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EFFECTS OF LAND USE ON SOIL MICRONUTRIENTS STATUS IN UGHOTON COMMUNITY OVIA NORTH EAST, EDO STATE, NIGERIA.

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ABSTRACT

The study was conducted to assess the effects of different land use practices on soil micronutrients in 18 soil samples collected at 0-15 cm and 15-30 cm depth respectively from three land use types (Cassava field, Oil palm and Banana plantation) and analyzed for physico-chemical properties and selected micronutrients (Zn, Cu, Fe and Mn) using standard laboratory methods. The results showed that Organic carbon. Total Nitrogen, Available F. and exchangeable bases were low across the land use types. Though soil content of Zn and Cu were generally low and below the critical limit for crop production. It implied that soil amendments of Zn and Cu and/or application of appropriate quantities of key elements would enhance their availability for optimum yield of crops in the study area. It is recommended that farmers within the study area need to adopt management practices that will encourage the return and incorporation of plant residue into the soils in order to build up the soil organic carbon which will in turn enhance the CEC of the soils.

Key words: Critical level, land use types, Micronutrients, Ughoton community.

INTRODUCTION

Micronutrients are plant nutrients required in relatively small amounts, However, micronutrients have the same agronomic importance as macronutrients and play vital roles in the growth of plants (Nazif *et al.,* 2006). According to Kabata-Pendias, (2001) and Jiang (2009) the availability of micronutrients in soils depends on soil PH, organic matter content, adsorptive surfaces and other physical, chemical and biological conditions in the root zone and is influenced by their distribution within the soil profile and other soil characteristics (Singh *et al*. 1989). Fageria *et al*. (2002) in their review of micronutrients in crop production, maintained that micronutrient deficiencies in crop plants are widespread worldwide. It is imperative to know that large hectares of arable land in Nigeria have been reported to be deficient in micronutrients (Osiname *et al.,* 1973; Chude *et al.*, 1985; Akinrinde *et al.*, 2005). According to Dar (2004), there is need for monitoring the micronutrient status through analysis of soils and plant tissues. Many researchers have advocated the need for assessing the micronutrients status of soils (Chaudari *et al.* 2012) and Nigeria in particular (Ibrahim *et al.,* 2011; Mustapha, *et al.,* 2011). Indeed a number of research work have been conducted in Nigeria on status and distribution of micronutrients (Akporhonor and Agbaire, 2009, Biwe *et al.,* 2012; Ibrahim *et al.*, 2011; Osayande *et al.*, 2016; Mulima *et al.*, 2015; Orhue *et al.*, 2015). However, there is little available research information on the distribution of these micronutrients in different land use types in the study area. The objectives of this study were therefore: (i) to assess the distribution of available micronutrients (Zn, Cu, Fe and Mn) in response to land use types, and (ii) to examine the relationships among changes of micronutrients with other soil properties under various land uses types in Ughoton community.

MATERIALS AND METHODS

The study was conducted at Ovia North East Local Government Area of Edo state, South-South, Nigeria under three land uses (Cassava field, Oil palm and Banana plantation).The study location falls between Latitude 6.12-6.25°N and Longitude 5.26-5.63°S with an altitude of l49.4m asl. The climate of the study sites can be described as the rain forest zone with distinct dry and wet seasons. The dry season runs from early November to the end of March or early April, while the rainy season is from March to November. There are two rainfall peaks in June and September with dry spell in August (August break) which produces the bimodal rainfall pattern in South-South, Nigeria. Rainfall ranges from 1500 mm to 2135 mm (Osayande *et al.*, 2016). The average minimum and maximum temperature during the period of research ranged from 27.2 °C and 30.1°C over time and relative humidity with a mean monthly relative humidity of between 80.5 and 85 %.

Vegetation and land use

The study area is dominated by agricultural farmlands which made up of 85% of the vegetation cover. Land use in the entire area comprises farm lands used for the cultivation of food crops mainly cassava which is often cultivated along with maize in a mixed cropping system, banana and oil palm plantation. These are mainly subsistence agriculture. There were a few infrastructures for residential and commercial use outside of the farming occupation of the people in the study area.

