

Agro –industrial Effluents And Agricultural Wastes Effects On Soil Chemical Properties And Yield Of Okro (*Abelmosclus esculentus l. Moench*)

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ABSTRACT
The effects of agro-industrial wastes and poultry manure on soil organic matter pH and total N and on the yield of okra was carried out in the green house of Michael Okpara University of Agriculture Umudike (MOUAU). The agro-industrial wastes (palm oil mill effluents, cassava mill effluents, and sawdust) were applied at five levels of concentration (0,100, 200, 300 and 400 grammes per 10kg soil) and replicated three times. Soils were incubated after waste application for two weeks and then sown to Okro seeds. Soil chemical properties were analyzed six weeks after planting and results subjected to analysis of variance using a 4 x 5 factorial in completely randomized design. Significant treatment means were separated using FLSD 0.05. Organic matter, soil pH and total nitrogen increased in soils treated with poultry manure. But saw dust and cassava mill and palm oil mill effluent had no effect on total nitrogen. The industrial effluents had little effects on yield of okra, however, the use of poultry manure as an agricultural amendment, gave better boost in the yield of the okro plant than the effluents from the industrial waste.

Keywords: agro-industrial effluents, soil acidity, organic matter, okro yield, sawdust

1. Introduction

The accumulation of agricultural or organic waste produce increases in the organic carbon content of the soil, they exert positive influences on soil nitrogen which is an important source of nitrogen supply for crop production and could have a long term effect on the soil nitrogen (Anikwe and Nwobodo, 2002,; Eneje and Ukwuoma, 2005), animal maures e.g poultry dropping influence the level of soil ammonium nitrogen (NH^+_4-N) and nitrate nitrogen (NO^-_3-N) which is the form of nitrogen that is absorbed by plants through their roots (Ano and Agwu 2006). Oguike and Mbagwu (2001) reported of increase in soil PH due to organic soil amendment application representing decrease in soil acidity. Other reports (Ano and Agwu, 2005), indicate that exchangeable acidity of the soil decreased from 3.00 cmol/kg to values less than 0.50cmol/kg by the rate of manure application. Similarly, the accumulation of organic waste produced in industrial premises causes increase in the organic carbon content of the soil especially those of plant origin such as sawdust (Eneje and Ukwuoma, 2005). Cowell (1971) stipulated that organic amendments or industrial waste like sawdust have very complex effects on soil such as improving the air: water ratio, increasing the exchange capacity of the soil, detoxifying some heavy metals, releasing chemical compounds that stimulate root growth and the growth of soil micro and macro organisms. Mbah and Mbagwu (2006), also reported that the application of waste significantly increased the cation exchange capacity (CEC) indicating greater nutrient retention capacity of the soil. However, some organic industrial effluents like the palm oil effluent application to soil may result in some beneficial chemical properties like increase in organic matter, organic carbon, major nutrient such as nitrogen and phosphorus, it brings about undesirable changes such as decrease in pH, and increase in salinity (Kittikun and Krause, 2000). Thus the effects of these effluents upon the receiving soil may range from behaving as a clean water input to that causing serious sodicity/salinity problem in the soil or clogging the soil micro pores with solids. There is therefore the need to monitor the effects of these wastes on the chemical status of the soil and plant growth as the level of influence will vary depending on the inherent characteristics of the soil and content of effluent.

Okra thrives well in a wide range of soil types, however, well-drained, fertile soils with adequate content of organic manure reserves for the major elements, generally prove suitable (Anon, 1990). The crop is slightly tolerant to acid condition and can be grown in soils with pH between 6.0 and 6.8 (Raymond, 1985). The growth inhibitions of different vegetables like okra, tomatoes etc. after POME and CME application to soil have been observed (Radziah, 2001). Since the cost of fertilizer is high for small scale farmers research attention has been shifted to the use of agricultural waste for supplying nutrients to okra, tomatoes and other crops. Although POME is a pollutant as far as the palm oil industry is concerned, it has enormous potentials for animal feed improvement and soil amendment (Binder et al., 2002).Therefore the objective of this study is to assess the effect of agro- industrial and agricultural wastes on the germination percent and yield of okra (Abelmosclus esculentum), to relate these effects to changes in soil pH and electrical conductivity of study soil

2. MATERIALS AND METHODS

2.1 STUDY AREA

The experiment was conducted at the green house of Michael Okpara University of Agriculture Umudike, located at a latitude of $05^0 29^0$N and longitude $07^0 33^0$E in the rainforest area of South east Nigeria. This area is characterized by mean annual rainfall range of 1512-2731mm, temperature range of 32^0C and 23^0C for maximum and minimum temperature respectively and relative humidity of 63-80%. Umudike lies about 122m above sea levels (NRCRI, Umudike 2005).

2.2 SOIL SAMPLE COLLECTION

Soil samples were collected from the Western farm Michael Okpara University of Agriculture Umudike, at dept of 0-15cm using a spade. The samples were a air dried and sieved through a 2mm mesh sieve. Ten kilogram of the soil sample were weighed into plastic bucket with a height of 22cm and a diameter of 23.5cm, a total of 60 plastic buckets were used. A composite of three replicates was bulked and used for characterization of the soil before treatment application.

