ISRJ ONLINE
International Science Research Journal 1(2): 141 - 145, 2008
ISSN: 2006 - 1730

Effect of Rice Husk Mulch and Fertilizer Rates on an Acid Altisol and the Yield of Okra *(Abelmoschus Esculentus)* in South East Nigeria

EKPE, I.I
Department of Soil and Environmental Management, Faculty of Agriculture and Natural Resources Management, Ebonyi State University, P.M.B. 053, Abakaliki E-mail : ibiamik@yahoo.com

ABSTRACT: A research was conducted at the Teaching and Research Farm of Ebonyi State University Abakaliki, to investigate the effect of blanket rice husk used as mulch at the rate of 7.5t/ha and NPK 20:10:10 at the rate of 250.200 and 150kg/ha on acid altisol in Abakaliki. The soil chemical parameters measured include cation exchage capacity (CEC), nitrogen (N), phosphorus (p), pH, exchangeable acidity (EA), calcium (Ca), magnesium (Mg), and base saturation (BS) while plant height and stem diameter were the plant parameters measured. The experiment was laid out in randomized complete block design with 4 treatment and 5 replications. The treatments were T1=control (the control received no mulch and no fertilizer) T2= 250kg/ha, T3=200kg/ha, T4=150kg/ha.There was statistical difference when the chemical properties of the treated plots were compared with the control. There was also statistical difference when the treatments were compared among themselves. The measured plant parameters also showed significant difference when the treatments were compared with the control and among themselves.

KEY WORDS: Effects, Rice husk mulch, fertilizer rate, Acid Altisol, Yield, Nigeria, *Abelmoschus esculentus*

INTRODUCTION

Tropical soils are beset with problems of acidity, acute nutrient deficiency and soil erosion. The use of fertilizers (organic and inorganic) has been found to solve these problems (Enwezor and Moore., 1989). The important use of organic manure and mineral fertilizer in tropical agriculture for increase food production has been thoroughly discussed (Aliyu and Olanrewaju, 1996; Abed *et al*., 1997). In most cases, single applications of these organic or inorganic fertilizers are carried out (Akanbi and Togun, 2002; Babatola and Olanaiyi, 1997). Inorganic fertilizers are materials of a concentrated nature; they are applied to the soil mainly to increase the supply of one or more of the essential nutrient e.g. nitrogen, phosphorus and potassium while organic manure are added to improve the physical and sometimes the chemical properties of the soil; to maintain humus status of the soil and also maintain the optimum condition for the activities of soil micro and macro organisms.

Researchers have evaluated the agronomic potentials of inorganic fertilizers and organic manure available to farmers in improving soil fertility status, chemical; and physical properties and improving crop yield (Schlein 1986). Regular and substantial addition of mulch materials like rice husk dust left on the surface rather than incorporated into the soil have proven to be a beneficial practice for a wide range of soil and agro- ecological environments. The main benefits include maintenance of moisture and temperature regimes in the root zone, favorable biological activities, particularly earth worm activity and addition of plant nutrients when fully mineralized (Maurya and Lal, 1980).

Agro-industrial waste such as rice husk dust contains an estimated 0.45, 0.25 and 0.45% nitrogen (N) Phosphorus (P_2O_5) and potassium (K_2O) (Karikari and yayock, 1987). The agronomic potentials of organic and inorganic fertilizers are measured by their ability to supply essential plant nutrients, improve on soil properties and increase the yield of crops (Mbagwu and Ekwealor, 1990).

Okra (*Abelmoschus esculentus*) is one of the vegetable crops grown in Nigeria. It is a native of tropical Africa . it is also widely grow in the subtropics and in the warm temperate regions. Okra is adapted to a pH range of 6.0 to 6.5. The problem of Okra production in Ebonyi State is that the soil native fertility is not adequate for its production. More-so, the use of the industrial waste (Rice husk dust) for improving the chemical properties of the soil for Okra production has not been give enough attention. Also the combined effect of inorganic and organic fertilizers in Okra production has not been thoroughly examined in the study area. This work when concluded will add to the existing knowledge on the importance of organic and inorganic manure on soil properties and the yield of Okra. It will also point to an economical and environmental friendly means of disposal of the abundant rice husk dust from the rice mill.

