Nigerian Journal of Soil Science 25 (2015) 80 – 94

Nigerian Journal of Soil Science

Journal homepage:www.soilsjournalnigeria.com

IMPACT OF COMPOSTED OIL PALM WASTES ON SOIL PHYSICAL PROPERTIES, ORGANIC MATTER CONTENT AND GROWTH OF OIL PALM SEEDLINGS UNDER DIFFERENT MOISTURE REGIMES

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ABSTRACT

A greenhouse study was conducted at the University of Nigeria, Nsukka to evaluate the effect of composted oil palm bunch waste for improvement of somesoil physical properties, organic matter status and growth of oil palm seedlings under different water management conditions. The experiment was a 4 x 3 factorial fitted into completely randomized design with three replications. It consisted of 2 factors–composted oil palm bunch waste and irrigation intervals. Composted oil palm bunch waste was applied at 0g, 100g, 200g and 300g/seedlings/polybag. The different moisture regimes were imposed by observing irrigation intervals of 7days, 14days and 21days after irrigating the soil in the polybag to field capacity water content. Result showed that every 14 day intervals of irrigation significant ($P<0.05$) gave the lowest bulk density, as well as highest aggregate stability, mean weight diameter and organic matter compared to 7 and 21 day intervals of irrigation. Similarly, every 14 days irrigation intervals showed ($P<0.05$) effect on all growth parameters of oil palm seedlings throughout the growth period. However, lowest ($P<0.05$) bulk density,dispersion ratio as well as highest ($P<0.05$)aggregate stability; mean weight diameter and soil organic matter were observed with the highest rates of 300gcompost/polybag compared to other compost rates. Result also indicated that the application of 300gcompost/seedlings gave highest ($P<0.05$) effect on all growth parameters studied compared to other compost application rates Generally, the application of 300g compost/seedlings/polybag was most effective in improving the soil properties and growth of oil palm seedling under 14 day irrigation intervals.

INTRODUCTION

Tropical soils are highly susceptible to degradation under continuous cultivation without putting conservation measures in place. Ultisols, a prominent soil order within the tropics are subject of low productivity and soil degradation, and exhibits characteristics that makes its management important. These characteristics include low water holding capacity, poor surface soil stability and relatively high bulk density (Babalola and Obi, 1981).They are also coarse-textured with low organic matter content (Igweet al., 1995; Mbagwuet al., 1995). As human populations are increasing more lands are being brought under cultivation, including marginal lands that are practically vulnerable to degradation by such processes as erosion, depletion in soil organic matter and nutrient (Owinoet al., 2006). To increase soil productivity and crop yields farmers now apply mineral fertilizer. However, continuous usage of these mineral fertilizers has been found to decrease base saturation, increase acidification and physical degradation (Isherwood, 2008).

Researchers (Aoyama et al., 1999; Olayinka, 2009) have recommended the application of organic manures to tropical soils as sources of nutrients because of the inherently low organic matter content, and low activity clays predominant in the clay mineralogy (Okusamiet al., 1997). Application of farmyard manure to soil improves crop performance, soil fertility, soil organic matter, microbiological activities and soil structure for sustainable agriculture (Blair et al., 2005; Kunduet al., 2006). The application of organic materials influence the degree of aggregation and aggregate stability and can reduce bulk density, increase porosities, water holding capacity, moisture retention and transmission, and drought resistance in plant (Cheng et al., 1988).

The West Africa oil palm (Elaeisguinensis-Jaeq) is perennial monocotyledons which belong to the family Arecacena (Hartley, 1988). The fruit pulp and nut provide palm and kernel oil, respectively (Coley and Tinker, 2009). The oil palm industry constitutes a significant sector of the Nigerian economy providing food and raw materials for the confectionery, and oleochemical industry. As a result of the intensive nature of its cultivation, oil palm provides gainful employment for many Nigerians. At present, palm oil production is second to that of soybean oil in terms of world vegetable oil production and the demand for palm oil is expected to increase in future (Yusuf, 2007; Coley, 2009).To ensure self-sufficiency in palm produce, concerted efforts are needed to develop strategies for improving the crop performance under degraded conditions of ultisols. Therefore the presentstudy was designed to determinethe effect of composted oil palm bunch wastefor improvement ofsome soil physical characteristics, organicmatter status and growth of oil palm seedlings under varied irrigation intervals.

MATERIALS AND METHODS

Description of study area: This study was conducted at the greenhouse of the Department of Soil Science, University of Nigeria,Nsukka. Nsukka, is in Enugu State in the derived savannah agro-ecological zone of Nigeria. The area lies within latitude 060521N and longitude 070241E; with a mean elevation of 419 metre above sea level. Humid tropical climate prevails with annual rainfall of 1700-1800mm. The rainfall pattern is bimodal and falls between April and October, while the dry season is between November and March. The area is characterized with mean annual maximum (day) and minimum (night) temperatures of 31oC and 21oC, respectively, while the average relative humidity is rarely below 60% (Asadu, 2002). The soil used for the study has been classified as TypicKandiustult, derived from a false bedded sandstones (Akamigbo and Igwe, 1990).

GREEN HOUSE STUDY

Soil sampling and analysis: Topsoil from 0-15cm was collected and sieved using 2mm mesh. Some portions were analyzed for initial physico-chemical properties.

Preparation of composted oil palm bunch waste (COBW): Materials used for the composting were oil palm bunch waste, poultry droppings and palm oil mill effluent. Oil palm bunch wastes were shredded into smaller particles.

The shredded bits were packed in windrows (aerated compartment) and mixed with poultry droppings in a ratio of 4:1(bunch waste: poultry droppings). Palm oil effluent was added to increase microbial activity and to reduce the C/N ratio. The heap was turned weekly and moistened with the effluent for proper degradation. The composting process lasted for 10 weeks after which the compost was air dried in preparedness for chemical analysis. The overall procedure was the method adopted by Hang (1993) and Catton (1983).

