Journal of Sustainable Development in Africa (Volume 25, No.2, 2023)
ISSN: 1520-5509
Pennsylvania Western University, Clarion, Pennsylvania

EVALUATION OF DIFFERENT ORGANIC SOURCES OF NUTRIENTS ON GROWTH, YIELD, AND QUALITY OF OKRA (*Abelmoschus species*) VARIETIES IN NORTHERN GUINEA SAVANNA ZONE OF NIGERIA.

Ursulla Ukamaka, EMEGHARA

Federal College of Forest Resources Management Ishiagu, Ebonyi State, NIGERIA.

ABSTRACT

Agriculture cannot be sustainable without using manure. Agriculturists throughout the world are continuously experimenting and enhancing agricultural practices in an effort to reach the goals of sustainability. Field experiment was carried out to examine the effects of different organic sources of nutrients on the growth, yield and quality of okra varieties (Abelmoschus esculentus) varieties at Abuja, Northern Guinea Savanna in 2022 cropping season. The treatments consist of poultry manure, cow dung and goat manure applied at 10 tonnes/ha with control (no application). The experiment was laid in a completely randomized block design (CRBD) with three replicates. Results obtained indicated that the application of poultry manure at 10 tonnes/ha significantly enhanced the growth and yield parameters of okra. On the other hand, the lady finger variety of okra significantly produced taller okra, higher numbers of leaves and branches when compared with NHe-47 -4. However, NHe-47 -4 variety, LD 88 -1 varieties had no significant differences in the yield characteristics. There was no significant difference in the varieties of okra used in the study at 5% probability level ($P<0.05$) during the 2022 cropping season in the northern guinea savannah ecology of Nigeria. Based on this outcome of this research, the application of 10 tonnes/ ha of poultry manure as organic source of plant, the use of poultry manure is recommended instead of other organic manure tested in this study for the optimum production of Okra.

Keywords: Organic Sources of Nutrients, Okra Varieties, Growth, Yield, Quality, Northern Guinea Savanna, Nigeria

INTRODUCTION

Sustainable agriculture can be defined as a system which over the long term enhances environmental quality and the resource base on which agriculture depends, provides food and fibre for basic human needs, is economically viable, and enhances the quality of life for farmers and society as a whole (Kambewa, 2007). Okra is widely farmed in Africa, just like other native vegetables, and is available in most regional markets. Its green, soft fruit is its main selling point. The crop comes from the genus Abelmoschus, which has two main species: *A. caillei* (A. Chev.) Stevels and *A. esculentus* (L.) Moench. The crop is a member of the Malvaceae family. Popular worldwide in tropical and subtropical regions is okra (*Abelmoschus esculentus* L. Moench), sometimes known as "lady's finger" (Bisht and Bhat, 2006). Throughout the tropics, especially Nigeria, it is now widely dispersed (National Research Council, 2006). It is a significant vegetable crop, growing on 277,000 hectares of land, producing 731,000 metric tons globally, and yielding 2.63 tons per hectare (FAO, 2006). Okra is farmed in Nigeria throughout both the rainy and dry seasons, however the dry season generates higher profits because to the excess demand and scarcity of supplies (Ayeni *et al*., 2012). Okra is a versatile vegetable with several uses, including being consumed raw or cooked, as animal feed, in medicine, and in industry. It is a rich source of carbohydrates, amino acids, and vitamins (Farinde *et al*., 2007; Kumar *et al*., 2017). However, the application of organic fertilizers, such as liquid seaweed and chicken manure can affect the nutritional content of okra (Zodape *et al*., 2008). Okra is used to address nutritional and food security issues in poor nations because of its several nutritional benefits (Kumar *et al*., 2017). When cooked, okra fruits have mucilage. The mucilage is important in medicine because it serves as a replacement for plasma or blood volume expander and binds toxins like cholesterol and bile acids that the liver secretes into it (Gemede *et al*., 2015). Okra fruits are rich in antioxidants, vitamin C, folate, and fiber (Adekiya *et al*., 2018). The seeds contain oil that can be used to make soap and is edible by people (Oyolu, 2003). The limitations of inorganic fertilizer, to which many crops have responded favorably, have been overcome by organic manure, which can range from fresh/dried plant materials to animal waste and agricultural byproducts (Green, 2015; Gordon *et al*., 2003; Ibeawuchi *et al*., 2006). With enhanced soil structure and little leaching, organic manure raises soil nitrogen, phosphorus, and potassium levels and sustains soil fertility (Kwayep *et al*., 2021; Omotoso *et al*., 2018). Chicken manure is abundant in organic matter, enhances the physical characteristics of the soil, and provides more nutrients compared to other organic manures in the development of okra (Fagwalawa and Yahaya, 2016; Afe and Oluleye, 2017; Khandaker *et al*., 2017; Omotoso *et al*., 2018). Nigerians have successfully employed the annual weed *Tithonia diversifolia* to increase soil fertility by planting it along roads and in vacant fields (Opala *et al*., 2015). Livestock manure is a significant source of N, P, and K, and its addition to soil raises the soil's availability of P and exchangeable K, Ca, and Mg. Manure has a number of positive effects on soil qualities in addition to providing nutrients for crop growth. According to several studies, applying organic waste increases soil's structural stability, lowers bulk density by increasing the proportion of organic matter in the soil and achieving a balance between fine and coarse pores, and increases soil's water infiltration rate and hydraulic conductivity (Tisdale *et al*., 2000; Young, 2007).Organic manures generally increase the soil's physical, chemical, and biological properties, such as infiltration rate, aggregate stability, cation exchange capacity (CEC), and biological activities, while also preserving the soil's ability to hold moisture. This increases crop productivity, while also maintaining the quality of crop products, even though organic manures contain fewer plant nutrients than synthetic manures (Adekiya, *et al*., 2012). Despite the vast potential for okra fruit production, Nigeria's low soil fertility and organic matter content have severely hindered the crop's yield per hectare and quality, which results in low productivity and, as a result, lower farmer income (Adekiya *et al*., 2018). The current yield of okra in Nigeria is quite poor, about 2.7 t ha, according to Adekiya *et al*. (2018), due to a low native soil fertility condition among other things. Low yields are the outcome of the crop doing poorly due to poor growth caused by insufficient nutrition levels. According to reports, maintaining soil organic matter (OM) is the key to producing crops sustainably in Nigeria and other tropical nations (Oladipo, *et al*., 2005). For continued and enhanced agricultural production, it is therefore necessary to increase the soil's fertility. The continual application of inorganic fertilizer, which raises soil acidity and negatively affects the microbiological characteristics of the soil (Onunkun, 2012), is blamed for the fall in okra output in Nigeria. Yet, according to Akande *et al*. (2003), the addition of organic manure reduces the soil's acidity, which boosts crop yields.

