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EVALUATION OF RICE HUSK AND POULTRY MANURE COMPOST AS ORGANIC FERTILIZER FOR MAIZE PRODUCTION IN ABRAKA DELTA STATE NIGERIA

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ABSTRACT

Effects of compost on maize and soil chemical properties were evaluated in 2015 at Abraka, Delta State. It was applied at 10.0 t ha^{-1}, laid out in randomized complete block design with three replicates. Plant height, leaf area, plant girth, dry matter and maize yield were measured. Soil samples were taken for pre-planting and for post-harvest analysis. Data were subjected to analysis of variance, Duncan Multiple Range Test was used to compared means at0.05% level of significance. Results revealed that maize yields were significantly improved compared to control. Rice husk 50% + poultry manure 50% recorded the highest at both seasons followed by Rice husk 60% + poultry manure 40%. It had the highest soil pH, total N, available P and ECECwhile Rice husk 60% + poultry manure 40% had the highest organic carbon. The Rice husk 50% + poultry manure 50% is recommended for farmers in Abraka.

Key words: maize yield, rice husk, poultry manure, soil fertility, soil chemical properties

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INTRODUCTION

Population growth with corresponding demand for more food has led to increase production of crop. In this situation, continuous cropping that will meet the need of ever growing population requires successful management of soil resources for sustainable food production. Soil management practices that will increase soil fertility and influence crop yield need to be evaluated. One of such practices is the use of organic fertilizer that has proven qualities on properties of soil. Inorganic fertilizer commonly use is not sustainable on continuous cropping because, it is associated with soil acidity and nutrients imbalance in addition to crop yield reduction (Ojoniyi, 2000). Also, farmers are constrained by unavailability of the fertilizer at the

time of need and the technicality associated with its application (Chude, 1999). Organic fertilizer can serve as alternative source of plant nutrient because, it can easily be obtained from animal and plant processing centers (Mishra and Jain, 2013). According to Roddy and Reddi (1992), the nutrients in organic fertilizer are released slowly and are stored for a longer time, this increases the residual effects and improves crop yields. Organic manure is the type of fertilizer that can supply soil organic matter and improve the fertility of the soil. Application of organic fertilizer as a source of plant nutrients have received attention due to increasing costs of inorganic fertilizers, high rate of nutrient loss and negative effects on soil and the environment (Roy and Kaashem, 2014). Ayoola and Makinde (2008) have reported that application of organic fertilizer increase soil organic carbon, total nitrogen, soil pH, cation exchange capacity, exchangeable bases and crop yield. This further emphasized the potential of the organic fertilizer to improved soil properties and increase crop yield.

The yield of the maize is consumed by over half of the world population (Ogunsumi, 2005). According to Daramola and Taiwo (2008), the demands for maize have increased due to its consumption. The maize is use in industries for production of food and medicines (Oladejo and Adetunji, 2012) placing a high demand for its crop production. With the economic importance of maize and the problem caused by inorganic fertilizer application in this country, organic fertilizer use is important for its cultivation. The organic fertilizer is less detrimental on soil properties compared to inorganic fertilizers. It can serve as short-term suppliers of plant nutrients as well as long-term maintenance of soil organic matter (Undie*et al.*, 2015). The low soil fertility justifies the need for appropriate soil management techniques for sustainable maize production. Hence, this study evaluated rice husk and poultry manure compost as organic fertilizer for maize production and soil improvement.

MATERIALS AND METHODS

The study was carried out at the Department of Agricultural Education, Delta State University Abraka Campus during the early (March to June) and late season (August to November) 2015. Abraka is located in the rainforest zone of Nigeria with longitude 5^0 47'N and latitude 06^0 06'N of the equator characterized with bimodal rainfall. The rainfall ranges from 1500 to 2000 mm and annual temperature of 23.8-37.3 ^{0}C (Asaba Meteorological Station, 2009). The organic fertilizer used was made with rice husk and poultry manure. The mixtures were: Rice husk only (RH100), Rice husk 90% + poultry manure 10% (RHPD90), Rice husk 80% + poultry manure 20% (RHPD80), Rice husk 70% + poultry manure 30% (RHPD70), Rice husk 60% + poultry manure 40% (RHPD60), Rice husk 50% + poultry manure 50% (RHPD50) and a control. The

