RESPONSE OF RICE AND SOIL CHEMICAL PROPERTIES TO RICE HUSK AND PIG MANURE COMPOST IN ASABA, DELTA STATE, NIGERIA.

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Abstract
Pot experiment was conducted in Delta State University, Asaba Campus to evaluate the response of rice and soil chemical properties to composted rice husk and pig manure. Rice husk and pig manure were used in ratios by weight to formulate different composts for twelve weeks. Ten kilogram of processed erosion soil was taken from drainage in Asaba and weighed into experimental polythene bags.The compost treatments were applied at 5 ton^{-1}. The experimental bags were arranged in completely randomized design. Rice seed taken from WARDA Division, IITA was used as test crop. Parameters measured were plant height, number of leaves, leaf area, plant girth, dry matter and rice yield. Soil chemical properties were also measured after harvest. The growth and yield data collected were subjected to analysis of variance and Duncan Multiple Range Test at 5% level of probability was used to separate treatment means.The results revealed that growth and yield of rice increased due to compost application. RHM50 had the plant height, plant girth, number of tillers, dry matter yield and rice yield. Similarly, its application also resultedin highest effects on soil chemical properties after harvest. It is there concluded that rice husk and pig manure compost has the potential to improve soil fertility and increase rice yield, this could be further validated on field experiment.

Keywords: soil fertility, pig manure, rice husk, compost, rice yield

Introduction

Soil fertility maintenance is a keyresponsible for increasecrop production most especially now in Nigeria that emphasis is on Agriculture. Continuous cropping has imposednegative effects onplant nutrient supply,this had led toreduction of soil organic matter.The amount of organic matterin most top soil is around 10 gkg^{-1} where crop like rice is mainlycultivated (Zhou *et al*., 2003). This level is regarded inadequate for crop production (Gao *et al*., 2000; Wang and Ren, 2002). The price of inorganic fertilizer use to replenished lostsoil nutrients has been deregulated, leading to high cost and concomitantreduction in amount of fertilizer used by farmers(Valerie andCrawford, 2007). To maintain ricecultivation, organic fertilizer applicationhas to been intensified. Akinrinde *et al.* (2000) supported the use of organic manureas sustainable practice for crop production in the tropics. Other studies havealso shown that application of organic fertilizer increases soil organic matter, buffer the soil, improve aggregate stability and enhance water retention capacity (Spaccini *et al.*, 2002 and Olanlikan, 2006).

According to Schulz *et al*. (2000) and Adeoye *et al*. (2005),rice husk applicationhas the potential in improving soil productivity and increase rice yield. With the availability of rice husk in rice producing localities in Nigeria, there is need to properly investigate its potentials to supply plant nutrients and improve soil fertility which will lead to rice yield increase.The rice husk can be added to the soil to enhance its productivity. Olanlikan, (2006) reported that, apart from increasing soil organic matter content and serves as a nutrient store, it also improves soil structure, stimulates soil biological activities and adsorbs mineral nutrients. The use of organic manure in maintaining soil productivity is a practice that iswell known all over the world today (Palaniappan and Annadurai, 1999). However, for optimal condition for the use of organic manure, certain precautions need to be taken, as regards the choice of material to be employed in achieving biological transformation, an efficient method is that of composting (Gigliotti *et al.*, 1997). Composting of organic materials is a microbiologically mediated process in which the readily degradable organic matter in organic materials is degraded and stabilized.Hence, the objective of this study was to compost rice husk with pig manureand evaluate it effects on soil chemical properties, also on the growth and yield of rice after harvest.

Materials and Methods

This study was conducted at the Department of Agronomy, Delta State University Asaba Campus, between February and June, 2015. The erosion soil used for the study was collected from drainage in Asaba Campus, it was further leached by soaking in water for one week to reduce the nutrient content; this was done to easily evaluate the potential of the compost. The soils were packed in sacks and were soaked in Anwai River for one week. Rice seeds of

New Rice for Africa variety (WAB4501-IB-P38-HB) obtained from the WARDA Division of IITA were used as test crop. Ten kilogram of 2 mm sieved soil was used per ten kilogram experimental poly bags. The polythene bags were arranged in a randomized complete block design, replicated four times.

The composts wereformulatedwith rice husk and cow dung in different ratio (by weight) for twelve weeks. The different mixtures of the composts were: Rice husk only(RH100), Rice husk 90% + pig manure 10% (RHM90), Rice husk 80% + pig manure 20% (RHM80), Rice husk 70% + pig manure 30% (RHM70),Rice husk 60% + pig manure 40% (RHM60), Rice husk 50% + pig manure 50% (RHM50) and control (without compost application). The rice husk and pig manure were thoroughly mixed manually in each of the compost batch during composting. The composts were turned at three days intervals for the first two weeks and subsequently at weekly intervals to keep compost well aerated. Also, water was added during turning to keep the moisture content at optimum level for biological activities. The composts were left to cure for twelve weeks. Daily temperatures of each compost batch were taken with the use of Thermometer.

