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Effects Of Poultry Manure On Growth And Yield Of Improved Maize In Asaba Area of Delta State, Nigeria

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Abstract: *Field experiments were conducted in 2008 and 2009 to evaluate the effects of poultry Manure on growth and yield of improved maize (Suwan -1-SR) in Asaba area of Delta State. The experiments were carried out in a Randomized Complete Block Design (RCBD) with three replicates. Four rates of poultry manure were applied –O tha-^{1}, 10 tha-^{1}, 20 tha-^{1} and 30 tha-^{1}. Data collected from the 4th to the 8th week after sowing were plant height, number of leaves, and leaf area. At the end of the 16th week, grain weight and number of grains/cob of maize were evaluated. The results obtained indicated that plants that received 30 tha-^{1} of poultry manure were superior at 8 weeks after sowing in 2008 and 2009, with mean height of 209.3 cm, mean number of leaves of 13.1, mean leaf area of 682.6 cm^{2}, mean grain weight at 16 weeks after sowing of 2.14 tha-^{1} and mean number of grains/cob of 518.4 in 2008 and 2009. Based on the findings of the study, 30 tha-^{1} of poultry manure was recommended to farmers as most appropriate rate of application to enhance growth and yield of maize in Asaba area of Delta State.*
Keywords: *Rates of Poultry Manure, Maize Growth and Yield Asaba, Nigeria*

I. Introduction

One of the members of the cereal family that has added great value to man and animals is maize (*Zea mays L*). It ranks third following wheat and rice in world production (FAO, 2002). Widely grown in the humid tropics and sub-Saharan Africa, the crop serves for food and livelihood for millions of people today. (Enujeke, 2013). It is consumed roasted, baked, fried, boiled or fermented in Nigeria (Agbato, 2003). In developed countries, maize is source of such industrial products as corn oil, syrup, corn flour, sugar, brewers' grit and alcohol (Dutt, 2005). As an energy supplement in livestock feed, maize is cherished by various species of animals, including poultry, cattle, pigs, goats, sheep and rabbits (DIPA, 2006).

The numerous uses of maize notwithstanding, yield in Africa has continuously declined to low as 1 tha^{-1} due to such factors as rapid reduction in soil fertility and negligence of soil amendment materials. (Olakojo, 1993, Kim, 1997, DIPA, 2006, Enujeke, 2013). Sonetra (2002) suggested that subsistence farmers should apply organic manure directly to the soil as a natural means of recycling nutrients in order to improve soil fertility and yield of crops. Manures and fertilizers are the life wire of improved technology contributing about 50 to 60% increase in productivity of food grains in many parts of the world, irrespective of soil and agro-ecological zone (DIPA, 2006). Reijnties *et al,* (1992) and Adepetu (1997) remarked that the downward trend in food production should prompt farmers to amend the soil with different materials in order to enhance growth and yield of crops. Several organic materials such as cattle dung, poultry dropping, pig dung and refuse compost have been recommended to subsistence farmers in West Africa as soil amendments for increasing crop yield. Sobulo and Babalola (1992) reported that poultry dropping and cattle dung increased root growth of maize and the crop extracted soil water more efficiently for increased grain yield. Stefan (2003) indicated that fresh poultry dropping contain 70% water, 1.4% N, 1.1% P_2O_5 and 0.5% K_2O while dried poultry manure contains 13% water, 3.6% N, 3.5% P_2O_5 and 1.6% K_2O. Among the different sources of organic manure which have been used in crop production, poultry manure was found to be the most concentrated in terms of nutrient content (Lombin *et al,* 1992). Kostchi *et al,* (1989) observed that application of poultry manure improved the availability of some minerals in the soil, and especially the transfer of nutrients from rangeland to the crop plant. Izunobi (2002) reported that poultry manure, especially those produced in deep litter or battery cage house are the richest known farmyard manure supplying greater amounts of absorbable plant nutrient. Fabiye and Ogunfowora (1992) noted that poultry dropping play significant roles in enhancing yield of crops in the southern part of Nigeria. Amujoyegbe *et al,* (2007) reported that poultry manure increased the leaf area total chlorophyll content and grain yield of maize and sorghum. According to Brady and Weil (1999), poultry manure mineralizes faster than other animal manure such as cattle or pig dung; hence it releases its nutrients for plant uptake and utilization rapidly. Sharply and Smith (1991) reported that poultry manure contains basic nutrients required for enhancing growth and yield of crops. Application of poultry manure increases carbon content, water holding capacity, aggregation of soil, and decreases bulk density (Egerszegi, 1990). It also increases the water soluble and exchangeable potassium and magnesium which enhance crop yield (Jackson *et al,* 1999). Ibeawuchi *et al,* (2007) reported that 8 t/ha of poultry manure resulted in significantly higher grain yield, dry matter and increased leaf area of maize. Fagimi and Odebode (2007) reported that poultry droppings applied at the rate of 10 t/ha and 20 t/ha, increased plant height, number of leaves and fruit yield of Pepper, while the incidence and severity of Pepper Veinal Mottle Virus (PVMV) was reduced. The nutrient composition of poultry droppings as reported by DIPA (2006) is 1:0-1.8% N, 0.4-0.8% P and 0.5-1.9% K.