Chemical analysis of the uncomposted and composted materials used for the study: Samples of the base materials including the oil palm bunch waste, palm oil mill effluent, poultry manure and the final compost were crushed and passed through a 2mm sieve and chemical properties such as pH, total N, available P, exchangeable bases and organic carbon were determined.

Pre-nursery establishment of oil palm seedlings: Pre nursery polybag measuring 12.5x 25cm were filled with sieved topsoil and pre-sprouted oil palm seeds sourced from the Nigerian Institute for Oil Palm Research (NIFOR), Benin City were planted out. A shed was erected for the pre-nursery to prevent the seeds from desiccation, and cultural practices such as weeding, watering and disease control were observed.

Main-nursery establishment: At three leaf stage, i.e. after 10 weeks of growth at the pre-nursery, all healthy seedlings of uniform growth were selected and transplanted singly into each prepared main nursery poly bag measuring 40cm X 45cm. The main nursery polybags contained a mixture of 7kg sieved topsoil and the composted oil palm waste according to the treatment levels. They were carefully arranged in the greenhouse and watered uniformly for a period of three weeks in order to obtain good plant establishment. The various irrigation intervals were then established every 7, 14 and 21 days. Cultural practices such as weeding and pest control were observed. The oil palm seedlings were weeded regularly by hand picking and Dithane M45 was sprayed every fortnight to control moderate infection of freckle.

Experimental Design: The experiment was laid out as 3x4 factorial in a completely randomized design with three replications. The factors included composted oil palm bunch waste and irrigation intervals. Soil moisture deficit was imposed by observing irrigation intervals of 7days, 14days and 21days after irrigating the soil to field capacity. The composted empty fruit bunch wastes were applied at four levels, thus, 0g, 100g, 200g and 300g per seedling/polybag.

Irrigation procedure: After the three weeks period of uniform watering in the greenhouse, the polybags were weighed 48 hrs later so as to determine the weight at field capacity by assuming that free gravitational water would have stopped draining (Richard and Weaver, 1944). The water stress was imposed by observing irrigation intervals at every 7, 14 and 21 days from the field capacity water content. The nursery polybags were also weighed at the different irrigation intervals so as to determine the level of soil water depletion. The deficit in soil water at the different irrigation intervals was ascribed to be the approximate water loss by evapotranspiration. The deficits were estimated and the calculated amount of irrigation water (volume) was added to raise the soil water to the predetermined field capacity following the procedures of Boutraa and Sanders (2001).

Growth measurement: Plant height which was measured as the distance from the soil surface to the tallest leaf and the number of leaves per seedlings was determined by counting the fully unfurled leaves on each plant. Stem girth was measured with a screw gauge placed at the maximum girth of the seedlings. The leaf area was estimated as the leaf length multiplied by its maximum width multiplied by 0.05 following, Harden et al. (1965). Data were collected at 5, 8 and 12 months after planting. Core and surface soil samples were collected at 6 and 12 months after planting for the determination of bulk density, aggregate stability, mean weight diameter, dispersion ration andorganic matter respectively.

LABORATORY METHODS

Physical properties: Particle size distribution was determined by hydrometer method (Gee and Bander 1996). Bulk density was measured by the core method, as described by Blake and Hartge (1986). The distribution of water stable aggregate was estimated by the wet sieving technique described in detail by Kemper and Rosenau (1986). Mean weight diameter was calculated using the method of Van Bavel as modified by Kemper and Rosenau (1986). The dispersion ratio (DR) of Middleton as described by Mbagwu (1990) was used as an index to determine micro-aggregate stability

Chemical properties:Soil pH was determined in 1:2.5 soil to water ratio using pH meter (Mclean, 1965). Total nitrogen was determined by semi-micro kjeldahl method (Bremner, 1996). Organic carbon was determined by chromic acid wet oxidation method of Nelson and Sommers (1982), while organic matter was determined by multiplying percentage organic carbon by 1.724. Available phosphorus was determined using Bray No 1 method (Bray and Kurtz, 1945). Exchangeable bases were determined by 1N neutral NH4OAC saturation method of Grant (1982).

Data Analysis: The statistical analysis was performed using Genstat Statistical Package for the analysis of variance (ANOVA). Treatment means were compared using the Fisher's Least Significant Difference (F-LSD) at 5% probability.

RESULTS

Table 1 shows the properties of the soil before treatment application. The soil was sandy loam with a high percentage of sand, low percentages of clay and silt. The textural class may negatively affect plant growth by exhibiting low water and nutrient retention capacities. The soil was low in pH, total nitogen, available phosphorus, exchangeable (potassium, calcium, magnesium, sodium) and organic matter respectively.Table 2 showed the chemical properties of the materials used during the nursery media composting and composted oil palm bunch waste. Chemical

Table 1: Initial physico–chemical properties of the soil used for the study

Characteristics	Values
Fine sand (%)	26
Coarse sand (%)	50
Silt (%)	11
Clay (%)	13
Textural class	Sandy Loam
pH (H_20)	4.4
Total nitrogen (%)	0.03
Organic matter (%)	1.15
Organic carbon (%)	0.67
Available phosphorus (mgkg^{-1})	9.14
Exchangeable potassium (cmolkg^{-1})	0.06
Exchangeable calcium (cmolkg^{-1})	2.02
Exchangeable sodium (cmolkg^{-1})	0.37

Table 2: Chemical properties of the materials used for composting OBW and composted OBW

Properties	Poultry Manure	POME	SOBW	Composted OBW
pH (H_2O)	5.8	3.3	7.3	8.2
EC(ds/m)	18.80	7.44	10.44	5.4
Total nitrogen (%)	1.62	0.44	0.36	2.24
Potassium (%)	1.05	0.49	1.30	9.81
Magnesium (%)	0.32	0.07	0.24	3.12
Calcium (%)	1.89	0.42	0.49	4.82
Phosphorus (%)	0.05	0.02	0.04	0.65
C/N ratio	0.39	7.00	35.47	17.85
Organic Carbon (%)	0.64	3.08	12.77	40.00

POME = Palm oil mill effluent, SOBW=Shredded oil palm bunch waste C/N = carbon/nitrogen ratio

analysis of the composted oil palm bunch waste showed higher nutrient composition in terms of total nitrogen, available phosphorus, exchangeable bases and pH relative to the raw materials. The composted oil palm bunch waste had a lower C/N ratio compared to the raw oil palm bunch waste used for the composting (Table 2).

