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EFFECT OF ORGANIC AMENDMENTS ON SOME PHYSICAL AND CHEMICAL PROPERTIES OF SOILS PLANTED TO SWEET MELON (CUCUMIS MELO L.) IN PORT HARCOURT, NIGERIA.

[1]Peter, K.D, [2]Orji. O.A. and [3]Bakare, A.O.
[1&2]Department of Crop/Soil Science, Faculty of Agriculture, Rivers State University, P.M.B. 5080, Port Harcourt, Rivers State, Nigeria
[3]Department of Soil Science and Land Resource Management, Faculty of Agriculture, University of Benin, Benin City, Edo State

Abstract: This study was conducted in Teaching and Research Farm, Rivers State University, Port Harcourt, Nigeria with the sole aim of assessing the effect of organic amendments on some physical and chemical properties of the soils planted to sweet melon (Cucumis melo L). The treatments administered were no amendment (control), 10 ml of organic liquid fertilizer (OLF), 20 kg of poultry dropping (PD) and 20 kg of pig manure (PM). The experiment were laid out in a Randomized Completely Block Design replicated three times. Soil samples were collected from each of the treatment plot using hand trowel before application, two weeks after application, six weeks after application and transplanting and after harvesting and were analyzed for soil physical and chemical properties such as bulk density, total porosity, soil temperature, soil pH, organic carbon, total nitrogen, available phosphorus, exchangeable bases, cation exchange capacity, total exchangeable acidity and percent Base saturation. The results showed that application of the various amendment materials improved soils physical and chemical properties. Bulk density decreased from 1.87 M gm-3 before amendment to 1.28 Mg m-3 in soil amended with pig manure. Total porosity also increase from 36.9 % in soils before amendment to 65.5% in soils amended with pig manure six weeks after transplanting (6WAT). Soil pH was higher (7.70) in soils amended with poultry dropping compare to control (5.40). There was also an increase in soil organic carbon in soils amended with poultry droppings from (1.88 g/kg) in comparison to control (1.00 g/kg) and after harvest (AH). Total nitrogen increase to 0.72 g/kg after harvest in soils amended with poultry dropping as compared to control (0.05 g/kg) after harvest. Available phosphorus also increased to 0.14 g/kg in soil amended with organic liquid fertilizer (OLF) compared to control (0.013Mg/kg) in after harvest. Poultry dropping was recommended for the improvement of some soil physical and chemical properties and soil fertility status. Therefore, there is need for further research on the recommended rates of application for effective improvement in soil physical and chemical properties for sustainable agricultural production.

Keywords: Amendment materials, physical and chemical properties, Port Harcourt, sweet melon, ultisols

INTRODUCTION

Ultisols are deep clayed soils characterized by the presence of argillic or kandic horizon with low base saturation (less than 35%) and are naturally acidic with low fertility status which can be made agriculturally suitable or productive with the application of lime and fertilizers Peter and Umweni (2020b). Ultisols are mostly sandy and acidic soils with low organic matter contents, which makes it unproductive, except with application of fertilizers (organic or inorganic) (Ikati and Peter, 2019). They are ultimate weathered soils with low fertility problems as a result of excessive leaching and characterized by low activity clay and organic matter contents. According Omenihu, (2010), ultisols is one of the soils order that can enhance sustainable crop production in the rain forest ecological zone of the tropics, if properly managed by adopting appropriate soil management practices. Thus with proper soils fertility management system, using some amendment materials, its productive capacity can be restored for crop production on sustainable basis. In order to have adequate knowledge to manage these soils, it is necessary to have a full understanding of the physical and chemical properties of the soils. Physical and chemical properties of soil can help the best management approach to be adopted for sustainable agricultural crops production, (Peter and Umweni, 2020a). This is because assessing soil physical and chemical properties will help the farmers to ascertain the particle size distribution and their nutrient status, thus, serve as a guide for the best management practices to be adopted by the land user. It was reported by Maynar*d et al. (2001),* Sabo et al. (2013) and Villanueva *et al.* (2004), that Sweet melons (*Cucumis melo* L.) originates from South West Asia, and over time, have traveled from Africa to Asia, Europe and North America. It is widely grown in the northern part of Nigeria especially in the Middle belt because of its sweet pulp and pleasant aroma (Villanueva et al, 2004). Sweet melon was the test crop in the present study

MATERIAL AND METHODS

Brief description of the study site

The study was carried out at the Rivers State University Teaching and Research Farm, Nkpolu-Oroworukwo, Port Harcourt. It is located between latitude 04.80388N and longitude 006.97698E at an elevation of 21m above sea level. The mean annual rainfall of the study area ranged between 2000 mm – 2500 mm with a bimodal pattern (Peter and Ayolagha, 2012). Mean annual temperature ranged between 23^{o}C and 29^{o}C. The soils of the study area are derived from the well drain coastal plain sand with humid tropical rainforest vegetation.

