GLOBAL JOURNAL OF PURE AND APPLIED SCIENCES VOL 15, NO. 3&4, 2009: 293-299

 ISSN 1118-057

EFFECT OF COW DUNG AND POULTRY DROPPINGS ON NUTRIENTS UPTAKE, GROWTH AND YIELD OF GARDEN EGG (*SOLANUM AETHIOPICUM*) IN OBUBRA RAINFOREST ZONE OF NIGERIA

M.A. KEKONG AND T.O. OJIKPONG

(Received 16, August 2008; Revision Accepted 2, February 2009)

ABSRACT

Field experiments were conducted during the cropping seasons of 2006 and 2007 at the teaching and research farm of the Cross River University of Technology (CRUTECH), Obubra – Nigeria, to determine the effect of cow dung and poultry droppings on nutrients uptake, growth and yield of garden egg (*Solanum aethiopicum*). Treatments comprised four levels of cow dung as follows: (0, 10, 20 and 30 t/ha) and four levels of poultry droppings: (0, 5, 10 and 15 t/ha). These were factorially combined to give sixteen treatment combinations and arranged into a randomized complete block design (RCBD) with three replications. The parameters measured were; plant height, number of branches per plant, shoot dry matter, number of fruits per plant and fruit yield (kg/ha). Applications of cow dung at 30 t/ha in 2006 and 20 to 30 t/ha in 2007 produced the tallest plants with highest number of branches, highest number of fruits and highest fruit yield. Application of poultry droppings at 15 t/ha produced tallest plants with highest number of branches, highest number of fruits per plant and fruit yield per unit area. Combined application of cow dung at 30 t/ha and poultry droppings at 15 t/ha produced tallest plants, highest number of branches, highest number of fruits per plant and fruit yield.

KEY WORDS: Cow dung, poultry droppings and garden egg.

INTRODUCTION

The need for the adoption of organic manure for crop production in tropical soils has become necessary in view of the potentials of animal manures for soil fertility maintenance and the deleterious effect of inorganic fertilizers on soil properties in addition to their scarcity and cost. Although there is a considerable variation in the percentage nutrient composition of animal manures depending mainly on the source, handling and management, the main nutrients supplied are; nitrogen, phosphorus, potassium, calcium and a host of micronutrients (Lombin *et al*., 1991). Lunin (1977) reported that the composition of selected animal wastes including cattle, poultry and hog to include; N, P, K, Ca, Mg, S, Mn, Fe, B, Cu, Zn and Mo. Esu (2005) stated that the nutrient composition of organic manures include; N, P, K, S as well as micronutrients such as B, Cu, Mo, Zn, Fe and Mn. Yield increases due to the application of animal manures have been reported by various workers. Ojeniyi (2000) reported higher yield of okra due to the application of goat manure, significant increase in yield of corn using cow dung (Eghball *et al*., 2004), higher yield of oat using poultry manure (Zhang, et al., 2006),increase in lint yield and quality of cotton using poultry manure (Tewolde *et al*., 2007) and increase in yield of ginger with the application of cow dung up to 30 t/ha and poultry droppings up to 20 t/ha (Ayuba *et al*., 2005).

Place *et al*., (2003) noted that the effect of organic manures on non-cereal crops remain under-researched especially on highly priced vegetable crops like garden egg. Kogbe (1982) and Ezeakunne (1985) have earlier reported that studies on nutrients requirements of garden egg in Nigeria are few despite the importance of the crop in the diet of the people. Moreover, Vanlauwe (2000) stated that the problem of quantitative understanding on how yields will increase as a result of application of given organic manure still poses a problem.

It is this dearth of information and lingering problems on animal manures on vegetable production that informed the need for this study.

MATERIALS AND METHODS

A field study was conducted at the teaching and research farm of the Cross River University of Technology, Obubra located at longitude 08^{o} 16' E and latitude 05^{o} 59'N with an altitude of 184 m above sea level during the 2006 cropping season and repeated during the 2007 cropping season to evaluate the effectiveness of cow dung and poultry droppings on shoot nutrient content, growth and yield of garden egg. Treatments comprised four rates of cow dung namely 0, 10, 20 and 30 t/ha and four rates of poultry droppings; 0, 5, 10 and 15 t/ha, which were obtained from the cattle pen and the poultry farm of the Cross River University of Technology, Obubra Campus. Using the randomized complete block design (RCBD) in factorial arrangement, the sixteen treatment combinations were randomly allocated to plots in each of the three blocks. The

M.A. Kekong, Department of Agronomy, Faculty of Agriculture and Forestry. Cross River University of Technology, Obubra – Nigeria.