OBJECTIVES OF THE STUDY

The major goal of this study is to assess how various organic manures affect the productivity, yield, and quality of several okra types.

The specific objective of the study is to:

(i) evaluate the effect of different organic manures on growth, yield and quality of okra varieties.

(ii) determine the suitable organic manure for okra production.

(iii) determine the relationship between organic manures and okra varieties.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Faculty of Agriculture, University of Abuja, Nigeria. The experimental area lies on the Latitudes 9^{o} 4’20’’N and Longitudes 7^{o} 29’28” E respectively in the Northern Guinea Savanna zone of Nigeria with the annual rainfall of 1308 mm and temperature ranging between 24^{o}C and 32^{o}C (Figure 1).

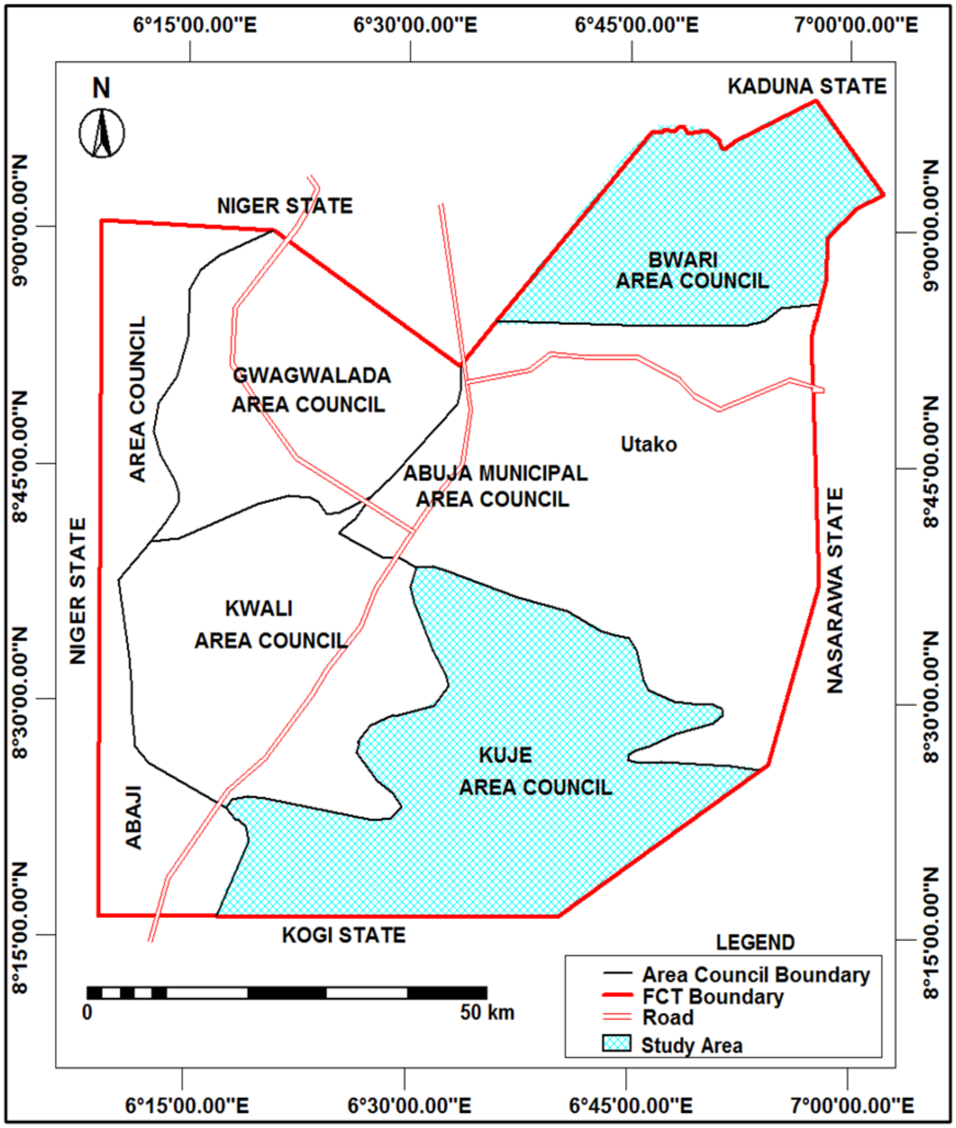

Figure 1: Map of Federal Capital Territory Showing Area Councils.

