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SOIL PROPERTIES OF SEVEN STUDY FALLOW PLOTS IN NIGERIAN RAINFOREST REGION

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ABSTRACT: The soil properties of seven fallow plots in a Nigerian rainforest region were studied with the objectives of providing profile descriptions which would aid their recognition in the field, and of presenting their physical and chemical properties which are important for their use. The soils of younger plots are well drained while the soils of the older plots are poorly drained. Sand fraction was significantly higher than clay and silt within each plot, but showed no significant difference between different plots. Organic matter content was low in all the plots and there was no significant difference between the plots, but the content was significantly higher in the upper layer than in the lower layer in all the plots. In general the soils of the fallow plots are not seriously leached of bases. Percentage base saturation significantly varied among different plots. The cation exchange capacity is low in correspondence with kaolinitic nature of soil clay and low organic matter content.

1. INTRODUCTION

In order to provide adequate food for the growing population of Nigeria, the existing small-scale, shifting cultivation system of farming must be replaced by a large-scale continuous cultivation system. The change to such a system requires for its success a good knowledge about soils, which constitute a unique resource base for agricultural production.

In slash and burn agriculture in the rainforest ecosystem in Nigeria, the original forest vegetation is cleared, the cut material is allowed to dry and is burnt before the land is cropped on. Subsequently the land is cleared, burnt and cropped yearly or at intervals of 2 to 5 years, thereby varying the duration of the fallow. However, during the clearing of the original forest, stands of some tree species are left on the land for their economic value and this leads to degradation of the tropical rainforest *[1]*. Though the trees are left for their economic value they may affect the local soil properties through their litter, leaching of nutrients from their canopies, extraction of nutrients from deeper layers of soil, and trapping of dust particles.

The influence of vegetation, particularly roots, on soil characteristics is greatest during the first year after its growth. The influence decreases rapidly during the succeeding year *[2]*. Research efforts directed towards accumulating knowledge about forest soil conditions during extended fallow periods are therefore considered necessary.

This study aims at examining the fallow age as it affects the soil conditions of fallow plots in a rainforest region in Ile-Ife area of south-western Nigeria.

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2. STUDY AREA: The study was carried out in seven fallow plots located in Ile-Ife area of south-western Nigeria, in the rainforest zone of Nigeria. Ile-Ife lies between latitudes 7°31'N and 7°33'N and longitudes 4°31' E and 4°34' E. These plots were selected on the basis of their vegetaion and the apparent extent of deforestation. The seven representative plots of 50m x 50m each were designated as plots TA, TB, TC, R7, PH, AG and FR. Plots TC and TA are one-year old fallows, plot TB is a two-year old fallow while plots R7 and PH are three-year old fallows. Plot AG is a five-year old fallow while plot FR is a forested plot.

The original vegetation of Ile-Ife area was lowland rainforest or semi-deciduous moist forest *[3]*. White *[4]* described the vegetation of this area as Gunea-congolian rainforest of drier type. The vegetation characteristics of the seven study fallow plots in Ile-Ife area of south-western Nigeria are presented in Table 1. The mean rainfall at Ile-Ife is about 1400mm (five-year mean). The rainy season lasts from mid-March to late October and rainfall is bimodal with peak periods in July and September. Mean temperature in the area ranges from an annual minimum of 27°C to 34°C.

The area is underlain by metamorphic rocks of the Precambrain base complex. These rocks show great variation in structure, mineral composition and grain size *[5]*.

3. MATERIALS AND METHODS: Central line transects (50m) were used for soil sampling. Five 50m central line treansects were laid randomly within each 50m x 50m plot. Soil samples were collected systematically at every fifth meter point from the 0 to 5 and 5 to 10cm depth using a soil auger. The soil samples were placed in polythene bags and transported to the laboratory for air-drying. Each sample was homogenised, passed through 2mm sieve and stored for chemical analysis. Soil samples were also collected along the same transects using core samplers to take undisturbed soil samples (pod) for bulk density determination. Each soil sample was then placed in an air-tight container.

A 2m deep profile pit was located at the mid-slope portion of each plot. Detailed morphological description of profiles was carried out according to the guidelines for soil profile description *[6]*. The multiple sub-sampling of horizon method *[7]* was employed to ensure representatives of the samples collected for the given horizon.

The soil samples were analysed for the following properties: pH, particle size distribution, organic matter, bulk density, exchangeable cations (Ca, Mg, K, Na), total nitrogen, and available phosporous.

