Innovations

The Impact of Some Wastes, on Selected Physical Properties of Soil, Growth and Yield of Maize (Zea mays L), in Asaba

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Abstract: *Deformations of soil physical properties may decline most physical strength and is manifested by reduction of wet aggregate stability, rising in soil bulk density and clod density, decline in total porosity, an increase in modulus of rupture, decline in hydraulic conductivity and increasing root penetration resistance which hampers growths and yields of crops in any environment. Organic matter derivable from organic residues and wastes are important factor in soil reclamation using organic matter derivable from organic residues and wastes. This work was established to determined the impact of hotel food wastes, swine droppings and bat wastes on sensible elements (physical), growth and maize yield in 3 seasons. The research was experimented at the Teaching and Research establishment of Delta State University, Asaba. Materials and methods: Maize seeds were collected from the Ministry of Agriculture. Seeds were air dried before planting. Organic wastes materials such as hotel food wastes was sourced from various hotels while swine wastes and bat wastes were collected from Department of Animal Science, Delta State University, Asaba. Soil samples were collected at the depth of 0-30cm from disturbed and undisturbed sites. Results generally indicated that all parameters studied were substantially improved in plots amended with bat wastes (T_3= BW) relative to other treatments. In this results, significant differences only existed among treatments in soil physical properties in cropping season 1and among agronomic parameters studied, significant differences only existed among treatments on maize germination while non significant differences was shown in other agronomic attributes. Highlights: After the end of 3 cropping seasons experiment, this results indicated that bat wastes gave maximum productivity of all parameters studied than control.*

Key words*: Hotel food, wastes, sensible elements, swine droppings, growth, yield and bat wastes*

1 Introduction

Losses of nutrients and deformations of soil physical status may hamper growths and yields of cereal crops. Organic materials which are also attributed to as soil fertility improvers (Oyetunji *et al.,* 2001). Organic materials applied into soils, is not only important for nutrients supply to crops, but also essentially for sustainability and maintenance of physical properties such as soil bulk density, total porosity, moisture content, hydraulic conductivity, penetrometer resistance, soil aggregate stability and particles size distribution (Onyibe *et al.,* 2021) Applied organic materials into soils, could also be essential in the rehabilitation of degraded soils (Alemayehu *et al.,* 2016). Decline in most physical strength is manifested by reduction of wet aggregate stability, rising in SBD and clod density, decline in total porosity, an increase in modulus of rupture, decline in HC and increasing root penetration resistance (Iren. *et al.,* 2015). An important factor in soil reclamation using organic matter derivable from organic residues and wastes, is its role in improving soil physical parameters by forming stable aggregates for an improved soil structure, buffer the soil, increasing the population of soil micro organisms and enhance water retention capacity (Spaccini, *et al.,* 2002; Ogunlade, *et al.,* 2006; Olatunji, *et al.,* 2006). Several agricultural wastes have been used as wastes. These wastes include fruit and vegetable wastes which contains considerable amount of organic nutrients that is beneficial for soils and crop productivity (Iren. *et al.,* 2015; Agama, *et al.,*2016). Also, in relations to other wastes, Onyibe, *et al*., (2021) reported that yam peels as plant residue increased soil fertility and crop production relative to control. According to Igboji and Onyibe, (2019) observed and explained that the use of rice husk dust decomposed with human urine significantly improved soil physical attributes more than untreated soils. Underground application wastes for maize production and other crops, provides an environment favorable for crop growth. Uses of wastes improved soil water content, reduce run-off, increased the rate of infiltration, lowers evaporation, reduces weed growth, increased growth of crops and yield (Amenkhienan, 2018; Teame, *et al.,* 2017). Famers are actively involved in agricultural production of fruit crops and vegetable maize, okra, tomatoes etc. in Nigeria but the socio-economical conditions have constrained them and they lack access to scientific and technological information that could enhance their production capacity of cereal crops (Olaniyi and Adewale, 2012). Maize is an important member of the grass (Graminaea) family which originated from South and Central America. It was introduced to West Africa by the Portuguese in the 10th century. Maize is an important grains in Nigeria, not only to the farmers that engage in its cultivation, but also to its economic value. Maize being an important cereal crop is cultivated in the rain forest and the derived savannah zones in Nigeria. It started as a subsistence crop and has gradually become more an important crop. Maize has now risen to a commercial crop on which many agro-based industries depend on as raw materials (Iken and Amesa, 2004). Maize is highly yielding, easy to process, readily digested and cost less than other cereals. It is also a versatile crop allowing it to grow across a range of agro-ecological zones (Olaniyi and Adewale, 2012). For maintenance of a meaningful sustainable and high productivity in agricultural lands, the research therefore determined the impact of hotel food wastes, swine droppings and bat wastes on the physical parameters in an aflfisol, growth and yield of maize, in Asaba, Delta State.

