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Effect of Sawdust and Straw Material Compost on Yield of Okra and Physicochemical Properties of Igbariam Soil

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Abstract:
The effect of saw dust and straw material compost on the physicochemical properties of Igbariam soil and yield of okra were studied in a field trial at Teaching and research Farm of the Faculty of Agriculture, Chukwuemeka Odumegwu Ojukwu University, Anambra State. The experiment was laid out in a randomized complete block design (RCBD) with four treatments; CO, SDSMC, SMC and SDC replicated four times. Data collected from the study were subjected to an analysis of variance test based on randomized complete block design and treatment means were separated using least significant difference (LSD) at 5 % alpha level. The findings from the study showed that okra responded positively to saw dust and straw materials compost in all parameters tested. The compost also recorded different effects in all the parameters measured in the study. The highest number of pods (3.0) and weight of pods (2.28gkg^{-1}) was recorded in SDC and SMC respectively. The composts enriched the soil as was evidence in physicochemical properties results. Among the composts the SDC compost was found to be comparatively richer and better in nutrient contents released to the soil. Therefore it is recommended that for maximum yield of crops in the study area saw dust or straw materials compost could be used as soil amendment for soil fertility improvement, since it influenced the growth and yield of okra. The materials are cheaper and available in large quantity in the study area.

Keywords:
Compost, Okra, Growth Parameters, Soil Properties, Saw Dust, Straw Material

1. Introduction

Okra is an important vegetable crop grown in Nigeria and all other parts of the world mainly for its immature pods that are usually used as a soup condiment, salad and other dishes. On the basis of land area production and values the crop can be

ranked next to tomato or even at par with tomato production in Nigeria as it can be used in fresh and canned form. According to Taylor [1] it is a leading fruit in the Nigeria market on the basis of values and land area production. This is because okra command high market price in Nigeria as it features daily in the diet of most Nigerians. All parts of okra are useful; the pod can be consumed fresh or dried form, the leaves, buds and flowers are edible and the tender shoots are equally rich in nutrients. The values and the influence of the vegetable crop in the diet of Nigerians notwithstanding the yield per land area in Nigeria are still low and in particular southeast, Nigeria. Due to the fragile nature of the soil and decline in soil fertility, as a result of high rain fall, relative humidity and solar radiation among other things experienced in the area cause nutrient depletion and reduce the productivity of soil and lower the yield and quality of crops. Tropical soils according to ECA, [2] are adversely affected by sub optimal soil fertility and erosion causing deterioration of the nutrient status and changes in soil organism population.

Since soil fertility improvement and improved environmental quality are panacea for healthy growth of crops, yield and soil productivity, then deliberate effort should be made towards the promotion of the use of organic residues compost for crop production activities in Nigeria and southeast in particular as this will ensure the life of the soil and increased crop yield to enable it withstand the increased population and intensive pressure on the available land. Organic manures generally improved the soil biophysical, biochemical, biological and physiochemical properties along with conserving water holding capacity of soil, enhanced crop productivity along with maintaining the quality of crop produced. Beri and Bhat [3] and Nweke and Nsoanya [4] found out that physical properties of the soil like bulk density, porosity, void ratio, water permeability, hydraulic conductivity, aggregate stability among other things were significantly improved when organic residues were applied in combination with or without chemical amendments resulting in higher crop yield. Organic farming is an ecological production and management systems that provokes and enhances biodiversity. Food produced from such farming is relatively free from toxic residues. In addition organically fertilized okra is more acceptable than the chemically cultivated counterparts [5]. Moyin-jesus [6] reported the superiority of an organic based fertilizer over an inorganic fertilizer both in quality and quantity. The author suggests that the consumers will gain more minerals in their meals of okra and spend less money on purchasing vitamins and minerals to meet health requirements. Ansari and Sukhraji [7] in their studies emphasised the importance of the bio crop cultivation of okra as helping to improve the health of the soil. Decomposing plant residues are reported by Yih-chin et al. [8] to release substantial levels of nutrients and organic matter into the soil.

There is need to investigate the use of local materials such as decomposed straw material and saw dust for soil fertility improvement and crop yield. Some of these local materials such as saw dust and rice husk has being found to control pathogens and increased the growth and yield of crops [9, 10], with this sustainability in agricultural production can be ensured. With these ideas in mind a field trial was designed to evaluate the effect of straw material and saw dust compost as soil amendment on soil physicochemical properties and yield of okra (Abelmoschus esculentus).