At present, there are no recommended standards with respect to rate of poultry manure or other soil amendment material for enhancement of maize yield in the study area. The objective of this study therefore, was to identify the most appropriate rate of application of poultry manure for increased growth and yield of maize in Asaba area of Delta State, Nigeria.

II. 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 2008/2009 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 metamorphic crystalline 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 area measuring 33 x 9.8 m^2 was selected for the study, prepared manually by clearing and marked out using basin formation according to the experimental layout. Plot sizes of 2.6 x 2.25 m^2 were made and composite samples collected from the plots at 0-15cm depth in order to assess the initial phyisco-chemical properties of the soils.

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 2mm 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, 10, 20, and 30.

Seed collection and planting

Improved maize seeds (Suwan-1-SR) was purchased from Delta Agricultural Procurement Agency (DAPA) Ibusa and sown on the plots at the rate of 1 seed per hole at a depth of 2-3 cm, using 75 cm x 15 cm giving a population density of 88, 888 plants/ha.
Weeding: Weeding was done three times using hoe.

Data Collection

Fourteen middle stands were used as sample population for data collection. Data collected were plant height, number of leaves, leaf area, grain weight and number of grains/cob. Plant height was measured with tape from the base of the first tassel. Leaf area was measured also with tape using non-destructive analysis method-length x breath by correction factor of 0.75 according to Duke and Dulelar as reported by Enujeke (2013); number of leaves and grains/cob were obtained by direct counting; grain weight was measured using weighing scale.

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) and means were separated with Duncan Multiple Range Text (DMRT) according to Wahua, (1999)

III. 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.

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

Effects of poultry manure on plant height of maize

The response of plant height of maize to poultry manure in 2008 and 2009 is shown in Table 2. There were gradual increases in plant height of maize from 4-8 weeks after sowing. In 2008, plants that received 30 tha^{-1} of poultry manure had the highest height at 4 weeks after sowing (44.4 cm), while plants in the control which were grown without poultry manure had the lowest plant height (34.7cm). In 2009, the trend did not change. Plants that received 30 tha^{-1} of poultry manure also had the highest plant height (44.2 cm), while plants grown without poultry manure had the lowest height at 4 weeks after sowing (34.3 cm). At 6 weeks after sowing in 2008, plants that received 30 tha^{-1} of poultry manure also had the highest height (98.2 cm) while plants in the control plot had the lowest height (75.5 cm). In 2009, plants that received 30 tha^{-1} of poultry manure were superior in height (101.0 cm), while plants that did not receive poultry manure had height of 76.8 cm. During the 8^{th} week of both 2008 and 2009, plants that received 30 tha^{-1} of poultry manure grew tallest with mean height of 209.3 cm, while plants in the control plot had the lowest mean height of 160.2 cm.

The order of superiority in height of maize plants based on poultry manure received in tons per hectare was 30 > 20 > 10 > 0.

Table 2. Effects of poultry manure on plant height of maize in 2008 and 2009

	Weeks After Sowing								
	4			6			8		
	Plant height (cm)								
	2008	2009	Mean	2008	2009	Mean	2008	2009	Mean
Rates of application (tons or kg/ha)									
0	34.7_d	34.3_d	34.5_d	75.5_d	76.8_d	76.2_d	161.3_d	159.1_d	160.2_d
10	35.7_c	37.8_c	36.8_c	81.8_c	83.6_c	82.7_c	169.5_c	170.0_c	169.8_c
20	40.7_b	41.3_b	41.0_b	90.0_b	91.7_b	90.9_b	187.2_b	185.7_b	186.5_b
30	44.4_a	44.2_a	44.3_a	98.2_a	101.0_a	99.6_a	204.5_a	214.1_a	209.3_a

Means with the same letter(s) under the same column are not significant using Duncan Multiple Range Test (DMRT).