Effects of treatments on growth of oil palm seedlings

Stem girth: Figure 1 showed main effects of irrigation intervals on stem girth of oil palm seedlings at 5, 8 and 12 MAP. At 5MAP, highest (P<0.05) value was obtained at irrigation intervals of 14 days. On the contrary, at 8MAP, highest (P<0.05) was obtained under 7days irrigation intervals. At 12MAP, highest (P<0.05) value was observed at 14 days irrigation. Figure 2 showed main effect of compost on stem girth of oil palm seedlings at 5, 8 and 12 MAP. At 5MAP, highest (P<0.05) value was obtained at 300gCOBW. Similar trend were observed at 8 and 12MAP.

At 5MAP, Table 3 showed that the highest stem girth value was observed at 14 days intervals of irrigation. At 8 MAP, every 7 days intervals of irrigation recorded the highest. Whereas at 8MAP, 14 day intervals of irrigation gave the highest stem girth compared to 7 and 21 days irrigation intervals respectively. At 5MAP, composted oil palm bunch waste applied at 200g/seedlings and 300g/seedlings gave the highest values respectively relative to control (0gCOBW/polybag/seedlings). At 8 and 12 MAP, fertilizing with 300gCOBW/seedlings gave the highest values compared to the control 0gCOBW/seedlings. The interactions between irrigation intervals and composted OBW showed significant differences only at 8 and 12 MAP (Table 3).

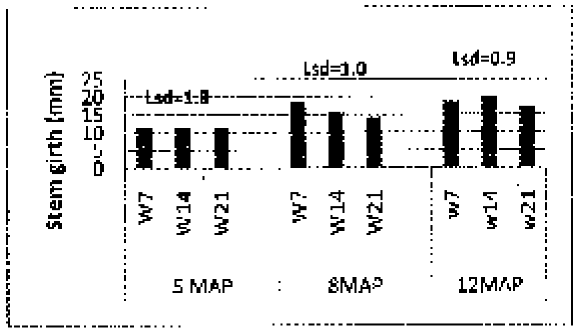


Fig 1: Main effect of irrigation intervals on stem girth at 5, 8 and 12MAP

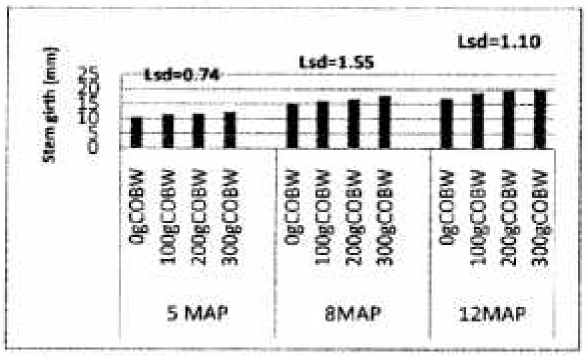


Fig 2: Main effect of composted OBW on stem girth at 5, 8 and 12MAP

Plant height: Figure 3 showed main effects of irrigation intervals on plant height of oil palm seedlings at 5, 8 and 12 MAP. At 5MAP, highest (P<0.05) value was obtained at irrigation in-

Table 5: Effect of composted oil palm bunch waste on stem girth (mm) of oil palm seedlings under different irrigation intervals at 5, 8 and 12 MAP

	5 MAP Irrigation intervals (days)				8 MAP Irrigation intervals (days)				12 MAP Irrigation intervals (days)			
COBW(g/polybag)	7	14	21	Mean	7	14	21	Mean	7	14	21	Mean
T1= 0gCOBW	10.35	11.11	10.13	10.53	18.44	15.31	12.35	15.37	16.85	18.50	15.68	17.01
T2= 100gCOBW	11.79	11.36	11.82	11.66	18.66	16.71	14.98	16.78	19.38	20.18	17.16	18.91
T3= 200gCOBW	12.25	11.97	11.37	11.86	18.97	16.24	14.94	16.72	19.35	21.17	18.21	19.58
T4= 300gCOBW	11.91	12.07	11.57	11.85	19.78	15.90	15.05	16.91	20.16	21.18	18.02	19.79
Mean	11.58	11.63	11.22		18.96	16.04	14.33		18.94	20.24	17.27	
F- L.S.D 0.05		NS				1.91				2.00		

COBW: Composted oil palm bunch waste. MAP=Months after planting

tervals of 14 days. However, at 8MAP, highest significant value was observed under 7days irrigation intervals. At 12MAP, highest (P<0.05) value was recorded at 14 days irrigation intervals (Fig 4). Figure 4 showed main effect of composted oil palm bunch waste on plant height of oil palm seedlings at 5, 8 and 12 MAP. At 5MAP, highest (P<0.05) value was obtained at 300gCOBW relative to the control (0gCOBW). Similar trend were observed at 8 and 12 MAP (Figure 4)

At 5MAP, Table 4 showed that highest plant height value was observed at 14 days intervals of irrigation. At 8 MAP, every 7 days intervals of irrigation recorded the highest. Whereas at 8MAP, 14 day intervals of irrigation gave the highest stem girth compared to 7 and 21 days irrigation intervals respectively. At 5, 8 and 12 MAP composted oil palm bunch waste applied at 300g/seedlings gave the highest values respectively relative to the control (0gCOBW/polybag/seedlings). The interactions effects between irrigation intervals and composted OBW were significant throughout theduration of the study(Table 4).