Soil sampling

Three land uses were chosen for the study; Cassava field, Oil palm and Banana plantations. This was done to ensure that the study covered the extensive land use variations in the study area. In each of the land use, three sampling points were located and a total of 18 soil samples were collected at 0 -15cm and 15-30cm depth respectively.

Laboratory Analysis

In the laboratory, the soils were dried at ambient temperature (22-25 C), crushed in a porcelain mortar and sieved through a 2 mm (10 meshes) stainless sieve. The air-dried less than 2 mm sieved soils were stored in polyethylene bags for subsequent analysis. The less than 2 mm fraction was used for the determination of selected soil physico-chemical properties. Particle size distribution (sand, silt and clay) was determined by hydrometer method (Gee and Or, 2002). Soil pH was measured using 1:2 soil water ratio (Gruhn *et al.*, 2000). Organic matter was determined by wet oxidation method. (Idigbor *et al.*, 2008). Available P was determined using Mehlich-3 extraction procedures as described by Olsen and summer, (1982). Total Nitrogen was determined by Kjeldah digestion method. (Ndukwu *et al.*, 2009). Soil exchangeable bases (Ca, Mg, K and Na) were extracted with lN Ammonium acetate (NH_4OAc); Ca and Mg were determined using atomic absorption spectrophotometer (Perkin elmer 370 Model) while K and Na were determined using flame photometer. The cation exchange capacity

(CEC) was the summation of the exchangeable bases. The extractable micro nutrients: Zn, Cu, Fe and Mn were extracted using 0.1M HCl solution (Osiname *et al.,* 1973) and determined on an atomic absorption spectrophotometer (Model 210) at appropriate wave length.

DATA ANALYSIS

Data obtained from the laboratory were subjected to statistical analysis using Genstat computer package. One-way analysis of variance (ANOVA) and the Least Significance Difference (LSD) at 5 % level of probability were used to separate the means of both the micro nutrients and the selected physico-chemical properties.

RESULTS AND DISCUSSION

Physical and chemical properties of soils under different land use types

Particle size distributions of the soils are shown in (Table: 1). The content of sand in the study area ranged from 82.5 to 94.7% in all the land use types. It was observed that high content of sand were recorded in cassava field than oil palm and banana plantations across the land use types. The sand and silt content of the soils significantly decreased with soil depth while the clay content increased significantly ($P<0.05$) with soil depth. The textural class of the soils in the different land use was found to be the same except for banana plantation (15-30 cm depth) which was clay loam. This suggests that the different land use types did not have significant effects on the soil texture in the study area. This observation is consistent with earlier findings by Shobayo *et al.,* (2013). In all the land use types, the soils were slightly acidic to strongly acidic ranging from 4.70 to 4.95 and decreased with soil depth. The acidic nature of the soils further confirmed earlier reports of Jacob and Olowokere (2013). The mean pH in cassava field (4.95) was highest as compared to oil palm and banana plantations a both sampling depth, (Table 2). However, the pH recorded were within the desirable range for plants nutrition availability (Brandy and Weil, 2002). The organic carbon content of the soils were low and ranged from 0.89- 1.10 mg/kg, However, these values were relatively high in oil palm at (0-15cm) and banana plantation (15-30cm) depth as compared to Cassava field. This result agrees with the findings of Negassa (2001) and Malo *et al*. (2005), who reported less organic carbon in the cultivated soils than uncultivated soils. Similarly, the depletion of organic carbon as a result of intensive cultivation in Cassava field had, therefore, reduced the CEC of the soils as earlier reported by Boke (2004) and Negassa (2001). The low organic carbon observed in the study area could be due to rapid decomposition and mineralization of organic matter and to poor management practices by farmers as earlier reported by Lawal *et al. (*2012) and Greenerland (1995). Thus, farmers within the study area need to adopt management practices that will encourage the return and incorporation of plant residue into the soils in order to beef up the soil organic carbon. The Nitrogen content in the soils ranged from 0.80 to 1.08 mg/kg and decreased significantly with soil depth in all the land use and fell below the critical level of 1.5-2.0 mg/kg (Sobulo and Osinarne, 1981). Based on this critical level the soil was deficient in N-level. Similarly the phosphorus content of the soils was generally low and ranged from 5.66 to 9.46 mg/kg and decreased with soil depth. Although the 0-15cm soil depth of all the land use had higher phosphorus content, the soils were deficient in phosphorus when compared with 10-16 mg/kg critical level

