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Zinc profile and physio-chemical properties of soil of ehime mbano local government authority (L.G.A) of Imo state Nigeria

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ABSTRACT

Total and available zinc status of soil samples from eight community farms in Ehime Mbano was determined using AAS. The physiochemical properties of the soil samples were determined by standard methods. The relationship existing between the zinc profile and soil physiochemical properties were examined by simple correlation analysis. Result showed that the total zinc content in the soil samples ranged from 16.9-156.31mg/kg with a mean value of 67.1mg/kg while available zinc ranged from 4.96-20.12mg/kg with a mean value of 11.91mg/kg. About 87.5% of the soil samples from the community farms had available zinc greater than the critical level of zinc(7.00mg/kg). The results showed that the soil in Ehime Mbano is moderately acidic and is physiochemical properties have no significant relationship with the forms of zinc studied.

KEYWORDS

Total available zinc;
Soil;
Ehime mbano;
Physiochemical properties.

INTRODUCTION

Soil is a natural plant environment more complex than the aerial environment. It is the medium that constitutes the most important factors that affect plant life, growth and yield. These factors include nutrients and minerals of which Zn is an essential member.

Zinc is a trace element found in soil and plant. It is the third most important nutritional factor affecting grain yield after nitrogen and phosphorus[6]. Zn plays important role in many ways in a plant life both in photosynthesis and in proper regulation of their metabolic pathways. It also helps to resist infection by certain pathogens[12]. Zinc is essential for the normal growth and reproduction of plants and when in inadequate supply, crop yield is impaired[17]. Zinc deficiency is the most widespread micronutrient disorder affecting a wide range of plants[10]. The adverse effect of Zn deficiency in soil had been highlighted by many researchers[9,2,10,20,19]. This deficiency of Zn in plant can remain undetected for many years because there is no obvious sign of stress[7,15]. Early detection can only be achieved by carrying out diagnostic tests on plants or soil.

Mbano Local Government Authority(L.G.A.) is one of the food baskets of Imo State of Nigeria. Many government food programmes are currently very active there. There is little or no literature on the state of the soils there. This work will determine the physiochemical characteristics of the soil of Ehime Mbano L.G.A., evaluate the zinc status of the soil and compare with the

existing critical value of this element. The baseline data generated could be used to formulate policies that would help correct any deficiency in the soil and increase crop yield and improve health.

MATERIALS AND METHOD

Background of the studied area-ehime mbano local government authority(L.G.A)

This L.G.A. is one of the nine Local Government Authorities in Imo State of Nigeria. It has an area of 179sq km and a projected population of 150,000 people according to 1991 Nigeria census figures. The people are predominantly farmers. Ehime Mbano is made up of the following communities-Ikpe-Nzerem, Umuakabia, Agbaja, Umunumo, Nsu, Umuezeala, Umueze I, Umueze II, Umueleke, Umualumaku, and Umunakamu. Eight of the communities account for most of the food produced in that L.G.A. and each community had an area designated as community land where farming occurs.

Soil sampling and identification

Soil samples(0-20cm) were collected randomly from each of the food producing community's farm lands as indicated on the graphical map of Ehime Mbano L.G.A.

Soil of each community were bucked and one sub-sample obtained. The sub samples were then identified by the name of that community as tabulated below(TABLE 1) the soil sample were air-dried, sieved with a 2mm mesh size and divided into triplicate and stored in black polyethylene bags for analysis[8].

Total zinc determination

(a) 1g of each soil sample was weighed into pyres glass beaker.

(b) 10ml of Conc. $HN0_3$ was added. The mixture was heated to dryness on a hot plate. After cooling, 5ml of Conc. $HN0_3$ and 3ml of $Hcl0_4$ were added and then heated until fumes started coming out of the beaker.

(c) The mixture was allowed to cool and then diluted with distilled deionized water, filtered into 50ml volumetric flask as made up to the mark with distilled deionized water. Zinc in the solution was determined with A.A.S. (UNICAN Model 919).

TABLE 1: Soil sample identification

Sample identification			
Sample	**Community**	**Sample**	**Community**
1	Umunumo	5	Umueze I
2	Umualumaku	6	Umueleke
3	Nsu	7	Umuezeala
4	Agbaja	8	Umunakanu

Available zinc determination

5g of each soil samples was weighed into a plastic container followed by 50ml of 0.1m HCl. The mixture was placed in a reciprocating shaker and allowed to shake for one hour and then filtered into a 50ml volumetric flask. The filtrate was made up to the mark with distilled deionized water. Zinc in the filtrate was determined with atomic absorption spectrometer(AAS UNICAM Model 919).

Physio-chemical properties

Soil pH

The pH of the soil samples were determine using pH meter (SUNTEX TS-2).

