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INFLUENCE OF TWO LAND USE SYSTEMS ON SOIL PROPERTIES AND MICROBIAL BIOMASS IN COASTAL PLAIN SANDS OF AKWA IBOM STATE, NIGERIA

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ABSTRACT

A research to investigate the influence of two land use systems (Organic farming (OF) and conventional farming (CF)) on soil properties and microbial biomass was carried out between 2019 and 2021 at the Department of Soil Science and Land Resources Management, University of Uyo, Nigeria. Soil samples were collected from three local government Areas (Ikot Ekpene, Uyo and Itu) where these agricultural practices are located at three different depths (0-10, 10-20 and 20-30cm). The soil samples were conveyed to the Soil Science Laboratory for the assay of soil physico chemical properties and microbial biomass. The results showed that sand particle ranged from 771.30 – 849.60 gkg^{-1} with a mean of 738.89 ± 22.72 gkg^{-1}, silt fraction ranged from 2.50-14.30 gkg^{-1} with a mean of 9.40 ± 3.74 gkg^{-1}, Clay fraction ranged from 136.40 – 220.40 gkg^{-1} with a mean of 181.43 ± 25.25 gkg^{-1} soil giving a textural class as Sandy loam in Organic farm (OF), whereas in Conventional farm, sand fractions ranged from 802.0 – 938.0 gkg^{-1} with the mean of 867.32 ± 44.49 gkg^{-1}, silt fraction ranged from 6.0 – 49.20 gkg^{-1} with a mean of 25.94 ± 15.28 gkg^{-1} and Clay fractions ranged from 49.0 – 174.0 gkg^{-1} with a mean of 106.73 ± 35.81 gkg^{-1} giving rise to Loamy sand texture. Saturated hydraulic conductivity (ksat) in OF soil ranged from 0.67 – 1.78$Cmhr^{-1}$ with a mean of 1.13 ± 0.33 $Cmhr^{-1}$, Bulk density (BD) ranged from 669.0 – 132.0 Mgg^{-3} with a mean of 1007.89 ± 17.0 Mgg^{-3} and total porosity of 50.15 – 74.75% with a mean of 61.97%, For conventional soil (Ksat range) from 0.55 – 1.43 $Cmhr^{-1}$ with a mean of 1.02 ± 0.35 $Cmhr^{-1}$, BD ranged from 578.0 – 1461.0 Mgg^{-3} and TP ranged from 44.87 – 78.19% with the mean of 58.87 ± 11.8%. Chemical properties of the soil revealed that OF soil had very high organic carbon (23.91 gkg^{-1}) while CF had medium (14.91 gkg^{-1}), OF soil had medium total nitrogen (1.04 gkg^{-1}), CF had low (0.65 gkg^{-1}), available P was high in OF soil, while CF soil had medium, exchangeable Ca was high in both OF and CF soils while exchangeable Mg was high in OF soil and low in CF soil, K was low in OF and very low in CF soil respectively. pH was slightly acid in

OF and acid in CF soils respectively. Microbial biomass Carbon (MBC) was higher in OF soil than CF soil. Microbial biomass Nitrogen (MBN) was very low in the two land use types with a wide coefficient of variability (CV) of 34.93% in CF soil, Microbial biomass phosphorus (MBP) also had wide CV in CF soil (50%) compared to the OF soil with (21.12%). The application of organic manure to soils significantly enhanced both soil physical and chemical properties. The OF soil resulted in reduction in Bulk density and increased soil pH.