Soil pH was measured in 0.1M $CaCl_2$ (at soil to solution ratio of 1:2). Organic matter was determined by the Walkley-Black method *[8]* and total nitrogen by the Kjeldahl method *[9]*. The particle size distribtuion was determined by the hydrometer method after dispersing the soil in sodium hexametaphosphate (Calgon) *[10]*. Exchangeable cations (Ca, Mg, K and Na) were determined by the analysis of neutral 1M ammonium acetate extracts. Postassium and sodium were estimated by the flame emission photometry and calcium and magnesium by atomic absorption spectrophotometry. Available phosphorus was determined by Bray's method *[11]*. The effective cation exchange capacity was determined as the sum of exchangeable cations

TABLE 1

Vegetation Characteristics of the Seven Study Fallow Plots in Ile-Ife Area of Southwestern Nigeria.

Plots	Age (year)	No of woody species	Total density of Wood species per ha^{-1}	Total mean basal area of woody species m^2 ha^{-1}	Total mean crown horizontal area M^2 ha^{-1}	Mean percentage aerial and basal cover of Herbaceous.		Density of woody species in each of three height classes ha^{-1}			Sorensen index of similarity is	Shannon-Wigne Species diversit index (H^1)
						Aerial	Basal	3m	3-7m	7m		
1 (TC)	1	11	216	2.104 ± 0.213	878.088 ± 51.645	708.13 ±164	41.30	60	96	60	TA = 55.55% TB = 32.26% R7 = 21.62% PH = 33.33% AG = 22.86% FR = 09.52%	1.835
2 (TA)	1	7	176	0.041 ± 0.002	176.406 ± 17.095	823.75 ±132	39.14	48	128	0	TA =22.22% R7 = 34.78% RH =25.00% AG = 09.52% FR = 07.89%	1.445
3 (TB)	2	20	224	1.239 ± 0.056	1001.408 ±33.927	825.63 ±115	15.85	68	116	56	R7 = 16.67% PH = 44.44% AG = 23.53% FR = 39.22%	2.349
1 (R7)	3	16	401	0.296 ± 0.007	227.560 ± 9.754	778.13 ±135	13.44	180	236	9	PH = 43.9% AG = 46.67% FR = 17.02%	2.226
5 (PH)	3	25	392	1.563 ± 0.101	657.828 ± 11.594	745.25 ±150	10.46	136	140	64	AG = 41.03% FR = 28.57%	2.711
6 (AG)	5	15	192	4.008 ± 0.177	226.128 ± 78.543	828.25 ±137	6.21	36	140	64	FR = 40.00%	2.093
7 (FR)	25	31	732	9.040 ± 0.237	7796.328± 91.129	-	-	48	50	184	-	2.538

and exchangeable acidity. The exchangeable acidity was determined by extraction with IN KCl and titrating with sodium hydroxide.

4.0 RESULTS AND DISCUSSION

4.1 Soil Morphology: In the determination of soil properties of any plot in south-western Nigeria, Smyth and Montgomery *[5]* considered soil morphology mainly. The morphological criteria employed were those considered important in the Soil Survey Manual *[12]* and comprise the following: soil colour designated by standard munsel notation, soil texture, soil structure, and depth of solum and depth of bed rock.
The descriptions are for moist soil conditions unless otherwise stated.

4.1.1 Plot TC (01)

Location:	Along Tonkere Road, about 1km from the Obafemi Awolowo University gate 3.
Series:	Balogun series
Higher Category Classification:	Ultisol/Luvisol
Parent Material:	Granite gneisis
Slope:	10%
Drainage:	Well drained
Age of Fallow:	1 year

Horizon	**Depth**	**Description**
AP	0 to 17cm	Humic, dark yellowish brown (10 YR 3/4) to dark brown (7.5YR 3/2), sandy loam, weak, fine to medium, granular; slightly friable, abundant medium and fine roots, gradual smooth boundary.
AB	17 to 47cm	Dark reddish brown (5YR 3/3); slightly gravelly; sandy loam, weak to medium, subangular blocky, friable; common quartz stones and gravels; occasional rock fragments observed; few fine roots, gradual smooth boundary
B_1	47 to 114cm	Dusky red (10R 3/4); sandy, clay loam, moderate, medium, subangular blocky, firm, no quartz gravel and stones observed, few patchy thin cutans along channels and occassionally on ped surface; diffuse smooth boundary
B_2	114 to 228cm	Essentially as B_1 except that it has more of the rock fragments than B_1.
B_3	228cm +	Red (10R 4/8); with patches of red (2.5YR 4/6); brittle sandy loam moderate, medium subangular blocky, abundant patches of rotten rock; rotten felspar observed; gradual smooth boundary to the rotten rock.

