STATUS AND DISTRIBUTION OF OXIDES AND MONOSACCARIDES ON SOILS OF COWPEA AND MAIZE FARMS

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CERTIFICATION

This is to certify that this project titled '' Status and distribution of oxides and monosacarides in Soils of cowpea and maize farms '' was carried out by Osakpolor Divine IGBINOSUN in the Department of soil science and land management, Faculty of Agriculture, university of Benin, Benin city, Nigeria.

DEDICATION

This project work is whole heatedly dedicated to the Almighty God and to my entire family, the Francis igbinosun Family, whose love made me not to hunger for love elsewhere and for making sure that I am morally, educationally and spiritually ground today.

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TABLES OF CONTENT

CONCLUSION AND RECOMMENDATION

5.1 conclusion

5.2 Recommendations

LIST OF TABLES

Table 4.1 Physical and chemical properties in soils of cowpea and maize farm studied

Table 4.2 Oxides of iron and manganese in soils of cowpea and maize farms studied

Table 4.3 Monosaccarides in soils of cowpea and maize farm studied

Table 4.4 Correlation coefficient between some soil physical and chemical properties and forms of iron and manganese oxides from cowpea farm.

Table 4.5 correlation coefficient between some soil physical and chemical properties and forms of iron and manganese oxides from maize farm.

ABSTRACT

The status and distribution of some selected oxides and monosaccarides research on soils of cowpea and maize farms was carried out in faculty of Agriculture, university of Benin suitated in Ovia North east of Edo state,Nigeria. 24 soil samples was collected using a factorial experimental design of 2×4×3 .I.e two different farms at four different depths(0-30,30-60,60-90,90-120cm) replicated three times.The results shows that the soils were strongly acidic for the pH of both farms, the oxides of iron was higher in soils of maize farm compared with cowpea farm.Also, for monosaccarides, Arabinose was higher compare to glucose, galactose,mannose and xylose for both farms(kuzyavok,Y ,2006y). The correlation coefficient matrix showing the relationship between forms of iron and manganese oxides from maize farms was negatively correlated and significant at pH while the correlation coefficient matrix showing the relationship between the oxides of iron and manganese from cowpea farm was positively correlated and significant with clay.

CHAPTER ONE

1.0 Introduction

An oxide is a chemical compound that contains at least one oxygen atom and one element in its chemical formular. Oxides common in the soils are silicon(Si), iron (Fe), maganese(Mn) and Aluminium(Al).Oxides of Iron, Maganese and Aluminum exhibit a high surface area with reactive surface sites which strongly bind oxyanions and metal cations, thereby impacting the availability and mobility of plant nutrients and toxic metals.(Huang *et al*, 2017). The most important properties of the different soil iron(Fe) oxides is the surface structure and the resultant dependency of surface charge on pH , because the surface is the region of their interaction with the soil solution, and with other solid phase, plant roots and soil biota. Manganese (Mn) oxides on the otherhnad are ubiquitous in its environment, being found for example under the form of coatings and nodules in soils, freshwater and marine sediments and as rock varnishes in temperate,arid and polar areas. Hence, manganese (Mn) oxides can be used as sorption mediums of trace metals and metalloids (Van Hullebusch, *et al* 2020). Aluminum (Al) plays a responsible role for its behaviour on the environment (Quintal *et al*, 2017). The reaction of Aluminum in soils differs from other soluble metals.

Monosaccarides are simple sugars, and the most abundant organic compounds in biosphere because they are the basic components of all polysaccharides: cellulose, hemicellulose(polyoses), starch, pectin, fructanes and Glucanes as well as of chitin (consisting from amino sugars). Kuzyakov(2006). Monosaccarides are inputted by plants by decomposition of above and below ground liter plant biomass including above and below liter, is the important primary source of carbohydrate in the soil(Gunina and kuzyakov,2015).Forms of soil monosaccarides present in soils could be useful indicators of the nature ,utility and origin of soil carbohydrates. For instance, the ratio of Galactose plus mannose to arabinose plus xylose and Mannose plus fructose to Arabinose plus xylose have been noted as important indicators of the origin of soil carbohydrates (Guggenberger *et al* 2009)

According to Evans *et al*. 2001 the ratio greater than unity of galactose plus mannose to Arabinose plus xylose indicates that a soil carbohydrate material to synthesized by micro-organism otherwise it is derived from plant tissues. Hence, considering the dominance of polysaccharides in plants(50-70% of dry mass), monosaccarides are the most important primarily input of organic carbon (C) in the soil with a mean residence time(MRT) of few weeks to months(Kuzyakov *et al*, 2006).

