

## Residual effect of poultry manure on growth and yield of okra

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### ABSTRACT

Field studies were conducted during 2011 and 2012 cropping seasons in the Teaching and Research Farm of the University of Agriculture, Makurdi to examine the residual effect of poultry manure on growth and yield of okra. The okra used was LD 88-1 obtained from National Horticultural Research Institute (NIHORT) Ibadan. The experiment was laid in a Randomized Complete Block Design (RCBD) with four treatments (0.00, 5.00, 10.00 and 15.00 t ha<sup>-1</sup>) and replicated thrice. The poultry manure was applied at the previous year cropping. Growth parameters measured at first and last harvests were plant height and number of primary branches. Pods were harvested at three day intervals with 10 harvests; length, girth and weight of fresh pods were determined. The result showed that there were significant differences between the treatments in most of the parameters assessed. Treatment 15.00 t ha<sup>-1</sup> had the highest values in all the parameters and was significantly different from other treatments in both cropping seasons. Tallest plants observed were 191.74 and 196.22 cm, highest number of primary branches were 9.07 and 10.01 in 2011 and 2012 cropping seasonings, respectively at 15.00 t ha<sup>-1</sup>. The highest yield was recorded for 15 t ha<sup>-1</sup> (7.86 and 7.94 t ha<sup>-1</sup>). In a nut shell, residual effect of 15 t ha<sup>-1</sup> performed better than other treatments. Therefore, it is recommended that 15 t ha<sup>-1</sup> rate of poultry manure be used for optimum growth and yield of okra.

**Keywords:** Poultry manure, residual effect, okra, growth, yield.

### INTRODUCTION

Okra production constitutes about 4.6 percent of the total staple food production in Nigeria in the year 1970 – 2003 (CBN, 2004). Okra is the most important fruit vegetable crop and a source of calorie (4550 Kcal/kg) for human consumption. It ranks first before other vegetable crops (Babatunde *et al.*, 2007). It is one of the most commonly grown vegetable crops in the tropics. Okra production worldwide is estimated at six million tons per year. In

West Africa, it is estimated at 500,000 to 600,000 tonnes per year (Burkil, 1997). The total area under cultivation has increased over the years. India is the world largest producer followed by Nigeria and Sudan (Varmudy, 2011). Okra cultivation and production has been widely practiced because of its importance to the economy development and can be found in almost every market in Africa. Varieties vary by plant height, size of fruit, color, early or late maturing etc., viz; white velvet, green

velvet, long pod, lady finger, dwarf green pods (Udoh *et al.*, 2005). Christo and Onuh (2005); Katung and Kashina (2005) documented that okra is consumed throughout Nigeria.

Okra contains carbohydrate, protein and vitamin C in large quantities (Adeboye and Oputa, 1996). The essential and non-essential amino acid which Okra contains is comparable to that of soybean (Farinde, 2007). It was also reported by Eke *et al.* (2008) that fresh okra fruit is a good source of vitamins, minerals and plant proteins. As a result, it plays a vital role in human diet; it can be consumed boiled, fried or cooked for the young immature fruits. In Nigeria, okra is usually boiled in water resulting in slimy soups and sauces, which are relished. The fruits also serve as soup thickeners (Schippers, 2000). The leaves, buds and flowers are also edible. Okra seed could be dried. The dried seed is a nutritious material that can be used to prepare vegetable curds, or roasted and ground to be used as coffee additive or substitute (Farinde *et al.*, 2001). Okra leaves are considered good cattle feed, but this is seldom compatible with primary use of the plant. Okra mucilage is suitable for medicinal and industrial applications. It has medically food application as a plasma replacement or blood volume expander. Industrially, okra mucilage is usually used in glazing certain papers and also useful in confectionery among other uses (Markose and Peter, 1990).

Okra production in the North Central of Nigeria often recorded low yield. The low yield experience has been attributed to poor soil fertility and deficiency in important mineral nutrients (Tan *et al.*, 2005). Also the extent to which farmers can depend on this input is constrained by unavailability of the right type of inorganic fertilizers at the right time, high cost, lack of technical know-how and lack of access to credit (Chude, 1999).

The organic matter of the soil which can be replenished and maintained by the application of animal manure has been considered by Roddy and Reddi, (1992) as the life of soil as well as store house of plant nutrients. Hence animal wastes that result to animal manures is better alternative and a necessary option.

