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Effects of Organic Manure on the Growth Parameters and Yield of Okra in Anyigba, Kogi State, North Central, Nigeria

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Abstract

A field study was carried out during the 2014 cropping season in Kogi State University Teaching and Research Farm, Anyigba to examine the effect of organic manure such as cow dung, poultry waste, rabbit droppings and swine dung on growth and yield of okra (*Abelmoschusesculentus L Moench*). The crop used was velvet 35obtained from National Horticultural Research Institute (NIHORT) Ibadan. The experiment was laid in a Randomized Complete Block Design (RCBD) with five treatments and four replications under rain-fed conditions. The organic manures were applied at the rate of 7 ton/ha each using drill method two weeks before planting. Data were taken on the growth and yield parameters. Parameters such as plants height, numbers of leaves, plant girth, length and weight of fruits were taken at 2, 4, 6, and 8 weeks after sowing. The result showed that there were significant differences between the treatments in most of the parameters assessed. Poultry manure had the highest values in all the parameters and was significantly different from other treatments and control. Highest height was observed in poultry dropping (12.3cm & 21.88cm) at 4 and 6 WAS, poultry droppings had the highest number of leaves (3.75, 7.60 & 11.23) at 2, 4 and 6 WAS and also had the highest girth at 6 WAS (3.1cm), the highest fruit length was recorded for poultry waste with mean of (9.18) at 8WAS, while the highest yield was recorded for poultry waste (555kg/ha). In a nut shell, poultry manure performed better than other treatments, therefore, it may be recommended that a higher rate of poultry manure be used for optimum growth and yield of okra.

Keywords

Drill Method, Rain-Fed, Velvet 35, Replication, Optimum, Organic Manure, Poultry Manure, Rabbit Dropping, Swine Dung

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1. Introduction

Okra (*Abelmoschusesculentus L. (Moench))* from the plant family *Malvaceae* is of Africa origin. It is an important soup condiment in Nigeria. It is rich in vitamins, minerals and has several medicinal values as well. It is consumed throughout Nigeria (Christo and Onuh (2005), and ranked third in production, after tomato and onion (Grubben, 1997). The seeds can be used as source of edible oil as well as in the soup industry (Oyolu, 1983). Okra is an important vegetable as its contribution to Ghana's Agricultural Gross Domestic Product (GDP) was 32,309,445,186, U.S Dollars (FAO, 2011). It is a high value crop producing excellent income, generating opportunities to small scale farmers (Selleck and Opena 1985). Okra production in Nigeria often recorded low yield, the low yield experience has been attributed to poor soil fertility and deficiency in important mineral nutrients. Use of organic manures to meet the nutrient requirement of crop would be an inevitable practice in the years to come for sustainable agriculture since, organic manures generally improve the soil physical, chemical and biological properties along with conserving the moisture holding capacity of soil

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and thus resulting in enhanced crop productivity along with maintaining the quality of crop produce (Maheswarappa *et al*., 1999). Different opinions have been expressed with regards to okra fertilization using organic manures like poultry droppings and cow dung. For instance, Schippers (2000) recommended poultry manure to be applied at the rate of 20tonnes/ha before sowing. Currently, the utilization of these organic materials in soil fertility management in Africa is not encouraging when compared with the countries in Asia (Agboola and Omueti, 1985). Many workers have tried to assess the importance of organic manures in crop production. Senjobi *et al.* (2010) reported that the use of poultry, sheep/goat manures improved all the growth parameters of the leaf vegetable they worked with. Other workers have reported beneficial effects of organic manure on soil properties such as bulk density (Fawole *et al*, 2010); soil moisture content (Adeleye *et al*, 2010); water–holding capacity and other soil physical properties (Fawole *et. al.* 2010). According to Ojeniyi (2000), published works on the organic manure use in Nigeria is rather scanty. 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. Hence animal wastes that result to animal manure is a better alternative and a necessary option. The broad objective is to determine the role of organic fertilizer on the growth and yield of okra and the specific objectives are to determine the influence of organic manure on the growth and yield of okra, ascertain the nutrient management practice for optimum growth and yield of okra and to determine which of the organic manure used performed best