Table 1: Some soil physical properties at 0-15cm and 15-30cm depth under different land use.

Soil properties	Land use type (0-15) cm			Land use type (15-30) cm		
	Cassava Field	Oil palm plantation	Banana Plantation	Cassava Field	Oil palm plantation	Banana plantation
Sand %	94.7	91.6	89.8	90.3	87.4	82.5
Silt %	3.6	2.8	3.6	2.6	2.4	3.2
Clay %	7.3	6.4	6.9	7.9	6.7	7.8
Texture	LS	LS	LS	LS	LS	CL

Key: LS=loamy sand
CL=clay loam

Table 2: Mean values of soil quality indicator under different land use types

Indicator	Cassava field		Mean	Oil palm plantation		Mean	Banana plantation		Mean
Depth (cm)	0-15	15-30	---	0-15	15-30	---	0-15	15-30	---
pH (H_20)	5.10	4.80	4.95	4.50	4.90	4.70	5.00	4.80	4.90
O.M (g/kg)	1.25	0.58	0.92	1.32	0.89	1.11	1.13	1.06	1.10
Total N	1.10	0.50	0.80	1.14	1.01	1.08	1.12	0.90	1.01
Av.P (mg/kg)	7.24	4.08	5.66	10.2	8.72	9.46	6.84	6.66	6.75
Ca^{2+}	2.28	1.59	1.94	2.60	1.15	1.88	2.75	2.44	2.60
Mg^{2+}	0.75	0.70	0.73	0.32	0.42	0.37	0.75	0.86	0.81
Na^{2+}	1.10	0.92	1.01	1.34	1.03	1.19	1.12	1.20	1.16
K^+	2.10	1.60	1.85	1.31	1.60	1.46	1.40	1.00	1.20
CEC	4.29	3.42	3.86	4.39	2.79	3.59	4.75	4.40	4.58
Texture	LS	LS		LS	LS		CL	CL	

Key: LS=loamy sand
CL=clay loam

Table 3. Mean values of available micronutrients of soils of the study area

Land use types	Zn (mg/kg) Soil depth (cm)		Mean	Cu (mg/kg) Soil depth (cm)		Mean	Fe (mg/kg) Soil depth (cm)		Mean	Mn (mg/kg) Soil depth (cm)		Mean
	0-15	15-30		0-15	15-30		0-15	15-30		0-15	15-30	
Cassava field	41.2	34.7	38.00	2.06	2.72	2.39	385.9	370.8	378.4	28.13	21.4	24.8
Oil palm	50.4	44.8	47.60	1.20	1.69	1.45	395.3	371.6	383.5	30.8	19.1	25.0
Banana plantation	31.8	36.1	34.00	1.00	1.61	1.31	353.4	133.5	243.5	24.7	22.4	23.6
LSD (0.05)	NS			NS			NS			NS		

Key: Ns= not significant.

reported by Adeoye and Agboola, (1985). The values of exchangeable bases (Na, Ca^{2+} Mg^{2+} and K^{+}) in the soils were relatively low. Similarly, the mean values of CEC in the soils were low and ranged from 3.6 to 4.6 crnol/kg across the land use types evaluated and these values showed a decreasing trend at both sampling depth. The values of CEC observed in the study area supported the conclusion by Amakhian and Osemwota (2012), who reported low values of CEC in soils of southern guinea savanna zone of Nigeria. The low CEC coupled with low organic matter are indications of low inherent soil fertility status which increases the need for improved soil management techniques.