Animal manure plays a vital role in the soil fertility and productivity and act as a reservoir of plant nutrients especially nitrogen, phosphorous, potassium and micronutrients and as well prevents leaching of nutrients. Poultry manure, Goat manure and Pig manure are very good sources of organic matter and play a vital role in soil fertility improvement as well as supplying primary, secondary and micronutrients for crop production. Nutrients contained in organic manures are released more slowly and are stored for a longer period in the soil ensuring longer residual effects, improved root development and higher crop yields (Sharma and Mittra, 1991). Ramamurthy and Shivashankar (1996) reported that organic fertilizers applied to preceding crops had a remarkable residual effect on yield and yield contributing components of succeeding crop. It was concluded that the residual effect of green manure may double the yield of subsequent cereal crop (Ghosh, 1980). In another study, residual effect was equivalent to 20% of NPK as chemical fertilizers on the yield of succeeding wheat and winter maize in rice-wheat and rice-maize cropping systems (Prasad, 1994). For long term sustainability of soil fertility and environment, it seems a better option to use organic wastes. Thus the present study was undertaken to assess the effectiveness of residual effect of poultry manure on growth and yield of Okra.

## **MATERIALS AND METHOD**

The study was conducted in the Teaching and Research Farm of the University of

Agriculture, Makurdi, Nigeria during 2011 and 2012 cropping seasons. The study area is located at latitude  $7^{\circ} 41'N$  and longitude  $8^{\circ} 31'E$ . The soil of the experimental site is inceptisol, classified as typic Ustropepts (USDA) or Eutric cambisols (FAO), (FDALR, 1990). The site was fertilized with poultry manure at different rates in the previous year. Poultry manure was applied in 2010 and 2011 to different plots and residual effect was monitored in 2011 for 2010 application and 2012 for 2011 application.

The trial consisted of four rates of poultry manure: 0.00, 5.00, 10.00 and 15.00 t ha<sup>-1</sup>. The poultry manures were applied at the previous year cropping. The experiment was laid out in a randomized complete block design (RCBD) with three replicates in plot size 5 m x 4 m. The site was cleared and cultivated manually. Okra seeds (LD 88-1) were sown at a spacing of 50 cm within rows and 75 cm between rows at three seeds per hole and were thinned to two per stand, two weeks after planting. Weeding was done manually at 3 and 6 weeks after planting.

As a measure of growth, the following data were collected from growing plant at first and last harvest; plant height and number of primary branches. Pods were harvested at three day intervals with 10 harvests, length, girth and weight of fresh pods were determined. Data collected were subjected to analysis of variance (ANOVA). Significant means were compared using Duncan New Multiple Range Test (DNMRT) at 5% probability level.

Surface soil samples (0-15 cm) were taken prior to the application of treatments in 2010 and 2011 and each year has a different plots. The pre-treatment samples comprised of a composite sample made up of 20 cores per

experimental site. Soil samples were taken at the end of previous planting season on the bases of treatments. The samples comprised of a composite sample of four cores per plot. The soil samples were air-dried sieved to pass through a 2-mm mesh prior to analysis. Particle size as determined by hydrometer method (Bouyocous, 1981), while soil pH was determined in a 1:1 soil to water suspension using a pH meter. Organic carbon was determined by wet oxidation method (Nelson and Sommers, 1982). While total Nitrogen was done by Macro-kjeldahl method and available P by Bray-1 method (Bray and Kurtz, 1945). Exchange bases were extracted with neutral IM NH<sub>4</sub>OAc at a soil solution ratio of 1:10 and measured by flame photometry. Magnesium was determined with an atomic absorption spectrophotometer. Exchange acidity was determined by titration method (McClean, 1982).

## RESULTS

Textural and soil chemical properties of the experimental site is presented in Table 1. The results of the analysis showed that the soil is slightly acidic with pH of 6.01 and 6.02 in 2010 and 2011, respectively. The results of chemical analysis indicated that soil was low in organic matter, nitrogen, available phosphorus and magnesium. Other nutrient elements such as potassium, calcium and sodium were also low, cation exchange capacity was moderate. The particle size distribution shows that the soil is sandy loam.

Nutrients analysis of poultry manure used is also presented in Table 1. The values for N, P, K, Ca and Mg in the poultry manure were adequate for the growth of vegetable crop such as okra.