Experimental design

The experiment involved four (4) treatments and three (3) replicates in a Ramdomized Complete Block Design given a total of twelve (12) plots. Ten kilograms of top-soil (0 – 15 cm depth) were collected and placed into each treatment bag. Composite soil samples were collected for laboratory analysis to ascertain the physical and chemical properties of the soils before application of amendment materials. Two kilograms of the various amendment materials such as Pig manure (PM), and Poultry dropping and 10ml of organic liquid fertilizers (OLF) were applied to the soil according to the experimental design and allowed to fallow for two weeks before transplanting. The seeds were raised in nursery crates according to the different treatments and watered for two (2) weeks. After two weeks in the nursery crates, the seedlings were transplanted into nursery bags for another two (2) weeks. Transplanting was done after two (2) weeks in the nursery bags into the potted soil bags amended with the various amendment materials as per the experimental design. Soil samples were collected from each of the treatment plot before application of amendment, two weeks after application of amendment, six weeks after transplanting and after harvesting for laboratory analysis to determine the effect of the various amendment on the physical and chemical properties of the soils. Soil samples collected were properly bagged and labeled and, transferred to the Soil Science laboratory of the Rivers State University, Port Harcourt where they were air dried, ground, and sieved with a 2mm mesh sieve for physical and chemical properties analysis.

LABORATORY ANALYSIS

Particle size distribution was determined by the hydrometer method according to *Bouyoucos (1951*). Textural class was determined using the soil textural triangle. The soils were also evaluated for bulk density, total porosity and temperature. Bulk density was determined using core soil sampler, while soil porosity was calculated using the values of the bulk density. Soil temperature was determined by inserting soil thermometer into a 10 cm depth of the soils. Soil pH was determined in 1:1 Soil water suspension using electronic pH meter (*Hossner. 1996)*. Organic carbon was determined by dichromate wet oxidation method of Walkey and Black (1934) as described in methods of soil analysis (Juo, 1979). Total nitrogen was determined using the Macro kjeldahl method (*Hossner, 1996; Ibitoye, (2008.* Available phosphorus was determined using the Bray-1 method *(Bray and Kurtz, 1945),* exchangeable bases (Ca, Mg, K, Na) were determined by leaching the soil with NH4OAc solution. Sodium (Na) and K were determined with flame photometry; while Ca and Mg were determined by the EDTA titration method of Heald (1965). Exchangeable acidity was determined using the E-A- Titration method (*Ibitoye, 2008*), *while* CEC was determined as the sum of total exchangeable bases plus exchangeable acidity. That was done by summing up the exchangeable basic cation and exchangeable acidity. Base Saturation was calculated by dividing the sum of exchangeable bases (Na, K, Ca and Mg) by the CEC and multiplying the quotient by 100.

RESULTS AND DISCUSSION

Initial Physical and Chemical Properties of Soils and Amendment Materials Used for the Experiment

The initial physical and chemical properties of soils and amendment materials indicated that, the soils had 84.2 g/kg of sand fractions, 2.4 g/kg of silt and 13.4 g/kg of clay in the composition (Table 1). Bulk density of the soil was 1.87 Mg m^{-3}; while total porosity was 36.9 %. The soils was slightly acidic with value of 5.50 in 1:1 soil-water ratio while the pH of amendment were 6.1 (organic liquid fertilizer OLF), 6.4 (Pig manure PM) and 8.23 (Poultry dropping PD). Organic carbon content of soils was low (1.15 g/kg), followed by OLF (6.5 g/kg), PM (17.2 g/kg) and PD (20.1 g/kg). Soil total nitrogen content was low, while PD had the highest total nitrogen content (25.8 g/kg), followed by OLF (16.3 g/kg) and PM (11.54 g/kg). The available phosphorus content of the imported soil was very low (0.007 g/kg) while PM had 0.29 g/kg followed by OLF (0.8 g/kg) and PD (3.86 g/kg). Exchangeable bases (calcium, magnesium potassium and sodium) content of the imported soils were generally low (2.2, 0.4, 0.103 and 0.413 cmol/kg). Calcium content of organic liquid fertilizer (OLF) had 18.1 cmol/kg, PM had 0.16 cmol/kg and PD had 4.62 cmol/kg. The experimental soils had the lowest magnesium content (0.4 cmol/kg), while PM had the highest exchangeable Mg (10.6 cmol/kg). The imported soils also had the lowest exchangeable K and Na (0.103 and 0.413 cmol/kg). The experimental soils also had low CEC (3.116 cmol/kg) with high percent base saturation (82.30 %).