II. Materials and Methods

A. Site location

The research was experimented at the research site of Agronomy Department, Delta State University, Asaba. The research farm was located at latitude 16^{o}14^{l} N and 6^{o}49 ^{l} E. The area is characterized by bimodal pattern of rainfall with peak in July and September (NIMET, 2015). Annual rainfall ranges from 1,550 – 1,1847mm with temperature 27^{0}C and humidity ranges from 65-85%. The area is mainly of secondary habitation of plants. The texture of the area, is coarse sand and the nature of the land have smoothly rising and falling with rolling hills. Initial soil testing; before the preparation of land, soils were collected randomly at the depth of 30cm using soil augar. Soil collected, were bulked and thoroughly mixed to prepare a composite sample. This composite sample was oven dried at 105^{o}C, crushed, passed through a 2mm sieve mesh and was packaged for laboratory test.

B. Materials

Maize variety known as oba supper II was collected from the Ministry of Agriculture. Seeds were air dried before planting. Also, organic wastes materials such as hotel food wastes was sourced from various hotels, swine wastes and bat wastes were collected from Department of Animal Science, Delta State University, Asaba.

***C. Methods*:**

Preparation of land**;** site was cleared of existing bush and debris were removed from the site and was portioned in plots of 2m x 2m (4m2) in size. The ground plan of the study, was demonstrated in a Randomized Completely Block Design (RCBD) along side 4 treatments; (T0=Control), (T1=hotel food wastes(10kg), (T2 = swine droppings(10kg) and (T3 = bat wastes(10kg) with 3 replicates.

D. Physical properties studied

Bulk density (g/cm^3) at 9 WAP was described, measured and calculated with a modified procedure by Nnabude and Mbaqwu, (1998) as stated;

$$D_b = \frac{MS}{V_b}$$

Where, D_b = Bulk density, M_s = Mass of soil and V_b = Volume of core sample

Total porosity(%) was determined from bulk density (D_b) values with assumed P^d of 2.65g/cm^3 and was calculated using the stated formula;

$$T_P = \frac{(1 - \text{Dry Bulk density})}{\text{Particle density}} \times \frac{100}{1}$$

Moisture content (%) was measured at interval of 9 WAP and determined with the pressure plate apparatus as stated by Klute, (1986)

E. Growth parameters studied

Germination count(%) was measured at 2WAP and calculated using the formula below;

$$\frac{\text{Number of plant germinated}}{\text{Total number of plant planted}} \times \frac{100}{1}$$

Height of maize stands: Five plants of maize were randomly selected and tagged and measured from the base of the maize plants to its apex, for 6WAP and 9WAP were used to ascertain maize height in various plots. Number of maize leaves were also randomly selected from the 5 tagged maize stands and were used to determine the number maize of leaves according to plots. Total leaves were counted, added together and divided by the selected 5 maize stands and average was recorded according to plots for the periods of 6WAP and 9WAP. Using the same five tagged maize stands, leaf area was computed and calculated at 6WAP and 9WAP by $LA=0.34(LW)^{1.12}$, where L= Length and W= Width. Stem girth**: T**his is the measurement of distance around plant stem or trunk of a tree. The same selected 5 tagged maize stands, determined maize stem girth using meter tape, recorded and average was taken in various plots through 6WAP and 9WAP and grain yield was computed at harvest.

F. Analysis of Data

Collected data for physical and growth parameters, were statistically examined through Analysis of Variance (ANOVA) as reported and reformed by Steven Sawyer, (2009) while means were distinguished and reported at significance of 5% probability level.

III Results and Discussion

Reports of wastes material used are stated that highest pH, TN, OM, K, Mg and Ca registered, were 5.88 (H_2O), 10.6 %, 80 %, 2.4 cmolkg^{-1}, 2.2 cmolkg^{-1} 2.2 cmolkg^{-1} 1.2 cmolkg^{-1} and 1.1 respectively for bat waste materials while hotel food wastes was maximum with 5.40 mgkg^{-1} for AP.

