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RESEARCH ARTICLE

Application of Rice Husk Waste and Npk Fertilizer on a degraded Acid Sand in Anambra area, Southeastern Nigeria
Effect on the Chemical and Nutritional Composition of Maize (Zea Mays) Grown on it

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ABSTRACT
A field trial experiment in a completely randomized design was conducted on a sandy soil in Ukpor, Nnewi area of Anambra State, Southeast Agro-ecological zone of Nigeria to evaluate the impact of combination of Rice husk waste (RHW) and NPK fertilizer on food qualities of maize. The factors were; 10 tonsha^{-1} RHW + 300kgha^{-1} NPK, 5tonsha^{-1} NPK, Otonha^{-1} + 300kgha^{-1} NPK, 10 tonsha^{-1} + Okgha^{-1} NPK and the control in four replicates. The test crop was maize cultivar Oba super 2. The grains were harvested at 10 weeks after planting and the mineral Composition, Carbohydrate, Protein and Amino acids determined. Data obtained were analyzed using ANOVA and significant means subjected to fisher LSD at P = 0.05. The effects of the treatments were significant on the amino acid having a range of 1260 - 1693.5mg/l00g, while the Carbohydrate had a range of 72.17 - 75.12 percent but was not significantly different at < 0.05. Though there was improvement among the treatments. The minerals, K, P and K were also improved by the treatments.

Keywords: Rice husk waste, NPK fertilizer degraded, acid soils, minerals, amino acid, carbohydrate, maize.

INTRODUCTION
Tropical soils including soils of Southeastern Nigeria are usually characterized by low fertility and productivity (Igwe *et al*., 1995). They are prone to degradation which is brought about by intensive cultivation, leaching and erosion (Babalola, 1987). This problem can be minimized by sound soil management. The quest for a sustainable soil nutrient management system in tropical countries is imperative, in the face of declining soil fertility and low productivity coupled with the high cost of agricultural inputs. However, for soil to maintain a good productive potential even with the use of inorganic fertilizer to replenish soil nutrients, organic matter is indispensible (Cook, 1975). Organic matter is the life-wire of the soil. In recent times, organic manure is modified to improve their efficiency through fortification with inorganic fertilizer leading to organo-mineral fertilizers (Omueti *et al.*, 2014). Low soil organic matter content of the tropical soils leads to high bulk density, affects soil porosity and water holding capacity and infiltration rates (Ahukaemere *et al*; 2012, and Mbagwu, 1988).

In sustainable low input agriculture systems where nutrient depletion is a serious constraint to crop production, the use of organic manure is inevitable; supplements such as manures with mineral fertilizers might be the key to attaining the desired good yield. (Soulmare, 2003, Kiani, 2005). Organic manure improves soil structure, soil aggregation, infiltration, microbial activities and water holding capacity (Gilley and Risse, 2000; Hayness and Naidu 1998), hence it is a valuable soil amendment. These organic materials are readily available to the resource poor farmers of the tropics, for an instance in major rice producing areas of Nigeria, rice husk constitutes environmental problems and is commonly disposed only by burning but can be made useful by developing a technology that will utilize the material in agriculture and check the menace caused by its disposal. (Nwosu *et al.*, 2014). The

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objective of the present study is to determine the impact of the combination of Rice husk waste and NPK fertilizer on the nutrient Composition and food value of maize grain grown on acid soils of Southeastern Nigeria.

MATERIALS AND METHODS

The trial was conducted at Ukpor, Nnewi South, Anambra State, 15M X 20M experimental plot of 3m X 3m plot units were planted with Oba super 2 maize variety from Obasanjo Ota farm. The experiment was laid in a randomized complete block design (RCBD) with five treatment replicated four times. The treatment combinations were; T1=10tonaha^{-1} RHW+300kgha^{-1} NPK, T2 = 5tonsha^{-1} RHW +l50kgha^{-1} NPK, T3 ORHW+300kgha^{-1} NPK, T4 = 10tonsha^{-1} RHW+ONPK and T5=control. The treatments were applied in band after thinning down the test crop to two plants per hole. Weeding was carried out at two weeks interval till maturity. The grains were harvested at maturity, 10 weeks after treatment applications.

