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Effects of pig dung and poultry manure with plant residues on the production of some fruit vegetables

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Abstract

The experiment was carried out to investigate the impact of different types of manure mixed with plant residue on the soil microbial biomass and performance of fruit vegetables. The field experiment was carried out during the raining season at Organic Agricultural Farm of the Federal University of Agriculture, Abeokuta. Nigeria. Compost was prepared using pig dung and poultry manure with plant residue. It was applied at the rate of 0 and 10t ha^{-1} replicated three times. The observation on growth parameter showed that at 5 WAP okra with composted poultry manure was low although there was increase at 7 and 9 WAP. The observation on growth parameter showed that at 5 WAP okra with composted poultry manure was low than composted pig manure and no amendment but later showed increase in height at 7 and 9 WAP while pepper with poultry manure was higher than composted pig manure and no amendment which later increase in highest. Observation on yield parameter revealed that okra with composted pig manure had the highest number of fruits than pepper with composted pig manure. The soil micro biological parameters after adding compost showed that pepper with no amendment had the highest viable counts than pepper composted pig dung and poultry manure than okra with composted pig manure and no amendment. Fungal counts were high in un-amended soil planted with pepper than all other treatments. Microbial biomass carbon was high in soil amended with composted poultry manure planted with okra than all other treatment. Microbial biomass phosphorus was high in soil amended with poultry manure planted with okra than other treatments and microbial biomass nitrogen was high in soil amended with poultry manure planted with pepper and that of okra with pig manure. The soil microbiological parameters were affected by treatments.

Keywords: pig dung, poultry manure, okra, pepper, microbial biomass, fungal count

INTRODUCTION

One of the major problems facing crop production in Nigeria is the declining soil fertility. In the past, soil fertility was maintained through fallowing by leaving or abandoning the piece of land for a period of three to ten years. Presently, due to population pressure, land is insufficient therefore fallow periods were reduced resulting in declining crop yield. The use of inorganic fertilizer to achieve high crop yield in Nigeria farming system is unsustainable because the cost is beyond the reach of resource poor farmers [1]. Therefore, Soil Scientists are now shifting emphasis from the use of inorganic fertilizer to use of organic manure. Organic farming is the agricultural system that avoids the use of synthetic fertilizers, pesticides and gene manipulation. It relies on developing biological diversity in the field to disrupt habitat for pest organism and the purposeful maintenance and replenishment of soil fertility [2]. Organic farming sometimes referred to as sustainable agriculture that improves the entire food and agricultural system by balances production and consumption. It also addresses the environment, economic and social issues related agricultural system. Organic farming to attempts to ensure that arable land is protected so that current and future generations will be able to farm from it successfully. However, organic matter in the soil is a major source of plant nutrient and it plays an important role in maintaining aggregate stability, water holding capacity, improves soils structure and nutrient status. However, it is essential to maintain and improve organic matter level of the soil in order to increase soil fertility and achieve sustainable crop production. Many farmers rely chiefly on chemical fertilizers, grow green manure crops which they plough under for organic matter, such crops may consist of rye grass clover, buck wheat etc. The digestive power of soil which is the ability to breakdown organic matter depends on beneficial micro organism as described by [3]. He said further that the presence of large amount of raw plant matter can inhibit the action of bacteria, fungi and earthworm and thus reduce the digestive power in the soil. The digestibility of a soil is in direct relation to the amount of microbes and other life contained in that soil. The use of synthetic fertilizers in the soil destroys the beneficial organisms most especially bacteria and this lowers the digestibility of the soil and make the soil less fertile [4]. The use of pesticides on crop made conventional food to contain pesticides residues than organic food as reviewed by [5] in a report which indicated that 71% of pesticide residue was found in conventional produce sampled while organic produce contained 13%. Composting

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is a biological process, carried out under controlled conditions, which converts organic material into a stable humus-like product called compost [6]. Composting transform raw organic waste materials into biological stable humic substances that make excellent soil amendment.Compost has a unique ability to improve chemical, physical and biological characteristics of soil. It improves water retention capacity in sandy soils, promotes soil structure by increasing the stability of soil aggregates. The soil becomes microbially active and also accumulation of breakdown of pesticides. Physical, chemical and biological characteristics of compost can be affected by feed stock material, composting method, size and time of production [7]. Compost can be a source of both macro and micro nutrient and it strengthens crop resistance to pest. The use of compost wholly or partially enhance waste management and nutrient recycling in vegetable production. It also improves the quality and yield of vegetables.Composting continues to be the most energy efficient method for dealing with organic wastes. However, these benefits can be reduced in hot humid climate in which decomposition of organic matter is faster than in temperate climate [8].

