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Effects of different Levels of Compost Manure on Upland Rice and Soil Chemical Properties in Asaba, Delta State, Nigeria

Ojobor, S. A., Obiazi C. C. and Egbuchua, C. N.
Department of Agronomy, Delta State University, Asaba Campus, Nigeria
Corresponding author: smartojobor@gmail.com, ojoborsmart@yahoo.com 08065938821

ABSTRACT
Field experiment evaluated effects of compost level on growth and yield of upland rice, and soil chemical properties, carried out in Agronomy Department Teaching and Research Farm, Delta State University, Asaba Campus in two cropping seasons. The compost was formulated with rice husk and cowdung at the ratio of 7:3, water was added during turning at weekly intervals for twelve weeks. It was applied at four levels: 0, 2.5, 5.0 and 10.0 t ha^{-1}, while inorganic fertilizer was applied at 200 kg ha^{-1}. The experiment was layout in randomized complete block design with four replicates. Parameters measured were plant height, number of leaves, total leaf area, plant girth, dry matter, rice yield and soil chemical properties were soil pH, organic matter, nitrogen, phosphorus and exchangeable bases. Data were subjected to analysis of variance and mean were separated with DMRT at 5% level of probability. The result shows that 10.0 t ha^{-1} had highest plant height, plant girth, number of tillers, dry matter and rice yield at second season while the inorganic fertilizer had highest in all growth parameters in first season. All the levels improved the soil chemical properties than the inorganic fertilizer and 0 t ha^{-1}. Therefore, 10.0 t ha^{-1} could be recommended for farmers in Asaba.
Key words: Soil fertility, organic manure, application rates, NERICA, rice waste

INTRODUCTION
Most soils in Nigeria lack the optimum environmental conditions for normal growth and yield of crops. This is mainly attributed to the excessive, frequently uncontrolled and routine use of inorganic fertilizers in the country that had adverse effects on soil chemical properties (acidity, toxicity and nutrient imbalance) and yield efficiency and quality (Milosevic and Milosevic, 2009). This had led to the poor fertility status of soil.
Organic fertilizers have been used to improved soil chemical properties especially decreasing acidity and improving the humus content of the soil ((Olanikan, 2006 and Spaccini *el at*., 2002). Studies have also showed that they are highly effective, environmentally safe and biologically justified mostly on degraded soils. One of such organic fertilizer is composted rice husk (Ojobor, 2008, Ojobor *et al*., 2009 and Adeoye *et al*., 2005). Rice husk and cowdung formulations showed great potential and were successfully used in cultivation of upland rice (Ojobor, 2004 and Adeoye *et al*., 2005). Hence, this study evaluated the changes in soil chemical properties and growth and rice yield of upland rice influenced by different levels of compost manure in Asaba, Delta State.

MATERIALS AND METHODS
The field experiment was carried out at the Teaching and Research Farm, Department of Agronomy, Delta State University, Asaba Campus for two cropping seasons (2008 and 2009). The site is situated in the rainforest zone, with longitude 6^0 14^l E and latitude 6^0 14^l N. It has a bi-modal rainfall pattern, the rainy season runs between mid March and mid November while the dry seasons runs from late November to the end of March. Cassava, maize, yam and vegetables were cultivated previously and no proper record of fertilizer application. The compost manure was spread and incorporated into the soil with hoe and spade during seed bed preparation two days before sowing. Seven seeds of New Rice for Africa used as test crop were sown and later thinned to four per stands two weeks after sowing. The compost manure was formulated by mixing rice husk and cowdung in ratio 7:3 by weight, and water was added during turning at weekly interval for twelve. The compost manure was applied at four levels (0, 2.5, 5.0, and 10.0 t ha^{-1}) while inorganic fertilizer recommended for the location was applied at 200 kg ha^{-1} (NPK15:15:15).

