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Available Molybdenum Forms Distribution in some Soil Profiles of Different Locations of Southwestern Nigeria.

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Abstract*: Available molybdenum in soil profiles of twelve (12) different locations of Ogun and Oyo States in South Western Nigeria was investigated to know its status with respect to soil depths.Soil samples derived from sedimentary and igneous/metamorphic rockscomprising of Alfisols (8 profiles) and Ultisols (4 profiles) were collected at four (4) different soil depths of 0-20 cm, 20-40 cm, 40-60 cm and 60-80 cm respectively from savanna and forest vegetational zones. Soil physic-chemical properties of pH, organic carbon, total nitrogen, CEC, clay, silt, and sand were determined using standard methods and correlated with the available molybdenum. The results showed that available molybdenum was positively correlated with pH, silt and clay (r = 0.403**, r = 0.072** and r = 0.025**) and also negatively correlated organic carbon, with total nitrogen, CEC and sand (r = -0.092**, r = -0.114**, r = - 0.253** and r = -0.061**) respectively. The status of available Mo fell above the critical limits of 0.05 and 0.1ppm and as a result, Farmers are advised not to apply molybdenum fertilizers in these soils so as not to cause environmental pollution and soil toxicity.*

Keywords: *Available Molybdenum, Form distribution, Sol Profiles, Alfisols & Ultisols, Vegetational Zones, Correlation and Critical Limits*

I. Introduction

One of the most important micronutrients required for plant growth is molybdenum which is known to be essential for N_2 fixation by Rhizobia in leguminous crops such as soybeans and groundnuts because it is the component of nitrate reductase enzyme that converts nitrate to nitrite and helps in fixing nitrogen as NH_3(Jethra andKorthari, 1995). Deficiency symptoms of this element are similar to those of nitrogen.Factors affecting deficiency of this micronutrient in the soil include crop removal, leaching, high soil phosphate, soil compaction cool, wet growing conditions; tie–up in high organic soils, copper deficient soils to mention but a few. Availability of Mo to plants is affected by some soil characteristics such as pH, soil texture, soil moisture, temperature, oxide content, organicmatter content and clay mineralogy (Reisenauer*et al.*, 1973). According to Murphy and Walsh, 1972, Mo deficiencies have been reported for many agronomic crops throughout the world but little or no information is however available on the available Mo in the soils of South Western Nigeria. The present study was carried out to investigate the availableMo status in relation to some soil characteristics of twelve (12) differentlocationsof Southwestern Nigeria.

II. Materials And Methods

Sample Collection and Preparation

Soil samples (0-20 cm, 20-40 cm, 40-60 cm and 60-80 cm) depths, derived from igneous/metamorphic and sedimentary rocks were collected at twelve (12) locations in Southwestern Nigeria from forest and savanna vegetational zones (Table 1).

Physico-chemical Analysis

The samples were analyzed for pH in 1:1 soil to water slurry. The soil organic carbon was determined by the chromic acid digestion, the soil total nitrogen was determined by macro-kjeldal method, exchangeable cations were extracted with neutral 1N NH_4OAc, Ca^{2+} and Mg^{2+} in the extracts were analyzed using an Atomic Absorption Spectrophotometer (AAS) while K^+ and Na^+ were determined by a Flame Photometer. The soil CEC was estimated as the sum of the exchangeable cations, the particle size was determined with KCl and NH_4OAc (pH 4.8) respectively, however, available soil Mo was extracted by acid ammonium oxalate solution, buffered at pH 3.3 (Johnson and Arkeley, 1954) and determined by thiocyanate method as described by Chapman and Pratt, 1961.

Simple correlations and multiple regressions were calculated between available Mo and soil properties by adopting standard statistical procedures.

