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Full Length Research Paper

Growth and yield responses of cucumber to five different rates of poultry manure in Asaba area of Delta state, Nigeria

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ABSTRACT

Field experiments were conducted in 2011 and 2012 cropping seasons in the Teaching and Research Farm of Delta State University, Asaba Campus, Nigeria to evaluate the growth and yield responses of cucumber to five different rates of poultry manure. The study was carried out in a Randomized Complete Block Design (RCBD) with three replicates. Rates of poultry manure in tons per hectare were 0, 5, 10, 15 and 20, while the parameters investigated were vine length, number of leaves per plant, fruit diameter (cm), fruit length (cm), and fruit weight of cucumber at harvest. Data collected were subjected to analysis of variance (ANOVA), and means separated using Duncan Multiple Range Test (DMRT). The results of the study showed that parameters assessed were significantly influenced by the application of poultry manure. At 4, 6 and 8 weeks after planting, plants that received highest rate of poultry manure (20 tha^{-1}) were superior in the parameters tested with mean vine length of 116.2 cm, 144.5 cm, and 167.3 cm, respectively, mean number of leaves of 14.6, 46.3, and 56.4, respectively, mean fruit diameter of 16.7 cm, mean fruit length of 22.6 cm and mean fruit weight of 49.3 tha^{-1} in 2011 and 2012. Based on the findings of the study, it was recommended that farmers in the study area apply 20 tha^{-1} of poultry manure for increased growth and yield of cucumber.

Keywords: Growth and yield of Cucumber, rates of poultry manure, Asaba, Nigeria.

INTRODUCTION

Cucumber (*Cucumis sativa L*) is one of the monoecious annual crops in the Cucurbitaceae family that has been cultivated by man for over 3, 000 years (Adetula and Denton, 2003; Okonmah, 2011). With respect to economic importance, it ranks fourth after tomatoes, cabbage and onion in Asia (Eifediyi and Remison, 2011), and second after tomato in Western Europe (Phu, 1997), though its place has not been ranked in tropical Africa because of limited use. Soft and succulent, the vegetable crop is cherished by man and eaten in salads or sliced into stew in tropical regions. It's juice is often recommended as source of silicon to improve the health and complexion of the skin (Duke, 1997). Cucumber is a very good source of vitamins A, C, K, B_6, potassium, pantothenic acid, magnesium, phosphorus, copper and manganese (Vimala *et al*., 1999). The ascorbic acid and caffeic acid contained in cucumber help to reduce skin irritation and swollen (Okonmah, 2011).

In spite of the increasing relevance of cucumber in Nigeria, low yields are obtained in farmers' fields because of declining soil fertility due to continuous cropping and disregard for soil amendment materials. Application of poultry manure is one of the ways of improving soil fertility and final yield of crops. Reported as the richest known animal manure, Lombin *et al*., (1992); Mangila *et al.,* (2007) and Enujeke *et al*., 2013 indicated that poultry manure is not only cheap and effective but is also essential for establishing and maintaining the optimum soil physical conditions for plant growth and yield. As a good source N for sustainable crop production, Ewulo *et al*., (2008) and Agbede *et al*., (2008) reproted that the application of 10-50 tha^{-1} of poultry manure improves the

soil physical properties by reducing soil temperature and bulk density, and increasing the total porosity. Adekiya and Ojeniyi (2002) and Ewulo *et al*., (2008) reported that high rates of poultry manure improves moisture availability which results in improved nutrient release to plants for increased growth and yield. According to Agbede *et al*.,(2008), poultry manure increased plant N, P, K, Ca and Mg status in leaf of Sorghum. The manure increased plant height, leaf area, stem diameter, number of roots, shoot weight and grain weight in the years of evaluation. Enujeke (2013) reported that 20 tha^{-1} of poultry manure significantly increased the vine length, number of leaves/plant, number of branches/plant, and fruit weight of watermelon above their control counterparts. John *et al*., (2004) and Dauda *et al*., (2008) attributed the vigorous growth and increased fruit yield of watermelon to increased supply of nutrient elements associated with high photosynthetic activities which promote growth and yield. Aliyu, (2000) made similar report that higher rates of poultry manure resulted in higher yield of eggplant. The nutrient composition of poultry manure as reported by DIPA (2006) is 1.0-1.8% N, 0.4-0.8% P, and 0.5-1.9% K. The composition of poultry manure used in this study, however, was 1.4% N, 0.6% P, and 0.6 % K.

