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PHYSICOCHEMICAL PROPERTIES OF SOIL FROM TRANSFORMER INSTALLATION SITES IN SELECTED LOCATIONS IN JOS METROPOLIS, JOS PLATEAU STATE

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ABSTRACT: *The total of twenty soil samples were collected in August 2017 from different Locations of power Installation Station and investigated for physicochemical properties. The result revealed the soil texture to be 75% Sandy loam and 25% sand, the pH of the soil ranges from 5.53-6.42, showing the soil is acidic. Other physicochemical properties show the results of moisture of the soil to be in the range of 3.65-35.62%, total organic carbon 2.06-3.81%, organic matter 3.36-6.62%, Phosphorus 0.5-8.20ppm, Nitrogen 0.06-0.13%, electrical conductivity 3-20µs/cm. For exchangeable bases, Sodium has 0.8-12ppm, Calcium 198-347ppm and Potassium 2-25ppm. Cat ion exchange capacity 2.42-3.00 mMol/100g, exchangeable acidity for hydrogen ion (H^+) 1.54-1.70 mMol/100g and Al^{3+} was no detected.*

KEYWORDS: Physicochemical, Properties, Soil, Electricity Transformer, Nigeria

INTRODUCTION

Pollution of soil arises majorly from anthropogenic activities which may be agricultural, industrialization, mining and natural phenomenon is a thing of concern worldwide. Different contaminants are discharged into the soil as waste without regard to rules and regulations. The major challenge associated with population growth, urbanization and industrialization within the developing countries is poor sanitary conditions among the rural dwellers, and normally soil is at the receiving end of all the pollutants generated which in turn constitutes hazards to plants, animals, water and the end user (Human beings)

Material and Methods

All reagents used are analytical grade obtained from Merc Chemicals.

Study Area

Jos in the administrative capital of Plateau State located in middle belt of Nigeria with a total population of about 900, 000 residents based on 2006 census. The city is located on the Jos Plateau at the elevation of about 1,238 meters or 4,062 feet high above sea level. During the British colonial rule, Jos was an important centre for Tin mining. The city is situated at an attitude of 1,217m above sea level. Jos enjoys a more temperate climate than most of the rest of Nigerian. Average monthly temperature ranges from 21-25^oC (70-79^oF) and from mid-November to late January night time temperature drops as low as 11^oC (52^oF). Jos receives about 1,400 millimeters (55 inches) of rainfall annually.