Source of Materials

The seeds of *Abelmoschus species* was gotten from a reliable and reputable seed vendor in Abuja.

Land Preparation and Manure Application

The experimental site was cleared by removing all the debris from the site, afterwards the experimental site was ploughed and then demarcated into plots and ridges were made inside the plots. The experimental site was divided into three blocks covering a total area of 240m^2 each block consists of eight (8) plots of 2×2.5m^2 with pathway of 1m and 1.5m between blocks and plots respectively. Cow dung and Goat manure was sourced from private farms, while Poultry manure was sourced from University of Abuja teaching and research farm. The manures were applied to the ridged on assigned plots and ploughed into the soil and left for two weeks. A total of 3kg of Goat, Cow and Poultry manures were applied to each plot respectively.

Abelmoschus seeds were directly sowed at a spacing of 40 × 65cm which gives a total of 24 plants per plot. Two seeds were put per hole and later were thinned to one seedling per stand after their germination

Experimental Design

The experiment was laid out in a 4×2 factorial in the Randomized Complete Block Design (RCBD) using three different organic fertilizers (Cow dung, Poultry manure and Goat dung) as treatments along with two varieties of okra and each treatment will be replicated thrice along with control.

Agronomic Practices

All agronomic practices were carried out as at when due. Weeding was done regularly using hoe to keep the field neat and free from weeds. While pest and diseases were controlled using emulsified neem oil extract.

Parameters Measured

This include:

Plant Height

Plant height was measured at 2, 4, 6, 8, 10 and 12 weeks after planting (WAP). Five plants were randomly selected in each plot and tagged. The plant height was measured at harvest from base of the plant to tip of the main shoot the plant using a measuring tape.

Stem Girth

The stem girth was measured using a measuring tape at 4, 6, 8, 10 and 12WAP**.**

Number of Leaf

Leaf number was taken. This was done by counting the number of leaves per record plant at 2, 4, 6, 8, 10 and 12WAP.

Leaf Area

The leaf area was measured at 4, 6, 8, 10 and 12WAP.

Number of Branches

Number of branches was measured by counting the number of branches on the plants at 4, 6 and 8, 10 and 12WAP.

Days to First Flowering

The plants were monitored daily for 35 days after seeding to track the emergence of the first bloom, and the total number of days between sowing and flowering was recorded.

Fruit Length

Five different okra fruits were chosen, and the length of each one was measured in cm from base to tip using a measuring tape.

Fruit Weight

After measuring length, the same fruits were weighed using an electronic balance to determine their average weight in grams. It was also determined how much fruit each plant produced.

Yield per Plot (kg)

After each picking, the fruits from every plant on the entire plot were weighed, and their totals were added up at the end for this reason.

Data Analysis

The Duncan Multiple Range Test (DMRT) was used to differentiate significant means at 5% probability levels after all gathered data were submitted to Analysis of Variance (ANOVA).

RESULTS

Sustainable agriculture is defined as a commitment to satisfy human food and fibre needs and to enhance the quality of life for farmers and society as a whole, now and the future (Abubakar and Attanda, 2013).

Physio-Chemical Analysis of Experimental Field and Manure

The results obtain from the pre-cropping physio-chemical soil chemical soil analysis shown that the soil used for this trial was moderately acidic (Table 1) and texturally sandy-loam (sand 55.60%, silt 14.46% and clay 29.84%). Also, the nutrients observed in the soil were, total N 0.15%, available P 20.63mgkh^{-1} and exchangeable bases (C molkg^{-1}), K 0.08, Ca 2.80, Na 0.15 and Mg 3.28, and organic carbon, 0.77%. the data recorded on the chemical characters to poultry manure, cow dung and goat manure are given in table 1.

Okra Plant Height

Table 2 shows the effects of organic manure sources on the plant height of okra at Northern Guinea Savanna in 2022 Cropping season. The result indicated the okra height were significantly different at 5% probability ($P < 0.05$) level using Duncan Multiple Range Test in the 2022 Cropping Season. At 2 weeks after planting (WAP), poultry manure significantly supported taller okra plant which was significantly different from cow and goat manure in 2022 cropping season. The control (no application) produced the shortest plant in 2022 cropping season.

Okra Number of Leaves

In 2022 cropping season, the organic sources of plant nutrient significantly differ at ($P<0.05$) at Northern Guinea Savanna. The application of poultry manure significantly supported highest number of leaves when compared with the application of cow dung, goat manure and the control. Similarly, control showed the least number of leaves at 4, 6, 8, 10 and 12WAP. On the contrary, there NHe-47 -4 significantly supported higher number of leaves (Table 3).

Okra Number of Branches

The effect of different nutrient sources on okra number of branches in 2022 cropping season was significantly different as showed in the Table 4. The result showed that poultry manure showed the highest number of branches at 2, 4, 6, 8, 10 and 12WAP the experiment at 5% probability ($P<0.05$) level. Control (no application) supported the shortest number of branches at 12 weeks after planting in the 2022 cropping season.