MATERIALS AND METHOD

Site Description

The experiment was conducted at the Teaching and Research Farm of the Faculty of Agriculture and Natural Resources Management. Ebonyi State University, Abakaliki. The study area was located between Latitude 06^0 4^1N and longitude 08^0 5^1E and rainfall pattern was bimodal (April-July), September-November with a short spell in August. The annual rainfall was between 1200mm-1500mm located in the derived Savannah of the Southeast agro-ecological zone of Nigeria. The mean annual temperature was about 24°C and relative humidity is between 60-80% (Ofomata, 1975). Common crops and grasses found in the study area include cassava, yam etc; the grases are *pennisetum purpurea*, panicum *maximum*, *tridax procumbens;* short trees, herb and shrubs are found scattered at different locations around the site . The soil type is sandy clay loam which in some places are poorly drained (Anikwe, 2000)

Corresponding Author: Ekpe I.I. Dept of Soil and Env. Management, Faculty of Agric & Natural Resources Mgt, Ebonyi State University.i

Site Selection / Field Layout

The site was cleared of the existing Vegetation manually using cutlass. The field was marked into four blocks of 15m X 22m (330 m^2), with 1 m alley between them. Each block was divided into five as replicates with 0.5m alley between the plots of 3 X 4 m size. The site was tilled using conversional hoe.

Soil Sampling

Pre-planting soil samples were collected randomly from the study site using soil auger. The samples were bulked together to form a composite sample ,air dried, crushed and allowed to pass through a 2mm sieve later subjected to analysis. Again a second set of soil sample was collected randomly from the different treatment plots. The 20 samples were bulked according to treatments and treated accordingly for analysis. From each treatment three samples were collected from the composite and analyzed for total organic carbon was determined using walkly and Black method (1954). Available phosphorus was determined using bray II solution (Bray and Kurtz, 1945). Total Nitrogen was determined by the Micro Kjeldahal procedure as recommended by (Bremner, 1965). pH was determined using the glass electrode pH meter in water (MacLean, 1965).Amount of K and Na was determined using the flame photometer with appropriate filter; while Ca and Mg were determined by the atomic absorption spectrometer (Tel and Rao, 1982).Base Saturation was by calculation. The rice husk dust was collected from the Abakaliki rice mill, NPK 20:10:10 fertilizer was purchased at the Ebonyi State Chemical Fertilizer Blending Plant. Okra variety "Clemson spineless" used as test crop was purchased at the Enugu State Agricultural Development Programme (ENADEP).

Tilling/treatment Allocation/planting

The plot was pulverized before application of treatments and planting. NPK fertilizer 20:10:10 was applied at the rate of 250kg/ha, 200kg/ha and 150kg/ha and a blanket application of rice husk at the rate of 7.5 t/ha was uniformly spread as a surface mulch on the treated plots only. The Okra seeds were planted four per hole and later thinned down to two, one week after germination (WAG). There was a plot without treatment which was used as the control but upon which okra was planted too. The study consists of four treatments namely: T1- control; T2-rice husk dust mulch + 250kg/ha NPK 20:10:10; T3-rice husk dust mulch + 200kg/ha NPK 20:10:10; T4- rice husk dust mulch + 150kg/ha NPK 20:10:10

Plant Measurement

Agronomic characteristics such as plant height, and stem diameter, were determined with measuring tape at 40 days after planting (DAP)

Experimental Design/ Statistical Analysis

The experiment was laid out in a Randomized complete block design in four blocks with five replications. Raw data emanating from the study was analyzed according to Gomez and Gomez (1982).

Weeding:

weeding was done as regularly as the need arise using conventional hoe.

RESULTS AND DISCUSSIONS

Soil pH

The mean values of the effect of treatment on soil pH, CEC, organic matter, available phosphorus and percent nitrogen is presented in table 1. There was statistically significant effect (P=0.05) on soil Ph when the treatments were compared with the control. However, multiple comparisons of the treatments showed that the amended plot had significant negative effect relative to the control. T2 and T4 showed no significant effect when compared among themselves. When T3 was compared with T1, T2 and T4, there was positive significant effect. More so, T^4 showed positive significant effect when compared with T1, but when compared with T3 it showed negative significant effect. The lower pH in the control explains the acidifying effect of fertilization and the neutralizing effect of rice husk mulch .This is why the plots with 200 and 150kg/ha NPK 20:10:10 had lower acidity than the plots treated with 250kg/ha and the control. The combined effect of the rice husk and the inorganic fertilizer helped to reduce the acidity of the treated plots hence the reduced acidity recorded in these plots.