Table 1: Results of chemical compositions of organic materials (Hotel food wastes, swine wastes and bat droppings) used for the experiment.

Chemical properties	Hotel food wastes	Swine droppings	Bat wastes
pH	5.65	5.60	5.88
Total nitrogen	9.40	9.70	10.6
Avail phosphorus	5.40	3.12	3.24
Organic matter	78	72	80
Potassium	2.04	2.10	2.4
Calcium	1.1	1.11	1.2
Magnesium	1.0	1.1	2.2

Nutrient element values of organic wastes used.

Tables 2 – 4 estimated bulk density values, ranging from 1.33 - 1.58 g cm^{-3} (CPS 1), 1.30 - 1.55 g cm^{-3} (CPS 2) and 1.28 – 1.55 g cm^{-3} (CPS 3) successively at 6 and 9WAP as minimum values were registered under treated plots of bat wastes and maximum values were recorded in control plots with percent increase 7.3% - 8.9%. Values of total porosity and moisture content were significantly increased in treated plots relative to the control with values ranging from 40.4 - 49.8 % and 34.2 – 46.2 % in CPS 1 and in CPS 2, values ranged from 41.5 – 50.9 % and 35.2 – 48.2 % respectively at both 6 and 9WAP while TP and MC values recorded in CPS 3, ranged from 41.9 – 51.7 % and 35.8 – 49.5 % (6 and 9WAP) with percent increasing range of 8 - 10 % (TP) and 13- 13.9 % (MC). Bulk density decrease in the treated plots and the increase in the control is an indication that bulk density is a major determinant for total porosity and moisture content increase because, as bulk density decreases, total porosity, moisture content, hydraulic conductivity, penetration resistance and infiltration rate increases. According to the trend of Bd decrease as against total porosity and moisture content in the first, second and third cropping season, displayed that; T_3(BW) < T_2(SD) < T_1(HFW) < T_0(control) in all the sampling (6 & 9WAP) while the trend in the increase for total porosity and moisture content had an opposite direction of increase as; T_3(BW) > T_2(SD) > T_1(HFW) > T_0(control) in all the sampling (6 & 9WAP) of all the CPS. Results presented (Table 2 - 4), indicates that organic materials released to soil, improved all physical characters studied. Present study, collaborates with Mahmoodabadi *et al.,* (2013) that addition of manure as similar trend in minimizing soil BD, increasing TP, soil OC and also increased SMC. Similar results were also found by Sabir, Ziaur-Rehman, (2015) and Nest *et al.,* (2016). It has also been proven that organic additives reduces soil compactness (bulk density) by improving soil aeration, increasing TP and SMC through water penetration into the soil (Kuncoro *et al.,* 2014). Residue materials incorporated into soils, improves SMC which also formally decreases BD and increased soil TP. In agreement with this experiment, was the experiment carried out by Mbah and Mbagwu, (2006).

Table 2: Impact of hotel food wastes, swine dropping and bat wastes on bulk density, total porosity and moisture content at 6WAP and 9WAP in cropping season 1

Treatment	Bulk Density		Total Porosity		Moisture content	
	6 WAP	9 WAP	6 WAP	9 WAP	6 WAP	9 WAP
T_0 (control)	1.58	1.58	40.4	40.4	34.2	34.2
T_1 (HFW)	1.38	1.34	47.9	49.4	42.8	45.6
T_2 (SD)	1.40	1.38	47.2	47.9	40.8	42.8
T_3 (BW)	1.36	1.33	48.7	49.8	44.2	46.2
FLSD	1.81	1.21	0.97	0.61	0.80	0.56

HFW=Hotel food wastes, SD=Swine droppings and BD=Bat wastes.

Table 3: Impact of hotel food wastes, swine dropping and bat wastes on bulk density, total porosity and moisture content at 6WAP and 9WAP in cropping season 2

Treatment	Bulk Density		Total Porosity		Moisture content	
	6 WAP	9 WAP	6 WAP	9 WAP	6 WAP	9 WAP
T_0 (control)	1.55	1.54	41.5	41.9	35.2	35.8
T_1 (HFW)	1.36	1.32	48.7	50.2	44.4	46.6
T_2 (SD)	1.38	1.35	47.9	49.1	42.5	45.4
T_3 (BW)	1.34	1.30	49.4	50.9	40.8	48.2
FLSD	ns	Ns	Ns	Ns	ns	ns

HFW=Hotel food wastes, SD=Swine droppings and BD=Bat wastes.