**Table 1.** Soil properties of the experimental site and nutrients analysis of poultry manure used

Soil samples Properties	2010 Values	2011 Values	Poultry manure Properties	2010 Values	2011 Values
pH(H <sub>2</sub> O)	6.01	6.02	pH(H <sub>2</sub> O)	6.70	6.89
Org. M (g kg <sup>-1</sup> )	1.79	1.78	N (%)	2.83	2.91
Total N (g kg <sup>-1</sup> )	0.09	0.10	P (%)	0.88	0.89
Avail. P (mg kg <sup>-1</sup> )	8.70	8.71	K (%)	4.50	4.52
Na (cmol kg <sup>-1</sup> )	0.12	0.14	Ca (%)	1.23	1.26
K (cmol kg <sup>-1</sup> )	0.06	0.05	Mg (%)	0.58	0.59
Ca (cmol kg <sup>-1</sup> )	3.79	3.78	Na (%)	0.37	0.36
Mg (cmol kg <sup>-1</sup> )	1.30	1.29	OM (%)	37.01	36.98
Exch. A (cmol kg <sup>-1</sup> )	0.36	0.37			
CEC (cmol kg <sup>-1</sup> )	2.13	2.14			
Sand (%)	78.21	77.63			
Silt (%)	13.54	13.06			
Clay (%)	8.25	9.31			
Textural class	Sandy loam	Sandy loam			

### Growth parameters

The residual effect on plant height is presented in Table 2. The results at 1<sup>st</sup> harvest in 2011 indicated that plot that received 15.00 t ha<sup>-1</sup> of poultry manure had the tallest plant height (177.26 cm) that was statistically similar with height produced by 10.00 t ha<sup>-1</sup> (170.32 cm) and significantly higher than other treatments. Treatments 5.00 and 10.00 t ha<sup>-1</sup> recorded 155.02 and 170.32 cm, respectively and statistically similar. The plant that received 5.00 t ha<sup>-1</sup> was significantly taller than control. The shortest plant height of 121.43 cm was obtained from the control plot and was statistically lower than all treatments. The

results obtained in 2012 were similar to what was observed in 2011.

Plant height results at last harvest showed that treatment 15.00 t ha<sup>-1</sup> and 10.00 t ha<sup>-1</sup> recorded 191.74 and 189.54 cm, respectively and showed no statistical different, but were taller significantly than the other treatments. The plot treated with 5.00 t ha<sup>-1</sup> produced 168.95 cm height and was lower statistically than 10.00 t ha<sup>-1</sup> and 15.00 t ha<sup>-1</sup> but higher than control. The plant height (138.26 cm) observed at control showed that it was the short plant and lower statistically than all the poultry manure rates. The 2012 cropping season showed similar trend to 2011 cropping seasons' results.

**Table 2.** Residual effect on Plant height (cm)

Treatments	1st harvest		last harvest	
	2011	2012	2011	2012
0.00 t ha <sup>-1</sup>	121.43c	123.51c	138.26c	131.07c
5.00 t ha <sup>-1</sup>	155.02b	151.76b	168.95b	170.01b
10.00 t ha <sup>-1</sup>	170.32ab	176.22ab	189.54a	188.78a
15.00 t ha <sup>-1</sup>	177.26a	179.86a	191.74a	196.22a

Means sharing similar letter (s) in a column do not differ significantly at  $p=0.05$

The results of the effect of residual poultry manure on primary branches are presented in Table 3. The table showed significant differences in the 1<sup>st</sup> and last harvest in both cropping seasons. Poultry manure at 15 t ha<sup>-1</sup> had the highest number of primary branches (8.01) which was followed by 10.00 t ha<sup>-1</sup> that recorded a mean value of 6.9 primary branches. Poultry manure at 15 t ha<sup>-1</sup> was higher significantly than other rates. All the poultry manure rates were statistically different from each other. The least mean value of primary branches 2.95 was observed at the control plot.

In 2012 cropping season, the highest number of primary branches (7.52) of okra was

obtained at 15.00 t ha<sup>-1</sup> which was similar statistically with treatment 10.00 t ha<sup>-1</sup>. The least number of primary branches of okra was obtained from the control which had 3.11 mean values. At last harvest, the mean values of treatments 10.00 and 15.00 t ha<sup>-1</sup> were 8.21 and 9.07, respectively. These treatments were statistically similar and significantly different from others. The plots that received 5.00 t ha<sup>-1</sup> recorded 6.11 mean of primary branches and higher significantly than control. This result indicated that control had the least mean number of primary branches (4.75). The observation in 2012 cropping season showed similar trend to 2011 cropping seasons' results.

