Influence of Nitrogen, Phosphorus and Cow Dung Manure on the Yield and Yield Components of Two Okra Varieties in Anyigba, Kogi State

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Abstract
A field experiment was conducted at Kogi State University Research and student demonstration farm Anyigba during the 2015 raining season to determine the influence of Nitrogen, Phosphorus and Cow dung manure on the yield and yield components of okra varieties. The treatment consisted of two okra varieties (Velvet 35 and Lima F1), four levels each of Nitrogen (0, 55kilogram/hectare, 110 kilogram/hectare, 220 kilogram/hectare), Phosphorus (0, 125 kilogram/hectare, 250 kilogram/hectare and 500 kilogram/hectare) and Cow dung (0, 6.25tonnes/hectare, 12.5tonnes/hectare, and 25tonnes/hectare), which were replicated three times and laid out in randomized complete block design (RCBD). Urea and Single Super Phosphate were used as the source of Nitrogen and Phosphorus respectively. Data were obtained for growth and yield parameters, three plants were randomly selected and tagged per plot for data collection. Results shows that stem girth, number of leaves, branches, fruits, leaf area, fruit length, and fruit yield etc. were significantly influenced for the okra varieties as Lima F1 out-yielded velvet 35. There was a significant interaction of fertilizer and variety on yield characters such as fruit length and yield etc.
Keywords: Cow dung, growth, interaction, nitrogen, okra seeds, phosphorus, soil analysis, yield.

INTRODUCTION

Okra, *(Abelmoschus esculentus)* is an important vegetable crop grown in most parts of Nigeria and in other tropical and sub-tropical countries. Okra production quantity worldwide is estimated at 8.7 million tonnes per year with an estimated 1-2 million hectares of land used for its cultivation in Nigeria, constituting 4.6 % of the total staple food production from 1970 to 2003 [5]. It is a member of the Malvaceae family that is usually grown in Nigeria for its mucilaginous content.

The nutritional composition of okra includes calcium, protein, oil, carbohydrates, iron, magnesium and phosphorus etc [25].Okra pods contain approximately 86.1% water, 9.7% carbohydrate, 2.2% protein, 0.2% fats, 1.0% fibre, 0.8% ash [26].Its every pod 100g green pod contains among others, protein 2.0g, carbohydrate 7.45g, fibre 3.1g, vitamin C 23mg and calcium 82mg.

Okra is tolerant to a wide range of climatic condition, in Nigeria its cultivation area spread right from south to the far north. Okra seed can be dried and the dried seeds are a nutritious material that can be used to prepare vegetative curds, or roasted and ground to be used as coffee additive or substitute while in southwestern Nigeria it is taken as peri urban crops for it is grown both as rain fed and dry season fruit vegetable crop to supply the teeming urban population. The importance of okra as a vegetable crop lies in its "drawing quality" that aids the easy consumption of bulky staple foods like Garri, Fufu and pounded yam [1], it is also used to compliment such staple foods since it is a good source of vitamin, minerals, and protein [10], okra fruits contain vitamin A and C with traces of vitamin B.

The importance of okra in our diet cannot be over-emphasized; as they help to neutralize the acid substance produced in the course of digestion of meat and other foods and as reported by Fatokun [9] the consumption of these edible parts helps to promote digestion and prevent constipation and other gastronomic disorders, they are also good source of calcium, phosphorus, iron and iodine with significant amount of riboflavin and according to [27] okra is good for people that suffer from renal colic, leucorrhoea, and general weakness.

They are also used as a medicine for the treatment of peptic ulcer as well as the production of margarine; it is used in curries and chutneys and as a substitute for coffee in India. Okra is a fruit vegetable, grown mainly for the pods, the tender fruits are used as vegetables either boiled or sliced and fried. Ripe seeds contain 20% of edible oil which thrives well in moist, friable, well drained and well matured soils but are unable to thrive well in continuous dry spell. Okra seed cake is rich in protein and makes an invaluable animal feed. The fruit contains mucilage which gives a slippery texture on cooking which can be served as a thickener and also used in gum production. The mucilaginous extract from okra is reportedly useful in curing ulcers as well as for the relief of hemorrhoids and also as a cleansing agent in sugar processing.