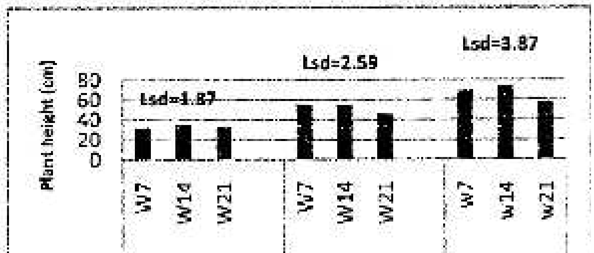


Fig 3: Main effects of irrigation intervals on plant height (cm) at 5, 8 and 12 MAP

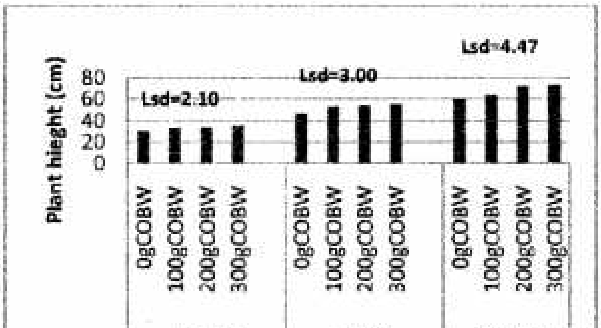


Fig 4: Main effect of composted oil palm bunch waste on plant height at 5, 8 and 12 MAP

Table 4: Effects of composted oil palm bunch waste on the plant height (cm) of oil palm seedlings under different irrigation intervals at 5, 8 and 12 MAP

	5 MAP Irrigation intervals (days)				8 MAP Irrigation intervals (days)				12 MAP Irrigation intervals (days)			
COBW(g/polybag)	7	14	21	Mean	7	14	21	Mean	7	14	21	Mean
T1= 0g COBW	27.02	31.15	31.28	29.82	52.19	48.99	40.90	47.36	60.44	68.78	51.50	60.24
T2= 100gCOBW	37.55	36.85	34.68	36.36	52.81	55.44	49.43	52.56	65.85	66.56	58.52	63.66
T3= 200gCOBW	32.57	36.08	32.85	33.83	57.97	57.04	47.47	54.16	75.67	80.94	59.89	72.17
T4= 300gCOBW	32.05	42.45	37.75	37.42	59.70	56.72	46.50	54.31	77.00	82.83	61.89	73.91
Mean	32.30	36.63	34.14		55.67	54.55	46.07		69.75	74.77	57.55	
F-L.S.D 0.05		3.74				5.19				7.75		

COBW: Composted oil palm bunch waste. MAP =Months after planting

Leaf Area: Figure 5 showed main effects of irrigation intervals on leaf area of oil palm seedlings at 5, 8 and 12 MAP. At 5MAP, highest (P>0.05) value was obtained at irrigation intervals of 14 days. At 8MAP, highest ($P<0.05$) value was observed under 7days irrigation intervals. At 12MAP, 14 days irrigation intervals had the highest value (Figure 5). Figure 6 showed main effects of compost on leaf area of oil palm seedlings at 5, 8 and 12 MAP. At 5MAP, highest ($P<0.05$) value was obtained at 300g/COBW relative to the control. Similar trend were observed at 8 and 12 MAP.

At 5MAP, Table 5 showed that highest leaf area value was observed at 14 days intervals of irrigation. At 8 MAP, every 7 days intervals of irrigation recorded the highest. Whereas at 8MAP, 14 day intervals of irrigation gave the highest stem girth compared to 7 and 21 days irrigation intervals respectively. At 5, 8 and 12 MAP, composted empty oil palm bunch applied at 300g/seedlings gave the highest values respectively relative to control (0gCOBW/polybag/seedlings). The interactions between irrigation intervals and compost had significant effects on leaf area of oil palm seedlings throughout the sampling period (Table 5).

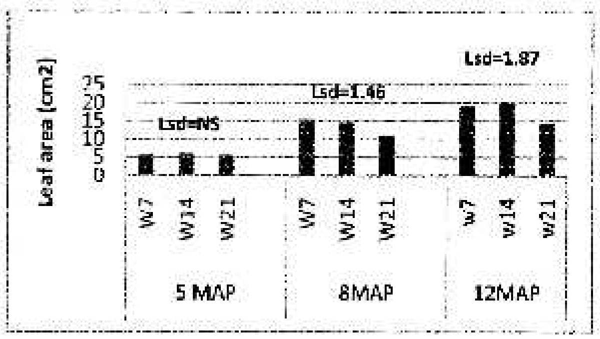


Fig 5: Main effect of irrigation intervals on leaf area at 5, 8 and 12 MAP

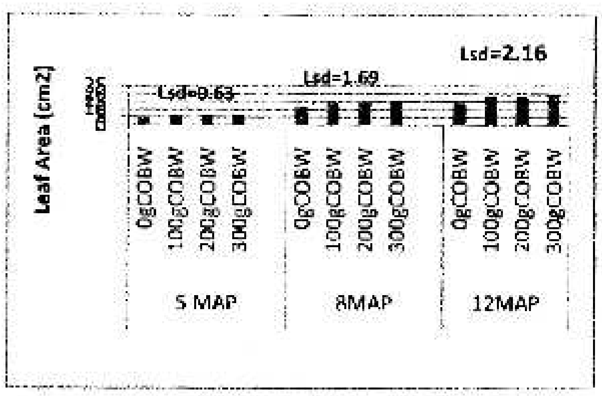


Fig 6: Main effect of compost on leaf area at 5, 8 and 12 MAP

Leaf number: Figure 7 showed main effects of irrigation intervals on leaf number of oil palm seedlings at 5, 8 and 12 MAP. At 5MAP, highest ($P<0.05$) value was obtained at irrigation intervals of 14 days. On the contrary, at 8MAP highest ($P<0.05$) value was obtained under 7days irrigation intervals. At 12MAP, highest ($P<0.05$) value was detected under 14 days irrigation intervals. Figure 8 showed main effects of composted oil palm bunch waste on leaf number of oil palm seedlings at 5, 8 and 12 MAP. At 5MAP, highest ($P<0.05$) value was obtained at 200gCOBW relative to the control. At 8 and 12 MAP, highest significant value was observed at 300gCOBW relative to the control (Figure 8).