III. Results And Discussion

Result

Table 1: General Characteristics of the Soils samples

Soil No	Location	Parent Material	Vegetational Zone	Soil Order
1	Abeokuta	Igneous/Metamorphic	Forest	Alfisol
2	Owode-Egba	Igneous/Metamorphic	Forest	Ultisol
3	Ishaga-Orile	Igneous/Metamorphic	Savanna	Ultisol
4	Ibara-Orile	Igneous/Metamorphic	Savanna	Ultisol
5	Ayetoro	Sedimentary	Savanna	Ultisol
6	Papalanto	Sedimentary	Savanna	Alfisol
7	Ilaro	Sedimentary	Forest	Alfisol
8	Ifo	Sedimentary	Forest	Alfisol
9	Eruwa	Igneous/Metamorphic	Forest	Alfisol
10	Omi-Adio	Igneous/Metamorphic	Forest	Alfisol
11	Idi-Ose	Igneous/Metamorphic	Forest	Alfisol
12	Oyo	Igneous/Metamorphic	Savanna	Alfisol

Table 2: Range and Mean values of Physico-chemical properties of Soil samples

Location	pH		Organic Carbon (g/kg)		Total Nitrogen (g/kg)		CEC (Cmol/kg)		Clay (%)		Silt (%)		Sand (%)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Abeokuta	3.90-6.75	5.38	0.50-1.50	0.81	1.12-3.92	2.80	1.06-2.59	1.61	36.00-46.00	42.75	3.70-31.40	13.78	32.60-50.30	43.43
Owode-Egba	5.90-7.60	6.30	1.24-3.05	2.00	7.01-11.98	8.67	2.06-2.61	2.30	9.40-17.40	12.88	5.40-9.40	6.40	77.20-85.20	80.73
Ishaga-Orile	4.80-5.80	5.51	0.60-0.88	0.77	2.17-4.62	3.47	2.67-3.80	3.10	1.40-10.00	6.05	6.00-22.00	12.25	72.60-92.60	81.70
Ibara-Orile	5.69-6.45	5.93	0.60-1.04	0.80	1.61-2.73	2.01	2.19-2.60	2.64	5.40-5.60	5.45	Nil	3.40	91.00-91.20	91.15
Ayetoro	4.67-5.50	5.17	0.94-1.32	1.09	4.13-4.76	4.45	1.56-3.06	2.00	4.00-26.00	12.88	5.40-13.40	9.47	60.60-90.60	77.65
Papalanto	5.36-8.26	6.51	0.74-1.18	1.00	2.66-4.41	3.34	2.57-3.02	2.82	11.40-13.40	12.25	11.40-17.40	14.15	73.20-81.20	76.10
Ilaro	6.42-7.78	7.04	0.90-1.04	1.00	1.75-4.20	2.49	2.09-2.21	2.14	5.40-11.40	7.70	2.90-21.40	10.20	67.20-89.70	82.10
Ifo	4.67-6.08	5.39	0.50-1.72	1.24	3.71-5.32	4.64	0.50-2.28	1.19	8.60-32.60	22.95	5.40-17.00	9.30	59.00-84.00	67.75
Eruwa	5.32-6.22	5.79	0.48-1.32	0.87	1.82-2.59	2.19	2.20-2.47	2.31	4.00-14.00	7.50	3.40-18.00	9.83	78.00-90.60	82.68
Omi-Adio	6.69-7.26	7.04	0.74-2.00	1.34	2.03-14.50	6.29	2.20-2.77	2.50	1.40-27.40	9.70	4.00-14.00	7.95	58.60-94.60	82.35
Idi-Ose	6.48-6.84	6.68	0.50-1.44	1.04	1.75-12.40	5.10	2.45-3.17	2.76	1.40-13.40	7.35	7.40-12.60	9.75	79.20-87.20	82.90
Oyo	6.05-7.07	6.56	0.14-1.54	1.00	1.96-11.00	4.55	2.12-2.58	2.33	0.60-10.60	3.85	12.40-15.40	13.40	78.00-86.00	82.75

Table 3: Distribution of available Molybdenum (mg/kg)

Average Depth (cm)	Available - Mo Range	Mean
Alfisols (8 profiles)		
0- 20	1.80-6.30	3.18
20- 40	1.90-6.40	3.79
40-60	2.80-6.90	4.41
60-80	2.80-6.80	4.84
Ultisol (4 profiles)		
0-20	1.60-2.90	2.30
20-40	2.60-2.90	2.73
40-60	2.90-3.90	3.38
60-80	3.60-4.30	3.85

Table 4: Coefficients of Correlation between different Available molybdenum and soil properties

	pH	Organic – C	Total – N	CEC	Clay	Silt	Sand
Alfisols and Ultisols							
Available-Mo	0.403**	-0.092**	0.114**	-0.253**	0.072**	-0.246**	0.061**
	0.193	0.775	0.724	0.428	0.940	0.823	0.850

