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Comparative Effect of Rice Husk Compost and Urea on Soil Chemical Properties, Growth and Yield of Fluted Pumpkin (*Telfairiaoccidentalis*) in Akanuibiam Federal Polytechnic, Unwana, Afikpo, Ebonyi State, Nigeria

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Abstract:
A pot experiment was conducted at the Green House of AkanuIbiam federal Polytechnic, Unwana, Afikpo, Ebonyi State of Nigeria, to investigate the effect of rice husk compost(RHC) and urea on soil nutrient status indices such as soil pH, organic carbon, total nitrogen, available phosphorus, effective cation exchange capacity and growth and yield of fluted pumpkin(Telfairiaoccidentalis). Soil samples were collected from 0-20cm depth from the polytechnic multi-purpose farm and the treatments comprised of three rates of RHC (0, 1, and 2t/ha) and three rates of urea (0, 1, and 2t/ha) arranged factorially in completely randomized design (CRD) with three replications. Results showed that both fertilizer materials influenced the soil chemical properties (P<0.05) relative to control and the influence on these properties increased as the rate of application increased. RHC was more effective in improving soil pH, available P, organic C, and ECEC compared to the urea alone, while the application of urea as a lone treatment showed greater improvement on the total N compared to the RHC. With the exception of pH in salt, exchangeable bases and ECEC, all treatments both as lone or combined showed significant difference (P<0.05) in influencing all the soil chemical properties. Similarly, the application of both fertilizer materials significantly improved both the growth and marketable yield parameters, with the combined treatments showing greater effect than the lone treatments. At (P<0.05), the treatments were statistically significant in improving both the growth and yield parameters measured.

Keywords*: Rice husk compost, Urea, Soil chemical properties and Telfairiaoccidentalis*

1. Introduction

The dwindling crude oil prices in the international market has adversely affected the economy of most oil producing nations, especially mono-economy countries like Nigeria which depends on oil for more than 90 percent of its foreign exchange earnings. In order to curb the menace of the present economic realities, oil dependent countries like Nigeria are currently shifting emphasis on agriculture as an alternative and sustainable source of economic growth. Agriculture plays an important role in the economy of developing countries like Nigeria. However agricultural productivity in tropical soils is hindered by soil fertility constraints and deteriorating nutrient status due to interrelated factors, both natural and managerial such as rapid crop production with inappropriate farming practices (Olatunji and Ayuba, 2011). To solve this problem, synthetic fertilizers were always thought to be a better resource to improve the soil fertility and crop productivity because of their relatively quick rate of nutrient release to growing plants. Many countries have enacted policies that encourage the use of these synthetic fertilizers and other modern farming technologies to boost crop yield to keep pace with population growth and economic decline. Unfortunately, over time, the excessive use of these inorganic fertilizers have created a number of serious environmental and health risks and ironically, diminished soil quality and crop yield (Moyin, 2007). Reports have shown that the consistent use of mineral fertilizers encourages loss of soil quality, reduces organic matter in soil, which results in decreased microbial activity that eventually affect the soils physical, chemical, biological and fertility conditions (Okonkwo*et al*., 2010), leading to decline in land productivity and crop yields. In response to environmental concern, sustainable organic agriculture has become an increasingly popular option. Naturally occurring organic fertilizers, namely, animal and plant manures, fall residues, food and urban wastes are now currently use as better alternatives of commercially available fertilizers. The use of organic fertilizers is particularly appealing for several reasons including soil organic matter enhancement, improvement of microbial activity and improvement of soils physical conditions (Brady and Weil, 2008). Reports have shown that organic farming improves soil composition, fertility, and soil fauna which in the long run have a beneficial effect on crop production (Olatunji and Ayuba, 2011). Long-term conservation of the soil health is the key benefit of organic fertilizers, which is vital in sustainable Agriculture (). Consequently, farmers and scientist are now showing renewed interest in proper and effective use of organic manure to improve the nutrient status of the soil, increase the level of organic matter and give high residual effect on soil fertility. (Ghabbour, and Davis, 2001).