Other medicinal uses of okra are the role of pod mucilage in blood plasma replacement or as blood volume expander [31]. Due to its high iodine contents, the fruit is considered useful to control goiter. The roots and stem of okra are used for clearing the cane juice from which gur or brown sugar is prepared [6]. With test conducted in China suggesting alcohol extract of okra leaves can eliminate oxygen free radicals, Okra has huge potential in the enhancement of livelihoods, alleviating of renal tubular-interstitial diseases, reduces proteinuria and improve renal function stakeholders in both rural and urban areas (NAP, [18]) with the immature fruits been used in the treatment of venerable diseases [23]. According to Schippers [30] it can be found in almost every market all over Africa. Okra is multi-seasonal crop which can grow almost all year round hence can play a vital role in ameliorating the lower availability of vegetable to a certain extent.

Decline in soil nutrient is one of the major constraints of crop production in Nigeria hence the advocacy on the combined use of inorganic and organic fertilizers in order to ameliorate low inherent fertility of soils in the tropics since the slow release of organic fertilizers can complement the quick speed at which inorganic fertilizer are been release into the soil. As a result of the low-input system commonly adopted for okra production, green pod yields in most instances have been relatively modest.

However the combination of organic and inorganic fertilizer is a sound/better soil fertility management strategy that is currently been used in some countries as apart from enhancing crop yields, the strategy has a greater beneficial residual effect that can be derived from use of either organic or inorganic fertilizers applied alone. Makinde et al [14].reported that maize *(Zea mays L.)* yields obtained from application of combination of synthetic fertilizer and manure improved yield over that from manure alone. Akande et al. [2] reported that combined use of ground rock phosphate applied together with poultry manure significantly improved growth and yield of okra *(Abelmoschus esculentus L Moench)* compared to application of each material separately.

1.2. OBJECTIVEOFSTUDY

The objective of this study therefore is to find the effect of:

[I] Nitrogen, Phosphorus and Cow dung manures on the yield and yield component of two varieties of okra.

[II] Nitrogen Phosphorus and Cow dung manures on the growth characteristics of two varieties of okra in Anyigba.

[III] Interaction of Nitrogen Phosphorus and Cow dung manure on the growth, yield and yield components of two okra varieties in Anyigba.

3.0 Materials and method

3.2. ExperimentalDesignandtreatments

The land was thoroughly ploughed using conventional tillage implements this was done so as to ensure good tilth, with organic materials been broadcast to the land before final cultivation.The treatments were arranged in a 2x4 factorial experiment and laid out in a randomized complete block design (RCBD) with three replications. The varieties of okra are:

Lima F1,Velvet 35.The fertilizers are: Nitrogen, Phosphorus, Cow dung manure

Sowing: Okra was propagated by seeds which were sown directly into the field at a recommended spacing of 30 cm apart and at a depth of 2 cm. The seeds were soaked overnight before sowing so that living seeds are separated from the dead seeds, three seeds were sown which were later thinned to two seeds at two weeks of emergence.Manure and fertilizer application: Cattle manure was applied during sowing and Single super phosphate was applied at side placement with Urea applied in split doses first at three weeks after sowing and second at flowering. The urea fertilizer was applied 5cm away from every plant. The spot method of application was adopted.The field was weeded three and eight weeks after sowing using hand hoe. For the control of beetles and some leaf hoppers, a mixture of cypermethrin + perfekthion at the rate of 1litre + 0.5 litre/ha respectively was applied. Harvesting was done at about 3-4 months for the various varieties when 70-80% of the okra fruit hairs were soft.

3.3. Data collection: For data collection, three randomly selected plants were tagged for measurements.
1. **Germination percentage**: This was calculated as the percentage of the ratio of the plant stand that germinated to the total number of plant stands in a plot.
2. **Plant height at 3, 6 and 9 weeks after sowing**: Plant heights were measured with the aid of a meter rule as the distance from the soil surface to the collar of the top most leaf according to (Farnham, 2001).
3. **Number of leaves at 3, 6 and 9 weeks after sowing**: This was achieved by counting the total number of established leaves on the plants.
4. **Number of Branches at 9 weeks after sowing**:This was achieved by counting the total number of branches on a plant.
5. **Number of days to first flowering**:The number of days to flower initiation.
6. **Number of days to 50% flowering**: This was determined as the number of days it took half of the number of plants in a plot to start flowering.
7. **Stem girth**: This is the measurement of the girth from 5cm above the ground level using a rope.
8. **Leaf area**: This was achieved by measuring the mid/lobe length of the leaf using K coefficient of 0.62.
9. **Number of matured fruits per plant**: This was achieved by counting the total number of fruits on a plant.

