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EFFECT OF INDUSTRIAL MANUFACTURED ORGANIC AND ORGANOMINERAL FERTILIZERS ON SOIL pH, MAJOR NUTRIENTS AND THEIR INTERACTIONS

Abstract

Incubation study was carried out to determine the effect of organic fertilizer (OG) and organomineral fertilizer (OMF) on soil major nutrients in Ondo, South Western Nigeria. Organic and organomineral fertilizers were separately applied to 100g soil at the rate of 0.25 and 0.5g. The treatments were arranged on completely randomized design with six replications in the laboratory and incubated for 90 days. Compared with control, OG applied at 0.25 and 0.5g/100g soil increased soil pH by 5 and 8% respectively, all the treatments significantly increased OC, between 12 and 23%, total N between 39 and 108%, available P (35-84%) and exchangeable K (5-17%). Application of 0.25g OG, 0.5g OG and 0.25g OMF increased exchangeable Ca by 6, 30, and 0.02% respectively while Mg was increased by 52, 17 and 9.1% respectively. Application of 0.25g and 0.5g OMF increased EA by 17 and 33% respectively. Application of OG and OMF increased soil major nutrients beyond the critical level recommended for optimum crop production in south western Nigeria.

INTRODUCTION

Increase in human population leads to reduction in available agricultural land as a result of different purposes to which lands are used such as road construction, buildings of different kinds etc. There is extinction of shifting cultivation that naturally enhances soil fertility without the addition of fertilizers. The inherent low soil fertility as a result of nutrient depletion through mining calls for addition of external inputs that can increase plant nutrients. The two types of fertilizers that improve soil nutrients are mineral fertilizers and organic fertilizers. There are different kinds of organic fertilizers with different nutrient constituents. In Nigeria, farmers apply organic fertilizers indiscriminately because there is no formulation that shows the amount of plant nutrients present in a particular fertilizer type. Indiscriminate fertilizer application may cause nutrient imbalance that can lead to nutrient

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antagonism. In order for crops to produce optimum yield, there is need to add nutrients to the soil in proper amount and in proper balance. In order to apply organic fertilizers in proper balance, some organic fertilizer companies in Nigeria have embarked on manufacturing organic fertilizers. Among the organic fertilizers manufactured by industries include sunshine organic fertilizer and sunshine organomineral fertilizer by Ondo State Government "Waste to Wealth programme". Also, in Oyo State there are pacesetter organic fertilizers and pase setter organomineral fertilizers. Manufactured organic fertilizer companies collect the organic waste materials from the city wastes to manufacture organic fertilizers. Organomineral fertilizer is a combination of organic wastes with small quantity of mineral fertilizers. Though, the nutrient constituents of the manufactured organic and organominral fertilizers by these organic fertilizer companies are written on the label, there has not known any research that integrates organic and organmineral fertilizers with soil constituents to determine the rate of their nutrients mineralization. Hence, the objective of the study was to determine the rate of mineralization of plant nutrients from sunshine organic fertilizer and sunshine organomeniral fertilizers.

Key words: pH, Nitrogen, Phosphorus, Potassium and Calcium

Materials and method

A laboratory incubation study was conducted at the Department of Agricultural Science of Adeyemi College of Education to determine the rate of nutrient release from manufactured organic fertilizer and organomineral fertilizer. The soil samples used were collected from a farmer's farm at Okegun about 20 km from Ondo Town in Southwestern Nigeria.

Twenty (20) core soil samples were collected with auger, bulked, air-dried and passed through 2mm mesh. The soil sample was weighed 100g each into thirty (30) plastic cups of 250g.

Organic and organomineral fertilizers were separately added to the cups at 0.0.25 and 0.5mg/100g soil to represent 0.5 and 10t/ha on the field. The treatments were arranged on completely randomized design with replications. Twenty (20ml) of water was added to each treated soil sample at two weeks interval. Foam was placed on each plastic cup to avoid drying up. The treated soil samples were incubated for 90 days. At 90 days of incubation, the

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treated soil samples were air dried and analyzed for pH, total, N, available P, exchangeable Ca and Mg.