Hence, the research work was carried out in New faculty of Agriculture building, university of Benin, Edo state, Nigeria.

1.1. Objectives Of The Study

The study seeks to evaluate:

i. some selected oxides (iron and manganese oxides) in soils of cowpea and maize farm

ii. some selected monosaccarides (Glucose,galactose,arabinose,mannose and xylose) in soils of cowpea and maize farm.

iii. the relationship between the distribution of some selected oxides and monosaccarides in soils from cowpea and maize farms

CHAPTER TWO

2.0. LITERATURE REVIEW

2.1 Monosaccarides in the Soils

Carbohydrates are important components of soil organic matter,which can be decomposed to different types of monosacarides. Neutral monosacarides in the soil are also called neutral sugars including xylose, Ribose, Arabinose, Glucose, galactose, mannose, fucose and rhamnose. These neutral monosaccarides can be termed as soil sugars. Soil sugars are the main carbon and energy resources for soil microorganisms and play a vital role in aggregates formation. Among them, plant-derived sugars mainly include pentodes such as xylose and arabinose while microbial-derived sugars mainly consist of hexoses including Galactose, mannose, fucose and Rhamnose. Generally, the ratio of hexoses to pentoses are used to evaluate the contribution of microbial a versus plant derived sugars.Neutral sugars are the main carbon and energy resources for soil micro organisms and plays important role in aggregate formation(kuzyakov,2006).

2.2 HEXOSE AND PENTOSE SUGARS IN SOIL

Hexoses dominate over pentoses in soils because: hexose originate from microorganisms and partly from plants,the synthesis of hexoses by microorganisms is much higher than pentoses. This already reflects the importance of microbial synthesis and recycling of sugars for their composition in soil .Even though plant litter components are rapidly decomposed,considerable amounts of pentoses are accumulated in soil organic matter,the onset and offset of Pentose accumulation in soil occurs due to the selective decomposition of plant polymers (Cheshire et al., 1971).Glucose is the dominant hexose overall and in the non-cellulose sugars. The contents of galactose, mannose and rhamnose are similar, but 1.5 times lower than glucose. The fucose content is even 5 times lower than glucose. Arabinose and xylose are the dominant pentoses, with almost equal contents 1.5 times more glucose, rhamnose, ribose and fucose are obtained from the soil by total sugar extraction versus extraction of non-cellulose sugars. In general, the amount of pentoses is comparable with the amount of all hexoses except glucose.The highest amount of glucose compared to other sugars is explained by its diverse origins: from the decomposed cellulose of plant residues, released by living roots, and synthesized by microorganisms.

2.3 Primary Source of sugars in soils

The primary source of sugars in soils includes;

2.3.1 Sugars in root exudates

Plants release 15-40% of photosynthetically fixed C into the soil via rhizodeposition (Kuzyakov and Domanski,2000; warembourg and Estelrich,2000; Hustch et al,2002). Among the numerous components exuded by roots, carbohydrates are the most abundant (Kraffczyk et al., 1984; Hutsch et al., 2002; Derrien et al., 2004). In root exudates, carbohydrates are present mainly in the form of monosaccharides, whereas in secretions mainly as polysaccharides, e.g. mucilage. Sugars account for 46-52% in the exudates of wheat, alfalfa and pea plants, whereas they comprise only 15% in the exudates of oil radish and Chenopodium album (Hutsch et al., 2002). The dominant sugars in root exudates areglucose, fructose, galactose, arabinose, maltose,rhamnose,sucrose and xylose(Grayston and campbell,1996).Glucose is common in root exudates of variousl tree species ,whereas arabinose amd mannose are absent. Glucosw makes up the main part of root exudates 40-50%,whereas xylose and galactose presents 23% and 8% respectively (Hutsch et al,2002). Carbon in root exudates are easily available for micro organisms and a major part of it (64-86%) is decomposed to CO2 (werth and kuzyakov,2008). About 2-5% of C released by roots to the soil is accumulated in the soil organic matter.