MATERIALS AND METHODS

Location of site

The site for this project was Organic Agricultural Farm at the Federal University of Agricultural Abeokuta. Nigeria The University is within the humid lowland tropical region with two distinct seasons. The mean annual rainfall is 1113.11m. The rainfall has the characteristics bimodal distribution with peak in July and September and a break in August.The mean monthly temperature during the cropping season varies from 22.94^{0}C in August to 32.26^{0}C in March. The relative humidity is high ranging from 75-52% in February to 85-15% in July.

Field lay-out

The field was prepared manually. The total land of 352m^2 was used for the experiment and these were divided into 18 plots of 3mx2m each. Two rate of compost O and 10tha^{-1} was applied randomly and replicated along the row and 1m apart across the row. Two crops were tested. (Okra and pepper).

Nursery establishment

The seed of pepper was broadcasted on rich loamy soil which was prepared to fine tilts. These pepper seedling was transplanted the fourth week of planting when at least three true leaves was observed.

Source of material

Compost material of ratio 1:3 i.e. 1 of poultry manure and pig manure and 3 of plant residues was used for the experiment. Plant residue consisted of Maize stover, soya bean husk and *Leucaena leucocephala* were cut, mixed with poultry manure and pig dung and applied as green matter.

Experimental design

The experimental design was 2 by 3 factorial in randomized complete block design.

Treatments

Two types of compost (poultry and pigmanures) were used at the rate of 0 and 10tha^{-1} on two types of crop varieties (Okra and pepper).

Description of variety

Two crops tested were improved varieties. Okra –V35 (Abelmuscus esculentus) and pepper-Roma (Capsicum fructescens).

Data collection

The growth parameters that were collected are plant weight, number of leaves, number of branches and leaf are on weekly bases. The number of fruits, number of days to first flowering, number of days to first harvest, weight of fruit per plot, fresh and dry shoot weight was the yield parameters collected. The soil microbiological parameters collected are total viable count, fungal count, microbial biomass carbon, microbial biomass phosphorus and microbial biomass nitrogen.

Soil sampling and preparation for analysis

Soil sampling were randomly collected from the field for microbial and chemical analysis and mixed thoroughly, so also soil for chemical analyses samples were collected, airdried and grounded to pass through 2mm and 0.5 diameter sieves. A physicochemical property of the soil was done. Microbial counts of soil samples were estimate using the serial dilution method. While normal chemical analyses for C, N, and P was done and calculated as
Microbial biomass C = extracted Cti – extracted Cto) x 2.64
Microbial biomass P = extracted Pti– extracted Pto) x 2.5
Microbial biomass N = extracted Pti – extracted Pto) x 1.46
to = extracted unfumigated, ti = extracted fumigated sample.
Plant tissue analyses for P and K was done using AAS and flame photometer respectively.

TABLE 1: Physicochemical Properties of the initial soil (0-15cm) before plantin g

Soil properties	Values
Sand, g 100g^{-1}	90
Silt, g 100g^{-1}	60
Clay, g 100g^{-1}	40
Textural class	Sandy
pH (1:1 soil-water suspension)	5.28
Organic Carbon, g C kg^{-1} soil	0.62
Exchangeable bases	
Na^+ cmol kg^{-1}	0.21
K^+ cmol kg^{-1}	1.38
Ca^{2+} cmol kg^{-1}	0.61
Mg^{2+} cmol kg^{-1}	1.00
Available (Bray 1) P, mgkg^{-1}	4.30
Total Nitrogen, g kg^{-1}	0.06

RESULTS

The result of initial soil parameter taken prior to the experiment shown in Table 1 shows that the soil is sandy, acidic with relatively low nutrient as indicated in its low organic matter, total nitrogen and available phosphorus. Table 2 shows that plant height at 5 WAP for

okra with composted poultry manure was significantly lower than composted pig manure and zero amendment. The plant height of pepper at 5, 7, 9 WAP were the same with all the treatments. Table 3 shows the result on number of leaves of Okra and pepper with respect to their treatment at 5, 7 and 9 WAP. Pepper produced more leaves than Okra with compost amendment at 7 and 9 WAP. Table 4 shows the result on the effect of compost at 5, 7 and 9 WAP of Okra and pepper with respect to their treatment though there was no significant difference.