2. Materials and Methods

2.1. Site Location

The research was carried out in the experimental Teaching and research Farm of the Faculty of Agriculture, Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus. The site lies between latitude 06^{o} 14^{I} and longitude 06^{o} 45^{I}. The rainfall pattern is between April and October with an annual rainfall of over 1300mm. The relative humidity of the area range from 64-85% and temperature range is 25- 35^{o}C. The soil of the study area is of the sandy clay loam textural class (Table 1), hydromorphic and poorly drained classified as typic tropaqualf [11].

2.2. Land Preparation/Compost Making/Treatment Application/Experimental Design

The planting site was cleared by the use of cutlass and the land area measuring 9.5m x 11m was mapped out. The treatments evaluated were saw dust and straw material. 4kg each of saw dust and straw material were weighed differently into 16 white nylon polythene bags and soaked in water for 1 week. The essence is to soften the materials and made them easy for decomposition. After 1 week of soaking the water was removed from the polythene bag. 2kg pig manure was moistened and mixed well with each of the 4kg of saw dust and straw material; water was sprinkled on them and then composted for one month. The treatments are designated as; SDC – Saw dust compost, SMC – straw material compost, SDSMC – sawdust straw material compost and CO – control that did not receive any treatment. The experiment was then laid out in a randomized complete block design (RCBD) with four replicates to give a total of 16 plots each measuring 2m x 2m ($4m^2$). Plots were separated from each other by 0.5m path and each block was separated by 1m alley. After the one month the composted materials were incorporated into the soil in their respective plots and allow for 7 days for ageing before planting okra seeds. A hybrid okra seeds (Lady's finger) sourced from Anambra State Agricultural Development programme were planted 2 seeds per hole at the spacing of 75cm x 75cm and later thinned down to one plant per stand 2 weeks after planting. Weeding was done by use of hoe at 2 weeks interval till harvest. Five okra plants were selected and used for the measurement of plant height, leaf area at 30 and 60 days after planting, number of pods per plant and weight of pods per plot. Soil samples were collected randomly from the field site at the depth of 0 – 25cm before cultivation and bulk together as composite sample. After harvest soil samples were collected from each plot using soil auger to a depth of 0 – 25cm. These soil samples were air dried and sieved with 2mm mesh sieve and used to analyze selected soil chemical properties and core samples used for the analysis of selected physical properties of the soil. The analysis of both physical and chemical properties follow the method outlined in Black [12] data generated were subjected to analysis of variance test based on randomized complete block design (RCBD), statistical significance difference between treatment means was estimated using least significance difference (LSD 0.05).

3. Results

The result of yield and yield component of okra presented in Table 2 showed that the composts varied in their effect on yield and yield component of okra. The leaf area at 30 days after planting was significantly ($P < 0.05$) difference among the composts, but as days increased to 60 DAP the leaf area result of the composts become non – significant. The result variations for the compost were SDSMC > SMC > SDC > CO for 30 DAP and SDC > SDSMC > SMC > CO for 60 DAP. The result of the plant

height showed that SDSMC recorded the highest value and next in rank was the value obtained in SDC, SMC and CO values were almost similar as the percentage difference between the two treatments were merely 7%. The number of pod and weight of pod of the okra showed statistical significant ($P < 0.05$) difference among the composts. The SDC recorded the highest value of 3.0 in number of pods compare to the values obtained from the other composts of which the percentage difference with CO was 110%. The SMC and SDSMC values were similar but significantly better than CO value with 36.84% increase in value. The result of weight of pod indicated that the yield values obtained from SDC, SMC and SDSMC were statistically similar but significantly better than the value obtained from the CO, the percentage yield increase over the control were 22.58%, 26.32% and 24.66% respectively.

Table 1. *Initial physicochemical properties of the experimental site.*

Parameter	Value
Sand	562gkg^{-1}
Silt	220gkg^{-1}
Clay	220gkg^{-1}
Textural class	sandy clay loam
pH	4.90
OC	0.59%
TN	0.269%
Avail. P	2.98mgkg^{-1}
Ca	2.57cmolkg^{-1}
Mg	1.53cmolkg^{-1}
ECEC	10.69cmolkg^{-1}
BD	1.39gcm^{-3}
TP	49%
MWD	1.77mm
AS	18.78%
HC	10.40 cmhr^{-1}

Table 2. *Effect of compost on the yield and yield component of okra.*

Treatment	Leaf area cm^2		Plant height	Number of pod	Weight of pod
	30DAP	60DAP	cm		gha^{-1}
CO	27.04	126.39	40.53	1.90	1.68
SDC	45.02	190.75	50.00	3.0	2.17
SMC	48.27	160.48	42.60	2.60	2.28
SDSMC	53.68	165.15	52.55	2.60	2.23
LSD0.05	11.07	NS	NS	0.50	0.12