2.3.2 Plant sugars input by decomposition of above and below ground litter

Plant biomass, including above and below ground litter, is the main primary source of carbohydrates in soil.cellulose consists mainly of glucose. Whereas hemicelluloses includes the rests of various pentoses and hexoses: glucans,xylans, Mannas ,galactans,fructosanes Arabinogalactans,with abundant pentoses(arabinose and xylose). Some plant species contains significant amounts of galactose and mannose(sariyildiz and Anderson,2003; Schaedel et al,2010). The green leaves contains 15-35% cellulose and 20-40% hemicullose of dry weight.Cellulose is relatively enriched in forest litter(except coniferous trees), agricultural crops and grasses compared to green leaves (Salamanca et al ,2003; sariyildiz and Anderson,2005). Roots tissues contains 2-3 times more cellulose than green leaves (Zhang et al ,2014). Cellulose decomposition in soil is estimated to range from 30% during three months (Blagodatsakaya et al,2014.) to 50-86% during two years (zech et al, 2012). Decomposition of intact hemicellulose is faster cellulose and amounted to 70% during 7 months .The rates shows that most of the celluloses and hemicelluloses will be decomposed to their monomers sugars within a few months.

Furthermore, Soil monosaccharide distribution provides useful information about its carbohydrate origin and tendency for carbon sequestration

2.4 Distribution of Iron(Fe) and Manganese (Mn) oxide in the soils.

2.4.1. Iron(Fe)

Iron is an essential micronutrient same as manganese and aluminum .Iron on the other hand plays critical role in metabolic processes such as DNA synthesis, respiration, and photosynthesis. Because of iron's redox properties and its ability to form complexes with diverse ligands, this element is a constituent of many electron carriers and enzymes; therefore, it plays an important role in plant metabolism. On the other hand, low solubility of inorganic iron at physiological pH levels and its high reactivity in the presence of oxygen, which generates toxic hydroxyl radicals, represent a severe difficulty (Hell and Stephan, 2003).). Soil conditions that result in insufficient or excess iron uptake are widespread in nature (Snowden and Wheeler, 1993; Schmidt and Fuhner, 1998; de la Guardia and Alcantara, 2002a). Iron uptake by plants is fastest when iron is present in ferrous form (Chaney et al., 1972). In anaerobic soils, high concentrations of ferrous ions may lead to iron toxicity via excessive iron uptake. Plants may limit iron uptake under those conditions by the oxidation of ferrous ions with oxygen, which is transported from the shoot via aerenchyma (Foy et al., 1978). Iron in aerobic soils is mainly present as the ferric ion in precipitates (Lindsay et al., 1982) or in soluble chelates (Powell et al., 1980). Increase of iron in the soils with increase in PH results to antagostic relationship.Iron oxides are useful field indicators of pedogenic environments for three reasons: they include several minerals, these minerals have different colors, and the type of mineral formed is influenced by the environment. Therefore, recognizing the iron oxide mineral in the field by its color has a potential to yield information about pedogenesis. Iron oxide nanoparticles also play a key role in efficient growth and improved yield of plants, starting right from seed germination to localization of its reserve stores. Seed germination rate is enhanced by the application of iron oxide nanoparticles that provokes shoot growth as well as root growth (Wang et al., 2011; Liu et al,2016). Geothite and Haematite are by far the most common iron oxides in soils.

