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Effect Of Guinea Grass Compost on Soil Properties, Growth And Yield of Maize

KEYWORDS: Compost, Pannicum maximum, Maize, Soil

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ABSTRACT *The study investigated the effect of guinea grass compost on soil properties and yield of maize. The treatments consisted of Grass Compost (GC), Poultry grass compost (PGC), Pig grass Compost (GPC), Poultry pig grass compost (PGPC) and Control (CO) with four replications and were laid out in a randomized complete block design (RCBD). Data generated were subjected to the analysis of variance and significant differences among treatment means were tested using least significant difference (LSD) at 0.5 probability level. The results of the study showed that guinea grass compost significantly (P=0.05) increased soil parameters studied, enhanced growth and yield of maize. PGPC recorded the highest value in all the parameters assessed in the trial, its available P value was 93.6% relative to the control value and highest grain yield of 2.10kgha-1 was recorded in PGPC. The values of total N, organic C and cation exchange capacity (CEC) were all increased relative to control plots. The findings of the study suggest that guinea grass compost is capable of improving the fertility status of soil, enhance the growth and yield of maize and therefore advised to use in place of chemical fertilizer for organically produced food is needed now for the life of soil and man.*

Introduction

Maize is one of the most important and widely cultivated cereal crops in Nigeria and southeast in particular. This probably maybe due to the fact that it constitutes the main stable food even food supplements for majority of people in Nigeria. IITA (1992) annual report showed that maize constitutes food for an estimated population of 150 million Nigerians. Maize is a major source of carbohydrate used in livestock, textile and pharmaceutical industries. The mature grains contain about 20-25% edible oil (Uguru, 1996), easy of processing readily digested and cost less than other cereals (Jaliya et al, 2008). Rovanet (1999) reported that maize grain contain a lot of minerals and carotene which is precursor of vitamin A and other Vitamins such as ascorbic acid, these essentials are required for normal functioning of the human body and healthy growth. For academic purposes, maize stands out as major study plant for many disciplines such as soil fertility, genetics, biochemistry and physiology (Lance and Garren 2002).

Maize production in Nigeria stretched out wide ecological distribution, ranging from the forest through the savannah to the sahelian zone and in the mid altitude of the Mambila Plateau (Carsky and Iwuafor 1999), but in spite of this wide coverage that attest to increase in land area under maize production, the yield is still low. The major causes of low yield in maize grown in Nigeria have been partly blamed on depletion in soil nutrients and insufficient use of fertilizers resulting in severe nutrient depletion in soil (Obi and Ebo 1999). Obi and Ebo, (1999) found out that the top soil of southeastern Nigeria are predominantly very delicate and as a result suffer rapid decline in soil fertility after cultivation. Maize plant requires adequate supply of nutrients particularly nitrogen, phosphorous are very essential for good vegetative growth and grain development in maize production and was observed to have failed to produce good grains in plots without adequate nutrients (Adediran and Banjoko 2003). Cultivation of high yielding crop varieties and multiple cropping as obtainable in southeast and other parts of Nigeria depletes the fertility of the soils at a rapid pace, this hindered greatly maize production and maize has a strong exhaust effect on soil nutrient, because of its high nutrient requirement. Hence its productivity in tropical environment will depend closely on nutrient management system.

The restoration and rehabilitation of degraded soils to an acceptable level of productivity can be enhanced by using various off-farm sources of organic wastes such as sewage sludge, municipal soil wastes, crop wastes and agricultural wastes (Sidhu and Beire, 1999) and compost has equally been found useful in reinvigorating the fertility of agricultural soils to meet up the desired crop yield. Mature compost has little resemblance in physical form to the original bio degradable from which it is made (Brady and Wed 2005). Hence it is valued for its organic matter content and used to enhance the biological, physical and chemical properties of the soil, where applied. Bhat and Berri, (2001) observed that the physical and chemical properties of the soil such as bulk density, porosity, void ratio, water permeability and hydraulic conductivity were significantly improved by using compost. In addition, Parr et al, (1994) reported that compost application alleviated acidic and alkaline conduction and stimulated beneficial micro organism to produce polysaccharides and antibiotics. Jena and Pattanayak (2001) observed that compost increases organic matter content of the soil, enhanced biological activities of the soil, water and nutrient holding capacity improved and that same composts have the ability to suppress fungal diseases. Thus with the application of compost, the water holding capacity and nutrient content of sandy textured soils and the structure and water movement in heavier textured soils that are high in silt and clayey content can be improved. According to Powel and Linger (1997), compost provides nutrient and help the soil to maintain good tilth and thereby better aeration for germinating seeds and plant root development. Therefore, because of productivity potential of maize compared to any other cereal crop grown in Nigeria and its use as a major human food, farmers are therefore challenged on the nature and kind of soil management strategies that will be adopted to ensure high crop yield and more economic returns, without much

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stress to sustainability of the agricultural lands. Hence, this study was conceptualized to evaluate the effect of Guinea grass compost on soil properties, growth and yield of maize.