10. **Fruit yield**: This was achieved by weighing together the okra fruits that were harvested.

3.4.DataAnalysis

Datacollected were subjected to Analysis of Variance (ANOVA) as recommended by Snedecor and Cochran (1967) and Significant Mean differences were separated using F-least significant difference (F-LSD).

4.1 RESULTS

4.1.1. Stem Girth

Application of Nitrogen, Phosphorus and Cow dung significantly ($P \leq 0.05$) influence the girth size of okra in Anyigba during 2015 rainy season. The biggest girth of 9.8 cm, 16.2 cm and 24.96 cm were obtained when 220 kgN +500 kgP_2O_5 +25 tonnes of Cow dung were applied during 3, 6 and 9 weeks of sampling respectively. The smallest girth of 8.29 cm, 12.8 cm and 15.5 cm were obtained for the 3, 6 and 9 weeks respectively for the control plot (Table 2).

For the three sampling period (3, 6 and 9 weeks) Lima F1 consistently produced bigger stem girth than Velvet 35. Lima F1 produces thick stem girth of 25.56 cm, 43.51 cm and 57.03 cm while Velvet 35 gave 10.80 cm, 17.83 cm and 26.84 cm respectively (Table 2).

Interaction between fertilizer and variety response in relation to stem girth was found not to be significant throughout the period of sampling (Table 2).

4.1.2. Number of Leaves

Application of Nitrogen, Phosphorus and Cow dung significantly ($P \leq 0.05$) influence the number of leaves produced by okra in Anyigba. The highest number of leaves of 37.99, 43.33 were obtained at 6 and 9 weeks respectively when 110 kgN +250 kgP_2O_5 +12.5 tonnes of Cow dung were applied while the least number of leaves of 27.66, 31 and 33.34 were obtained in the control plot during the sampling period.For the three sampling period (3, 6 and 9 weeks) Lima F1 produced the highest number of leaves of 68.67, 88.67 and 94 than Velvet 35 which gave 50.34, 53.65 and 62.01 respectively.Interaction between fertilizer and variety response in relation to leaves produced was found not to be significant throughout the period of sampling (Table 3).

4.1.3. Plant Height

Nitrogen, Phosphorus and Cow dung application was not significant at 3 weeks, however it significantly ($P \leq 0.05$) influence the height of okra at 6 and 9 weeks of sampling. The highest height of 101.16 cm and 212.03 cm were obtained when 110 kgN +250 kgP_2O_5 +12.5 tonnes of Cow dung were applied while the least height of 44.76 cm, 90.60 cm and 157.34 cm were obtained in the control plot during the sampling period.Lima F1 variety was consistently higher in height than Velvet 35 throughout the 3, 6 and 9 weeks. Lima F1 produces highest height of 100.48 cm, 216.46 cm and 531.74 cm while shorter plant of 92.09 cm, 166.23 cm and 207.90 cm were produced by Velvet 35 at 3, 6 and 9 weeks of sampling respectively (Table 4).There was no significant interaction of fertilizer and variety on the plant height produced throughout the sampling period.

4.1.4. Number of Branches and Fruits

Table 4 shows that the number of branches and fruits at 9 WAS were significant ($P \leq 0.05$) when N, P and Cow dung were applied to okra in Anyigba. Application of 55 kgN +125 kgP_2O_5 +6.25 tonnes of Cow dung and 110 kgN +250 kgP_2O_5 +12.5 tonnes of Cow dung gave the largest branches and fruits of 22.33 and 39.33 respectively during the 9th week of sampling while the least number of branches and fruits were obtained at the control plot.During the sampling period (9 weeks) Velvet 35 produced a larger branch of 44.02 to Lima F1which had shorter branches of 34.66. In contrast Lima F1 produced higher number of fruits (94.67) than Velvet 35 which produced 34.67 fruits (Table 5).Interaction of fertilizer and variety in relation to number of branches produced were found not to be significant at 9 weeks; however there was a significant interaction of fertilizer and variety for the number of fruits during the period under study (Table 6).

4.1.5. Days to Flowering

Nitrogen, Phosphorus and Cow dung significantly ($P \leq 0.05$) influence formation of flower in okra. The earliest flower initiation were obtained when 55 kgN +125 kgP_2O_5 +6.25 tonnes of Cow dung was applied the application of 220 kgN +500 kgP_2O_5 +25 tonnes of Cow dung resulted to late flowering as shown in table 6.For the period of sampling (First and 50% flowering) Lima F1 consistently flowered earlier than Velvet 35 (Table 7).Interaction of fertilizer and variety on the number of days okra flowered was found to be significant only at 50% flowering (Table 8).