A contribution of iron oxides to soil aggregation and cementation is usually assumed but has not been accepted unequivocally. However, aggregation into microaggregates (<1 mm) is particularly obvious in oxisols and ultisols rich in goethite and hematite. Cementation by iron oxides exists in concretions and ferricretes where iron oxides fill part of the pore spacein which their crystals grew(Cornell et al,2003).

The total amount of iron oxides in soils is usually determined by an extraction with the strongly reducing Na-dithionite ($Na2S2O4$)in a buffered solution (Fed). Other reducing agents of different strengths (e.g., ascorbic acid, hydroxylamine, $TiCl3$) are also used.

Acid oxalate (pH 3) extracts poorly crystalline iron oxides(Feo), especially ferrihydrite, as well as organically-bound F and fine-grained magnetite. (Schwertmann et al,2000)The ratio Feo/Fed is frequently used to characterize the degree to which Fe-oxides have transformed to goethite and hematite, because the latter two are barely soluble in oxalate solution. In acid soils rich in organic carbon, such as spodosols, pyrophosphate is used to extract organically-bound iron, though some ferrihydrite is also extracted by dispersion.

2.4.2 Manganese (Mn)

Manganese (Mn) is a naturally occurring element that is found in rock, soil, and water. It is ubiquitous in the environment and comprises about 0.1% of the Earth’s crust(Garrison *et al* 1965). Crustal rock is a major source of manganese found in the atmosphere. Ocean spray, forest fires, vegetation, and volcanic activity are other major natural atmospheric sources of manganese (Malucak *et al*, 2002). Important sources of dissolved manganese are anaerobic environments where particulate manganese oxides are reduced, the direct reduction of particulate manganese oxides in aerobic environments, the natural weathering of Mn(II)-containing minerals, and acidic environments (Cherry *et al*, 2001).Manganese exist predominantly as oxides, hydroxides and oxhydroxide in aerobic environments and these oxides sorb trace elemebte at higher concentration (Hall et all 1996a, Tessier et al, 1979).The sorbed elements can be solubilized by reductive dissolution of the manganese (Hindersmann and Mansfeldt,2014). Manganese oxides minerals in soil are important as a source of the plant nutrient Mn, and for their interactions with other minerals and with other cations (Adams et al., 1969). Also, the oxidative and catalytic properties of manganese oxides influence humus formation (Shindo and Huang, 1984). The presence of manganese oxide minerals in soils can easily be detected by their dark colour, and by the vigorous reaction of these minerals on addition of Hydrogen peroxide. Chen et al ,2000 showed that the application of manganese oxides decrease cadbium and lead solubility in soils and decrease their uptake.

Furthermore, the iron and maganese oxides ranges from amorphous to completely crystalline compounds of iron and maganese(Owliaie ,2012). The availability of iron and maganese in the soil and the uptake by plant roots largely depends on the pH, oxidation and reduction conditions of the soils and forms of soluble iron and maganese. In a research reported that aquic conditions of paddy fields reduce Iron and maganese and increase their concentration in soil solution and sometimes cause iron and maganese toxicity in rice(kpongor,vlek and Becker 2003).

2.5 COWPEA

The most prominent in the leguminosae family is cowpea (Vigna unguiculata L. Walp). Cowpeas are rich in protein, iron, starch, calcium, phosphorus and vitamins B, which make them excellent food even when eaten in small amount (Ebong, 1972). In west and central Africa, cowpea is second in importance after groundnuts, with

Nigeria accounting for over 70% of the total world production (Sing et al., 2000). In Cameroon cowpea is the third most important legume food crop after groundnuts

(Arachis hypogaea) and common beans (Phaseolus vulgaris) and is frequently intercropped with cereals (Taffouo et al., 2004). The most important beneficial attribute of this legume is its contribution to the soil nitrogen status through symbiotic nitrogen fixation, thereby enhancing soil fertility and reducing the need for N-fertilizer application (Martins et al., 2003). In Nigeria, where nearly 70% of the country's crop is produced, cowpea production is on the increase due to high demand from both the local and external markets, and many farmers in the rural area now grow cowpea for