Keywords: *Land Use Systems, Coastal Plain Sands, Microbial Biomass.*

INTRODUCTION

Industrialized agriculture has been feeding the growing would population but large-scale land conversion and excessive application of synthetic fertilizers and pesticides led to considerable adverse environmental impacts, and human health, soil quality degradation, water eutrophication ground water pollution, accumulation of heavy metal greenhouse gas emission, and biodiversity loss (Smith et al., 2013; Wang et al., 2021). Many studies have shown that application of chemical fertilizers and pesticides reduced soil pH and increased reactive nitrogen in the soil, and the nitrogen oxide produces by nitrogen fertilizers could also damage the ozone layer in the atmosphere (could, 2006; Zhou et at., 2016). Organic cultivation has been considered to be one of the most important measure for sustainable agriculture in the world which could produce high quality food while protecting the environment, it improves soil fertility through crop rotation, planting legumes and the application of organic fertilizers at the same time prohibits the use of any synthetic fertilizers and pesticides to maintain a sustainable agricultural system (Aulakh et al., 2022; Gomoen et al., 2011). Long term organic farming experiments have shown that the organic system improved food quality, soil organic carbon (SOC) is significantly higher than in the conventional systems and the nutrient contents were elevated as well (Aulakh et al., 2022). Organic cultivation has also been considered an important measure to reduce greenhouse gases because of its potential to sequester SOC (Gattencer et al., 2013). Organic cultivation also significantly increased soil microbial diversity by applying organic fertilizers without any synthetic fertilizer and pesticide pathogenic infections and helped in degrading external pollutants (Gomorgova et al., 2010).

However, in organic farming, all cultivation procedures aim to protect food, air, water, and soil quality leaving the environment safe for the present and future generation. In conventional agriculture, the ultimate aim is high yield, that is maximum economic efficiency. In order to achieve the intended goal in conventional agriculture, repeated high doses of artificial fertilizers and chemical crop protection materials are often used (Domagala – swiatkdewicz and Gastol 2013). These may then degrade the soil environment, contaminate the ground water and negatively affect microorganisms. Hence, an alternative to the intensification is organic farming (Bobulska et al., 2015). Organic farming may be defined as a system of sustainable management of plant and animal production within a farm, based on technologically unprocessed biological and mineral substances (EEC 1991). Organic farming promotes plant biodiversity management practices, conservation, tillage with permanent plant cover, more extensive use of crop rotation, associated crops or intercropping, weed management and establishment of refugee areas for natural enemies of pest. The transition from conventional to organic farming with extensive use of organic practices, may lead to increase of pest populations (Branchi et al., 2013). The decreasing pesticide application and stable environment in organic management could improve the diversity of species suppressing pest population (Degune and Penvenn, 2014). This research was aimed at investigating the influence of and CF systems have on soil properties and microbial biomass.

Materials and Methods

Study Area

The study was conducted in Akwa Ibom State, South South Nigeria. Akwa Ibom State is located between Latitude 4º 30´ and 5º 30´ and longitude 7º 30´ and 8º 30´E. Two different land use types were considered for this study (Organic farm and conventional agricultural land use types).

Table1: Materials used in each land use system.

Organic Farm (OF)	Conventional Farm (CF)
Use of goat, poultry manure, Farm yard manure, and kitchen refuse and wood ash. Yam and cassava peels	Application of mineral fertilizer e.g. NPK 15:15:15, use of herbicides, fungicides.

Soil Sampling

This experiment was conducted in a randomized complete block design. The two land use types are located in three locations of Akwa Ibom Stat: Ikot Ekpene, Itu and Uyo. From each land use types, three composite soil samples were collected at the depths of 0-10, 10-20 and 20-30cm using soil auger. Core samples were also collected using core cylinder measuring 7.2cm height and 6.8cm width. The core samples were for the determination of saturated hydraulic conductivity and bulk density while the bulk samples were used for the determination of routine soil analysis.

