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ELEMENTAL ANALYSIS AND PHYSICOCHEMICAL STUDIES OF *TERMITERIA*AND ADJACENT SOILS IN MAIHA LOCAL GOVERNMENT AREA OF ADAMAWA STATE, NIGERIA.

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ABSTRACT

The study was carried out to investigate some physicochemical properties (TDS, EC, P^{H}, %,SMC and temperature), and mineral contents of termiteria and 10 M surrounding soils during wet and dry seasons. The aim was to ascertain status of termiteria and 10 M adjacent soils in supporting crop cultivation in Maiha Local Government Area of Adamawa State, Nigeria. X-ray fluorescence spectrophotometric (XRF) method of analysis was used for the determination of the presence of the elements, while standard methods were used for the studies of the physicochemical properties. Results showed that all the physicochemical parameters were within acceptable limit for good soils. XRF result showed presence of the following elements: Al, Si, K, Na, Ca, Mg, Fe, Mn Ti, Ni, Cr, V, Cu, Ba, Zn, Sr, Ir, GaRb, Zr, Yb, Eu, Re, and Ag. Major elements can be arranged quantitatively in decreasing order as; Si > Al > Fe > K > Ti >Ca> Na > Mg >Mn. The elements consisted of most of the sixteen elements needed for proper plant growth and development. Analysis of variance (ANOVA) showed no significant differences between mineral contents of termiteria and 10 M adjacent soils and those of wet and dry season, this shows that mineral contents of termiteria distribute up to 10 M away from them.

Keywords: XRF, Termiteria, Physicochemical, Analysis, Termites

Introduction

Termites are small soft–bodied social insects classified at the taxonomic rank order of *Isoptera*(Adeyeye, 2005) Termites, ants, some bees and wasps are placed in a separate order of *Hymenoptera* (Aiki et al., 2013). There are 2000 species of termites(Ndu et al., 2001). Apart from being destructive(1996), termites are known to be helpful in modifyingboth physical and chemical statusof tropical and subtropical (Reddy,2014; Semhi et al.,2008) showed that there is positive correlation between termites' activities and mobility of some elements (Reddy,2014 ; Daniel and Emana, 2014).

Termiteria are seen dotting many tropical grassland of African landscape(Retallack, 1990). Noticeable feature common to all *termiteria* in farmlands is the flourishing growth of crops surrounding them which extend to certain distance away from them. *Termiteria* soils are known to be eroded by rainfalls, where it covers certain distance away from the*termiteria*(Abel et al., 2009). This marked difference in plant growth between those affected by *termiteria*soils and the unaffected ones have always been a cause of enquiry as to what could be present in *termiteria*soils? Plants require thirteen to sixteen elements for proper growth and development.Some of which include: primary nutrients; nitrogen, phosphorus and potassium (N, P & K) respectively; Calcium, Magnesiumand Sulphur (Ca, Mg & S) respectively are secondary nutrients while;boron, copper, chlorine, iron, manganese, molybdenum and zinc (B,Cu, Cl, Fe, Mn, Mo, &Zn)respectively are micronutrients(Njinga et al., 2013). Although micronutrients are required in little amount, their deficiency effects on plants are devastating(Millaleo, 2010). Some farmers use *termiteria* soils to amend their farmlands(Ndahi et al., 2016).Amendment of poor farm soils using *termiteria* soil pays the dividend but the method lacks empirical backing hence the need to scientifically analyze *termiteria* and 10 M surrounding soils for their elemental contents and to study the physicochemical properties of the *termiteria*. This may provide solutions to most farmers in particular and the public in general.

Materialsand Methods

***Materials*:**

Materials used in this study includes; X-ray Fluorescence Spectrophotometer (XRF),P^H/conductivity meter, core scoop, hammer, polythene bags, sieve, Pestle and mortar, spade, crucibles, analytical balance and some glass wares.

***Study Area*:**

The study area, Maiha is the headquarters of Maiha local government area, one of the twenty one local government areas in Adamawa State, Nigeria. It is located at the Nigeria-Cameroon border with coordinates: 9° 59’ 44”N and 13°13’05” E.The study area was stratified into two sampling locations (east- west) from where a *termiterium*and its 10 M adjacent soil were chosen as sampling sites in each sampling location.

Sample Collection

*Termiteria*soils were sampled according to a method outlined by(Dhembare, 2013) with some modifications. Ten metre adjacent Soil samples were collected as described by(Okunola et al., 2008). Dry season samples were collected in April while Rainy season samples were collected in August.