cash markets.Agriculture in Sub-saharan Africa is characterized by its poor productivity. Several factors related to soil fertility limit agricultural production. Many factors such as soil type, farmer's practices, crop residues and mineral fertilizers management influence crop yields (Bado et al.,2004). Among those factors, the texture and the chemical composition of soils remain a major constraint to crop production in large scale in tropical regions of Africa. The production of grain legumes is affected by the texture of soil and organic matter content richness (Nyabyenda,2005). The influence of soil texture on organic matter decomposition indicate that the rate of decomposition and net mineralization depend on the accessibility of organic substrates to soils organisms (Hassink, 1992). Changing the texture through sand amendments increased the bulk densities of the soil (Mtambanengwe et al., 2004). Clay particles are believed to protect some of the more easily decomposable organic compounds from rapid microbial breakdown through encrustation and entrapment (Tisdall and Oades, 1982). A well structured soil is less in Arabinose, Xylose, Glucose and Mannose.(Kuzyavo et al 2006)

2.6 Maize

Maize (Zea mays L.) is presently the world's second most important cereal after wheat (FAO, 2009; Pingali, 2001). It is however, the most essential cereal in most African countries including Nigeria(Morris et al., 1999; FAO, 2008). The crop serves as a staple food for some more than 300 million people in less developed countries such as Africa and Latin America. It accounts fordaily total calories of about 15–20% in the diets of more than 20 less developed nationsespecially in Africa and Latin America and the most essential cereal crop in Sub-Saharan Africa (Adetiminrin et al., 2008). Maize thrives in most Soils, as far as they are deep (more than 1 meter) and fertile, and a have a good water holding capacity. Maize grows best on sandy clay (Loams), loamy and silty clay soils; it is less adapted to compact clays and sands. The major soil factor is soil water storage, and this is determined by texture and structure. Available soil moisture is a major elements of Success in rain fed Maize production, particularly where the rains are not uniformly distributed over the season. In this case, the plant have to rely on the moisture stored in the root zone to overcome the temporary water deficit.The ability of the soil to retain or hold few weeks of water in case of dry periods during the season is a most important determinants of the pontential of such soil to produce maize.In soils where this moisture retention capacity does not exist, i.e in sandy and/or shallow soils, or when the intermediate dry spell extends beyond the time that the plant can survive on stored moisture the crop will either suffer or must be irrigated. Maize has a shallow root system, reaching as much as 2 m deep in some cases, and these roots need space to develop. For normal root development, the maize crop requires a minimum soil depth of 80-100 cm. any soil shallower than this critical depth will give smaller yields, especially where irrigation not practiced and where water tends to limit yield

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3.0. MATERIALS AND METHODS

3.1 Study Area

The study was carried out in the Faculty of Agriculture, located in university of benin in ovia north east local government area of Edo state. Ovia north east has an area of 2301km^2 (230,100 hectares). Its lies within the and latitude 6°38'40.7N and longitude 5°34'47.6 E

3.2 Climate

Ovia north east Local Government Area is siutiated in the Southern part of Edo State. Rainfall is the most important weather factor that influences crop yields and production (Alabi and Ibiyemi, (2000). The area is characterized by tropical climate with an annual rainfall amount of 1500-2500mm with average of 1900mm, mean annual temperature range of 23^{oc} to 27° .The area has two climatic seasons namely; rainy and dry seasons. The rainy seasons is between April to october with a two weeks break in august while the dry season is between Novemeber and April with cloudy, humid and dusty harmattan period between December and January.

3.3 Parent Material

The soils of the area are derived from coastal plain sand(unconsolidated sand and sandy clay) and alluvial deposits which are formed from sedimentary rocks.

3.3.1 Topography

The topography of the land is gentle slope which falls east wards.

3.3.2 Vegetation

Ovia north east falls within the derived savanna vegetation zone of Nigeria and it is characterized with grasses, dispersed forest trees of economic importance, arable and plantation farms common crops are , cowpea groundnut, maize and plantain and weeds such as Mimosa pudica, panicum Maximum and pennisteum purpureum.

