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Effect of Oil Palm Bunch Refuse Ash Rates as Soil Amendment for Increased Maize Production in Nigeria

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INTRODUCTION

Maize (*Zea mays L.*) one of the oldest and widely cultivated world cereal is an annual of the order Poacea and it is an important member of the Graminaea family. It provides food for man, feed for livestock and raw materials for industries. In many parts of West Africa, this is a staple food and is occasionally cultivated on garden scale where it cannot be grown as a farm crop. It is an important source of carbohydrate and vitamins.
Oil palm bunch refuse ash is a plant derived ash that serves as an effective liming material and also a source whereby major soil and plant nutrients are enhanced (Owolabi *et al*., 2003).

In Port Harcourt South eastern Nigeria most soils are acidic due to the nature of their parent material, land use and climate. These inherently infertile soils are called ultisols, formed from coasted plain sands and are low in mineral reserve and fertility (Eshett, 1993). The soils are deficient in essential plant nutrient in a few years of cropping, hence, the need for a suitable liming programme. Due to scarcity and high cost of liming materials, research into low cost, internally sourced, cheap and affordable organic material that could serve as liming agent was carried out. Earlier Omoti *et al*., (1989), had indicated that there was great potential of reducing fertilizer bill in oil palm plantation by recycling empty oil palm bunch waste.

However, very little has been reported on crop response to unorthodox liming materials Obi and Ekerigin (2001). However, Adetunji (1997), studied effect plant derived ash on maize yield. According to Ojeniyi and Adejobi (2002), the use of wood ash can ameliorate soil acidity. Other studies carried out in parts of Africa found that plant derived ash increase P, K, Ca, Mg status of soil and pH and yield of vegetable, rice, millet and maize (Adu-Dapaah *et al*., 1994).

However, the potential of oil palm bunch refuse ash as a liming material has not been adequately investigated in the field. Hence, this work is geared towards putting together the gain derived from the use of oil palm bunch refuse ash for the production of organic manures and agricultural development with respect to Maize (*Zea mays L.*).

MATERIALS AND METHODS

SITE LOCATION/ CLIMATE: The experiment was conducted in 2013/ 2014 cropping season at the Teaching and Research farm of Rivers state University of Science and Technology Nkpolu, Port Harcourt, Rivers State. The site in Port Harcourt was located on latitude 04^0 $51^{/}$N and longitudes 7^0 $01^{/}$ East with an elevation of 17.34m above sea level in the heart of the humid tropical rainforest zone of Nigeria (FAO ,1994) with minimum and maximum annual ambient temperatures of 20^0 C and 32^0 C respectively . It has a mean annual rainfall range of 2200mm-2500mm which span from March –November with peaks in July and September and it is bimodal. It has a mean relative humidity of 89%. The experiment was carried out on a site on which the previous cropping was fluted pumpkin (*Telfairia occidentalis*) and Chili Pepper (*Capsicum annum*).

LAND PREPARATION.: The experimental site was manually cleared using cutlass, spade and hoe, and the dry matter packed off the field. The field was marked out and a randomized complete block design (RCDB) was used. There were 6 treatments replicated 4 times. There were six plots on each block measuring 4×2 m (i.e. $8m^2$) with a 0.5 m between plots and 1 m between blocks. Flat tilled land surface were made to define the experimental plots. The total land area used was 370 m^2 (0.0370 ha).

TREATMENTSThe treatments include: 0t/ha - Control (no palm bunch ash used) **,**2t/ha - Palm bunch refuse ash **,**4t/ha - Palm bunch refuse ash **,**6t/ha - Palm bunch refuse ash **,**8t/ha - Palm bunch refuse ash **and** 10t/ha - Palm bunch refuse ash

PLANTING MATERIALS AND PLANTING: The maize seeds Oba super 2 hybrid were planted at a spacing of 0.75m x 0.60m apart in each plot at 3 seeds per hole and later thinned down to two plants per stand. The treatments were applied before planting. Planting was done in May; 2009.Manual weeding was done at 2, 4, and 6 weeks after planting.

SOIL SAMPLING AND ANALYSIS:Before commencing the trial, soil samples were randomly collected from the experimental site at a depth of 0-20cm for determination of some soil chemicals properties.

Such factors determined in the laboratory include: Soil pH, Calcium (Ca), Magnesium (Mg), Potassium (K), Nitrogen (N), Phosphorous (P), Organic Matter /Carbon (OM/OC).