T.O. Ojikpong, Department of Agronomy, Faculty of Agriculture and Forestry. Cross River University of Technology, Obubra – Nigeria.

nursery site was cleared, packed and tilled to fine seedbed. Prior to sowing, the seeds were dressed with *Apron plus* and sown on the 23rd June in 2006 and 22nd June in 2007.

The experimental site in each year was manually cleared, packed and ridged between 7th and 9th July and the treatments applied two weeks before the garden egg seedlings were transplanted (i.e. four weeks after sowing (24th July) in the nursery). The seedlings were spaced 100 cm x 50 cm at one plant/stand yielding a plant population of 20,000 plants/ha. Each plot measured 3 m x 4 m (12 m^2). The garden egg variety used for the experiment was "Gilo". Plots were manually weeded using the West African hoe three times at four weekly intervals after transplanting. The crop was protected against insect pests by spraying at weekly interval with *Ultracide* at the rate of 40 ml/20 litres of water.

Prior to incorporation of the treatments, a composite soil sample was collected at the 0 – 20 cm depth from random points in the experimental plot for each year, and used for the determination of physico-chemical properties of the soil. Five plants were randomly selected from the inner rows and used for the determination of plant height, shoot dry matter (g/plant) at 7 weeks after transplanting (WATP). The fruits were harvested weekly and the cumulative fruit yield per net plot from the first harvest at 10 WATP up to the last harvest at 16 WATP were used to determine the fruit yield in t/ha. At 8 WATP two plants from each plot were cut at ground level, oven-dried at 100°C and weighed to a constant weight to determine the dry matter weight. Five plants were randomly selected from each plot and used for the determination of shoot dry matter (g/plant) at 8 WATP. While the plant height, number of branches per plant, number of fruits per plant as well as the cumulative fruit yield (kg/ha) were determined at the last harvest. After the last harvest, three plants from each plot were randomly selected and cut at the base, bulked according to their respective treatments, air-dried, crushed and sieved with a 0.5 mm sieve before subjecting them to the method of digestion using nitric perchloric acid mixture (Greweling, 1976) to produce extracts used to determine the absorbed nutrients. Total nitrogen was determined by the Micro Kjedhal method as described by Bremmer and Mulvancy (1982). Plant phosphorus was determined by the Vanado-molybdate colorimetric method as outlined by Page *et al*., (1982). Plant exchangeable bases (Ca, Mg, K and Na) were determined by the Atomic Absorption Spectrophotometer (AAS).

RESULTS

The result of the analysis of soil from the experimental site is presented in Table 1. The soil was sandy loam, low in organic matter (8.5 g/kg), total N (0.9 g/kg), low in available P (2.80 mg/kg), exchangeable bases and the cation exchange capacity (CEC).

Table 1: Some physical and chemical properties of the soil of the experimental site before treatments application

Parameter	Value
Clay (g/kg)	52
Silt (g/kg)	82
Sand (g/kg)	866
pH (H_2O)	5.48
pH (KCl)	4.75
Organic matter (g/kg)	8.5
Total N (g/kg)	0.9
Available P (mg/kg)	2.80
Exchangeable bases (cmol/kg):	
K	0.28
Mg	0.98
Ca	2.10
Na	0.18
CEC (meq/100g)	1.8

Effect of cow dung and poultry droppings on the nutrients uptake of garden egg (*Solanum aethiopicum*)

The shoot nutrient content (Table 2) showed that application of cow dung and poultry droppings significantly increased the N and P contents of garden egg shoot over where no manure was applied. The nitrogen content of the above ground biomass was highest in plants that received single application of poultry droppings at 15 t/ha and in combination with all rates of applied cow dung. Although phosphorus values in all manure treated plants were higher than the control, the increase did not follow any definite trend. In the second year the result showed similar trend as those of 2006 with respect to the N and P content. The amount of Ca, K, Mg and Na in the shoot as influenced by the different rates of the manures and their combinations were higher than the control for the 2006 and 2007 crops. Combined application of cow dung (15 t/ha) and poultry droppings (15 t/ha) produced the highest concentration of these nutrient elements in both years except for the Na in the second year where the highest values were obtained when cow dung was applied at 30 t/ha either singly or in combination with poultry droppings at10 to 15 t/ha and cow dung at 20 t/ha with poultry droppings at 15 t/ha.