Effect of amendment materials on soil physical properties two weeks after application before transplanting

The data on physical properties of the soils as affected by the application of amendment materials before transplanting are presented in Table 2. Sand fraction had the highest value followed by clay and silt. Similar trend was also observed among the soil particle size distribution in both the control and amended soils. It was also observed that, application of the various amendments greatly influenced some of the soil physical properties. There was a decrease in soil bulk density from 1.79 Mg m^{-3} in the control to 1.38 Mg m^{-3} in soils amended with pig manure. Total porosity increased from 40.2 % in the control to 59.96% in the soils amended with pig manure. The highest total porosity was observed in soils amended with pig manure (59.96 %) followed by poultry dropping (56.71 %), while the least was observed in the control (40.2%). This in line with the report of Peter and Ayolagha (2012), who reported that organic amendment materials have the ability to bind the soil particles to form a good soil structure, thereby improving the moisture retentive capacity of the soils and its porosity. There was also an increase in soil temperature from 28^{oC} in the control to 33.1^{oC} in soils amended with pig manure. The increase in temperature in soils amended with PD might be attributed to its microbial process of their decomposition and mineralization in the soils (Peter and Ayolagha, 2012).

Effect of amendment materials on soil physical and chemical properties two weeks after application before transplanting

The chemical properties of the soil as affected by the application of amendment materials are shown in Table 3. Soil reaction (pH) in 1:1 water – soil ratio showed that the control (not amended) had pH of 5.40 followed by OLF amended soils (6.10), PM (7.50) and PD (7.70). Soils of the control (C) were acidic (5.40); while soils amended with OLF were slightly acidic (6.10) and soils amended with pig manure and poultry dropping were neutral (7.50 and 7.70) respectively. The increase in pH value in the soils amended with the various amendment materials to neutral indicated the ability of organic amendment materials to control soil acidity. It also showed the ability of the various amended materials to be used as liming materials to an acid soil. These results showed that soil pH increased with application of amendment materials confirming the findings of Peter and Onweremadu (2016) who also reported that soil amendment materials served as buffers to regulate the soil reaction activities. Soil organic carbon content increase from 1.05 g/kg (control) to 2.00g/kg in the pig manure amended soils. The increase in soil organic carbon in the amended soils revealed the ability of the various amendment materials to improve soil physical and chemical properties. This collaborated with the findings of earlier workers Danjuma et al (2012), Onyegbule and Asawalam (2015), who reported that poultry manure increased soil organic carbon. Soil organic matter had similar trend with an increase from 1.86 g/kg (Control) to 3.45 g/kg in the soils amended with pig manure. Organic matter enhanced the activities of soil microorganisms, thereby increasing the nutrient content of the soils for sustainable agricultural production. There was no significant difference between the control and soils amended with organic liquid fertilizer. Total nitrogen was generally low in the control (0.09 g/kg) and soil amended with poultry dropping (0.105 g/kg) but increase from 0.09 g/kg (control) to 0.44 g/kg in the soils amended with pig manure. These results also showed that, available phosphorus was low in the control (0.004 m/kg), poultry dropping and pig manure amended soils except in soils amended with organic liquid fertilizer, however, there were no significant difference between the control and amended soils. The content of exchangeable cations content showed that calcium increased from 4.4 cmol/kg (control and OLF amended soils) to 6 cmol/kg in soils amended with poultry droppings. Similar increases were also observed for Mg, K and Na (0.6 to 4 cmol/kg), (0.19 to 0.64 cmol/kg) and (0.349 to 0.586 cmol/kg) respectively. The cations exchange capacity of the soils also increased from 5.692 cmol/kg (OLF amended soil) to 10.09 cmol/kg in the pig manure amended soils. There was also an increased in total acidity in the poultry dropping amended soils (4.07 cmol/kg), while the least was obtained in the pig manure amended soils. The increase in total exchangeable acidity and Effective cation exchange capacity of the soils indicated that poultry manure can increase the organic component of the soils. These findings are line in with earlier work (Adenyien and Ojeniyi, 2003, Peter and Ayolagha 2012 and Onyegbule and Asawalam 2015), who reported that application of poultry manure to the soils, improve the organic content of the soil, thereby enhancing the physical and chemical properties of the soils as well as improving the exchange capacity of the soils. High percent base saturation was observed in the soils amended with poultry dropping.