2.3 Agro-industrial and agricultural wastes used for the study

The agro- industrial effluents used were cassava mill effluent (CME), palm oil mill effluents (POME) well as sawdust (SD). Sawdust was collected from timber shade Umuahia while the effluents (POME and CME) were collected from the processing centre in the locality. The agricultural wastes was poultry manure collected from Michael Okpara University of Agriculture Umudike (MOUAU) poultry farm.

2.3.1 APPLICATION OF THE WASTE

The agro-industrial effluents and agriculture wastes were applied to the 10kg soil and five rate/levels namely: 0g, 100g, 200g, 300g and 400g respectively. Each treatment was replicated three times. The wastes were thoroughly mixed with the 10kg soil in the plastic buckets and moistened to field capacity.

2.4 PLANTING MATERIAL

Okra seeds of variety Oboro dwarf were sourced from National Root Crop Research Institute, Umudike. (NRCRI). Five (5) seeds were sown per bucket and the seedlings were thinned down to three (3) per bucket. The seeds were sown two weeks after application of treatment to allow for mineralization. The buckets and its contents were monitored for a total of six weeks before samples were collected for chemical analysis in the laboratory.

2.5 LABORATORY ANALYSIS

Soil samples were analyzed in the laboratory after harvesting of crops (six WAP) for the following chemical properties; the pH was measured electronically with a glass electrode pH meter in KCL using a soil, liquid suspension ratio of 1:2.5 as modified by Jones (2001). The organic carbon was determined using dichromate wet oxidation method (Walkley and Black, 1934). The value for organic matter was obtained by multiplying the organic carbon values by 1.724 (Van Bemmelen factor) based on the fact that soil contains 58% carbon.

2.6 PLANT DATA COLLECTION

Two plants were selected from each bucket and tagged for observations (plant height, number of leaves and stem girth) plant heights were measured as the height from the soil level to the tip of the highest leaf. These were done on two weeks interval for six weeks. Two plants each were harvested from each plastic bucket six weeks after planting (6 WAP) for the estimation of the total dry matter weight. The plants were oven dried at a temperature of about 65^0C and weighted to obtain the dry matter weight, after taking note of the fresh weight using a weighing balance. Percent dry matter weight is calculated thus:

$$\%\ \text{dry matter} = \frac{(Y_3 - Y_1)}{(Y_2 - Y_1)} \times \frac{100}{1}$$

Where; $(Y_3 - Y_1)$ is the weight of dry sample
$(Y_2 - Y_1)$ is the weight wet sample.

Note: Weight of container is = Y_1
Weight of container + sample = Y_2
Weight of container + sample after drying = Y_3

2.7 STATISTICAL ANALYSIS

All the data collected were subjected to analysis of variance (ANOVA) using CRD, as outlined by Murray (1992) while the means were separated using the fisher's least significant difference (LSD) at 5% probability level.

3.0 RESULT AND DISCUSSION

The chemical compositions of the effluents and wastes used shown in Table 1 clearly show that sawdust had the highest organic carbon and organic matter content followed by poultry manure, cassava mill effluent and palm oil mill effluent in that sequence. However, soil reactivity measured by the pH of the soil extracts show that, poultry manure had a value of 5.01 closely followed by sawdust (pH= 5.87). Thus the application of poultry manure slightly increased pH value of the soil, this increase in soil pH value was associated with increases in exchangeable acidity which could be attributed to the removal of Al^{3+} from the soil exchange site by organic matter decomposition. This observation supports the reports Eneje and Ukwuoma (2005), that improvement in soil organic matter is associated with increases in soil activity and exchangeable activity.

Table 2, shows the growth parameters of okra at two weeks and four weeks respectively with the different applications. It was obvious that the growth parameters assessed under the application of poultry manure increased tremendously compared to other treatments, this could be as a result of high nitrogen content of poultry manure which is reported to increase vegetative growth of plants. The number of leaves per plant increased with poultry manure application but was slightly reduced for palm oil mill and cassava mill effluent application. Sawdust had relatively low effect on growth parameters at two WAP and four WAP, this is attributable to little or no effect on chemical properties of the soil due to low surface area as well as low degradability due to high carbon and low nitrogen content, it is possible that nitrogen immobilization result in depressed plant growth. The growth inhibitions of plants in terms of plant height after POME and CME to soil have been observed by Radziah, (2001). In this study the mean value for plant height (88.70 cm) was observed at six WAP and it is the highest value of plant height (Table 3) compared to the other applications. Also highest value for fresh and dry matter weight were 280g and 137g respectively which was obtained for poultry manure application. This could be explained by the observation of Barth, (1985), that poultry manure, (especially the fresh ones) contains twice as much nitrogen as other organic wastes, also the addition of poultry manure to the soil on decomposition releases essential nutrients which are readily available for plants (Mbah and Mbagwu, 2006) when compared to the nutrient released from the agro-industrial effluents.