Table 5: Regression Coefficients between different Available molybdenum and soil properties

	pH	Organic – C	Total – N	CEC	Clay	Silt	Sand
Alfisols and Ultisols							
Available – Mo	0.233	-0.042	-0.187	0.521	0.226	0.195	44.335
	-5.760	-7.823	-25.934	-0.115	-48.145	-4.275	-0.631

The general characteristics of distribution of the soil samples, the range and the mean values of the physico-chemical properties of soils as well as the available molybdenum in the soils investigated are presented in the tables 1, 2 and 3 respectively. Two main types of soils namely Alfisol and Ultisol occur in the twelve (12) different locations considered. The mean pH values of most of the soils in these locations were fairly acidic with the exception of Ilaro and Omi –Adio which were considered to be neutral. Owode-Egba soil had the highest organic carbon (2.00g/kg) with the lowest concentration observed for Ishaga-Orile Soil (0.77g/kg). The highest organic carbon found at Owode-Egba soil could be due to the forest vegetation present therein which has resulted in the larger mater litter fall as well as the rate of organic matter decomposition due to microbial activity. Also, the rate of litter fall was very low in Ishaga-Orile soil which has contributed to its low organic carbon content of the soil therein since the location is within the savanna vegetational zone.

Owode–Egba has the highest nitrogen content of 8.67 g/kg which was closely followed by Omi–Adio with 6.29 g/kg, with Ibara–Orile having the lowest of 2.01 g/kg. However, the highest CEC of 3.10 cmol/kg was found at Ishaga–Orile whereas the lowest value of 1.19 cmol/kg was observed for Ifo Soil. It is interesting to report that higher percentages of sand were observed in nearly all the locationsinvestigated with the exception of Abeokuta soil which had 43.43% of sand but with the highest percentage of clay (42.75%) Generally, the distribution of available Mo concentrations through the four (4) soil depths at twelve locations investigated showed consistent increase down the soil profile as the soil depth increased with the exception of Ishaga-Orile and Ilaro which showed irregular trends in their available Mo distribution, Available Mo in the surface soil of both the Alfisol and Utisol ranged from 1.80 to 6.30 and 1.60 to 2.90 mg/kg with the mean values of 3.18 and 2.30 mg/kg respectively. Available Mo in all the soils investigated could be considered to be more adequate since0.05ppm was regarded as the critical limit for soils above pH 6 (Kanwar and Randhawa, 1978) and also 0.1 ppm was considered as the critical limit for soils with pH 6 (Grigg, 1953). However, since most of the soils in these locations are fairly acidic with the exception of two locations, it would be seen that there was no Mo deficiency in these soils and hence, no Molybdenum nutrition is required in these soils. Available Mo showed weak and very weak positive significant coefficient of correlation with pH, silt and clay (Alfisols and Ultisols, r = 0.403, r = 0.246 and r = 0.072) respectively. It however, showed weak and very weak negative relationships with total nitrogen, CEC, Sand and organic carbon (Table 4). However, the significant values of 0.193, 0.775, 0.724, 0.428, 0.940, 0.823 and 0.850 respectively showed that the correlation was insignificant, meaning that these parameters contributed little to the availability of Mo in the soils of these locations.

In multiple regression studies, the available Mo showed significant positive and negative regression coefficients with pH, CEC, Sand, Silt and Clay (b = 0.233 and -5.760, 0.521 and - 0.115, 44.335 and -0.631, 0.195 and -4.275, 0. 226 and-48.145) respectively. The multiple regression studies for both the Total N and Organic Carbon showed significant and negative regression coefficients with available Mo (b = -0.187 and -25.934, -0.042 and -7.823).

IV. Conclusion

It could be seen from the results obtained that available molybdenum in the soils of the twelve (12) different locations investigated, increased down the soil profile as the depth increases. Also, soil properties examined contributed both positively and negatively to the available molybdenum concentrations in the soils of these locations. However, the contents of the molybdenum were more than the required level for optimum yield of most leguminous crops so, farmers are advised not to amend the soils therein with molybdenum-containing fertilizer as this would tend to increase the molybdenum concentration in the soil thereby making it to be toxic to both the soil and the plant which can consequently lead to environmental pollution and poses risk to the entire populace in these locations.

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