4.1.6. Leaf Area

Application of Nitrogen, Phosphorus and Cow dung were not significant in the 3rd week but significantly influence the leaf index of okra in Anyigba at 6 and 9 weeks. At 3WAS, application of 220 kgN +500 kgP_2O_5 +25 tons of Cow dung produced the broadest leaf while the application of 110 kgN +250 kgP_2O_5 +12.5 tonnes of Cow dung produce the largest leaves at 6 and 9 weeks of sampling (Table 9).For the period of 3, 6 and 9 weeks Lima F1consistently produces bigger leaves than Velvet 35. The biggest leaf area of 329.84 cm^2, 1112.85 cm^2 and 1278 cm^2 were produced by Lima F1 while Velvet 35 gave the smallest leaf area of 233.86 cm^2, 395 cm^2 and

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604.91 cm^2 respectively.A significant interaction of fertilizer and variety in relation to the leaf area was found to be significant only at 6 weeks of sampling (Table 10).

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4.1.7. Number of matured Fruits

Nitrogen, Phosphorus and Cow dung application was found to be significant on the number of fruits produced by okra in Anyigba. The highest number of fruits (100 fruits &62 fruits) was obtained when 110 kgN +250 kgP_2O_5 +12.5 tonnes of Cow dung was applied. The least number of fruits of 61 and 31 fruits were obtained during the application of 220 kgN +500 kgP_2O_5 +25tonnes of Cow dung at first and second harvest (Table 11).

For the period of sampling (1st and 2nd harvest) Lima F1 consistently produced higher number of fruits than Velvet 35. Lima F1 produced 178 & 102 fruits while 152 & 78 Fruits were produced by Velvet 35 respectively.

Interaction of fertilizer and variety on number of fruits produced was significant ($P \leq 0.01$) at first harvest only (Table 12).

4.1.8. Fruit length

Application of Nitrogen, Phosphorus and Cow dung significantly ($P \leq 0.05$) influence fruit length produced by okra in Anyigba during the 2015 rainy season. The longest fruit length of 49.52 cm and 48.81 cm were obtained when 110 kgN +250 kgP_2O_5 +12.5 tonnes of Cow dung were applied. The application of 220 kgN +500 kgP_2O_5 +25 tonnes of Cow dung resulted to shortest fruit length of 45.50 cm and 35.36 cm at first and second harvest respectively.

For the first and second harvest Lima F1 produced a higher fruit length than Velvet 35, Lima F1 produced long and tender fruits of 118.46 cm and 102.48 cm while Velvet 35 gave 70.02 cm and 62.62 cm respectively (Table11).

Interaction of fertilizer and variety on the fruit length produced was significant for both first and second harvest (Table 13&14).

4.1.9. Fruit yield

Application of Nitrogen, Phosphorus and Cow dung significantly ($P \leq 0.05$) influence the yield of okra in Anyigba during the 2015 rainy season. 2.41 metric tons and 1.28 metric tons were the highest yield obtained when 110 kgN +250 kgP_2O_5 +12.5 tonnes of Cow dung were applied while the least yield of 1.38mt and 0.53 metric tons were obtained when 220 kgN +500 kgP_2O_5 +25 tonnes of Cow dung were applied for the first and second harvest respectively (Table 15& Fig 1).

For the first and second harvest Lima F1 produced higher yield of 4.70 metric tons and 1.98 metric tons compared to Velvet 35 which produced 2.54 metric tons and 1.46 metric tons respectively (Table 15 and Fig 2).

Interaction of fertilizer and variety response in relation to fruit yield was found to be significant at first harvest only (Table 16 and Fig 2).

Table 2: Influence of nitrogen, phosphorus and cow dung on the stem girth produced by two okra varieties during 2015 raining season in Anyigba, Kogi state.

Treatment	Weeks after sowing		
	3	6	9
F	8.29	12.80	15.54
F_1	8.83	15.34	20
F_2	9.44	17.0	23.37
F_3	9.80	16.20	24.96
LSD (5%)	0.36	0.71	1.33
Variety			
Velvet 35	10.80	17.83	26.84
Lima F1	25.56	43.51	57.03
LSD (5%)	0.36	0.71	1.33
Interaction			
F X V	NS	NS	NS

Means followed by the same alphabet(s) are not significantly different ($p \leq 0.05$) at 5% level of probability.
Where **= Significant at 1% level of test. NS=Non significant

F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_2O_5 +6.25 tonnesCowdung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5 tonnesCowdung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25 tonnesCowdung[4]

Table 3: Influence of nitrogen, phosphorus and cow dung on the number of leaves produced by two okra varieties during 2015 raining season in Anyigba, Kogi state.

