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Impact of the Different Soil Amendment Materials on the Performance of Tomatoes (Lycopersicum Esculentum) in Delta South Ecoloigical Zone, Nigeria

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Abstract:
This research work evaluated the effect of three different soil amendment materials on the performance of tomatos (Lycopersicum esculentum) in Delta south ecological zone, Nigeria. The research was carried out in Delta State Polytechnic research farm Ozoro in two growing seasons between April 2014 and April 2015. The study was a potted experiment with four treatments: palm oil mill effluent (POME) poultry manure (PM) compound fertilizer (N.P.K 15:15:15) and control, replicated five times in a randomized complete block design (RCBD). Tomatos seedling of 10cm height were transplanted into each pot of different treatments. Performance parameters collected at monthly interval for three months were plant height (cm), branch numbers, numbers of fruit and fruit weight (g). Data collected were subjected to analysis of variance (ANOVA). The result obtained revealed that tomatos grown on soil amended wit poultry manure (PM) and palm oil mill effluent (POME) significantly performed better in height (cm), numbers of branches, numbers of fruits and weight (g) of fruits compared with other treatments. Therefore, tomatos are recommended to be cultivated in soil amended with poultry manure or palm oil mill effluent in Delta south ecological zone, Nigeria.

Keywords: *Amendment, parameters, treatment, variance.*

1. Introduction

Tomato (Lycopersicum esculentum) is nutritious and contains a significant amount of vitamin C and polate. Tomato is an important source of red pigment called lycopene which has antioxidant properties and may be anti carcinogenic. Higher plasma lycopene levels are associated with reduced incidence of some cancer. The national and international dietary guidelines recommended increased consumption of tomatoes to reduce the incidence of cancer in human being (Berry Ottaway, 2001). The significant importance of tomatoes calls for increase in demand and production of tomatoes. Increasing the production of tomatoes many a time demand for more land use. Land for agriculture purposes is faced with some challenges: it is fixed by nature (it cannot be increased quantitatively), most valuable portions of land had been lost to urbanization and degradation (Cooke, et al., 2013).

Globally, it is estimated that over the years as much as two billion hectares of land have been rendered unproductive through land degradation (UNEP, 2010). In Nigeria, it has been reported that over 35 million tones of soil are lost annually to land degradation and this has caused great decline in agricultural yield (Dike, 2005) and food sustainability.

Increasing land qualitatively and restoring degraded land has been one of the major challenges to soil scientist, environmentalist and agriculturalist. However, depending on natural replenishment of lost nutrients is no longer reliable because of increased pressure on land resulting from population explosion and hence the use of different soil amendment materials become necessary (Ogboi and Odeh 2012).

Over the year, different types of soil amendment materials have been used to supplement natural replenishment of lost nutrients. These amendment materials ranged from organic to inorganic materials and have contributed positively to nutrient replenishment. (Agbim, 2000; Mbagwu 2007, Ogboi and Izeke, 2010)

Soil amendment material is any material added to a soil to improve its properties such as water retention, water infiltration, permeability, aeration, structure, nutrient retention and exchange. The main goal of soil amendment is to provide better environment for crops roots (Agbim 2000). Soil amendment materials can be organic or inorganic. The organic amendment materials come from something that was alive. Inorganic amendment materials are either mine or man-made (Duruigbo 2008). Organic amendment materials include farm yard manure (Poultry Manure), compost manure, wood chips, grass chips, palm oil mill effluent, and while the inorganic amendment materials include vermiculites, fertilizers, (N.P.K) gravels, sand, perlite. These materials when added to the soil, increase soil organic matter content and other many benefits over a time (Mbagwu, 2007). They improve the water and nutrient

holding capacity of loose coarse textured sandy soil and in fine textured clay soil, organic amendment materials help to glue tiny clay particles into larger chunks or aggregates thus creating large pore space (Garden, 2001)

In Nigeria, different soil amendment materials ranging from agricultural waste to industrially processed materials are been used. Available literatures on the effectiveness of different soil amendment materials on crop yield/performance such as pepper, okra, pumpkin and maize exist (Anikwe 2001; Mbagwu 2007; Opara, 2007, Ogboi and Izeke, 2010). However, recommendation to extend the research works to other crops like tomatos, egg plant abound. Hence, the need to evaluate the impact of different soil amendment materials on the performance of tomatos (Lycopersicum esculentum) in Delta south ecological zone formed the basis of this study. Therefore, the objectives of this research work are to evaluate the impact of three different soil amendment materials (poultry manure (P.M)), palm oil mill effluent (POME) and compound fertilizer (N.P.K 15:15:15) on the performance of tomatos in Delta South ecological zone, Nigeria and identity the most suitable soil amendment materials for the cultivation of tomatos in the study area and make recommendation based on the findings.