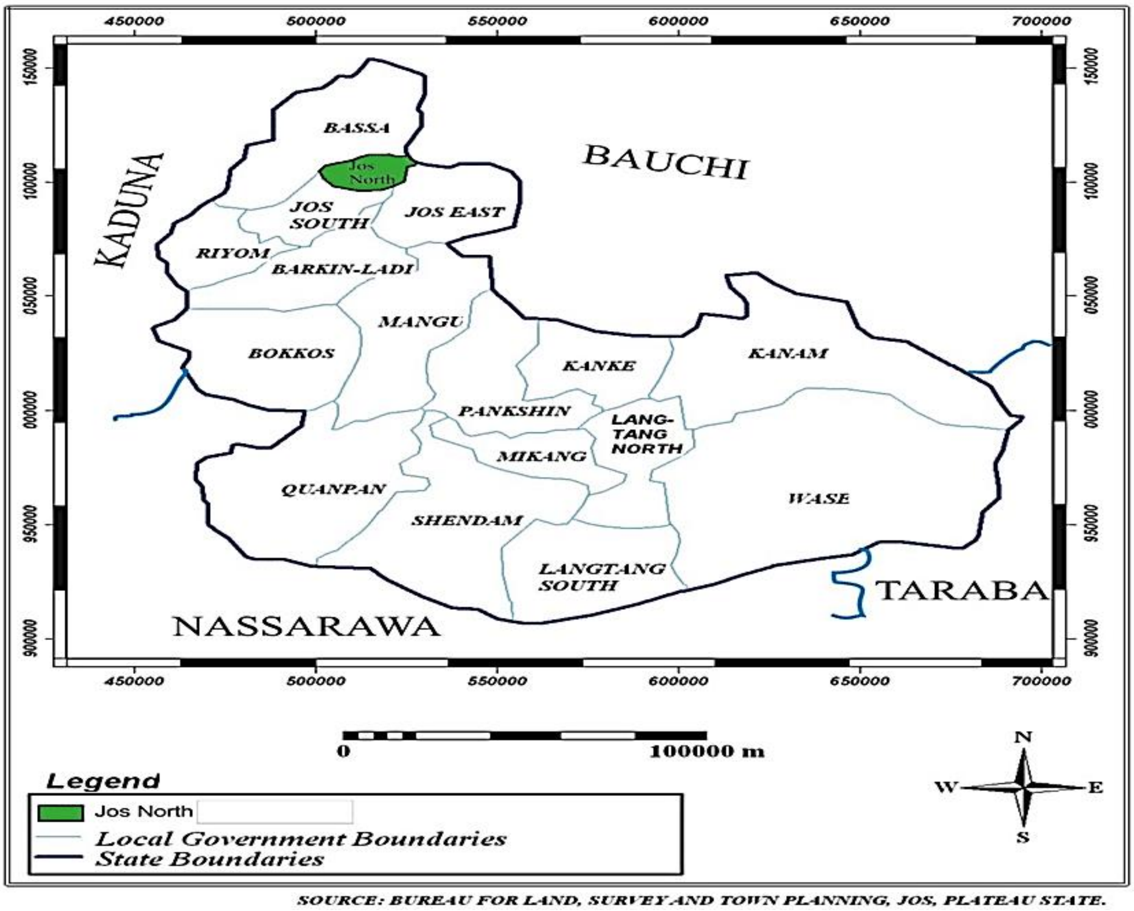

Figure 1: Map of Plateau State Indicating Study Area

Sample Collection

The samples were collected in August 2017 at various locations of electricity transformers installation within Jos metropolis. Soils samples were collected within the depth of 10-15cm using spade that has been thoroughly washed and rinsed with distilled water and immediately packed into a pre-washed polyethylene bag. The soil samples were transported to laboratory for further treatment.

Sample Preparation

The soil which was used for physiochemical determination was air dry for five days under ambient temperature, this was sieved using 2mm sieve after all debris were removed, the sieved soil sample was packed in a sterile polyethene bags and properly tied and kept for further analysis of the physiochemical parameters.

Determination of Soil Moisture Content Method

Method: Two crucibles were dried in an oven at 105^{o}C for 24hrs, then cooled in desiccators and their weights were taken separately. One gram of the air-dried soil sample was weighed into each of the crucibles. Each of the samples in the crucibles was heated in an oven until constant weight was obtained with occasional stirring. The crucibles with the samples were transferred into desiccators and allowed to cool and weighted again and the moisture content of the soil was calculated using the formula below (AOAC, 1990).

$$\% \text{ moisture} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Where W_1= initial weight of empty crucibles

W_2= weight of crucibles + soil sample before drying

W_3= final weight of crucibles + samples after drying.

This was done in two separate crucibles in order to find the average of the final result.

Determination of Soil Organic Matter

Method: A dried clean empty porcelain dish was weighed to be M_1, then two gram of the air dried soil sample was added into the dried empty porcelain and put it in oven at 105^0c for 2hrs until constant weight is obtained and was recorded as M_2, this was then transferred into muffle furnace and increase the temperature to 440^0c and allowed it to stay overnight then removed carefully using tongs and allowed to cool and weighed it as M_3. The organic matter content was calculated using the formula.

$$OM = \frac{MO}{Mb} \times 100$$

Where OM is the organic matter content, Mo is the mass of dry heated soil obtained by M_2– M_1

Ma is the mass of the ash (burned) soil obtained by $M_3 – M_2$

Mb is the mass of organic matter obtained by M_b = Mo– M_a

Where M_1 = mass of the empty dry clean porcelain

M_2 = mass of the dry porcelain and the sample after drying.