Table 1: Physio-Chemical Analysis of the Soil, Goat Manure, Cow Dung and Poultry Manure

Parameter	Soil	Goat Manure	Cow dung	Poultry Manure
pH	5.8	8.07	8.98	7.61
Organic matter (%)	0.89	45.51	42.42	48.26
Total carbon (%)	0.77	13.07	28.60	25.24
Total N (%)	0.15	1.55	2.21	2.38
Available P (mg/kg)	20.63	0.22	0.47	1.08
Total K (C mol/kg)	0.08	0.87	1.72	3.18
Total Ca (C mol/kg)	2.80	1.27	0.49	3.27
Na (C mol/kg)	0.15	0.28	0.34	0.46
Total Mg (C mol/kg)	3.28	1.36	0.18	4.70
Exchangeable acid (C mol/kg)	0.10			
CEC (C mol/kg)	6.41			
Fe	0.113			
Cu	0.011			
Zn	0.173			
Sand (%)	55.60			
Silt (%)	14.46			
Clay (%)	29..94			

Table 2: Effect of Difference Organic Manures on Plant Height of Okra

Treatment	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
Nutrient Sources (N)						
Control	5.06b	7.84b	11.14b	14.08b	17.39bc	18.32b
Poultry Manure	6.91a	10.41a	15.14a	17.26a	21.67a	24.64a
Cow Dung	5.68b	9.73ab	13.51a	17.32a	18.69b	19.81b
Goat Manure	5.22b	8.56ab	11.24b	14.49b	18.05b	18.06b
SE±	0.378	0.676	0.692	0.824	1.046	0.430
Varieties (V)						
NHe-47 -4	5.89	8.93	12.99	16.14	19.32	20.69a
LD 88 -1	5.54	9.35	12.51	15.43	18.57	19.72ab
SE±	0.267	0.478	0.489	0.583	0.740	0.304
Interaction (N×V)	NS	NS	NS	NS	NS	NS

Means followed with same letter(s) are not significantly different at 5% probability level using DMRT, SE = Standard error, WAP = Weeks after Planting, NS = Not significant.

Table 3: Effect of Difference Organic Manures on Number of Leaves of Okra

Treatment	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
Nutrient Sources						
Control	4.27	6.27ab	7.60b	10.17b	10.67b	8.23b
Poultry Manure	4.40	6.87ab	9.30a	12.83a	12.13a	8.90b
Cow Dung	4.07	7.30a	8.70ab	12.07ab	11.60a	9.53a
Goat Manure	4.33	7.17a	8.78ab	13.00a	11.80a	10.10a
SE±	0.264	0.264	0.463	0.572	0.894	0.673
Varieties						
NHe-47 -4	4.45	6.88	8.53	11.32	11.55	9.62a
LD 88 -1	4.08	6.92	8.67	12.72	11.55	8.77b
SE±	0.088	0.187	0.327	0.405	0.632	0.450
Interaction (N×V)	NS	NS	NS	NS	NS	NS

Means followed with same letter(s) are not significantly different at 5% probability level using DMRT, SE = Standard error, WAP = Weeks after Planting, NS = Not significant.

Table 4: Effect of Difference Organic Manures on Number of Branches of Okra

Treatment	Number of Branches				
Nutrient Sources	4WAP	6WAP	8WAP	10WAP	12WAP
Control	1.98b	2.57ab	3.04bc	3.50bc	3.97c
Poultry Manure	2.53a	3.37a	4.39a	4.96a	5.11a
Cow Dung	2.30a	3.04ab	3.60b	4.13b	4.48b
Goat Manure	1.98b	3.00ab	3.24b	3.92bc	4.28b
SE±	0.055	1.105	0.105	0.138	0.16
Varieties					
NHe-47 -4	2.22	3.09	3.55	4.16	4.41
LD 88 -1	2.17	2.90	3.59	4.14	4.51
SE±	0.039	0.074	0.074	0.098	0.113
Interaction (N×V)	NS	NS	NS	NS	NS

Means followed with same letter(s) are not significantly different at 5% probability level using DMRT, SE = Standard error, WAP = Weeks after Planting, NS = Not significant.

Okra Stem Girth

The shoot girth among the different varieties of okra and different sources of nutrient was not significantly different at 5% probability level ($P<0.05$) in northern guinea savannah geological zone of Nigeria during the 2022 cropping season as shown in the Table 5. The result was not significantly different at 4, 6, 8, 10 and 12WAP. Similarly, the effect of okra varieties was not significantly different on the stem girth of Amaranths at 4, 6, 8, 10 and 12WAP.

Days to Flowering

The result indicated in Table 6 revealed the effects of different sources of nutrient and variety on growth and yield of okra in northern guinea savannah ecology in respect to flowering. From the result, it was revealed at 5% probability level (P<0.05) that Poultry manure took shortest number of days to flowering while control (no treatment) took the longest number of days to flower with an average mean of 54.00 respectively.

Days to 50% Flowering

The effects of different nutrient sources and verities of Okra in Northern Guinea Savannah ecology of Nigeria is presented in Table 6. There was a significant difference at 5% probability (P<0.05) between seedlings treated with poultry manure and other treatment, as plants treated with poultry manure took shorter number of days to 50% flowering. However, there was no significant differences between cow dung and goat manure while control (no treatment) took longer time for 50% flowering of okra plants.