At 5MAP, Table 6 showed that highest leaf number value was observed at 14 days intervals of irrigation. At 8 MAP, every 7 days intervals of irrigation recorded the highest. Whereas at 8MAP, 14 day intervals of irrigation gave the highest leaf number compared to 7 and 21 days irrigation intervals respectively.At 5MAP, composted oil palm bunch waste applied at 200g/seedling gave the highest values respectively relative to control (0gCOBW/polybag/ seedlings). At 8 and 12 MAP, fertilizing with 300gCOBW/seedlings gave the highest values compared to the control 0gCOBW/seedlings. The interactions between irrigation intervals and compost gave no significant effects on leaf number throughout the sampling period (Table 6).

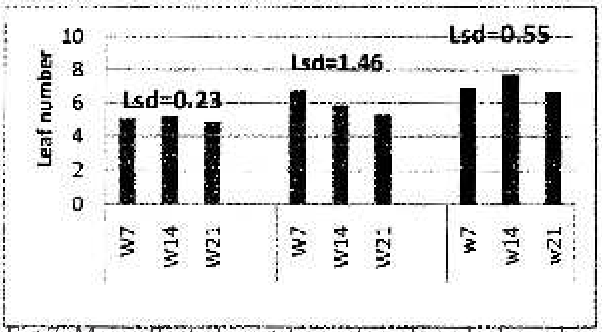


Fig 7: Main effect of irrigation intervals on leaf number at 5, 8 and 12 MAP

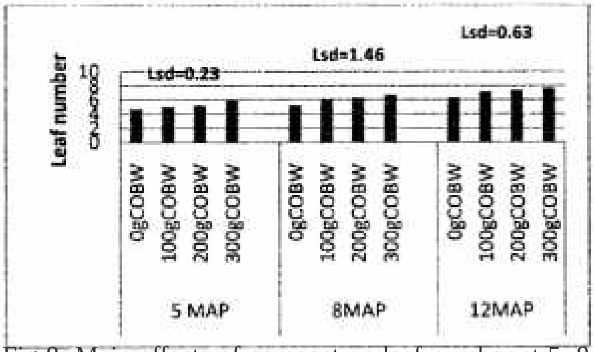


Fig 8: Main effects of compost on leaf number at 5, 8 and 12 MAP

Effect of treatments on soil properties

Bulk density: Figure 9 showed main effect of irrigation intervals on bulk density at 6 and 12 MAP. At 6MAP, lowest (P<0.05) value was obtained at irrigation intervals of 14 day. Figure 10 showed the main effect of composted oil palm bunch waste on bulk density at 6 and 12 MAP. At 6 and 12MAP, the lowest (P<0.05) value was obtained at 300gcompost/seedlings/polybag relative to the control 0g compost/seedlings/polybag (Figure 10). Table 7 showed that the lowest bulk density was observed at 14 days irrigation intervals throughout the sampling period. At 6 and 12 MAP, composted oil palm bunch waste

Fig 9 :Main effect of irrigation intervals on bulk density at 6 and 12 MAP

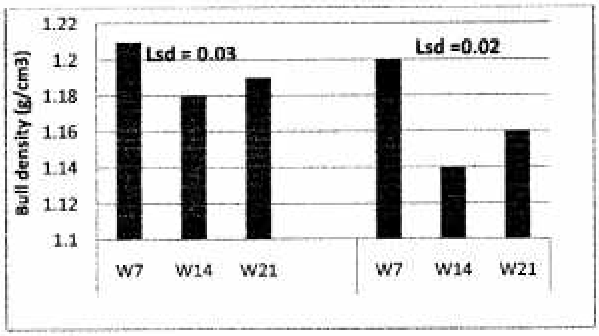
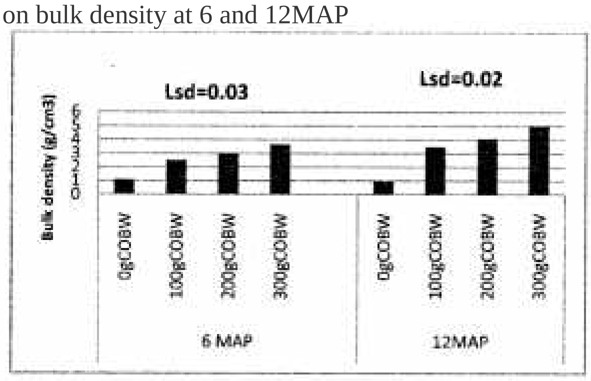


Fig 10: Main effect of composted oil palm bunch waste on bulk density at 6 and 12MAP



applied at 300gcompost/seedling/polybag gave the lowest values relative to control (0gCOBW/ polybag/seedlings). The interactions effects between irrigation intervals and compost was significant and lowest values were observed with 300g COBW/seedlings under 14 days irrigation intervals at both 6 and 12 MAP (Table 7).