Randomized complete block design (RCBD) was used; the plot measured 15m by 14m, with four replicates, each sub-plot measured 3m by 4m, and plant spacing of 25 cm by 30 cm was used. Data collection on growth parameters started three weeks after sowing and subsequently on weekly basis while yield parameters were measured after harvest. The growth and yield parameters were: plant height (cm), number of leaves, plant girth (cm), total leaf area (cm^2), number of tillers, dry matter and rice yield (t ha^{-1}). Soils were sampled for pre-planting analysis and also post-harvest chemical analysis at each season. Soil sample for pre-planting analysis was randomly collected from the experimental plot while the samples for post planting soil analysis were taken from each sub-plot and were bulked together according to treatment. The soil samples were dried at room temperature and sieved with 2mm sieve before analyses. Soil parameters determined were: soil pH, organic matter, total nitrogen, available phosphorus and exchangeable bases. The soil pH was on a ratio of 1:2 soil/water suspensions (IITA, 1979). Organic carbon was determined using the Walkley Black Method (IITA, 1979). Exchangeable bases (K, Ca. Mg and Na) were extracted by ammonium acetate extraction method. The Ca and Mg were determined by Atomic Absorption Spectrophotometer (AAS) while K and Na were read using Flame

Photometer. The available P was extracted using Bray-1 extracting solution and further reading was carried out Colormetrically. Total N was determined by the Kjeldhal distillation method. Analysis of variance was done for the data collected using linear model (GLM) routine of SAS Institute, Inc. (2010) and DMRT at 5% level of probability was used to separate differences among treatment means.

RESULTS

Particle size and chemical properties of pre-planting soils

The properties of soil before planting shows that it was sandy loam, acidic and low in organic matter, total N, and available P (Table 1). Also, the soil was low in exchangeable bases except K that was moderate, the effective cation exchange capacity was low and had high base saturation high.

Effects of the levels of compost manure on growth and yield of rice

Plant height: Table 2 shows the effects of different levels of organic manure on the plant height at both cropping seasons. It increases with increased of weeks after sowing (WAS) and the level of compost manure application, there were significant ($p<0.05$) differences. In 2008, growth rate of control (0 t ha^{-1}) were higher at the early stage, thereafter, reduces at 6 to 11 WAS. The NPK15:15:15 had the tallest plant height the period data were collected (66.0 cm). Among the levels of the compost manure application, at 3 WAS, 0 t ha^{-1}, 2.5 and 5.0 t ha^{-1} had the tallest height 6 WAS, while from 7 to 11 WAS, 10.0 t ha^{-1} level maintained the tallest height. In 2009, 10.0 t ha^{-1} had the tallest plant height while the lowest was 0 t ha^{-1} (78.7 and 36.0 cm respectively).

Table 1: **Particle size and chemical properties of pre-planting soils**

Parameter	values
pH (H_2O) 1:2	5.5
Organic matter (gkg^{-1})	1.7
Total Nitrogen (gkg^{-1})	0.5
Available P ($mgkg^{-1}$)	6
Exchangeable bases (cmol kg^{-1})	
K	0.3
Mg	1.3
Ca	1.2
Na	0.1
Exch. Acidity	0.6
ECEC	3.5
BS %	82.9
Particle Size (gkg^{-1})	
Sand	680
Silt	90
Clay	220
Textural Class	**Sandy clay loam**

Table 2: **Effects of the levels of compost manure on mean plants height (cm)**

	Weeks after sowing								
Levels	3	4	5	6	7	8	9	10	11
2010									
0 t ha^{-1}	19.2ab	24.6b	29.1c	31.5d	35.0c	37.1d	40.4e	43.4e	46.3e
2.5 t ha^{-1}	19.1b	25.4ab	31.0b	35.4c	41.2b	45.5c	50.4d	54.7d	59.8d
5.0 t ha^{-1}	19.0b	25.5ab	29.8bc	36.7b	41.5b	46.2bc	52.9c	58.4c	62.5c
10.0 t ha^{-}	19.0a	24.1b	30.5b	36.7b	41.7b	47.1b	53.4b	60.0b	64.0b
NPK	20.8 a	26.1a	32.7a	38.9a	43.4a	48.1a	55.0a	62.2a	66.0a
2011									
0 t ha^{-1}	17.4d	20.6c	24.1d	27.5d	29.0d	31.1c	32.4d	35.4e	36.0d
2.5 t ha^{-1}	22.3b	27.5b	32.1c	36.3c	42.8c	48.9b	53.3c	58.7d	64.7c
5.0 t ha^{-1}	20.4c	31.2a	35.9b	41.9b	46.6b	51.3b	56.9b	61.9c	67.3b
10.0 t ha^{-}	25.5a	31.6a	36.9a	43.6a	50.8a	57.8a	65.1a	73.0a	78.7a
NPK	21.3b	27.2b	32.0c	37.7c	42.6c	49.6b	55.8b	63.5b	65.3c

Treatments within each column with the same letters are not significantly different.
($P< 0.05$) DMRT