Sample Preparation

Soil samples were dried by spreading them on clean polythene sheet in the laboratory for seven days. The dried soil samples were ground using mortar and pestle and sieved with < 2 mm sieve to obtain powder form. Gross samples were reduced to test sample sizes through the process of cone and quartering(Okonkwo and Maribe, 2004)

Experimental

X-rayFluorescence(XRF) analysis X-ray fluorescence procedure for determination of elements was carried out as described by (Baronowska et al, 2002). 20g of each of the ground soil samples was fused with 0.40 g stearic acid in a 20 ml platinum crucible and press with hydraulic press. The fused button was then x-rayed and counted to determine the elements, the excitation source emitted Ag-k X-ray (22.1 KeV) hence all elements with lower characteristics excitation energy weredetected in the samples.

Determination of physiochemical properties

P^H, electrical conductivity values andsoil moisture content (SMC)/ water holding capacity:

pH and Electrical Conductivity determination were carried out using combine pH-conductivity meter (Model-Jenway 4520) as described by(Wagh et al., 2013). Soil moisture content (SMC)/ water holding capacity of the soil samples were determined as outlined by(Zaid, 2010).

Resultsand Discussion

Temperatures of the samples range between (28.1 – 28.4) oCwhile P^H of the soil samples range between (7.1 – 7.3). P^H value of soil expresses the hydrogen ion concentration of the soil solution. It determines availability of nutrients in the soil and influences physical condition of the soil as well as those of microbial activities. The range of P^H values (fig.1) favors solubility of micronutrients which can be accessible to plant (Wagh et al., 2013).Soiltotal dissolved substances (TDS) and soil electric conductivity (EC)of the samples follow similar trend: higher values were recorded in*termiteria* soils compared to the 10 M adjacent soils. TDS of soil is a measure of soluble ions in solution. This reflects in the soil EC value, which is a measure of the conducting ions in the soil solution. TDS values range from 64.8 – 87.63 in Maiha East ten meter adjacent soil sampling location (ME10) and Maiha East*termiteria*sampling location (MET) while EC ranges between 107.6 – 146.4 in ME10 and MET respectively. The pattern of correlation between TDS and EC shows that the higher the TDS the higher the EC and vice versa (Fig. 1). This is explained in terms of the quantities (concentration) of electric carrying species present in the soil solution this corresponds with the magnitude of soil TDS. EC is used in estimating soil salinity. Soil having EC below 400 (µS/cm) is a non-saline or marginally saline soil while those with EC above 800 (µS/cm) are severely saline soils (Zaid, 2010). The range of values for soil TDS and EC in this work provide a medium in which soluble plant nutrients stay in solution.

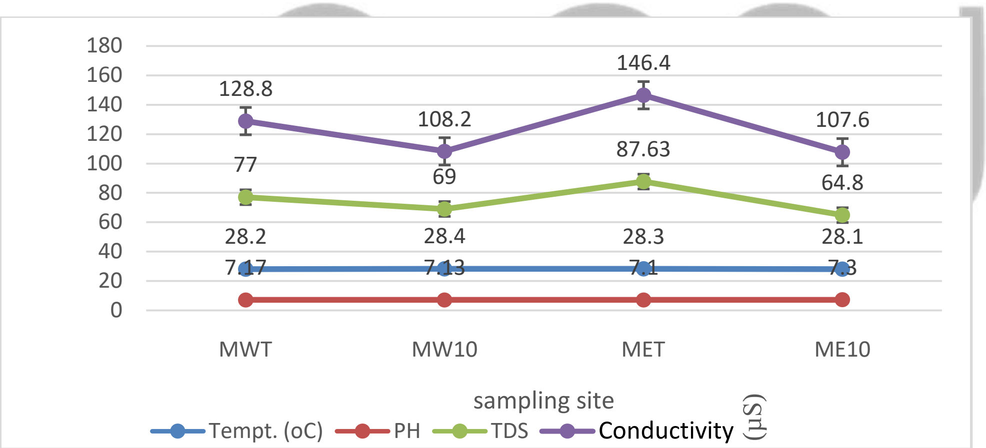

Figure 1: Some physicochemical properties of *termiteria* and 10 M soil samples.