Days to Fruiting

Table 7 shows the effect of different nutrient sources on fruiting of okra in 2022 cropping season. The result reveals that poultry manure is significantly different from other sources of nutrient as it took shorter days to fruiting. There were no statistical differences at 5% probability level(P<0.05) between goat manure and poultry manure. However, control (no treatment) took longer time (days) to fruit.

Table 5: Effect of Difference Organic Manures on Stem Girth of Okra

Treatment	4WAP	6WAP	8WAP	10WAP	12WAP
Nutrient Sources					
Control	2.11a	2.47a	2.76ab	3.17a	3.27
Poultry Manure	1.98ab	2.53a	3.09a	3.43a	3.53
Cow Dung	2.01a	2.58a	2.84ab	3.12a	3.28
Goat Manure	1.99ab	2.62a	3.13a	3.43a	3.69
SE±	0.043	0.065	0.074	0.106	0.098
Varieties					
NHe-47 -4	2.03	2.52	3.00	3.35	3.48
LD 88 -1	2.02	2.59	2.91	3.22	3.40
SE±	0.031	0.046	0.052	0.075	0.068
Interaction (N×V)	NS	NS	NS	NS	NS

Means followed with same letter(s) are not significantly different at 5% probability level using DMRT, SE = Standard error, WAP = Weeks after Planting, NS = Not significant.

Table 6: Effect of Different Organic Manures on Days to Flowering of Okra

Treatment	Day First Flowering	Day to 50% Flowering
Nutrient sources (N)		
Control	58.17c	66.50c
Poultry Manure	54.00a	57.00a
Cow Dung	57.00b	61.50b
Goat Manure	57.17b	61.10b
SE±	0.401	0.581
Varieties		
NHe-47 -4	57.17a	63.08a
LD 88 -1	56.83a	63.67a
SE±	0.284	0.411
Interaction (N×V)	NS	NS

Means followed with same letter(s) are not significantly different at 5% probability level using DMRT, SE = Standard error, WAP = Weeks after Planting, NS = Not significant.

Table 7: Effect of Different Organic Manures on Days to Fruiting of Okra

Treatment	Days to First Fruit	Days to 50% Fruit
Nutrient Sources (N)		
Control	64.71c	69.50c
Poultry Manure	58.56a	62.92a
Cow Dung	59.67b	62.50b
Goat Manure	62.66ab	64.50ab
SE±	1.135	0.869
Varieties		
NHe-47 -4	59.58a	63.08a
LD 88 -1	60.33a	63.67a
SE±	0.284	0.411
Interaction (N×V)	NS	NS

Means followed with same letter(s) are not significantly different at 5% probability level using DMRT, SE = Standard error, WAP = Weeks after Planting, NS = Not significant.

Fruits Length of Okra

Table 8 shows the effect of organic manure and different variety on the fruit length of okra. The result shows that there is significant difference in the fruit length at 5% probability level ($P<0.05$). Poultry manure produced significantly longer fruits compared to other soil treatments. There was no significant difference between control, cow dung and goat manure, however control (no treatment) produced short fruit lengths.

Fruit Breadth of Okra

During the 2022 cropping season in the northern guinea savannah ecology of Nigeria, the effect of different nutrient sources on fruit breadth of okra was significant at 5% probability level (P<0.05) as shown in Table 8. Poultry manure produced wider fruits compared to cow dung and goat manure. However, there was no significant differences between goat manure and control (no treatment) with an average mean of 6.29 and 6.04 respectively.

Fruit Weight of Okra

The result shown in Table 8 depicts the effect of different nutrient sources and varieties of okra on the weight of okra fruit. It was observed that seedlings treated with poultry manure produced the highest weight with an average mean of 213.19 while the least weight was observed in seedlings treated without treatment.

Cumulative Yield of Okra

Table 8 showed the effects of organic manure sources on yield of okra at Northern Guinea Savanna in 2022 Cropping season. The result indicated the okra yield were significantly different at 5% probability (P < 0.05) level using Duncan Multiple Range Test in the 2022 Cropping Season. Poultry manure significantly supported higher yield of okra plant which was significantly different from cow and goat manure in 2022 cropping season. The control (no application) produced the smallest yield of okra plant in 2022 cropping season.

Table 8: Effect of Different Organic Manure on Yield of Okra

Treatment	Fruit length per plant (cm)	Fruit breadth per plant (cm)	Fruit weight per plot (g)	Cumulative yield tonnes/ha
Nutrient Sources (N)				
Control	6.79b	6.04b	197.42c	0.95c
Poultry Manure	8.17a	7.02a	213.19a	1.92a
Cow Dung	7.62ab	6.58ab	203.54b	1.22b
Goat Manure	6.92b	6.29b	203.54b	1.22b
SE±	0.145	0.195	1.348	0.318
Varieties (V)				
NHe-47 -4	7.29a	6.53a	203.95b	1.02
LD 88 -1s	7.47a	6.43a	206.34a	1.03
SE±	0.614	0.138	0.953	0.005
Interaction (N×V)	NS	NS	*	NS

Means followed with same letter(s) are not significantly different at 5% probability level using DMRT, SE = Standard error, WAP = Weeks after Planting, NS = Not significant.