Nitrogen (N) % was determined by the modified micro-kjeldehl digestion method. Available phosphorous (P) Cmol kg^{-1}, exchangeable potassium (K) (mol kg^{-1}) were determined by the Bray II method and flame photometry respectively.

Calcium (Ca) and Magnesium (Mg) (mol kg^{-1}) were determined using the Atomic Absorption spectrophotometry (AAS) while the soil pH was determined in distilled water at 1:2, 5 soil water solution rates using Beckman Zeromatic pH meter.

DATA COLLECTION: Data were collected on the following parameters: Plant Height (cm),Leaf Area (cm^2),Cob weight (g/ha),Cob length (cm),1000 grain weight (g/ha) and Total yield (kg/ha). Data collected were subjected to analysis of variance and means separated using the least significant difference (LSD)and presented according to Wahua , 1999.

RESULTS AND DISCUSSION

Table 1 Oil palm bunch refuse ash analysis

pH	% OM	%N	P (ppm)	K(cmol/kg)	Ca (cmol/kg)	Mg (cmol/kg)
8.8	1.6	0.19	13.2	29.8	7.9	3.9

Results (Table 1), show the analysis for oil palm bunch refuse ash (OBRA).The values of OBRA contrast with those of Omoti *et al*., (1991) which were 1.1-2.3% N, 13.0-34.4 K, 3.0-8.5% P, 5.8% Ca and 24.0% Mg for Oil palm bunch refuse ash. From Table 1 OBRA is an alkaline and contained relatively high value of K, Ca and Mg respectively but low values of OM, N and P. Therefore, it is said to be a liming material, apart from its potential to supply the major nutrient to soil and plant. The most important nutrient in OBRA is K, which approaches 34% (Chan *et al*., 1980)

Table 2 Soil physical and chemical properties before and after the experiment

		pH	%OM	%N	P	K	Ca	Mg
					Ppm	cmol/kg		
Before		5.05	1.226	0.031	3.48	0.013	1.25	0.30
OBRA*	0	5.25	0.626	0.03	3.70	0.043	1.55	0.20
After	2	5.50	1.224	0.07	4.04	0.053	1.55	0.40
Treatment:	4	5.60	1.324	0.08	4.48	0.153	1.75	0.20
t/ha	6	5.90	1.624	0.11	4.46	0.053	1.55	0.20
	8	6.10	2.424	0.12	4.43	0.143	2.15	0.50
	10	6.30	2.834	0.13	4.45	0.143	1.85	0.30

*OBRA –Oil palm bunch refuse ash

Table 2 represents data on soil physical and chemical properties before and after the experiment as influenced by OBRA. Soils were strongly to moderately acidic, and this could be as a result of parent material (costal plain sands) from which soils were derived (Eshett, 1993). However, Akamigbo (1999) reported a combination of parent materials, land use and climate in producing acidic soils in Southeastern Nigeria. Compared with control, OBRA at 2, 4, 6, 8, 10t/ha increase soil OM, N, P, K, Ca and Mg content respectively. The increase in soil OM and nutrient content is consistent with the earlier observation on the composition of OBRA. OBRA increase soil pH, indicating its reliability and efficacy in reducing soil acidity due to the high content of K, Ca and Mg. This confirms its effect as a liming material. It was observed that the value of soil pH, OM, N, P, K, Ca and Mg tend to increase with different levels of OBRA. This attest to the additive effect of OBRA on soil nutrients and it is in line with (Adu-Dapaah, 1994) who found out that plant derived ash increase the P, K, Ca, Mg, and pH status of the soil. An earlier study by Ikpe *et al*., (1997) attributed increase in available P in soil with application of OBRA to the release of P from soil complexes of Al and Fe under increasing soil. The increase in soil nutrient by application of OBRA could be attributed to enhanced microbial activities in soil were increased pH makes available in the soil the presence of many nutrient elements (Baath and Arnebrant 1994) and production of organic matter and attendant increased availability of N, P, K, Ca and Mg.