Table 7: Effect of composted oil palm bunch waste on bulk density(gm^{-3}) under different irrigation intervals at 6 and 12months after manure planting

	6MAP Irrigation intervals (days)				12MAP Irrigation intervals (days)			
COBW(g/polybag)	7	14	21	Mean	7	14	21	Mean
T1= 0gCOBW	1.26	1.26	1.25	1.26	1.29	1.23	1.31	1.28
T2= 100gCOBW	1.24	1.18	1.14	1.19	1.18	1.14	1.15	1.16
T3= 200gCOBW	1.23	1.18	1.20	1.20	1.16	1.10	1.16	1.14
T4= 300gCOBW	1.14	1.12	1.20	1.15	1.14	1.02	1.14	1.10
Mean	1.22	1.19	1.20		1.20	1.14	1.16	
F-L.S.D 0.05		0.06				0.05		

COBW: Composted oil palm bunch waste, MAP: Months after planting

Aggregate stability: Figure 11 showed the main effect of irrigation intervals on aggregate stability at 6 and 12 MAP. At 6MAP, the highest ($P<0.05$) value was obtained at irrigation intervals of 14 day. At 6 and 12MAP, the highest ($P<0.05$) value was obtained at 300gcompost/seedlings/polybag relative to the control 0g (compost/seedlings/polybag) (Figure. 12). Table 8 showed that the highest aggregate stability value was observed at 14 days irrigation intervals throughout the sampling period. At 6 and 12 MAP, composted oil palm bunch waste applied at 300gcompost/seedling/polybag gave the lowest values relative to control (0gCOBW/ polybag/seedlings). The interactions effects between irrigation intervals and compost was significant and highest values were observed with 300g COBW/seedlings under 14 days irrigation intervals at both 6 and 12 MAP (Table 8).

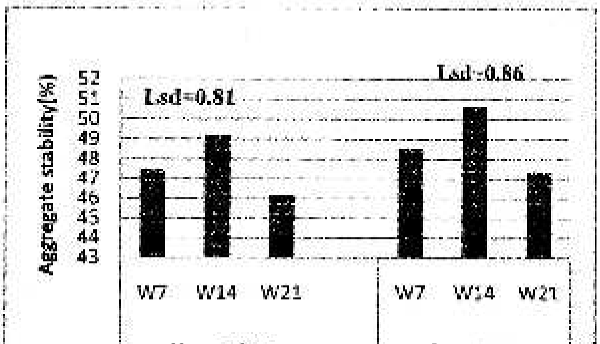


Fig 11: Main effect of irrigation intervals on aggregate stability at 6 and 12 MAP

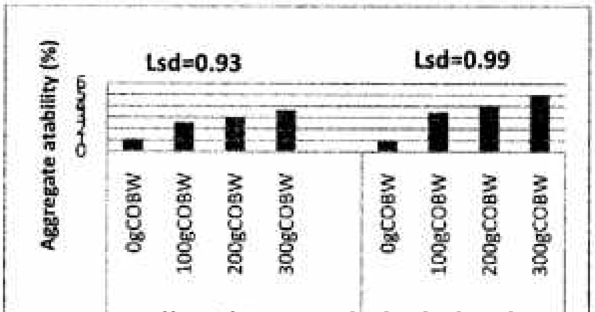


Fig 12: Main effect of composted oil palm bunch waste on aggregate stability at 6 and 12MAP

Table 11: Effects of compost on aggregate stability (%) under different irrigation intervals at 6 and 12 months after planting

	6MAP Irrigation intervals (days)				12MAP Irrigation intervals (days)			
COBW(g/polybag)	7	14	21	Mean	7	14	21	Mean
T1= 0g COBW	27.30	26.88	35.95	30.04	27.13	26.71	35.50	29.78
T2= 100g COBW	44.71	51.73	51.58	49.34	46.27	53.27	52.90	50.82
T3= 200g COBW	52.86	54.42	48.74	52.00	54.45	56.05	50.19	53.56
T4= 300g COBW	59.80	61.17	53.93	58.93	61.59	63.00	55.55	60.04
Mean	46.17	48.55	47.55		47.36	49.76	48.54	
F-L.S.D 0.05		1.62				1.73		

COBW: Composted oil palm bunch waste MAP=Months after planting

Mean weight diameter (MWD): At 6MAP, the highest (P<0.05) value was obtained at irrigation intervals of 14 day (Fig 13). At 6 and 12MAP, the highest (P<0.05) value was obtained at 300gcompost/seedlings/polybag relative to the control 0g (compost/seedlings/polybag) (Figure 14). Table 9 showed that the highest value was observed at 14 days irrigation intervals throughout the sampling period. At 6 and 12 MAP, composted oil palm bunch waste applied at 300gcompost/seedling/polybag gave the highest values relative to control (0gCOBW/polybag/seedlings). The interactions effects between irrigation intervals and compost showed no statistical difference throughout the sampling period (Table 9).

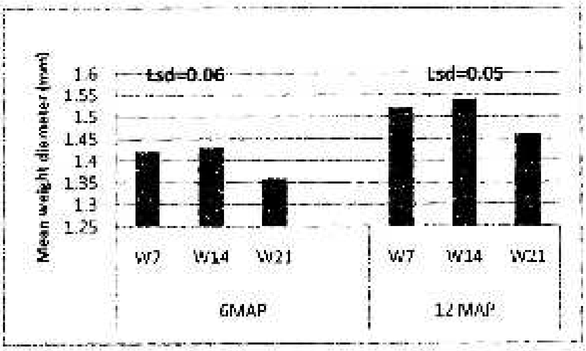


Fig 13: Main effect of irrigation intervals on mean weight diameter at 6 and 12 MAP

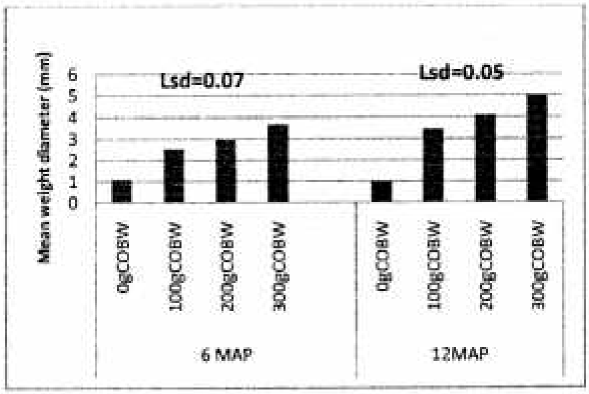


Fig 14: Main effect of composted oil palm bunch waste on mean weight diameter at 6 and 12MAP