Agronomists have long recognized the benefit of maintaining and increasing soil organic matter and one of the organic fertilizer source is rice husk dust (Njoku*et al*.,2015). During rice refining processes, the husks are removed from grains. It is of little commercial value and because of its high silicon dioxide content; it is not useful to feed either human or cattle, but can be incorporated into the soil to enhance soil and crop productivity. For example, organic modification of soil with rice husk was found effective in the yield of many crops like cowpea and rice (Njoku*et al*., 2015). Just like other organic manures, the problems in the use of rice husk compost as fertilizer source is the difficulty in obtaining large amount for commercial agriculture (Eneje and Azu, 2009). Consequently, recent studies are now focusing on the combined use of organic and inorganic fertilizers as a better option. The combine use of organic and inorganic fertilizers has proved a sound soil fertility management strategy in many countries of the world such as India, Tanzania and Central African Republic (FAO, 1976). Other studies (Ano and Asumugha 2000; Adediran et al, 1999), observed that supplementation of organic and inorganic fertilizers were more superior to the application of either of the amendment alone.

In Africa, indigenous vegetables remain popular in rural areas where they are often considered to be more nutritive than exotic vegetables (Horsefall and Spiff, 2005). *Telfairiaoccidentalis* commonly called fluted pumpkin is an important leaf and seed vegetable with high nutritional, medicinal and industrial values (Shippers, 2000); and therefore can be a valuable source of combating nutritional deficiencies in diets of Nigerians (Williams, 1993).

Ebonyi state is one of the rice producing states in Nigeria and therefore produces large amount of rice husk dusts which are always thrown away as a waste. Rice husk dust as a solid organic waste is very common and is produced daily in all the milling centres in Ebonyi State. They are disposed to the extent that mountainous heaps of it abounds in all the milling centres. The overgrown heaps of rice husk dust often causes environmental hazards such as contamination and reduction in water quality especially when they move in runoff into nearby water bodies. This study therefore seeks to determine how these wastes in combination with urea can be used to improve the soil fertility and therefore reduce the amount of synthetic fertilizers use in this agro ecological zone. Therefore, the present work was designed to investigate the effect of composted rice husk and urea on soil chemical properties and yield of fluted pumpkin in AkanuIbiam Federal polytechnic Unwana, south eastern Nigeria.

2. Materials and Method

A pot experiment was carried out in the Green House of AkanuIbiam Federal Polytechnic Unwana, tropical rain forest zone of Nigeria (coordinates: latitude 5^{0}48'N and longitude 7^{0}55'E). The soil of the experimental area is a Typic Hapludult (Federal Department of Agriculture and Land Resources, 1985; Nwaogu and Ebeniro, 2009). The two main soil types found in the study area are silty clayey hydromorphic soil and the grey sandy clay hydromorphic soil. The silty clayey hydromorphic soil has a brown loamy top horizon which overlies reddish brown silty clay subsoil (Obasi et al., 2015). The air temperature is generally high all year round and the current temperature range is 32^{o}C -21^{o}C with total annual rainfall exceeding 3,500 mm (Njoku, 2006).The area has being use for cassava cultivation for more than ten years

2.1. Soil Sample Collection and Preparation

Soil samples were collected with the soil anger from the Polytechnic multi-purpose farm at 0-20cm depth. This was air dried, sieved with 2mm sieve, after which sub-samples of 5kg each were weighed into 12L capacity plastic buckets perforated at the bottom to allow for air and water movement.

2.2. Rice Husk Dust Collection and Composting

The rice husk used for the study was collected from the rice mill at Afikpo Ebonyi State and this was used to prepare composted organic fertilizer.40kg of the rice husk dust was weighed into 100 litre capacity drum and incubated under shade for two month. During this period of incubation, adequate moisture was ensured by continual addition of water and turning daily to promote sufficient aeration for microbial activities. After incubation period, composted rice husk was oven dried at 80°C for 2 hours and grinded to be used as composted organic fertilizer in pot experiment

2.3. Pot Experiment

The experiment consisted of 27 treatments, corresponding to three rates (0,1 and, 2, t/ha) of rice husk compost (RHC) and three rates of urea (0, 1, and 2t/ha), arranged factorially in a completely randomized design (CRD) with three replications giving a total of 27 observational units.

Seeds of fluted pumpkin were extracted from the pods which were obtained from the National Seed Service, Umudike, Abia State. These were air dried for 24 hours before planting. Planting was done two weeks after soil amendment. Two seeds were sown per hole in each bucket and later thinned down to one seedling per stand after two weeks of germination. Adequate watering, weeding and pest control were observed throughout the growing period.