Table 4: Impact of hotel food wastes, swine dropping and bat wastes on bulk density, total porosity and moisture content at 6WAP and 9WAP in cropping season 2

Treatment	Bulk Density		Total Porosity		Moisture content	
	6 WAP	9 WAP	6 WAP	9 WAP	6 WAP	9 WAP
T_0 (control)	1.55	1.53	41.9	42.3	35.8	37.4
T_1 (HFW)	1.34	1.30	49.4	50.9	45.6	48.2
T_2 (SD)	1.36	1.33	48.7	49.8	44.4	45.9
T_3 (BW)	1.32	1.28	50.2	51.7	46.6	49.5
FLSD	ns	Ns	Ns	Ns	ns	ns

HFW=Hotel food wastes, SD=Swine droppings, BW=Bat wastes and CPS 3=Cropping season 3.

Estimates of percentage germination as stated in Tables 5 – 7 in the 1st, 2nd and 3rd CPS, ranged from 70 % - 100 % of which T_3(BW) was highest with 100 % while control plots was lowest of 70 and 85 % in all the cropping seasons with significant differences *(P>0.05)* among treatments. In the 1st CPS, germination was improved more under T_3(BW) than T_0 (control), T_2(SD) and T_1(HFW) by 13.3%, 7.11% and 5.4% and in all CPS, the sequence of increment indicated that T_3(BW)> T_1(HFW)> T_2(SD) > T_0(control) respectively. At 9WAP, where the highest maize germination occurred in T_3(BW), had percent increase of 17.6% over all other treatments. Maize height through 6WAP and 9WAP as represented in all CPS (Table 5 - 7). Maize height showed significant differences (P>0.05) among treatments in all cropping seasons at various periods of planting (6WAP and 9WAP) with range of 70 – 114 cm treated soils of bat wastes had highest results while control was lowest with 70 cm. At the first CPS, T_3(BW) ranked over (T_1(HFW), (T_2(SD) and control by 5.9 %, 9.1 % and 12.9 % while in the 3rd CPS at 6WAP and 9WAP, T_3(BW) with highest in all the height by 114 cm, increased above control with 85 cm by 16.9 % and 14.6 %. The array of increment among treatments in all the cropping seasons (first – third CPS) had its pattern as T_3(BW)>T_1(HFW)>T_2(SD)> T_0(control) accordingly. Percentage germination and height of maize as indicated (Table 5 - 7), showed significant increase in soils amended with wastes materials than control. Highest estimates for germination count and height occurred under plots amended with bat wastes. It was discovered that germination count was not able to attain 100% rate in the first cropping, either because of un-viability, weak nature of some plant seeds used for planting and negative environmental influence on the plant seeds and inadequate nutrient availability in the first season. Nevertheless, after the second and third application of organic wastes both parameters increased which gave rise to improved values for amended plots that ranked higher because of increased nutrient availability via organic residues than the (T_0(control). Increased germination and height in amendment plots, may likely be associated with increased nitrogen, potassium, SOM content and most important micro-nutrients which are contained in bat manure. Studies have indicated that applications of organic wastes helps soil to improve seed germination and increase height of plants and other growth parameters (Taiwo and Awodoyin, 2005). According to Rehman *et al.*, (2016), crop height and seed germination were increased with the addition of farm manure over control. Application of food wastes as soil amendments, increased seed germination and melon plant height over control (Nathan *et al.,* 2005) similar result was obtained by Xu, (2000).