Generally the soil is dark humic surface overlying brownish to reddish fairly clayey sub-soil. Solum (A and B) extended to approximately 228cm depth. Small medium rock particles very common from about 20cm depth. The soil is well drained.

4.1.2 Plot TA (02)

Location:	Along Tonkere Road, about 1.5km from the Obafemi Awolowo University gate 3.
Series:	Ekiti series
Higher Category Classification:	Alfisols (soil taxonomy) Lixisol (FAO/UNESCO)
Parent Material:	Granite gneisis
Slope:	10%
Drainage:	Well drained
Age of Fallow:	1 year

Horizon	**Depth**	**Description**
A	0 to 20cm	Brown to dark brown (7.5YR 4/2); sandy loam, moderate; medium granular and few sub-angular blocks; abundant fine medium and coarse roots; non-gravelly; non-stony; gradual wavy boundary.
AB	20 to 40cm	Brown to dark brown (7.5YR 4/4);; slightly gravelly; sandy loam, moderate; medium, sub-angular; firm; common quartz stones and gravels with occasional rotten rock pieces, mostly fine roots, gradual smooth boundary.
B	40 to 100cm	Strong brown (7.5YR 5/6) coarse sandy clay loam, moderate, medium subangular blocky; firm moist; occassional quartz gravel and stone; few rotten rock pieces; sharp smooth boundary to underlying bed rock.
Bed-rock	100cm +	Hard impervious slightly weathered rock.

The soil is shallow, overlying hard impervious basement complex rock (granite-gneisis). The dark humic surface overlies the brownish subsoil. Quartz gravels, few rotten rock particles and stones were observed. The soil is well drained.

4.1.3 Plot TB (03)

Location:	Along Tonkere Road, about 1.2km from the Obafemi Awolowo University gate 3.
Series:	Oba series
Parent Material:	Hill wash material over mottled clay
Slope:	10%
Drainage:	Well drained
Age of Fallow:	2 years

Horizon	**Depth**	**Description**
A	0 to 14cm	Brown to dark brown (7.5YR 4/2); loam, weak fine to medium; subangular blocky; friable common fine to medium roots; common macropores; gradual smooth boundary.
AB	14 to30cm	Reddish brown (5YR 5/4); loam, weak; medium subangular blocky; slightly plastic, non-sticky friable; slightly gravelly (mainly quartz gravel) few patchy thin cutans along ped surfaces; common macropores, common fine roots; gradual smooth boundary.
BW_1	30 to 55cm	Yellowish red (5YR 4/6); sandy clay loam; plastic, sticky; firm; moderate, medium, subangular blocky; slightly gravelly; mainly quartz; common macropores; patchy thin cutans along ped surfaces and root channels, no mottles; few medium roots; diffuse smooth boundary.
BW_2	55 to 81cm	Essentially like the horizon above except the presence of few medium to coarse distinct yellowish brown mottles and essentially non-gravelly, wavy clear boundary .
2BC	81 to 150cm	Highly mottled; common dark red (10R 3/6) and yellowish brown mottles (10YR 5/6). Sandy clay loam, very firm; coarse platy; common brown specks of felspar, slightly gravelly; common patchy thin cutans.

Generally the parent material is hill wash over mottled clay. It is a fine textured soil distinguished into many horizons. The soil is well drained.

4.1.4 Plot R7 (04)

Location:	End of Road 7F, Senior Staff Quarters, Obafemi Awolowo University
Series:	Itagunmodi series
Parent Material:	Probably biotile or hornblende schist
Slope:	10%
Drainage:	Somewhat poorly drained
Age of fallow:	3 years

Horizon	**Depth**	**Description**
A	0 to 6cm	Non-humic yellowish red (5YR 4/6), fine sandy clay, plastic, slightly sticky, very firm, moderate to strong, medium and coarse, angular and subangular blocky, common thin cutans and slickenside (pressure surface) few quartz gravels, few medium roots approximately 1 to 2mm; cracks observed; deffuse smooth boundary.

