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Assessment of some Micronutrients, Copper, Iron and Zinc (Cu, Fe, Zn) in Soils Formed from Coastal Plain Sand, Akwa Ibom State, Nigeria

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ABSTRACT: This study was conducted to examine the levels of available copper (Cu), Iron (Fe) and Zinc (Zn) in some soils formed from Coastal Plain Sand in Akwa Ibom State. Sixteen (16) composite soil samples 0-20 cm and 20-40 cm depth were collected in eight (8) different locations and used for the study. The physicochemical properties of the soils were determined in the laboratory using standard methods while the available forms of the micronutrients were determined by the ethylene- diamine-tetra- acetic acid (EDTA) extraction method. The results show that, the soils were loamy sand and highly acidic (pH 3.6 – 5.8) with low exchangeable potassium (K) (0.02 – 0.19 cmol/kg), low to moderate total nitrogen (TN) (0.06 – 0.17 %), effective cation exchange capacity (ECEC) (6.85 – 16.98 cmol/kg) and low to high contents of organic matter (OC) (1.98 – 7.19 %). The order of abundance of exchangeable cations were Ca > Mg > K > Na. All the soils were high in available Fe (7.08 – 12. 09 mg/kg) and Zn (91.05 – 3.61 mg/kg), but low in Cu (0.06 – 0.76mg/kg). Correlation analysis showed that the micronutrients in the soils were influenced by soil pH, silt, clay and organic matter. The significant correlation among the micronutrients indicates that, their abundance and release to plant is controlled by these soil properties. So, it is recommended that, regular soil test be carried out to monitor the levels of these micronutrients for proper fertility management of the soils to increase crop production.

Keywords: Micronutrients, coastal plain sands, soil properties, soil depth
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INTRODUCTION

Micronutrients are chemical elements required by plants in small quantities for growth and development (Mustapha *et al.,* 2011). They include elements such as zinc (Zn), iron (Fe), nickel (Ni), copper, lead (Pb), cadmium (Cd) and mercury (Hg) amongst others. Some of these nutrients (the essential heavy metals) have been reported to play vital roles in plant nutrition (Havlin *et al.,* 2012) although their specific roles in plant nutrition vary, but they are important in the activation of various enzymatic processes in plants (Food and Fertilizer Technology Center, 2001). Even though the elements are required by plants in small amounts, vital plant metabolisms are impaired or limited if the elements are unavailable, thus leading to plant growth dysfunctionality and reduced yield. According to Verma *et al,* (2005) the distributions of micronutrient forms vary with parent materials and depths. Brady and Weil (2002) reported that the deficiency and toxicity of micronutrients are often related to the level of these element in the parent material from which the soil was form. Ijah *et al.,* (2023) reported that, soils developed on coastal plain sand, sandstone and beach ridge sand have relatively high content of iron and zinc. Mustapha *et al.,* (2011) found higher concentrations of zinc and copper in the topsoil than in subsoil whereas the concentrations of iron and manganese were higher in subsoil than topsoil. Ideriah *et al.* (2013) observed a decreased in the concentration of nickel with soil depth.

Several factors such as soil mineralogy, soil pH, redox state and the quantities of other nutrient elements present in the soil are known to affect the availability of trace elements in the soil. Brady and Weil (2010) observed that soil pH especially in well aerated soils influence the availability of micronutrient in the soil except chlorine. Under acidic conditions, molybdenum is rendered unavailable while most of the cationic trace elements are available or presence at toxic level.

Information on micronutrient status of soils has become of utmost concern. Soil chemical fertility particularly lack of nutrient input is a major factor in soil degradation (Hartemink, 2010). Due to inherent low soil fertility status, tropical soils often have negative nutrient imbalance (Smaling, 1995). In order to sustain an adequate supply of trace elements to crop, soil management practices that will enhance continuous nutrient in soil must be considered including fertilizer application for soils deficient in some of these nutrients. Hence, the objective of this study was to assess the level of some micronutrients, copper, iron and zinc (Cu, Fe, Zn) in soils formed from coastal plain sand in Akwa Ibom State, Nigeria.

