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Response of Maize to Soil Amended with Oil Palm Effluent, Fibre and N.P.K Fertilizer

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Abstract
Palm oil mill effluent (POME), the liquid waste from oil palm processing industries was collected and filtered through the soil, the filtered effluent, waste fibre and N.P.K were used to amend soil at the rate of 0, (control), 10Kgha^{-1}, and 20Kgha^{-1}, with the possibility of using them as supplement to inorganic fertilizer. The results of the soil analysis shows a considerable increased in available Nitrogen, Phosphorus, organic carbon and organic matter, potassium and other essential nutrient. Performance characteristics of the maize used as biomonitor shows that there is an increased in stem girth, leaf length and yield per hectare, therefore result of the study shows that POME and oil palm fibre could be used to improve productivity of soil and create alternative waste management in oil palm processing industries.
Keywords: palm oil mill effluent, soil fertility, waste management.

1. Introduction

Maize is considered as one of the most important annual crop across various part of Nigeria. It is grown by many farmers as good sources of carbohydrates, minerals and some amino acids like lysine. In industries it is one of the major raw materials in flour, feed and brewing industries. With the over dependent of man on processed food, the annual demand for maize keep increasing and demand can no longer meet up with supply.

The non-availability of fertile soil arising from increased population, bad agricultural and industrial practices makes farmers to adopt means of enhancing the productivity of the soils. This includes the use of inorganic fertilizers, organic matter addition, and tillage practices. Where available the chemical fertilizers are very expensive and cost do not give corresponding high yield. The effect of fertilizer application to soil and maize yield has been reported by Odedina, (2005) while Mbagwu et al (2006) and Mbah (2006), separately reported the effect of animal waste on yield of maize.

Palm oil mill effluent (POME) is the liquid waste generated from oil palm processing (Agamuthu, 1995). POME contains significant amount of solids both suspended solids and total dissolved solids in the range of 18000mL^{-} and 40,000mgL^{-} (Ma, 2000). It is also rich in Ca, Mg, N, P and K (Habib et al, 1997, Akinyele et al, 2009).

When filtered it has been excellently used to improve soil productivity. Organic matter plays an important role in soil productivity and the solid in raw POME are a good source of organic matter (chan et al, 1980).

The oil palm fiber account for 30% of the solid waste generated from fresh fruit bunches processing (Pleanjai et al, 2004). Moisture content of the fibre is high and it has substantial amount of Nitrogen, Carbon, Phosphorus, Calcium and Iron, Akinyele et al, (2011). Though POME has been used as poultry and cattle feed (Vadireloo, 1987) because it contains large amount of nutrients such as proteins, liquids and amino acids. The need to look for more ways of reducing pollution impact of POME and fiber on the environment cannot be over emphasized

Therefore this work is aim at using POME and fiber as means of increasing the productivity of the soil as an alternative to the expensive inorganic fertilizer and at the end creating an environmentally friendly ways of managing the wastes.

2.0 Materials and Methods

Collection of palm oil mill effluent and fibre.

The palm oil mill effluent was collected from Okitipupa oil palm mill, in Ondo State, Nigeria. The POME was filtered through the soil to remove water; filtered POME was air –dried and sieved to remove stone. It was then preserved in polythene bag prior to use.

The fibre was collected under moist condition from freshly processed oil palm fruit. It was packed in black polythene bag to hasten the decay process.

DESIGN OF EXPERIMENTAL PLOT

The plot of land used was manually cleared, ploughed harrowed and divided into four blocks with each separated by 1m guard row. Each block measuring 3m x 3m and separate plot was used each crop as biomonitor. The soil was amended with the soli filtered effluents, fibre and N P K fertilizer while the unamended plot serve as control .Three application rate (0 10 and 20kgha^{-1}) were carried out on each plot .Treatment were arranged on randomized complete block design and were replicated three times. Top soil at 0-20cm depth were collected

before and after amendment and analyzed for physico-chemical properties. Three maize seeds were planted per hole and this later thin to one after two weeks of planting. Three maize plant were sampled per plot, tagged and their agronomic parameters determined after 60 days of planting. At maturity (90 days) the grains were harvested, dried and yield determined.

3.0 Analysis.

The physic-chemical properties of the soil before and after amendment were determined by standard methods as described in methods of soils analysis (IITA, 1979). The pH was measured in soil-water suspension of 1:10; Total organic carbon was determined by using the dichromate wet oxidation method in Conc. H_2S0_4 followed by measurement of excess dichromate using ferrous ammonium sulphate (Carter, 1993). Total nitrogen in the soil, effluent and fibre were determined using the macro-kjeldahl method. While the phosphorus was determined using the Vanado-molybdate colorimetric method after acid digestion, Na was by flame photometry method while other metals viz : Fe, Mn, Zn , Ca and Mg were determined using Atomic Absorption Spectrophotometry method at their respective metal resonance (Rowel, 1993; Ademoroti, 1996).

4.0 Results and Discussions

The result of the chemical composition of the fibre and palm oil mill effluent is as presented in Table in 1.

Table 1: chemicals composition of the fibre and palm oil mill Effluent

Parameters	Fibre	Pome
% Organic matters	83.30 ± 1.40	5.23±1.00
% oil	5.60 ± 0.01	7.36 ± 1.17
% Ash	16.70 ± 0.10	1401.93 ± 7.17
% Moisture	36.05 ± 0.02	nd*
Na (Mg/Kg)	722.50 ± 2.5	859.40 ± 6.45
K	841.75 ± 0.70	650.08 ± 8.84
Ca	15.25 ± 0.15	186.85 ± 3.08
Mg	62.50 ± 0.39	572.71 ± 2.36
Fe	56.30 ± 1.30	489.10 ± 8.77
Mn	33.10 ± 0.20	32.32 ± 3.61
Zn	28.75 ± 1.00	19.28 ± 2.20
P	33.40 ± 0.20	39.95 ± 2.32
% N	0.14 ± 0.01	1045 ± 0.16

*nd =not detected.