The composts were applied at 5.0 ton ha^{-1} one week before planting. Pre-soil planting analysis was done to determine properties of the soil before compost application. The effects of the composts were evaluated by measuring the rice plant height, number of leaves per plant, leaf area, dry matter and paddy yield after harvest, and also soil samples were taken for laboratory analysis to test the effects on soil chemical properties.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 were determined using 1N ammonium acetate extracting solution (Jackson, 1964). K was read with flame photometer and Mg, Ca, and Na was measured on the Atomic Absorption Spectrophotometer (AAS). The available P was extracted using Bray-1 extracting solution and further reading was carried out Colourmetrically (Federal Department of Agriculture, 1979). Total N was determined by the Kjeldhal distillation method (Anderson and Ingram, 1993). Analysis of variance was done on rice data collected using linear model (GLM) routine of SAS Institute, Inc. (2012), and treatments means were separated with Duncan Multiple Range Test at 5% level of probability.

Results and Discussion

Table 1 shows the temperature of compost during composting. The temperature rose to maximum at the first week before gradually falling and settling at ambient temperature at 8 weeks of composting. Rice husk and pig manure mixture at equal weight (RHM50) maintained the highest temperature all the weeks of incubation. The RHM90 had the lowest temperature at 1, 2, 4 and 7 weeks while at 3, 5 and 6 weeks, RH100 recorded the least temperature.

The nutrient contents of the composts are shown on Table 2. Increasing cowdung led to increase of percentage N, K and Ca. All the composts had higher percentage of N and P except RH100 that had equal percentage of P. The K, Ca and Mg content of compost were higher than the un-composted rice husk (UCRH).

The pre-planting physical and chemical properties of the soil are shown onTable 3. The soil pH was 6.1, organic carbon was 1.12 gkg^{-1}, total N was 0.11 gkg^{-1} available P was 6.8 $mgkg^{-1}$ while ECEC was 2.64 $cmolkg^{-1}$. The soil textural class was sand.

Response of growth and yield of rice to rice husk and pig manure compost are shown on Table 4. Significant differences were recorded for all the growth and yield parameters measured. There were increases in all parameters measured with increase of pig manure. The RHM50) had the highest plant height closely followed by RHM60 and RHM70 while control treated plot had the least. The RHM50 and RHM60 had equal number of leaves closely followed by RHM80 and RHM90. The leaf area produced by RHM50 and RHM70 were highest followed by RHM60 while the control had the least. Plant girth of rice plants treated with RHM50 were highest followed by RHM60. The RHM50 also had the highest number of tillers, dry matter and rice yield while the control plot produced the least.

The responses of soil chemical properties to rice husk and pig manure compost are shown on Table 5. Soil pH was highest in plots treated with RHM50 and RHM60 while RHM50 had the highest organic carbon, total N, available P and ECEC. The control treated plot had the least in all the soil chemical properties measured except Kand Mg that it was similar with UCRH while it had the highest exchangeable acidity.

The increasing of growth and yield of rice over the control could be due to application of the formulated compost.This might be due to availability of balance nutrients that resulted in a favorable condition for the growth ofrice. The condition can improves soil fertility and water holding capacity that resulted to yield increase (Rashid *et al*., 2013). The result is in agreement with the finding of Detpiratmonakol *et al*. (2014) who reported that organic fertilizer increased the vegetative growth and biomass production. Furthermore, Mishra and Jain (2013) observed that increase of organic fertilizer application increases the growth, yield and quality of plant.

The organic carbon and total N of the soils treated with the compost types increases after harvest. The observed increase in organic carbon and total nitrogen in the amended plots relative to control could be due to rice husk and pig manure contained higher organic matter and total nitrogen than the soil (Njoku *et al*., 2015). This was also in line with the report of Mbah *et al*. (2011) who observed higher organic matter and total nitrogen content in wastes amended soils.
Santillan *et al*. (2014) noted that soil amended with organic fertilizer increased nitrogen content, is due to nitrate generated and incorporated into the soil during the process of organic matter decomposition. Increase available phosphorus was recorded in compost treatedplots, this could partly due of the rice husk and pig manure used to formulate the compost (Njoku *et al*., 2015). It was noted that decomposition of organic manure break the fixation of phosphorus (P) caused by some ions, making it available in the soil (Sankaram, 1996). Exchangeable acidity of the soil decreased after harvest, that after compost application. The decrease with application of organic fertilizer was reported by Ano and Ubochi (2007), they said that as organic fertilizer decomposed, Ca ions are released into the soil solutions which get hydrolyzed, and reacts with soluble aluminum ions and form insoluble $Al(OH)^3$. This reacts with hydrogen ions to form water and led to the reduction of EA in the soil (Uwah *et al*., 2014). The process could also result to increase of the effective cation exchange capacity of the soil as observed in this study. Increase soil acidity is a major problem in soil fertility maintenance in the humid tropics, as the soil pH declines,nutrients supply decreases while aluminum becomes more soluble.