Table 2: Combined effect of cow dung and poultry droppings on shoot nutrients content in 2006 and 2007 cropping seasons

	Cropping Season									
	2006					2007				
Manure treatment	N	P	K	Ca	Mg	N	P	K	Ca	Mg
C_0P_0	0.03	0.05	0.11	0.55	0.12	0.04	0.05	0.10	0.50	0.11
C_0P_1	0.08	0.08	0.12	0.62	0.17	0.07	0.07	0.12	0.72	0.17
C_0P_2	0.09	0.08	0.13	0.70	0.17	0.06	0.09	0.14	0.80	0.18
C_0P_3	0.11	0.01	0.14	0.88	0.23	0.10	0.11	0.14	0.90	0.20
C_1P_0	0.06	0.09	0.12	0.64	0.20	0.07	0.08	0.12	0.80	0.18
C_lP_1	0.08	0.11	0.16	0.70	0.19	0.08	0.10	0.12	0.80	0.19
C_1P_2	0.08	0.09	0.15	0.75	0.20	0.09	0.10	0.13	0.85	0.21
C_1P_3	0.11	0.12	0.19	0.88	0.24	0.12	0.12	0.16	0.90	0.23
C_2P_0	0.06	0.09	0.12	0.64	0.20	0.07	0.08	0.12	0.80	0.18
C_2P_1	0.08	0.11	0.16	0.70	0.19	0.08	0.10	0.12	0.80	0.19
C_2P_2	0.08	0.09	0.15	0.75	0.20	0.09	0.10	0.13	0.85	0.21
C_2P_3	0.11	0.12	0.19	0.88	0.24	0.12	0.12	0.16	0.90	0.23
C_3P_0	0.07	0.13	0.20	0.75	0.30	0.09	0.08	0.15	0.80	0.26
C_3P_1	0.07	0.12	0.20	0.89	0.31	0.08	0.09	0.16	0.82	0.30
C_3P_2	0.08	0.14	0.22	0.89	0.32	0.10	0.09	0.16	0.80	0.33
C_3P_3	0.11	0.15	0.24	0.90	0.34	0.12	0.14	0.18	0.90	0.33

Key:

C- Cow dung
C_0 - 0 t/ha
C_1 – 10 t/ha
C_2 – 20 t/ha
C_3 – 30 t/ha

P – Poultry droppings
P_0 – 0 t/ha
P_1 – 5 t/ha
P_2 – 10 t/ha
P_3 – 15 t/ha

Effect of cow dung and poultry droppings on the growth of garden egg (*Solanum aethiopicum*)

Application of cow dung and poultry droppings significantly ($p<0.05$) influenced the growth of garden egg (Tables 3 and 4**)**. In 2006, the tallest plants (75.4 cm) were obtained when cow dung was applied at the rate of 30 t/ha as single application, followed by 20 t/ha (70.6 cm) and 10 t/ha (67.5 cm) while the shortest plants (61.6 cm) were produced by the control where no manure was applied. In 2007, application of cow dung at 20 and 30 t/ha produced the tallest plants (80.8 cm and 78.9 cm), respectively, followed by the application of 10 t/ha (76.1 cm). However, the application of poultry droppings at 15 t/ha produced the tallest plants (78.2 cm) in 2006 and (85.6 cm) in 2007. This was followed by the application of 10 t/ha (71.3 cm) in 2006 and (79.8 cm) in 2007 and 5 t/ha (67.2 cm and 75.2 cm) in 2006 and 2007, respectively. The interaction between cow dung and poultry droppings also significantly influenced the plant height of garden egg. The application of cow dung at 30 t/ha and poultry droppings at 15 t/ha produced the tallest plants (85.3 cm).