Soil micronutrients

The micronutrients status of the soils was influenced by different land use types (Table 3). Significant variations (p 0.05) in available Zinc (Zn) were observed across the soil depth. The highest zinc was measured under oil palm with mean value of (47.6 mg/kg) and decreased significantly with soil depth. Similar decrease with depth was also observed by Singh and Shukla, (1985) and Bassirani, *et al.* (2011). This is consistent with findings of Mustapha, *et al.* (2011) in soils of Gombe, Nigeria. The content of available Cu in the soils ranged from 1.45 to 2.61mg/kg. The Cu content significantly decreased with soil depth in all the land use types. Higher content of Cu were recorded in banana plantation in comparison to other land use types. The critical level of extractable Cu in soils is 1.0-3.0 mg/kg (Deb and Sakal, 2002). Based on these critical levels, the mean values of Cu content in the top soils (0-15cm) were below the critical level which indicated that the soils are deficient in Cu. This observation is similar to the earlier report of Sillanpaa (1982), who reported deficiency of Cu in top soils in his global study of soil micronutrients. The available iron content of the soils across the land use types ranged from 243.4 to 283.5 mg/kg. In 0-30 cm depth highest Fe was obtained in oil palm (395.3 mg/kg) followed by cassava field (385.9 mg/kg). In spite of the significant variation observed, available Fe was in a sufficient level for plant growth in all the land use types. Based on the Fe rating established by Havlin *et al.* (1999). The soils were confirmed rich in iron. The higher iron content at the top (0-15 cm depth) soils could be attributed to the presence of high organic matter and the acidic conditions of the soils as earlier reported by Oyinlola and Chude (2010). Manganese (Mn) in the soils ranged from 23.6 to 25.0 mg/kg. However, higher values were recorded in oil palm as compared to other land use. (Table 3). These values suggest that Mn content of the soils is high and cannot be a limiting factor to successful crop production in the study area. Kparmwang (1996), reported similar findings in similar Nigerian soils. The surface soils (0-15cm) had higher Mn content than sub- surface (15-30 cm) and decreased with increasing soil depth and fell within the high category, based on Esu (1991) nutrients fertility ratings.

CONCLUSION/RECOMMENDATION

The results showed that low level of Organic carbon; Total Nitrogen, Available P. and exchangeable bases were observed. Although soil content of Zn and Cu were generally low and below the critical limit for crop production and this implied that soil amendments of Zn and Cu and/or application of appropriate quantities of key elements would enhance their availability for optimum yield of crops in the study area. It is recommended that farmers within the study area need to adopt management practices that will encourage the return and incorporation of plant residue into the soils in order to build up the soil organic matter content which will in turn enhance the CEC of the soils.

REFERENCES

Adeoye, O. O. and Agboola, A. A. (1985). Critical levels of soil pH, available P, K, Zn and Mn and maize ear leaf content of P. Cu and Mn in sedimentary soil of Southwest Nigeria. *Fertilizer Research* 6:65-71

Akinrinde, E. A,. Obigbesan G.O. and Onanuga, O. A. (2005). Extractable Micronutrients in Relation to Physiochemical Properties of Soils in Four Ecological Zones in Nigeria. *Global J. Pure Applied Sci*. (II) 2:197-200.

Amakhian, S.0. and Osemwota, 1.0. (2012). Physical and chemical properties of soils in Kogi State, Guinea Savanna zone of Nigeria. *Journal of Soil Science.* 22(1)11-33

Bassirani, N. Aboihassani, M. and Galavi, M. (2011). Distribution of Available Micronutrients as related to the soil characteristics of Hissar; Haryana (India). *Africa Journal of Agricultural Research* 6 (1 8):4239—4242.

Biwe, E. R. (2012). Status and distribution of available micronutrients along a toposequence at Gubi Bauchi North Eastern.

Boke, S. (2004). Soil phosphorus fractions as influenced by different cropping systems in Andosols and Nitosols in Kembata-Tembaro and Wolayta Zones, SNNPRS. *M.Sc. Thesis.* Alemaya University, (AU).P. 131.