MATERIALS AND METHODS

The study was conducted in Akwa Ibom State in eight (8) different locations namely Utu Abak in Abak L.G.A., Ukana in Essien Udim L.G.A., Ikot Obong Edong in Ikot Ekpene L.G.A., Ikpe Mbak Eyop in Obot Akara L.G.A., Utu Ikot Eboro in Etim Ekpo L.G. A., Udi in Ika L.G.A. Ikot Akpa Nkuk in Ukanafun L. G. A., and Obio Akpa in Oruk Anam L.G.A. Akwa Ibom State lies between latitudes 4˚ 30' and 5˚ 30'N and longitudes 7˚ 30' and 8˚ 20'E 7E[1] and falls within the humid rain forest ecological zone with two distinct seasons; the rainy season which lasts from April to October and the dry season which spans from November to March. It is characterized by annual rainfall of about 2500 to 3000 mm with temperature ranging between 26˚ C to 28˚ C. (Ekpoh 2015). in the rainforest zone, with a mean annual rainfall of over 3000 mm. Temperature values are relatively high with mean annual temperature varying between 26˚ and 28˚C (Ekpoh, 2015).

Soil sampling and processing

Soil samples were collected in triplicate at 0-20 cm and 20-40 cm within each location. A total of 48 samples was generated. The samples were air-dried, crushed and sieved using a 2 mm mesh sieved. The sieved samples were used in the determination of particle size distribution and chemical analysis.

Laboratory analysis

Particle size distribution was determined by the Bouyoucos hydrometer method using sodium hexametaphosphate as dispensing agent (Gee and Or, 2002) The soil pH was measured in a soil to water ratio of 1:2.5 using a glass electrode pH meter as described by Udo *et al*. (2009). The electrical conductivity **(**EC**)** was measured in 1:2.5 soil/water suspension using an electrical conductivity meter. Soil organic carbon was determined using Walkley and Black method (Nelson and Sommers, 1996) and the value was multiplied by a factor of 1.72 to obtain organic matter. Total nitrogen in the soil was determined by the Micro-Kjeldahl distillation method (Bremmer, 1996) The available phosphorus was determined by the Murphy and Riley method after extraction by Bray P-1 extractant. The exchangeable cations (Ca, Mg, K and Na) in the soil were extracted using 1N NH_4 OA_C solution (pH 7.0). K and Na in the extract were measured using flame photometry while Ca and Mg were determined by atomic absorption spectrophotometry). Exchangeable acidity was determined by the titration method. Effective Cation Exchange Capacity (ECEC) was determined by summing up the exchangeable cations (TEB) and the exchangeable acidity (TEA). Base saturation was calculated by dividing the sum of exchangeable bases by ECEC and multiplying by 100. The micronutrients (Cu, Fe and Zn) were extracted using 0.5M/litre of Di-sodium ethylene-diamine-tetra-acetic acid (EDTA) and also separated with 0.1N HCl acid.

Statistical analysis

The soil data collected were subjected to t-test analysis (paired t-test) to compare the concentrations of the selected micronutrients between the surface (0-20 cm) and sub surface (20-40 cm) soils. The relationships between the micronutrients (Fe, Cu and Zn) and some soil properties were determined using the Pearson correlation analysis with SPSS.

RESULTS AND DISCUSSION

Physicochemical properties of the studied soils

The physiochemical properties of the soils are presented in (Table 1). The Ikot Akpa Nkuk soil at the depth of 0-20cm had the highest sand content of 87.46% while Utu