Number of leaves: The levels of application were significantly different (p<0.05). The NPK15:15:15 treatments had the highest number of leaves in both seasons (Table 3). In 2008, among the levels of compost manure, 0 and 5.0 t ha^{-1} had the equal number of leaves at 3 WAS, while at 4 WAS, 5.0 t ha^{-1} had the highest number of leaves. Five to 10 WAS, 2.5 t ha^{-1} of the compost manure maintained the highest number of leaves, but at 11 WAS, 10.0 t ha^{-1} had the highest number of leaves (6.66). In 2009, NPK15:15:15 not inclusive, 5.0 t ha^{-1} of the compost manure had the highest number of leaves at 4 to 11 WAS, but at 3 WAS, 2.5 t ha^{-1} had the highest number of leaves.

Plant girth: Plant girth increased progressively with increase in WAS, except 0 t ha^{-1} that had no increment at 5 to 11 WAS in both years (Table 4). Significant differences (p<0.05) exist among the levels of compost manure application. In 2008, 0 t ha^{-1} had the fattest plant girth at 3 to 4 WAS, and was significantly different from higher levels except 10.0 t ha^{-1} at 4 WAS. The 0 t ha^{-1} and 5.0 t ha^{-1} at 5 WAS had similar plant girth. The 2.5 t ha^{-1} had highest plant girth at 6 WAS, while 10.0 t ha^{-1} recorded the highest from 9 to 11 WAS. In 2009, 10.0 t ha^{-1} had the highest plant girth at 6 to 11 WAS, it was also significantly different from the lower levels.

Table 3: **Effects of the levels of compost manure on number of leaves**

	Weeks after sowing								
Levels	3	4	5	6	7	8	9	10	11
2010									
0 t ha^{-1}	4.3b	4.7a	4.7c	5.0b	5.0c	5.1c	5.1b	5.13b	5.0c
2.5 t ha^{-1}	4.5b	4.7a	4.8c	5.1b	5.2b	5.3b	5.4b	5.5b	5.4b
5.0 t ha^{-1}	4.3b	4.8a	5.0b	5.2b	5.4b	5.4b	5.3b	5.7b	5.6b
10.0 t ha^{-1}	4.7a	5.1a	5.4a	5.5a	6.0ab	6.2ab	6.3ab	6.5a	6.7a
NPK	5.3a	5.7a	6.0a	6.4a	6.7a	7.0a	7.0a	6.7a	6.7a
2011									
0 t ha^{-1}	4.3b	4.7a	4.7c	5.0b	5.0c	5.1c	5.1b	5.3b	5.0c
2.5 t ha^{-1}	4.5b	4.7a	4.8b	5.1b	5.2b	5.3b	5.4b	5.5b	5.4b
5.0 t ha^{-1}	4.3b	4.8a	5.0b	5.2b	5.4b	5.4b	5.3b	5.7b	5.6b
10.0 t ha^{-1}	4.1b	4.2b	4.6c	5.0b	5.0c	5.0c	5.2b	5.5b	5.6b
NPK	5.0a	5.0a	5.4a	6.7a	6.0a	6.0a	6.0a	6.7a	7.0a

Treatments within each column with the same letters are not significantly different (P< 0.05) DMRT

Table 4: **Effects of the levels of compost manure on mean plants girth (cm)**

	Weeks after sowing								
Levels	3	4	5	6	7	8	9	10	11
2010									
0 t ha^{-1}	0.19a	0.22a	0.24a	0.24ab	0.24b	0.24b	0.24c	0.24d	0.24d
2.5 t ha^{-1}	0.14bc	0.16a	0.23b	0.26a	0.28a	0.31a	0.33ab	0.34bc	0.35c
5.0 t ha^{-1}	0.13c	0.15ab	0.24a	0.25a	0.28a	0.31a	0.33ab	0.35b	0.36c
10.0 t ha^{-1}	0.13c	0.14c	0.17c	0.22c	0.26a	0.30a	0.33a	0.38a	0.41b
NPK	0.19a	0.21a	0.25a	0.31a	0.36a	0.41a	0.48a	0.50a	0.51a
2011									
0 t ha^{-1}	0.19b	0.21b	0.23b	0.23c	0.23c	0.23d	0.23d	0.23d	0.23d
2.5 t ha^{-1}	0.18c	0.21b	0.23b	0.25b	0.28b	0.31c	0.33c	0.36c	0.38c
5.0 t ha^{-1}	0.18c	0.20c	0.22c	0.25b	0.28b	0.31c	0.33c	0.35c	0.38c
10.0 t ha^{-1}	0.18c	0.20c	0.22c	0.26b	0.30a	0.33b	0.37b	0.42b	0.47b
NPK	0.20a	0.22a	0.24a	0.28a	0.31a	0.35a	0.39a	0.44a	0.49a