2. Materials and Methods

Location of the Experiment: Field trials were conducted during the cropping seasons of 2014at the Kogi State University Student Research and Demonstration Farm, Anyigba. Anyigba is located on (latitude $7^{0}29^{1}$N and longitude $7^{0}11^{1}$E) in the Southern Guinea Savana agro-ecological zone of Nigeria. It has a bimodal rainfall pattern with the peak occurring in July and September. The mean annual rainfall is 1,808mm (Amhakian *et al.,* 2012). The temperature varies from 17°C to 36°C and the relative humidity is moderately high and varies from an average of 65-85% throughout the year (Amhakhian *et al.,* 2012)

S0ilAnalysis: Samples were randomly taken from six (6) different locations at the site using a soil auger at a soil depth of 0-15cm deep prior to manure application and a composite sample was taken. The sample was air dried, ground and sieve to pass through 2mm sieve before being subjected to routine physical and chemical analysis. Particle size was determined using the hydrometer method (Bouyoucos 1962). Soil pH was measured in a soil: water of 1:2 with the aid of glass electrode pH meter (Maclean, 1982). Organic carbon was determined using wet dichromate method (Nelson and Sommers, 1996). Exchangeable bases (Ca, Mg and Na) were extracted with 1 N NH_4OAC buffered at pH 7 (Thomas, 1982). The Ca and Mg was determined using atomic absorption spectrophotometer. P and Na were read on flame photometer. Exchange acidity was extracted with 1 N KCL (Thomas, 1982) and determined by titration with 0.05 N NaOH using phenolphthalein as indicator. Nitrogen was determined using macro Kjedahl method (Bremner and Mulvaney, 1982). Effective Cation Exchange Capacity (ECEC) was calculated by the summation of exchangeable bases (Ca, Mg, K and Na) and exchange acidity (Carter, 1993). Percentage base saturation (PBS) was calculated by multiplying total exchangeable bases by 100 and dividing by ECEC. Total P was determined by perchloric acid ($HCLO_4$) digestion method (Murphy and Riley, 1962). Available P was estimated using Bray P-1 extraction method (Bray and Kurtz, 1945).

Agronomic Practices: 118.75m^2 land areas was ploughed, harrowed and ridged at 75cm apart at the Kogi State University Student's Research and Demonstration Farm. The experiment had five plots replicated four times. They include control, poultry waste, cow dung, rabbit droppings and swine dung at a rate of 7ton/ ha each using drill method and left for about two weeks before planting in order to equilibrate with the soil. These were laid in a Randomized Complete Block Design (RCBD). The test crop was velvet 35 and obtained from National Horticultural Research Institute (NIHORT), Ibadan. The seeds were soaked a night and drained before planting to aid quick germination. Seeds were sown at the recommended spacing of 30cm apart on a row at a depth of 2cm with two seed per hole which was later thinned to one at two weeks of after emergence. A mixture of cypermethrin and imidacloprid was sprayed at 100ml/20L of water according to the prescription to control insect pest. Weeding was conducted manually using hoe as at when necessary weeks after sowing in order to reduce weed competition. Harvesting was carried out over two months after sowing by hand picking of the fresh pods. Fruits were measured with an electronic weighing scale immediately after harvest.

Datas were generated from 3 sampled plants from the 1st, 2nd and 3rd ridge from each plot. These data included growth and yield parameters. Plant height; this was measured from the soil surface to the tip of the youngest fully opened leaf. Number of leaves; this was done by counting the number of leaves on every tagged plant in the net plot. The average number of leaves was then determined. Stem girth; this was the measurement of the girth from 5cm above the ground

level. It was done using a thread. Length of fruit; this was measured using thread from the base of the fruit to the tip, weight of fruit; this was measured with an electronic weighing scale. Yield per hectare was determined. The data collected was subjected to Analysis of Variance (ANOVA) and Fisher's- LSD test was applied to check the least significant difference among treatment means as described by Steel and Torrie, 1980.

3. Results and Discussions

Physical and chemical properties of the soil and manure: The characteristics of the soil used for the study are shown in Table 1. The result of the physiochemical and characteristics shows that the soil texture was loamy sand. This loamy sand is acceptable as a slightly acid soil is desirable for most vegetables with pH 6.0-7.0 which is ideal for vegetable production. The sand content was found to be high (87.52%), average in clay (10.92%) and low in silt (3.28%). The soil Ca was (2.94 cmol/kg), Mg (1.06 cmol/kg,), K (1.90 cmol/kg), Na(0.69cmol/kg), CEC (6.59), ECEC (7.66), percentage base saturation (86.03 %), exchangeable bases (6.59) cmol/kg, exchangeable acidity (1.07) cmol/kg percentage organic matter(0.45%), % total N(0.13%), organic carbon (0.25%), pH (6.3) and available P (6.43ppm).