TABLE 2: Effect of Compost and Crop Varieties on Plant Height at 5, 7 and 9 weeks after planting (WAP)

Crop	Treatment	5	7	9
Okra	Pig	12.30a	17.05a	27.85a
	Poultry	5.28b	15.94a	24.61a
	No amendment	10.69a	11.83a	19.21a
Pepper	Pig	11.28a	16.87a	16.91a
	Poultry	13.97a	17.69a	18.86a
	No amendment	12.51a	13.39a	17.01a

TABLE 3: Effect of Compost and Crop Varieties on the Number of Leaves at 5, 7 and 9 weeks after planting (WAP)

Crop	Treatment	5	7	9
Okra	Pig	5.00b	6.33b	11.08b
	Poultry	4.75b	5.24b	9.33b
	No amendment	5.08b	6.42b	7.50b
Pepper	Pig	23.25b	14.92b	67.42a
	Poultry	21.42a	30.16a	88.75a
	No amendment	17.16a	27.42ba	49.33ba

TABLE 4: Effect of Compost and Crop Varieties on number of branches at 5, 7 and 9 weeks after planting (WAP)

Crop	Treatment	5	7	9
Okra	Pig	0.02b	2.00ba	3.92a
	Poultry	0.00b	1.58ba	2.70a
	No amendment	0.00b	0.67b	2.51a
Pepper	Pig	3.75ba	3.58ba	4.08a
	Poultry	3.42ba	4.42a	5.83a
	No amendment	6.33a	3.08ba	3.66a

TABLE 5: Effect of Compost and Crop Varieties on Leaf Area at 5, 7 and 9 weeks after planting (WAP)

Crop	Treatment	5	7	9
Okra	Pig	68.70b	190.11a	183.5ba
	Poultry	36.21a	182.75a	131.49a
	No amendment	64.82a	84.43ba	153.24a
Pepper	Pig	14.24a	15.83b	16.81b
	Poultry	26.78a	21.55b	14.37b
	No amendment	13.14a	13.78b	13.54b

TABLE 6: Effect of Compost on Yield Components of Okra and Pepper

Crop	Treatment	Number of days to first flower	Fresh shoot weight(g)	Dry shoot weight(g)
Okra	Pig	49.83a	15.10ba	5.88a
	Poultry	51.25a	17.89a	4.62ba
	No amendment	50.33a	12.09ba	1.41ba
Pepper	Pig	0.00b	4.65ba	1.67ba
	Poultry	0.00b	9.59ba	3.92ba
	No amendment	0.00b	2.85b	0.81b

TABLE 7: Effect of Compost and Crop Varieties on Yield Parameters

Crop	Treatment	Number of fruit per plot	Weight of fruit(kg)
Okra	Pig	73.67a	43.77a
	Poultry	70.33a	27.51a
	No amendment	69.67a	26.89a
Pepper	Pig	71.00a	3.01a
	Poultry	21.67ba	3.24a
	No amendment	49.33ba	0.73ab

TABLE 8: Effect of Compost and Crop Varieties on Soil Microbiological properties

Crop	Treatment	Total Viable count (cfug-1)	Fungal count (cfug-1)	Microbial biomass carbon (mgkg-1)	Microbial biomass phosphorus (mgkg-1)	Microbial biomass nitrogen (mgkg-1)
Okra	Pig	11.50c	0.60b	8.20ba	2.86b	0.17a
	Poultry	13.50cb	0.76b	10.42a	10.77a	0.07b
	No amendmer	11.43c	0.53b	4.77b	2.86b	0.06b
Pepper	Pig	16.66b	0.80b	8.12ba	3.50b	0.20a
	Poultry	15.66b	0.70b	9.86a	3.49b	0.21a
	No amendme	**20.60a**	**1.20a**	**4.56b**	**2.70b**	**0.15ba**