Laboratory Analysis

Determination of physical and chemical properties of the soils

- Soil particle size distribution was determined by hydrometer method (Bouyoucosl 962).
- Soil reaction' (pH) in I :2.5 soil/water suspension was determined by pH meter (Rowel, 1994).
- Electrical conductivity (EC) in I :5 soil/water suspensions were determined by an electrical conductivity meter (Rhodes, 1982).
- Soil moisture was determined by the gravimetric method.
- Bulk density of soils (g/cm3) was calculated using mass and volume Olacke,1965).
- Particle density of soils (gcm3) was measured using the psychomotor method and pore space was calculated using bulk and particle density densities (Brody, 1990).
- Organic Carbon: Total organic carbon was determined following Walkley and Black Wet Oxidation Method as elaborated by Allison (1965).
- Available Phosphorus: This was determined by extracting soil samples with Bray P-I extracting and phosphorus in the extracts determined by the method of Murphy and Riley (1962).
- Total Nitrogen: Total nitrogen was determined by the micro-Kjedahl digestion method (Bremner 1965)
- Exchangeable Acidity: Exchangeable acidity was determined by successive leaching of soil with neutral unbuffered IN KCI using a 1:10 soil: liquid ratio was determined by the titration method of Maleanx (1982).
- Exchangeable cations (Ca2+ mg2+ K+, Na+): These were determined with IN ammonium acetate (pH 7.0) using 1:10 soil quid

/liquid ratio. Ca2+ and Mg2+ in the filtrate was determined with atomic absorption spectrophotometer (AAS) while Na+ and K was determined with a flame photometer (Udo et al,2009)

- Percent Base Saturation (PBS): PBS was determined from CEC and ECEC by dividing total exchangeable bases (Ca, Mg, K and Na) by effective cation exchange capacity (ECEC).

Microbial Biomass Carbon:

Soil microbial biomass carbon was estimated by extracting 20g field moist soil samples in 0.5M of the K_2SO_4 (1:4wlv) known as the chloroform fumigation extracting method described by Brookes et al, (1985) and Vance et al. (1987). Duplicate soil samples from each land use type were placed in 50 ml flat bottom flask, samples designated for fumigati011 were placed in the Vacuum desicator and fumigated by exposing the soil to chloroform vapour for 24hrs, the desiccators were sealed, placed in a laboratory hood, after the $CHCL_3$ evacuated, allowing the Chloroform to boil for appropriately 30sec, After $CHCL_3$ was removed by vacuum extraction soil was transferred to a 250 ml beaker where 120ml of 0.5 NK_2SO_4 was added. At the same time, the unfumigated soil sample placed in conical flask and was treated in the same way, where it served as control. Flasks were shaken for 30min in on a reciprocating shaker and super-materials filtered through a What man No.43 filler paper. Filtrates were stored up to I week at 40°C.

Microbial biomass carbon was measured in 8ml aliquots of K_2SO_4 extracts after oxidation with 5ml 0.4 $NK_2Cr_2O_7$ for 3 minutes and 5ml concentrated H_2SO_4 for 10 minutes. After digestion, it was filtered back with ferrous ammonium sulphate phenolphthalein as indicator. Microbial biomass carbon was calculated by measuring the difference in extractable organic carbon between the fumigated and unfumigated soils which was formulated as equation I (Vance et al., 1978).

Biomass C = 2.64xEC
(1) where,
EC refers to the difference in extractable organic C between the fumigated and unfumigated treatment, 2.64 is the proportionality factor for biomass c released by fumigation extraction.

Microbial Biomass Nitrogen (N mic)

The kjeldahl digestion- distillation- titration method was used to determine the total N in the K_2SO_4extract with 10ml conc. H_2SO_4, 15ml of the K_2SO_4 extract was digested after addition of 0.4 ml of 0.2M $CUSO_4$ to promote organic matter break down, The mixture was digested at 360°c for 3hr until all of the organic components were decomposed. The Solution was brought to a volume of 250ml with deionized water. A 50ml sub sample was Stream-distilled in a strong alkaline solution (1M NaOH) and the distillate was collected in a boric acid mixed indicator solution. The solution was then back titrated (Anderson and Ingram, 1993) biomass N was calculated using the following equation (2) (Brooks et al., 1985). (2).

Biomass $N=F_N/Kn$

Where;

FN = (Flush ofNH4+ - N due to Fumigation)

(NH4+ - N produced in the unfumigated soil during the 24hr of incubation) and Kn = 0.54, which is the proportionality factor for converting the Kn to Nmic (Jekinson, 1988).