Effect of amendment materials on some soil Physical properties six weeks after transplanting (6WAT)

Application of amendment materials does not alter the particle size (texture) of the soils, rather, there was an improvement in the soil structure (Table 4). The data also revealed that there were no change in soil textural across the treatments. However, it was observed that at 6WAT, there was decrease in bulk density. The highest bulk density 6WAT was observed in the control (1.68 Mg m^{-3}), while soils amended with pig manure had the least bulk density (1.28 Mg m^{-3}). There was a reverse trend in total porosity 6WAT. Total porosity increased from 43.1 % (control) to 65.4 % in soils amended with pig manure (PM). It was also observed that, the amended materials greatly influence the soil bulk density, total porosity and temperature and as result of their binding ability to form good soil structures (Peter and Ayolagha 2012).

Effect of amendment material on soil chemical properties six week after transplanting 6WAT)

Application of amendment materials brought slight improvement in some chemical properties of the soil as shown in Table 5. Soil pH increase from 5.42 (control) to 7.66 in the sols amended with poultry dropping. The control had the least organic carbon (1.00 g/kg) and organic matter (1.6 g/kg). The highest organic carbon (1.93 g/kg) and organic matter (3.37 g/kg) was obtained in the soils amended with pig manure. There were decrease in the level of some of the soil chemical properties such as pH, OC, OM and TN when compared to the level in soils amended before transplanting. The decrease in nutrient element, demonstrated that plant made use of some of the nutrient element for growth and development six week after transplanting. The results indicated a decrease in the level available phosphorus due to plant uptake.

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Exchangeable cations (Ca, Mg, K and Na) level increased in soils amended six weeks after planting when compare to amended soils before transplanting. The least was observed in the control. The results indicated that the various amendment materials improved the level of soil exchangeable bases. There were also an increase in CEC, TEA, ECEC and BS from 5.21, 5.56, 6.75 cmol/kg and 94.20 % in the control to 9.56 cmol/kg (PM), 10.7 cmol/kg (PD), 11.03 cmol/kg (PD) and 93.55 % (PM). The decrease in level in level of CEC, TEA ECEC and BS observed in soils amended six weeks after transplanting was as a results of plant uptake and microbial activities in the soils (Peter and Onweremadu (2016).

Effect of amendment materials on some Soil Physical Properties after harvesting

The data on some soil physical properties after harvest as influence by amendment materials (OLF, PD and PM) application are presented in Table 6. There were no significant differences in particle size distribution (sand, silt and clay) when compare to the initial results on soils used for the study. The control (C) gave the highest bulk density (1.70 Mg m^{-3}), while pig manure amended soils had the least bulk density (1.44 Mg m^{-3}). Pig manure had the highest total porosity (52.5%), while the control (C) had the least total porosity (32.1 %). Soil temperature after harvest also increased from 28oC poultry droppings (PD) to 32oC in control and OLF respectively. It was also observed that, soil bulk density and temperature tended to decrease, while soil total porosity increase. This is in line with the findings of Peter and Onweremadu (2016) and Peter and Onweremadu (2019), who reported that application of organic manure as amendment materials improved the physical and chemical properties of soils supporting maize and okro. There was improvement in soil physical properties as reflected in low bulk density and high total porosity. The results also collaborated with the findings of Aluko and Oyedele (2005), who reported that soil bulk density values were lowered by application of organic amendments (Poultry manure)

Effect of amendment materials on soil chemical properties after Harvesting

Effect of the different soil amendment materials on soil chemical properties is presented in Table 7. Application of the various amendment materials as indicated that after harvest, soil pH increased from 5.3 (control) to 7.40 in soils amended with pig manure. There was a slight decrease in soil pH after crop harvest when compared to its level in soils 6WAT. This also agreed with the fact that amendment materials are good soil buffer agents to reduce soil acidity. The decline in soil pH values was also in line with the findings of Donahue (1983), who reported that crop removal leads to the washing away of highly mobile elements from the soils. Organic carbon and organic matter also decreased from 1.88 g/kg (PM) to 1.00 g/kg (C) and 1.42 g/kg (C) to 3.25 g/kg (PM) respectively. Similar trend were observed in the level of other soil chemical properties across treatments after harvest. The changes were attributable to plant uptake and crop removal after harvest.