2. Materials and Methods

The experiment was conducted in Delta State Polytechnic research farm, Ozoro between April 2014 and April 2015. Ozoro is located within the rain forest zone of south central, Nigeria between Latitudes $5^0 30''$ and $5^0 45''$ North of the Equator and Longitude $6^0 5''$ East of the Greenwich meridian. The temperature and relative humidity are 28^0C and 85% respectively and its altitudinal position is below 50 meters above the sea level (Meteorological Station, 2013). Then soil of the study area is moderately drained acidic loamy sandy soil (Ogboi and Emakpor, 2006)

The experiment/research work was a potted experiment and polythene bags of 45cmx45cm dimension were used. The amendment materials/treatments used were Palm oil mill effluent (POME), Poultry manure (PM), compound fertilizer (NPK 15:15:15) and the control. These treatments were replicated five times in a randomized complete block design (RCBD). The amendment organic materials (PM or POME) were mixed with soil in the ratio of 1:3 (Organic materials: soil) while the NPK was 20g per polythene bag.

The seedlings of *Lycopersicum esculentum* were raised in a nursery for three weeks and thereafter one tomato seedling of 10cm height was transplanted into each polythene bag of different treatments.

The performance parameters observed were: Plant height (cm), number of branches, number of fruits and weight of fruits. These parameters were taken at monthly interval for three months after transplanting. All the data collected were subjected to statistical analysis using Analysis of Variance (ANOVA).

Results in table (1) and table (2) result are the properties of soil of the study area as well as the poultry manure (PM) and Palm oil mill influent (POME) respectively.

Table (3) shows the performance of tomatoes grown in different soils amended with different soil amendment materials between one and three months after transplanting. It reveals that at first month, the average heights (cm) of tomatoes ranged from 20.3 to 21.5cm with the highest height (21.5cm) obtained from NPK 15:15:15 treatment and the least height (20.3cm) was obtained from the control. However, no significant different ($p>20.05$) in height exist between POME, PM and NPK. The highest height obtained from NPK treatment at first month may be attributed to the quick release of nutrients in the fertilizer to the tomato plant. This result is in line with Mbagwu (2007) who observed higher growth of pepper seedlings treated with fertilizer within the first month of application. Agbim (2000) states that mineral elements are quickly released in inorganic manure than organic manure.

The average branch numbers within the first month ranged from 2.6 to 6.5 highest average branch numbers (6.5) was obtained from PM treatment followed by NPK treatment (4.3), POME (3.2) and the least (2.6) was obtained from control treatment. Significant difference ($p<0.05$) in branch number exist between PM, POME and control obtained in PM treatment may be attributed to increased nourishment of the tomato plant by poultry manure. Humic acid contain in organic manure may have contributed to increase metabolic activities in tomatoes plant which manifested in the increased number of branches recorded. This observation was in line with Hilitizer (2010) who observed rapid early branches of eggplant treated with poultry manure. However, data on average fruit number and fruit weight were not obtained within the first month of the research from all the treatments.

At the second month after transplanting, the average plant height (cm) ranged from 33.3 to 53.6. The highest average height (53.6cm) was obtained from PM treatment, followed by POME (50.6cm), NPK (45.8cm) and the least 33.3cm was obtained from control treatment. Significant differences in tomato height exist between PM, NPK and control. The average branch numbers within the second month ranged from 4.60 to 8.90. The highest average branch number (8.90) was obtained in PM treatment, followed by POME (8.40), NPK (7.10) and the least (4.60) was obtained from control treatment. Significant differences equally exist between PM, NPK and control. Average fruit numbers of tomatoes plant ranged between 10.5 and 18.3. The highest number (18.3) was obtained in PM treatment, followed by POME (17.4), NPK (16.2) and the least (10.5) was obtained in the control. More so, the average weight (g) of fruits ranged between 86.3g and 62.4g. The height, weight (g) of fruits (86.3g) was obtained in PM, followed by POME (82.1g), NPK (73.2g) and the least (62.4g) was obtained in the control treatment. More-so, significant differences ($p<0.05$) exists between PM, NPK and control.