Brady, N.C. and Weil, R.R. (2002). *The Nature and Properties of Soils.* 13th ed. The Iowa state PVT. Ltd., India.

Chude, V.O., Obigbesan, G.O. and Egbe, N.E. (1985). In: AKinrinde, E. A. *et al.* (2005). Micronutrient Status of Selected cocoa-growing Soils in South-Western Nigeria: Profile Distribution of Total and Available Zinc.*Canadian J. Soil Sci*. 65(1): 2 1-24.

Dar, W. D. (2004). Macro-benefits from Micronutrient for grey to green revolution in Agriculture. A paper presented in IFA. *International Symposium on Micronutrients* on 23-25. February 2004, New Delhi, India.

Deb, D. L. and Sakal, R. (2002). Micronutrients. In: Indian Society of Soil Science. Indian Research Institute, New Delhi, PP 391- 403.different soils of Semi-arid region, *J. India Soc. Soil Sci.* 33:381—835.

E. E. Akporhonor and P. 0. Agbaire (2009). Physiochemical properties and micronutrients status of farmland soils in Abraka, Nigeria. *African Journal of Pure and Applied Chemistry* Vol. 3 (7), pp. 131-134

Esu, I. E. (1991). *Detailed Soil Survey of NIHORT farm at Bunkure, Kano State,* Nigeria. Institute of Agricultural Research, Zaria, pp:72.

Fageria, N. K., Baliger, V. C. and Clark, R. B. (2002). Micronutrients in Crop Production, *Advances in Agronomy*, Vol., 77: 185-268.

Gee, G.W. and D. Or, (2002). Particle Size Analysis. In: *Methods of Soil Analysis, part 4. Physical Methods.* Eds., Dane, J.H. and G.C. Topp. Soil Science Society ofAmerica. Book series. No. 5 ASA and SSA Madison, Wl, pp: 25 5-293.9.

Greenland, D. J. (1995). Long-term cropping experiments in developing countries: the need, the history, and future. In: J. C. Waterlow, D.G. Armstrong, L. Fowden and R. Riley (eds.). Feeding the world population of more than eight billion people: a challenge to Science. Oxford University Press, Oxford, UK.

Havlin, J.L., Beaton, J.D., Tisdale, S.L. and Nelson, W.L. (1999). *Soil fertility and Fertilizers: An Introduction to Nutrient management*. 6th ed. Prentice Hall. Upper Saddle River, New Jersey. P. 499.

Ibrahim, A. K., Usman, A., Abubakar, B. and Aminu, U. H (2011). Extractable micronutrients status in relation to other soil properties in Billiri Local Government Area. *Journal of Science and Environmental Management*. Vol.3, (10). pp. 282-285

Idigbor, C.M., D.O. Asawalam and 0.0. Agbede, (2008). Phosphorus Forms and P sorption Capacity of Fauna Modified Soils of Southeastern Nigeria. 1 *Agricultural Production and Technol*., 4(2): 190-106.11.

Jiang, Y., Zhang, G., Zhou, D., Qin, Y. and Liang, W.J. (2009). Profile Distribution of Micronutrients in an aquic brown soil as affected by land use. *Plant. Soil. Environ.*, 155(11): 468 - 476.

Kabata-Pendias, A. (2001). *Trace Elements in Soils and Plants*. 3rd Edition. CRC Press, Boca Raton, Florida.