Effects of poultry manure on number of leaves of maize

The effects of poultry manure on number of leaves of maize in 2008 and 2009 is shown in Table 3. Number of leaves of maize consistently increased from 4-8 weeks after sowing. There were significant differences in number of leaves with respect to rates of poultry manure applied. During the 4^{th} week, plants that received 30 tha^{-1} of poultry manure were outstanding with mean number of leaves of 8.1 in 2008 and 2009. Plants in the control plots had the lowest mean number of leaves in both years (6.8). At 6 weeks after sowing, mean number of leaves of plants that received 30 tha^{-1} of poultry manure was also highest (10.8), while mean number of leaves of plants in the control plots was lowest (8.8). During the 8^{th} week of 2008 and 2009, mean number of leaves of plants that received 30 tha^{-1} of poultry manure was highest (13.1), while plants that did not receive poultry manure had the lowest mean number of leaves (11.1). The order of superiority in number of leaves with respect to ton per hectare of poultry manure received was 30 > 20 > 10 > 0.

Table 3. Effects of poultry manure on number of leaves/plant of maize in 2008 and 2009

	---Weeks After Sowing---								
	4			6			8		
	--- Number of leaves/plant---								
	2008	2009	Mean	2008	2009	Mean	2008	2009	Mean
Rates of application (tons or kg/ha)									
0	6.5_d	7.1_d	6.8_d	8.9_d	8.7_d	8.8_d	11.2_d	10.9_d	11.1_d
10	7.0_c	7.4_c	7.2_c	9.4_c	9.3_c	9.4_c	11.5_c	11.3_c	11.4_c
20	7.5_b	8.2_b	7.8_b	10.5_b	10.6_b	10.5_b	12.3_b	12.6_b	12.5_b
30	7.9_a	8.3_a	8.1_a	10.9_a	10.7_a	10.8_a	13.1_a	13.2_a	13.1_a

Means with the same letter(s) under the same column are not significant using Duncan Multiple Range Test (DMRT).

Effects of poultry manure on leaf area of maize

The response of leaf area of maize to rates of poultry manure in 2008 and 2009 is shown in Table 4. There were significant differences in leaf area of maize in both years of evaluation. During the 4^{th} week, the mean of leaf area of plants that received 30 tha^{-1} was highest (215.7 cm^2), while plants that received O tha^{-1} of poultry manure had mean leaf area of 161.5 cm^2. At 6 weeks after sowing, mean leaf area of plants that received 30 tha^{-1} of poultry manure was highest (510.3cm^2). Plants in the control plot had lowest mean leaf area of 404.2 cm^2 in both years of evaluation.

During the 8^{th} week, plants that received 30 tha^{-1} of poultry manure were superior with mean leaf area (682.6 cm^2), while plants that did not receive manure had lowest mean leaf area (566.0cm^2). The order superiority in leaf area based on rates of poultry manure received in tons per hectare was 30 > 20 >10 > 0.

Table 4. Effects of poultry manure on leaf area of maize in 2008 and 2009

	---Weeks after sowing---								
	4			6			8		
	--- Leaf area (cm^2)---								
	2008	2009	Mean	2008	2009	Mean	2008	2009	Mean
Rates of application (tons or kg/ha)									
0	153.7_d	169.2_d	161.5_d	375.3_d	433.1_d	404.2_d	573.1_d	558.8_d	566.0_d
10	161.9_c	185.9_c	173.9_c	432.3c	457.4_c	444.4_c	587.3_c	599.2_c	593.3_c
20	192.1_b	203.8_b	198.0_b	474.4_b	478.7_b	476.6_b	$625,8_b$	636.4_b	631.1_b
30	213.1_a	218.3_a	215.7_a	521.3_a	499.3_a	510.3_a	683.4_a	683.4_a	682.6_a

Means with the same letter(s) under the same column are not significant using Duncan Multiple Range Test (DMRT).

Effects of poultry manure on grain weight of maize

The response of grain weight of maize to poultry manure is shown in Table 5. There were significant differences in grain weight of maize as affected by rates of applied manure. In 2008, plants that received 30 tha^{-1} of poultry manure had highest grain weight (2.10 tha^{-1}), while plants that did not receive manure had lowest grain weight (0.8 tha^{-1}). In 2009, the trend did not change. Plants that received 30 tha^{-1} of the manure had highest grain weight (2.19 tha^{-1}) while plants in the control plots had lowest grain weight (1.27 tha^{-1}). The order of superiority in grain weight based on rates of poultry manure received in tons per hectare was 30 > 20 > 10 > 0.

Table 5. Effects of poultry manure on grain weight of maize in 2008 and 2009

	Grain weight (tha^{-1}) 2008	2009	Mean
Rates of application (tons or kg/ha)			
0	0.80_d	1.27_d	1.03_d
10	1.10_c	1.52_c	1.31_c
20	1.80_b	1.98_b	1.89_b
30	2.10_a	2.19_a	2.14_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).

