.60a	3,940.74a
120	77.89	350.67a	29.36a	4,140.72a
F-LSD $_{(0.05)}$	ns	45.89	2.00	963.62
Variety (V)				
Oba-super-6 (Hybrid)	76.56b	324.04	27.89	3,649.38
Samaz-52 (OPV)	78.56a	316.07	26.76	3,471.59
F-LSD $_{(0.05)}$	1.30	ns	ns	ns
Interactions				
NPK 20:10:10 x Urea	*	*	ns	*
NPK 20:10:10 x Variety	ns	ns	ns	ns
Urea x Variety	ns	ns	ns	ns
NPK 20:10:10 x Urea x Variety	ns	*	ns	*

*Means followed by the same letter(s) within a sampling period are statistically not significant at 0.05 level of probability using N-DMRT, ns = not significant at 5% level of test, * = significant at 5% level of test*

Interactions of NPK 20:10:10 x Variety was significant for number of spikes/tassel, Urea x Variety was significant for grain weight/cob and NPK 20:10:10 x Urea X Variety was significant for grain weight/cob respectively. Other interaction was insignificant. NPK 20:10:10 x Variety interaction on number of spikes/tassel shows that Oba-super-6 (Hybrid) didn't respond to NPK 20:10:10 and thus had the highest number (16.99) under control plots. This was statistically at par with 60kg NPK 20:10:10 (Table 12a).

For grain weight/per cob, Samaz-52 (OPV) responded better than its counterpart as it had the highest number of grain weight/per cob (91.75g), this was however not significantly different from those obtained with 60kg N/ha. Oba-super-6 (Hybrid) responded in the same manner as the control plots produced the least weight of grains/cob (table 12b). NPK 20:10:10 x Urea x Variety interactions on grain weight/cob revealed that Samaz-52 (OPV) had the highest weight when combined 120kg N/ha and 120kg NPK 20:10:10 was applied. This was not significantly different from other rates of fertilizers combined. Oba-super-6 (Hybrid) behaved in similar manner (Table 12c). NPK 20:10:10 and Urea fertilizer application had significant influence ($P \leq 0.05$) on threshing %, number of grains/cob, 100-seed weight and final grain weight/ha (final yield) (Table 13).

for these characters, but results obtained from the application of 60kg NPK 20:10:10 were not significantly different from those of the control plots (Table 13).

Table 14a. Interactions of NPK and Nitrogen fertilizer applications levels on the threshing % of maize crop in Anyigba, during 2021 rainy season

Urea [N - levels (kgha^{-1})]	**NPK 20:10:10 (kgha^{-1})**		
	0	**60**	**120**
0	76.95^{b}	77.36^{ab}	77.95^{ab}
60	77.06^{b}	77.47^{ab}	78.06^{ab}
120	77.25^{b}	77.67^{ab}	78.25^{a}
C.V	**7.02%**		

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT.

Similarly, application of 120kg N/ha produced higher number of grains/cob (350.67), 100-seed weight (29.36g) and final grain yield (4,140.72kg/ha) respectively. However, these results were not significantly different from those obtained with 60kg N/ha Urea application. Control plots consistently produced the least results for these characters. N-levels did not influence significantly ($P \geq 0.05$), threshing %. However, significantly influenced threshing % as Samaz-52 (OPV) recorded higher threshing percentage (78.56%) than its counterpart. Variety did not significantly influence other growth characters (grains/cob, 100 – seed weight and final yield) respectively.

Table 14b. Interactions of NPK and Nitrogen fertilizer applications levels on number of grains per cob in Anyigba, during 2021 rainy season

Urea [N - levels (kgha^{-1})]	NPK 20:10:10 (kgha^{-1})		
	0	60	120
0	297.83^{b}	302.17^{b}	326.84^{ab}
60	305.28^{ab}	309.61^{ab}	334.29^{a}
120	324.25^{ab}	328.59^{ab}	353.26^{a}
C.V	**20.58%**		

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT.