Proximate Analysis Okra Fruit

The effect of different nutrient sources and varieties on the quality of okra fruits. The proximate Table 9 showed analysis showed that LD 88 -1s+cow dung supported higher moisture content of 89.00 followed by LD 88 -1+goat manure, NHe-47 -4+cowdung, NHe-47 -4+goat manure while NHe-47 -4+goat manure supported the lowest number of 78.80. The result of the proximate analysis shows that NHe-47 -4+control supported 1.75 Ash content, 11.17 fat content, 0.89 protein, 2.94 crude fibre, 1.25 carbohydrate and 18.0 dry weight. The result of the proximate analysis shows that ladies ingers+goat manure supported 2.22 Ash content, 9.95 fat content, 1.03 protein, 3.84 crude fibre, 4.16 carbohydrate and 21.20 dry weight. The result of the proximate analysis shows that NHe-47 -4+poultry manure supported 1.34 Ash content, 4.84 fat content, 0.51 protein, 2.01 crude fibre, 4.22 carbohydrate and 13.00 dry weight. The result of the proximate analysis shows that NHe-47 -4+cow manure supported 1.36 Ash content, 8.50 fat content, 0.32 protein, 1.17 crude fibre, 3.25 carbohydrate and 14.60 dry weight The result of the proximate analysis shows that LD 88 -1+goat manure supported 1.01 Ash content, 5.86 fat content, 0.40 protein, 0.89 crude fibre, 3.04 carbohydrate and 11.20 dry weight. The result of the proximate analysis shows that LD 88 -1s+cow manure supported 0.86 Ash content, 3.69 fat content, 0.34 protein, 0.83 crude fibre, 5.28 carbohydrate and 11.00 dry weight. The result of the proximate analysis shows that NHe-47 -4+goat manure supported 1.04 Ash content, 7.45 fat content, 0.31 protein, 1.53 crude fibre, 2.67 carbohydrate and 13.00 dry weight. The result of the proximate analysis shows that LD 88 -1+control supported 0.88 Ash content, 5.91 fat content, 0.60 protein, 3.37 crude fibre, 7.24 carbohydrate and 18.00 dry weight.

Table 9: Proximate Analysis of Okra Varieties Cultivated under Different Sources of Nutrient (g/100g)

Sample	Moisture	Ash	Fat Content	Protein	Crude Fibre	CHO	Dry Weight
NHe-47 -4 + No Manure	82.00	1.75	11.17	0.89	2.94	1.25	18.00
LD 88 -1 + Poultry Manure	78.80	2.22	9.95	1.03	3.84	4.16	21.20
NHe-47 -4 + Poultry Manure	87.00	1.34	4.84	0.51	2.09	4.22	13.00
NHe-47 -4 + Cow Manure	85.40	1.36	8.50	0.32	1.17	3.35	14.60
LD 88 -1 + Goat Manure	88.80	1.01	5.86	0.40	0.89	3.04	11.20
LD 88 -1 + Cow Manure	89.00	0.86	3.69	0.34	0.83	5.28	11.00
NHe-47 -4 + Goat Manure	87.00	1.04	7.45	0.31	1.53	2.67	13.00
LD 88 -1 + No Manure	82.00	0.88	5.91	0.60	3.37	7.24	18.00

Discussion

Sustainable agriculture should be taken as an eco-system approach where soil-water-environment-living beings live in harmony with a well-balanced equilibrium of food chains and their related energy balances. The goal is to address environmental issues of natural resources management to sustain significant increase in farm productivity through the efficient use of land and other resources and provide better economic returns to individuals and contribute to the quality of life and economic development (Abubakar and Attanda, 2013). The influence of different variety of okra on the plant height of *Abelmoschus esculentus* was no significant at 5% probability level (P<0.05) in northern guinea savannah ecological zone of Nigeria during the 2022 cropping season at 2, 4, 6 and 8WAS. As no significant treatment and variety interaction was seen in the study, the differences between the two kinds may be attributed to their genetic makeup. This is in line with the findings of Ibrahim *et al*. (2019), who confirmed that changes in the genetic makeup of these crops usually lead to differential development of crops under similar environmental conditions. The two types' different yields complement the findings of Akinfosoye *et al*. (1997), who found that okra cultivars' yields varied significantly. The findings concur with those of Abdulmaliq *et al*. (2016) who found that the NHAe 47-4 variety of okra outperformed all other soil treatment treatments over the course of two years of research. They explained this observation by pointing to the selection of the cultivar cultivated and its particular genetic composition. They explained this observation by pointing to the selection of the cultivar cultivated and its particular genetic composition. The number of leaves, plant height, and number of branches all significantly varied in the growth and productivity of okra treated with poultry manure. When compared to the control, the application of poultry manure significantly ($P<0.05$) increased the vegetative parameters (no treatment). In comparison to the control, the plant treated with poultry manure generated higher plants. Cow dung and goat manure had non-significant ($P<0.05$) variations in the quantity of branches. It's possible that the treatments to improve the soil's fertility contributed to the beneficial effect of organic manure on okra development. This supports the findings of Masarirambi *et al*. (2007) who found that plants grown in soil containing fertilizer from poultry dung were taller and had an average of more leaves per plant, with cow and inorganic fertilizer following in decreasing order. When manure decomposes, it boosts soil macro- and micronutrient levels and improves the physio-chemical characteristics for okra's best growth. When compared to other organic soil treatments, okra cultivated on poultry manure produced higher results in terms of growth and output. Low lignin, lignin/N, and C: N ratio readings may also be connected to this. These characteristics of poultry manure will cause quick mineralization and early nutrient release to a short-gestation crop like okra, therefore there was an increase in the plant's morphological growth, which translates to increased production compared to other treatments. This is consistent with research done by Wolf and Snyder (2003), who found that the C: N ratio of organic materials has a significant impact on the rate of decomposition and the mineralization of nitrogen because N controls the growth and turnover of the microorganisms that mineralize organic carbon. When soils are treated with animal dung with high lignin concentrations, which originates from the diet consumed by the animal, this immobilization of soil nutrients occurs and reduces the growth and yield of okra in plots compared to those treated with poultry manure (Togun *et al*., 2004). In comparison to chemical fertilizers, poultry manure is claimed to be a better soil treatment because of its stronger ability to maintain nitrogen (N) (Olaniyi *et al*., 2010). The improved growth and production of okra in plots with poultry manure in this experiment may be due to the superior N supply provided by the manure during okra cropping (Olaniyi *et al*., 2010). The acquired results supported Akande *et al*. (2003) who reported that poultry manure boosted okra's height in comparison to other treatments.