Soil pH was determined in 1:2 soil-water and read with pH water. Organic matter was determined by Walkely and dichromate oxidation method, total N by steam distillation method, available P by Bray -1- method and exchangeable Ca and Mg were extracted with ammonium acetate and determined by atomic absorption spectropHotometer from the filtrate.

Data Analysis

Data collected were subjected to analysis of variance using Statistical Analytical System Institute Package (SAS, 2000) and means were separated with the use of Duncan Multiple range Test (DMRT).

Result and Discussion

Table 1 presents the initial soil properties before the conduct of the experiment. The soil pH was slightly acidic, low in OM, N and available P, adequate in Ca and Mg. The exchanged acidity was adequate for crop production as recommended by Sobulo and Osiname (1987) in south west Nigeria. The textural class of the soil shows 80.90% sand, 8.0% silt and 11.13 clay hence, the soil is sandy loam. The organic fertilizer according to the manufactures label comprised 3.5, 1.0 and 1.2% for N, P and K respectively while organomineral fertilizer comprised 3.5, 2.5 and 2% for N, P and K respectively meaning that organomineral fertilizer was expected to add more P and K to the soil than organic fertilizers because of its higher N and K values.

Table 1: Initial Soil Properties

Soil properties	Values
pH	6.68
OM %	1.13
Total N%	0.12
Available P (mg/kg)	6.69
Exchangeable K^+	0.14
Ca^{2+}	0.14
Mg^{2+}	2.72
Exchange acidity	0.16

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Application of 0.02g OG had the highest increase in OC (Table 2) followed by 0.025g OMF. It was observed that 0.025g OG and 0.25g OMF recorded higher N percentage when compared with 0.5g OG and 0.5g OMF. Application of 0.25 and 0.5g OMF recorded higher percentage increase in available P. Cations observed in the experiment did not follow a definite pattern. Exchangeable K recorded the highest percentage increase with the application of 0.5g OG followed by 0.25g OG, 0.5g OG recorded the highest increase in exchangeable Ca followed by 0.25g OG while 0.25g OG recorded the highest percentage of exchangeable Mg followed by 0.5g OG. Application of 0.5g OMF recorded the highest increase in exchange acidity followed by 0.25g OMF. The exchange acidity was significantly reduced by the application of OG at all rates.

Generally, the pH of all the soil samples were still favorable to the release of soil nutrients especially N, P and K. Researchers have shown that N is abundance in soil within pH range 5.6 - 9 and P between 6 - 8. Averagely the productive soil is expected to have pH range 5.5 - 8.5 (Sobulo and Osiname, 1987). This experiment showed that soil pH correlates with Cations and EA. This observation is buttressed by the fact that 0.5g OG that recorded the highest soil pH, also recorded highest K, Ca and Mg and least EA. The rate of nutrient mineralisation of organic and organomineral fertilizers at 90 days of incubation is presented in table 2. Compared with control, applications of organic and organomineral fertilizers as 0.25 and 0.5g/100g soil significantly increased (P>0.5) soil pH (except 0.25 and 0.5g OMF), OC, total N (except 0.25g OG), available P, exchangeable K, Ca (except 0.5g OMF) and Mg (except 0.5g OMF). Application of 0.25 and 0.5g OMF significantly increased (P>0.05) exchange acidity of the soil. The increase in soil pH with the application of 0.25g and 0.5g OG by 4.64 and 7.93% respectively shows that the organic fertilizer used had liming effect. Whalen et al. (2000) noted that application of organic manures reduce soil acidity since they have liming effect. Calcium is known to reduce soil acidity.

The slight reduction in soil pH by 0.3 and 2.4% at 0.25 and 0.05g OMF respectively showed that OMF has acidifying effect on soil. This might be as a result of the minerasation fertilizers blended with the organic wastes. Researches by Ayeni et al. (2015) showed that mineral fertilizers have acidifying effect on soil because many of them are manufactured from acidic materials.