Microbial biomass Phosphorus MBP)

Microbial biomass P was measured with the fumigation- extraction method as described by Brookes et al. (1982). Briefly, 10.0g of the moist soil sample was fumigated with ethanol free chloroform. After chloroform removal, the P in the soil sample was extracted with Sodium Bicarbonate (200 ml pH 8.5) for 30 minutes while shaking at 300 rpm. The suspension was centrifuged (800 rpm) before filtering through a Whatman No 92 filter paper. Because soil MBP includes organic P (PO) and inorganic P (Pi), the soil extract was digested to transform the PO to Pi before measuring the MBP concentrations with ascorbic acid molybdenum value method (Murphy and Riley, 1992). Another 10.0 g of non-fumigated moist soil was extracted with the Sodium bicarbonate method before determining the P concentration as described above. Finally, MBP was calculated by subtracting the non-fumigated soil P concentration from the fumigated soil P concentration before dividing the K value (K=0.4).

Statistical Analysis

Collected laboratory data were subjected to statistical analusis using mean, standard deviation, coefficient of variability, correlation analysis of variance. Land use means were separated using Least Significant Difference (LSD).

RESULTS AND DISCUSSION

The OF surface horizon (0-10cm depth) comprised 833.33 gkg^{-1} sand fraction, 59.72 gkg^{-1} Silt fraction, 165.28 gkg^{-1} Clay fraction, 1.32 $Cmhr^{-1}$ saturated hydraulic conductivity, 1122.80 mgm^{-3} bulk density and 65.56% total porosity. The subsurface soil (10-20cm depth) had 755.56 gkg^{-1} sand fraction, 62.50gkg^{-1} silt fraction, 131.94gkg^{-1} clay fraction, 1,.01 $cmhr^{-1}$ saturated hydraulic conductivity, 1039.40Mgm^{-3}, and 70.0% total porosity. The deeper soil horizon (20-30cm depth) it comprised 738.89gkg^{-1} sand fraction, 55.83gkg^{-1} Silt fraction, 168.06 gkg^{-1} clay fraction, 1.10 $cmhr^{-1}$ saturated hydraulic, 981.70 mgm^{-3} bulk density and 74.0% total porosity (Table 2). The soil textural class on the OF were silt loam. The CF surface horizon (0-10cm depth) comprised 894.44 gkg^{-1} sand fraction, 74.72gkg^{-1} silt fraction, 148.61 gkg^{-1} clay fraction, 0.93 $cmhr^{-1}$ saturated hydraulic conductivity, 953.0 mgm^{-3}, and 71.11% total porosity. The subsurface (10-20 cm depth) comprised 833.33gkg^{-3} sand fraction, 56.94 gkg^{-1} silt fraction, 130.56 gkg^{-1} clay fraction, 1.07 $cmhr^{-1}$ saturated hydraulic conductivity, 1095.10 Mgm^{-3} bulk density and 71.11% total porosity. At the deeper surface (20-30cm depth), it comprised of 811.11 gkg^{-1} sand fraction, 44.0gkg^{-1} silt fractions, 137.50 gkg^{-1} clay fraction, 1.16 $cmhr^{-1}$ saturated hydraulic conductivity, 1063 mgm^{-3} bulk density and 65.56% total porosity. The textural class in the CF soil were similar to OF soil. The CV values for sand, silt and clay fractions were higher than those in OF, indicating high variability, and significantly higher than the soils in OF.