TABLE 9: Effect of Compost and Crop Varieties on uptakes of N, P and K in okra and pepper plant at flowering

Crop	Treatment	N(mgkg-1)	P(mgkg-1)	K(mgkg-1)
Okra	Pig	1.15a	1.27a	0.49a
	Poultry	0.79a	1.29a	0.50a
	No amendment	1.17a	1.16ab	0.53a
Pepper	Pig	1.29a	0.91b	0.46a
	Poultry	1.33a	1.33a	0.42a
	No amendment	1.31a	1.27a	0.40a

DISCUSSION

Pepper produced branches earlier than Okra; however by 7 WAP pepper amended with composted poultry manure produced more branches than Okra with no amendment. Branching was comparable in Okra and Pepper at 7 WAP where okra amended with composts and with no treatment at 9 WAP. Table 5 shows the result on the effect of compost on leaf area at 5, 7 and 9 WAP of Okra and pepper with respect to their treatment there was no significant difference. At 7 WAP Okra treated with compost produced bigger leaves than pepper while leaf area was the same in all pepper leaves than Okra while leaf area was the same in all pepper treatments and unamended okra. However at 9 WAP Okra irrespective of the treatment produced bigger leaves than pepper. Table 6 shows the result on number of days to first flowering, Okra flowers earlier than pepper. The number of days to first flowering of okra and pepper to their treatments showed no significant difference with individual crop. However, amide okra produced more fresh shoot weight than unamended pepper while only okra amended with composted pig manure produced more dry matter than unamended pepper. Table 7 shows the result of fruit per plot for Okra and peppers with respect to their treatments, though there was no significant difference although okra with pig treatment had the highest number of fruit than pepper with poultry treatment. However, pepper with composted poultry was

numerically lowest. The weight of fruit for pepper with no amendment was lower than that of other treatments. Table 8 shows the result of microbial parameters as affected by treatments and crop varieties It shows that microbial parameters were significantly affected by the higher viable count than all the other treatments while soils amended with pig and poultry compost and grown with pepper were comparable to okra with poultry treatment, which was higher than okra with pig treatment [9].

Fungal counts were also higher in unamended soil planted with pepper than all the other treatments. Biomass carbon was higher in soil amended with composted poultry manure and planted to okra and composted pig manure and planted to okra and composted pig manure planted to pepper than other treatments with the exception of okra with pig treatments. Soils amended with poultry compost planted to okra provided higher biomass than all the other treatments with the exception of soil amended with pig manure compost and plant to okra. Soil amended with poultry compost and planted to okra was the same as unamended soil planted to okra and less than other treatment in biomass nitrogen. Table 9 shows the result of uptake of nitrogen, phosphorus and potassium. It showed that okra with pig treatment was significantly low while okra with pig and no amendment showed no significant difference. The pepper with respect to all its treatment showed no significant difference. The uptake of phosphorus showed that pepper with pig treatment was low than other treatments. However, okra with no amendment was low than okra with composted pig and poultry treatments [10]. The uptake of phosphorus with all treatments for okra and pepper showed no significant difference.

CONCLUSION

In this experiment okra with pig treatment gave the highest number of fruit than pepper with poultry manure. Pepper with respect to their treatments matured late by having the smallest number of fruits. It also showed that okra with pig treatment utilized the nutrient released by the compost more efficiently. Therefore, it can be concluded that okra with pig treatment gave better result for soil amendment in okra cultivation. Then pepper with poultry treatment gave the smallest no of fruit than pepper with pig and no amendment. This means that pepper with poultry treatment did not respond well to soil amendment by compost, therefore, okra plant performed better when soil is been amended by compost. Okra with poultry manure treatment is better in order to have high quality and yield of fruit. Okra plant performed better with soil amendment by compost. The experiment should be further increase in rate of compost used in order to ascertain that the appropriate rate is recommended for okra and pepper cultivation.

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