Table 1: The physicochemical properties of the soils

Location	Depth (cm)	Sand (%)	Silt (%)	Clay (%)	TC	pH (H_2O)	EC (ds/m)	OM (%)	TN (%)	Av. P (mg/kg)	Ca (cmol/kg)	Mg (cmol/kg)	K (cmol/kg)	Na (cmol/kg)	EA (cmol/kg)	ECEC (cmol/kg)	Bs (%)
Utu Abak	0-20	82.54	6.08	11.39	LS	4.60	0.15	4.01	0.09	18.32	3.2	1.12	0.03	0.09	3.52	7.96	55.63
	20-40	76.48	7.29	16.24	LS	4.80	0.15	1.98	0.06	16.02	2.33	0.96	0.04	0.08	3.52	7.10	50.33
Ukana	0-20	76.32	9.42	14.26	LS	5.20	0.09	6.79	0.17	11.13	3.86	1.12	0.05	0.06	2.72	7.82	65.26
	20-40	77.04	6.79	16.17	LS	5.20	0.08	5.78	0.14	12.90	3.8	1.24	0.05	0.06	2.61	7.76	66.1
	0-20	85.02	3.46	11.53	LS	3.86	0.16	6.37	0.16	22.76	5.53	1.4	0.02	0.08	1.49	8.53	82.16
Ikot Obong Edong	20-40	79.04	5.98	14.86	LS	3.60	0.17	5.44	0.13	26.02	4.0	1.36	0.02	0.08	1.39	6.85	79.56
	0-20	79.67	6.73	13.27	LS	5.16	0.07	7.15	0.17	31.36	4.46	1.4	0.19	0.06	3.73	10.03	65.36
Ikpe Mbak Eyop	20-40	74.35	7.7	14.4	LS	5.36	0.08	5.00	0.12	33.13	3.33	1.08	0.16	0.06	3.41	7.92	55.36
	0-20	73.97	10.54	15.49	LS	5.53	0.08	4.75	0.12	15.79	5.12	2.7	0.11	0.09	2.83	10.84	73.96
Utu Ikot Eboro	20-40	69.99	10.52	19.49	LS	5.30	0.07	3.63	0.09	13.78	5.12	3.2	0.11	0.09	2.24	10.76	78.9
Udi	0-20	84.87	4.2	10.93	LS	4.45	0.09	6.31	0.16	28.35	5.28	2.88	0.14	0.07	2.16	10.53	79.0
	20-40	81.72	5.41	12.87	LS	4.35	0.11	5.90	0.15	26.01	7.44	4.56	0.13	0.07	2.08	14.28	85.45
	0-20	81.43	17.44	12.76	LS	5.00	0.09	2.59	0.07	37.13	5.76	3.2	0.13	0.08	2.06	11.19	81.86
Obio Akpa	20-40	77.23	7.91	14.86	LS	5.17	0.09	2.29	0.06	36.47	5.6	2.88	0.15	0.1	1.71	10.43	83.93
	0-20	87.46	2.91	9.63	LS	5.56	0.10	7.19	0.18	12.01	9.28	5.44	0.11	0.07	2.08	16.98	88.0
Ikot Akpa Nkuk	20-40	84.05	5.03	10.92	LS	5.76	0.09	6.74	0.17	10.23	8.32	4.48	0.10	0.06	2.77	15.74	81.23
Mean		79.45	7.34	13.69		4.93	0.10	5.12	0.13	21.96	5.15	2.44	0.10	0.08	2.52	10.30	73.26
SD		4.76	3.51	2.54		0.61	0.03	1.75	0.04	9.37	1.89	1.45	0.05	0.01	0.74	3.06	11.93
CV		**5.99%**	**47.84%**	**18.53%**		**12.43%**	**32.06%**	**34.13%**	**32.84%**	**42.67%**	**36.64%**	**59.48%**	**56.25%**	**17.55%**	**29.45%**	**29.73%**	**16.29%**

OM= Organic matter, EC= Electrical conductivity, TN= Total nitrogen, Av. P= Available Phosphorus, K= Potassium, Ca= Calcium, Mg=Magnesium, Na= Sodium, EA= Exchangeable acidity, Al= Aluminum, ECEC= Effective cation exchange capacity, BS = Base saturation, SD = Stander Deviation, CV= Coefficient of Variation

Ikot Eboro soil at depth 20-40cm had the least sand content of 69.99%. Utu Ikot Eboro soil at depth 0-20cm had the highest silt content of 10.54% while the Udi soil at 0-20cm depth had the least silt content of 4.2%. Utu Ikot Eboro soil at the depth of 20-40cm had the highest clay content (19.49%) while Ikot Akpa Nkuk soil at depth 0-20cm had the least clay content (9.63%). The textural class of each of the soils was loamy sand.