Table 1: Effect of treatment on soil PH, Exchangeable acidity, CEC, Organic matter, Nitrogen and phosphorous

Treatment	pH H_2O	E/ A Cmol/kg	CEC Cmol/Kg	Organic matter(%)	Av. p Cmol/kg	% N
T1	4.90^a	2.11^a	3.83^a	1.63^a	48.6^a	0.65^a
T2	5.30^b	1.13^b	5.99^b	2.23^b	36.2^b	1.31^b
T3	5.5^b	1.48^c	5.62^c	2.24^b	55.1^c	1.31^c
T4	5.5^c	1.57^d	4.66^d	2.42^c	55.1^c	1.12^c
$FLSD_{(P=0.05)}$	0.064	0.079	0.069	0.046	0.20	0.039

Figure with the same subscript are not statically significant

Key

T1 = Control
T2 = Rice husk dust mulch + 250k/ha NPK 20: 10:10
T3 = Rice husk dust mulch + 200kg/ha NPK 20:10:10
T4 = Rice husk dust + 150kg/ha NPK 20:10:10

Exchangable Acidity (EA)

The table showed significant (P=0.05) difference in exchangeable acidity. The result showed that T2, T3 and T4 had 46.4, 29.8 and 25.6% lower in exchangeable acidity than control. The table also showed reducing value of EA in the amending plots with increasing soil pH. Comparatively, T1 showed positive significant effect with the amended plots. However, T2 when compared with T1, T3 and T4 showed negative significant change .T3 showed negative significant change when compared with T1 and T4 but showed positive effect with T2. T4 when compared with T1 showed negative significant effect, but showed positive effect with T2. On the other hand T4 when compared with T3 had no significant effect.

Cation Exchange Capacity (CEC).

The result of the effects on CEC produced significant effects (P=0.05) when the treated plots were compared with the control. T1 had 17.8, 36.0 and 31.9% lower CEC than T2, T3 and T4 respectively. Multiple comparison of T1 with T2, T3 and T4 showed negative significant effect. Similarly, when T2 was compared with T3 and T4, there was also negative significant effect. But, when T3 was compared with T1 and T2 there was positive significant effect. T3 and T4 showed no significant effect at all. The higher CEC values recorded within the treated plots could be attributed to the level of organic matter in the mulch material and also the quantity of material elements release from the organic matter when mineralized. The higher CEC recorded in the plots treated with 250kg/ha may have resulted from the released nitrogen in the NPK. The extra nutrient may have fed the microorganisms in the soil sufficiently for the mineralization of organic matter which is the bank of plant nutrients, hence the high CEC.

Organic Matter (OM)

The mean values of percentage organic matter of the soil were1.63, 2.23, 2.24 and 2.42 for T1, T2, T3 and T4 respectively. The organic matter content in T1 (control) was 26.9, 27.2 and 32.6% lower than those of T1, T2, T3 and T4 respectively. Treatment (T1) showed negative significant effect when compare with T2, T3 and T4, However, statistical comparison of T2 with T3 showed no significant effect. Treatments (T2) and (T3) when compared with treatment T1 showed positive significant effect. Mulch increase the organic matter content of soils (Brady and Weils, 1999).Therefore the plots with rice husk should have higher organic matter.

Phosphorus (P)

The results showed that treatments (T1) when compared with the amended plots had significant effect on the soils. T2 showed negative significant effect when compared with T1, T3 and T4. However, there was positive significant effect when T4 was compared with T1, T2 and T3. Similarly, T3 showed positive significant effect when compared with T1 and T2, but negative significant effect was observed when T4 was compared with T3.