Table 2: Rate of Mineration of Soil Major Nutrients Followed By Organic and Organomineral Fertilizers

Treatment	pH	OC%	N%	P	K	Ca	Mg	EA
				mg/kg	cmo/kg			

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Control	6.68ab	1.6b	0.13b	6.61b	1.13b	6.89b	2.75b	0.12ab
0.25g OG	6.99A	1.9a	0.24b	8.90a	1.29a	7.32a	2.90a	0.10b
0.5g OG	7.21a	1.79a	0.18a	10.21a	1.32a	8.93a	3.21a	0.07b
0.25g OMF	6.66b	1.97a	0.27a	11.140a	1.19b	6.99ab	3.00a	0.14a
0.5g OMF	6.52b	1.88a	0.21a	12.18a	1.27a	6.78b	2.64b	0.16a

Means with the same letter are not significantly different at 5% using DMRT

Table 3: Percentage increase in the Rate of Mineralization of Soil Major Nutrients by Organic and Organomineral Fertilizers

Treatment	pH	OC%	N%	P	K	Ca	Mg	EA
Control	–	–	–	–	–	–	–	–
0.25g OG	4.64	19	85	35	14	6	52	**-17**
0.5g OG	7.93	12	39	55	17	30	17	**-42**
0.25g OMF	-0.30	23	108	69	5.3	0.02	9.1	**17**
0.5g OMF	2.40	18	62	84	12	-2.0	-4	**33**

Table 4: Soil Nutrient Interaction as Affected by Organic and Organomineral Fertilizers

Treatment	C/N	K/Ca	Ca/Mg	K/Mg
Control	12.3	6.7	2.5	2.4
0.25g OG	7.9	5.6	2.5	2.3
0.5g OG	9.9	6.8	2.8	2.4
0.25g OMF	7.3	5.9	2.3	2.5
0.5g OMF	9.0	5.3	2.6	2.1

It was observed that 0.25mg of both soil samples fertilized with OG and OMF released more OC and total N to the soil compared with 0.5mg of both soil samples fertilized with OG and OMF. This might be as a result of the bulkiness of 0.5mg which might led to N immobilization due to the activities of bacteria acting on the decomposition of organic matter leading to the mineralization of N. The same trend of mineralization followed by OC and N in this experiment butressed the assertion that there is strong relationship between OC and

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total N. Also, application of 0.25mg of both OG and OMF might just be sufficient for the optimum release of N. Judging from the nutrient composition of OMF and OG, since the percentage composition of N in the formulations was higher than P and K, differences in the rate at which N, P and K mineralized was expected. It was also observed that OMF applied at 0.25 and 0.5mg/100g soil recorded highest soil available P. This might be as a result of the mineral fertilizers combined with the agrowastes that enhanced quick mineralization of P. The low EA observed in all the treatments might have caused the availability of N, P, K, Ca and Mg. This is in line with the assertion of Ayeni et al. (2015) that increasing the soil pH improves availability of macronutrients while reducing the solubility of Al^{3+}.

It was also observed that the C/N ratio of the soil samples treated with OG and OMF were slightly lower than the control (Table 4). The low C/N ratio might have also caused early mineralization of the nutrients. Ogunlade *et al* (2011) observed that C/N ratio less than 20 would lead to N mineralization likewise Ca: Mg less than 20 and Ca: K less than 13 would equally enhance early release of Ca, Mg and K since there would not be a problem of nutrient antagonism. This research shows that addition of organic and organomineral fertilizers could increase soil major nutrients to the level that optimum crop production could be achieved. Kwabiah *et al* (2003) asserted that the problem of nutrients deficiency especially P could be corrected through the addition of organic fertilizers to the soil. This assertion was also supported by Haynes and Mokolobate (2001). Moyinjesu (2007) also supported that agrowastes increase soil nutrients.

Conclusion

A laboratory incubation study was conducted in Ondo South West Nigeria to determine the rate at which manufactured organic and organominaral fertilizers released N, P, K, Ca and Mg to the soil. Soil pH affected the release of OC, N, P, K, Ca, Mg and E.A. Organic and organominearal fertilizes released the nutrients to the soil at different rates. Application of 0.25g of organic and organomineral fertilizers to 100g of soil equivalent to 5 t/ha is sufficient to increase soil nutrients to the level that would cause optimum crop production.

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