2.4. Data Collection

At 10 weeks after sowing (WAS), agronomic and growth parameters data were collected from each pot. Data collected at the early bloom stage (10 WAS) included length of primary vine and number of leaves. At pod maturity, the pod yield and yield components collected included number of pods per plant, fruit weight per plant (kg), length of fruit, number of seed per pod, seed weight per pod (kg).

2.5. Soil Chemical Analysis

Post-harvest soil samples were collected from each pot and the following chemical analysis were carried out:Soil pH (Udo, et al.,2009), org. C (Pansu and Gautheyrous, 2006), total N (Simmone et al., 1994), Available P (Bray and Kurtz, 1945) ECEC (Udo, et al.,2009)and base saturation was obtained mathematically with:

$$B5(\%) = \frac{\text{Total cations}}{\text{ECEC}} \times \frac{100}{1}$$

2.6. Statistical Analysis

Data from the agronomic parameters and soil chemical analysis were subjected to analysis of variance (ANOVA) and the means separated using FlsD.0.05.

3. Results

3.1. Physical and Chemical Properties of the Soil and the Rice Husk Compost Used for the Study

The physical and chemical properties of the soil and rice husk compost used for this study is shown in Table 1 below. The textural class was a clayey – loam with pH values of 4.10 and 3.92 in water and $Cacl_2$ respectively. The soil reaction indicated acidity which is in agreement with the reports of other researchers (Onwuku*et al.,* 2007; Eneje and Azu 2009) for most ultisols of southeastern Nigeria. Both organic carbon and organic matter were low (1.43 and 2.47 %) respectively. The low Organic carbon and organic matter is an indication of low soil fertility status (Woomer and Ingram, 1990). Generally, the soil was low in nitrogen, available phosphorus, and basic cations indicating low fertility. The low nitrogen content which is less than the critical level of 0.15% reported by Adeoye and Agboola, (1984) for soils of humic tropical region, could be as a result of high mineralization and subsequent high rate of leaching that accompany the heavy rains associated with the forest zone of southeastern Nigeria as reported by Osodeke, (1996). The soil was moderate in available phosphorus but lower than the critical value of 15mg/kg for most tropical crops (Osodeke and Uba, 2005). Most of the nutrients in this soil were below the critical level for tropical crops (Ojetayo*et al.,* 2011), making it necessary for the application of soil amendments in the form of organic and inorganic fertilizers.

Similarly, results showed that the pH value of the RHC was high. The basic cations especially, K and Ca where also high. Both P and N were high, indicating its potentials as soil fertility management resource. The high nutrient composition of the RHC can be attributed to the fact that it is a plant material and therefore composed of nutrients absorbed from the soil which are subsequently released through microbial decomposition (Brady and Weil, 2008). The high pH value indicates the potentials of this material to improve acidic soils for better crop yield when they decompose into the soil. Similar observations have been made by several authors (Njoku*et al*., 2015; Aliyu*et al., 2011*). Thus, it is expected that, the high nutrient content in RHC will have the potentials of establishing greater improvement on both the physical and chemical conditions of the soil under study and the yield of Telfairia.

Properties	Values	RHC
Sand (%)	38.41	-
Silt (%)	26.77	-
Clay (%)	34.82	-
Texture	Clayey – loam	-
pH (H_2O)	4.10	8.06
pH ($Cacl_2$)	3.92	7.92
Org. C. (%)	1.43	3.02
Org. M (%)	2.47	
Total N (%)	0.16	2.74
Av. P (mg/kg)	9.27	19.92
Ca (cmol. /kg)	2.03	5.53
Mg (cmol. /kg)	1.10	2.13
K (cmol. /kg)	0.12	1.04
Na (cmol. /kg)	0.01	0.10
Exc. Acidity	2.19	-
ECEC	5.45	-
B.S%	59.82	

Table 1: Some physical and chemical properties of the soil and rice husk compost (RHC) used for the study

3.2. Effect of Rice Husk Compost and Urea on Soil Chemical Properties

The effect of RHC and Urea on soil chemical properties is presented in table 2. The result showed that the application of RHC and urea positively influenced the soil pH. Relative to control, there was increase in P^H when the soil was amended with RHC and Urea and the increase was proportional to the rate of application. This finding is in agreement with the reports of Onwuka*et al*., (2007) and Eneje and Azu, (2009) who reported improvement on soil pH when amended with organic manure. At 5% probability level, the lone applications of both materials were statistically significant in improving the soil reaction.

At 5% probability level, lone application of RHC and Urea significantly improve the soil organic carbon and also the improvements were proportional to the amendment rates. Results showed that the RHC was consistently higher than urea in improving the soil organic matter.