Dispersion ratio: Figure 15 showed main effect of irrigation intervals on dispersion ratio at 6 and 12 MAP. At 6MAP, lowest (P<0.05) value was obtained at irrigation intervals of 14 day. Figure 16 showed the main effect of composted oil palm bunch waste on dispersion ratio

Fig 15: Main effect of irrigation intervals on dispersion ratio at 6 and 12 MAP

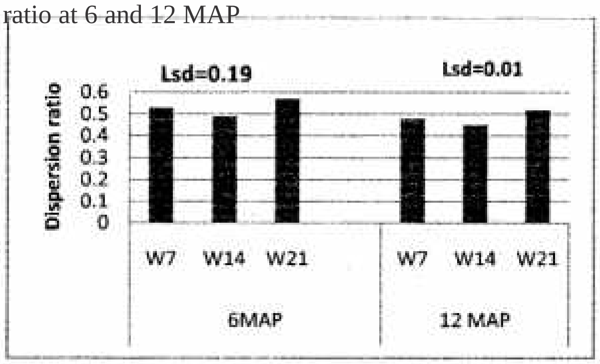
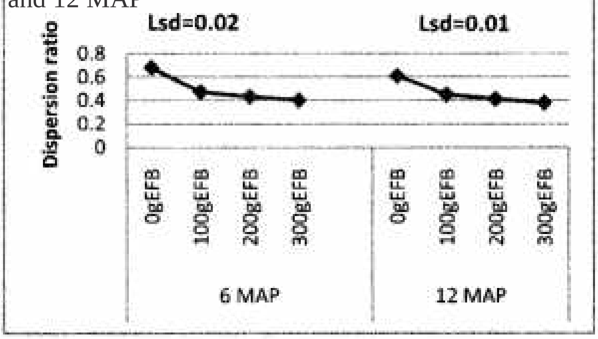


Fig 16: Main effect of compost on dispersion ratio at 6 and 12 MAP



at 6 and 12 MAP. At 6 and 12MAP, the lowest ($P<0.05$) value was obtained at 300gcompost/seedlings/polybag relative to the control (0g compost/seedlings/polybag) (Figure 16). Table 10 showed that the lowest dispersion ratio value was observed at 14 days irrigation intervals throughout the sampling period. At 6 and 12 MAP, composted oil palm bunch waste applied at 300gcompost/seedling/polybag gave the lowest values relative to control (0gCOBW/polybag/seedlings). The interactions between irrigation intervals and compost had significant effect on dispersion ratio and lowest values were observed at 300g compost/seedlings under 14 days irrigation intervals throughout the sampling period (Table 10).

Table 10: Effect of compost on dispersion ratio under different irrigation intervals at 6and 12 months after planting

	6MAP Irrigation intervals (days)				12MAP Irrigation intervals (days)			
COBW(g/polybag)	7	14	21	Mean	7	14	21	Mean
T1= 0gCOBW	0.70	0.62	0.73	0.68	0.63	0.57	0.66	0.62
T2= 100gCOBW	0.55	0.44	0.49	0.49	0.50	0.40	0.44	0.45
T3= 200g COBW	0.48	0.43	0.43	0.45	0.45	0.37	0.38	0.39
T4= 300g COBW	0.42	0.36	0.37	0.38	0.38	0.34	0.35	0.36
Mean	0.54	0.46	0.50		0.49	0.42	0.46	
F-L.S.D 0.05		0.039				0.036		

COBW= composted oil palm bunches waste

Soil organic matter: Figure 17 showed main effect of irrigation intervals on soil organic matter at 6 and 12 MAP. At 6MAP, highest ($P<0.05$) value was obtained at irrigation intervals of 14 days. Figure 18 showed that at 6 and 12 MAP the highest ($P<0.05$) value was obtained at 300g compost/seedlings/polybag relative to the control 0gcompost/seedlings/polybag (Figure 18). At 6 and 12 MAP, Table 11 showed that the highest soil organic matter was observed at 14 days intervals of irrigation. At 6 and 12 MAP, composted oil palm bunch waste applied at 300gcompost/seedling/polybag gave the highest values relative to control (0gCOBW/polybag/seedlings). The interactions between irrigation

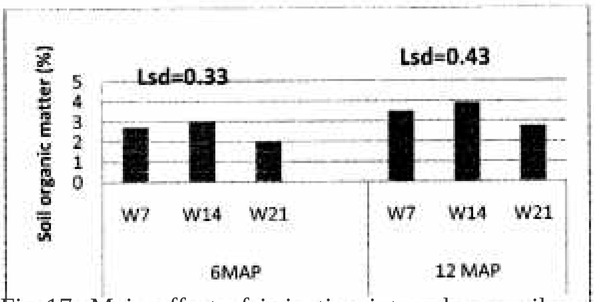


Fig 17: Main effect of irrigation intervals on soil organic matter at 6 and 12MAP

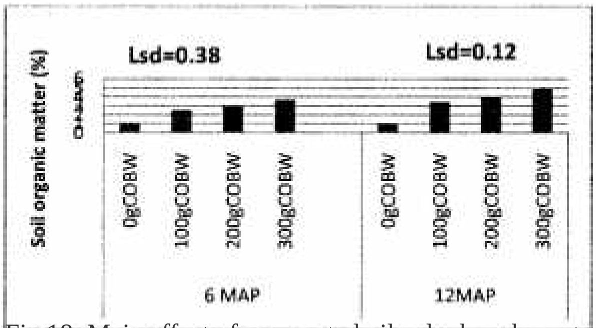


Fig 18: Main effect of composted oil palm bunch waste on soil organic matter at 6 and 12 MAP