M_3 = is the mass of the porcelain and the sample after ashing.

Determination of pH. (AOAC, 1990)

Method: Twenty gram of air-dried sieved soil sample was measured into a 100cm^3 beaker, 40cm^3 of distilled water was added and stirred the suspension with a glass rod intermittently for 30 minutes. The pH meter was calibrated with a pH buffer tablet of 4 and 7, this was carried out by dissolved the pH buffer tablet with 100cm^3 distilled water the pH meter was powered on and then reading was adjusted to 4, after which the electrode was cleaned and rinsed with distilled water and the electrode dipped into buffer 7 solution and the reading adjusted into 7 hence, this is calibrated. After the calibration the electrode was cleaned and rinsed with distilled water, the soil suspension was stirred and the cleaned electrode was dipped into the soil suspension and after some minutes of fluctuation, the reading became stable and it was taken as the pH of the soil.

Soil Electrical Conductivity

Method: Twenty gram of the sieved air-dried soil samples was weighed into $100cm^3$ beaker and $40cm^3$ of distilled water was added and stirred intermittently for 30 minutes, this was then filtered using Whatman No1. Filter paper, the filtrate was collected into $100cm^3$ beaker, the conductivity meter (sprite) was calibrated using double distilled water, after which the filtrate of the sample was poured into the instrument sample holder and read bottom was press after five minutes a stable reading was obtained and this was taken as the electrical conductivity of the soil sample in us/cm

Determination of Soil Phosphorus

Method: Five gram of air dried sieved soil sample was weighed into a $50cm^3$ Erlenmeyer flask and $50cm^3$ of 0.5m $NaHCO_3$ solution was added and shake in a mechanical shaker for 30 minutes, filtered through with whatman No. 5 filter paper, $1cm^3$ of this soil filtrate was measured into a test tube and $8cm^3$ of distilled water was added, to this solution $1cm^3$ of colour solution was added and shake after which $0.5cm^3$ of ascorbic acid solution was added shake and allowed to stay for 15 minutes, and then the colour intensity was measured in a spectrophotometer at wavelength of 710nm standard phosphorus curve was also prepared by pipeting 1ml of 0, 0.2, 0.5, 1.0, 2.0, 4.0 and 8.0ppm standard phosphorus working solution in 7 tubes and $8cm^3$ of distilled water was added as well as $1cm^3$ of colour solution and $0.5cm^3$ of ascorbic acid solution was added and shake and allowed to stand for 15 minutes, then the reading was obtained with spectrophotometer at the wavelength of 710nm, this was use to plot the curve of the reading against the phosphorus cementations and the concentration of the sample was obtained from the curve using:

P (ppm) = P (ppm) found from standard curve multiply by the dilution factor.

Determination of Total Organic Carbon

Method: one gram of the air-dried sieved soil sample was weighed into $500cm^3$ conical flask and $1cm^3$ of $INK_2Cr_2O_7$ was added and mixed by swirled the conical flask gently, followed by addition of $20cm^3$ of concentrated H_2SO_4 containing 1.25% of Ag_2SO_4slowly along the inner wall of the flask. The flask was rotated gently to ensured complete contact of the reagents with the soil; the content was kept in a wire gauge for 30 minutes to allow the complete oxidation of organic carbon. After the 30 minutes of oxidation of organic carbon by the chromic acid $100cm^3$ of 85% H_3PO_4, $10cm^3$of 2%NaF and $2cm^3$ of diphenylamine, this solution was titrated by addition of ferrous ammonium Sulphate in small portion until the colour of the solution changes from blue violet to green. The flask was swirled after each addition of the titre and the Burette reading was taken, $0.5cm^3$ of $INK_2Cr_2O_7$ was added and titrate the solution again by ferrous ammonia sulphate to same end point and the burette reading was taken, blank was also run and reading taken, finally the result of total organic carbon was calculated by:

$$\% \, total \, organic \, carbon \, in \, soil = \frac{(B - S) \times N \times Meg \, ont \, C \times 100}{weight \, of \, sample}$$

Where B= volume of ferrous ammonium sulphate for blank titration of $10.5cm^3$ of 1.0 $NK_2Cr_2O_7$.