Table 5: Impact of hotel food wastes, swine droppings and bat wastes on percentage germination count at 1WAP and height of plant at 6 and 9WAP in first cropping season

Treatments	2WAP Germ%	6 WAP Height (cm)	9 WAP Height (cm)
T_0 (control)	75	70	85
T_1 (HFW)	85	80	88
T_2 (SD)	88	75	96
T_3 (BW)	98	90	105
FLSD	2.31	1.32	1.14

HFW=Hotel food wastes, SD=Swine droppings and BW=Bat wastes

Table 6: Impact of hotel food wastes, swine droppings and bat wastes on percentage germination count at 1WAP and height of plant at 6 and 9WAP in second cropping season

Treatments	2WAP Germ%	6 WAP Height (cm)	9 WAP Height (cm)
T_0 (control)	70	70	85
T_1 (HFW)	98	90	96
T_2 (SD)	92	80	88
T_3 (BW)	100	94	105
FLSD	2.31	1.32	1.14

HFW=Hotel food wastes, SD=Swine droppings and BW=Bat wastes

Table 7: Impact of hotel food wastes, swine droppings and bat wastes on percentage germination count at 1WAP and height of plant at 6 and 9WAP in third cropping season

Treatments	2WAP Germ%	6 WAP Height (cm)	9 WAP Height (cm)
T_0 (control)	78	74	85
T_1 (HFW)	100	101	110
T_2 (SD)	98	95	100
T_3 (BW)	100	104	114
FLSD	2.31	1.32	1.12

HFW=Hotel food wastes, SD=Swine droppings and BW=Bat wastes

Obtained estimates for maize girth, leaf area, number of leaves and grain yield in first, second and third cropping seasons showed non significant differences ($P<0.05$) in midst of treatments, of all sampling periods (Table 8 - 10). In the CPS, both periods (6WAP and 9WAP) recorded maize girth of 6.5 cm and 8.2 cm for To (control) as lowest to 10.5cm and 11.5cm for T_3(BW) as maximum values. Illustrating the trend of increase in all cropping seasons for the period of growth, was obtained as; T_3(BW)> T_1(HFW)> T_2(SD)> To(control) respectively and T_3(BW) ranked over To(control), T_2(SD) and T_1(HFW) by 23.52%, 7.7% and 5% through 6WAP and by 9WAP, T_3(BW) was raised more by 14.6%, 4.8% and 3.8% than those same respectively. Treatments of T_3(BW) obtained maximum maize girth and lowest was under control. In the 2nd and 3rd CPS, stem girth ranged from 6.7 – 12. 2 cm and 7.0 – 12.6 cm in control as lowest and in T_3(BW) as from 6WAP to 9WAP and a similar trend of increase was observed. Observed percent increase from these cropping seasons showed and revealed that T_3(BW) was higher than control in the 2nd and 3rd CPS by 29.1% and 28.6% accordingly.