In the study area, there are no recommended standards with respect to the most appropriate rate of application of poultry manure for increased growth and yield of cucumber at present. The objective of this study, therefore, was to identify the most appropriate rate of application of poultry manure for enhanced growth and yield of cucumber in Asaba Area of Delta State, Nigeria.

MATERIALS AND METHODS

Description of experimental site

Field experiments were carried out at the Research and Teaching Farms of Anwai Campus of the Delta State University. The experimental site is located within latitude 06°14'N and longitude 06°49'E of the equator. The experiment was conducted during the 2011/2012 cropping seasons in a typical humid environment that is characterized by a bimodal rainfall pattern with peaks in July and September and an interrupted dry spell in August otherwise called (Harmattan). The annual mean rainfall is about 1,650 mm, the mean annual temperature is 37.3°C and a mean relative humidity of 73.2% (NIMET, 2011). By nature of its geomorphological settings, the study area falls within the classification of Ancient metamorphiccrystalline basement complex formation which are more acid than base (Egbuchua, 2007). They are essentially gneisses and pegmatites that gave rise to coarse-textured soils that are deficient in dark ferromagnessium minerals (Egbuchua, 2007). The topography is undulating with pockets of hills, and land use is typically based on rain - fed agriculture with root, tuber, spices, pulses and vegetables prominently cultivated. The vegetation is of rainforest origin but has been drastically reduced to derived savanna due to continuous use of the land.

Field studies

A land measuring 323.2 m^2 (32.0 m x 10.1 m) was selected for the study and prepared by using a tractor to plough and harrow the land. It was marked out according to the experimental layout. Fifteen plots of 6.0m x 2.7 m each were made and composite samples collected from the plots at 0-15 cm depth in order to assess the initial physio-chemical properties of the soil.

Laboratory studies

The composite soil samples collected from the individual plots were air-dried in a room temperature of 27°C for three days, crushed and sieved using 2 mm aperture. The parameters evaluated include the particle size distribution by hydrometer method (Gee and Bauder, 1986). The pH was determined using Pye Unican model MK2 pH meter in a 1:2:5 soil/water suspension ratio. Organic carbon was determined by Walkley-Black wet oxidation method (Nelson and Sommers, 1982). Total nitrogen was determined by micro-Kjeldahl distillation technique as described by Breminer and Mulvaney (1982). Available phosphorus was determined by Bray No. 1 method (IITA, 1979). Exchangeable potassium was determined by flame photometer, while cation exchange capacity (CEC) was determined by Amnonium acetate saturation method (Roades, 1982). The chemical analysis of the poultry manure used for the experiment was also evaluated using appropriate methods as described in the IITA manuals (1979).

Experimental Design

The experiment was carried out in a Randomized Complete Block Design (RCBD) with three replicates. Rates of poultry manure in tons per hectare were 0, 5, 10, 15 and 20. The manure was incorporated into the soil 2 weeks before planting.

Seed collection and planting

Seeds of proven variety of cucumber (Market more) were obtained from Agro-Allied Company, Ibadan. They were sown on the plots at the rate of 3 seeds/stand at a spacing of 1 m x 1 m and at a depth of 2.5 cm, but the seedlings were later thinned to 1 seedling/stand, giving a

plant population of 36 plants/plot. Alley pathways of 1 m were made for easy access to the plots.

Weeding

Regular weeding was done around the base, along and ahead of the vines using hoe.

Data Collection

Fourteen middle stands were used as sample population. Data collected were vine length, number of leaves/plant, fruit diameter (cm), fruit length (cm), and fruit weight at maturity. Vine length was measured with tape from the base to the growing tip of the plant. Number of leaves/plant were determined by direct counting. Fruit diameter and fruit length were measured using tape rule, while fruit weight was measured using a weighing scale after harvest.

Statistical Analysis

Data collected was subjected to analysis of variance (ANOVA) and means were separated using Duncan Multiple Range Test (DMRT) according to Wahua (1999).

RESULTS

Initial Soil Properties

The data on the initial physico-chemical properties of the soils used for the study is presented in Table 1. The particle size fracture showed that the soils were sandyloam in texture and low in fertility as reflected by the low content of organic matter (15.5 gkg^{-1}), and total nitrogen (0.87 gkg^{-1}). Soil pH was strongly acid with a mean value of 5.3. The available phosphorus (P) and water soluble, potassium (K) with mean values of 5.35 $mgkg^{-1}$ and 0.17 $cmolkg^{-1}$ were seemingly low based on the ratings of FMANR, (1996) for the ecological zone. The low fertility status of the soils is a true reflection of most ultisols of humid environment that are strongly weathered of low activity clay mineralogy and high acidity due to intense precipitation with its associated erosion and leaching in the environment.