S = volume of ferrous ammonium sulphate for sample titration + $10.5cm^3$ of 1.0 $NK_2Cr_2O_7$.

N = the normality of ferrous ammonium sulphate Fe $(NH_4)_2$ $(SO_4)_2$ = $\frac{10.5 \times 1.0}{black \, tiltre}$

Meq weight of carbon = 0.003

Determination of Soil Exchangeable Cat ion (Na, Ca, Mg, K)

Method: Ten gram of air-dried sieved soil sample was weighed into $150cm^3$ Erlenmeyer flask and $50cm^3$ of IN ammonia acetate solution was added and shake in a mechanical shaker for 30 minutes, then filtered through Whatman No. 5 filter paper, this filtrate was then analyzed with AAS after running set of standards to obtained a calibration wave. The concentration of sodium, calcium, magnesium and potassium were obtained from the curve and calculated as:

$X_{(ppm)} = X_{(ppm)}$ from the curve X dilution factor.

Where x = Na, Ca, or Mg, or K.

Determination of Soil Nitrogen

Method: one gram of the air dried sieved soil sample was weighed into macro Kjeldachl flask and 2g of catalyst (granulated Devarda alloy) was added, this followed by addition of $10cm^3$ of concentrated H_2SO_4, this was heated at low temperature in the digestion chamber for 20 minutes and the temperature was rinsed gradually to the boiling point until the next time turned white, this was allows to cooled, and labeled as the digested sample.

$10cm^3$ of H_3BO_3 was measured into $125cm^3$ of Erlenmeyer flask and added 2 drops of mixed indicator and placed in the condense and dipped into the H_3BO_3 indicator solution. The digested sample was transferred into the distillation Kjeldahl flask by washing it with distilled water and added $200cm^3$ of NaOH solution and distilled ammonium through the condenser into the receiver flask $50cm^3$ of the distillate was collected into the conical flask, the end of the distillation was control by litmus paper and a blank was also ran simultaneously. The distillate is then titrated against $0.02NH_2SO_4$ using micro burette. The colour changed from green to light pink and the nitrogen content of soil was computed using the formula % N = (a-b) X 0.28 X 100/n X 1000. Where n= volume of the $0.02NH_2SO_4$ required to tire up NH_4^+, b = volume of the 0.02N H_2SO_4 required for the titration of the blank solution.

N = weight of the sample in gram

0.28mgN = equivalent to $1cm^3$ of $0.02NH_2SO_4$ solution

100= conversion factor from gram to percentage and 1000 is the conversion factor of mg into g

Determination of Exchangeable Acidity Method

Method: Ten gram of the air-dried sieved soil sample was weighed into $150cm^3$ Erlenmeyer flask and $50cm^3$ of KCl solution was added and shaken for one hour in a mechanical shaker, then filtered with what man no.5 filter paper. $10cm^3$ of this filtrate was measured into a conical flask and heated to boil for the removal of CO_2, then three drops of phenolphthalein indicator were added while hot and titrated against 0.01NaOH solution, the result was labeled ‘a’.

Then $10cm^3$ of the extract was measured into $50cm^3$ conical flask and added 3.5% Sodium fluoride and heated to boil and allowed to cool for 5 minutes, this was to allow the precipitation of Aluminum in the form of the fluoride complex. To these three drops of phenolphthalein indicator was added and titrated against 0.01NaOH solution and the result labeled as ‘b’. The exchangeable acidity of the soil sample was calculated as.

