



PERFORMANCE OF OKRA VARIETIES (*Abelmoschus esculentus* L. Moench) AS
INFLUENCED BY INORGANIC FERTILIZER (NPK) IN BAUCHI, NIGERIA

Esmond, E., *Fagam, A. S., Amba, A. A. and Jibrin, M. S.

Department Crop production, Faculty of Agriculture and Agricultural Technology,
Abubakar Tafawa Balewa University (ATBU), PMB 0248, Bauchi, Nigeria

*Corresponding Author Email: safagam1@gmail.com

GSM: +2348032979469

ABSTRACT

The field experiment was conducted to evaluate the effect of NPK fertilizer on the growth and yield of okra varieties at the research Farm of Abubakar Tafawa Balewa University, Bauchi, Gubi Campus, Nigeria during the 2017 and 2018 rainy seasons. The four NPK rates (Control (0), 75, 150 and 225kg/ha) and three varieties (Clemson spineless, Lima F1 and Yar-Kodon) which were factorially combined and laid down in a randomized complete block design (RCBD) with three replications. The result of the experiment revealed significant difference ($P \leq 0.05$) in all the measured parameters. NPK fertilizer application from 0kg/ha to 225kg/ha significantly led to increase in all the parameters measured. The result also showed that the use of NPK fertilizer at the rate of 150kg/ha and 225kg/ha had the weightiest pod weight (2322.70kg and 2265kg and 2630.00kg and 2634.70kg) in 2017 and 2018 season respectively. The variety Clemson spineless and Lima F1 significantly performed better on many of the measured parameters in 2017, except plant height, Number of leaves, and leaf area in 2018. The interaction between variety and NPK fertilizer was however not significant. Stem girth had positive and highly significant correlation with number of leaves (0.6784**), leaf area (0.7531**), fruit weight (0.3986*) and pod girth (0.8939**). Number of leaves also had highly significant and positive correlation with leaf area (0.7399**), fruit weight (0.4546**) and pod girth (0.4959**). Pod weight had highly significant and positive correlation with pod length ($r = 0.6507^{**}$) and Number of pods ($r = 0.8929^{**}$). It could be concluded that the use of improved variety Lima F1 and Clemson spineless and NPK fertilizer at the rate of 150kg/ha can be adopted for okra production in study area.

Keywords: Fertilizer, Growth, Okra, Variety and Yield

INTRODUCTION

Okra (*Abelmoschus esculentus* L.) is an annual crop belonging to the family *malvaceae*. It is an important vegetable especially in West Africa, India, Brazil and the United State (Alimi; 2004). It originated from Ethiopia in Africa, but now grown all over the world (Khalid *et al.*, 2005). It is known as Kubewa, Okwuro and Ila in Hausa, Igbo and Yoruba languages of Nigeria respectively. It is vigorous half-woody herbaceous, semi-fibrous, warm season annual plant (Maurya *et al.*, 2013). There are numerous types which differ in fruiting time and shape, colour of leaves and stem length (Osawaru *et al.*, 2011) the most cultivated varieties are *Abelmoschus Caillei* (*A. chev*) and *Abelmoschus esculentus* (L) Moenh. The global okra production is estimated to be around 9.96 million tons, India leading with 6.18 million tons followed by Nigeria with 1.82 million tons (FAOSTAT, 2020). In Nigeria, Okra is widely grown as vegetable for its tender fruits and young leaves covering 1.5 million hectares of land annually (Oyelade *et al.*, 2003). The scarcity of improved okra varieties with important desirable end-user traits also contributes to the yield decline (Kumar *et al.*, 2010).

The limiting factors to okra production in Nigeria among others include sub-optimal planting density, weed management, tillage practices and low yielding varieties (Adeyemi *et al.*, 2008). The inherently poor soil fertility of the tropics, characterized by low activity clay, organic matter,

nitrogen, phosphorus and exchangeable bases (Akintomide and Osundare, 2015). Fertilizer application among the various agronomic practices also influenced the growth and green pod yield in okra. Use of improved cultivar is critical to increased productivity of okra, but most farmers used local varieties with low productivity as compared to improved once. Therefore, identifying suitable variety and fertilizer rate for agro-ecological location is critical to improvement in okra productivity. The specific objectives were:

- i. To determine the effect of NPK fertilizer on the growth and yield of Okra.
- ii. To access the performance of Okra Varieties.