Maize leaf area through 6WAP and 9WAP, in the 1st, 2nd and 3rd CPS ranged from 136.3 and 143.7 cm to 160 and 163.3 cm, from 136.9 and 144.2 cm to 167.4 and 170.2 and finally from 137.0 and 144.4 to 174.2 and 178.7 respectively in control to treated plots of bat wastes (T_3(BW). In all the cropping seasons (1st – 3rd CPS), percent increase for 6WAP and 9WAP indicated that (T_3(BW) was elevated more than control by 7.99 % and 11.9 % in 1st cropping seasons, 10.2 % and 8.3% in 2nd CPS and 11.9 % and 10.67% accordingly in 3rd CPS. Obtained number of maize leaves by 6WAP and 9WAP in the first, second and third cropping seasons showed that in Tables 8 – 10, the apex of all the treatments, was rated in soils treated with bat wastes while least occurred in control. Values of number of maize leaves recorded through 6WAP and 9WAP in 1st CPS were 8 and 12 for To(control), 10 and 14 for T_1(HFW), and 10 and 15 for T_2(SD) and finally 12 and 16 for T_3(BW) respectively. Among all these treatments, T_3(BW), increased over other treatments like T_0(Control), T_2(SD) and T_1(HFW) by 20%, 9.1% and 9.1% through 6WAP and was by 14.3%, 6.7% and 6.7% at 9WAP respectively. Number of maize leaves in 2nd and 3rd cropping seasons ranged from 9 and 12 to 14 and 22 accordingly at 6WAP and 9WAP. The percent increase indicated that bat wastes treated soils supersede control by 33.34% (6WAP) and by 37.5 % at 9WAP and the increasing pattern among treatments illustrated that T_3(BW) > T_1(HFW) > T_2(SD) > T_0(Control) as indicated in Tables 8 – 10. Grain yield (tons/ha) as indicated in Tables 8 – 10, was rated highest among other treatments. Obtained grain yield ranged from 6.10 tons in T_0(Control) as lowest to 10.3tons in T_3(BW) being the highest. All the cropping seasons at harvest (9WAP) gave an increasing order of arrangement within treatments as; T_3(BW) > T_1(HFW) > T_2(SD) > T_0(Control) and T_3(BW) increased over T_2(SD) and T_1(HFW) including T_0(control) by 9.12%, 11.62% and 25.72%. Tables 8 – 10 displayed values of grain yield in the 2nd and 3rd cropping seasons at harvest (9WAP) ranged from 6.2 and 6.3 tons for control (lowest) to 11.3 and 11.9 tons (highest). The increasing order of treatments expresses the following direction; T_3(BW) > T_1(HFW) > T_2(SD) > T_0(Control) with percent increase of 25.61%, 29.14 % and 29.8 % against control. The following agronomic parameters (maize girth, area of leaf, number of leaves and grain yield) as stated by the results (Table 8 - 10), were highest with bat waste, followed by hotel food wastes and least of them occurred under swine wastes treatment (T_2(SD). However the nutrient rates of the wastes (bat wastes, hotel food wastes and swine droppings) incorporated, generally improved all growth variables. The reason for highest maize grain to have occurred in plots T_3(BW), may be identified from increased essential nutrients of the incorporated materials, reduction in SBD, increase in TP and SMC which may also have been the reason for the increase. In this regard, improved organic matter usually results to reduced bulk density, higher air filled porosity and high moisture content to increase in crop production was also reported by (Akinrende, 2006). Also, relating to a research conducted by Kibria, *et al*., (2013) and Iren *et al*., (2015), disclosed that poultry manure, as soil amendments significantly increased number of maize leaves, and leaf area index of water leaf and most vegetable crops. Long term residual effects on manure couple with slow release pattern of its nutrients, resulted and contributed to a substantial enhancement of height, number maize leaves, leaf area and height yield of water leaf plant (Isitekhale *et al*., 2014).

Table 8: Impact of hotel food wastes, swine droppings and bat wastes on Stem girth, Leaf area, Number of leaves at 6WAP and 9WAP and Maize grain yield (kg/plot) in first cropping season

Treatment	Maize stem girth (cm)		Maize Leaf area (cm)		Number of maize leaves		Grain yield (tons/ha)
	6 WAP	9WAP	6 WAP	9 WAP	6WAP	9 WAP	9WAP
T_0(control)	6.5	8.2	136.3	143.7	8	12	6.10
T_1 (HFW)	9.5	10.2	146.3	158	10	14	8.6
T_2 (SD)	9.0	10	137.6	144.7	10	15	8.2
T_3 (BW)	10.5	11.5	160	163.3	12	16	10.3
FLSD	ns	Ns	Ns	Ns	ns	ns	ns

HFW=Hotel food wastes, SD=Swine droppings and BW=Bat wastes

Table 9: Impact of hotel food wastes, swine droppings and bat wastes on Stem girth, Leaf area, Number of leaves at 6WAP and 9WAP and Maize grain yield (kg/plot) in second cropping season

Treatment	Maize stem girth (cm)		Maize Leaf area (cm)		Number of maize leaves		Grain yield (tons/ha)
	6 WAP	9WAP	6 WAP	9 WAP	6WAP	9 WAP	9WAP
T_0(control)	6.7	8.5	136.9	1.44.2	9	12	6.20
T_1 (HFW)	9.8	10.9	148.4	159.9	12	17	9.7
T_2 (SD)	9.5	10.4	142.2	150.5	11	16	8.4
T_3 (BW)	10.7	12.2	167.4	170.2	13	18	11.3
FLSD	ns	Ns	Ns	Ns	ns	ns	Ns

HFW=Hotel food wastes, SD=Swine droppings and BW=Bat wastes

Table 10: Impact of hotel food wastes, swine droppings and bat wastes on Stem girth, Leaf area, Number of leaves at 6WAP and 9WAP and Maize grain yield (kg/plot) in third cropping season