Conclusion

The various amendment materials improved the physical and chemical properties of soils planted to sweet melon. The results showed that the different amendment materials effectively impacted on the soil physical and chemical properties. The study showed that application of the various amendment materials improved the physical and chemical properties of the soils. Therefore, the quantity of the various amendment materials added to the soils had relative influence on both soil physical and chemical properties. Poultry dropping gave appreciable influence on soils properties. It is concluded that amendment materials such as OLF, PD and PM have good fertilizing effect on soil properties. Thus, more research should be conducted on the different levels of these amendment materials bring significant improvement in soil physical and chemical properties for sustainable crop production.

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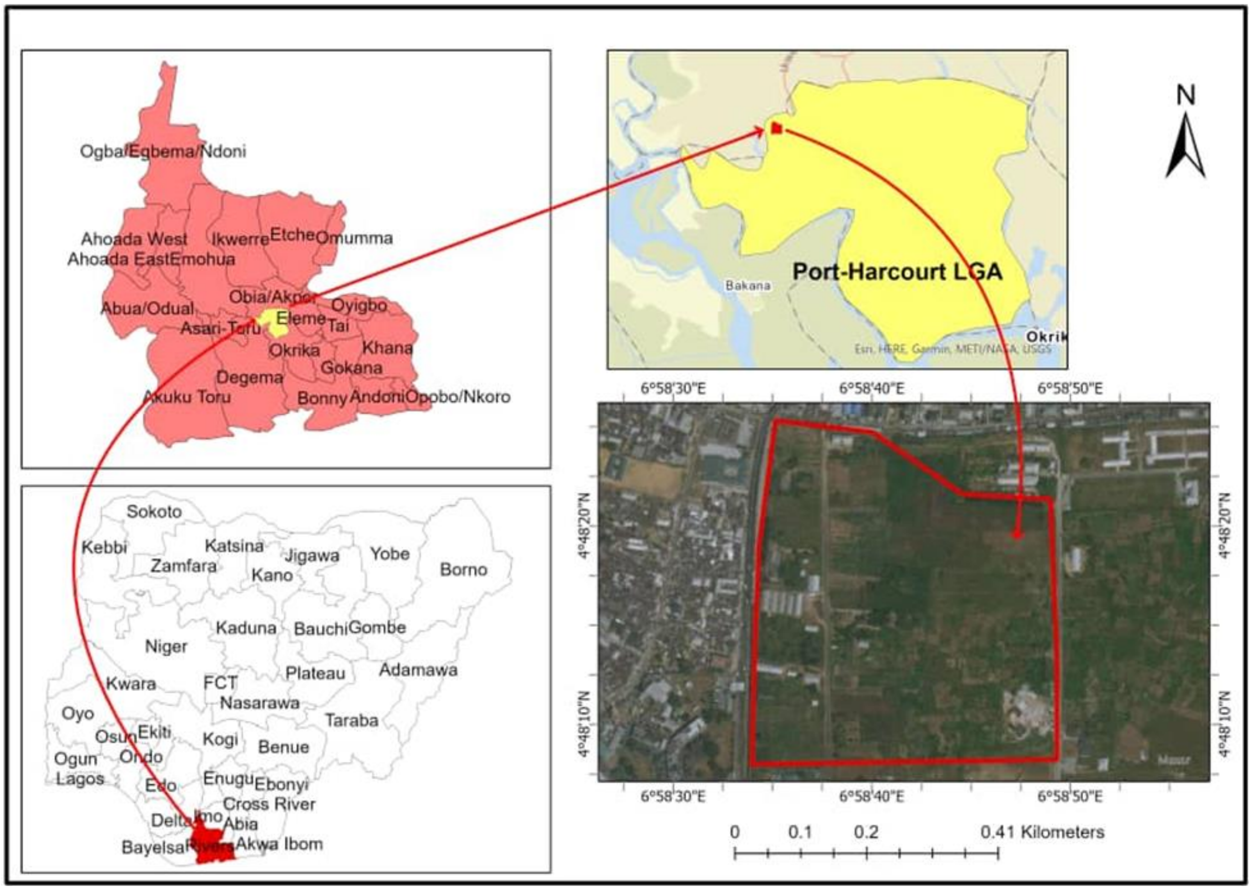