Kparmwang, T. (1996). Inherent fertility status of upland and Fadama State, Nigeria. *Institute. Agric. Res*., Zaria pp 72

Lawal, B. A., Odofin, A. J., Adeboye, M. K. A. and Ezenwa, M. I. S. (2012). Evaluation of selected Fadama soils in Katcha Local Government Area of Niger State for arable cropping. *Nigerian Journal of Soil Science* (2) 22

Malo, D.D., Schumacher, Y.E. and Doolittle, J.J. (2005). Long-term cultivation impacts on selected soil properties in the northern Great Plains. *Soil. Tillage Res*. 81:277—291

Mulima, I. M., Ismaila, M., Benisheikh, K. M. & Saminu, I. (2015). Assessment of Micronutrients status of soils under millet cultivation in Geidam Local Government Yobe state, Nigeria. *Asian Journal of Basic and Applied Sciences.* Vol.2. No.2, pp.32-41

Mustapha, S., Voncir, N. and Umar, S. (2011). Content and Distribution of Nitrogen Forms in Some Black soils in Bauchi State Nigeria *Noma*: 12—17.

Nazif, W., Perveen, S. and Saleem, I. (2006). Status of Micronutrients in soils of District Bhimber (Azad Jammu and Kashmir). *Journal of Agriculture and Biological Sciences*, 1: 34-40.

Ndukwu, B. N., C.M. Idigbor, S.U. Onwudike, P.O. Okafor and S.K. Osuaku (2009). Spartial Variability in some Properties of Soils formed under different Lithologies in Southeastern Nigeria. In: *Proceedings of the 5th National Conference of Organic Agriculture Project in Tertiary Institution in Nigeria*, pp: 94-97.

Negassa, W. (2001). Assessment of Important Physicochemical Properties of Nitosols under Different Management Systems in Bako Area, Western Ethiopia. *M.Sc. Thesis*, Alemaya University, Alemaya. p.109.

Nigeria International Research Journal of Agricultural Science and Soil Science. Vol.2 (10) pp.436-439.

Olson, S. R. and Sommers, L.E. (1982). Phosphorus. In: Page, A.L, Miller, R.H. and Keeney, D.R. (Eds). *Methods of Soil Analysis, part 2 Amer. Soc. Agron*. Madison; Wiscousin 403-430.

Orhue, B. R., Ekuase, H. 0., Atere, 0. 0. and Eze, U. B. (2015). Status of some plant Nutrients of Basement Complex soils in Derived Savanna in Edo state, Nigeria. *Nigerian Journal of Agriculture, Food and Environment*. 1l(l):33-37.

Osayande, P. E., Omoruyi, E., Ovie, S., Aondona, O. and Ogbebor, C. O. (2016). Status and Distribution of Available Micro-Nutrients in Soils of NIFOR Main Station. *International Journal of Basic Science and Technology.* Vol. 2 (1) pp. 1 — 6.

Osiname, O. A., F. Kang and Corey, R.B. (1973). In: Akinrinde, E.A. *et al.* (2005) Zone Response of Maize Growth in Sandy Ineeptisols in Western Nigeria. *Agran J*. 65: 875-877.

Osiname, O. A. Schulte, E. E. and Corey, R. B. (1973). Soil test for available copper and zinc in soils of Western Nigeria. *Journal of Science, Food and Agriculture* 24: 1341-1349

Oyinlola, E.Y. and Chude, V. O. (2010). Status of available micronutrients of the basement complex rock derived alfisols in Northern Nigeria savanna. *Tropical and Subtropical Agro ecosystems* Vol 12(2): 229-237

Page, A.L., Miller, R.R., Keeney, D.R. (Ed) (1982). *Methods of Soil Analysis*. Agronomy 9 Part II American Society of Agronomy. Madison Wisconsin U.S.A.

Shobayo, A. R., Raji, B. A. Malgwi, W. B. and Odunze, A. C. (2013). Classification of soils developed on gneisses and schists in the Northern Guinea savanna of Nigeria. *Nigerian Journal of Soils and Environmental Research* vol 11: 86-93.

Sillanpaa, M. (1982). Micronutrients and the nutrient status of soils. A Global Study. *FAQ Soils Bulletin* No 48 FAQ Rome, Italy.

Singh, K. and Shukla, U.C. (1985). Response of wheat to Zinc application. In: Sobulo, R. A. and Osiname, O. A. (1981). Soils and fertilizer use in Western Nigeria. *Research Bulletin*. No 11. LA.R.T. University of Ife.