Materials and Methods

Site location:

The experiment was conducted at the Faculty of Agriculture Teaching and Research Farm, Anambra State University, Igbariam Campus. The area is located between longitude $06^{0}45^{1}$E and latitude $06^{0}46^{1}$N and 122 m above sea level (Meteorological Station, ANSU, 2010). The rainfall pattern is bimodal with peak in June and September. The annual rainfall is 1268.4mm. There are slight variations in the average daily temperature from December to January. The peak of the maximum temperature (37.6^{0c}) is usually between March and May just before the onset of the rains, while the lowest minimum temperature (28.4^{0c}) are usually between December and February during the harmattan. The relative humidity is high all year round with the highest (84%) in the wet season and considerable lower (65%) in the dry season January to February (Met. Ansu, 2010). The physical and chemical properties of the experimental site is shown in Table 1

Compost Preparation

Guinea grass, pig manure and poultry manure were used as a source of material in this study to produce compost. Four different compost treatments were prepared as follows;

Poultry + Grass Compost (PGC)
Pig + Grass Compost (GPC)
Poultry + Pig + Grass Compost (PGPC)
Grass Compost (GC)

The grass materials was harvested with a matchet, air dried for two days and chopped. 3kg of the chopped grasses were soaked in water for 2 weeks to ferment, 2kg each of poultry and pig manure and another 1kg pig manure + 1kg poultry manure were each differently bag for 2days. After 2 weeks 2kg of fermented manure, poultry and pig manure were each differently mixed thoroughly with 3kg of fermented grasses and tied up in a polythen bag and kept for decomposition that is anaerobic compositing. The treatments were replicated 4 times and after 2 months the compost was air dried to allow the removal of toxic gases such as methane and NH_3 before using as soil amendment.

Experiment Design/Treatment application.

A land area of size 17m x 11m was mapped out and cleared of its natural vegetation with matchet and cultivated with hoe. The experiment was laid out in randomized complete block design (RCBD) with four replications which consist of five blocks making it 20 plots. The block sizes were 3m x 2m. A bed of 0.3m height was made with 1m crest to crest and 0.5m alley. 2kg each of the treatment compost were spread and incorporated into soil in their respective plots. The treatments used were;

PGC – Poultry grass compost
GPC – pig grass compost
PGPC – poultry pig grass compost
GC – Grass compost
CO – Control (soil without treatment).

Two weeks after treatment incorporation, 2 maize grains (Oba Super II) were planted per hole, with a spacing of 75cm x 25cm, after two weeks of planting the seedlings were thinned down to one plant per hole, to have a 21 plant population per bed. The plots were kept weed free manually by hoeing every two weeks till harvest.

Agronomic Parameters

Ten maize plants were tagged and used for data collection on number of leaves, plant height and grain weight at moisture content 12% were measured and recorded.

Soil Sampling

Soil samples were collected from different representative locations of the site using soil auger to a depth of 30cm. The samples were bulked and into composite samples and used for the determination of physical and chemical content of the study site (Table 1). At the end of the harvest soil samples were collected from each plot. These soil samples air dried and sieved with a 2mm mesh after which chemical analysis were determined. Soil pH was determined both in water and KCl at 1:2.5 solid water ratios using digital pH meter. Organic carbon was analyzed by the method of Nelson and Sommers (1982) and the value for organic matter was obtained by multiplying the carbon value with the conventional Van Bemmelar factor 1.724. Total nitrogen was determined by a semi- micro- kjeldahl procedure as described by Bremner and Mulvancy (1982). Available Phosphorous was determined by Bray II method. Exchangeable bases were extracted using 1N NH_4OAC. Potassium and Sodium were determined on flame photometer while calcium and magnesium were determined by EDTA titration. Cation exchange capacity (CEC) was determined by ammonium acetate technique. Exchangeable acidity was determined by the titrimetric method of Mclean (1982).

Data analysis

The data generated was subjected to analysis of variance test based on randomized complete block design (RCBD) according to Steel and Torrie (1980), while statistical significant difference among the treatment means was estimated using least significant difference (LSD) at 5%.

Table 1: The physical and chemical parameters of the soil before compost application

Parameter	Value
Clay	9%
Silt	15%
Fine sand	42%
Coarse sand	35%
Textural class	sandy loam
Bulk density	$1.26gcm^{-3}$
Total porosity	44.91%
Moisture content	23.41%
pH_{H20}	5.5
pHKCl	4.2
Organic carbon	0.54%
Organic matter	0.93%
Nitrogen (N)	0.04%
Sodium (Na^{+})	0.23% $cmolkg^{-1}$

Volume : 4 | Issue : 10 | October 2014 | ISSN - 2249-555X

Potassium (K^+)	0.15% cmolkg^{-1}
Calcium	1.0 cmolkg^{-1}
Magnesium	1.0 cmolkg^{-1}
Cation exchange capacity (CEC)	5.2 cmolkg^{-1}
Base saturation (BS)	42.50%
Exchangeable acidity ($Al^{3+}+H^+$)	3.0 cmolkg^{-1}
Available phosphorous (Avail.P)	4.66 cmolkg^{-1}

Results and discussion

The result of initial soil analysis before treatment application in Table 1 showed that the soil of the experimental site contain low level of the essential plant nutrient elements. The soil of the experimental site is a sandy loam with values of 42%, 15%, 9% of sand, silt and clay respectively. The table equally revealed low contents of total Nitrogen (0.04%), carbon (0.54%) and organic matter % (0.93).