Effects of poultry manure on vine length (cm) of cucumber in 2011 and 2012.

The response of vine length of cucumber to poultry manure in 2011 and 2012 cropping seasons is shown in Table 2. Vine length gradually increased from 4-8 weeks after planting. At 4 weeks after planting, plants that received 20 tha^{-1} of poultry manure had the highest vine length with mean value for 2011 and 2012 as 116.2 cm. Plants that did not receive manure had the lowest vine length with mean value of 46.1 cm for 2011 and 2012. During the 6^{th} week after planting, plants that received 20 tha^{-1} of poultry manure also had the highest vine length with mean value of 144.5 cm for both years of evaluation, while plants in the control plot had the lowest vine length with mean value of 80.5 cm for 2011 and 2012. The trend did not change during the 8^{th} week after planting. Plants that received 20 tha^{-1} of poultry manure were superior in vine length over other plants, with mean value of 167.3 cm. The superiority in vine length of cucumber based on rate of poultry manure received in tons/hectares was 20>15>10>5>0.

Effects of poultry on number of leaves/plant of cucumber in 2011 and 2012

The response of number of leaves/plant of cucumber to poultry manure in 2011 and 2012 is shown in Table 3. There were gradual increases in number of leaves/plant from 4-8 weeks after planting. Plants that received 20 tha^{-1} of manure were outstanding in number of leaves/plant with mean value of 14.6 at the 4^{th} week of 2011 and 2012, while plants in control plot had the lowest number of leaves/plant with mean value of 6.3. During the 6^{th} week after planting, plants that received 20 tha^{-1} of manure also had the highest number of leaves/plant with mean value of 46.3 for 2011 and 2012. Plant grown without manure had the lowest number of leaves/plant with mean value of 30.1 for both years investigated. At 8^{th} weeks after planting, plants that received 20 tha^{-1} of poultry manure were also superior to other plants with respect to number of leaves /plant (56.4). Plants grown without poultry manure had the lowest number of leaves/plants with mean value of 43.3 for 2011 and 2012. The superiority in number of leaves/plant of cucumber based on rate of poultry manure received in tons/hectare was 20>15>10>5>0.

Effects of poultry manure on fruit diameter (cm) of cucumber in 2011 and 2012.

The response of fruit diameter of cucumber to poultry manure in 2011 and 2012 is shown in Table 4. Plants that received 20 tha^{-1} of manure had highest fruit diameter of 16.6 cm in 2011, while plants in the control plot had the lowest fruit diameter (12.0 cm). In 2012, plants that received 20 tha^{-1} of manure were also superior in fruit diameter with value of 16.8 cm, while plants in the control plot had the lowest fruit diameter with value of 12.6 cm.

Table 1. Initial phyisco-chemical properties of the soils used for the study

Parameters Measured	Values obtained
Particle size fractions (%)	
Sand	85.0
Silt	9.6
Clay	4.4
Textural class	Sandyloam
pH (H_2O)	5.3
Organic matter gkg^{-1}	15.5
Total Nitrogen (gkg^{-1})	0.87
Available P ($mgkg^{-1}$)	5.35
Exchangeable K ($Cmolkg^{-1}$)	0.17
CEC ($Cmolkg^{-1}$)	10.13

Table 2. Effects of poultry manure on vine length (cm) of cucumber in 2011 and 2012

_____ Weeks after sowing _____	4			6			8		
	Vine length (cm)								
	2011	2012	Mean	2011	20012	Mean	2011	20012	Mean
Rates of poultry manure tons /ha									
0	45.0 e	47.2 e	46.1 e	78.4 e	82.6 e	80.5 e	92.0 e	96.4 e	94.2 e
5	62.4 d	68.6 d	65.5 d	92.2 d	96.4 d	94.3 d	108.4 d	112.4 d	110.4 d
10	80.0 c	82.2 c	81.1 c	118.4 c	122.2 c	120.3 c	138.2 c	144.0 c	141.1 c
15	92.2 b	96.2 b	94.2 b	126.2 b	130.2 b	128.2 b	146.4 b	148.4 b	147.4 b
20	112.0 a	120.4 a	116.2 a	140.4 a	148.6 a	144.5 a	162.2 a	172.4 a	167.3 a

Means with the same letter(s) under the same column are not significantly different ($P \leq 0.05$) using Duncan Multiple Range test (DMRT).