Fig 1: Map of the study area
Source: Peter, 2022

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Table 1: Initial Physical and Chemical Properties of the Imported Soils and Amendment Materials Used for the Experiment

Properties (Physical/ Chemical)	Soil	Amendment materials OLF	PM	PD
Sand	84.2	-	-	-
Silt	2.4	-	-	-
Clay	13.4	-	-	-
Textural class	LS			
Bulk density (Mg m-3)	1.87			
Total porosity (%)	36.9			
pH (H_2O)	5.50	6.1	**6.4**	**8.23**
O.C (g/kg)	1.15	6.5	**17.2**	**20.1**
OM (g/kg)	1.98			
T.N (g/kg)	0.02	16.3	**11.54**	**25.8**
AV.P (mg/kg)	0.07	0.8	**0.29**	**3.86**
Ca^{2+} (cmol)	2.2	18.1	**0.16**	**4.62**
Mg^{2+} (cmol)	0.4	10.6	**7.12**	**0.91**
K (cmol)	0.103	0.5	**0.99**	**1.2**
Na (cmol)	0.413	0.61	**057**	**0.48**
CEC ((cmol))	3.116	19.11	-	-
ECEC (Cmol)	3.786	-	-	-
Base saturation (%)	82.30	-	-	-
C/N ratio	-	0.42	-	-

OLF = Organic liquid fertilizer, **PM =** Pig manure, **PD =** Poultry dropping

Table 2: Effect of amendment materials on some Soil Physical Properties after application before transplanting

Treatment	Particle size Sand	Silt (g/kg)	Clay	TC	BD Mg m^{-3}	TP %	T 0^{oC}
C	**86.2**	**5.4**	**8.4**	**L.S**	1.79	41.2	28
OLF	**86.2**	**5.4**	**9.4**	**L.S**	1.63	41.1	28.6
P.D	**87.2**	**3.4**	**9.4**	**L.S**	1.43	40.5	32.6
P.M	**87.2**	**4.4**	**8.4**	**L.S**	1.38	49.96	33.1

C= Control, OLF = organic liquid fertilizer, PD = poultry dropping, PM = pig manure,
TC= Textural class, BD = Bulk density, TP = Total porosity, T = Temperature,

Table 3: Effect of amendment materials on soil chemical properties after application before transplanting

S/N	Treatment	pH H_20	O.C g/kg	O.M g/kg	T.N g/kg	AV.P Mg/kg	Exchangeable Cmol/kg^{-1}		Bases		CEC Cmol/kg	TEA	ECEC Cmol/kg	B.S %
							Ca^{2+}	Mg^{2+}	K	Na				
1	C	5.40	1.05	1.82	0.09	0.004	4.4	1.4	0.212	0.349	6.36	5.88	6.75	94.22
2	OLF	6.10	1.19	2.05	0.46	0.018	4.4	0.6	0.192	0.5	5.692	7.024	6.122	92.98
3	P.D	7.70	1.58	2.72	0.10	0.004	6	2.6	0.64	0.532	9.772	11.7	11.06	88.34
4	P.M	7.50	2.00	3.45	0.44	0.004	5.2	4	0.308	0.586	10.09	5.44	10.67	94.57

C = Control OLF = Organic Liquid Fertilizer PD = Poultry dropping *PM = Pig Manure, ECEC = Effective Cation Exchange Capacity CEC = Cation Exchange Capacity * TEA = Total exchangeable acidity, TN = Total Nitrogen, 0.C = Organic Carbon, B.S = Base Saturation, O.M= Organic Matter *AV.P = Available Phosphorus. TC = Textural Class, L.S = Loamy Sand.