The pH in water ranged from 3.6 in Ikot Obong Edong soil at depth 20-40cm to 5.8 in Ikot Akpa Nkuk soil at depth 20-40cm. The range is considered good for crop production (Okalebo *et al.,* 2002; Ijah *et al.,* 2021). Electrical conductivity is used as a means of appraising soil salinity as a result of high concentration of salt (basic cations) in the soil. Esu (2010) reported that EC level above 2ds/m^{-1} indicates soil salinity. The electrical conductivity was low and ranged from 0.10ds/m^{-1} in Ikot Akpan Nkuk soil (0-20cm) to 0.15ds/m^{-1} in Utu Abak soil (0-20cm/20-40cm depth) indicating that the soils are non-saline.

The organic matter contents of the soils ranged from 1.98% in Utu Abak at depth 20-40cm to 7.19% in Ikot Akpa Nkuk soil at depth 0-20cm. The organic matter contents of the soils were above the critical level of 2mg/kg in all the locations studied as proposed by Aduayi *et al.* (2002) for soils of Eastern Nigeria except the organic matter contents in Utu Abak soil which were low. Total nitrogen was low in all the soils ranging from (0.06 – 0.17 %). This may be due to the low levels of organic matter in the soils. Available phosphorus ranged from 10.22mg/kg in Ikot Akpa Nkuk soil at the depth of 20-40cm to 35.13mg/kg in Obio Akpa soil at depth 0-20cm. The order of abundance of exchangeable bases were Ca > Mg > K > Na. ECEC ranged from 6.85cmol/kg in Ikot Obong Edong soil at depth 20-40cm to 16.98cmol/kg in Ikot Akpa Nkuk soil at depth 0-20cm. The soil recorded high base saturation belonging to the category as potentially fertile soil. Landon (1991).

Levels of the micronutrients (Copper, Iron and Zinc) in the soils

Table 2 shows the concentrations/levels of the available Cu, Fe and Zn in the soils. The concentrations of Cu ranged from 0.06 to 0.76 mg/kg, Fe ranged from 7.08 to 12.09 mg/kg and Zn ranged from 1.05 to 3.61 mg/kg at 0 -20 cm depth respectively. However, at 20 – 40 cm depth, Cu ranged from 0.05 to 0.64 mg/kg, Fe ranged

Table 2: Levels of the micronutrients in the soils.

Soil Location	Soil Depth (cm)	Cu (mg/kg)	Fe (mg/kg)	Zn (mg/kg)
Utu Abak	0 – 20	0.37	9.64	1.28
	20 – 40	0.16	8.32	2.07
Ukana	0 – 20	0.05	8.27	2.42
	20 – 40	0.56	8.47	2.48
Ikot Obong Edong	0 – 20	0.68	10.08	3.18
	20 – 40	0.64	8.61	2.72
Ikpe Mbak Eyop	0 – 20	0.76	10.13	3.61
	20 – 40	0.12	7.02	1.11
Utu Ikot Eboro	0 – 20	0.27	7.93	1.29
	20 – 40	0.41	9.67	2.01
Udi	0 – 20	0.46	8.19	2.22
	20 – 40	0.07	12.84	3.05
Obio Akpa	0 – 20	0.22	12.09	3.01
	20 – 40	0.08	9.73	1.08
Ikot Akpa Nkuk	0 – 20	0.18	7.08	1.05
	20 – 40	0.05	10.69	2.48

Cu= Copper, Fe= Iron, Zn= Zinc.

Table 3: Comparison of the concentrations of the micronutrients between the surface (0 – 20cm) and subsurface (20 – 40cm) layers of the soils studied.