According to Brady (1996), organic matter is the major component that stimulates the formation and stabilization of granular and crumb type of aggregates. As organic residue decomposes, organic acids, sugars, mucilaginous substances, and other viscous microbial by-products are evolved. Which, along with associated fungi and bacteria, encourage the crumbs formation and net effect of these activities will decrease bulk density and increase porosity as observed in this study. The CV of CF (30.26%) was higher than that in OF (17.05%), this showed high variability, and significantly higher at ($P < 0,.05$) than OF soils. Loganathan (1990) working on the effect of certain tillage practices and amendments on physico chemical properties of problem soil also observed low bulk density in soil managed with organic matter. Higher organic matter addition could increase organic carbon content of soil which resulted in an increased water holding capacity of the soil. It is also important to mention that soil organic matter is responsible to a great extent, directly or indirectly for making the physical environment of the soil suitable for the growth of crops. It exerted this benefit largely through its effect on improving soil aggregation and porosity, which in turn influenced soil structure, water infiltration, moisture conservation, aeration and microbial activities as observed in OF soils compared to CF soils.

Table 2: Physical properties of the soil

Variable	Depth	Sand	Silt	Clay	Tex class	Ksat	BD	TP
	(cm)	gkg^{-1}	gkg^{-1}	gkg^{-1}		$Cmhr^{-1}$	Mgm^{-3}	%
ORS	0-10	833.33	59.72^{b}	165.28^{ab}		1.32	1122.80^{a}	65.56
	10-20	755.56	62.50^{b}	131.94^{ab}		1.01	1039.4^{ab}	70.0
	20-30	738.89	55.83^{b}	168.06^{a}		1.10	981.70^{b}	74.0
	Range	771-849.60	2.50-	136.40-		0.67-1.78	669-1321	50.15-74.75
	Mean	738.89	14.30	220.40	SL	1.13	10007.89	61.97
	Sd (±)	22.72	9.40	181.43		0.33	171.85	6.49
	CV (%)	2.81	3.74	25.21		29.46	17.05	10.47
			39.78	13.9				
CNS	0-10	894.44	74.72^{a}	148.61^{b}		0.93	953.0^{bc}	71.11
	10-20	833.33	56.94^{b}	130.56^{bc}		1.07	1095.10^{ab}	65.56
	20-30	811.11	44.0^{bc}	137.50^{b}		1.16	1063^{ab}	68.33
	Range	802-938	6-49.20	49-174		0.55-1.43	578-1461	44.87-78.19
	Mean	967.32	25.94	106.73	LS	1.02	1037	58.87
	Sd (±)	44.49	15.28	35,81		0.35	313.82	11.84
	CV (%)	5.13	58.9	33.55		34.22	30.26	19.46
$Lsd_{(0.05)}$	LUT	23.50*	11.46*	20.80*		0.363	10.152*	5.737

ORS= Organic soil, CNS= Conventional soil, SL= Sandy Loam texture, LS= Loamy sand texture

* Significant at p < 0.05, ** Significant at p<0.01

Means with different superscript are significantly different (p<0.05)

Chemical Properties

The addition of organic matter OF land use system significantly (P < 0.05) enhanced the nutrient availability of soil in OF compared to CF. Available N, P, K, Ca, Mg were increased by organic manure application compared to CF soil. The observed pH increases OF soil although not significantly (P > 0.05) may be due to the suppression of the activity of Fe and Al oxides, and hydroxides, which play a vital role in protonation-deprotonation mechanization controlling H^{+} ion concentration in soil solution. The higher value of soil pH in OF soil may be attributed to the excretion of earthworm containing NH_4^+ ions from its calciferous glands. The worm is attracted to the OF soil due to organic matter application, the cast had a pH near neural range (Basker et al., 1994). The OF soil receiving organic matter are significantly superior in providing available N, P, K, Ca, Mg and base saturation (B.S) than soil CF land use system.