The result in Table 2 showed that the incorporation of Guinea grass compost significantly (P=0.05) affected the soil chemical parameters studied. The values of total N, organic carbon % available P Mgkg^{-1} and cation exchange capacity CEC Cmol kg^{-1} were increased relative to control plots. The PGPC recorded the highest value in all the soil chemical parameters assessed in this trial. The total N obtained in GPC and GC, PGC and GPC as well as PGPC and PGC were at par, but significantly better than the control. The application of Guinea grass compost raised the OC level compared to the control plots order of increase in the soil OC was PGPC>PGC>GPC>GC>CO. The result of the soil available P showed significant differences among the treatments with PGPC recording the highest value of 6.25 Mgkg^{-1}. The percentage increase relative to control was 93.6%. The CEC contents of the soil was equally increased with the application of Guinea grass compost and the order of increase was PGPC>PGC>GPC>GC>CO. However the result of the CEC content of the soil obtained in GPC and GC as well as GPC and PGC were not different statistically but significantly better than the control plots.

Table 2 Effect of Guinea grass compost on soil properties

Treatment	%N	Oc%	P Mgkg^{-1}	CEC Cmol kg^{-1}
CO	0.10	0.45	0.40	2.10
GC	0.18	1.13	3.15	4.60
GPC	0.22	1.50	4.23	5.55
PGC	0.26	1.80	5.20	6.15
PGPC	0.32	3.0	6.25	8.55
LSD	0.08	0.21	0.36	2.19

CO = Control without treatment, GC = Grass (Guinea grass) Compost, GPC = Pig grass compost, PGC = Poultry grass compost, PGPC = Poultry Pig grass compost, LSD = Least significant difference.

The observed improvement in total N and OC in the treatment plots relative to the untreated plots could be attributed to higher level of OC and total N in the compost than the soil. Adrien (2006) observed that the application of organic manure significantly increased the level of organic C and N and the formation of water-stable aggregates, while Liu et al (1996) found out that it improves soil properties and ameliorate the effect of acidifying fertilizer under continuous cultivation. The result showed that Guinea grass compost can affect the chemical properties and fertility status of the soil. Compost enhances the environmental sustainability of agriculture by decreasing chemical inputs and increasing soil organic matter (Mathur et al, 1993), while adding different organic compost to the soil was found to have caused remarkable improvement of different growth characters and yield (Tara et al, 1996).

Effect of Guinea grass compost on growth and yield of maize

The guinea grass compost was not significant (P = 0.5) for plant height. The value of plant height obtained in PGPC was highest comparable to the values obtained in the other treatments (Table 3). The order of increase was PGPC>PGC>GPC>GC>CO. The result of the number of leaves/plant showed significant differences among the treatments, though the value obtained in GC and GPC as well as PGC and PGPC were at par, but significantly better than the values obtained in the control plots. The grain yield in Table 3 was significant (P = 0.05), the highest grain yield of maize of 2.10 kgha^{-1} was obtained from PGPC. The plot differs significantly from every other plot except PGC.

Table 3 Effect of guinea grass compost on the growth and yield parameters of maize

Treatments	Plant height	Number leaves	Grain yield
	cm	/plant	Kg/ha
CO	176.9	10.3	1.5
GC	181.1	12.0	1.73
GPC	181.3	12.0	1.83
PGC	185.1	14.3	1.97
PGPC	190.4	15.0	2.10
LSD	N	1.9	0.25

TCO = Control without treatment, GC = Grass (Guinea grass) Compost, GPC = Pig grass compost, PGC = Poultry grass compost, PGPC = Poultry Pig grass compost, LSD = Least significant difference.

The result of the plant height could be attributed to the difference in plant nutrients in the compost applied. Increases in plant height following addition of organic amendment have been reported by Sharma (2004), Nweke et al, 2013, Nweke and Nsoanya 2013. The higher grain yield observed in the compost amended plots than the control could be due to higher content of nutrients in the compost than the soil because addition of manure increases the soil water holding capacity and this means that nutrients would be made more available to crops where nutrients have been added to the soil (Costa et al, 1991). The studies of Abou-Hadid et al., (2001), Nweke et al., 2013, Nweke and Nsoanya, (2013) and Nweke et al., (2014), showed that the application of organic amendments to soils increases yield of crops and improves soil parameters and the ability of the soil to hold plant nutrient elements.

Conclusion

From the result of the study, it has shown that Guinea

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grass compost can be good amendment for soil fertility improvement and enhance yield. The application of the compost significantly improved soil chemical parameters and maize grain yield. This grass species are bound in the tropical climates like Nigeria and can be harvested and composted, it will save the farmer the cost of buying fertilizer with its attendance problems and it is advised that organically produced food is needed now for the life of soil and man.

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