Treatment	Weeks after sowing		
	3	6	9
F	27.66	31.00	33.34
F_1	29.67	36.00	38.66
F_2	30.67	37.99	43.33
F_3	31.01	37.33	40.68
LSD(0.05%)	0.49	1.05	0.86
Variety			
Velvet 35	50.34	53.65	62.01
Lima F1	68.67	88.67	94
LSD (0.05%)	0.49	1.05	0.86
Interaction			
F X V	NS	NS	NS

Means followed by the same alphabet(s) are not significantly different ($p \leq 0.05$) at 5% level of probability.
Where **= Significant at 1% level of test. NS=Non significant

F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25tonnesCowdung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5tonnesCowdung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25tonnesCowdung[4]

Table 4: Influence of nitrogen, phosphorus and cow dung on the plant height of two okra varieties during 2015 raining season in Anyigba, Kogi state.

Treatment	Weeks after sowing		
	3	6	9
F	44.76	90.60	157.34
F_1	46.76	93.23	177.90
F_2	50.34	101.16	212.03
F_3	50.71	97.70	192.37
LSD (5%)	-	2.98	10.21
Variety			
Velvet 35	92.09	166.23	207.90
Lima F1	100.48	216.46	531.74
LSD (5%)	-	2.98	10.21
Interaction			
F X V	NS	NS	NS

Means followed by the same alphabet(s) are not significant different ($p \leq 0.05$) at 5% level of probability.
Where **= Significant at 1% level of test. NS=Non significant

F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25tonnesCowdung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5tonnesCowdung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25tonnesCowdung[4]

Table 5: Influence of nitrogen, phosphorus and cow dung on the number of branches and fruits produced by two okra varieties during 2015 raining season in Anyigba, Kogi state.

Treatment	Weeks after sowing at9weeks Number of branches	Number of fruits
F_0	13.66	20.67
F_1	22.33	35.34
F_2	22.01	39.33
F_3	20.68	37
LSD (0.05%)	3.27	2.3
Variety		
Velvet 35	44.02	37.67
Lima F1	34.66	94.67
LSD (0.05%)	3.27	2.3
Interaction		
F X V	NS	*

Means followed by the same alphabet(s) are not significant different ($p \leq 0.05$) at 5% level of probability. Where
**= Significant at 1% level of test. NS=Non significant
*=Significant at 5% level of test
F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25tonnesCowdung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5tonnesCowdung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25tonnesCowdung[4]

Table 6: Interaction of fertilizer rates and varieties of okra on number of fruits produced during the 2015 raining season at nine weeks in Anyigba

FERTILIZER RATES	VELVET 35	LIMA F1
F_0	7.66	13.01
F_1	10.01	25.33
F_2	9.33	30.00
F_3	10.67	26.33
LSD		2.47

Means followed by the same alphabet(s) are not significant different ($p \leq 0.05$) at 5% level of probability.
Where F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25 tonnes Cow dung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5tonnes Cow dung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25 tonnes Cow dung[4]

Table 7: Influence of nitrogen, phosphorus and cow dung on the number of days to flowering for two varieties of okra during the 2015 raining season in Anyigba

Treatment	Days to Floweringfirst	50%
F_0	175	195
F_1	164	189
F_2	169	197
F_3	182	202
LSD (5%)	3.38	2.87
Variety		
Velvet 35	367	409
Lima F1	323	374
LSD (5%)	3.38	2.87
Interaction		
F X V	NS	*

Means followed by the same alphabet(s) are not significant different ($p \leq 0.05$) at 5% level of probability. Where
**= Significant at 1% level of test. NS=Non significant
*=Significant at 5% level of test
F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25tonnesCowdung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5tonnesCowdung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25tonnesCowdung[4]

Table 8: Interaction of fertilizer rates and varieties of okra on the number of days to flower during the 2015 raining season in Anyigba

FERTILIZER RATES	VELVET 35	LIMA F1
F_0	107	88
F_1	100	89
F_2	98	99
F_3	104	98
LSD		3.10

Means followed by the same alphabet(s) are not significant different ($p \leq 0.05$) at 5% level of probability.
Where F_0 = Control plot[1]
F_1 = 55kgN +125KgP_20_5 +6.25 tonnesCowdung[2]
F_2 =110KgN +250KgP_2O_5 +12.5tonnesCowdung[3]
F_3 = 220KgN +500KgP_2O_5 +25 tonnesCowdung[4]

Table 9: Influence of nitrogen, phosphorus and cow dung on the leaf area produced by two okra varieties during 2015 raining season in Anyigba, Kogi state.