BW_1	6 to 50cm	Yellowish red (5YR 5/8); clay, very plastic; very sticky, very firm moderate to strong medium and coarse, angular and subangular blocky, common thin cutans and slickenside (pressure surface), few quartz gravels, few medium roots, approximately 1 to 2mm; crack observed, diffuse smooth boundary.
BW_2	50 to 80cm	Yellowish red (5YR 5/8). The horizon has fewer Fe/Mn oxide nodules/concretions than in 80 to 135cm depth. Also there are no rotten rock pieces. Texture, structure, consistence are as for 80 to 135cm depth, diffuse smooth boundary .
BC	80 to 135cm	Yellowish red (5YR 5/8) clay; very sticky, very plastic, firm moist moderate to strong, medium and coarse subangular blocky, many soft block nodules, probably of Fe/Mn oxides, common thin cutans on ped surfaces and along root channels, occasional quartz stones and gravels. Common rotten rock pieces.

The soil is somewhat poorly drained. The parent material is probably biotite or hornblende schist. The soil is reddish brown to 80cm with high clay content without mottles. Below 80cm depth are common rotten rock pieces and block nodules and/or concretions.

4.1.5 Plot PH (05)

Location:	Behind the Faculty of Pharmacy, Obafemi Awolowo University, Ile-Ife.
Series:	Apomu series
Parent Material:	Hill wash. The alluvial material deposited on top 45cm is derived from basement complex rocks.
Slope:	10%
Drainage:	Somewhat poorly drained
Age of Fallow:	3 years

Horizon	Depth	Description
A	0 to 10cm	Humic dark brown (7.5YR 3/2) sandy loam, weak, fine granular, friable, few coarse roots, common medium and fine roots, no stones, no gravel, clear smooth boundary.
AB	10 to 43cm	Brown (7.5YR 5/3), non-gravelly, non-stony, sandy loam, weak, fine to medium granular, common pores, medium with few fine roots, clear and smooth boundary.
$2B_1$	43 to 84cm	Brown (7.5YR 5/4), non-mottled, sand loam with abundant Fe/Mn oxide nodules/concretions, gravels and stones. Few medium roots, very hard and compact layer, with few fine earth materials. Boundary is clear and wavy.

$2B_2$	84 to 110cm	Brown (7.5YR 5/4) with common greyish (2.5YR 5/2) and brownish yellow (10YR 6/8) mottles; mottles are medium to coarse and distinct. Moderate to strong, medium to coarse, subangular blocky, friable, few pores, no roots, clear wavy boundary.
$2B_3$	110 to 180cm	Brown (7.5YR 5/4), with mottles of red (10R 4/6) and greyish brown (2.5Y 5/2). The mottles ae common, medium to coarse and clear. Slightly gravelly sandy clay loam, moderate, medium platy with few columnar, few pores, no roots. The consistence is friable.

The soil has weak, granular dark humic surface 10cm, underlain by greyish brown, non-gravelly friable layer (10 to 43cm) of soil material considered to be drift in nature. The layer is underlain by concretionery layer, brownish to reddish interior. Mottle colour is basically yellowish. The soil is somewhat poorly drained.

4.1.6 Plot AG (06)

Location: Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife.
Series: Iregun series
Parent Material: Drift material occupies 0 to 55cm, the upper layer; overlying the sedentary material.
Slope: 10%
Drainage: Somewhat poorly drained
Age of Fallow: 5 years

Horizon	**Depth**	**Description**
A	0 to 12cm	Dark brown (7.5YR 3/2), loose; sandy clay to sandy clay loam; non-gravelly, no stone, medium and fine root, common. Diffuse smooth boundary.
B_1	12 to 40cm	Brown (7.5YR 5/4), slightly gravelly, sand clay to sand clay loam, moderate fin to medium sub-angular blocky; very porous, slightly firm; diffuse smooth boundary.
B_w	40 to 55cm	Brown (7.5YR 5/4), loose; sandy loam; fine to medium roots, very porous; non-gravelly, gradual wavy boundary.
2Bt	55 to 84cm	Strong brown (7.5YR 5/6), slightly gravelly, sandy clay to sandy clay loam, moderate fine to medium sub-angular blocky; very porous, slightly firm; diffuse smooth boundary.
$2Bt_2$	84 to 130cm	Brown (7.5YR 5/6), with abundant mottles of yellow (10YR 6/8) and red (2.5YR 4/8). The mottles are prominent, common, with sharp boundaries. Texture is sandy clay loam; firm moderate, medium with angular blocky; few quartz stones and gravel; few patchy thin cutans along channels and ped surfaces. Gradual wavy boundary.