Exchangeable acidity meq/100g= a x N x 100 x V/n x v

Where a= volume of 0.01NaOH used for the first titration

b= volume of 0.01NaOH used for titration after precipitation of Al.

n= weight of soil sample

V= volume of the extraction solution

v= volume of the extraction solution used in the titration.

$$\text{Al exchangeable meq/100g} = \frac{b \times N \times 100 \times V}{N \times v}$$

Determination of Cat ion Exchange Capacity

Method: Ten gram of air dried sieved soil sample was weighed into $150cm^3$ Erlenmeyer flask and $50cm^3$ of 1.0N ammonium acetate solution was added stirred for few minutes and allow to stand overnight, the suspension was filtered through Whatman No.5 filter paper using Buckner funnel suction flask, the supernatant liquid was allowed to dried and $10cm^3$of ammonium acetate was added at the surface of the soil 10 times to give $100cm^3$ the suction was disconnected and filtrate collected into $250cm^3$ volumetric flask and makeup the volume with ammonium acetate solution. To the residue $10cm^3$ of propyl alcohol was added and applied suction repeatedly 10 times until the residue is free of NH_4^+. The soil was never allowed to dry in this case. To this $10cm^3$ of NaCl solution was added to replace absorbed NH_4^+ ions. This was repeated 10 times to give the total volume of leachate $100cm^3$, then $25cm^3$ of this was transferred into micro kjeldahl distillation flask and distilled with 4%NaOH. $50cm^3$ of the distillate was collected into $150cm^3$ Erlenmeyer flask containing $10cm^3$ of 4%H_3BO_3 solution and three drops of mixed indicator, this was titrated against standard 0.05NH_2SO_4 until the colour changed from banish green to pink at the end point ‘a’, the blank distillation was also run simultaneously as ‘b’.

Finally, the soil cat ion exchange capacity was calculated as:

$$\text{CAC meq/100g soil} = \frac{(a-b) \times N \times 100 \times V}{N \times v}$$

Where a = volume of 0.05NH_2SO_4 used for titration of the distillate sample.

b = volume of 0.05NH_2SO_4 used for the blank titration.

N = Normality of H_2SO_4 which is 0.05

n = weight of the soil sample

V =Total volume of leachate

v = volume of the leachate taken for distillation.

RESULTS AND DISCUSSION

The result of the soil physicochemical properties is shown in the Table 1 below.

Table 1: Physicochemical Properties of the Soil

Sample ID	pH	N (%)	OM (%)	P (ppm)	CEC (mMol/100g)	Clay (%)	Silt (%)	Sand (%)	EC (µs/cm)	TC (%)
NGS 1	5.53	0.10	5.21	8.20	2.85	6.60	12.00	81.40	200.00	3.02
NGS 2	6.42	0.06	6.51	0.70	2.42	4.60	8.00	89.40	30.00	3.78
NGS 3	6.41	0.07	6.56	1.20	2.50	8.60	10.00	81.40	100.00	3.81
NGS 4	5.75	0.08	6.07	4.10	2.60	12.60	14.00	73.40	100.00	3.52
NGS 5	6.09	0.09	6.45	5.80	2.49	10.60	12.00	77.40	200.00	3.74
NGS 6	6.05	0.08	6.37	1.00	2.64	10.60	12.00	77.40	200.00	3.70
NGS 7	6.19	0.11	5.08	2.00	2.90	5.60	10.00	84.40	100.00	2.94
NGS 8	6.02	0.13	4.36	7.80	2.86	6.60	8.00	85.40	200.00	2.53
NGS 9	5.94	0.07	6.56	1.30	2.47	6.60	8.00	85.40	100.00	3.81
NGS10	6.13	0.09	6.51	2.00	2.60	10.60	12.00	77.40	40.00	3.78
NGS11	5.45	0.10	3.56	1.90	3.00	7.60	10.00	82.40	200.00	2.06
NGS12	6.18	0.08	6.18	2.10	2.80	10.60	12.00	77.40	200.00	3.58
NGS13	6.16	0.06	6.62	0.50	2.48	3.60	6.00	90.40	200.00	3.84
NGS14	5.93	0.08	6.54	2.30	2.49	7.60	10.00	82.40	100.00	3.79
NGS15	6.39	0.09	6.48	1.40	2.59	4.60	6.00	89.40	100.00	3.76
NGS16	6.28	0.12	4.80	3.00	2.63	10.60	12.00	77.40	200.00	2.78
NGS17	6.08	0.08	6.54	2.60	2.52	6.60	8.00	85.40	80.00	3.79
NGS18	5.78	0.07	6.43	1.80	2.50	4.60	6.00	89.40	40.00	3.73
NGS19	5.98	0.08	6.34	2.00	2.57	3.60	6.00	90.40	100.00	3.68
NGS20	5.87	0.09	6.40	1.10	2.47	6.60	8.00	85.40	300.00	3.71