Table 14c. Interactions of NPK and Nitrogen fertilizer applications levels on final grain weight in Anyigba, during 2021 rainy season

Urea [N - levels (kgha^{-1})]	NPK 20:10:10 (kgha^{-1})		
	0	60	120
0	2920.37^{b}	2922.21^{b}	2098.13^{ab}
60	3593.74^{ab}	3595.58^{ab}	4071.52^{ab}
120	3690.73^{ab}	3692.57^{ab}	4168.51^{a}
C.V	**39.33%**		

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT

different from those of 60kg N/ha at 60kg NPK 20:10:10 (77.47%), 120kg NPK 20:10:10 (78.06%), 0kg N/ha at 60kg NPK 20:10:10 (77.36%), 120kg NPK 20:10:10 (77.95%) respectively. However, control plots consistently produced the lowest threshing percentage at all fertilizer level (Table 14a). Similarly, Interaction of NPK 20:10:10 x Urea on number of grains/cob (Table 14b) revealed that application of 120kg N/ha at 120kg NPK 20:10:10 produced the highest grains/cob (353.26), this was not significantly different from those obtained with 60kg N/ha at 120kg NPK 20:10:10 (334.29). grains/cob obtained at other application rates of both Urea and NPK 20:10:10 were statistically at par. However, control plots produced the lowest grains/cob at these rates.. As observed in table 13a, NPK 20:10:10 x Urea interaction on final grain weight (yield) took the same pattern of behavior (Table 14c). the interaction of NPK 20:10:10 x Urea X Variety on number of grains per cob revealed that combined application of 120kg NPK 20:10:10 (basal) and 120kg N/ha Urea (top dress) produced the highest number of grains/cob (343.52) for Oba-super-6 (Hybrid) variety. This was however, higher than other rates combined but not significantly different. Samaz-52 (OPV) similarly behaved in the same manner, as control plots produced the minimum grains/cob for both varieties examined (Table 14d). This result is also similar to that obtained with the final grain yield as combined application of 120kg NPK 20:10:10 (basal) and 120kg N/ha

Table 14d. Interactions of NPK, Nitrogen fertilizer and varieties of maize on number of grains per cob in Anyigba, during 2021 rainy season

NPK 20:10:10 (kgha^{-1})	Oba-super-6 (Hybrid)			Samaz-52 (OPV)		
	N_0 (0 kgha^{-1})	N_1(60 kgha^{-1})	N_2(120 kgha^{-1})	N_0(0 kgha^{-1})	N_1(60 kgha^{-1})	N_2(120 kgha^{-1})
0	306.57^{c}	309.46^{c}	325.91^{abc}	303.91^{c}	306.80^{c}	323.25^{abc}
60	311.53^{c}	314.42^{bc}	330.87^{ab}	308.87^{c}	311.76^{c}	328.21^{abc}
120	324.18^{abc}	327.07^{abc}	343.52^{a}	321.50^{abc}	324.41^{abc}	340.86^{ab}
C.V(%)	**17.70**					

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT

Table 14e. Interactions of NPK, Nitrogen fertilizer and varieties of maize on final grain weight in Anyigba, during 2021 rainy season

NPK 20:10:10 (kgha^{-1})	Oba-super-6 (Hybrid)			Samaz-52 (OPV)		
	N_0 (0 kgha^{-1})	N_1(60 kgha^{-1})	N_2(120 kgha^{-1})	N_0(0 kgha^{-1})	N_1(60 kgha^{-1})	N_2(120 kgha^{-1})
0	3163.37^{b}	3164.60^{b}	3481.89^{ab}	3104.11^{b}	3105.34^{b}	3422.63^{b}
60	3610.29^{ab}	3611.53^{ab}	3928.81^{ab}	3551.02^{ab}	3552.25^{ab}	3869.54^{ab}
120	3676.95^{ab}	3678.17^{ab}	3995.47^{a}	3617.68^{ab}	3618.91^{ab}	3936.20^{ab}
C.V(%)	**39.63**					

Means followed by the same letter(s) are not significantly different at 5% level of test using N-DMRT