Table 3: Chemical properties of the soil

LUT	Depth (cm)	pH	EC	OM	TN	AVP	K	Na	Ca	Mg	EA	ECEC	BS	C: N
				g/kg	g/kg	Mg/kg	←			Cmol/kg	→		%	
ORS	0-10	5.11	0.11	29.63^{a}	1.17^{a}	17.44^{ab}	0.14^{ab}	0.04^{ab}	6.54^{a}	1.75	2.14	11.26^{a}	76.19^{ab}	14.69^{c}
	10-20	4.67	0.11	26.30^{a}	0.82^{a}	19.41^{a}	0.19^{a}	0.03^{b}	6.08^{a}	1.90	2.52	10.67^{a}	71.43^{abc}	18.60^{b}
	20-30	5.10	0.10	23.10^{ab}	0.60^{ab}	17.63^{ab}	0.18^{a}	0.04^{ab}	6.88^{a}	1.81	2.14	11.56^{a}	77.62^{a}	22.33^{a}
	Range	4.77-5.92	0.11-0.19	16.90-30.10	0.73-1.30	22.41-31.69	0.10-0.21	0.03-0.05	5.63-7.25	1.29-2.38	1.57-3.29	9.78-12.44	67.14-82.86	12.47-13.43
	X	5.42	0.14	23.91	1.04	26.11	0.17	0.04	6.50		2.27	11.16	75.08	13.34
	Sd (±)	0.39	0.03	4.98	0.22	2.69	0.04	0.01	0.58	1.82	0.52	0.99	4.35	13.13
	CV (%)	7.22	19.14	20.84	20.84	10.31	24.35	14.62	8.92	0.39 21.67	22.78	8.84	5.80	98.46
CNS	0-10	4.92	0.13	24.30^{ab}	0.63^{ab}	10.05^{d}	0.12^{b}	0.05^{ab}	2.13	1.79	3.07	6.52^{b}	61.43^{ac}	22.37
	10-20	5.07	0.13	25.27^{ab}	0.63^{ab}	13.28^{bc}	0.10^{b}	0.05^{a}	3.42	0.65	2.38	6.89^{a}	59.52^{c}	23.27
	20-30	4.6	0.13	23.70^{b}	0.60^{b}	11.14^{cd}	0.08^{b}	0.05^{a}	2.13	0.61	3.24	6.59^{a}	43.81^{d}	22.91
	Range	4.49-5.4	0.05-0.2	9.10-22.3	0.39-0.97	12.71-24.88	0.08-0.13	0.04-0.08	1.75-3.75	0.33-3.34	1.79-3.79	6.0-7.33	38.57-78.57	13.53 15.34
	X	4.98	0.1	14.91	0.65	17.48	0.10	0.06	2.57		2.90	6.67	54.92	13.31
	Sd (±)	0.32	0.05	5.1	0.22	3.55	0.02	0.01	0.72	1.02	0.75	0.60	12.76	13.45
	CV (%)	6.34	50.25	34.21	34.21	20.28	19.94	20.92	28.11	0.92 90.0	25.84	8.98	23.23	101.06
	LSD (0.05)	0.493	0.027	3.469*	0.151*	5.567*	0.047*	0.02*	0.52*	0.64**	2.50*	3.52*	1.64**	0.461^{ns}

LUT= Land Use Type, *Significant at p<0.05, **Significant at p <0.01
Means with different superscript are significantly differently (p<0.05)