Table 3 Effects of Oil palm Bunch Refuse Ash on Leaf Area (cm^2)

OBRA* t/ha	2 WAP	4 WAP	6 WAP	8 WAP
0	96	128	173	188
2	203	273	354**	346**
4	185	264	327	317
6	212	262	352	322
8	112	163	227	253
10	88	126	164	227
LSD (0.05)	NS	NS	181.9	139.7

*OBRA –Oil palm bunch refuse ash; **Significant

Results, (Table 3) showed Leaf Area (cm^2) 2, 4, 6, and 8 weeks after planting (WAP); the leaf area of maize is calculated as (L ×W× a constant (0.75)). The maize leaf area gradually increased with increase in OBRA. At 2 and 4 WAP there were no significant differences. However, at 6 and 8 WAP, there were significant differences with the treatment at 2t/ha having more broad leaf area (cm^2). Maize crop loves bright sunlight and the exposure of the leaves to light and the uptake of essential nutrients especially N by the leaves of maize plant treated with 2t/ha OBRA treatment resulted to a broad leaf area (cm^2) at 6 and 8 weeks after planting (WAP). This may be attributed to the synergic action of OBRA application as against the control (No OBRA). (Ibeawuchi *et al*., 2007)

Table 4 Effects of Oil palm Bunch Refuse Ash on Plant Height (cm)

OBRA* t/ha	2 WAP	4 WAP	6 WAP	8 WAP
0	10.88	31.0	53.5	85.8
2	9.26	28.6	55.0**	87.3
4	10.26	30.8	51.5	92.7**
6	8.20	26.3	52.4	87.8**
8	9.28	27.3	52.7	78.1
10	9.12	25.8	43.4	75.0
LSD (0.05)	NS	NS	11.22	9.55

*OBRA –Oil palm bunch refuse ash; **Significant

Result, (Table 4) showed the Plant Heights (cm). At 6 and 8 WAP there was significant height differences in plant treated with OBRA: 2t/ha at 6 WAP, 4t/ha and 6t/ha at 8 WAP respectively being taller than other maize plants in the experiment. However, at 2 and 4 WAP, results showed that there were no significant differences in plant height. This could be attributed to no competition for plant resources (Ibeawuchi, 2004). Whereas, the significant differences at 6 and 8 WAP can be attributed to the OBRA being broken down and the nutrients were made more available in the inorganic form that the plant can make use of them for their fast growth (Hignette, 1999)

Table 5 Effect of Oil palm Bunch Refuse Ash on Cob Weight (g/ha) and Cob Length (cm).

OBRA* t/ha	Cob Weight	Cob Length
0	117.5	14.14
2	126.0	14.45
4	127.5	14.45
6	137.5	14.40
8	120.0	14.50
10	117.5	14.35
LSD(0.05)	NS	NS

*OBRA –Oil palm bunch refuse ash; **Significant

Table 5 showed results on Cob Weight (g/ha) and Cob Length (cm). The OBRA treatments increased cob length significantly relative to control. Application of 6t/ha increased cob weight of maize. Hence, 6t/ha gave highest cob weight among all the OBRA treatment. Also, the cob length (cm) increased significantly with increasing OBRA treatment which reduced at 6t/ha (14.40cm) and 10t/ha (14.35cm), but relative to control (14.14cm) they still gave significant cob length. Hence, 8t/ha gave highest cob length among OBRA treatments.

Table 6. Effect of Oil palm Bunch Refuse Ash on Total Yield (kg/ha) and 1000 Grain Weight (g/ha).

OBRA* t/ha	Total yield (kg/ha)	1000 Grain weight (g/ha)
0	2.00	442.5
2	1.85	425.0
4	2.00	457.5
6	2.17	430.0
8	1.77	425.0
10	1.55	422.5
LSD (0.05)	NS	NS

*OBRA –Oil palm bunch refuse ash; **Significant

Table 6 showed results on Total Yield (kg/ha) and 1000 Grain Weight (g/ha).Only 6t/ha OBRA treatment was significant and it gave the highest yield among OBRA treatments. Similar yield recorded for 6t/ha OBRA is consistent with similar values of leaf N, P, K, Ca and Mg recorded for treatments. Kayode and Agboola (1993) had observed responses of maize to application of OBRA in Southwestern Nigeria. Relative to control only 4t/ha OBRA treatment gave significant difference among the OBRA treatments for 1000 grain yield. The findings of the research showed that 6t/ha OBRA treatment performed better in the establishment of Zea *mays* in Port Harcourt southeastern Nigeria.

CONCLUSION

From the investigation carried out so far the result obtained from all the parameter shows that ash derived from oil palm residue increased soil nutrient content and uptake of nutrient by maize and these effects led to a significant increase in yield and yield components of *Zea mays L.* and soil improvement. Oil palm bunch refuse ash (OBRA) is an effective fertilizer and liming material for increasing soil fertility, pH and nutrient uptake by maize. It improves yield of maize significantly at 6t/ha. OBRA is an effective source of N, P, K, Ca and Mg for maize grown on acidic soil and an effective liming material.

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