Treatments within each column with the same letters are not significantly different (P< 0.05) DMRT

Legend

0 t ha^{-1} – Control treatment (without compost manure application)
2.5 t ha^{-1} – 2.5 tones of compost manure per hectare
5.0 t ha^{-1} – 5.0 tones of compost manure per hectare
10.0 t ha^{-1} – 10.0 tones of compost manure per hectare
NPK - 200 kg of NPK 15:15:15

Total leaf area: The NPK15:15:15 treated rice plant leaf covered the largest area in both years and levels of compost manure were significantly different ($p<0.05$) (Table 5). In 2008, from 3 to 5 WAS, 5.0 t ha^{-1} had the largest leaf area, it was significantly different from 0 and 2.5 t ha^{-1}. Then from 6 to 11 WAS, 10.0 t ha^{-1} had the largest leaf area and also, it was significantly different from the lower levels while 0 t ha^{-1} had the smallest total leaf area. In 2009, 0 t ha^{-1} had the least while NPK15:15:15 and 10.0 t ha^{-1} had the highest leaf area (127.9 and 126.6 cm^2 respectively).

Number of tillers: Number of tillers as influenced by the levels of compost manure were shown on Table 6. There were significant differences ($p<0.05$) among the levels of compost manure. The 0 t ha^{-1} had no tiller in both years. In 2008, 10.0 t ha^{-1} and NPK15:15:15 had equal number of tillers while 5.0 t ha^{-1} had one but 2.5 t ha^{-1} had no tiller. In 2009, 10 t ha^{-1} had the highest number of tillers while 5.0 t ha^{-1} and NPK15:15:15 had equal number of tillers, 2.5 t ha^{-1} had only one tiller.

Dry matter yield: Dry matter yield increased with increase of the compost manure, also there were significant differences among the levels of compost manure (Table 6). In 2008, 10.0 t ha^{-1} produced the highest dry matter yield (6.16 t ha^{-1}), and was significantly higher than the lower levels. The 5.0 t ha^{-1} was significantly higher than 2.5 t ha^{-1} and 0 t ha^{-1} while the 2.5 t ha^{-1} was also significantly different from the 0 t ha^{-1}. In 2009 also, 10.0 t ha^{-1} had the highest dry matter yield (7.69 t ha^{-1}) while the least was the 0 t ha^{-1} with 2.68 t ha^{-1} value of dry matter yield.

Rice yield: Significant differences ($p<0.05$) among the levels of compost manure application in both years were recorded (Table 6) and NPK15:15:15 produced the highest rice yield at first year. The level of compost manure with the highest rice yield was 10.0 t ha^{-1} and was significantly different from the lower levels.

Table 5: **Effects of the levels of compost manure on total leaf area (cm^2)**

	Weeks after sowing								
Levels	3	4	5	6	7	8	9	10	11
2010									
0 t ha^{-1}	25.2c	30.2c	41.1b	47.3c	50.7d	59.9c	65.3d	77.2d	84.2d
2.5 t ha^{-1}	28.4b	33.1b	40.8b	50.6b	60.2bc	71.6b	80.2c	90.0bc	101.1c
5.0 t ha^{-1}	31.0a	36.8a	47.1a	53.0a	62.2b	73.4b	84.5b	94.9b	106.2b
10.0 t ha^{-1}	30.1a	36.5a	45.5a	53.2a	67.8a	82.2a	96.0a	111.2a	124.6a
NPK	32.3a	37.3a	47.0a	55.1a	69.4a	85.0a	98.6a	115.6a	128.9a
2011									
0 t ha^{-1}	21.2c	26.2c	31.1d	37.3d	40.7d	49.9e	55.1e	67.4e	73.8d
2.5 t ha^{-1}	29.4b	36.1b	43.8c	52.6c	61.4d	72.6d	81.2d	91.0d	103.1c
5.0 t ha^{-1}	31.7a	38.9a	49.3a	57.0b	64.2c	75.4c	85.5c	96.9c	111.0b
10.0 t ha^{-1}	31.2a	39.3a	50.5a	61.2a	77.8a	89.2a	101.0a	118.2a	126.6a
NPK	32.3a	36.3b	47.0b	56.1b	70.4b	85.0b	97.6b	114.6b	127.9a