**Table 3.** Residual effect on number of primary branches

Treatments	1st harvest		last harvest	
	2011	2012	2011	2012
0.00 t ha <sup>-1</sup>	2.95d	3.11c	4.75c	4.23c
5.00 t ha <sup>-1</sup>	4.21c	4.55b	6.11b	7.04b
10.00 t ha <sup>-1</sup>	6.92b	7.23a	8.21a	9.85a
15.00 t ha <sup>-1</sup>	8.01a	7.52a	9.07a	10.01a

Means sharing similar letter (s) in a column do not differ significantly at  $p=0.05$

### Yield parameters

The yield parameters obtained from experiment is presented in Table 4. In 2011, the longest pod length of 8.56 cm was obtained from 15.00 t ha<sup>-1</sup> of poultry manure and statistically similar with 8.01 cm obtained from plots that received 10 t ha<sup>-1</sup> of poultry manure. These two rates were

significantly higher than other rates. Pod length (6.11 cm) recorded at 5.00 t ha<sup>-1</sup> was significantly higher than what was obtained at the control (5.26 cm). Control plots recorded the shortest pod length and significantly lower than other manure rates. The two cropping seasons had similar trend.

The girth increases with increased rate of poultry manure. Although, there were no significant difference among rates of poultry manure.

The fresh pod yield obtained was highest for plot treated with 15 t ha<sup>-1</sup> of poultry manure in both cropping seasons (7.86 and 7.94 t ha<sup>-1</sup>, respectively) which was significantly higher than all other treatments. This was followed by 10 t ha<sup>-1</sup> of poultry manure

(7.36 and 7.12 t ha<sup>-1</sup>, respectively) which was significantly higher than 5.00 t ha<sup>-1</sup> and control. The lowest pod yield was obtained from the control (3.08 and 3.06 t ha<sup>-1</sup>, respectively) which was significantly lower than all other treatments. There was no significant different between the cropping seasons.

**Table 4.** Residual effect on yield parameters

Treatments	Pod length (cm)		Girth (cm)		Fresh pod weight (t ha <sup>-1</sup> )	
	2011	2012	2011	2012	2011	2012
0.00 t ha <sup>-1</sup>	5.26c	5.02c	2.01a	2.04a	3.08d	3.06d
5.00 t ha <sup>-1</sup>	6.11b	6.63b	2.01a	2.09a	6.21c	6.48c
10.00 t ha <sup>-1</sup>	8.01a	8.23a	2.16a	2.17a	7.36b	7.12b
15.00 t ha <sup>-1</sup>	8.56a	8.72a	2.18a	2.20a	7.86a	7.94a

Means sharing similar letter (s) in a column do not differ significantly at *p*=0.05

## DISCUSSION

The positive effect of organic manure on plant height and primary branches could be due to the contribution made by manure to fertility status of the soils as the soils were low in organic carbon content. This confirms findings of Akande *et al.* (2003) that application of organic materials could ameliorate slightly acidic tropical soil to improve crop production. Organic fertilizer plays vital role as a major contributor of plant nutrients. It also acts as a store house for cation exchange capacity and as a buffering agent against undesirable pH fluctuation (Adepetu and Corey, 1975). The poor development of vegetative characters observed in treatment without manure (control) further confirmed the report of Akanbi *et al* (2000) and Akanbi 2002, that nutrient availability especially nitrogen determine plant vegetative grow. It can be adduced that increasing level of poultry manure could have resulted in an increase in the amount of nitrogen made available to the plants through mineralization and nitrogen is known to stimulate growth in plants

(Anyaeibu *et al.*, 2010). The better growth performance due to application of poultry manure can be attributed to the lower C:N ratios (Maerere *et al.*, 2001)

The non-significant difference observed in the treatments supplied with girth of the okra studied is perhaps more of genetic than an environmental trait. Significant increase in pod length and weight of okra due to poultry manure application could be attributed to easy solubilization effect of released plant nutrient leading to improve nutrient status of the soil. The results obtained were in agreement with the findings of Sanwal *et al.* (2007) in turmeric (*Curcuma longa*) Premsekhar and Rajashree (2009) in okra (*A. esculentus*) in which they reported that higher yield response of crops due to organic manure application could be attributed to improved physical and biological properties of the soil resulting in better supply of nutrients to the plants. Higher rate of poultry manure showed a better residual response in increasing okra yield as it contains a wide range of macro

and micro nutrients required for plant growth. The results obtained were in agreement with the findings of Shah and Anwar (2003). There was a general improvement in the growth and yield of *Jatropha curcas* due to application of poultry manure but the degree of such improvement increased with rate of application (Onwu *et al.*, 2017)

The residual effect of poultry manure had a significant effect on growth and yield of okra. The results obtained revealed that okra responded well to the residual effect of poultry manure compared to the control treatment in the study. Based on the finding of this study, it may be recommended that, the used of organic manure in crop production is desirable as it had variable impacts on the growth and yield of crops. The residual effect of poultry manure at 15 t ha<sup>-1</sup> performed better than other treatments, therefore, it may be recommended that 15 t ha<sup>-1</sup> rate of poultry manure be used for optimum growth and yield of okra.

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