Continuation of Table 1

Sample ID	Exchangeable Bases (ppm)				Exchangeable Acidity (mMol/100g)		Textural class	Moisture (%)
	Na	Ca	Mg	K	H^+	Al^{3+}		
NGS 1	0.80	319.00	90.00	18.00	1.62	Nil	Loamy sand	3.02
NGS 2	10.00	202.00	76.00	2.00	1.54	Nil	Sand	3.78
NGS 3	4.00	218.00	72.00	3.00	1.57	Nill	Loamy sand	3.81
NGS 4	2.00	279.00	80.00	3.00	1.55	Nill	Sandy loam	3.52
NGS 5	3.00	210.00	73.00	10.00	1.61	Nill	Sandy loam	3.74
NGS 6	3.00	246.00	84.00	17.00	1.60	Nill	Sandy loam	3.70
NGS 7	6.00	324.00	82.00	3.00	1.70	Nill	Loamy sand	2.94
NGS 8	6.00	318.00	79.00	25.00	1.63	Nill	Loamy sand	2.53
NGS 9	7.00	226.00	72.00	4.00	1.56	Nill	Loamy sand	3.81
NGS 10	6.00	241.00	75.00	6.00	1.64	Nill	Sandy loam	3.78
NGS 11	5.00	347.00	96.00	6.00	1.58	Nill	Loamy sand	2.06
NGS 12	6.00	294.00	81.00	5.00	1.59	Nill	Sandy loam	3.58
NGS 13	12.00	198.00	68.00	4.00	1.64	Nill	Sand	3.84
NGS 14	6.00	219.00	77.00	5.00	1.58	Nill	Loamy sand	3.79
NGS 15	7.00	232.00	82.00	4.00	1.63	Nill	Sand	3.76
NGS 16	3.00	242.00	80.00	11.00	1.65	Nill	Sandy loam	2.78
NGS 17	5.00	213.00	78.00	15.00	1.60	Nill	Loamy sand	3.79
NGS 18	8.00	220.00	76.00	9.00	1.57	Nill	Sand	3.73
NGS 19	10.00	236.00	81.00	8.00	1.56	Nill	Sand	3.68
NGS 20	5.00	210.00	74.00	6.00	1.59	Nill	Loamy sand	3.71

p.H. of the Soil

The result of the soil pH is shown in table 1 which revealed the pH range from 5.45 to 6.42 meaning the soil is slightly acidic. The result show sampling site NGS11 to have the least pH value of 5.42 and NGS2 has the highest value of 6.42. The pH of the soil which is the measure of the concentration of the hydrogen ion in the soil water or the measure of the acidity of the soil water is an important factor in the availability of the plant's nutrients. This play an important role in chemical compounds found in the soil since most of these compounds found in soil are most soluble, they are in a slightly acidic solution. When the elements are most soluble, they are at their most available for plants to take up and use. Thus, there is an optimum pH for plants growth and this is when the pH is slightly acidic. Most plants growth at an optimum pH around 6.5 to 7.0. The acidity of soil is mostly due to leaching. Leaching process removes bases from the soil and therefore tends to lower the pH with time. Fertilizer containing sulfur or nitrogen also tends to lower the pH. The most universal effect of pH on plant growth is nutritional. The pH value on the soil influences the rate of plant materials release by weathering, the solubility of all minerals in the soil and the amount of nutrition ions stored on the cat ion exchange sites. pH therefore is a very good guide for predicting which plant nutrients are most likely to be deficient. The rate of mineralization of the elements from organic matter is fastest between pH6 and 8. A pH from