Table 3. Effects of poultry manure on number of leaves/plants of watermelon in 2011 and 2012

_____ Weeks after sowing _____	4			6			8		
	number of leaves/plants								
	2011	2012	Mean	2011	20012	Mean	2011	20012	Mean
Rates of poultry manure tons /ha									
0	6.0 e	6.6 e	6.3 e	28.0 e	32.2 e	30.1 e	42.4 e	44.2 e	43.3 e
5	7.8 d	8.2 d	8.0 d	32.4 d	36.0 d	34.2 d	44.6 d	46.6 d	45.6 d
10	9.6 c	9.8 c	9.7 c	36.4 c	38.6 c	37.5 c	48.0 c	50.2 c	49.1 c
15	12.0 b	12.2 b	12.1 b	38.6 b	42.6 b	40.6 b	52.4 b	54.6 b	53.5 b
20	14.4 a	14.8 a	14.6 a	44.4 a	48.2 a	46.3 a	54.6 a	58.2 a	56.4 a

Means with the same letter(s) under the same column are not significantly different ($P \leq 0.05$) using Duncan Multiple Range test (DMRT).

Table 4. Effects of poultry manure on fruit diameter (cm) of cucumber in 2011 and 2012.

	Fruit diameter (cm)		
	2011	**2012**	**Mean**
Rates of poultry manure tons /ha			
0	12.0 $_c$	12.6 $_c$	12.3 $_c$
5	13.8 $_b$	14.4 $_b$	14.1 $_b$
10	14.2 $_b$	14.6 $_b$	14.4 $_b$
15	14.8 $_b$	15.2 $_b$	15.0 $_b$
20	16.6 $_a$	16.8 $_a$	16.7 $_a$

Means with the same letter(s) under the same column are not significantly different ($P \leq 0.05$) using Duncan Multiple Range test (DMRT).

Table 5. Effects of poultry manure on fruit length (cm) of Cucumber in 2011 and 2012.

	Fruit length (cm)		
	2011	**2012**	**Mean**
Rates of poultry manure tons /ha			
0	16.0 $_d$	16.2 $_d$	16.1 $_d$
5	17.7 $_c$	17.9 $_c$	17.8 $_c$
10	18.4 $_c$	18.6 $_c$	18.5 $_c$
15	20.2 $_b$	20.4 $_b$	20.3 $_b$
20	22.4 $_a$	22.8 $_a$	22.6 $_a$

Means with the same letter(s) under the same column are not significantly different ($P \leq 0.05$) using Duncan Multiple Range test (DMRT).

Table 6. Effects of poultry manure on weight of fruits of Cucumber in 2011 and 2012.

	Weight of fruits (tha^{-1})		
	2011	**2012**	**Mean**
Rates of poultry manure tons /ha			
0	14.2 $_e$	16.4 $_e$	15.3 $_e$
5	19.4 $_d$	23.2 $_d$	21.3 $_d$
10	26.5 $_c$	28.3 $_c$	27.4 $_c$
15	35.3 $_b$	39.5 $_b$	37.4 $_b$
20	48.1 $_a$	50.5 $_a$	49.3 $_a$

Means with the same letter(s) under the same column are not significantly different ($P \leq 0.05$) using Duncan Multiple Range test (DMRT).

The superiority in fruit diameter of Cucumber based on the rate of application of poultry manure in tons/hectare was 20>15>10>5>0.

Effects of poultry manure on fruit length (cm) of cucumber in 2011 and 2012

The response of fruit length of cucumber to poultry manure in 2011 and 2012 is shown in Table 5. Plants that received 20 tha^{-1} of manure had highest fruit length of 22.4 cm in 2011, while plants in the control plot had the lowest fruit length (16.0 cm). In 2012, plants that received 20 tha^{-1} of manure were also superior in fruit length with value of 22.8 cm, while plants in the control plot had the lowest fruit length with value of 16.2 cm. The superiority in fruit length of cucumber based on the rate of application of poultry manure in tons/hectare was 20>15>10>5>0.

Effects of poultry manure on weight of fruit (tha^{-1}) of cucumber in 2011 and 2012.