Also, at <0.05 probability level, the addition of RHC and urea significantly improve the soils available P both as single or combined treatment and the improvements were proportional to the rate of amendment.

The application of both materials both singly and interactively statistically influenced the total nitrogen at 5% probability level. The improvements were proportional to the amendment rates.

Results showed that, the application of both materials had increased effect on the soil basic cation. At (P<0.05), both single application of RHC and urea were significant in improving the soil basic cations, but their interactions were not statistically significant in improving the basic cations. Also, increased rate of amendment, had a corresponding increase on the soil basic cations. Many researchers (Awodun, 2007; Eneje and Azu, 2009; Osodeke, 2005), have reported improvement on the soil fertility of tropical soils of southeastern Nigeria when organic materials are used as soil amendment

R **+U (t/ha)**	**pH H_2O**	**Aval. P $Cacl_2$ (mg/kg)**	**Org. C (%)**	**(%)**	**Total N (Cmo1/kg)**	**Exc. Bases (Cmo1/kg)**	**Exc. Acidity (Cmo1/kg)**	**ECEC**
Control	4.11	3.99	9.18	1.37	0.17	4.11	1.69	5.43
0 + 1	5.34	5.00	9.21	1.41	0.18	5.42	1.06	5.47
0 + 2	6.34	5.06	9.28	1.46	0.21	8.84	0.53	5.78
1 + 0	4.17	4.96	9.53	1.73	0.18	4.93	1.33	6.22
1 + 1	5.40	5.17	9.99	1.78	0.23	8.35	0.77	7.15
1 + 2	6.38	5.20	10.82	1.97	0.35	12.77	0.42	8.92
2 + 0	4.23	5.02	11.47	2.38	0.43	6.86	1.03	9.99
2 + 1	5.55	5.28	11.67	2.47	0.49	12.28	0.59	10.13
2 + 2	6.59	5.64	12.31	2.70	1.14	15.70	0.38	10.20
Mean	**5.35**	**5.30**	**10.40**	**1.92**	**0.38**	**13.19**	**0.58**	**7.70**
F-LSD (0.05)*C.*	0.137	0.0067	0.262	0.191	0.026	0.00362	0.003	0.036
F-LSD (0.05)S	0.137	0.0109	0.262	0.190	0.026	0.00038	0.00021	NS
F.LSD (C XS)	0.237	NS	0.454	0.330	0.044	NS	0.012	0.143

Table 2: Mean effect of rice husk compost and urea on soil chemical properties

3.3. Effect of Rice Husk Compost and Urea on Growth Parameters, Seed Yield and Yield Components

Vine Length and number of leaves: The mean vine length and number of leaves of Telfairia as affected by the application of RHC and urea at 10 weeks after sowing is presented in figure 1. At (P< 0.05), these growth parameters were significantly affected by the application of RHC and urea both as lone and combined treatments. The highest vine length and number of leaves were recorded at treatment combination of 2t/ha RHC and 2t/ha urea, while the least values were obtained at 0t/ha RHC and 0t/ha urea (control). The combined treatments of both fertilizer materials were consistently greater than their lone application in the improvement of the growth parameters and these improvements were proportional to the rates of amendments. Also, the application of RHC as lone treatments was generally better in improving the vine length and numbers of leaves. Other researchers (Awodun, 2007; Olaniyi et al., 2010) have reported improvement of growth parameters of Telfairia when organic manures were used as fertilizer.