6.5 to 7.5 is best for phosphorous availability. A pH value near neutral is best for most plant growth. From the result biological activities in this soil will be greatly altar as a result of the acidic soil, some plant like beach, mock orange, asparagus sagebrush which tolerate soil with a pH value of 7 to 8 will find it difficult to grow here but other like rhododendron, camel hams, azaleas, blueberries ferns, spruce pine which prefers acidic soil can grow well here (Oyeyiola and Agbaje 2013)

Moisture Content

This indicates water holding capacity of the soil and most organism function well with the availability of water. The result in table 1 shown the moisture content varies from 3.65% to 35.62%. Sampling site NGS2 has the least value and NGS17 has the highest value. The moisture content of the soil is helpful to describe soil properties, evaluate conditions of plant growth and to estimate exact value of soil nutrient content from the result in table 4. Most of the soil have moisture content above 10% except only four sampling site that has the value of less than 10%. The moisture content of eleven sampling sites is greater than 10% but less than twenty while four sampling site moisture content is greater than 20% but less than 30% and one sampling site NGS17 has the moisture content of 35.62%. The moisture content varies greatly with the type of soil.

Soil Organic Matter

Soil organic matter influences many of the physical, chemical and biological properties of the soil. Some of these properties include soil structure, water holding capacity, nutrient contributions, biological activity, water and air infiltration rate and pesticides activity. Soil with a high level of organic matter will hold more plant available water from table 1 the organic matter ranges from 3.56% to 6.62%. The sampling site NGS13 has the highest organic matter of 6.62% while sampling site NSG11 has the least organic mater 3.56% this reveal microbial activities will be more in site NGS13 than the rest of the sites since the higher the organic matter level in the soil the higher the corresponding biological activity. The study also revealed different values of organic matter content from various sampling sites which shows that microbial activities will also varies base on the level of organic matter. All the values reported are less than 10%, this agreed with the work of Oyeyiola and Agbaje who reported value of organic in soil near microbiology laboratory at the University of Ilorin to be less than 10% (3.84 – 4.70%).

Soil Nitrogen

Soil nitrogen is needed in plant growth to develop and form new cell wall and shortage of nitrogen will halt the processes of growth and reproduction. The result of soil nitrogen in table 1 shows the soil nitrogen range from 0.06%to 0.13%. The sampling sites NGS2 and NGS13 each having 0.6%. Among the twenty soil samples studied none of the sites has nitrogen content equal to 1%, all the results are less than 1%, this agreed with the work of other researchers (Osakwe 2014, Odoh, Dauda, OKo and Lawal 2018), however Edori and Iyama reported the value of nitrogen in soil from selected Abattoirs in Port Harcourt Nigeria to be greater than 1% but less than 3%.

Soil Phosphorous

Phosphorous has been called 'the key to life' because it is directly involved in most life processes. It is a component of every living cell and tends to be concentrated in seeds and in the growing points of plants. Phosphorous deficiency causes stunting and delayed maturity. The result in table 1 revealed the concentration of phosphorous varies from 0.5ppm to 7.2ppm. Among the twenty soil samples studied only sampling site NGS2 and NGS13 has less than 1ppm (0.5 and 0.7ppm) whereas all others has concentration greater than 1ppm site NGS1 has the highest concentration value of 8.2ppm while sampling site NGS13 has the least 0.5ppm, this implies that those plant grow in NGS1 will mature faster than those in site NGS13 since phosphorous play a major role in plant maturity due to their concentration in the growing part of the plant.