Micronutrients/ Depth	Cu (mg/kg)	Fe (mg/kg)	Zn (mg/kg)
0 – 20cm	0.355	9.517	2.081
Standard deviation	0.217	1.297	0.826
20 – 40cm	0.282	9.085	2.303
Standard deviation	0.276	1.996	0.873
t-value	0.681	0.513	-0.488
p (< 0.05)	0.518 NS	0.624 NS	0.641 NS

Cu= Copper, Fe= Iron, Zn= Zinc; NS= Non-significant

from 7.02 to 12.84 mg/kg and Zn ranged from 1.08 to 3.05 mg/kg respectively. Based on their critical limit of 0.2, 0.5, 4.5 mg/kg (FDALR, 1990), Cu, Fe and Zn were moderate, high and low in virtually all the soils respectively. The moderate to high concentration of Cu and Fe in the soils could be due to the high acidity of the soils, as observed by Agbede (2009).

Comparison of the concentrations of the micronutrients between the Surface (0 – 20cm) and subsurface (20 – 40cm) soils

Table 3 shows the comparison of the concentrations of the micronutrients between the surface (0 – 20cm) and subsurface (20 – 40cm) layers of the soils studied. A paired sample t-test was conducted to compare the concentration of Cu, Fe and Zn between the soil surface (0 – 20cm) and subsurface soil (20 – 40cm) as shown in (Table 3).

Copper (Cu)

Table 3 shows the concentrations of Cu between

Table 4: Correlation matrix relating selected micro nutrients (Cu, Fe, Zn) and some soil properties (0-20cm)

0-20 cm	Cu	Fe	Zn	Sand	Silt	Clay	pH	EC	OM	TN	Av.P	K	Ca	Mg	Na	EA	ECEC	BS
Cu	1																	
Fe	-0.060	1																
Zn	0.587	0.445	1															
Sand	-0.398	0.403	0.220	1														
Silt	0.548	0.121	0.061	0.032	1													
Clay	0.473	0.154	0.023	0.049	0.995**	1												
pH	0.476	0.173	0.038	0.052	0.994**	1.000	1											
EC	0.474	0.181	0.038	0.053	0.994**	0.999**	1.000	1										
OM	0.447	0.183	0.022	0.056	0.990**	0.999**	0.999**	0.999**	1									
TN	0.474	0.181	0.038	0.053	0.994**	0.999**	1.000**	1.000**	0.999**	1								
Av.P	0.531	0.217	0.161	0.149	0.972**	0.965**	0.967**	0.967**	0.961**	0.967**	1							
K	0.475	0.181	0.039	0.053	0.994**	0.999**	1.000**	1.000**	0.999**	1.000**	0.967**	1						
Ca	0.476	0.187	0.041	0.065	0.994**	0.999**	1.000**	1.000**	0.999**	1.000**	0.970**	1.000**	1					
Mg	0.483	0.189	0.050	0.060	0.994**	0.999**	1.000**	1.000**	0.999**	1.000**	0.970**	1.000**	1.000**	1				
Na	0.474	0.181	0.038	0.053	0.994**	0.999**	1.000**	1.000**	0.999**	1.000**	0.967**	1.000**	1.000**	1.000**	1			
EA	0.472	0.173	0.038	0.049	0.994**	1.000**	1.000**	1.000**	0.999**	1.000**	0.967**	1.000**	1.000**	1.000**	1.000**	1		
ECEC	0.482	0.188	0.053	0.069	0.995	0.999	1.000	1.000	0.998	1.000	0.974	1.000	1.000	1.000	1.000	0.999	1	
Bs	0.208	0.471	0.014	0.747	0.459	0.39	0.446	0.451	0.436	0.450	0.542	0.450	0.464	0.460	0.451	0.441	0.464	1

Cu = Copper, Fe = Iron, Zn = Zinc, pH = potential different, Om = Organic matter, TN = Total Nitrogen, Av.P available phosphorus, K = Potassium, Ca = Calcium, Mg = Magnesium, Na = Sodium, EA = Exchangeable acidity, ECEC = Effective cation exchange capacity, BS = Base saturation

the surface and subsurface soils (0-20cm and 20-40cm) across all the locations. There was no significant (p>0.05) difference in the concentration of Cu for 0-20cm depth with a mean of 0.355mg/kg and 20-40cm depth with a mean of 0.282mg/kg. It was observed that the highest concentration of Cu was found in the surface soil and could be due to higher organic matter content as well as lower pH of the soil.