PERCENTAGE NITROGEN (%N)

The mean values for treatment on the percentages nitrogen in the soil presented in table 3 showed that T1 was 41.9, 42.5 and 50% lower than T2, T3 and T4 respectively. Statistical analysis of the values showed that the amended plots produced significant effect (p=0.05) when compared with the control. However, multiple comparison of the treatment showed that T1 had negative significant effect with T2, T3 and T4. When T2 and T3 were compared with T1 there was positive significant effect. T2 and T3 showed no significant effect when compared among themselves. Treatment (T4) when compared with T1, T2 and T3 showed positive significant effect. More nitrogen was found in the plots that received more nitrogen. The released nitrogen from the mulch combined with the added nitrogen from the inorganic fertilizer is responsible for the statistical difference recorded between the treated plots and the control.

Effect Of Treatment On Exchangeable Bases And Base Saturation

The data on the effect of treatment on exchangeable bases and base saturation are presented in table 2.

Exchangeable Bases

Calcium (CA)

The result showed that treatment T1 (control) had the lowest mean concentration of exchangeable Ca (0.89) than treatment T2 (1.77), T3 (2.35) and T4 (2.43). However, the concentration of Ca in the control (T1) was 49.79, 62.1 and 63.3% lower than that of T2 and T4 respectively. Comparatively, T1 showed negative significant effect with T2, T3 and T4. Similarly, T2 when compared with T3 and T4 showed negative significant difference. T3 and T4 when compared with T1 and T2 showed positive significant effect. The lower Ca recorded in the control explains the lower pH of the control plots.

Magnesium (MG)

The mean results on value for treatment (T1) were 34.1, 48.8 and 32.3% lower than that of T2, and T4 respectively. The amended plots produced significant effects when compared with the control. There was also significant difference when the values of Mg from the treated plots were compared among themselves. The multiple comparism results showed that when T1 was compared with T2, T3 and T4 there was significant negative effect. However, there was positive significant effect when the treatments were compared among
Themselves.

Effect Of Treatment On Percentage Base Saturation Of The Soil

Treatment 1 had 40, 42.8 and 36% lower base saturation than T2, T3 and T4 respectively. However, multiple comparison of the treatment showed that T1 had negative significant effect when compared with T2, T3 and T4. Also, treatment (T4) when compared with T2 and T3 showed negative significant effect. Treatment (T3) when compared with T1 and T4 showed positive effect. T4 when compared with T2 when compared showed no significant effect.

Table 2: Effect; of Treatment on Exchangeable bases and base saturation of the soil.

Treatment	Exchangeable Bases (Cmo/kg) soil		Base Saturation %
	Ca	Mg	
T_1	0.89[a]	0.83[a]	45.33[a]
T_2	1.77[b]	1.26[b]	75.60[b]
T_3	2.35[c]	1.60[c]	79.29[c]
T_4	2.43[c]	1.23[b]	70.91[d]
FLSD $_{(p=0.05)}$	0.047	0.07	0.024

Figures with the same subscript are not statistically significant

Table 3: Effect of treatment on Plant height, Stem diameter ofthe Okra plant

Treatment	plant height (cm)	stem diameter (cm)
T1	86.80[a]	2.08[a]
T2	142.70[b]	4.30[b]
T3	132.60[c]	3.28[c]
T4	110.40[d]	3.28[d]
FLSD $_{(P=0.05)}$	0.010	0.20

Figures with the same subscript are not statistically significant

Plant Height

The data on the effect of treatment on plant height is presented in table 3. The plant height for treatment (T1) was 39.2, 34.5 and 21.4% lower than T2, T3 and T4 respectively. Multiple comparison of the treatment showed that the amended plots had significant effect when compared with the control. When T[1] was compared with T2, T3 and T4 there was negative significant effect. However, when T2 was compared with T1, T3 and T4, there was positive significant change. Also, when T3 was compared with T1, T2 and T4; T1 showed positive significant effect when compared with T4 while T2 showed negative significant effect when compared with T1. There was also negative significant effect when T4 was compared with T2 and T3, but showed positive significant effect when compared with T1. The taller plants in the study produced more number of pods than the shorter ones. This means that the treatment improved the height and the general yield of Okra.

Stem Diameter

The mean treatment effect in stem diameter were 2.08, 3.28 and 3.28 (table 3) for T2, T1 and T4 respectively. Amended plots produced significant effect when compared with the control. The results showed that treatment T1 was 51.6, 36.6 and 36.6% lower than T2, T3 and T4 respectively. Multiple comparison of the control (T1) with the amended plots showed negative effect. However, there was positive significant effect when T2 was compared with T1, T3 and T4. Also, there was positive significant effect when T3 was compared with T1 and T4, but it showed negative effect with T2 .Similarly, T4 showed negative effect when compared with T2 and T3. But T4 showed positive significant effect when compared with T1.