MATERIALS AND METHODS

Field experiment was carried out at the research Farm of Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, Bauchi, during the 2017 and 2018 rainy seasons. Bauchi is located in 11° 17' North and longitude 9° 47' East and 903 m above sea level. Three varieties (Clemson spineless, Lima F1 and Yar-kodom) and four NPK (20:10:10) levels (0, 75, 150 and 225 Kg/ha) were used, the field experiment was laid out in a Randomized Complete Block Design (RCBD) with tree replications. The plot size was 7.35m². Each plot had 5 ridges, with intra-row spacing 30 cm. The inter row spacing of 70 cm was used. All other agronomic practices were carried out accordingly. Five plants were randomly sampled from each plot, tagged for data collection on growth and yield at two weeks' interval, starting from two weeks after sowing. The following parameters were measured; Plant height, Number of leaves per plant, Leaf Area, Number of fruits per plant, Fruit length, Fruit girth, Fresh fruit weight per plot and Fruit yield (kg ha⁻¹). The data collected was subjected to analysis of variance. The means were, separated using Duncan Multiple Range Test (Duncan, 1955). Correlation analysis was also carried out to find the magnitude and nature of association between the growth and yield parameters (Little and Hills, 1978).

Table1. Physical and chemical properties of the experimental site

Soil parameter	Soil test value
pH	5.4
Total N (g/kg)	0.13
Organic carbon (g/kg)	12.86
Available phosphorus (mg/kg)	7.45
Particle size distribution (g/kg) Sand	46.4
Clay	35.2
Silt	35.4
Textural class	Clay loam

RESULTS AND DISCUSSIONS

Effect of NPK fertilizer and variety on plant height (cm) of okra grown during 2017 and 2018 rainy seasons

The effect of variety and NPK fertilizer had Significant difference ($P < 0.05$) differences on the measured parameters. Table 2 shows the effect of the treatments on plant height and number of leaves. The variety Clemson spinless and Lima had taller plants as compared to Yar-Kodom in 2017. However, in 2018 Yar-Kodom had taller plants as compared to the other two varieties. On the effect of NPK fertilizer on plant height showed that application of NPK from 75kg/ha - 225kg/ha. Significantly increased the plant height as compared to the control. The effect of variety

on Stem girth showed that variety Clemson spineless had wider stem girth as compared to Lima F1 and Yar-Kodom. The application of NPK fertilizer revealed and increase in stem girth with increased rate of NPK. The observed difference in the variety could be attributed to their difference in genetic makeup. While the difference in NPK fertilizer rate could be due to the increased in amount of nutrient available to the plant with increased application rate. The result obtained lend support from the work of Mubarak (2014) who reported that growth parameters such as plant height, and number of branches are enhanced by genetic factor. The increase in the rate of NPK fertilizer led to an increase in growth parameters of Okra (Babatola *et al.*, 2002; Kolawole *et al.*, 2008). The performance of crop depends on the interplay of its genetic constitution, the environment under which it is grown and the management practices adopted in the culture.

Effect of NPK fertilizer and variety on Number of leaves and Leaf area (cm²) of okra grown during 2017 and 2018 rainy seasons

Table 3 Shows the effects of the treatments on Number of leaves and Leaf area (cm²). Clemson spinless significantly had a greater number of leaves and larger leaf area as compared to Lima F1 and Yar-kodom in 2017 and 2018 season. Increased rate of fertilizer significantly also increased the number of leaves and leaf area respectively. However, the interaction of variety and NPK fertilizer was not significant. The significant difference in number of leaves across the okra varieties might be due to variation in genetic NPK composition of the varieties in addition to their response to the prevailing environmental conditions, as reported by Iorlamen *et al.* (2015). The result obtained could be due to high nitrogen content which induced higher plant height, more leaves and larger leaf area. This agrees with the findings of Babatola *et al.* (2002); Kolawole *et al.* (2008) who reported that increasing the rate of NPK fertilizer led to increase in growth parameters of okra.

Effect of NPK fertilizer and variety on Number of pods of okra grown during 2017 and 2018 rainy seasons

Table 3 Shows that Clemson spineless and Lima 1 varieties had longer pod length in 2017 and 2018 respectively as compared to the variety Yar-kodom with. The effect of NPK fertilizer showed that high rate of 225kg/ha had longer pod of 19.55cm and 19.67cm in both years. No significant interaction was observed between the factors. The effect of variety on pod girth, showed that Clemson spineless in both years had the widest pod girth of 4.15cm and 2.17cm respectively. The effect of NPK fertilizer however, indicated significant difference only in 2017 season. Where NPK fertilizer at the rate of 225kg/ha had the widest pod girth, while the control, 75kg/ha and 150kg/ha were all statistically the same and lower than, 225kg/ha. The interaction was found to be not significant.