Table 1. The physicochemical properties of the soil used for the study before planting.

Soil sample desired	pH	% sand	% silt	% clay	Cmol/kg Ca	Cmol/kg Mg	Cmol/kg K	Cmol/kg Na	ECEC	CEC	% Base Sat	% O.M	% N	Av.P (PPM	%O.C
Soil	6.3	87.52	1.56	10.92	2.94	1.06	1.90	0.69	7.66	6.59	86.03	0.45	0.013	6.43	0.26

The pH of the soil measured recorded a value of (6.3). Landon (1996) reported that soil with pH value >8.5 are rated very high, 7.0-8.5 high, 5.5-7.0 medium and <5.5 low. Based on these ratings, the pH of the soil could be rated as medium. The percent organic carbon content of the soil was (0.26%) and that obtained for organic matter was (0.45%). According to Landon (1996), soil containing organic carbon >20% is rated as very high, 10-20% high, 4-10% medium, 2-4% low and <2% very low. With reference to these ratings, the percent organic carbon could be described as very low. This could be attributed to lack of addition of organic materials in form of crop residues and farm yard manure. The value obtained for total N (0.013) was very low. As reported by Landon (1996) percent total N content in soil >1.0 is rated as very high, 0.5-1.0 high, 0.2-0.5 medium, 0.1-0.2 low and <0.1 very low. The available P content of the soil (6.43) could be rated as low. Page *et al*. (1982) in referring to concentration of P soluble in dilute acid fluoride gave the following ratings <3mg/kg very low, 3-7mg/kg low, 7-20mg/kg medium and >20mg/kg high. The soil recorded a low amount of calcium (2.94 cmol/kg). Landon (1996) rated soils having Ca >10cmol/kg as high and <4cmol/kg as low. The magnesium content of the soil was 1.06cmol/kg. Mg content <0.2 cmol/kg is rated low, 0.2-0.5 cmol/kg medium and >0.5 cmol/kg high (Landon, 1996). Based on these ratings, the soil could be rated as having a high Mg content. The exchangeable potassium concentration of the soil sample recorded was 1.90cmol/kg and sodium was 0.69 cmol/kg.

Effects of treatments on plant height (cm)

Organic manure appears not to have any significant effect on plant height at 2 and 8 weeks after sowing (Tab. 3) however at 4 and 6 WAS, application of organic manure significantly ($P \leq 0.05$) influenced plant height. Poultry waste consistently produced taller plants at 4WAS (12.3) which is significantly different from rabbit dropping (9.3), swine dung (9.0) and control (8.5). At 6 WAS, poultry waste gave the highest (21.9) which is significantly different from rabbit dropping (17.7), swine dung (15.0) and control (14.9) however, application of poultry waste and cow dung with reference to plant height was statistically at per or the same at 4 WAS. The shortest plants were obtained from control.

Table 2. The chemical properties of the manures used for the study.

Sample	N (%)	P (%)	K (%)	Ca (mg/kg)	Mg (mg/kg)
Cow dung	2.40	1.40	2.08	7010	4030
Poultry Waste	3.83	1.88	2.45	1520	5100
Rabbit dropping	2.10	0.60	1.27	3129	452
Swine dropping	1.96	0.72	1.04	8121	311

Table 3. Effects of treatments on plant height (cm).

Treatment	2WAS	4WAS	6WAS	8WAS
Cow dung	19.8	10.8^{ab}	17.7^{b}	32.4
Rabbit droppings	19.3	9.3^{bc}	17.7^{b}	31.7
Poultry waste	20.0	12.3^{a}	21.9^{a}	39.8
Swine dung	18.4	9.0^{bc}	15.0^{bc}	31.5
Control	16.4	8.5^{c}	14.9^{c}	27.2
Significance	NS	*	*	NS
C.V (%)	8.8	14.2	13.6	15.7
L.S.D	-	2.2	3.67	-

Means followed by the same letter(s) within a treatment is not significantly different at 5% level of test or probability.

Effects of treatments on number of leaves.

Application of organic manure significantly produced higher number of leaves per plant at 2, 4, & 6 WAS (Tab. 4). Poultry waste consistently produced the highest number of leaves per plant throughout the period of sampling. The least number of leaves produced per plant were recorded from control plots.