In conclusion,all the compost formulated in this study improves the growth, yield of rice and soil chemical properties. Among the different compost, RHM50 had higher rice yield and had higher effects on soil chemical properties. It could be recommended for farmers in the Asaba and its environment, it can be reexamined on the field.

Table 1 Temperature of compost in ^{0}C

	Weeks of composting							
Compost	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RH100	56.3	54.3	44.5	42.1	33.8	28.4	28.1	27.0
RHM90	55.6	50.3	45.3	41.6	36.8	30.7	28.0	27.1
RHM80	60.1	56.2	47.2	42.6	38.5	31.7	28.2	27.0
RHM70	62.3	58.3	50.7	45.2	35.8	32.4	29.2	27.1
RHM60	64.2	60.1	53.5	46.4	40.6	33.5	30.1	27.2
RHM50	66.1	62.5	56.3	50.1	41.4	34.2	30.5	27.0
Ambient T.	26.1	25.6	26.2	25.7	26.3	26.7	26.1	25.3

Table 2 Analytical result of the compost (%)

Compost	**N**	**P**	**K**	**Ca**	**Mg**	**Na**
UNRH	0.09	0.54	0.30	0.46	0.18	0.46
RH100	0.10	0.55	0.31	0.47	0.19	0.47
RHM90	0.93	0.59	0.52	0.61	0.20	0.42
RHM80	1.10	0.56	0.60	0.56	0.21	0.42
RHM70	1.14	0.58	0.50	0.66	0.31	0.40
RHM60	1.17	0.49	0.61	0.71	0.15	0.37
RHM50	1.28	0.61	0.43	0.67	0.41	0.38

Table 3Pre-cropping soil physical and chemical properties

Parameter	values
PH (H_2O) 1:2	5.1
Organic Carbon (gkg^{-1})	1.12
Total Nitrogen (gkg^{-1})	0.11
Available P ($mgkg^{-1}$) 6.8	
Exchangeable bases ($cmolkg^{-1}$)	
K	0.39
Mg	0.13
Ca 0.11	
Na	1.91
Exch. Acidity	0.10
ECEC	2.64
Particle Size (gkg^{-1})	
Sand	911
Silt	45
Clay	44
Textural Class	**Sand**

Table 4 Response of growth and yield of rice to rice husk andpig manure compost

Compost	Plant height (cm)	No. of leaves	Leaf area (cm^2)	Plant girth (cm)	No of tillers	Dry matter (t/ha)	Rice yield (t/ha)
UNRH	44.3d	6.1b	19.4b	0.23e	0d	4.23d	1.11e
RH100	45.0d	6.1b	19.9b	0.24d	0d	4.45d	1.53d
RHM90	49.1c	6.4a	20.4b	0.24d	1c	5.01c	1.55d
RHM80	53.2b	6.4a	21.3b	0.31c	1c	5.08c	1.71c
RHM70	62.4a	6.3a	24.4a	0.32c	2b	5.19b	1.89bc
RHM60	62.3a	6.5a	24.1a	0.35b	2b	5.24ab	2.09a
RHM50	65.1a	6.5a	24.4a	0.38a	3a	5.33a	2.10a
Control	42.0de	5.1c	19.0b	0.20f	0d	2.41f	1.01e

Treatments within each column the same letters are not significantly different.

Table 5 Response of soil chemical properties to rice husk pig manure and compost after harvest

Compost	pH in water	Org.C g/kg	TotalN g/kg	Avai.P g/kg	K --------	Ca -------	Mg cmol/kg	Na ------	Ex. A -------	ECEC --------
UNRH	5.2	1.55	0.6	7	0.2	1.2	2.0	0.2	0.7	4.3
RH100	5.2	1.60	0.6	7	0.2	1.3	2.1	0.2	0.7	4.5
RHM90	5.2	1.71	0.6	7	0.3	1.4	2.1	0.2	0.6	4.6
RHM80	5.4	1.72	0.7	8	0.3	1.4	2.2	0.3	0.6	4.8
RHM70	5.4	1.81	0.8	9	0.3	1.6	2.3	0.3	0.6	5.1
RHM60	5.5	1.99	0.9	9	0.3	1.7	2.4	0.3	0.6	5.3
RHM50	5.5	2.01	1.1	11	0.2	1.8	2.4	0.4	0.6	5.4
Control	5.1	1.51	0.5	6	0.2	1.1	1.2	0.2	0.8	3.5

legend

UNRH – uncomposted rice husk
RH100 – Composted rice husk
RHC90 – Rice husk 90% and pig manure 10%
RHC80 - Rice husk 80% and pig manure 20%
RHC70 - Rice husk 70% and pig manure 30%
RHC60 - Rice husk 60% and pig manure 40%
RHC50 - Rice husk 50% and pig manure 50%

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