$2BC_2$	130 to 170cm	Strong brown (7.5YR 5/8), with many prominent mottles of grey, (10YR 6/1) (light grey to grey)and few yellow and red mottles. Sandy clay, with abundant unweathered felspar possible ortho clase felspar-k, felspar with abundant quartz gravel and stone, looks very firm and few thin flakes of mosquovite.

Deep soil with dark humic surface; brownish (0 to 55m) upper layer overlying mottled strong sub-soil. Evidence of greying observed at 130cm; 55 to 130cm layer is highly mottled; mottle colour range yellow to red with few patches of grey.

4.1.7 Plot AG (07)

Location:	Alakowe village via Ile-Ife.
Series:	Egbeda
Parent Material:	Fine grained biotic-gneises and schists
Slope:	10%
Drainage:	Fairly drained
Age of Fallow:	Above 25 years

Horizon	**Depth**	**Description**
A	0 to 15cm	Humic dark brown (7.5YR 3/2), sandy loam, weak, fine granular, abundant medium fine roots. Gradual smooth boundary.
AB	15 to 50cm	Dark grey to dark greyish brown (2.5YR 5/2), loose clayey fine sand to very clayey fine sand, weak crumb structure to structureless. Low concentrations of quartz and gradual smooth boundary.
B_1	50 to 90cm	Greyish brown (2.5YR 5/2), sandy clay loam; frequent quartz gravel and stones, moderate to stony; medium to coarse subangular blocky, few pores, abundant roots, clear wavy boundary.
B_2	90 to 120cm	Brown (7.5YR 5/4), with mottle of red (10YR 4/6) and greenish brown (2.5YR 5/2). The mottles are common medium to coarse and clear. Slightly gravelly, sandy clay loam, moderate, medium platy, few pores, root present.
B_3	120 to 150cm	Brown (7.5YR 5/4), with mottles of red (10YR 4/6) and greyish brown (2.5YR 5/2). Slightly gravelly, sandy clay loam, moderate, few roots, few pores.

The upper few centimeters of soil was dark grey to dark greyish brown, loose, clayey fine sand to very clayey fine sand with weak crumb structure to structureless. It has a fairly low concentration of quartz gravel and concretions. The soil is relatively deep and well drained. High concentration of silt and the low organic matter content along with its poor structure, top soil down to 50cm.

4.2 Physical Characteristics: Table 2 presents the physical data for the seven study fallow plots. Plot PH had the highest sand content (75.06% and 76.96%) at both 0 to 5cm and 5 to 10cm depths respectively while plot R7 had the lowest sand (38.06% and 33.20%) and highest clay and silt content with the values from the other plots intermediate. There was significant difference ($P<0.001$) in the particle size distribution within each plot with sand fraction significantly higher than clay and silt except in plot R7.

Table 2: Mean Values ± 95% Confidence Interval of Physical Soil Properties at 0 to 5cm and 5 to 10cm Soil Depth in Seven Plots in Ile-Ife Area of Southwestern Nigeria

Property	Soil depth	Plot TC (1)	Plot TA (2)	Plot TB (3)	Plot R7 (4)	Plot PH (5)	Plot AG (6)	Plot FR (7)
% Sand	0-5cm	71.5±2.0	65.5±2.7	67.6±3.7	38.1±2.9	75.1±3.7	70.4±4.8	70.5±4.6
	5-10cm	72.1±1.9	66.2±1.1	73.2±3.0	33.2±3.0	77.0±3.0	71.2±5.2	70.2±3.7
% Silt	0-5cm	11.5±1.3	11.8±1.6	13.7±2.5	18.2±1.9	10.0±4.6	7.8±2.0	9.5±1.7
	5-10cm	11.4±0.8	11.4±0.8	9.8±2.2	19.4±1.3	8.8±2.2	8.3±1.5	10.7±1.6
% Clay	0-5cm	17.0±1.2	23.0±1.9	18.7±2.2	43.7±3.2	14.9±1.5	21.8±3.6	20.0±2.9
	5-10cm	16.5±1.5	22.4±1.9	17.0±1.6	47.4±3.2	14.2±2.2	20.1±4.3	19.1±2.7
Sand/clay ratio	0-5cm	4.2±0.4	2.9±0.4	3.8±0.8	0.9±0.1	5.3±0.5	3.5±0.7	3.9±0.9
	5-10cm	4.4±0.4	3.0±0.3	4.3±0.6	0.7±0.1	5.4±0.9	3.9±0.9	3.9±0.9
Bulk density	0-5cm	1.32±0.10	1.20±0.13	1.19±0.09	1.35±0.22	1.30±0.11	1.32±0.11	1.22±0.13
	5-10cm	1.50±0.10	1.29±0.12	1.37±0.11	1.55±0.11	1.39±0.06	1.39±0.06	1.45±0.15