Cation exchange determination

2.5g of each soil sample was weighed into a plastic bottle; 100ml of 1N ammonium acetate of pH 7.0 was added. The plastic bottle was placed on a reciprocating shaker and shaken for two hours. The solution was filtered into a 50ml volumetric flask through Wattman No 42 filter paper. Then 10ml of the filtrate was pipetted into a flat bottomed flask and titrated again EDTA for Ca and Mg. The K and Na in the extract were determined by flame photometer.

Exchangeable acidity

2.5g of the soil sample was weighed into a plastic container then 50ml of 1m KCl solution was added and shaken for 1hr, then filtered and titrated against 0.02m NaOH solution using phenolphthalein indicator.

Organic matter determination

5g of the air-dry sample was grounded to pass through 0.5mm sieve and organic matter was determined using the Walkley-Black wet oxidation method (1937).

Particle size analysis

50g of the air-dry soil sieved to pass through 2mm sieve was weighed into a baffled cup and the particle size analysis was carried out using the Bougoucos method(1951).

RESULT AND DISCUSSIONS

The total and available zinc in Ehime Mbano soil are shown in TABLE 2 while the physiochemical properties are in (TABLE 3) the total zinc content of the soil ranged from 14.82mg/kg to 56.31mg/kg with a mean value of 67.1±0.0053mg/kg. This is in line with the total zinc concentrations in soils reported in the literature which ranged from 10-300mg/kg with a mean value of 75mg/kg. The range of zinc in soils of Nigeria coastal plan[3] conforms to this result. The available zinc contents of the soils studies ranged from 4.96-20.12mg/kg with a mean value of 11.91±0.0022mg/kg. This value is higher than the critical level for available zinc in soils[11]. About 87% of the soil samples from Ehime Mbano have high level and adequate available zinc content. The concentration of available zinc in Umunumo, Umuezeala, Umualumaku, Nsu, Umueleke and Umualumaku are above the critical level of 7.0mg/kg and agrees with the level of Zn in soils of Samara Zaria Nigeria[18]. However the concentrations of available zinc in soils of Agbaja and Umueze I are below the critical level of 7mg/kg. Therefore the soils in these two communities require the application of Zn fertilizer such as zinc sulphate to remedy the deficiency and increase agricultural output and quality. The soil of Ehime Mabno is moderately acidic in nature with a pH range of 5.05-6.76. The soil of Umueze I have a pH of 6.78 which is higher than the normal pH value of 6.50 at which soil zinc can exist and be useful to plants[2]. The predominant particle size in all the soil samples from all the communities is the sand fraction which ranged from 64.6% in Umunumo to 85.6% in Umunakanu. This indicates a high probability of the soils having been formed on sandstones or coastal plain sands[14]. Exchangeable base of Ca cation predominates in the exchange complex of all the soils varying from 2.0-5.2mole/kg with a mean value of 3.25mole/kg. This value compares favourably with the mean value of 2.30mole/kg reported by Esu[13] for the soils of upland basement of Nigeria. This shows that the soils are strongly weathered[16] and the values corroborated the findings of Isirima, et al., (2003). The low value of all the exchangeable cations in these soils could be ascribed to the excessive leaching looses of these cations. The Ca/Mg ratio obtained for all the soils were above unity, further confirming that these soils were strongly weathered[4]. Apart from Umunakanu soil with exchangeable K value of 0.6, all other community soils have exchangeable K value of less than 0.18 and so are considered not sufficiency endowed with readily available K.[1]. TABLE 4 shows the relationship between the physico-chemical properties of the soils and zinc forms. The correlation study showed that at 5% probability level, the physiochemical properties of the

TABLE 2: Total and available zinc in soil of ehime mbano L.GA

Community	Available Zn mg/kg	Total Zn mg/kg	Available Zn as percentage of total Zn (%)
Umumumo	14.564	14.82	98.27
Umualumaku	15.001	16.895	88.79
Nsu	9.753	17.169	56.84
Agbaja	5.731	19.890	28.81
Umueze I	4.962	99.110	5.01
Umueleke	20.121	137.565	14.63
Umuezeala	15.423	156.310	9.87
Umunakanu	9.731	75.065	12.96
Ranges mg/kg	4.96-20.12	14.82-156.31	
Mean (x)	11.9±0.0022	67.10±0.0055	