CO = Control; SDC = Saw dust compost; SMC = Straw materials compost; SDSMC = Saw dust + straw materials compost

The results of soil chemical and physical parameters of the soil studied showed effect of compost on the soil were statistical significant ($P < 0.05$) difference among the composts. The soil pH result showed higher value of 6.68 in SDC which tend to almost neutral, while the values obtained from CO, SMC and SDSMC indicated moderately to slightly acidic. The OC and TN values varied among the treatments and the highest value obtained for the two parameters were recorded in SDSMC. Available P, Ca, Mg and ECEC results showed highest value in SDC compared to their values recorded in other composts, with a mean value of 14.96mgkg^{-1}, 3.64cmolkg^{-1}, 1.40cmolkg^{-1} and 33.94cmolkg^{-1} respectively. The result of physical parameters of the studied soil showed that the compost application decreased bulk

density of the soil and increased the total porosity of the soil. The result variations of the compost for the two parameters were SDC < SMC < SDSMC < CO for the BD result and SDC > SMC > SDSMC > CO for the TP result of the compost. The result of MWD, AS and HC recorded for the composts were highest in SDSMC for the MWD and AS while SMC recorded highest value in HC with a value of 12.05cmhr^{-1} compared to the values obtained from other treatments studied.

Table 3. *Effect of compost on the chemical and physical properties of soil studied.*

Treatment	pH	OC	TN	P	Ca	Mg	ECEC	BD	TP	MWD	AS	HC
		%	%	mgkg^{-1}	←	cmolkg^{-1}	→	g/cm3	%	mm	%	cmhr^{-1}
CO	5.08	0.39	0.273	3.77	2.62	0.62	8.54	1.43	51.41	2.72	23.38	6.19
SDC	6.68	0.65	0.466	14.96	3.64	1.40	33.94	1.22	53.00	3.51	28.05	8.75
SMC	5.44	0.76	0.494	6.33	2.84	0.82	13.74	1.25	52.35	4.57	29.22	12.05
SDSMC	5.64	1.02	0.622	9.63	2.92	1.14	19.39	1.31	51.81	5.88	30.87	17.40
LSD0.05	0.92	0.07	0.067	0.06	0.46	0.37	0.72	0.18	0.95	1.75	1.25	2.48

CO = Control; SDC = Saw dust compost; SMC = Straw material compost; SDSMC = Saw dust + straw material compost

4. Discussion

Table 1 presents the result of initial soil analysis data. The sandy clay loam soil was acidic in reaction and medium values in other chemical parameters. Therefore it is expected that the compost application will be beneficial to the okra plant and studied soil. The positive increase in the yield and yield components of okra observed among the composts compared to the control plots probable may be due to high contents of macro and micro elements in the composts and in proportion required by the okra of which have the capacity to improve the morphological characteristics and yield of okra. Agboola [13] and Nweke et al. [14] stressing on the value of organic manure reported that it enhances plant growth, development, herbage and grain yield. Also the variation in yield and yield component of okra observed among the treatments and higher values recorded in composts amended plots compared to the control plots could be attributed to higher content of plant nutrients in the compost and differences in nutrient contained in the compost types applied.

The result of soil chemical and physical parameters in Table 3 indicated that the compost types applied had effect on the chemical and physical parameters of the studied soil. The soil physical and chemical content of the soil were found to be significantly affected by saw dust and straw material compost. The high content of nutrient release observed in SDC may have been associated with its pH result, because a pH range of approximately 6-7 promotes solubility of mineral nutrients and the most readily available plant nutrients. This is in line with the findings of [15, 16, 17, 18] who reported increased soil pH, chemical properties of soil and crop yield relative to control plots following organic material application on soil. The result simple indicates that saw dust and straw material compost can affect both the chemical and physical properties of the studied soil nutrient cycling that invariable transformed to increased yield of okra observed in the amended plots in this study..

5. Conclusions

The result of this study has shown that saw dust and straw material compost are excellent organic fertilizer in okra production as its application led to improved soil nutrient status and increased okra yield. Thus indicating that the fertility of the soil and okra production can be sustained adequately with the application of saw dust and straw material composts the saw dust and straw material are very cheap to get in the study area and it will save the farmer the cost of buying chemical fertilizer that is exorbitant in price if found at all.

Conflicts of Interest

There is no conflict of interest regarding the publication of this article.

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