SAMPLING PROCEEDURES AND ANALYSIS

The maize combs were sampled from four crops of each treatments and a total of twenty matured maize were sampled and labeled according to each treatments. The maize was allowed to sun dry and the seed removed from the combs.100 seed grains from each treatment was taken to the laboratory of Soil Science Department, National Root Crops Research Institute (NRCRI) Umudike for analysis.

LABORATORY PROCEEDURE

The maize seed grains were finally dried in an electric oven at 65 degrees centigrade's for about 6hours and milled to 0.5mm particle size using a Thomas Willey Milling machine and used for chemical analysis by multiple nutrient digestion (Novozarnsky *et al*, 1983). 0.2g of the sample was weighed into a 150m1 Pyrex Conical flask, 5ml of the multiple nutrient extraction reagents was added to the sample and allowed to stand at ambient temperature for l6hrs. The sample was heated at 30^{0c} for 3hrs, 5ml of 75% Perchloric acid was added to preheated sample and the temperature increased to 80^{0c} and allowed to digest.

The digest was allowed to cool and transferred into a 50m1 volumetric flask and made up to mark. The digest was used for determination of potassium K using the flame photometer, phosphorus by the vanado molybdate yellow method using the spectrophotometer and Nitrogen by semi-micro kjedhal method. The Amino acids was determined by the Sorensen's formol titration method while the total carbohydrate was determined by the anthrone method using spectrophotometer, protein was determined by converting total N X 6.25.

TABLE 1: Characterization of soils of the Study Site. (0-30cm depth)

Parameter	Unit of measurement	Values
Mechanical analysis Sand	(%)	78.40
Silt	(%)	4.30
Clay	(%)	17.30
Textural class	Sandy Loam	
pH (H_2O)	1:2.5 (Soil: Water)	4.45
Available P	(mgkg^{-1})	16.80
Total N	(%)	0.098
Organic C	(%)	0.998
Organic M	(%)	1.72
Exchangeable Bases	(cmolkg^{-1})	
Ca		2.40
Mg		1.20
K		0.051
Na		0.044
Exchangeable Acidity	(cmolkg^{-1})	2.08
ECEC	(cmolkg^{-1})	5.775
Bases Saturation	(%)	63.98
C/N Ratio		10.18

ECEC Effective Cation Exchange Capacity

RESULT AND DISCUSSION

Table 1 showed the result of soil properties of the study area. The soil is dominated by coarse to very fine sand nearing about 78.40% of the particle size determination of the site. Silt is in average of 4.30% while clay particle had an average of 17.30%. The dominant textural class of the area is sandy loam. The abundance of the sand particles is attributed to the coastal plain sands and sand stones dominant parent materials of the zone. Soil reaction is also very acidic with a pH range of 4.50 which is less than 5.50-6.50 pH established as ideal for arable crops by Enwezor (1997) for soils of Southeastern Nigeria. The organic matter is also very low, an average of 1.0%, Total —N in average of 0.098% exchangeable potassium 0.05cmol/lkg^{-1}, while phosphorus is at the medium level 16.8omgkg^{-1}. The low exchangeable acidity is an indication of the low mineral reserves of the area and strong acidity of the soil reactions. The characterization of the soil is a serious indication for amendment in order to sustain food production.