The fibre has high organic matter content and rich in essential micronutrient. The decomposition of the fibre will lead to increase in soil mineralization. The values of K, Na, Mg and P are consistent with earlier report by Batino et al, (1991) who analyzed various crops residue for possibility of using them to alleviate soil fertility.

The characteristics of the POME as presented in Table 1 shows that Na: 859.40mgL^{-}, K, 650.08 ± 8.84mgL^{-}; Mg: 572.71 ± 2.36mgL^{-}, Ca: 186.85 ± 3.08, Fe: 489.10 ± 8.77, Mn: 32.32 ± 3.61; Zn: 19.28 ± 2.20; P: 39.95 ± 2.32 and % N: 1045 ± 0.16. The high value of K, Ca, and Mg in the POME may be attributed to particulate matter that finds their way into it during processing while that of Fe may due to abrasion and wearing of processing unit. Generally the POME is also rich in essential nutrient for enhancing soil fertility. The decomposition of the organic matter in soil will increase soil mineralization, water holding capacity and cation exchange capacity.

Table II shows the chemical properties of the soil before and after amendment with filtered POME, fibre and N.P.K fertilizer.

Table 2: CHEMICAL PROPERTIES OF THE SOIL BEFORE AND AFTER AMENDMENT WITH POME,FIBRE, AND NPK FERTILIZER

Parameter	Control	POME 10kg/h	POME 20kg/h	Fibre 10kg/h	Fibre 20kg/h	NPK 10kg/h	NPK 20kg/h
pH	5.40±0.10	5.71±0.20	5.4 ±1.00	5.68 ±0.00	5.8 ±.01	5.78 ±1.20	5.4 ±1.10
Ca c mol/kg	1.6 ± 0.2	3.20 ±0.20	3.5 ±1.20	2.72 ±0.20	3.95 ±0.1	2.60±0.30	2.84 ±0.10
Mg c mol/kg	0.30± 0.01	1.80±0.01	2.76±0.20	1.73±0.30	2.64±0.30	1.6±0.03	2.36±0.03
K c mol/kg	0.20±0.20	0.24±0.01	0.40±0.03	0.31±0.10	0.42±0.04	0.29±0.15	0.43±0.20
Na c mol/kg	0.13±0.20	0.14±0.03	0.27±0.10	0.18±0.01	0.29±0.01	0.16±0.05	0.24±0.10
P mg/kg	33.53±1.40	35.56±1.44	38.66±0.30	40.05±1.50	42.10±1.20	39.90±1.60	44.06±1.30
Organic C %	1.03±0.10	1.46±0.20	2.20±0.10	1.80±1.20	2.30±0.10	2.24±0.30	3.20±0.25
Organic matter %	1.78±0.02	2.51±0.10	4.62±0.20	3.12±0.20	3.86±0.03	3.86±0.40	4.10±0.10
% N	0.06±0.00	0.14±0.01	0.23±0.10	0.16±0.01	0.26±0.10	10.34±0.06	0.46±0.30

The result shows that the soil is slightly acidic and there was slight increase in pH in the amended soil. It increases from 5.40 to 5.71 in POME amended soil and 5.78 in N.P.K treated soil. There was increased in the mineral composition of the soil as. Generally the 20Kgh^{-1} treated soil gave the highest nutrient performance. There was increased in metal concentration when values obtained were compared to their respective critical values of K, 0.20, Mg: 0.40; Ca: 2.00 in cmol/Kg (Kparwang, 2004).

Results of the agronomic parameters is as shown in Table 3

Table 3: Result of Agronomic Parameters

Treatment	RATE/ha	Plant height (cm)	Leaf length (cm)	Stem girth (cm)	Yield at maturity (t/ha)
CONTROL	0kg	50.50 ±0.20	70.00 ±1,30	5.00 ±0.20	2.04 ±0.40
POME	10kg	60.52 ±0.40	75.00 ±0.56	5.30 ±1.00	2.84 ±1.30
	20kg	77.00 ±1.20	80.10 ±0.34	6.10 ±0.01	3.02 ±0.10
FIBRE	10kg	55.40 ±0.50	71.36 ±1.40	5.10 ±0.00	2.00 ±0.30
	20kg	58.72 ±1.00	74.50 ±0.30	5.92 ±0.01	2.85 ±0.56
NPK	10kg	63.55 ±1.40	76.25 ±1.10	5.11 ±0.02	2.91 ±0.30
	20kg	70.20 ±1.22	81.20 ±1.00	6.36 ±0.13	3.26 ±0.20

There was significant improvement in the maize plant height and leaf length. Percentage increase in plant height was 72% while leaf length was 14.43%. The high increase recorded was attributed to the release of nutrient to the soil by POME during decomposition. (Anike, 2000).

The performances of the POME and fibre compares favorably with the N.P.K amended soil.

Grains yield increase by 50.20% in the POME treated soil, 59.80% in N.P.K while it was 39.71% in fibre treated soil. This implies that palm oil mill effluent and fibre can be used as supplement for inorganic fertilizer in soil. The result obtained from the study compares favorably with earlier report by Mbah,(2006) who used animal and organic waste for amending soil nutrient and Babalola et al, (2006) that used phosphate rock as alternative to fertilizers.

5.0 Conclusion

The result of the study revealed that POME can be used to ameliorate the chemical properties of soil. While taking the advantages of the nutrient inherent in the waste, the use of the waste in productive agricultural practices will create an avenue for an environmentally friendly ways of managing the huge waste arising from oil palm processing.

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