Effects of poultry manure on number of grains/cob of maize

The effects of poultry manure on number of grains/cob of maize in 2008 and 2009 is shown in Table 6. There were significant differences in number of grains/cob of maize as affected by different rates of poultry manure. In 2008, plants that received 30 tha^{-1} of manure had highest number of grains/cob (494.8), while plants in the control plot had lowest number of grains/cob (332.6). In 2009, plant that received 30 tha^{-1} of manure also had highest number of grains/cob (542.0), while plants that did not receive poultry manure had lowest number of grains/cob (394.0). The superiority in number of grains/cob based on rates of poultry manure received in tons per hectare was 30 > 20 >10 > 0.

Table 6. Effects of poultry manure on number of grains/plant of maize in 2008 and 2009

	No. of grains/cob 2008	2009	Mean
Rates of application (tons or kg/ha)			
0	332.6_d	394.0_d	363.3_d
10	382.6_c	423.0_c	407.3_c
20	434.6_b	482.0_b	458.3_b
30	494.8_a	542.0_a	518.4_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).

IV. Discussion

Effects of poultry manure on plant height of maize

Plants that received 30 tha^{-1} of poultry maize grew taller than other plants possibly because more concentrated nutrients or minerals were made readily available and easily absorbable by the receiving plants leading to faster growth and development. This is harmony with the findings and reports Kostchi *et al*, (1989), Lombin *et al*., (1992), Fabiye and Ogunfowora, (1992) and Izunobi, (2002). It is also similar to the findings of Fagimi and Odebode (2007) who reported increased plant height and number of leaves of pepper resulting from application of higher rate of poultry manure.

Effects of poultry manure on number of leaves of maize

Application of 30 tha^{-1} of poultry manure was superior to other rates applied with respect to producing higher number of leaves of maize. This could be attributed to the fact that 30 tha^{-1} was compatible with the requirements and growing characteristics of the crop, drainage and slope of the land. This is in consonance with the findings of DIPA, (2006) and Mubondeni *et al*, (1999) which recommended that manure be applied at rates that are compatible with the nutrient requirements and growing characteristics of the crops for growth and yield enhancement.

Effects of poultry manure on leaf area of maize

Poultry manure application rate of 30 tha^{-1} increased leaf area higher than other application rates investigated possibly because that rate was most suitable or appropriate for increasing carbon content, water holding capacity, aggregation of soil and decrease of bulk density, all of which interplay to increase leaf area and total chlorophyll content of maize. This is consistent with the findings of Egerszegi, (1990), Sharply and Smith, (1991) and Amujoyegbe *et al*, (2007) who reported that increased application rate of poultry manure enhanced lead area, total chlorophyll content, carbon content, water holding capacity, and decrease bulk density of soil which culminate and interplay to promote yield.

Effects of poultry manure on grain weight of maize

Plants that received 30tha^{-1} of poultry manure were superior to plants that received lower rates possibly because 30tha^{-1} was not only compatible with the crop requirement in the agro-ecological area but favoured the release of such plant nutrients as water soluble and exchangeable potassium and magnesium which enhance crop yield. This is consistent with the findings of Jackson *et al*, (1999) and Ibeawuchi *et al*, (2007) which reported that higher rates of manual increases the water-soluble and exchangeable potassium and magnesium which enhances grain yield and dry matter of maize.

Effects of poultry manure on number of grains/cob of maize

The number of grains/cob of maize obtained from plants that received 30tha^{-1} of poultry manure was higher than the number of grains obtained from plants that received lower rates of manure possibly because more nutrients were released which mineralized rapidly for plant uptake and utilization. It could also be attributed to reduction in mosaic diseases or other soil-borne diseases which depress yield, or to increased microbial activities which favour yield increases as reported by Gopinath et al.,(2008), Olanikan(2006) and Enujeke et al.,(2013). These reports are generally in harmony with the work and recommendations of Brady and Weils, (1999), DIPA, (2006), Sharply and Smith, (1991), and Fagimi and Odebode, (2007).

V. Conclusion and Recommendation

The study was carried out to evaluate the effects of poultry manure on growth and yield of improved maize variety (Suwan-1-SR). It was carried out in a Randomized Complete Block Design with three replicates. Five parameters were assessed to achieve the objectives of the study-plants height, number of leaves, leaf area, grain weight and number of grains/cob of maize. The results indicated positive response of maize to poultry manure. Plants that received 30 tha^{-1} of manure were superior in the parameters assessed. Based on the findings of the study, it was recommended that farmers' apply 30tha^{-1} of poultry manure to enhance growth and yield of maize in Asaba area of Delta State, Nigeria.

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