The response of weight of fruit of cucumber to poultry manure in 2011 and 2012 is shown in Table 6. Plants that

received 20 tha^{-1} of manure had highest weight of fruit (48.1 tha^{-1}) in 2011, while plants in the control plot had the lowest fruit weight (14.2 tha^{-1}). In 2012, plants that received 20 tha^{-1} of manure were also superior in fruit weight with value of 50.5 tha^{-1}, while plants in the control plot had the lowest fruit weight with value of 16.4 tha^{-1}. The superiority in fruit weight of cucumber based on the rate of application of poultry manure in tons/hectare was 20>15>10>5>0.

DISCUSSION

Effect of poultry manure on vine length of Cucumber

Cucumber plants that received poultry manure application rate of 20 tha^{-1} had longer vine length than other plants possibly because higher rate of manure improved moisture availability which enhanced the release of more nutrient elements for increased vine growth. This is consistent with the findings and reports of Adekiya and Ojeniyi (2002), and Ewulo *et al.,* (2008) which attributed increased growth of crop plants to the release of more nutrient elements through the moisture that has been made available by the manure. It is also in harmony with the report of John *et al.,* (2004) who indicated that poultry manure released essential elements which promoted high photosynthetic activities that enhanced growth and yield of watermelon.

Effects of poultry manure on number of leaves/plant of Cucumber

Higher number of leaves/plant was produced by cucumber stands that received 20 tha^{-1} of poultry manure possibly because the manure established and maintained soil physical condition for plant growth. This is consistent with the reports of Lombin *et al.,* (1992), Mangila *et al.,* (2007), and Enujeke *et al*., (2013) which indicated that poultry manure (the richest known animal manure) is essential for establishing and maintaining the optimum soil physical condition for plant growth. It is also synonymous to the findings of Agbede *et al.,* (2008), and Ewulo *et al.,* (2008) who reported that poultry manure is not only cheap and effective source of N for sustainable crop production, but improves soil physical properties by reducing temperature, bulk, density, and increasing total porosity, if higher rates are applied.

Effects of poultry manure on fruit diameter (cm) of cucumber in 2011 and 2012

The fruit diameter of plants that received 20 tha^{-1} of poultry manure was higher than the fruit diameter of plants that received other rates of manure possibly because the high rate of manure reduced soil erosion, increased water holding capacity, and increased moisture availability which favoured the release of more nutrients for higher growth and yield. This is in consonance with the findings of John *et al*., 2004 who attributed the vigorous growth and increased fruit yield of watermelon to higher supply of nutrient elements from the applied manure

Effects of poultry manure on fruit length (cm) of cucumber in 2011 and 2012

Poultry manure application rate of 20 tha^{-1} resulted in higher fruit length of cucumber possibly because that rate was compatible with the crop's requirement for yield enhancement in Asaba Agro-ecological Zone. This is in harmony with the report of Enujeke (2013) who attributed the higher yield of improved maize obtained from the application of high rate of poultry manure to possible compatibility with the crop's requirement in the agro-ecological zone. It is also consistent with the report of DIPA (2006) who suggested that manure should be applied at rates and times of the year that are compatible with the nutrient requirement and growing characteristics of the crop so as to achieve the desired growth and yield enhancement.

Effects of poultry manure on weight of fruits of Cucumber

Higher fruit weight was obtained from cucumber plants that received 20 tha^{-1} of poultry manure possibly because higher rates of manure improved the soil conditions for crop establishment as well as released adequate nutrient elements for yield enhancement. This is in harmony with the reports Aliyu (2000), Adekiya and Ojeniyi (2002), Mangila *et al.,* (2008), and Agbede *et al.,* (2008) which indicated that higher rates of manure increases crop yield.

CONCLUSION AND RECOMMENDATIONS

This study was carried out to evaluate the growth and yield responses of cucumber to five different rates of poultry manure in Asaba area of Delta State, Nigeria. It was conducted in a Randomized Complete Block Design (RCBD) with three replicates. Rates of poultry manure in tons per hectare were 0, 5, 10, 15, and 20. The parameters assessed to achieve the objectives of the study were vine length, number of leaves/plant, fruit diameter, fruit length, and fruit weight of cucumber. The result of the study showed that plants that received 20 tha^{-1} of poultry manure were superior in the parameters tested. Based on the findings of the study, it was

recommended that farmers in the study area apply 20tha^{-1} of poultry manure for increased growth and yield of cucumber.

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