Exchangeable Cat Ion (ppm)

The exchangeable cat ion studied here are Na, Ca, Mg and Ka sodium (Na) is mostly beneficial to animals than plant even though this can be beneficiary to plant when potassium (k) availability is limited, from the table 1. It is clear that the concentration of Sodium varies from 0.8ppm to 12ppm and it can also be seen in sampling point NGS1 that the lower concentration of sodium (0.8ppm) is made up with higher concentration of potassium (k) which will be of great important to plant growth in this particularly site. Exception of NGS1 all other sites has concentration of sodium more than 1ppm (2-12ppm). For calcium which is needed in production of cell wall in plant, the result in table 1 shows reasonable concentration of calcium in all the studied area and this varies from 198ppm which is the least (NGS1) to 347ppm (NGS11) which is the highest. Among all the sites studied is only NGS13 that has the concentration of calcium less than 200ppm but all the remaining site has calcium concentration above 200ppm, this could mean all the plant grow here will develop good cell wall. For potassium which help in maintaining electrical neutrality of both soil and plant by balancing the negative charge of nitrate, phosphate, and other anions, plant require large amount of potassium. This potassium is released to the soil when the change from non-exchangeable to exchangeable form. From table 1 the concentration of potassium ranges from 2ppm to 25ppm. Fourteen of the studied sites has the concentration of less than 10ppm (2-9ppm), five sites has the concentration above 10ppm but less than 20ppm (10-18ppm) while one site has a concentration of potassium above 20ppm (25ppm) which implies this soil NGS 8 will have more neutrality of negative charges from nitrate, phosphate and other anions than all other studied sites. For the magnesium which has a similar function with calcium, in building the cell wall of the plant, the results from table 1 shows the least concentration in sampling site NGS3 (72ppm) while sampling site NGS 11 has the highest concentration (96ppm). All the results where high but less than 100ppm, these results in combination with the concentration of calcium which is also very high will strengthen the cell wall of plants grown in these areas.

Exchangeable Acidity of the Soil

The exchangeable acidity of the soil varied from 1.54-1.70 mMoL/100g of H^+, the sampling site NGS7 has the highest value of 1.70 while sampling site NGS2 has the least value of 1.54 mMoL/100g. all the values where above 1.5 but less than 20 mMoL/100g of H^+ while the Al^{3+} were not detected in any of the samples. Other researchers reported similar thread in their work except that some of their results are lower but generally within same range with this which the reported the value to be between 0.77-1.55 mMoL/100g (Odoh, Dauda, Oko and Lawal, 2018).

Cat Ion Exchange Capacity of the Soil (Cec)

This is one of the main characteristics of the soil which is greatly influence by the total organic matter of the soil. From table 1 the CEC varied from 2.42 mMoL/100g to 3.0 mMoL/100g. All the values were above 2.0 but not greater than 3.0 mMoL/100g. The sampling site NGS11 has the highest concentration of the cat ion exchange capacity of 3.0 mMoL/100g while NGS2 has the least value of 2.42 mMoL/100g. This result agreed with other work reported earlier (Obasi, Akubugwo, Ugbogu and Otuchristian, 2012).

Soil TOTAL Carbon

From table 1 the total carbon varied from 2.06-3.84%. Among the twenty-soil sample Studied only four sampling sites has results greater than 2 but less than 3 (2.06-2.94%) while other result is greater than 3 but less than 4% (3.02-3.84%). The total carbon influences many soil characteristics which include colour, nutrient holding capacity, and nutrient turn over and stability which in turn influence water retentions, aeration and workability.

Soil Electrical Conductivity

Electrical conductivity of the soil is a measure of the ability of the soil to conduct an electrical current. It is important that soil should not have too high of electrical conductivity and it should not be too low. From table 1 the electrical conductivity of the sampling areas varied from 30 to 300 µs/cm.

Most of the studied area has electrical conductivity value between 100-300µs/cm except sampling site NGS2, NGS10, NGS17 and NGS18 that has the value of less than 100µs/cm (30, 40, 80 and 40 µs/cm).

Soil Texture

Table 4 shows that the soil from the sampling areas are mostly sandy loan, loamy sand and sand, other parametric like the percentage clay revealed the value from 3.60% to 12.60%, 6 to 14% for percentage silt and between 73.40 to 90.40% for sand. The sand has the highest percentage within the studied area.

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