The sand/clay ratio was lowest in plot R7 while that of plot PH was the highest. With the exception of plot R7, the clay content in the 0 to 5cm layer was consistently higher than that in the 5 to 10cm layer while there was only slightly significant difference in the sand and silt contents between the two layers. The difference in particle size distribution between soils in the upper and lower layers was however, not statistically significant when analysis of variance was applied Also the difference in the particle size distribution between soils among the plots was not statistically significant.

Sandy soils are nutrient-poor because of their porosity and inability to retain nutrients *[13]*. The results of this study showed that the surface soils were sandy thus increasing infiltration rates. Jones and Wild *[14]* stated that sand, silt and clay and organic matter affect soil structural stability and water-holding capacity. The bulk density of the soils ranged from 1.11g/cm^3 in plot TB to 1.35g/cm^3 in plot R7 in the 0 to 5cm layer and from 1.29gm/cm^3 in plot TA to 1.55/cm^3 in plot R7 in the 5 to 10cm layer. The bulk density of the upper layer was lower than that in the lower layer in all plots. In both the upper and lower soil layers, plot TB had the lowest bulk density in the upper layer while plot TA had the lowest in the lower layer and other plots had intermediate values. This difference in bulk density between upper layer and lower layer was

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TABLE 3

Mean values ± 95% confidence interval of Chemical Soil properties at 0-5cm and 5-10cm soil depth in seven study plot in Nigerian rainforest region

Properties	Soil Depth	Plot TC (1)	Plot TA (2)	Plot TB (3)	Plot R7 (4)	Plot PH (5)	Plot AG (6)	Plot FR (7)
Organic matter	0-5cm	2.66 ± 0.67	2.89 ± 0.5	3.97 ± 0.83	4.01 ± 0.67	3.99 ± 0.70	4.44 ± 0.39	3.95 ± 0.69
	5-10cm	2.34 ± 0.44	2.70 ± 0.36	2.74 ± 0.45	3.55 ± 0.21	2.64 ± 0.12	2.41 ± 0.88	2.38 ± 0.30
Nitrogen (%)	0-5cm	0.05 ± 0.1	0.06 ± 0.05	0.06 ± 0.3	0.07 ± 0.07	0.06 ± 0.05	0.08 ± 0.06	0.09 ± 0.05
	5-10cm	0.04 ± 0.1	0.06 ± 0.04	0.06 ± 0.2	0.07 ± 0.03	0.06 ± 0.02	0.08 ± 0.04	0.09 ± 0.04
Calcium (me/100g)	0-5cm	4.9 ± 1.0	5.3 ± 1.1	6.3 ± 1.1	6.2 ± 0.5	6.2 ± 0.4	6.9 ± 0.4	7.8 ± 0.5
	5-10cm	4.0 ± 1.1	5.2 ± 1.2	6.2 ± 1.2	5.9 ± 1.0	5.8 ± 1.0	6.6 ± 1.1	6.4 ± 1.0
Magnesium (me/100g)	0-5cm	0.9 ± 0.0	0.9 ± 0.0	1.3 ± 0.2	1.5 ± 1.6	1.5 ± 0.8	1.6 ± 0.7	1.9 ± 0.1
	5-10cm	0.8 ± 0.0	0.8 ± 0.1	1.2 ± 0.1	1.4 ± 1.6	1.3 ± 0.6	1.4 ± 0.5	1.6 ± 0.1
Potassium (me/100g)	0-5cm	0.4 ± 1.1	0.5 ± 1.1	0.5 ± 1.3	0.6 ± 0.0	0.6 ± 0.0	0.7 ± 0.1	0.6 ± 0.0
	5-10cm	0.4 ± 1.2	0.5 ± 1.1	0.5 ± 0.3	0.5 ± 0.1	0.5 ± 0.0	0.6 ± 0.1	0.5 ± 0.1
Sodium (me/100g)	0-5cm	0.1 ± 0.1	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.0	0.2 ± 0.0	0.2 ± 0.1
	5-10cm	0.1 ± 0.1	0.2 ± 0.0	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1
Cation exchange capacity (C.E.C me/100g)	0-5cm	5.6 ± 0.1	4.8 ± 0.1	5.6 ± 0.1	8.5 ± 0.2	8.4 ± 0.2	9.5 ± 0.1	9.6 ± 0.2
	5-10cm	5.2 ± 0.1	4.7 ± 0.1	5.3 ± 0.0	7.8 ± 1.0	7.7 ± 1.1	8.7 ± 1.1	9.3 ± 0.2
Percentage base saturation	0-5cm	98.9 ± 0.1	98.9 ± 0.1	98.6 ± 0.1	99.7 ± 0.0	99.2 ± 0.0	99.8 ± 0.0	99.6 ± 0.1
	5-10cm	98.9 ± 0.1	99.8 ± 0.1	98.7 ± 0.2	99.6 ± 0.1	99.1 ± 0.0	98.8 ± 0.0	99.6 ± 0.1
Phosphorus (ug/g)	0-5cm	1.4 ± 1.0	1.1 ± 0.1	1.4 ± 0.1	2.1 ± 1.9	2.1 ± 1.8	2.4 ± 1.7	3.1 ± 2.6
	5-10cm	1.0 ± 1.0	1.3 ± 0.1	1.2 ± 0.1	2.2 ± 0.9	2.2 ± 0.8	2.5 ± 0.9	2.9 ± 2.7