CONCLUSION

Sustainable agriculture refers to an agricultural production and distribution system that: achieves the integration of natural biological cycles and control, protect and renews soil fertility and the natural resource base, optimize the management and use of on-farm resources, reduce the use non-renewable resources and purchased production inputs, provide adequate and dependable farm income, promote opportunity in family farming and farm communities and minimizes adverse impacts on health, safety, wildlife, water quality and the environment (Sustainable Agriculture Network, 2002).

The yield of okra types differs significantly with 5% probability level ($P< 0.05$). Okra's growth and output are improved by organic manures. Poultry manure greatly outperformed other organic manures in terms of plant growth and output. Okra's growth and yield significantly increased after the application of chicken manure, leading researchers to draw the conclusion that it is the best organic manure for maximizing okra yield.

RECOMMENDATIONS

Based on the findings of the study, it is recommended that poultry manure is the most suitable organic manure for okra production in the Northern guinea savannah ecology of Nigeria. Furthermore, recommendation for further research was made:

(i) Further multi trial and multi-location research should be carried out to suggest the most suitable dose of poultry manure to obtain the maximum profit.

(ii) Other organic manure such as Vermi compost, sesame cake should be given a trial.

(iii) The report also recommends that more research be done, such as testing various treatment combinations of organic and inorganic fertilizers to determine what outcomes might be obtained.

References

Abubakar, .M.S and Attanda, M.L (2013). The Concept of Sustainable Agriculture: Challenges and Prospect.5th International Conference of Mechatronics (ICOM 13). IOP Conference Series: Material Science and Engineering 53 (2013) 012001. https://doi:10.1088/1757-899X/53/1/012001

Abdulmaliq, S.Y., Abayomi, Y. A., Aduloju, M. O., and Olugbemi, O. (2016): Effects of Curing Period of Livestock Droppings on the Growth and Yield of Okra (*Abelmoschus esculentus* L.) Varieties. *International Journal of Agronomy Volume* 2016, Article ID 3513954, 7. http://dx.doi.org/10.1155/2016/3513954.

Adekiya, A. O., Aboyeji, C. M., Dunsin, O., Adebiyi, O. V. and Oyinlola, O. T. (2018) Effect of urea fertilizer and maize cob ash on soil chemical properties, growth, yield, and mineral composition of okra, *Abelmoschus esculentus* (L.) Moench. *J. Hortic. Res.* 26(1), 67–76. https://doi.org/10.2478/johr-2018-0008.

Adekiya AO., Ojeniyi SO., and Agbede M. T. (2012) Poultry manure effects on soil properties, leaf nutrient status, growth and yield of cocoyam in a tropical Alfisol. *Nigerian Journal of Soil Science*. 2012;22(2):30–39.

Akande, M.O., Oluwatoyinbo, F.I., Adediran, J.A. and Buari, K. (2003). Soil amendments affect the release of P from rock phosphate and the development and yield of Okra. *Journal of Vegetable Crop Production*, 9(2): 3-9, https://doi.org/10.1300/J068v09n02_02

Akinfosoye, J. A., Olufolaji, A. O. Tairu, F. M. and Adewoola, R. A. (1997). "Effect of different phosphorus levels on the yield of four cultivars of rain-fed tomato (*Lycopersicon esculentum* Mill.),"in *Proceedings of the 15th Annual Conference of Horticultural Society of Nigeria (HORTSON '97)*, pp. 65–66, Ibadan, Nigeria.

Ayeni, L. S., Adeleye, E, O. and Adejumo, J. O. (2012). Comparative effect of organic, organo mineral and mineral fertilizers on soil properties, nutrient uptake, growth and yield of Maize (Zea mays). *International Research Journal of Agricultural Science and Soil Science,*2(11), 493-497.

Afe, A. I., and Oluleye, F. (2017). Response of okra (*Abelmoschusesculenthus* L. Moench) to combined organic and inorganic foliar fertilizers. International Journal of Recycling of Organic Waste in Agriculture, 6(3), 189-193.

Bisht, I. S and Bhat, K. V. (2006). Okra (*Abelmoschus spp*.). In: Ram, J. Singh (Editors), CRC Press. Genetic Resources, chromosome engineering, and crop improvement. *Vegetable Crops*, 3, 147-183.

FAO (2006). The state of food and agriculture, Food and Agriculture Organization of the United Nations, Database.

Fagwalawa, L. D., and Yahaya, S. M. (2016). Effect organic manure on the growth and Yield of Okra. *Imperial Journal of Interdisciplinary Research*, 2(3), 130-133.