Treatment	Weeks after sowing		
	3	6	9
F_0	92.58	340.17	394.10
F_1	134.94	355.87	436.43
F_2	157.64	438.57	541.10
F_3	178.54	373.24	512.13
LSD (0.05%)	9.42	19.62	29.32
Variety			
Velvet 35	233.86	395.0	604.9
Lima F1	329.84	1112.85	1278.85
LSD (0.05%)	9.42	19.62	29.32
Interaction			
F X V	NS	**	NS

Means followed by the same alphabet(s) are not significant different ($p \leq 0.05$) at 5% level of probability.
Where **= Significant at 1% level of test. NS=Non significant
F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25tonnesCowdung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5tonnesCowdung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25tonnesCowdung[4]

Table 10: Interaction of fertilizer rates and varieties of okra on leaf area produced during the 2015 raining season in Anyigba.

FERTILIZER RATES	VELVET 35	LIMA F1
F_0	86.35	253.82
F_1	74.76	281.11
F_2	114.31	324.26
F_3	119.58	253.66
LSD	21.18	

Means followed by the same alphabet(s) are not significant different ($p \leq 0.05$) at 5% level of probability.
Where **= Significant at 1% level of test. NS=Non significant
F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25tonnesCowdung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5 tonnesCowdung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25tonnesCowdung[4]

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Table 11: Influence of nitrogen, phosphorus and cow dung on number of fruits and fruit length produced by two okra varieties at harvest during 2015 raining season in Anyigba, Kogi state.

Treatment	Number of fruits		Fruit length	
	First harvest (15/09/2015)	Second harvest (26/09/2015)	First harvest (15/09/2015)	Second harvest (26/09/2015)
F_0	78	33	46.38	38.58
F_1	91	54	47.08	42.35
F_2	100	62	49.52	48.81
F_3	61	31	45.50	35.36
LSD (5%)	5.26	4.54	1.13	1.18
Variety				
Velvet 35	152	78	70.02	62.62
Lima F1	178	102	118.46	102.48
LSD (5%)	-	-	1.13	1.18
Interaction				
F X V	*	NS	*	*

Means followed by the same alphabet are not significantly different at 5% probability test.
**=Significant at 1%, *= Significant at 5%, NS= Non Significant.
F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25tonnesCowdung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5tonnesCowdung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25tonnesCowdung[4]

Table 12: Interaction of fertilizer rates and varieties of okra on number of fruits produced during the first harvest in Anyigba, Kogi state.

FERTILIZER RATES	VELVET 35	LIMA F1
F_0	28	50
F_1	30	61
F_2	42	58
F_3	36	25
LSD		5.68

Means followed by the same alphabet(s) are not significant different ($p \leq 0.05$) at 5% level of probability.
Where F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25 tonnes Cow dung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5 tonnes Cow dung[3]
F_3 = 220KgN +500 KgP_2O_5 +25 tonnes Cow dung[4]

Table 13: Interaction of fertilizer rates and varieties of okra on fruit length produced during the first harvest in Anyigba, Kogi state.

FERTILIZER RATES	VELVET 35	LIMA F1
F_0	17.14	29.24
F_1	17.86	29.22
F_2	15.46	34.06
F_3	19.56	25.94
LSD		1.22

Means followed by the same alphabet(s) are not significant different ($p \leq 0.05$) at 5% level of probability.
Where F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25 tonnes Cow dung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5tonnes Cow dung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25 tonnes Cow dung[4]

Table 14: Interaction of fertilizer rates and varieties of okra on fruit length produced during the second harvest in Anyigba, Kogi state.

FERTILIZER RATES	VELVET 35	LIMA F1
F_0	16.17	22.41
F_1	15.46	33.17
F_2	17.86	27.50
F_3	15.96	19.40
LSD		1.27

Means followed by the same alphabet(s) are not significant different ($p \leq 0.05$) at 5% level of probability.
Where F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25 tonnes Cow dung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5tonnes Cow dung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25 tonnes Cow dung[4]

Table 15: Influence of nitrogen, phosphorus and cow dung on fruit yield (mt) produced by two okra varieties at harvest during 2015 raining season in Anyigba, Kogi state.