Treatment	Maize stem girth (cm)		Maize Leaf area (cm)		Number of maize leaves		Grain yield (tons/ha)
	6 WAP	9WAP	6 WAP	9 WAP	6WAP	9 WAP	9WAP
T_0(control)	7.0	8.7	137.0	144.6	8	12	6.3
T_1 (HFW)	10.2	11.6	153.8	166.8	13	20	10.5
T_2 (SD)	9.8	11	146.3	157.2	13	18	9.2
T_3 (BW)	11	12.6	174.2	178.7	14	22	11.9
FLSD	ns	Ns	Ns	Ns	ns	ns	Ns

HFW=Hotel food wastes, SD=Swine droppings and BW=Bat wastes

IV. Conclusion

In this work, noted values for bulk density, total porosity and moisture content studied were significantly enhanced in plots amended with swine droppings compared to other treatments. Agronomic parameter studied were greatly improved and risen by values of the three amended treatments (Hotel food wastes, swine droppings and bat wastes). Though, among these three treatments, bat wastes gave highest while swine droppings followed. Based on the best outcome of the three treatments, both bat wastes and swine droppings could be incorporated into serious organic farming system for the maintenance of soil physical properties and maize cultivation. This is because of high SOM content, high nutrient elements with reference to nutrients composition of the incorporated materials.

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References

1. *Agama, Acevedo. E., Sanudo-Barajas, J. A., Velez-de-la, Rocha, R.,Gonzalez-Agurlar, G. A., Bello-Perez, L. A. (2016). Potential plantain peels flour (Musa paradisiacal L.) as a source of dietary fiber and antioxidant compound Cyta. Journal Food. 14(1); 117-123.*
2. *Akinrinde, E.A (2006). Evaluation of the fertility status of selected soil for crop production on five ecological zone of Nigeria. Proceedings of the 26th Annual Conference of Soil Science Society of Nigeria. October, 30th November 3, 2000, Ibadan, Nigeria. 279-288*
3. *Alemayehu, K., Sheleme, B and Schoenau, J (2016). Characteristics of problem soils in and around the South Central Ethiopia Rift Valley. Journal of Soil Science and Environmental Management. 7(11); 191-203.*
4. *Aluko, O. B and Oyeleke, D. J (2005). Influence of organic wastes incorporation on changes in selected soil physical properties during drying of a Nigerian alfisol. Journal of Applied Sci. 5, 257-362.*
5. *Amenkhienan, B (2018). Influence of cassava peels on some physical properties, maize growth and yield in an ultisol. International Journal of Innovation Agriculture Biological Resource. 6(3); 31-38.*
6. *Ano, A. O and Agwu, J. A (2006). Effects of animal manure on selected soil properties: Nitrogen, potassium and phosphorus. Nigeria Journal of Science. 16; 145-150.*
7. *FAO, (2017). Food and Agriculture Organization of the United Nation. World food production on maize and paddy production, 2017.*
8. *FAOSTAT, (2012). Food and Agriculture Organization Statistics. Production quantities of grain of maize and rice by countries from 1994-2012.*
9. *IITA, (2008). International Institute of Tropical Agriculture, Nigeria. Selected Procedures for Plants and Soil Analysis. Revised Journal Manual Series No 1, 2008.*
10. *Igboji, P. O and Onyibe, C. E (2019). Physical fertility of an ultisol enhanced by application of urine decomposed rice husk dust in Abakaliki Southeastern Nigeria. Acta Scientific Agriculture (ISSN: 2581- 365X) Vol. 3(2); 162-170*
11. *Iken, J. E and Amusa, N. A (2004). Maize research and production in Nigeria. African Journal of Biotechnology 3(6); 302-307, June 2004. Available online 2004 Academic Journals*
12. *Iren, O. B., Akpan, J. F., Ediene, V. F and Asanga, E. E (2015). Influence of cassava peels and poultry manure based compost on soil properties, growth and yield of waterleaf (Talinumtrianguleréjacq) in an ultisol of Southeastern Nigeria. Journal of Soil Sci. and Environ. Management 6(7); 187-194.*
13. *Isitekhale, H. H. E., Aboh, S. I and Ekhomen, F. E (2014). Soil suitability evaluation for rice and sugarcane in lowland soils of Anegbette, Edo State, Nigeria. International Journal of Eng. Science 3(5); 54-62.*
14. *Juma, C (2010). Incidence of Fusarium Species and levels of Fumonisium B1 in Sorghum and Finger Millet in Western Kena. Thesis for the Degree of Masters of Science (Plant Pathology) of Kenyatta University.*
15. *Kuncoro, P. H., Koga, K., Satta, N and Muto, Y (2014). A study on effect on compaction on transport properties of soil gas and water 1: Relative gas diffusivity, air permeability and saturated hydraulic conductivity. Soil and Tillage Research. 143.1/2-1/9 Doi: 10 1016/still 2014 02 006.*
16. *Mbah. C. N and Mbagwu, J. S. C (2006). Influence of organic wastes on plant growth parameters and nutrients uptake of maize (Zea mays L). Nigeria Journal of Soil Sci 16, 104–108*
17. *Mohamoodabadi, M., Yazdanpanah, N., Sinobas, L. R., Pazira, E and Neshat, A (2013). Reclamation of calcareous saline sodc soil with different amendments (1): redistribution of soluble cation within the soil profile. Agricultural Wastes Management. 120, 30-38.*