Treatments within each column with the same letters are not significantly different. ($P< 0.05$) DMRT

Table 6: **Effects of the levels of compost manure on mean number of tillers, dry matter and rice yield**

		t ha^{-1}	
Levels	Num of Tillers	Dry matter	Rice yield
2010			
0 t ha^{-1}	0c	2.83d	0.97d
2.5 t ha^{-1}	0c	3.29c	1.51c
5.0 t ha^{-1}	1b	5.32b	1.91b
10.0 t ha^{-1}	2a	6.16a	2.33a
NPK	2a	6.28a	2.40a
2011			
0 t ha^{-1}	0e	2.68d	0.93d
2.5 t ha^{-1}	1c	5.21c	1.77c
5.0 t ha^{-1}	2b	5.71b	2.31b
10.0 t ha^{-1}	3a	7.69a	2.60a
NPK	2b	6.55a	2.50a

Treatment mean within each column with same letters are not significantly different ($P< 0.05$) DMRT

Legend
0 t ha^{-1} – Control treatment (without compost manure application)
2.5 t ha^{-1} – 2.5 tones of compost manure per hectare
5.0 t ha^{-1} – 5.0 tones of compost manure per hectare
10.0 t ha^{-1} – 10.0 tones of compost manure per hectare
NPK - 200 kg of NPK 15:15:15

Effects of application levels of compost manure on soil chemical properties

There were effects of compost manure on soil pH (Table 7). All the levels had higher effects on soil pH value than the NPK15:15:15 treatment. The 10.0 t ha^{-1} had highest among the levels of compost manure (5.6), while 5.0 and 2.5 t ha^{-1} were similar (5.4 each). In second year, similar trend was recorded, 10.0 t ha^{-1} also had the highest value while the least was the 0 t ha^{-1}.

Increasing compost manure resulted to higher soil organic matter in soil (Table 7). The 10.0 t ha^{-1} had the highest soil organic matter in both years (2.8 and 12.8 gkg^{-1} respectively) while the least was 0 t ha^{-1}. The 2.5 and 5.0 t ha^{-1} of the compost manure had equal value soil organic matter (2.67gkg^{-1}). In the second year, 2.5 t ha^{-1} had the least soil organic matter content.

All the levels of compost manure had higher total nitrogen than 0 t ha^{-1} (Table 7). The 10.0 t ha^{-1} had highest total nitrogen (0.9 and 1.7 gkg^{-1}) in both years respectively while 2.5, 5.0 t ha^{-1} and NPK15:15:15 treatment had equal value of nitrogen (0.8 g kg^{-1}). In the second year, NPK15:15:15 had the lowest value of total nitrogen (0.7 g kg^{-1}).

There was increased available phosphorus as a result of increasing level of compost manure (Table 7). The 10.0 t ha^{-1} had the highest available phosphorus in both years (14 and 21 $mgkg^{-1}$) while the least was 0 t ha^{-1} (9 and 7 $mgkg^{-1}$) respectively. All the levels of compost manure had higher available phosphorus than NPK15:15:15 and 0 t ha^{-1}.

Potassium was improved as a result of compost manure application (Table 7). In first year, 10.0 t ha^{-1} had highest value of K (0.5 $cmolkg^{-1}$) while 0 t ha^{-1} and NPK15:15:15 had the least (0.3 $cmolkg^{-1}$). In the second year, 5.0 t ha^{-1} had highest amount of exchangeable K (0.9 $cmolkg^{-1}$) while 0 t ha^{-1} had the least (0.2 $cmolkg^{-1}$).

There was level effect of compost manure on soil Ca. Increase application level led to increase value of Ca. The 10.0 t ha^{-1} had Ca value of 1.8 $cmolkg^{-1}$ in first year and 3.0 $cmolkg^{-1}$ in second year. The compost manure had higher Ca value than the NPK15:15:15.

Magnesium in soil increased with increase of compost manure, all the levels of application except 0 t ha^{-1} had higher Mg than NPK15:15:15. The first year, 10.0 and 5.0 t ha^{-1} had the highest Mg (1.5 $cmolkg^{-1}$) while the least was 0 t ha^{-1} (1.0 $cmolkg^{-1}$). In the second year, 10.0 t ha^{-1} had significant highest exchangeable Mg (3.6 $cmolkg^{-1}$), while 0 t ha^{-1} had the lowest Mg (0.9 $cmolkg^{-1}$).