Plots treated with poultry waste produced approximately values of 11.23 and 10.65 and were recorded for the average number of leaves for poultry waste and cow dung respectively at 6 WAS, their values were however not statistically different from each other.

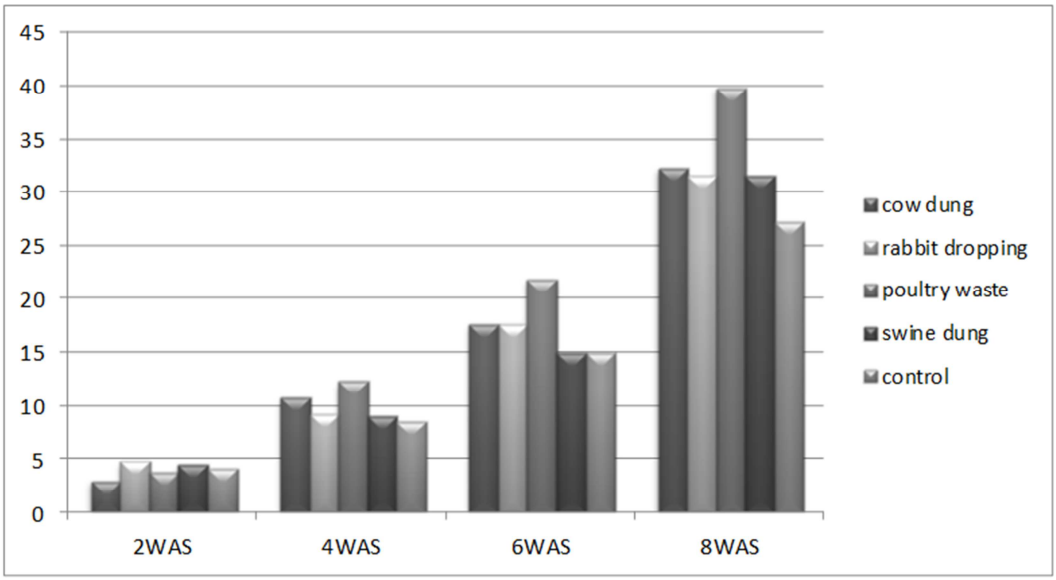

Fig. 1. Effects of treatments on plant height.

Table 4. Effects of treatments on the number of Okra leaves.

Treatment	2WAS	4WAS	6WAS	8WAS
Cow dung	3.68^{ab}	7.00^{b}	10.65^{ab}	21.10
Rabbit droppings	3.65^{ab}	6.18^{c}	8.93^{bc}	17.35
Poultry waste	3.75^{a}	7.60^{a}	11.23^{a}	21.65
Swine dung	3.25^{c}	6.18^{c}	8.90^{c}	17.10
Control	3.08^{c}	6.08^{c}	7.75^{c}	15.08
Significance	*	**	*	NS
C.V (%)	9.5	5.7	13.0	17.1
L.S.D	0.51	0.6	1.91	-

Means followed by the same letter(s) within a treatment are not significantly different at 5% level of test or probability.