Farinde, A.J; Owolarafe, O.I; and Ogungbemi, O.I. (2007). An overview of production, processing, marketing and utilisation of Okra in Egbedore Local Government Area of Osun State, Nigeria. *Agricultural Engineering International: the CIGR Ejournal*. 9, 1-10.

Gemede, H. F; Ratta, N; Haki, G. D., Woldegiorgis, A. Z. and Beyen, F. (2015). Nutritional quality and health benefts of "okra" (*Abelmoschusesculentus*): *A review. Int. J. Nutr. Food Sci.* 4(2), 208–215

Gordon, W. B., Whitney, D. A. and Raney, R. A. (2003). Nitrogen management in furrow irrigated, ridge tilled corn. *J. Production Agric*. 6, 213-217

Green, B.W. (2015). *Fertilizers in aquaculture.* In: Davis, D. A., editor. *Feed and Feeding Practices in Aquaculture*. Sawston, Cambridge: Woodhead Publishing Ltd. p. 27-52

Ibeawuchi, I.K.; Onweremadu, E.U; and Oti, N.N (2006). Effects of Poultry Manure on Green (*Amaranthus cruentus*) and Waterleaf (*Talinum trinagulare*) on Degraded Ultisol of Owerri Southeastern Nigeria. *J. Animal and Vet. Advances,* 5, 53-56

Kambewa, E.V (2007). Contracting for Sustainability: An Analysis of the Lake Victoria-EU, Nile Perch Chain: Wageningen Pers, 2007.

Khandaker, M. M., Jusoh, N., Hafiza, N. A. A. R., and Ismail, S. Z. (2017). The effect of different types of organic fertilizers on growth and yield of *Abelmoschus esculentus*.Moench (Okra). *Bulgarian Journal of Agricultural Science*, 23(1), 119-125.

Kumar Olapede, A. O; Alade, C.B.R; and Olaniyi, J. O (2017). Irrigating okra with secondary treated municipal wastewater: Observations regarding plant growth and soil characteristics. *International Journal of Phytoremediation*, 19 (5), 490 -499,
` https://doi.org/10.1080/15226514.2016.1244169

Kwayep, L. N., Suh, C., Konje, C., Manga, A., Kenfo, T., Lombeko, V., and Djomo Sime, H. (2017). Effects of different soil amendments on the performance of okra (*Abelmoschus esculentus* L.) in a bimodal rainforest zone. *African Journal of Agricultural Research,* 12(24), 2056-2062

Masarirambi, M., Hlawe, M., Oseni, O., and Sibiya, T. (2007). "Effects of organic fertilizers on growth, yield, quality and sensory evaluation of red lettuce (*Lactuca sativa* L.) 'Veneza Roxa'," *Agriculture and Biology Journal of North America*, vol. 1, no. 6, pp. 1319–1324.

NRC (2006). Okra Lost Crops of Africa. National Research Council, Volume II: Vegetables. Washington, DC: The National Academies Press. https://doi.org/10.17226/11763

Oyolu, C. (2003) Okra Seeds: Potential source of high quality vegetable oil. in Proceedings of 5th Annual Conference Horticulture Society, Nigeria, Nsukka.

Oladipo, O. G., Olayinka, A. and Aduayi, E. A. (2005). Effects of organic amendments on microbial activity, N and P mineralization in an Alfisol. *Environ. Manage. J.* **2**, 30–40.

Olaniyi J. O., Kolawole, G.O., Olapede, A. O., Alade, C. R., (2010). Response of okra (*Abelmoschus esculentus*) varieties to NPK fertilizer in the South Guinea Savanna of Nigeria. Niger. *J. Horticult. Sci*. 13: 99-108.

Omotoso, S. O., Fawole, F. O., Aluko, M and Kehinde-Fadare, A. F. (2018). Growth and yield of two okra (*Abelmoschus escullentus L.Moench*) varieties as affected by organic fertilizer grown on an OxicPaleustalf in Ekiti State. *Global Advanced Research Journal of Agricultural Sciences*, Vol.7(4), 137-144.

Onunkun, O. (2012). Evaluation of Aqueous Extracts of five plants in the control of flea beetles on Okra (*Abelmoschus esculentus* (L.) Moench). *J. Biopest,* 5 (Supplementary). 62-67

Sustainable Agriculture Network (2002). What is Sustainable Agriculture? Retrieved October 9,2002 from http:// www.sare.org/htdocs/SANandSARE.html

Tisdale, S.L., Nelson, W. L., and Beaton, J. W. (2000). *Soil Fertility and fertilizers*. Macmillan Publishing Company, New York, 369-655 pp.

Togun, A.O., Akanbi, W.B., Adediran, T.A., Olabde, O.S. and Olaniyi, J.O., (2004). Effect of split application of organo-mineral fertilizer on okra growth, nutrient uptake and fruit yield. *Crop Research*, 29(2): 223- 239.

Young, A. (2007). *Agroforestry for soil management*. CAB International Wallingford Oxan OX10 8DE, UK, 98-100pp.

Zodape, S. T; Kawarkhe, V. J; Patolia, J. S and Warade A. D. (2008). "Effect of liquid seaweed fertilizer on yield and quality of okra (*Abelmoschus esculentus* L.). *Journal of Scientific & Industrial Research*, 67, 1115-1117.

ABOUT THE AUTHOR

Emeghara, Ursulla Ukamaka, Principal Lecturer, Federal College of Forest Resources Management Ishiagu, Ebonyi State, Nigeria.