The number of branches produced per plant in 2006 was highest (10.2) with the application of cow dung at the rate of 20 t/ha or 30 t/ha followed closely with the application of 10 t/ha. In 2007, however, the highest number of branches (12.3) was obtained when cow dung was applied at the rate of 30 t/ha. This was followed by the application of 20 t/ha (11.4) and 10 t/ha (10.8), respectively. The effect of poultry droppings and on the number of branches of garden egg followed the same trend as that of plant height in both years. The interaction between cow dung and poultry droppings significantly influenced the plant height of garden egg in 2006 and 2007. The application of cow dung at 30 t/ha and poultry droppings at 15 t/ha produced the highest number of branches per plant (12.0 and 15.3) for 2006 and 2007, respectively.

Table 3: Plant height and number of branches of garden egg plant as affected by cow dung and poultry droppings in 2006 and 2007 cropping seasons

Manure treatment	Cropping season			
	2006		2007	
	Plant height (cm)	Number of branches	Plant height (cm)	Number of branches
Cow dung				
C_0	61.6	8.1	59.2	6.5
C_1	67.5	9.8	76.1	10.8
C_2	70.6	10.2	78.9	11.4
C_3	75.4	10.7	80.8	12.3
LSD (P<0.05)	3.4	0.7	0.82	0.8
Poultry droppings				
P_0	58.4	7.2	54.6	5.8
P_1	67.2	9.6	75.2	10.9
P_2	71.3	10.1	79.8	12.6
P_3	78.2	11.1	85.6	13.3
LSD (P<0.05)	3.4	0.69	0.82	0.78

Key:

C- Cow dung
C_0 - 0 t/ha
C_1 – 10 t/ha
C_2 – 20 t/ha
C_3 – 30 t/ha

P – Poultry droppings
P_0 – 0 t/ha
P_1 – 5 t/ha
P_2 – 10 t/ha
P_3 – 15 t/ha

Table 4: Combined effect of cow dung and poultry droppings on plant height and number of branches of garden egg plant in 2006 and 2007 cropping seasons

	Cropping season			
	2006		2007	
Manure treatment	Plant height (cm)	Number of branches	Plant height (cm)	Number of branches
C_0P_0	43.3	3.0	38.6	2.8
C_0P_1	61.0	10.0	67.2	11.2
C_0P_2	67.0	9.0	71.3	11.5
C_0P_3	75.0	10.3	80.1	12.1
C_1P_0	61.0	8.0	72.2	10.0
C_lP_1	63.7	9.7	78.2	11.7
C_1P_2	70.3	9.7	78.9	12.4
C_1P_3	75.0	13.3	86.1	14.1
C_2P_0	61.7	9.0	70.2	12.2
C_2P_1	68.3	7.7	75.3	12.9
C_2P_2	75.0	11.0	84.5	13.8
C_2P_3	77.3	11.7	89.2	14.8
C_3P_0	67.7	9.0	76.4	13.1
C_3P_1	69.6	11.0	80.4	13.8
C_3P_2	79.0	10.7	85.8	14.1
C_3P_3	85.3	12.0	94.2	15.3
LSD (P<0.05)	6.7	1.5	4.8	1.1

Key:

C- Cow dung
C_0 - 0 t/ha
C_1 – 10 t/ha
C_2 – 20 t/ha
C_3 – 30 t/ha

P – Poultry droppings
P_0 – 0 t/ha
P_1 – 5 t/ha
P_2 – 10 t/ha
P_3 – 15 t/ha

Effect of cow dung and poultry droppings on the yield of garden egg (*Solanum aethiopicum*)