Clemson spinless and Lima F1 statistically produced the weightiest fruits in both years. The effect of inorganic fertilizer showed that application of fertilizer at the rate of 150kg/ha and 225kg/ha significantly had more pod weight that were statistically higher than the control and 75kg/ha. In both 2017 and 2018. No significant interaction was observed between the factors. The result here lend support from the work of Dash *et al.* (2008), that significant difference was observed among the varieties due to fertilizer application. NPK fertilizer have been reported to cause a significant effect on fruit weight, fruit number and yield ok okra (Jan *et al.*, 2002). Similarly, Gudugi (2013) reported that application of NPK fertilizer at higher rate result in Okra with taller pod. NPK fertilizer have been reported to cause a significant effect on fruit weight, fruit number and yield of okra (Jan *et al.*, 2002). This proved that application of NPK fertilizer is so vital for enhanced crop development and yield.



Relationship between growth and yield components of okra combined across 2017 and 2018 rainy seasons

Table 5 present significant correlation matrix between growth and yield parameters combined across years (2017 and 2018). Plant height showed positive and highly significant correlation with all the parameters measured except number of pods. Stem girth had positive and highly significant correlation with number of leaves (0.6784^{**}), leaf area (0.7531^{**}), fruit weight (0.3986^{*}) and pod girth (0.8939^{**}). Number of leaves also had highly significant and positive correlation with leaf area (0.7399^{**}), fruit weight (0.4546^{**}) and pod girth (0.4959^{**}). Pod weight had highly significant and positive correlation with pod length ($r = 0.6507^{**}$) and Number of pods ($r = 0.8929^{**}$). Mubarak (2014) reported that the positive and significant correlations observed between fruit yield (kg ha^{-1}) and growth attributes such as plant height, number of leaves per plant, number of primary branches per plant, and yield characters such as number of fruits per plant, fruit length as well as fruit weight revealed theses as important to yield and critical determinants of fruit yield (kg ha^{-1}). It was observed that significant increase in each of these parameters leads to an increased in the total okra fruit yield (kg ha^{-1}).

Table 2: Effect of NPK fertilizer and variety on plant height (cm) of okra grown during 2017 and 2018 rainy seasons at Bauchi

Treatment	Plant height (cm)						Stem girth (cm)					
	2017			2018			2017			2018		
Variety (V)	2WAS	4WAS	6WAS	2WAS	4WAS	6WAS	2WAS	4WAS	6WAS	2WAS	4WAS	6WAS
Clemson spinless	21.91a	37.07a	59.14a	17.94b	34.78	45.13b	2.08a	4.12a	4.54	2.16	4.28a	4.64
Lima F1	20.42b	33.38b	56.27a	20.83b	34.33	56.67a	1.95b	2.93b	4.34	1.98	3.11b	4.45
Yar Kodom	19.60b	34.47b	45.10b	21.78a	35.34	56.91a	1.89b	2.85b	4.11	1.95	2.93b	4.26
LS	*	*	*	*	NS	*	*	*	NS	NS	*	NS
SE (±)	0.95	1.14	2.44	1.59	1.95	3.91	0.13	0.47	0.30	0.15	0.50	0.30
NPK Fertilizer (kg/ha) (F)												
0	17.70b	34.16	45.13b	17.94b	34.78	45.13b	1.65b	2.89	3.53b	1.69b	3.07b	3.69b
75	20.66b	34.18	56.38a	20.83b	34.33	56.67a	1.98ab	2.86	4.4ab	2.02ab	2.99b	4.48ab
150	21.73a	35.06	56.95a	21.78a	35.34	56.91a	2.19a	2.96	4.71a	2.92a	3.07b	4.81a
225	22.48a	36.50	55.54a	22.66a	36.88	55.80a	2.06a	4.52	4.68a	2.12ab	4.63a	4.83a
LS	*	NS	*	*	NS	*	*	NS	**	**	*	*
SE (±)	1.85	2.28	4.71	1.84	2.29	4.73	0.14	0.53	0.30	0.16	0.56	0.31
CV	28.19	19.07	24.03	28.18	18.87	24.15	22.06	22.66	69.71	21.05	71.66	22.14
Interaction												
V*F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

SE = Standard error, LS = Least significant difference, WAS = Weeks after sowing, NS = Not significant, * = Significant at 5 %, ** = Significant at 1 %, Means with the same alphabet are not significantly different from each other within column, CV = Coefficient of variance.