18. *Nathan, E. M., Christopher, J. S., Robert, J. K and Lewis W.J (2005). Effects of a food wastes-based soil conditioner on soil properties and plant growth.*
19. *Next, T. V., Ruyaschaert, G., Vandecastocle, B., Houot, S., Baken, S., Smolders, E., Counon, M., Reheul, D and Merekx, R (2016). The long term use of farm yard manure and compost effect on permeability, orthophosphate sorption strength and P leaching in Agriculture. Ecosystem and Environment 216: 23-33.*
20. *NIMET (Nigerian Meteorological Agency, (2015).Undertaking Seasonal Rainfall Prediction on weather and climate information and services.*
21. *Nnabude, P. C and Mbagwu, J. S. C (2001). Physical chemical properties and productivity of a Nigerian Typic Haplunstult amended with fresh and burnt rice will waste. Bio Resource Tech. 76, 265-272.*
22. *Ogunlade, M. O., Adeoye, G. O., Ipinmoroti, R. R., Ibiremo, and IIoyanomon, C. I (2006). Comparative effect of organic dung and NPK fertilizers on the growth and nutrient uptake of cocopa seedlings. Nigeria Journal Soil Sci. 16, 121- 125*
23. *Olaniyi, O. A and Adewale, J. G (2012). Information on maize production among rural youth: A solution for sustainable food security in Nigeria*
24. *Olatunji, O., Ayuba, S. A and Obeh, V. J. J (2006). Okra growth and yield and tomatoes as affected by pig dung and organic manures; Issues for Economic consideration in Benue State. Proceedings Of 30th Annual Soil Science Society Conference of the of Nigeria, 5th -9th Dec. 2006, held at the University of Makurdi Agriculture, Makurdi. Pp 91-98.*
25. *Onyibe, C. E., Alama, I. S. and Umukoro, P. O (2021). Influence of selected forms of yam peels on the physical parameters of an Alfisol and okra growth in Asaba, Delta State, Nigeria. Journal of Agriculture and Food Environment. 8(4); 44-53.*
26. *Oyenitunji, O. I., Ekanakay, I. N and Sonubi, O. O (2001). Influence of yam fungi on cassava – maize inter crop in an alley cropping system. Proceedings of Africa Crop Science Conference Uganda.*
27. *Sabir, M., Zia-ur-Rehman, M (2015). Phytoremediation of metal contaminated soil using organic amendments. In Hakeen, K., Sabir, M and Mermutt, A (eds). Soil remediation and plant propect and challenge. Academic Press. Cambridge 503-523.*
28. *Spaccini, R., Piccolo, A., Mbagwu, J. S. C., Zen-Teshale, A., Igwe, C. A (2002). Influence of the addition of organic residues carbohydrates content and structural stability of some highland soil Ethiopia. Soil Use Management, 18, 404- 411.*
29. *Taiwo, L. B and Awodoyin, R. O (2005). Comparative effect of Apronplus 50DS and soil amendment on the growth, yield and food components of soybean. Africa Journal of Biotechnology. 2005. 4(12), 1396-1400*
30. *Teame, G., Tsegay, A and Abrha, B (2017). Effect of organic mulching on soil moisture yield contributing components of sesame (Sesanium indicum L.). International Journal of Agronomy 2017: 1-6.*
31. *Xu, H (2000). Effects of a microbial inoculants and organic fertilizers on the growth, photosynthesis and yield of sweet corn. Journal of Crop production, 3, 255-268.*