Interaction of NPK 20:10:10 x Urea were significant only for threshing %, grains/cob and final grain weight/ha. Similarly, NPK 20:10:10 x Urea X Variety interaction was significant for number of grains/cob and final grain yield. There interactions are presented in Tables 14a – e. Interaction of NPK 20:10:10 x Urea on threshing % shows that application of 120kg of NPK 20:10:10 at 120kg N/ha of Urea produced the highest threshing percentage (78.25%) followed by 120kg N/ha at 60kg NPK 20:10:10 (77.67%) which was not significantly

Urea (top dress) produced the highest yield (3995.47 and 3936.20kg/ha) for both varieties [Oba-super-6 (Hybrid) and Samaz-52 (OPV)] respectively. Other fertilizer rates at different levels of application were found to produce closely related yield in all capacity for both varieties. However, control plots consistently produced the lowest yield at different combination levels (Table 14e). Improved yield characters resulting from fertilizer use corroborates with Ahmadu (2014) who reported that 90 kg N/ha significantly

improved length of cobs, grains/cob, cob diameter, and yield ha^{-1}. Yield increase as influenced by nitrogen is as a result of the fact that nitrogen plays a significant role in the manufacture of protein; it also influences production of grains and grain protein content significantly. (Gallais & Hirel, 2014). Grain yield of 2.43 and 2.96 tons/ha has been reported by Agba & Long (2005) in corn. Wajid et al. (2007) reported increases in the following parameters: plant height, 1000-grain weight, grain yield and harvest index on evaluation of three maize cultivars under three nitrogen levels. Increased grain yield and yield characters also correlates with Namakka (2002) and Ayub et al. *(*2002) who also reported increase in dry matter production, cob length and number of ear, grain weight per cob, number grains per cob, 1000-grain weight, grain yield and harvest index with increased N-fertilizer use. Non-significant effect of variety on grain yield has been reported by Mani et al. (2002) who observed a non-significant increase in heights of plants and yield (ha^{-1}) of grains between cultivars. An interaction of fertilizer and variety on yield characters conforms to the work of Ahmadu (2014).

CONCLUSION

Results obtained shows that NPK 20:10:10 fertilizers and Urea (N) application increased growth parameter such as; plant height, days to 1st and 50%, variety also influence some characters as Oba-super-6 consistently produced taller plants, thicker stems, higher leaf area, more spike/tassels than OPV. Application of NPK 20:10:10 fertilizer at 120kg/ha also significantly influence yield and some yield components such as cob length (13.84cm), threshing % (78.61) and final grain yield (4196.30kg/ha), number of grains/cob (355.85) respectively than at the application of 60kg/ha and 0kg/ha. Application of 120kg N/ha significantly influenced 100-seed weight (29.36). Oba-super-6 (hybrid) however, out yielded OPV in yield and its components. NPK x N Interaction studied shows that basal application of 120kg NPK 20:10:10 at 60kg N/ha Urea top dress suffices for most growth and yield characters. Similarly, N x V interaction shows that Oba-super-6 (hybrid) responded better than its counterpart samaz-52 (OPV) for most growth and yield characters at 60kg N/ha further application up to 120kg N/ha contribute insignificant yield differences and will trigger luxury consumption and possible leaching of N. For NPK 20:10:10 x V interaction, 120kg/ha is optimum for high yield. However, yield differences between 60kg and 120kg NPK 20:10:10 was found to be infinitesimal in some characters. For NPK 20:10:10 x N x V interaction on yield and yield characters, possible fertilizer combinations were almost statistically at par for both hybrid and the OP varieties. However, application of 120kg NPK 20:10:10 at 120 kg N/ha gave the best result for both varieties numerically. For final grain yield, this study recommends Oba-super-6 (Hybrid) variety at 120kg NPK 20:10:10 (basal application) and 60kg N/ha (top dress) for maize farmers. However, for farmers who prefer OPV to hybrid, application of 120kg NPK 20:10:10 at 120 kg N/ha will suffice for optimum yield.

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AUTHOR CONTRIBUTIONS

Musa U. T conceived the idea and developed the work all through to execution. Yusuf M. assisted in the field layout, data collection and analysis. He equally wrote the manuscript and final work was proofread by Musa U. T.

COMPETING INTERESTS

The authors have declared that no conflict of interest exists.

ETHICS APPROVAL

Not applicable

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