Treatment	Harvests	
	First	Second
F_0	1.39	0.62
F_1	2.06	1.03
F_2	2.42	1.28
F_3	1.38	0.53
LSD (0.05%)	1.87	71
Variety		
Velvet 35	2.55	1.46
Lima F1	4.70	1.99
LSD (0.05%)	1.87	71
Interaction		
F X V	*	NS

Means followed by the same alphabet(s) are not significant different ($p \leq 0.05$) at 5% level of probability.
Where **= Significant at 1% level of test. NS=Non significant
*=Significant at 5% level of test
F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25 tonnes Cow dung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5 tonnes Cow dung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25 tonnes Cow dung[4]

Table 16: Interaction of fertilizer rates and varieties of okra on fruit yield (kg/ha) produced during the first harvest in Anyigba, Kogi state.

FERTILIZER RATES	VELVET 35	LIMA F1
F_0	830.23	565.18
F_1	706.83	1354.54
F_2	656.01	1761.05
F_3	354.68	1022.43
LSD		202.28

Means followed by the same alphabet(s) are not significant different ($p \leq 0.05$) at 5% level of probability.
Where F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25 tonnes Cow dung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5tonnes Cow dung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25 tonnes Cow dung[4]

Graphical representation of fruit yield at first harvest

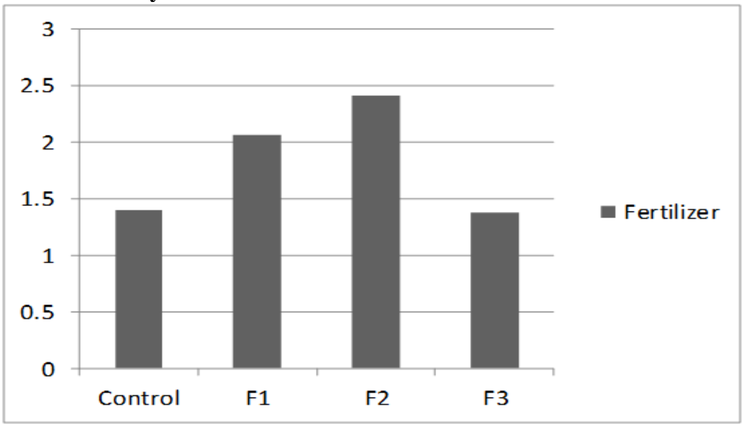

Fig 1: Influence of fertilizer on fruit yield (metric tonnes) at First harvest

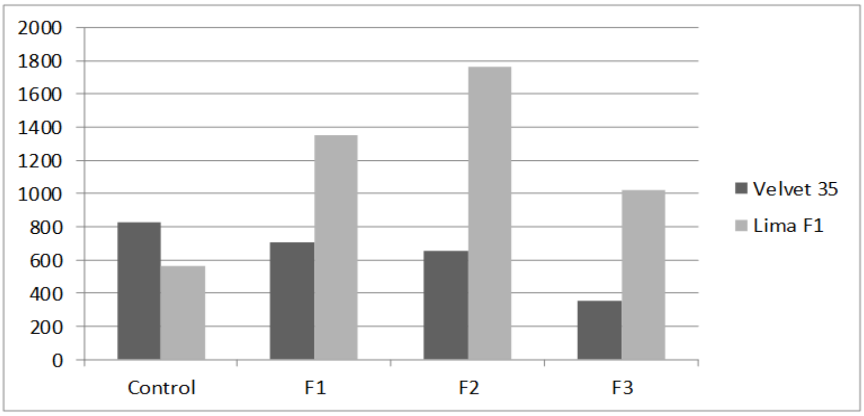

Fig 2: Interaction of fertilizer and variety on fruit yield (Kg/ha) at First harvest

Table 17:Influence of Nitrogen, Phosphorus and cow dung manure on yield and some yield components of two varieties of okra in Anyigba, during 2015 growing season.