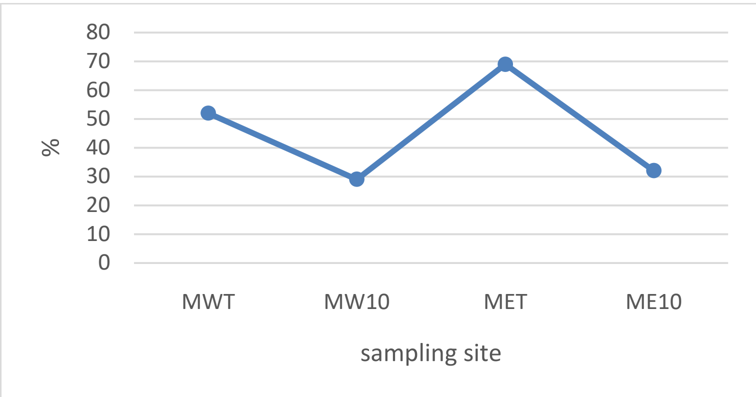

Figure 2: Percent moisture content (% SMC) of*termiteria* and 10 M soil samples

Per cent soil moisture content (%SMC) of the soil (Fig. 2) were higher in *termiteria*than the 10 M soils, highest values was 69% in MET lowest was 29 % in MW10. High SMC is a characteristic property of soil with high organic matter

Figure 3 and Table 1 show elemental contents of *termiteria*and 10 M adjacent soil samples as analyzed by XRF for major and trace elements available in the samples respectively. Twenty four elements were detected in this sampling area, nine major elements and fifteen trace elements. The major elements detected achieved 100% distribution within the sampling sites and were namely; Al, Si, K, Na, Ca, Mg, Fe, Mn and Ti (Fig.3). Trace elements include; Ni, Cr, V, Cu, Ba, Zn, Sr, Ir, GaRb, Zr,Yb,Eu, Re, and Ag. Major elements can be arranged quantitatively in decreasing order as; Si > Al > Fe > K > Ti >Ca> Na > Mg >Mn. Manganese had concentration values ranging from (0.25 ± 0.84 - 0.089 ± 0.03) %. ME had higher Mn contents compare to MW.

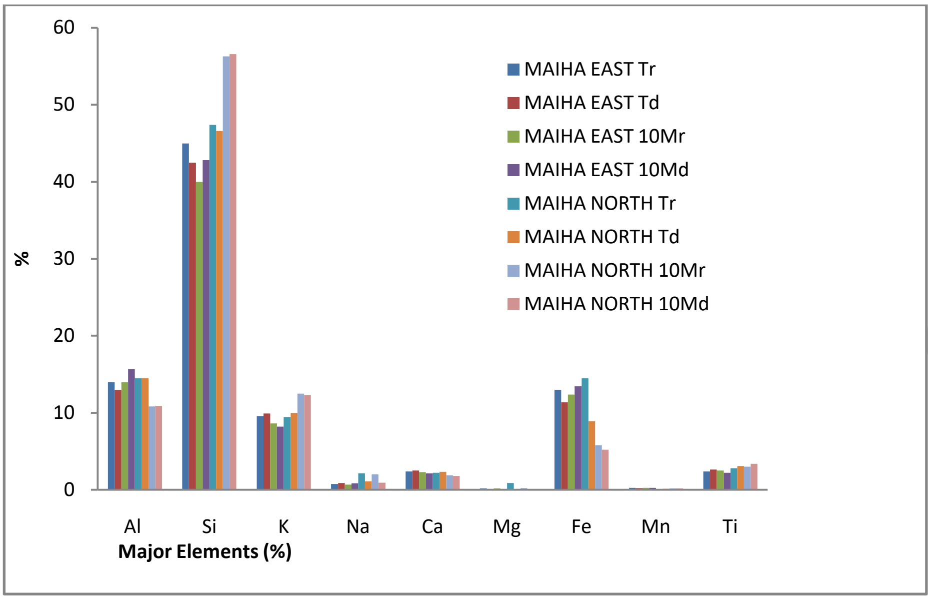

Figure 3: Major elemental composition of *termiteria* soil (T) and 10 M adjacent soils in Maiha local government area.

Concentrations of Mg were; 0.87 ± 0.33 % the highest the lowest was 0.04 ± 0.01 %. Na had concentration of 2.14 ± 0.07 % in $T^r$of MW and 0.73 ± 0.05% in T^r of ME. Calcium was found in *termiteria* soils with values ranging from 2.49 ± 0.20 % to 2.21 ± 0.43% while in 10 M soils the range was (2.29 ± 0.10 – 1.79 ± 0.25) %.