TABLE 3: Table of physio-chemical properties of the soil of ehime mbano L.GA

Community	Particle size distribution			Textural class	pH	Organic carbon %	Exchangeable base (mole kg)				Exchangeable acidity	Effective cation exchange capacity(ECEC)
	Sand %	Silt %	Clay %				Ca	Mg	K	Na		
Umumumo	64.6	19.7	15.7	Sandy, loam	5.75	10.04	2.8	2.0	0.036	0.313	1.0	6.159
Umualumaku	66.6	10.7	22.7	Sandy clay loam	6.03	16.28	3.6	2.0	0.031	0.365	1.00	6.996
Nsu	66.6	9.7	23.7	Sandy clay loam	5.17	9.91	2.4	1.6	0.046	0.392	3.0	7.438
Agbaja	64.6	5.7	15.7	Sandy clay loam	5.08	12.81	3.2	2.8	0.179	0.374	1.5	8.053
Umueze I	78.6	5.7	15.7	Sandy loam	6.76	9.27	2.0	1.2	0.082	0.331	1.5	5.113
Umueleke	69.6	10.7	19.7	Sandy loam	6.29	17.4	2.4	0.4	0.072	0.766	1.5	5.138
Umuzeala	77.6	6.7	15.7	Sandy loam	6.18	20.1	4.4	1.2	0.082	0.348	0.5	6.53
Umunakanu	82.6	11.7	11.7	Loamy sandy	5.76	9.27	5.2	2.0	0.260	0.383	1.5	9.343

TABLE 4: Relationship between physiochemical properties and zinc forms of soils of ehime mbano L.G.A.

Soil physiochemical properties	Coefficient (r) of total zinc	Coefficient (r) of available Zinc
Sand	0.650	-0.183
Silt	-0.371	0.451
Clay	-0.488	-0.191
pH	0.598	0.410
Organic matter	-0.582	0.484

soils have no significant relationship with the forms of zinc studied.

The study has revealed that about 85% Ehime Mbano has soil with enough available Zinc. However, soils in Agbaja and Umueze 1 are deficient in Zinc and therefore require Zinc fertilizer like Zinc sulphate while Umunnakanu deficient in readily available potassium requires potassium fertilizer.

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REFERENCES

[1] E.A.Aduayi, V.O.Chude, L.O.Adebusuyi, S.O. Oleyiaida; Federal Ministry of Agriculture and Rural Development Abuja, **(2002)**.
[2] D.C.Aldriano, J.M.Paulsen, I.S.Murphy; Agronomy Journal, **63**, 36-39 **(1971)**.
[3] A.O.Ano; J.Soils and Crops Journal, **4**, 1-5 **(1994)**.
[4] P.H.T.Becket; Soil.Sci., **97**, 376-383 **(1965)**.
[5] G.H.Bouyoucos; J.Agron, **43**, 434-438 **(1951)**.
[6] H.Brawande, L.R.Hossner; Agronomy Journal, **68**, 277-280 **(1976)**.
[7] R.H.Bray; Journal Soil Science., **66**, 88-89 **(1994)**.
[8] A.Carlosena, J.M.Andrade, D.Prada; Talanta, 753-767 **(1998)**.
[9] K.B.Chowdhury, W.E.Benne, D.E.Peastee;' The Profile Distribution of Total and Extractible Zinc', Selected Australian Soil Inkata Press Ply, D. Australian, 1-17 **(1996)**.
[10] R.B.Clark, P.A.Pier, D.Kundsen, J.W.Maranvile; Sorghum Journal of Nutrition, **(1981)**.
[11] F.R.Cox, F.J.Kamprath; Soc.America Inc Madison W.I.P, 289-317 **(1972)**.
[12] A.L.Dow, S.Roberts; Agronomy Journal, **677**, 4011-4013 **(1982)**.
[13] I.E.Esu; Journal of Soil Science, **7**, 155-183 **(1988)**.
[14] L.R.Fdlar; Federal Dept. of Agricultural Lands Resources, Reconnaissance Soil Map of Nigeria, Federal Ministry of Agriculture and Rural Development, Abuja, **(1987)**.
[15] I.F.Fergus, I.P.Little; Australian Society of Soil Science Incorporated. 118-128 **(1985)**.
[16] D.J.Greenland, M.H.B.Hayes; 'The Chemistry of Soil Constitutes', John Wiley and Sons Ltd London, **(1978)**.
[17] N.J.Grundon, C.J.Asle, D.J.Edwards; 'Symptoms of Nutritional deficiencies and toxicities in grain sorghum CV: Texas 610SR. In: Proceedings: First Australian Sorghum Conference', M.A.Foale, R.J.Henzell (eds.); Gratton Australia, **6**, 1-6, **(1986)**.
[18] T.Kparmwang; Nig.J.Soil.Ros., **3**, 27-32 **(2002)**.
[19] K.Ohki; Agronomy Journal, **66**, 328-330 **(1984)**.
[20] A.D.Robson, K.Snowball; 'Nutrient deficiency and toxicity symptoms, Plant Analysis: In: Interpretation Manual', D.L.Reuter J.B.Robinson (Eds.); Melbourne Australia Inkata Press Pty Ltd., 18-19 **(1986)**.