organic fertilizer were applied at 10.0 ton ha^{-1} and replicated three times in a randomized complete block design. Soil sample was taken to evaluate soil physico-chemical properties before amendment. Maize was used as test crop, manual weeding was done at 4 and 7 weeks by hoeing and hand pulling. Growth data taken were: plant height, leaf area, plant girth. Plant height was taken by using meter rule, stem girth by the use of vernier caliper and leaf are was calculated using the formula: LA = L x W according to Dwyer and Steward (1986) then multiply by a constant (0.75) while dry matter and maize yield were taken after harvest. Soil samples were also taken to test the effects of the organic fertilizer on soil chemical properties after two years of consecutive application. Soil samples taken were analyzed in Department of Agronomy analytical Laboratory, University of Ibadan following standard procedures. Analysis of variance was done on the growth and yield of maize data collected using linear model (GLM) routine of SAS Institute, Inc. (2012), while Duncan Multiply Range Test at 5% level of probability were used to compared treatment means.

Results and Discussion

The chemical properties of the organic fertilizer are shown in Table 1. Nitrogen, Ca and Mg content of the organic fertilizer increased with increment of poultry manure. Rice husk with poultry manure had higher percentage of N and higher exchangeable bases (K, Ca, Mg and Na). The physical and chemical properties of the soil before organic fertilizer application are shown in Table 2. The soil was acidic (pH 5.9), organic carbon was low (4.16 gkg^{-1}), total N was low (0.62 gkg^{-1}), available P was low (6.8 $mgkg^{-1}$) and ECEC was also low (5.66 $cmolkg^{-1}$). The soil was loamy sand. Table 3 shows the effects of organic fertilizer on soil chemical properties after harvest. The control had the lowest soil pH value, increase of poultry manure to rice husk led to increment of soil pH. The RHPD50 had the highest effect on soil pH. The RHPD60 had the highest organic carbon and RHPD50 had the highest total N, available P and ECEC while the control had the highest exchangeable acidity. The soil before organic fertilizer application was low in all the major plant nutrients (Akinrinde and Obigbesan, 2000) but the pH was moderate for maize production. The soil chemical properties increased after harvest. The increase as a result of organic fertilizer application could be link to organic carbon increased in soil (Masto*et al.*, 2007). The pH of soil has been reported to improved with organic fertilizer amendment (Santillan*et al*., 2014), this was observed in this study. The pH of all the treated soils were higher than the control, this shows the potential of the organic fertilizer in increasing soil pH.It has been reported by Wang and Zhang (2016) that rice straw add both macro and microelements to the soil, it also increase organic matter content as a result of improved physical, chemical and

biological properties of soil. In line with this also, Adeniyan and Ojeniyi (2003) and Audu*etal*. (2015) reported that soil amended with poultry manure improves soil organic matter and add plant nutrients to the soil. This could be responsible for increase of both growth and yield of maize recorded in this study.

Effects of organic fertilizer on the growth and yield of maize at the late and early seasons are shown in Table 4. The plant height increased with increment of poultry manure to rice husk up to 50% at both seasons. Plots applied with RHPD50 had highest plant height at both seasons than RHPD60 and RHPD70. The control plots produced the shortest plant height. Leaf area of plots treated with RHPD50 was significantly higher than the other organic fertilizer types and control. In similar vein, it also had the highest plant girth, dry matter and maize yield. It was not significantly higher than RHPD60, RHPD70 and RHPD80 at both seasons, though the control had the least. The dry matter yield produced in plot treated with RHPD50 was not significantly higher than RHPD60. But the maize yield produced by RHPD50 treated plot was significantly higher compared to other fertilizer types. The maize yield also increased with each increment in poultry manure. The higher plant height, leaf area, plant girth, dry matter and maize yield from RHPD50 throughout the period data were collected could be relative to higher availability of nutrient from the manure. The increase in growth and maize yield treated with organic fertilizer compared to control can be attributed to the effect of the organic fertilizer that improves soil properties (Khalid *et al*., 2014 and Iwuagwu*et al*., 2016) that supported the growth of maize. The effects were severe at the later stage of maize growth as a result of slow release the fertilizer nutrient. The result is in line with Iwuagwu*et al*. (2016) who attributed the growth and yield increase of crop treated with organic fertilizer to slow release of its nutrient.