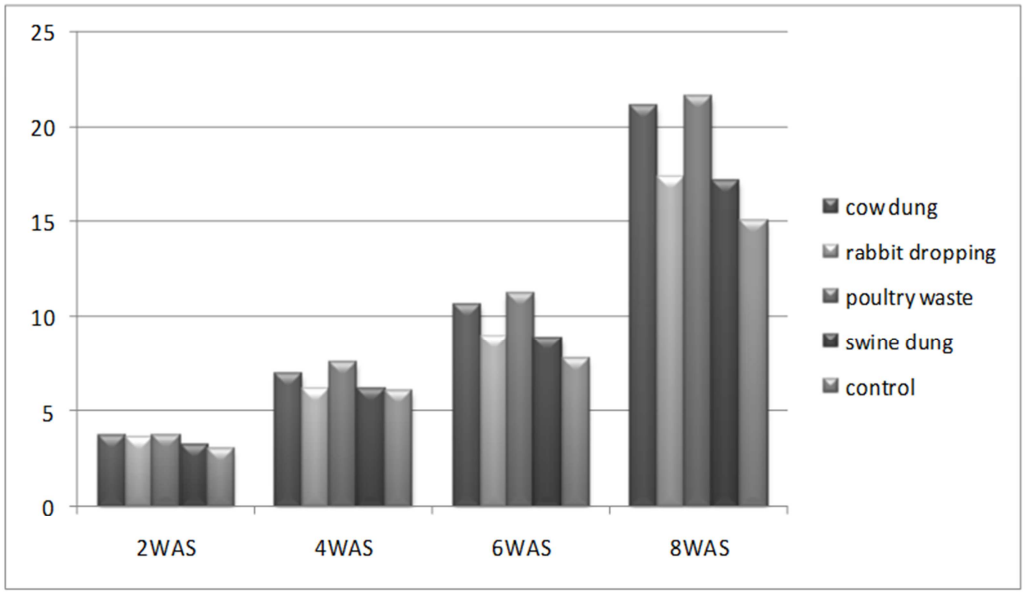

Fig. 2. Effects of treatments on nuumber of Okra leaves.

Effects of treatments on Okra girth (cm).

Application of organic manure has no influence on the girth size of okra at 2, 4 and 8 WAS. (Tab. 5). However, at 6WAS application of organic manure significantly produced larger girth than the control. Application of poultry waste significantly produced 3.10cm than other sources of organic manure. Swine dung, rabbit droppings and cow dung respectively produced 2.5, 2.5 and 3.0 (cm) girth diameter at 6WAS, this was however not statistically different at 5% level of test.

Table 5. Effects of treatments on Okra girth (cm).

Treatment	2WAS	4WAS	6WAS	8WAS
Cow dung	1.10	1.80	3.00^{ab}	4.20
Rabbit droppings	1.10	1.50	2.50^{ab}	4.00
Poultry waste	1.10	1.90	3.10^{a}	4.40
Swine dung	0.90	1.40	2.50^{ab}	4.00
Control	0.90	1.10	2.20^{b}	3.30
Significance	NS	NS	*	NS
C.V (%)	13.90	23.50	16.10	12.80
L.S.D	-	-	0.65	-

Means followed by the same letter(s) within a treatment is not significantly different at 5% level of test or probability

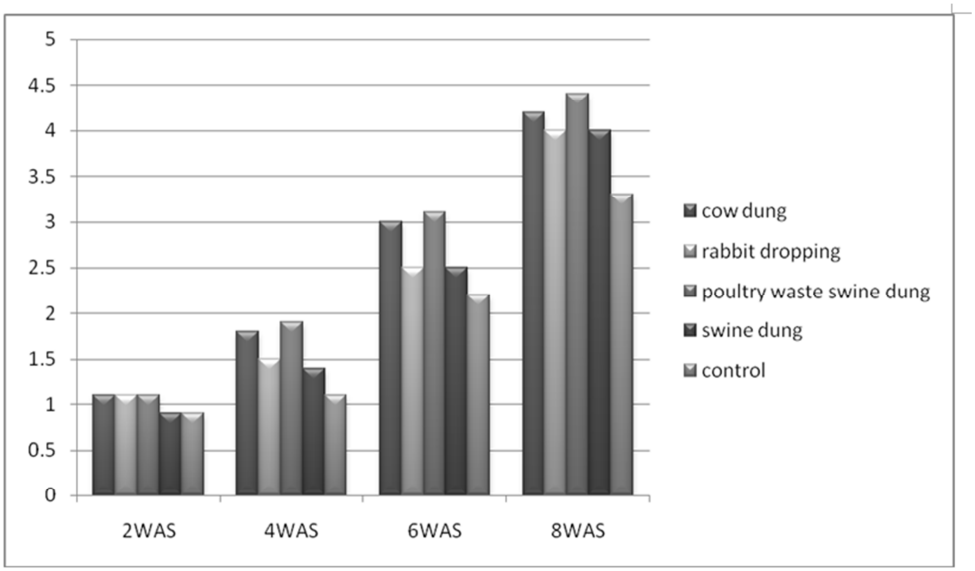

Fig. 3. Effects of treatments on plant girth (cm).