Table 3: Effect of NPK fertilizer and variety on Number of leaves and Leaf area (cm²) of okra grown during 2017 and 2018 rainy seasons in Bauchi

Treatment	Number of leaves						Leaf area (cm ²)					
	2017			2018			2017			2018		
Variety (V)	2WAS	4WAS	6WAS	2WAS	4WAS	6WAS	2WAS	4WAS	6WAS	2WAS	4WAS	6WAS
Clemson spinless	8.00a	10.00a	14.00	7.00b	10.00a	15.00b	121.24	252.16a	399.24	66.31b	208.23	255.26b
Lima F1	7.00b	9.00b	14.00	8.00a	9.00b	12.00b	93.99	191.92b	349.30	106.15a	214.04	371.32a
Yar Kodom	7.00b	9.00b	16.00	8.00a	9.00b	16.00a	85.16	201.43b	326.28	104.98a	199.79	426.69a
LS	*	*	NS	*	*	*	NS	*	NS	*	NS	*
SE (±)	0.29	0.42	1.66	0.30	0.43	1.72	19.91	16.90	46.32	17.04	19.93	46.28
NPK Fertilizer (kg/ha) (F)												
0	7.00b	9.00	11.00b	7.00b	9.00	15.00b	205.23	65.59b	254.27b	66.31b	208.23	255.26b
75	8.00a	9.00	15.00a	8.00a	9.00	12.00b	213.05	104.57ab	369.21ab	106.15a	214.04	371.32a
150	8.00a	10.00	16.00a	8.00a	10.00	16.00a	197.97	104.42ab	425.01a	104.98b	199.79	426.69a
225	8.00a	10.00	17.00a	8.00a	10.00	17.00a	244.43	125.94a	384.62ab	126.58a	245.23	386.60a
LS	*	NS	*	*	NS	*	NS	*	*	*	NS	*
SE (±)	0.32	0.51	1.80	0.33	0.53	1.85	24.74	19.63	50.58	19.75	24.88	50.52
CV	12.43	14.88	33.09	12.80	14.99	33.94	32.76	63.60	42.83	63.42	32.74	42.54
Interaction												
V*F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

SE = Standard error, LS = Least significant difference, WAS = Weeks after sowing, NS = Not significant, * = Significant at 5 %, ** = Significant at 1 %, Means with the same alphabet are not significantly different from each other within column, CV = Coefficient of variance.

Table 4: Effect of NPK fertilizer and variety on Number of pods of okra grown during 2017 and 2018 rainy seasons in Bauchi

Treatment	Number of pods		Pod length (cm)		Fruit girth (cm)		Pod weight (kg/ha)	
	2017	2018	2017	2018	2017	2018	2017	2018
Variety (V)								
Clemson spinless	114.00b	116.00b	19.45a	4.15a	4.15a	2.17a	1953.1ab	1960.7ab
Lima F1	184.00a	186.00a	19.726a	3.84b	3.84b	1.82b	2717.6a	2675.10a
Yar Kodom	117.00b	118.00b	15.42b	3.99b	3.99b	2.03b	1727.2b	1730.30b
LS	**	*	**	**	**	*	**	*
SE (\pm)	14.2	14.43	0.95	0.12	0.12	0.16	270.17	271.64
NPK Fertilizer (kg/ha) (F)								
0	109.22b	110.09b	16.45b	3.85b	3.85b	1.83	1558.30b	1562.40b
75	155.11a	156.59a	18.73b	3.95b	3.95b	2.14	2019.60b	2025.40b
150	138.33b	140.52b	18.05b	3.94b	3.94b	1.9	2322.70a	2265.60a
225	150.22a	151.49a	19.55a	4.23a	4.23a	2.15	2630.00a	2634.70a
LS	*		*	*	*	NS		*
SE (\pm)	19.05	19.35	1.27	0.13	0.13	0.18	324.55	324.48
CV	35.62	36.02	15.76	27.67	27.67	31.39	43.4	44.77
Interaction								
V*F	NS	NS	NS	NS	NS	NS	NS	NS

SE = Standard error, LS = Least significant difference, WAS = Weeks after sowing, NS = Not significant, * = Significant at 5 %, ** = Significant at 1 %, Means with the same alphabet are not significantly different from each other within column, CV = Coefficient of variance.

Table 5: Correlation coefficient matrix between growth and yield components of okra combined across 2017 and 2018 rainy seasons

	Plant height(cm)	Stem girth(cm)	Number of leaves	Leaf area (cm ²)	Fruit weight (kg/ha)	Pod girth (cm)	Pod length (cm)	Number of pods
Plant height(cm)	1.0000	0.7600**	0.5796**	0.8353**	0.5249**	0.5325**	0.5663**	0.2620NS
Stem girth(cm)		1.0000	0.6784**	0.7531**	0.3986*	0.8939**	0.2959NS	0.0730
Number of leaves			1.0000	0.7399**	0.4546**	0.4959**	0.2943NS	0.2187NS
Leaf area (cm ²)				1.0000	0.5102**	0.5708**	0.5427**	0.2360NS
Fruit weight (kg/ha)					1.0000	0.2693NS	0.6507**	0.8929**
Pod girth (cm)						1.0000	0.1182NS	-0.0281NS
Pod length (cm)							1.0000	0.5456**
Number of pods								1.0000



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