There were also improvements of Na in soil, 10.0 and 2.5 t ha^{-1} had equal value of Na (0.3 $cmolkg^{-1}$) while the NPK15:15:15 recorded the least (0.1 $cmolkg^{-1}$) the first year. Then in second year, 10.0 and 5.0 t ha^{-1} had the highest value (0.4 $cmolkg^{-1}$) while NPK15:15:15 and 0 t ha^{-1} had the least exchangeable Na (0.1 $cmolkg^{-1}$).

The effective cation exchange capacity of the soil was influenced and all the treatments were significantly different. All the levels had significant higher ECEC than 0 t ha^{-1} and NPK15:15:15 in first year. In second year, 10.0 t ha^{-1} had higher ECEC than the lower levels of compost manure and NPK15:15:15, the least was the 0 t ha^{-1} (3.1 $cmolkg^{-1}$).

The percentage base saturation of the soil was high. All the levels of compost manure had higher percentage base saturation than NPK and 0 t ha^{-1}. The 10.0 t ha^{-1} had highest base saturation in both years (89.1 and 95.1% respectively) while the least was NPK in first year and 0 t ha^{-1} the second year (76.7%).

Table 7: **Effects of the levels of compost manure on post chemical properties**

Levels of application	pH (H_2O)	OM (gkg^{-1})	N (gkg^{-1})	P (mgkg^{-1})	K (Cmol kg^{-1})	Ca (Cmol kg^{-1})	Mg (Cmol kg^{-1})	Na (Cmol kg^{-1})	Ex A. (Cmol kg^{-1})	ECEC (Cmol kg^{-1})	BS (%)
2010											
0 t ha^{-1}	5.0c	1.5b	0.5a	6de	0.2a	1.1b	1.1a	0.1a	0.2a	2.7b	92.6b
2.5 t ha^{-1}	5.3ab	2.6a	0.6a	7cd	0.2a	1.2b	1.2a	0.2a	0.2a	3.0a	93.3b
5.0 t ha^{-1}	5.4a	2.6a	0.6a	10b	0.3a	1.7a	1.3a	0.2a	0.2a	3.7a	94.6a
10.0 t ha^{-1}	5.5a	2.7a	0.7a	12a	0.4a	1.8a	1.4a	0.2a	0.2a	4.0a	95.0a
NPK	5.0c	1.6b	0.6a	8c	0.2a	1.2b	1.2a	0.1a	0.3a	3.0a	90.0c
2011											
0 t ha^{-1}	4.9b	1.5d	0.5d	4e	0.2d	1.0b	1.0e	0.1a	0.7a	3.0c	76.7c
2.5 t ha^{-1}	5.5a	10.1b	1.1bc	12c	0.4c	2.2a	2.5c	0.3a	0.5a	5.9b	91.5a
5.0 t ha^{-1}	5.6a	10.3b	1.3b	14b	0.6b	2.3a	2.9b	0.4a	0.6a	6.8a	91.2a
10.0 t ha^{-1}	5.7a	12.5a	1.6a	18a	0.8a	2.7a	3.4a	0.5a	0.5a	7.9a	93.7a
NPK	4.9b	4.1c	0.9c	9d	0.4c	2.0a	1.9d	0.1a	0.8a	5.2b	84.6b

Treatment mean within each column with same letters are not significantly different ($P < 0.05$) DMRT

Legend

0 t ha^{-1} – Control treatment (without compost manure application)
2.5 t ha^{-1} – 2.5 tones of compost manure per hectare
5.0 t ha^{-1} – 5.0 tones of compost manure hectare
10.0 t ha^{-1} – 10 .0 tones of compost manure per hectare
NPK - 200 kg of NPK 15:15:15