Application of cow dung and poultry droppings significantly ($p<0.05$) influenced the yield of garden egg (Tables 5 and 6**)**. In 2006 and 2007, the highest dry matter (162.4 g/plant) and highest number of fruits/plant (63) and fruit yield (9.3 t/ha) were obtained when cow dung was applied at the rate of 30 t/ha, followed by 20 and 10 t/ha, respectively. While poultry droppings applied at the rate of 15 t/ha produced the highest dry matter (166.2 g/plant) and number of fruits/plant (69) and fruit yield (11.4 t/ha). This was followed by the application of 10 and 5 t/ha, respectively. The interaction between cow dung and poultry droppings (Table 6) also significantly ($p<0.05$) influenced the dry matter and fruit yield of garden egg. The application of cow dung at the rate of 30 t/ha and poultry droppings at 15 t/ha produced the highest dry matter (216.7 g/plant) and highest number of fruits/plant (83.7) and fruit yield (12.4 t/ha) for 2006 and 230.4 g/plant, 100.2 fruits/plant and 13.1 t/ha fruit yield in 2007. However, the highest fruit yield (12.0 t/ha and 12.4 t/ha) was produced when cow dung was applied at the rate of 20 or 30 t/ha and poultry droppings at 15 t/ha in 2006 and 2007, respectively.

Table 5: Yield and yield components of garden egg plant as affected by cow dung and poultry droppings in 2006 and 2007 cropping seasons

	Cropping season					
	2006			2007		
Manure treatment	Dry matter (g/plant)	Number of fruits/plant	Fruit yield(t/ha)	Dry matter (g/plant)	Number of fruits/plant	Fruit yield (t/ha)
Cow dung						
C_0	105.8	39	5.8	94.4	26	3.9
C_1	134.3	51	7.6	137.2	58	7.8
C_2	131.9	56	8.3	148.8	61	9.0
C_3	162.4	63	9.4	169.6	75	9.8
LSD($P<0.05$)	7.3	6.7	0.41	8.5	8.2	0.51
Poultry droppings						
P_0	105.1	37	4.5	95.2	27	3.6
P_1	125.5	47	7.0	143.4	60	8.2
P_2	137.7	56	8.5	149.8	80	9.6
P_3	166.2	69	11.4	174.1	89	11.9
LSD($P<0.05$)	7.3	6.7	0.41	8.5	8.2	0.51

Key:

C- Cow dung
C_0 - 0 t/ha
C_1 – 10 t/ha
C_2 – 20 t/ha
C_3 – 30 t/ha

P – Poultry droppings
P_0 – 0 t/ha
P_1 – 5 t/ha
P_2 – 10 t/ha
P_3 – 15 t/ha

Table 6: Combined effect of cow dung and poultry droppings on yield and yield components of garden egg plant in 2006 and 2007 cropping seasons

	2006			2007		
Manure Treatment	Dry matter (g/plant)	Number of fruits/plant	Fruit yield (t/ha)	Dry matter (g/plant)	Number of fruits/plant	Fruit yield (t/ha)
C_0P_0	54.0	18.3	2.0	48.0	11.6	1.4
C_0P_1	107.3	38.0	5.0	109.2	40.4	5.8
C_0P_2	120.3	47.0	6.8	124.6	50.1	7.1
C_0P_3	141.7	75.0	10.4	150.1	86.4	11.4
C_1P_0	110.7	40.7	4.2	113.4	50.2	5.4
C_lP_1	133.7	41.3	7.3	140.5	58.1	7.9
C_1P_2	132.3	47.7	8.1	141.2	60.2	9.2
C_1P_3	160.7	53.0	11.0	170.6	88.0	11.9
C_2P_0	119.7	40.7	5.3	125.4	60.1	6.4
C_2P_1	123.0	58.7	7.1	135.2	75.0	8.1
C_2P_2	139.0	61.3	8.9	150.2	80.4	9.1
C_2P_3	157.7	63.3	12.0	182.6	90.1	12.4

C_3P_0	136.0	50.3	6.5	156.2	81.2	7.2
C_3P_1	138.0	51.7	8.6	160.2	88.4	8.8
C_3P_2	159.0	68.7	10.3	178.1	92.4	11.2
C_3P_3	216.7	83.7	12.4	230.4	100.2	13.1
LSD (P<0.05)	14.5	13.5	0.82	19.2	14.8	0.71

Key:

C- Cow dung
C_0 - 0 t/ha
C_1 – 10 t/ha
C_2 – 20 t/ha
C_3 – 30 t/ha

P – Poultry droppings
P_0 – 0 t/ha
P_1 – 5 t/ha
P_2 – 10 t/ha
P_3 – 15 t/ha

Nutrient Composition of the Animal Manures

The nutrient content of the cow dung and poultry droppings is presented in Table 7. The poultry droppings had higher values of N, P, K and Ca (1.45, 2.12, 2.25 and 7.80 %), respectively, than the cow dung with 1.24, 0.89, 0.36 and 3.35 % of N, P, K and Ca, respectively. The Mg, Na and organic carbon content of poultry droppings was 1.90, 0.11 and 8.60 %, respectively; while the cow dung contained 0.53 % Mg, 0.15 % Na, and 13.4 % organic carbon. The difference observed in the nutrient contents of the animal manures is a function of the physiological differences between cattle and poultry and the quality of the feed type which differ between the two animals. Poultry droppings are generally richer in nutrients such as N, P, K, Ca and Mg. These higher values of poultry manure agrees with the results of Mbah *et al.,* (2004).

Table 7: Nutrient composition of fresh cow dung and poultry droppings

	Nutrient composition	
Nutrient element	Cow dung	Poultry droppings
N	1.24	1.45
P	0.89	2.12
K	0.36	2.25
Ca	3.35	7.80
Mg	0.53	1.90
Na	0.15	0.11
Organic carbon	13.14	8.60

DISCUSSION

The values of soil pH obtained at the experimental site (Table 1) shows that the soil is slightly acidic. The low soil N, available P, exchangeable bases and CEC typifies the locations' characteristics of the rainforest soils. Although Nigerian soils are generally said to be low in nutrients, Chude (1998) specifically noted that soils of Cross River State have low P, Ca, and Mg with the exception of K which is relatively high.

The higher content of N, P and exchangeable cations in plants treated with animal manures over plants grown in the control where no manure was applied resulted from the mineralization and release of nutrients in the cow dung and poultry droppings in available form which were taken up by the garden egg plants (Table 2). The increase in nutrient concentration in plants with increasing rates of poultry droppings up to 15 t/ha is similar to the observed uptake of these nutrients by Ojeniyi and Adejobi (2005) on sweet potato when poultry droppings was applied up to 12 t/ha, and on *Ammaranthus* when goat manure was applied. Increased K content was also reported by Mc Andrews *et al*., (2006) due the application of swine dung.

The increase in plant height, number of branches (Tables 3 and 4), shoot dry matter, number of fruits and total fruit yield (Tables 5 and 6) due to the application of cow dung and poultry droppings especially at the higher rates is a manifestation of the role of animal manure on soil fertility status and consequently on its productivity. Similar results on increased dry matter production due to application of animal manure have also been reported. Laure-lyanda *et al*., (2004) obtained similar increases in dry matter production in maize with the application of cow dung, while Ogboghodo, *et al.* (2004) also obtained similar results on maize using poultry manure.

In conclusion, the Application of poultry droppings at 15 t/ha produced tallest plants with highest number of branches, highest number of fruits per plant and fruit yield per unit area. Application of cow dung at the rate of 30 t/ha greatly increased the fruit yield of garden egg. The combined application of cow dung and poultry droppings at the rate of 20 t/ha and 15 t/ha, respectively, produced tallest plants, highest number of branches, highest number of fruits per plant and fruit yield and is therefore recommended for the Obubra agro-ecological zone of Nigeria.

REFERENCES

Ayuba, S. A.; John, C. and Obasi, M. O., 2005. Effect of organic manure on soil chemical properties and yield of ginger. Nigeria Journal of soil science. 15: 136-138.

Bremmer, J. M. and Mulvancy, C. S., 1982. Nitrogen-total. *In*: Methods of soil analysis, Part 2. A. L. Page *et al*., (ed). America Society of Agronomy, Madison, W.I. 595 – 624.

Chude, V. O., 1998. Understanding Nigerian soils and their fertility management for sustainable agriculture. Inaugural Lecture delivered at A.B.U., Zaria, Nov . 26, 1998. Inaugural Lecture, series 13: 33pp.

Eghball, B., Ginting D. and Gilley, J. E., 2004. Residual effect of manure and compost application on corn production and soil properties. Agronomy Journal 96: 442-447.

Esu, I. E., 2005. Characterization, classification and management problems of major soil orders in Nigeria. 26th Inaugural Lecture, Department of Soil Science, University of Calabar- Nigeria. April 26th, 2005, 54pp.