At the third month after transplanting, the average plant heights (cm) ranged from 36.1cm to 56.3cm. The highest height (56.3cm) was obtained in PM treatment, followed by POME (56.1cm), NPK (47.2cm) and the least (36.1cm) was obtained in the control. Significant difference equally existed between PM, NPK and control. In addition, the average branch number ranged from 4.6 to 8.7. The highest branch number (8.9) was obtained in PM, followed by NPK (8.7), POME (8.6) and the least (4.6) was obtained in control. Significant difference ($P \leq 0.005$) existed between PM and control. More so, the average fruit numbers ranged from 13 to 24. The highest average fruit number was obtained in PM, followed by POME (23), NPK (20) and the least (13) was obtained in the control treatment. The

average fruit weight (g) ranged from 68.3 to 98.2. The highest (98.7g) was obtained in PM, followed by POME (98.2g), NPK (78.3g) and the least (68.3g) was obtained from the control. Significant differences exited between PM, NPK and control.

3. Discussion

Tomato grown in soil amended with PM and POME gave better performance compared with soil amended with NPK and the control. This observation of better performance was line with Ogboi (2012) and Agbim (2009). They observed better performance of pepper grown in soil amended with POME and PM. Better performance of tomatoes grown in soil amended with organic materials (POME and PM) may be attributed to improved soil physical and chemical properties. These amendment materials increased soil organic matter content and offer many benefits over a time (Mbagwu, 2007).

The significance increased in plant height (cm), branch members, fruit members and fruit weights in PM and POME treatments could be attributed to increase nutrient status due to PM and POME application. Application of PM and POME might have changed the soil reaction which increase the availability of soil nutrient elements and uptake by the plants. This is evidence in the applicable performance of the crop (tomatoes) in PM and POME amended soil.

4. Conclusion and Recommendation.

Tomatoes grown on soil amended with organic materials poultry manure (PM) and palm oil mill effluent (POME) were significantly difference from those grown on is soil amended with inorganic manure or fertilizer (NPK 15:1515) and the control (that is soil without amendment). Therefore, it is recommended that tomatos should be grown in soils amended with poultry manure or palm oil mill effluent. More so, research on the combination of POME and PM's influence on the performance of a named vegetable crop or other crops should be conducted.

Parameters	Measure values
Clay	16%
Silt	10%
Coarse sand	50%
Total sand	24%
Textural class	74%
Bulk density	Loamy sand
Porosity	1.25g/dm^3
MWDD	47.1%
MWDW	1.203
PH(H2O)	0.816
Pf(KCL)	5.6
Carbon	4.1
Organic matter	0.6%
Nitrogen	1.10%
Sodium	0.24%
Potassium	0.05meg/100g
Calcium	0.03neg/100g
Magnesium	0.059meg/100g
ACBC	5.2meg/100g
BCES	4.8meg/100g
B.sat	25%
Phosphorus	3.5%
Aluminum	2.8%
Hydrogen	0.8%
Exchangeable acidity	3.6%

Table 1: Characteristics of soil of the study area

MWDD = mean weight diameter Dry, MWDW = mean weight. Source: Lab, 2012.

Parameters	POME	PM
PH	50	4.8
Nitrate	35ppm	1065ppm
Total nitrogen	769ppm	250ppm
Total carbon	NA	160ppm
Phosphorus	180ppm	1055ppm
Potassium	2,275ppm	955ppm
Magnesium	20ppm	10.5ppm
Calcium	37ppm	205ppm
Iron	46.3ppm	20ppm
Boron	7.6ppm	4.3ppm

Table 2: The Characteristics of palm oil mill effluent (POME) and poultry manure (PM)
Source: Lab, 2012.

	Months after transplanting											
	1				2				3			
Treatments	APH (cm)	ABN	AFN	AFW (g)	APH`(cm)	ABN	AFN	AFW (g)	APH	ABN	AFN	AFW (g)
POME	20.5	3.2	-	-	50.6	8.40	17.4	82.1	56.1	8.6	23	96.5
NPK 15:15:15	21.5	4.3	-	-	45.8	7.10	16.2	73.2	47.2	8.7	20	78.3
PM	20.6	6.5	-	-	53.6	8.90	18.3	86.3	56.3	8.9	24	98.2
Control	20.3	2.6	-	-	33.3	4.60	10.5	62.4	36.1	4.6	13	68.3
LSD	1.12	2.31	-	-	9.21	1.12	1.02	5.34	9.13	1.02	2.13	1.59

Table 3: Effect of different soil amendment materials on performances of tomatos from one to three months after transplanting.

APH= Average Tomatos Height (cm), ABN=Average Branch Numbers, AFN=A Verge Fruit Numbers, AFW= Average Fruit Weight (g).

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