The concentration range of Ti in *termiteria* was (3.07 ± 0.44 – 2.39 ± 0.64) % while in 10 M soils was (3.35 ± 0.26 – 2.22 ± 0.37). K was found in *termiteria* samples with concentration ranging between (10.00 ± 0.21 – 9.57 ± 0.15) % in T^d of MW and T^r of ME. In 10 M soils K had concentration values ranging from, 12.50 ± 0.01% in $10M^r$ of

MN to 8.19 ± 0.10 % in 10M^d of ME.T^{r}of MN had highest concentration of Fe 14.50 ± 0.26) % among the *termiteria*sampling sites the lowest was 11.34 ± 0.15 % in T^d of ME while in 10 M samples concentration of Fe ranges from (13.44 ± 0.49 – 5.20 ± 0.36) %. Concentration of Al in *termiteria s*oils ranges from (14.50 ± 0.22 – 13.00 ± 0.17) % while in 10 M soils the range was from (15.70 ± 0.017 – 10.80 ± 0.20) %.

ME contained the lowest concentration of Si (40.00 ± 0.27) % obtained in 10M^r while the highest was 56.60 ± 0.50 % found in 10M^d of MN

Table 1: Trace Element Contents of *Termiteria* (T) and 10 M Adjacent Soils in Maiha

TRACE		**MAIHA EAST**						**MAIHA WEST**		
ELEMENTS (PPM)	**Tr**	**Td**	**10Mr**	**10Md**		**Tr**	**Td**	**10Mr**	**10Md**	
Ni	0.033	0.200	0.020	0.027		0.030	0.020	0.018	-	
Cr	0.031	0.027	0.032	0.029		0.048	0.034	0.019	0.020	
V	0.140	0.110	0.120	0.101		0.170	0.130	0.150	0.160	
Cu		0.067	0.058	0.049	0.046		0.065	0.048	0.051	0.050
Ba		0.570	0.560	0.060	0.062		0.820	0.660	0.860	0.790
Zn		0.077	0.053	0.059	0.050		0.061	0.043	0.00	0.020
Sr		0.300	0.190	0.190	0.190		0.25	0.180	0.420	0.250
Ir		-	0.110	0.110	0.097		-	-	-	-
Ga		0.048	0.020	0.025	0.027		0.061	0.035	-	0.038
Rb		-	-	-	-		0.350	0.025	-	0.027
Zr		1.400	1.00	1.00	0.990		1.900	1.300	3.00	2.700
Yb		-	0.040	0.030	-		0.050	0.030	-	-
Eu		0.290	0.190	0.240	0.100		0.220	0.170	0.190	0.200
Re		0.100	0.090	0.060	0.080		0.090	0.060	0.130	0.120
Ag		0.033	0.051	0.044	0.410		0.540	0.003	0.030	0.005

Key: r = rainy season d = dry season - = not detected

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Variation in concentration values of Al, K, Ca and Fe were observed between *termiteria*samples and samples from 10 M soils in MW only, example, Fe had 8.91 ± 0.20 % in T^d of while in 10M^d it had 5.20 ± 0.36 % all in MW but in ME no pronounced variation was found. Concentration values of Mg, and Na in wet season were slightly different from those of dry season in the sampling area, example, concentration of Mg in T^r = 0.15 ± 0.04 % while in T^d = 0.08 ± 0.02 %. Sixty percent (60%) of the fifteen trace elements found in this sampling area were distributed throughout the sampling sites. The trace elements can be arranged in the following order; Ba (0.86 ± 0.13) ppm > Ag (0.54 ± 0.06) ppm >Sr (0.42 ± 0.12) ppm >Rb (0.35 ± 0.02) ppm >Eu and Ni (0.2) ppm > V, Re, and Ir (0.1) ppm > Ga, Zn, Cu, Cr and Yb (0.01 and above) ppm. Most of the concentration of trace elements did not show differences in values due to either season of the sampling (wet or dry season) or sampling sites (*termiteria* or 10 M).

Statistical Studies

Statistical treatment of the data obtained from this sampling area using analysis of variance (ANOVA) via SSPS software, showed no significant differences in concentration values of the trace elements in *termiteria*soil samples and those of 10 M adjacent soil samples. Neither was there significant differences between concentration values of samples obtained during wet season and those obtained in dry season.

Conclusion

The results of this work as obtained in Figures 1, 2 and 3 and Table 1, indicate that *termiteria*soils and their 10 M adjacent soils are good for most plants cultivation because they contain most of the minerals responsible for plant growth and development and that the minerals distribute to the immediate vicinity of the*termiteria* up to ten meters away. It also provides reason for the good growth of most crops in the vicinity of *termiteria* compared to those in the same farmland but far away from it.

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