DISCUSSION

Compost manure application significantly increased rice yield, increased compost manure led to increase growth and yield of rice. At the early stage of growth (2-3 weeks after sowing), 0 t ha^{-1} (control treatment) grew taller and look healthier than the higher levels of application (2.5. 5.0 and 10.0 t ha^{-1} of compost manure) especially at the first year. Five to seven weeks after sowing, there was a critical point of gradual increase of plant height. This could be attributed to high rate of mobilization of nutrient by microorganisms and subsequent release during mineralization (Mary *et al*., 1998 and Sakala *et al*., 2000). The lower levels of application produced higher number of leaves at the early stage but the leaves were smaller, while at the later stage, higher number of leaves was produced by the higher levels of application. Significant increased were observed on dry matter yield with the level of application. Increased N and P released during decomposition of the compost manure probably increased vegetative growth as a result of increase cell division (Onyishi *et al*., 2010). This led to higher dry matter and rice yield produced. The application of inorganic fertilizer compared to 10.0 t ha^{-1} of compost manure increased rice yield but no appreciable difference during the first season but by second season, the yield of the inorganic fertilizer reduced. The plants were taller, the girth was bigger and the leaves were wider and healthier at the second year than the first year. This could be attributed to the residual effects of the compost manure applied at the first year. The rice started booting at 9 to 11 weeks after sowing in first season and 8-10 weeks in second season. Plots with higher compost manure boot first before the lower levels. This could be attributed also to nutrient released rate and the residual effects of the previous application.

The result of soil analysis showed that the location was sandy loam, slightly acidic with low level of organic matter, total N, available P, exchangeable bases. This shows poor fertility status of the location. The poor fertility status has been observed as the major characteristics of the tropical soil (Tolessa, 1999 and Ogunwale *et al*., 2002). The location could be regarded as having poor soil fertility for crop production (Agboola, 1982, Landon, 1991 and FMARD, 2012

The lower value pH value of control, NPK treated soil and higher pH value in compost manure treated soil explains the acidifying effects of the NPK fertilizer and the neutralizing effects of compost manure. The increase was proportional to the levels of application. The compost manure has been found to be capable of improving soil pH because of the relative exchangeable Ca, Mg and K it contained (Olayinka and Adebayo, 1985). The soil organic matter increased, and this increase could be attributed to the levels of compost manure application. Similar results have been reported by Oguike and Mbagwu, (2001 and 2004) and Oguike *et al*. (2006). There was no appreciable improvements in total nitrogen after the first year. though they had higher total nitrogen than the control. The nitrogen contents of all the levels were generally low. This could be attributed to slow decomposition rate of the compost manure which caused immobilization of soil nitrogen in all the compost manure treated soils. As a result, most of the soil nitrogen was still held in organic form (Vanlauwe *et al.*, 1998). This finding was also in line with result of Oguike *et al*. (2006). Available phosphorus significantly increased and also, all the levels of the compost manure had higher available P than the NPK and control treatments. This could be attributed to effects of compost manure which increased P solubility of soluble carbon compounds competing with P for sorption. Also, mineralization of organic P releases P into the soil solution, contributing to the observed high available P from application of compost manure (Paul *et al*., 2003 and Mohammadi *et al*., 2009). The data obtained indicated that as application level increase from zero to 10.0 t ha^{-1}, the soil CEC as one of the soil quality indexes was also increased (Muhammand *et al*., 2001), indicating a considerable improvement in nutrient exchange capacity of the soils.

In conclusion, compost manure improved rice yield and soil chemical properties than the NPK fertilizer, also there were significant differences among the levels of application. The 10.0 t ha^{-1} had the highest effects on soil chemical properties. In addition, it produced the highest rice yield. Therefore it could be recommended for farmers in Asaba and its environment to apply 10.0 t ha^{-1} of the compost manure. Though, application level higher than 10.0 t ha^{-1} can further be evaluated.

REFERENCES

Adeoye, G. O., Ojobor, S. A. and AdeOluwa, O. O. (2005). Evaluation of potential of co-organic manure of rice waste, cow dung and poultry treatments for production of rice. Conference proceedings, Soil Science Society of Nigeria Annual Conference held at Senate Chamber, University of Abeokuta, Nigeria, Dec. 6-10, 2004. P213-218.

Agboola, A. A. (1982). Organic manure in tropical Africa. Symposium paper 1. International Conference on Soil Science. New Delhi India. P8-16.

FMARD (2012). Literature Review on the Soil Fertility Investigation in Southern Nigeria. Federal Ministry of Agriculture and Rural Development. Edited by Chude V. O., 2nd Edition. Pp 250.

International Institute of Tropical Agriculture (1979). *Selected Method for Soil and Plant Analysis*. Manual series 1:53.