SUMMARY

The results indicated that NPK 20:10:10 and rice husk dust used as mulch in the amended plots improved the soil chemical properties and crop yield. Soil chemical properties like CEC, exchangeable bases and acidity, % base saturation, % nitrogen and organic matter were significantly improved relatively to the control. Hence could be attributed to the amendment, which directly added organic matter to the soil, as sources of energy for soil microbes and added plant nutrient elements through the inorganic fertility.

CONCLUSION

In conclusion, it was observed that a combination of organic waste and inorganic fertilizer is very useful as soil amendment, as it improved the chemical properties of the soil which enhanced the plant parameters studied.

REFERENCES

Abed, MB, Clement, MD, Aragan, R.P and Camrero A.S (1997): *the influence of Solid Urban W a s t e C o m p o s t a n d N i t r o g e n M i n e r a l Fertilizer on Growth and Productivity in potatoes. Common soil science plant Analysis. 28 (17 and 18). 1653-1161.*

Akanbi, W.B. and Togun, A.o. (2002). *The influence of Maize- Stover Compost And Nitrogen fertilizer o n G r o w t h . Y i e l d a n d N u t r i e n t u p t a k e o f Amaranth.* Scienctia Horticultural 93:1-8.

Aliyu,L.and OLanrewaju, J.D. (1996): Response of Pepper to Fertilizers.Nutrient Concentration and Uptake as Affected by Nitrogen and Phosphorus Level. In: Proc. 14th HORTSON Conference. Ago-Iwoye, 1-4 April, 1996.

Ainkwe, M.N.A. (2000): Amelioration of Heavy Clay Application of Town Refuse Compost on the soil Plant System. A Review of Biological waste 19, 35-63, *Aust J. Agricultural Resource 9.129-137.*

Babatola,L.A. and Olanaiyi,J.O.(1997):Effect of NPK 15-15-15 fertilizer levels and plant spscing of performance and shelf life of okras.In:Proc.15th HORSON conference.NIHORT,Ibadan 8-11th April,1997

Bremner,J.M.(1965): Total Nitrogen in Methods of soil A n a l y s i s p a r t 2 (e d) C . A . B l a c k , D . D Evens,J.L White,I.E. Ensminger and E.E Clark,Am Soc of Agron.9,1149-1178.

Brady, N. and Weils, R.R.(1999): The Nature and Properties of Soils.(Twelfth Edition) Prentice-Hall, Inc.

Enwezor, W.O and moore, A.W. (1986): Phosphorus Status of some Nigeria Soils. Soil science 102:322-326.

Gomez, K.A and Gomez, A.A. (1982): *Statistical Procedure for Agricultural Research.John Wiley and* Son N.Y. Pp 680.

Karikari,S.K. and Yayock,J.Y.(1987): Organic Fertilizer Sources in Nigerian in Producing the National Fertilizer. Serminar held at Port Harcourt, 1987.Pp 65-85.

Maclean, E.O. (1965): Aluminum. In C.A. Block et method of soilk Analysis Part 2 Am. Soc. Of Agron 9:978-996.

Maurya, P and Lal, R. (1980): Effects of no Tillage and Ploughing on roots. Maize and Leguminous Crops Exp. Agric. 16: 185-193.

Mbagwu, J.S.C and Ekwualor, G.C (1990): Agronomic Potentials of Brewers Spent Grains. Biol Waste 34, 335-347.

Ofomata, G.E.K. (1975): Nigeria in Maps. (eastern States) Ofomata Ed Ethiopia Pub. House Benin City. Pp 46.

Schlein K. (1986): the Use of Cattle Dung in Agricultural Natural Resource and Development 23:53-87.

Tel, D and Rao, P. (1982): Automated and semi-automated Method for soil and plant Analysis. ITA Manual Series No.7 IITA Ibadan Nigeria.

Walkley, A and Black, C.A. (1954): An Examination of the Different Method of Determiningg soil Organic Matter and a Proposed Modification of The Chromic Acid Titration Method. Soil Sc 37; 29-38.