According to the Food and Fertilizer Technology Center (2010), concentrations of micronutrients tend to be higher in the surface soils of uncultivated soils, probably due to organic residues.

Iron (Fe)

The concentrations of Fe between the surface and subsurface soils (0 – 20cm and 20 – 40cm) across the different locations are shown in (Table 3). There was no significant (p>0.05) difference in the concentrations of Fe at the depth of 0-20cm with a mean of 9.514mg/kg and 20-40cm with a mean of 9.085mg/kg. It was observed that the highest concentrations of Fe were found in the surface soil (0-20cm). The amount of available Fe in these soils could be due to the acid conditions of the soils resulting from leaching of most basic cation due to intense rainfall (Ijah et al., 2021). However, Biwe (2012) reported that the presence of Fe in high concentration in soils could lead to its precipitation and accumulation and upon complexes leading to the formation of laterite. This could further lead to restriction of root penetration due to indurations formed as a result of alternate drying and wetting of the soils.

Table 5: Correlation matrix relating selected micro nutrients (Cu, Fe, Zn) and some soil properties (20-40cm).

20-40 cm	Cu	Fe	Zn	Sand	Silt	Clay	pH	EC	OM	TN	Av.P	K	Ca	Mg	Na	EA	ECEC	BS
Cu	1																	
Fe	-0.078	1																
Zn	0447	0.762*	1															
Sand	-0.783	0.241	-0.388	1														
Silt	0.736	-0.187	0.379	-0.954**	1													
Clay	0.632	-0.227	0.361	-0.910**	0.875**	1												
pH	0.403	0.171	0.323	-0.157	0.284	-0.036	1											
EC	-0.696	0.067	-0.140	0.307	-0.409	-0.112	-0.818*	1										
OM	0.007	0.462	0.118	0.556	-0.624	-0.571	-0.021	-0.134	1									
TN	-0.051	0.466	0.100	0.614	-0.669	-0.617	-0.005	-0.115	0.994**	1								
Av.p	-0.114	-0.563	-0.644	-0.070	0.042	-0.141	-0.293	0.083	-0.267	-0.308	1							
K	0.335	-0.306	-0.280	-0.120	0.238	-0.198	0.498	-0.681	-0.048	-0.053	0.523	1						
Ca	-0.216	0.317	-0.143	0.609	-0.403	-0.600	0.220	-0.314	0.506	0.550	-0.121	0.401	1					
Mg	-0.130	0.221	-0.125	0.462	-0.236	-0.439	0.217	-0.328	0.342	-0.394	0.143	0.444	0.063**	1				
Na	-0.075	-0.264	-0.163	-0.398	0.554	0.496	-0.219	0.156	-0.771*	-0.782*	0.338	0.072	-0.094	0.042	1			
EA	0.197	-0.005	0.302	-0.153	0.061	-0.020	0.537	-0.192	-0.107	-0.070	-0.296	0.074	-0.356	-0.317	-0.514	1		
ECEC	-0.152	0.286	-0.080	0.544	-0.334	-0.565	0.355	-0.380	0.424	0.484	-0.206	0.463	0.965**	0.971**	-0.142	-0.131	1	
BS	-0.174	0.187	-0.226	0.386	-0.176	-0.257	-0.166	-0.119	0.314	0.314	0.096	0.217	0.800*	0.773*	0.323	-0.837**	0.646	1

Cu = Copper, Fe = Iron, Zn = Zinc, pH = potential different, Om = Organic matter, TN = Total Nitrogen, Av.P available phosphorus, K = Potassium, Ca = Calcium, Mg = Magnesium, Na = Sodium, EA = Exchangeable acidity, ECEC = Effective cation exchange capacity, BS = Base saturation