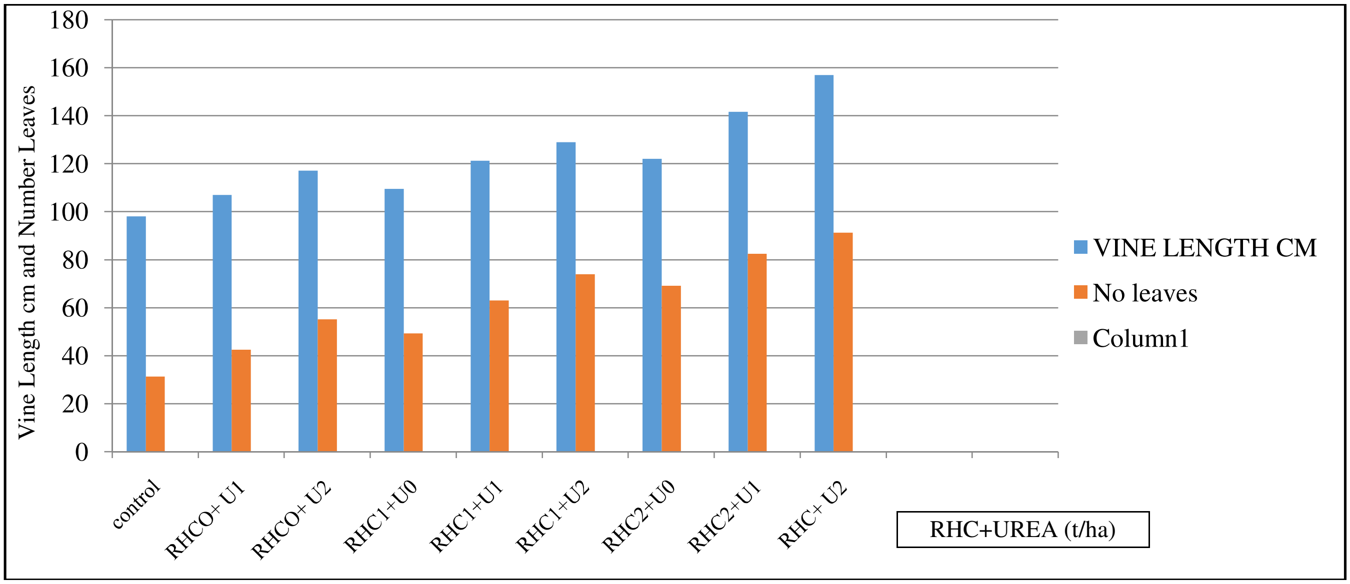

Figure 1: Effect of RDC and Urea on vine length and number of leaves of Telfairia at 10 weeks of planting. Where RHD=Rice Husk Compost and U= Urea

Marketable Seed Yield and Yield Components: The effect of different rates of RHC and urea on seed yield and yield components of Telfairia at harvesting are shown in table 2. Relative to control, the mean number of fruits, fruit weight, fruit length, number of seeds/fruit, weight of seeds/plant showed significant improvement ($P<0.05$),by the application of RHC and urea either as single or combined treatments. For these seed yields and yield attributes, the highest values were obtained at the treatment combination of 2t/ha RHC and 2t/ha urea, while the least values were obtained from plants that were grown in non- amended soils. Also, the combined treatments of both fertilizer materials gave better improvement on the seed yield and yield components and the improvements increased with increase on the rate of application.

RHC +U	No of fruits/ (kg)	Weight of fruit (cm)	Fruit length fruit fruit (kg)	No of seeds/	Weight of seeds/plant
Control	2.00	2.24	41.00	38.00	0.93
0 + 1	2.00	3.09	53.00	44.00	0.98
0 + 2	3.00	3.45	62.13	54.00	1.03
1 + 0	2.00	3.17	57.11	51.00	1.00
1 + 1	2.00	3.94	69.00	61.00	1.12
1 + 2	4.00	4.14	72.18	79.00	1.15
2 + 0	3.00	4.03	72.00	76.00	1.12
2 + 1	4.00	4.37	86.66	95.00	1.21
2 + 2	4.00	4.55	91.93	103.00	1.24
Mean	**2.88**	**3.66**	**67.22**	**66.90**	**1.09**
F-LSD (0.05) *C*	0.0145	0.0109	0.262	0.1448	0.00038
F-LSD (0.05) S	0.137	0.190	0.026	0.330	0.0045
F.LSD (C XS)	0.237	0.218	0.454	0.044	0.066

Table 3: Yield and yield components of Telfairia as affected by the addition of RHC and Urea

4. Conclusion

In Nigeria, soil fertility restoration for improved Agricultural production is a recurrent issue of immersed importance mostly with the drastic and continual decline in the price of crude oil in the global market. Therefore, Identifying sustainable ecological practice to improve soil fertility is one of the surest ways to enhance food security and sustain economic growth. Addition of organic materials such as rice –husk has become popular practice in improving soil fertility. This study has led to the conclusion that soils amended with rice-husk compost and urea both as lone treatment and interactively gave appreciable higher improvement on soil chemical properties and yield of *Telfairia* relative to control, it is therefore recommended that to improve the fertility status of Unwana soils, rice-husk compost should be in combination with urea added to the soils as fertilizer resources to enhance better yield and sustained crop productivity.

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