The process of aminization, ammonification and oxidative deaminisation brought about by microbially mediated enzyme systems are active in organic matter amended soil, thus contributing more of soluble N (Table 3). The OF land use system receiving organic manure registered superior values for all the soil chemical properties like pH, effective cation exchange capacity (ECEC), organic matter, base saturation (B.S) and C/N ratio (Table 3). The increased level of organic carbon is a good indication of better carbon sequestration in soil by reducing the amount of CO_2 in OF soil than in CF soil. In this study, the values for soil microbial biomass C in OF soils were 0.73µgg^{-1}, 0.64 µgg^{-1} and 0.56 µgg^{-1} for 0-10, 10-20, 20-30cm depths respectively, whereas, in CF soils, the values were 0.48 μgg^{-1}, 0.46 μgg^{-1} and 0.40 μgg^{-1} for 0-10, 10-20 and 20-30cm depths respectively. The values for microbial biomass N were 0.02, 0.02, and 0.02 μgg^{-1} soil in 0-10, 10-20, and 20-30cm depths for OF soil respectively and in CF soil, the values were 0.02, 0.05, and 0.04 μgg^{-1} soil in 0-10, 10-20, and 20-30cm depths respectively. The values for microbial biomass P for OF soil were 0.073, 0.06, and 0.056 μgg^{-1} soil for 0-10, 10-20, and 20-30cm depths respectively. For CF soil, the values were 0.048, 0.046, and 0.040 μgg^{-1} soil for 0-10, 10-20, and 20-30cm depth respectively. The microbial biomass C for the top soil (0-10cm depth) in OF soil was significantly ($P < 0.05$) higher than those in 10-20, and 20-30cm depths in OF soil and in all the depths in CF soils. There was no significant ($P > 0.05$) in microbial biomass N in both OF and CF soil and across the depths but microbial biomass P in OF soil was significantly ($P < 0.05$) higher than those recorded in CF soil and across the depths. Microbial biomass C values obtained in this study did not coincide with those reported (61-2000 μgg^{-1} soil) by Vance et al., (1987), and (1.02 – 2073 μgg^{-1} soil) by Hermot and Robertson (1994) for various temperate and tropical forest soils. Microbial biomass N in OF soils were lower than those obtained in CF soils in the 10-29 and 20-30cm depths respectively, but were not significantly ($P > 0.05$).

Table 4: Biomass carbon, Nitrogen and Phosphorus in the soils.

Land use type	Depth (cm)	BMC ($\mu g^{-1}g$)	BMN($\mu g^{-1}g$)	BMP($\mu g^{-1}g$)
ORS	0-10	0.73^{a}	0.02	0.073^{a}
	10-20	0.64^{ab}	0.02	0.064^{ab}
	20-30	0.56^{abc}	0.02	0.056^{ab}
	Range	0.44-0.84	0.02-0.02	2.12-4.11
	X	0.63	0.02	3.01
	Sd (±)	0.13	0.0	0.66
	CV (%)	20.15	0.0	21.89
CNS	0-10	0.48^{bc}	0.02	0.048^{ab}
	10-20	0.46^{bc}	0.05	0.046^{ab}
	20-30	0.40^{c}	0.04	0.040^{b}
	Range	0.30-0.55	0.01-0.04	1.32-3.23
	X	0.43	0.02	2.28
	Sd (±)	0.08	0.01	0.73
	CV (%)	18.63	34.93	500.0
	LSD (0.05)	0.010^{**}	0.001	0.707^{**}

*Significant at $p<0.05$, **Significant at $p<0.01$

Means with different superscript are significantly different ($p<0.05$).

Microbial biomass C and microbial biomass P were seen to be significantly ($P < 0.05$) higher in OF soil (0-10cm depth) than those recorded in CF soils. The results for microbial biomass obtained in this present study are far below what had been reported in various soils and agro-climatic zones.

The reasons for the wide variability in biomass values obtained in this and those reported, Gonza lez-Quin-Ones et al., (2011) highlighted that, the size of the SMB qualitative expresses thee influence of soil type, climate, ecosystem, and management practices on the growth and maintenance of soil microorganisms. The range of values given for Australian agricultural system were between 20 – 700 mgc/kg soil (Vliet et al., 2000; Pankhurst et al., 2003), but with values up to 1700 mgc/kg soil measured in forest systems of south-eastern Queensland (Chen et al., 2005), they concluded that, there is no single value of SMB that can be considered as an attainable value for all soils.

CONCLUSION

Among the two agricultural systems, organic cultivation significantly increased soil fertility than conventional, cultivation. There was a very high variability in bulk density between the two agricultural systems, of had a CV of 17.05% compound 30:26% of CF, this resulted in proper donation in OF than CF soils. High percentage of total N was recorded in OF soil than in CF soil. High microbial biomass C and P were recorded in OF soil than in CF soil but there was however, no significant different in microbial biomass N among the two farming systems.

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