Ipinmoroti, R. R., Adeoye, G. O., Tijani-Eniola, H., Okogun, J. A., Akinrinde, E. A. and Iremiren, G. O. (2006). Residual effects of organic and NPK fertilizers on dry matte yield and nutrient uptake of *Zea mays* at Ibadan and Nsuka, Nigeria. Proceedings of the 24th Annual Conference of Horticultural Society of Nigeria p96-99.

Landon, J. R. (ed.) (1991). Booker Tropical Soil Manual: A handbook for soil survey and agricultural land evaluation in the tropics and subtropics. John Wiley and Sons Inc., 605 Third Avenue, New York, USA. 474p.

Mary, B., Recous, S., Darwls, D. and Robin, D. (1996). Interaction between decomposition of plant residues and nitrogen cycling in soils. *Plant and Soil* 181: 71-82.

Milosevic, T and Milosevic, N. (2009). The effect of zeolite, organic and inorganic fertilizers on soil chemical properties, growth and biomass yield of apple trees. *Plant and Soil Environ*. 12: 528-535.

Mohammadi, S., Kalbasi, M. and Shariatmadari, H. (2009). Cumulative and Residual Effects of Organic Fertilizer Application on Selected Soil Properties, Water Soluble P, Olsen-p and P Sorption Index. *J. Agric. Sci. Tech.. 11: 487-497.*

Muhammad, S., Suberu, H. A., Amusa, N. A. and Agaiji, M. D. (2001). The effect of soil amendment with sawdust and rice husk on the growth and incidence of seedling blight of Tamarindus indica L., caused by Macrophomina and Rhizotonia solani. *Moor J. Agric. Res.* 2: 40-46.

Ogunwale, J. A., Olaniyan, J. O. and Aduloju, M. O. (2002). Morphological, physic-chemical and clay mineralogical properties of soils overlying basement complex rocks in Ilorin East, Nigeria. *Moor Journal of Agricultural Research* 3(2): 147-154.

Oguike, P. C., Chukwu, G. O. and Njoku, N. C. (2006). Physico-chemical properties of a Haplic Acrisol in Southeastern Nigeria amended with rice mill waste and NPK fertilizer. Proceedings of the 30th Annual Conference of Soil Science, Makurdi p38-45.

Oguike, P. C. and Mbagwu, J. S. C. (2001). Effects of water hyacinth residues on chemical properties and productivity of tropical soils. *Agro-science* 2: 44-51

Oguike, P. C. and Mbagwu, J. S. C. (2004). Changes in some physical properties of two degraded soils treated with water hyacinth residues. *Int. Journal of Agric. And Biol. Sci.* 3: 47-52

Olanikan, P. C. (2006). Organic manures as soil amendments in eroded tropical soils of south western Nigeria. In soil and nutrient. *Journal of tropical soils*. 5(3): 11-18.

Olayinka, A. and Adebayo, A. (1985).The effects of methods of application of saw dust on plant growth nutrients uptake and soil chemical properties. *Plant and soil* 85: 47-56.

Onyishi, G. C., Ajagu, C. O., Onuoha, E. R., Okprie, E. O. and Dialoke, S. A. (2010). Evaluation of the performance of upland rice cultivars as affected by fertilizer levels in clay loam ultisol. Niger. Agric. J. 4(1):71-76.

Paul, R., Adler, A. and Sikora, J. (2003). Changes in Soil Phosphorus Availability with Poultry Organic manure age. *Commun. Soil Sci. Plant Anal. 34: 81-95*
Sakala, W. D., Cadisch, G. and Giller. K. E. (2000). Interaction between residues of maize and pigeonpea and mineral N fertilizer during decomposition and N-mineralization. *Soil Boil. Biochem*. 32: 679-688
SAS Institute Inc. (2010). SAS/STAT users guide. SAS Institute, Inc. Cary, NC.
Spaccini, R., Piccolo, A., Mbagwu, J. S. C., Zena-Teshale, A. and Igwe, C. A. (2002). Influence of the addition of organic residues on carbohydrates content and structural stability of some high land soils in Ethiopia. *Soil Use and Management*, 18: 404-411.
Tollessa, D. (1999). Effects of organic and inorganic fertilizers on maize grain yield in western Ethiopia. Africa Crop Science Conference Proceedings. 4: 229-232.
Vanlauwe, B., Sanginga, N. and Merckx, R. (1998). Recovery of Leucaena and Dactyladenia residue nitrogen-15 in alley cropping systems. Soil Sci. Soc. *Am. J*. 62: 454-460.