Ezeakunne, C. O., 1985. Effect of N, P and farm yard manure on the growth and yield of local garden egg variety "Samaru stripe". A.B.U. Samaru Journal of Agriculture. 111: 22-27.

Greweling, T., 1976. Chemical analysis of plant tissue. Search Bulletin 6 (8). Cornel University of Agric. Expt. Station, Ithaca New York.

Kogbe, J. O. S., 1982. Effect of N and spacing on the yield of local garden egg. *In:* Proceedings of the 5thAannual Conference of the Hort. Soc. of Nigeria, A.B.U., Zaria. Pp 54 – 63.

Lanre-Iyanda, Y. A., Adekunle, M. I. and Arowolo, T. A., 2004. Evaluation of the effect of N.P.K. fertilizer and cow dung on maize plant grown on copper contaminated soil. Int. J. of Food and Agric. Res.1: 182.

Lombin, I. O., Adepetu, J. A. and Ayotade, K. A., 1991. Complementary use of organic manure and inorganic fertilizers in arable crop production. Organic fertilizer in the Nigerian agriculture: Present and future. In: Proceedings of National Organic Fertilizer Seminar, Kaduna, Nigeria, March 26-27 1991.

Lunin, J., 1977. Soils for the management of organic wastes and waste waters. American Society of Agronomy (ASA), Crop Science Society of America (CSSA), Soil Science Society of America (SSA) - Madison, Wisconsin, USA. Pp 33-37.

Mbah, C. N., Mbagwu, J. S. C. and Anikwe, M. A. N., 2004. Effect of animal wastes application on soil sodicity and sulphate concentration on an ultisol in south eastern Nigeria. Paper presented at the 29th annual conference of the Soil Science Society of Nigeria. 6 - 10 December, 2004 at the University of Agriculture, Abeukuta, Ogun State.

McAndrews, G. M., Liebman, M., Cambardella, C. A. and Richard, T. L., 2006. Residual effect of composted and fresh solid swine (susscrofalis) manure on soybean (*Glycine max* L. Merrill) growth and yield. Agronomy J. 98: 873-882.

Ogboghodo, I., Erebor, E., Osemwota, I. and Isitekale, H., 2004. Effect of application of Poultry manure to crude oil polluted soils on maize growth and soil properties. Environmental Monitoring and Assessment. 96: 153-161.

Ojeniyi, S.O., 2000. Effect of goat manure on soil nutrient content and okra yield in rainforest areas of Nigeria. Applied Tropical Agric. 5: 20-23.

Ojeniyi, S.O. and Adejobi, K.B., 2002. Effect of ash and goat dung manure on leaf nutrient composition, growth and yield of *Ammaranthus*. Nig. Agric. J. 33:46-57.

Ojeniyi, S.O. and Adejobi, S.K., 2005. Comperative effect of poultry manure and NPK fertilizer on growth and yield and nutrients contents of sweet potato (*Ipomea batata*). Proceedings of the 39th Annual Conference of Agricultural Society of Nigeria, University of Benin, Benin City, Nigeria. October 9th - 13th 2005. Pp 115 – 116.

Page, A. L., Miller, R. H. and Keany, D. R. 1982. Methods of soil analysis, Part 2. Chemical and microbiological properties. America Society of Agronomy, Madison. 55 pp.

Place, F. C., Barreth, B., Freeman, H. B., Ramiscis, J. J., and Vanlauwe, B., 2003. Prospect for integrated soil fertility management using organic and inorganic inputs; Evidence from small holder African agricultural systems. Ecosystems and the environment 84: 28-42.

Tewolde, H. K., Sistani, R., Rowe, D. E., Adeli, A., and Johnson, J. R., 2007. Lint yield and fibre quality of cotton fertilized with broiler litter. Agron. J. 99:184-194.

Vanlanwe, B., 2000. Soil organic matter and crop production in a West African context. In: Agronomy in Nigeria. Agronomy Re-Union Day, October 4th 2000. Univ. of Ibadan-Nigeria. Pp 202 – 207.

Zhang, M., Garlak, R., Mitchell, A. and Sparrow, S., 2006. Solid and liquid cattle manure application in a sub arctic soil. Agron. J. 98: 1551-1558.