Table 4: Effect of amendment materials on soil Physical properties Six weeks after Transplanting

Treatment	Particle size Sand	 Silt g/kg	 Clay	TC	BD Mg m^{-3}	TP %	T 0^{oC}
C	**81.2**	**6.4**	**8.4**	**L.S**	1.68	43.1	32
OLF	**86.2**	**5.2**	**9.6**	**L.S**	1,6	47.5	32
P.D	**86.2**	**4.2**	**9.6**	**L.S**	1.32	56.71	27.7
P.M	**87.2**	**5.4**	**9.4**	**L.S**	1.28	65.4	28

C= Control, OLF = organic liquid fertilizer, PD = poultry dropping, PM = pig manure,
TC= Textural class, BD = Bulk density, TP = Total porosity, T = Temperature

Table 5: Effect of amendment materials on soil chemical properties Six weeks after Transplanting

S/N	Treatment	pH H_20	O.C g/kg	O.M g/kg	T.N g/kg	AV.P Mg/kg	Exchangeable Cmol/kg^{-1}			Bases	CEC Cmol/kg	TEA	ECEC Cmol/kg	B.S %
							Ca^{2+}	Mg^{2+}	K	Na				
1	C	5.42	1.00	1.6	0.07	0.02	3.7	1.01	0.20	0.318	5.21	5.86	6.73	94.20
2	OLF	6.19	1.16	1.18	0.43	0.18	4.1	0.45	0.142	0.46	5.152	7.011	6.12	92.94
3	P.D	7.66	1.50	2.52	0.8	0.04	5.5	1.70	0.58	0.471	8.251	10.7	11.03	88.34
4	P.M	7.50	1.93	3.37	0.42	0.04	5.01	3.67	0.38	0.50	9.56	5.32	10.647	93.53

C = Control *OLF = Organic Liquid Fertilizer *PD = Poultry dropping *PM = Pig Manure, ECEC = Effective Cation Exchange Capacity CEC = Cation Exchange Capacity, TEA = Total exchangeable acidity % N = Percentage Total Nitrogen * % 0.C = % Organic Carbon * % B.S = Base Saturation * %O.M= Organic Matter, AV.P = Available Phosphorus. * TC = Textural Class. *L.S = Loamy Sand

Table 6: Effect of amendment materials on some Soil Physical Properties after harvest

Treatment	Particle size			TC	BD	TP	T
	Sand	Silt	Clay		Mg m^{-3}	%	0^{oC}
	g/kg						
C	**81.2**	**6.4**	**8.4**	**L.S**	**1.70**	**42.1**	**32**
OLF	**86.2**	**5.2**	**9.6**	**L.S**	**1.64**	**46.6**	**32**
P.D	**86.2**	**4.2**	**9.6**	**L.S**	**1.57**	**50.1**	**28**
P.M	**87.2**	**5.4**	**9.4**	**L.S**	**1.44**	**52.5**	**28.5**

C= Control, OLF = organic liquid fertilizer, PD = poultry dropping, PM = pig manure, TC= Textural class, BD = Bulk density, TP = Total porosity, T = Temperature,

Table 7: Effect of amendment materials on soil chemical properties after Harvesting

S/N	Treatment	pH H_20	O.C g/kg	O.M g/kg	T.N g/kg	AV.P Mg/kg	Exchangeable Bases Cmol/kg^{-1}				CEC Cmol/kg	TEA	ECEC Cmol/kg	B.S %
							Ca^{2+}	M_g^{2+}	K	Na				
1	C	5.3	1.00	1.42	0.05	0.013	3.6	0.96	0.14	0.28	4.7	5.81	6.65	94.05
2	OLF	6.19	1.14	1.19	0.40	0.14	3.92	0.40	0.13	0.41	4.86	6.92	6.10	93.10
3	P.D	7.26	1.50	2.21	0.72	0.028	5.35	1.70	0.58	0.471	8.10	10.00	11.92	88.21
4	P.M	7.40	1.88	3.25	0.40	0.031	4.87	3.45	0.36	0.49	9.17	5.12	10.61	91.4

C = Control *OLF = Organic Liquid Fertilizer *PD = Poultry dropping *PM = Pig Manure * ECEC = Effective Cation Exchange Capacity CEC = Cation Exchange Capacity * TEA = Total exchangeable acidity * % N = Percentage Total Nitrogen * % 0.C = % Organic Carbon * % B.S = Base Saturation * %O.M= Organic Matter AV.P = Available Phosphorus. * TC = Textural Class. *L.S = Loamy San