Table 11: Effect of composed oil palm bunch waste and irrigation intervals on soil organic matter at 6 and 12 months after planting

	6MAP Irrigation intervals (days)				12MAP Irrigation intervals (days)			
COBW (g/polybag)	7	14	21	Mean	7	14	21	Mean
T1= 0g COBW	0.90	1.66	0.80	1.12	0.86	1.25	0.88	0.10
T2= 100g COBW	2.44	3.19	2.01	2.55	3.17	4.46	2.81	3.48
T3= 200g COBW	3.48	3.20	2.36	3.01	4.52	4.48	3.30	4.10
T4= 300g COBW	4.18	3.96	2.93	3.69	5.48	5.54	4.10	5.04
Mean	2.75	3.00	2.03		3.51	3.93	2.77	
F-L.S.D 0.05		NS				0.86		

COBW: Composted oil palm bunch waste, MAP=Months after planting intervals and compost showed significant differences only at 12 MAP having the highest value at 300gcompost/ polybagat 14 days irrigation intervals (Table 11).

DISCUSSION

The relative high sand content of soil used for the study is a reflection of a sandy parent material. The parent materials of the soils of eastern Nigeria have been noted to influence the texture of the native soils (Akamigbo and Asadu, 1983). The relatively low pH, total N, available P, exchangeable K, Ca, Mg and soil organic matter content of the experimental soil confirmed the soil to be low in fertility (Ibeawuchiet al., 2006). The observed improvements in nutrient composition of the composted material relative to the raw materials may be adduced to increased organic matter mineralization and humification brought about by the action of micro-organisms. Brady and Weil (2002) reported that finished compost is generally more concentrated in nutrients than the initial combination of raw material used. The improvements in growth parameters of oil palm seedlings that were observed under irrigation intervals of 14 days throughout the sampling periods may be adduced to the improved soil physical properties and organic matter content that were observed under 14 day intervals of irrigation. However, organic matter is known to ameliorate soil physical properties by reducing bulk density, increase porosities, saturated hydraulic conductivity, enhancing aggregation, and water holding capacity of soils (Mbagwu and Picolo, 1990; Adesodunat al., 2005). The improved soil physical properties may result in greater root distribution and proliferation and hence greater nutrient and water uptake (Dexter, 1988) and may result in increasing plant growth. On the other hand, the poorer growth of oil palm seedlings observed under 7 days irrigation intervals may be due to applied irrigation at short intervals which led to increased soil moisture content that may lead to weakening and breakdown of aggregate resulting in rearrangement of soil particle, reorientation of soil pores and increased compaction and plant root restriction. These results were in agreement with those reported by Haynes and Swift (1990). The poorest growth parameters of oil palm seedlings as observed with the extension of irrigation to 21 days throughout the sampling period may be attributed to the negative effects of water stress. Irrigation intervals of 21 days may have resulted in the decline in soil nutrient availability, their movement (mass flow and diffusion) and uptake by the oil palm seedlings. Guiterrez-Boen and Thomas (1999) reported that the decrease in soil water availability affects the rate of diffusion of many plant nutrients and finally their composition and concentration. The reduction of plant size and growth under water stress may be attributed to a decrease in the activity of meristemic tissues responsible for elongation (Siddiqueat al., 1999). Water stress conditions have been found to disrupt several physiological processes leading to reduction in growth and chemical composition of sugar beet (Bloch and Hoffman, 2005).

The improvements in growth of oil palm seedling that were observed with composted oil palm bunch waste relative to the control may be attributed to the enhanced soil physical properties brought about by the improved soil organic matter content as a result of the amendments. This is further supported by Singh et al. (2007) who reported that soil organic carbon content increased by manuring, which in turn improved its aggregate stability, infiltration rates, decreased bulk density, dispersion ratio and soil strength correspondingly. Similarly, Razziet al. (2004) reported that compost can help in the formation of a larger number of water stable aggregate through links between smaller particles strong enough to withstand the dispersing action of water.

Under moisture stress conditions, the application of composted oil palm bunch waste showed excellent improvements in soil properties and growth parameters of oil palm seedlings compared to the control. These unique attributes may be in connection with the fact that the applied composted oil palm bunch waste enhanced the organic matter and other soil physical, chemical and biological properties (El-bady and Asaad, 1983). This further collaborates the findings of Woomeret al. (1994), Hossner and Juo (1999) who reported that compost material improves soil structure, increases water holding capacity of soils, increases cation exchange capacity (CEC) and increase the capacity of low activity clays to buffer changes in pH.

CONCLUSION

The study has demonstrated the effectiveness of using composted oil palm bunch waste for improvements of some soil physical properties, organic matter content and growth of oil palm seedlings relative to the unamended soil under soil moisture deficit conditions. However, result showed that irrigating at 14-day intervals significant ($P<0.05$) gave the lowest bulk density, dispersion ratio, as well as highest aggregate stability, mean weight diameter and organic matter followed by 7-day and then to 21-day intervals. Similarly, 14-day irrigation intervals showed highest ($P<0.05$) effect on all growth parameters of oil palm seedlings throughout the growth period. Moreover, lowest ($P<0.05$) bulk density, dispersion ratio as well as highest ($P<0.05$) aggregate stability, mean weight diameter and soil organic matter were observed with the use of 300 g compost/polybag compared to other compost rates. The application of 300gcompost/seedlings gave highest ($P<0.05$) effect on all growth parameters studied relative to other compost application rates In this study, the application of 300g compost/seedlings/polybag and 14-day irrigation intervals was most effective in improving the selected soil physical properties, organic matter status and growth of oil palm seedlings and its therefore recommended.

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