TABLE 2: Effect of the combination of Rice husk wastes and NPK fertilizer on some mineral composition of maize seed grains

Treatments (RFW + NPK)	Mineral composition (%)

Tonsha^{-1} + Kgha^{-1}	MC	DM	N	P	K
10T.ha^{-1} + 300Kgha^{-1}	8.22	91.78	2.74	0.59	0.77
5T.ha^{-1} + 150Kgha^{-1}	9.92	90.08	1.98	0.59	0.76
0T.ha^{-1} + 300Kgha^{-1}	11.56	88.44	2.12	0.65	0.74
10T.ha^{-1} + 0Kgha^{-1}	9.74	90.26	1.59	0.51	0.68
Control	9.15	90.85	1.84	0.58	0.71
LSD		NS	NS	NS	NS

The moisture and dry matter content of the maize seed grain is shown in table 2. The effect of the combination of Rice husk waste and NPK fertilizer did not show significant differences (P = < 0.05) in the moisture and dry matter content of the grains. However, the zero response to the different combinations by moisture content could be attributed to the fact that only one variety of the test crop was used in the study. The range of the moisture content is 8.22-11.56%.

The chemical composition of the maize grain as affected by the different rates of RHW and NPK fertilizer is shown in table 2. There was no significant difference (P=<0.O5) in the Nitrogen content of the maize by the treatments. 10tonsha^{-1} +300kgha^{-1} gave the highest nitrogen (2.79%) while 10tonsha^{-1} RHW and 0kgha^{-1} NPK gave the least value of 1.59% N.

The magnitude of the nitrogen distribution among the treatments is 10tonsha^{-1}+RHW+300kgNPK<0tonsRHW+300kyha^{-1}NPK<5tonsha^{-1}RHW + 150kgNPK <control<10tonha^{-1}RHW + 0kgNPK. The trend has shown that NPK fertilizer has much influence in the percent nitrogen content of the maize grain. The same trend was observed for Potassium and Phosphorus content. 10tonsha^{-1} RHW+300kgNPK gave the highest K (0.77%) response having a range of 0.68%-0.77% among the treatment. However 300kgha^{-1} NPK gave better P response (0.65%) contrary to N and K. The range of P values is O.51%-0.65%. There was no significant difference in P values.

TABLE 3: Effect of the combination of Rice husk wastes and NPK fertilizer on the crude protein, carbohydrate and amino acids of the maize seed grains

Treatments (RHW + NPK)	Food values		
	CP (%)	CHO(%)	Amino acid (mg/100g)
10T.ha^{-1} + 300Kgha^{-1}	17.13	74.48	1260.00
5T.ha^{-1} + 150Kgha^{-1}	12.38	73.13	1179.00
0T.ha^{-1} + 300Kgha^{-1}	13.25	72.17	1215.00
10T.ha^{-1} + 0Kgha^{-1}	9.94	75.12	1693.50
Control	11.50	74.73	1115.00
LSD	NS	NS	NS

The effect of treatments on some food value of the maize grain is presented in Table 3. The amino acid, the carbohydrate and the protein contents are evaluated. The amino acid content had a range of 1115mg/100g in the control to 1693.50mg/100g in the 10tonsha^{-1} RHW. There was great significant difference among the treatments.10tonsha^{-1} RHW alone gave the greatest response to amino acid composition of the grains; this was followed by 10tonsha^{-1} RHW+300kg NPK which gave a response of 1260mg/100g while the control had the least of amino acid (11 15.0mg/100g). The crude protein content had a mean of 12.83%. 10tons+300kgha^{-1} gave a crude protein value of 17.13% and the range of crude protein content across the treatment is 9.94% in 10tonsha^{-1}RHW and 17.13% in the 10tonsha^{-1}+300kg NPK. Maize is a carbohydrate staple food across the globe. The various treatments though were not significantly different but there was remarkable improvement on the carbohydrate content of the maize (72.17%-75.12%) by the various treatment combinations. The highest value of 75.12% CHO was seen in the 10tonsha^{-1} RHW and the least in the 300kgha^{-1}NPK application.

CONCLUSION

Apart from the amino acid content of the maize grains, all other chemical nutrient did not show significant different (P<0.05) to the applied treatments 10tonsha^{-1}RHW+300kgha^{-1}NPK gave the overall best result. The result has shown that to amend the soil with an industrial organic waste like the rice husk waste has the potential of improving on the growth and nutrient parameters of crops like maize. The residual effect of this work will be monitored.

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