statistically significant at P<.005. The difference in the bulk density among the different plots was, however, not statistically significant.

4.3 CHEMICAL CHARACTERISTICS: Table 3 presents the chemical data for the seven study fallow plots. The pH of the soils of all the plots showed that they were slightly acidic (6.3 to 6.9) with only a slight difference among the plots. There was no significant difference between the pH values in the upper and lower layers (Table 3). The different plots were also not statistically significant. Soil pH can be used as a diagnosis of fertility problems. For instance, acidity markedly curtails the activity of bacteria and actionmycetes at pH<5.5 whereas nitrification and nitrogen fixation take place vigorously at pH>5.5 *[15]*. The pH values (6.3 to 6.9) obtained in this study fall within the range reported by Ojanuga *[16]* for soils of Ife area.

Soil organic matter content in the upper layer (0 to 5cm) was significantly higher than in the lower layer (5 to 10cm) (P<.05) in all the plots. Plot AG had the highest organic matter in the upper layer while plot TC had the lowest with others having intermediate values. Plot R7 had the highest organic matter in the (5 to 10cm) lower layer, while plot TC had the lowest organic matter closely followed by plot FR. This difference in the organic matter content among the plots was not statistically significant. In general, the soils possess low organic matter. Similar observations have been made by Ojaunga *[16]* and Adejuwon and Ekanade *[17]* who worked on soils of Ife and Ondo areas.

The amounts of exchangeable bases (Ca, Mg, K and Na) are lower in the young plots than in the older plots. The amount of exchangeable bases differs from plot to plot but the difference is not significant.Plot FR recorded the highest value while plot TC had the lowest value, and other plots had intermediate values. Of particular significance is the higher amounts of exchangeable bases in the upper horizons of soil under the old plot. The relative accumulation of bases in the upper horizons is believed to be due to plant recycling of bases. No significant differences were observed in the cation exchange capacity among the different plots at the different depths. Cation exchange capacity (CEC) of the soil is low and the value is consistent with the low organic matter content in the soil and the kaolinitic nature of soil clay fractions *[18]*. Base saturation varied and differed significantly among plots and with soil depth. This further substantiates the statement that in general the soils are not seriously leached and this could be attributed to the presence of herbaceous ground cover of vegetation.

The variations in the morphological, physical and chemical properties of the soils of the various plots, to some extent, are related to age and floristic composition of the fallow plots. The present study has revealed the kind of relationships that exist between floristic composition, fallow age and the soil properties in a Nigerian rain forest. The results suggest some degree of homogeneity among the soils of the study fallow plots.

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