CONCLUSION

The result of this study shows that the organic fertilizer can be used to produce maize yield and improve soil chemical properties. Rice husk amended with poultry manure at ratio 1:1 by weight had the highest effects, therefore it could be recommended for Abraka and its environment.

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Table 1: Chemical properties of organic fertilizer (%)

Organic fertilizer	N	P	K	Ca	Mg	Na
RH100	0.12	0.57	0.31	0.044	0.20	0.44
RHPM90	0.94	0.48	0.53	0.050	0.21	0.39
RHPM80	1.11	0.47	0.61	0.056	0.25	0.39
RHPM70	1.14	0.59	0.42	0.061	0.32	0.42
RHPM60	1.18	0.51	0.63	0.067	0.34	0.41
RHPM50	1.31	0.55	0.46	0.068	0.42	0.44

Table 2: Soil physic-chemical properties before organic fertilizer

Parameter	**values**
PH (H_2O) 1:2	5.9
Total Carbon (gkg^{-1})	4.16
Total Nitrogen (gkg^{-1})	0.62
Available P ($cmolkg^{-1}$)	8.1
Exchangeable bases ($cmolkg^{-1}$)	
K	0.34
Mg	1.23
Ca	2.22
Na	1.91
Exch. Acidity	0.06
ECEC	5.66
Particle Size (gkg^{-1})	
Sand	800
Silt	120
Clay	80
Textural Class	**loamy sand**

Table 3: Effects of organic fertilizer on soil chemical properties after harvest

Organic fertilizer	pH in water	Org. Cg/kg	Total Ng/kg	Avai. Pg/kg	K --------	Ca -------	Mg cmol/kg	Na ------	Ex.A	ECEC --------
RH100	6.1	4.60	0.62	8	0.33	2.3	1.24	1.2	0.6	4.5
RHPD90	6.2	4.71	0.62	8	0.34	2.4	1.31	1.2	0.6	4.6
RHPD80	6.4	4.72	0.71	9	0.35	2.4	1.32	1.3	0.5	4.8
RHPD70	6.4	4.81	0.83	9	0.36	2.6	1.33	1.3	0.5	5.1
RHPD60	6.5	4.99	0.86	10	0.36	2.7	1.34	1.3	0.5	5.3
RHPD50	6.6	4.01	1.00	11	0.37	2.8	1.34	1.4	0.5	5.4
Control	5.4	2.51	0.56	7	0.28	2.0	1.11	1.0	0.7	3.5

Table 4: Effects of organic fertilizer on growth and yield of rice

Organic fertilizer	Plant height (cm)	Leaf area (cm^2)	Plant girth (cm)	Dry matter t/ha)	Maize yield (t/ha)
Early					
Control	122.0d	450.4d	1.3c	17.1d	2.1d
RH100	125.4d	500.4c	1.4c	18.9cd	2.4c
RHPD90	126.0d	511.0c	1.5bc	20.1bc	2.4c
RHPD80	128.1d	512.1c	1.6ab	20.8bc	2.6bc
RHPD70	135.6c	550.1b	1.6ab	21.4b	2.7b
RHPD60	144.7b	560.4b	1.7ab	23.3a	2.8b
RHPD50	156.5a	601.4a	1.8a	24.7a	3.8a
Late					
Control	110.0f	400.0d	1.1c	15.0e	1.5e
RH100	134.3e	510.5c	1.6b	20.7d	2.5d
RHPD90	139.0de	521.5c	1.6b	22.3c	2.6d
RHPD80	144.0de	532.3c	1.7ab	23.0bc	2.8c
RHPD70	145.1cd	561.0b	1.7ab	24.5ab	2.9c
RHPD60	154.9b	569.9b	1.8ab	25.3a	3.2b
RHPD50	166.4a	641.7a	1.9a	26.7a	4.1a

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