4. CONCLUSION

The agricultural waste (poultry manure) used in this study, significantly affected soil properties and its effects were also clearly observed on yield of okra, when compared to the industrial wastes such as saw dust, which had higher organic matter (degradable and non-degradable organic matter). Generally, the industrial effluents had little effects on yield of okra, and this study suggests that the use of poultry manure as an agricultural amendment on soils, gave better soil fertility boost than the effluents from the industrial waste.

References

Anikwe, M.A.N Nwobodo K.C.A (2002), "Long term effect of Municipal waste disposal on Soil Properties and Productivity of Sites used for Urban Agriculture in Abakaliki, Nigeria" Biores technol 83: 241-250.

Ano, A.O and Agwu J.A (2006), "Effect of Animal manures on Selected Soils, properties (II) Nitrogen Potassium and Phosphorus". Nigeria Journal of Soil Science. Vol. 16.

Anon, A.O. (1990), " A review of soil and fertilizer use research in Nigeria. Literature review on soil fertility investigation in Nigeria". Porbama Lagos. Pp. 251.

Barth, C.L. (1985), " Livestock characterization A new approach in agricultural waste utilization and management" Trans ASAE 4 (2), 286-291.

Cowell, R. (1971), "Tropical Tomato Symposium" Sweden AVRDS 1: 72.

Eneje, R. C. and Ukwuoma V. E. (2005), " Plant and Animal organic Manure, effects on Vegetable and orchard farm Soils (Part 1) Effect on Soil Chemcial properties". Journal of Agriculture", Agricultural technology and Environment. Vol 1. No 1.

Jones, Benton Jr. (2001)," Laboratory Guide for conducting soil tests and plant analysis", C.R.C Press, New York, Washington D.C.

Kittikun, A. H. Prasertsan, P. Srisuwan, G. Krause, A. (2000), "Environmental Management for palm oil mill material flow analysis of integrated Biosystems" p.11. retrieved May 23. from http://ias.unu.edu/proceedings/icmfa/kittikun/paper.html

Mbah, C.N. and Mbagwu J.S.C. (2006), " Effect of Animal Waste in Physico-chemical properties of a Dystric Leptosol and maize yield in South-eastern Nigeria". Nigerian Journal of Soil Science.

NRCRI Umudike (2005) National Root Crop Research Institute, Umudike Bulletir;

Oguike, P. C. Mbagwu J. S. C. (2001), "Effect of water Hyacinth Residues on Chemical properties and Productivity of Tropical Soils". Agro-Science. 2:44-51.

Radziah, O. (2001), "Alleviation of Phytotoxicity of Raw POME by microorganism" retrieved Sept. 2005, from www.agri.upm.edu.my/agrosearch/ v3n2/irpa3.htm.

Raymond, P. A. (1985), "Cytodifferentiation of photoreceptors in larval goldfish Delayed maturation of rods". J. Comp. Neurol. *236*:90–105.

Walkley, A. and Black, T. A. (1934), "An examination of the degt jare method for determining Soil organic matter and proposed modification of the chronic acid and titration method". Soil Science 37:39-38.

Table 1: Chemical composition of the agro- industrial and agricultural wastes.

Properties and compositions	P.M	S.D	CME	POME
Organic carbon (%)	1.443	47.417	0.216	0.12
Organic matter (%)	2.488	81.746	0.372	0.21
Total nitrogen (%)	0.126	0.290	0.039	0.05
PH (H_20)	5.01	5.87	3.60	4.66

TABLE 2: Effect of applications on mean growth parameters at two and four WAP

Treatments	Plant height (cm)	Number of leaves per plant	Stem girth (cm)
	Two WAP		
C	6.25	3.5	0.55
P.M	6.80	4.0	0.85
S.D	6.10	3.5	0.50
CME	5.80	3.5	0.45
POME	5.45	3.0	0.45
	Four WAP		
C	25.45	11.0	0.935
P.M	27.45	16.5	1.060
S.D	22.80	9.5	0.855
CME	23.10	9.0	0.905
POME	20.95	8.5	0.750

Keys: C= control, PM = poultry manure, SD = sawdust, CME = cassava mill effluent, POME= palm oil mill effluent, WAP = weeks after planting.

Table 3: Effects of applications on mean growth and yield parameters at six WAP

Treatments	Plant height (cm)	Number of leaves per plant	Stem girth (cm)	Fresh weight (g)	Dry weight(g)	Dry matter weight (%)
C	79.25	20.0	1.200	215	117.5	54.7
P.M	88.70	25.5	2.525	280	137.5	49.1
S.D	76.85	19.0	1.160	195	102.5	52.6
CME	78.00	20.0	1.210	205	12.5	54.9
POME	71.60	17.5	1.190	185	100.0	54.1

Keys: C= control, PM = poultry manure, SD = sawdust, CME = cassava mill effluent, POME= palm oil mill effluent, WAP = weeks after planting.