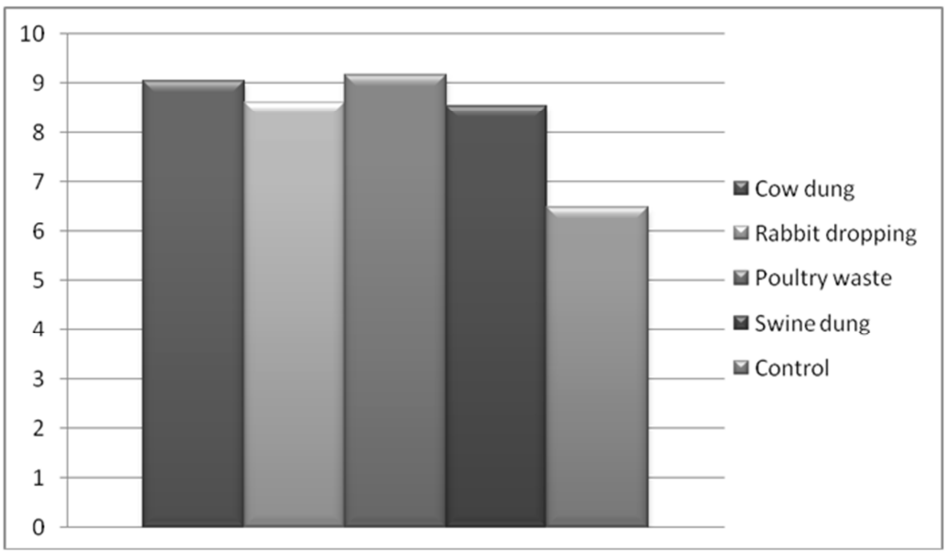

Fig. 4. Effect of treatments on fruit length (cm).

Fruit length produced per plant was not statistically different when various sources of organic manure were applied at 8 WAS (Tab. 6). However, poultry waste gave the highest length (9.18), while control gave the lowest length (6.50).

Table 6. Effect of treatments on length of Okra fruit (cm).

Treatment	Mean (8WAS)
Cow dung	9.05
Rabbit droppings	8.63
Poultry waste	9.18
Swine dung	8.55
Control	6.50
Significance	NS
C.V (%)	20.60
L.S.D	-

The final okra weight is shown in (Tab. 7). Poultry waste was significantly different from others. Poultry manure gave the highest fruit yield of 276.6g/plant as compared to the controlled which gave the lowest 103.5g/plant. Although there was no significant difference among cow dung (167.6), rabbit dropping (154.8) and swine dung (137.8), but there was a significant difference between swine dung and control.

Table 7. Effects of treatments on fruit weight (g).

Treatment	Mean (8WAS)
Cow dung	167.6^{b}
Rabbit droppings	154.8^{b}
Poultry waste	276.6^{a}
Swine dung	137.8^{b}
Control	103.5^{c}
Significance	*
C.V (%)	38.8
L.S.D	100.4

Means followed by the same letter(s) within a treatment is not significantly different at 5% level of test or probability.

4. Discussion

From the results of the physical and chemical analysis of the soils used for the trial, it was obvious that the fertility status of the soil was inherently low, based to the nutrients rating for soil fertility classes in Nigeria (Obigbesan, 2000) and this implies that cropping the soil without the use of soil amendments will not be economical, there is need to supplement with organic manures. Results obtained before planting indicated that Poultry manure had higher values of N, P, and K required for the growth of vegetable crop such as okra. According to Landon (1996) rated nitrogen content of the soil to be very high when it is > 1.0 and phosphorus to be very low when it is <3mg/kg. Therefore the manure was very high in N and very low in phosphorus. These nutrients have been implicated in the synthesis of chlorophyll and enhancement of foliage growth in plants (Ramlingam, 2003). This was followed by cow dung, rabbit dropping and swine dung respectively. This shows that poultry manure was easily available and in the best form for easy absorption by the plant roots, hence there was a boost in the morphological growth of the plant. The result corroborated with the findings of Ajari et al., (2003) in okra production in which they reported that organic manure especially poultry manure could increase plant height of crops when compared with other sources of manures. The increase in number of leaves per plant, fruit length and plant girth with organic fertilizer application stressed its importance during the vegetative growth of plants (Tindall, 1992). The increase in fresh pod weight of okra due to poultry manure application could be attributed to easy solubilization effect of released plant nutrient leading to improved nutrient status and water holding capacity 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 (*Abelmoscusesculentus*) 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 plants. 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 play 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.

5. Conclusion and Recommendations

In all the sources of organic manure tried, poultry manure gave the highest influence on growth and yield of okra. This may not be unconnected with the high rate of mineralization and nutrient level in it. These characteristics will ultimately lead to high rate of water absorption, high level of nutrient and ultimately high rate of photosynthesis. With high photosynthesis, more growth and yield will be recorded. Based on the findings of this study, it may be recommended that a higher rate of poultry manure and cow dung should be used given the low fertility status of the soil. Also, it is recommended that organic manure be made into easily handled packages for easy use, that is, in pelletized forms.

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