Treatment	Number of fruits		Fruit yield(Kg/ha)'000MT		Fruit length	
	First harvest (15/09/2015)	Second harvest (26/09/15)	First harvest (15/09/15)	Second harvest (26/09/2015)	First harvest (15/09/15)	Second harvest (26/09/2015)
F_0	78	33	1.39	0.62	46.38	38.58
F_1	91	54	2.06	1.03	47.08	42.35
F_2	100	62	2.42	1.28	49.52	48.81
F_3	61	31	1.38	0.53	45.50	35.36
LSD	5.26	4.54	187	71	1.13	1.18
Variety						
Velvet 35	152	78	2.55	1.46	70.02	62.62
Lima F1	178	102	4.70	1.99	118.46	102.48
LSD	-	-	187	71	1.13	1.18
Interaction						
F X V	**	NS	*	NS	*	*

Means followed by the same alphabet(s) within a treatment are not statistically different ($p \leq 0.05$) using Fisher's Least Square Difference.
Where **= Significant at 1% level of test. NS=Non significant
*=Significant at 5% level of test
F_0 = Control plot[1]
F_1 = 55 kgN +125 KgP_20_5 +6.25 tonnesCowdung[2]
F_2 =110 KgN +250 KgP_2O_5 +12.5 tonnes Cowdung[3]
F_3 = 220 KgN +500 KgP_2O_5 +25 tonnes Cowdung[4]

5.0 DISCUSSION, SUMMARY AND CONCLUSION

5.1. INFLUENCE OF NITROGEN, PHOSPHORUS AND COW DUNG ON THE GROWTH AND YIELD OF OKRA.

5.1.1. Growth characters

Generally growth characters such as plant height, number of leaves, stem girth, number of branches and leaf area increased significantly with increase in fertilization. This agrees with the works of [17] that high level of fertilizer can enhanced cell division and formation of more tissues resulting in luxuriant vegetative growth. It was also in line with [12] lesser growth component in plants can be due to the poor nutritional status of control treatment. The significant increase in plant height stated above was also in conformity with Singh *et.al.*[32]Who observed that increase in the plant height could be as a result of better weed encroachment and adequate interception of sunlight which tends to make them grow more.

The significant increase in the number of branches were also supported by the works of [31] who reported that optimum fertilizer intake by plant improves the branching pattern through the photosynthetic process of absorbing light by leaves. Also increase in leaf area during fertilization were also supported by [19],[20],[21] who reported that increase fertilization will increase the leaf area index for better photosynthesis provided there are no deleterious effects.

Increase in the growing pattern of Lima F1 variety over Velvet 35 also agrees with the findings of Khan et al., [12] that high number of fruits, branches; leaves might be due to plant vigor, fertilizer intake or genetic differences.

5.1.2. Yield characters

Yield components such as number of matured fruits, fruit length and fruit yield significantly increase with increase in fertilizer application. This agree with the works of Singh *et al.,* [32] and Sarnaik *et al.,* [29] that fruit yield potential depends on the fertilizer intake and was also supported by Khan *et. al.*[12*],* who reported that balanced fertilization increase the number of okra fruits and survived plants.

However highest fertilizer application of 220 kgN +500 kgP_2O_5 +25 tonnes of Cow dung resulted to lowest fruit length and yield potential which was in line with the works of Okonmah [24] that over application of fertilizer will have adverse effects on crop growth and development. Better yield recorded by Lima F1 over Velvet 35 in this study can also be related to the works of Khan et al., [12] which says that difference in the number of fruits produced by plants might be due to plant vigor and genotype.

The interaction of fertilizer and okra varieties in respect to the yield characters (fruit length and yield) were significant which agrees with the works of Nwangburaka[21] who reported that a positive interaction can exist between yield and yield components such as leaf area, number of fruits (Table 15 and Fig1)

5.2 SUMMARY AND CONCLUSION

Generally application of 110 KgN +250 KgP_2O_5 +12.5 tonnes of Cow dung significantly gave higher fruit number and fruit yield per hectare than other lower rates. Application of 220 KgN +500 KgP_2O_5 +25 tonnes/ha of Cow dung resulted in significant lower yield than the rate quoted above. It can therefore be concluded preliminarily that application of 110 KgN +250 KgP_2O_5 +12.5 tonnes of Cow dung may be optimum for fruit growth and yield in Anyigba.

Lima F1 out-yielded Velvet 35 by 64.9% and 57.6% in the first and second harvest respectively. This may not be unconnected with the higher nutrient demand of Lima F1 over Velvet 35 since the former is a hybrid.
The seemingly high interaction obtained for variety x fertilizer with respect to fruit yield and fruit length is an indication that blanket recommendation for all varieties of okra may after all be wrong as this preliminary investigation indicates that the two varieties behave differently to different fertilizer regimes.

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