Zinc (Zn)

The concentrations of Zn between the surface and subsurface soils (0 – 20cm and 20 – 40cm) across the different locations are shown in (Table 3). There was no significant ($p > 0.05$) difference in the concentrations of Zn for 0 -20cm with a mean of 2.081mg/kg and 20 – 40cm with a mean of 2.303mg/kg. It was observed that the concentrations of Zn increased slightly down the soils. The low available Zinc in the soil surface could be due to the sandiness of the soils and excessive rainfall in the area coupled with the nature of the soil which encouraged leaching losses of zinc. The results obtained from this study contradict that of Ijah et al. (2023), who reported higher contents of zinc in coastal plain soils of Akwa Ibom State, but in consonance with the report of Alloway (2008).

Relationships between the micronutrients (Cu, Fe, Zn) and selected physicochemical properties of the soils

The relationships between the micronutrients (Cu, Fe and Zn) and selected physicochemical properties of the soils are presented in (Table 4 and 5). In 0-20cm depth of the soils, though not significant, Cu and Zn correlated or related negatively with sand ($r = -0.398$, $r = -0.220$ respectively), whereas Fe related positively with sand ($r = 0.403$). Copper, Fe and Zn correlated positively with silt ($r = 0.548$, $r = 0.121$, $r = 0.061$ respectively). Copper, Fe and Zn had positive relationships ($r = 0.473$, $r = 0.154$, r -= 0.023 respectively) with clay. Copper, Fe and Zn had positive relationships ($r = 0.447$, $r = 0.183$, $r = 0.022$) with organic matter. The soil pH correlated positively but non-significantly ($r = 0.476$, $r = 0.173$, $r = 0.038$) with Cu, Fe, Zn. The relationship indicates that pH did not significantly influence their availability in the soils. This report is in conformity with that of Ahukaemere *et al.*, (2014) of soils of the coastal plain sands in south eastern Nigeria. Sims and Johnson (1991) reported that the availability of trace element in the soil is affected by pH and texture. Also, the results obtained from this study conformed to the report of Deb and Sakal, (2002) and Tisdale *et al.,* (2003) that the availability of most micronutrients in soils depend on soil pH, OC content and adsorptive surfaces. However, the positive correlation implies that increase in one soil property increases the other while; negative correlation implies that increase in one soil property decreases the other and vice versa. In 20 – 40cm depth of soil, though not significant, sand correlated negatively (r = -0.783, r = -0.388) with Cu and Zn and positively (r = 0.241) with Fe. Silt correlated positively (r = 0.736, r = 0.379) with Cu and Zn but negatively (r = -0.187) with Fe. Clay correlated positively (r = 0.632, r = 0.361) with Cu and Zn but negatively (r = - 0.227) with Fe. OM had a positively correlation (r = 0.007, r = 0.462, r = 0.118) with Cu, Fe, Zn. The soil pH correlated positively but non-significantly (r = 0.403, r = 0.171, r = 0.323) with Cu, Fe, Zn. This report is in conformity with the findings of Kparmwang *et al.,* (2000) in the sedimentary soils.

Conclusion and recommendation

The study indicated that the textural class of each of the soils was loamy sand. The soil pH was moderately acidic which is satisfactorily for crop production. The soils were non-saline with low to moderate organic matter contents, low nitrogen and high contents of available phosphorus. The order of abundance of exchangeable cations were Ca > Mg > K > Na with high base saturation. There was no significant (P>0.05) difference in the concentrations of Cu at depths 0-20cm (0.336mg/kg) and 20-40cm (0.28 mg/kg), Fe at depth 0-20cm (9.51mg/kg) and 20-40cm (2.30 mg/kg). The results show that Fe and Zn were high in all the soils while Cu was low. It is recommended that; regular soil tests be carried out to monitor the levels of these micronutrients to prevent possible toxicity to plants grown on these soils.

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