3.4 Soil Sampling and preparation

Soil auger was used in making borings during soil mapping at observation points encoded in the GPS at depth intervals of 0-30 cm, 30-60 cm, 60-90 cm, and 90-120cm from two different farms; the maize farm and cowpea farm. The experimental design was a factorial experiment of 2×4×3 i.e two different farms,at 4 depth replicated 3 times. Sample preparation was done in which the collected soils were air-dried,crushed and passed through a 2mm sieve.

3.5 Laboratory Analysis

The sieved samples were analyzed for some physical and chemical properties using standard laboratory procedures.

3.5.1 Soil pH

pH 1:1 in H_2O

Weigh 20 g of fine air dry soil into 50 ml beaker

20 ml of distilled water was added and the mixture was stirred intermittently for 30 minutes.

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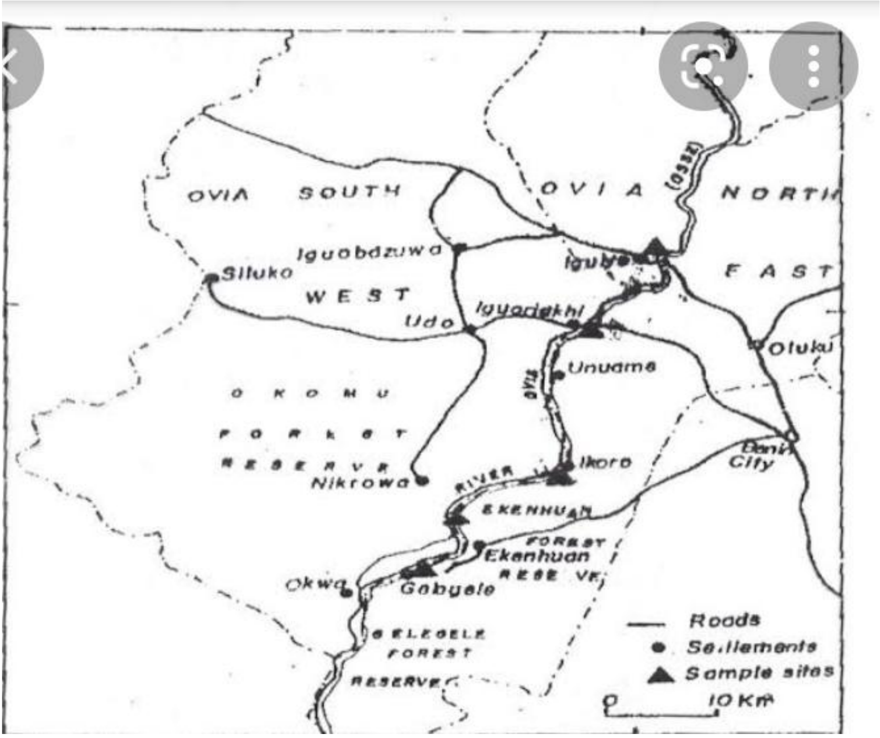
The pH was measured by immering the glass electrode into the partially settle suspension and pH was recorded as soil pH in H_2O 1:1 by Udoh (2009).



SOURCE: Google imagery 2021

3.5.2 Particles Size Distribution

The particle size distributions were determined using the hydrometer method of Bouyoucos (1951) as modified by Day (1965).

Weigh 51 g of air- dry or 50 g of oven-dried soil into a soil shaking bottle

100 ml of calgon was added and was allowed to soak for 30 minutes.

The mixture was stirred with a mechanical stirrer.

The soil suspension was transferred into a sedimentation cylinder and was filled to mark with distilled H_2O.

A plunger was inserted and moved up and down to mix the content thoroughly, while the sediment was dislodged with their upward strokes of the plunger near the bottom, the hydrometer was lowered carefully into the suspension and readings were taken after 40 seconds (R 40 sec.).

The temperature reading was taken thereafter with a thermometer.

The second reading came up in 120 minutes time, while the first (R 40 sec.) reading calculate for % silt + clay, the second reading will calculate for % clay and subtracted from % silt clay and both subtracted from 100 to get % sand.

3.5.3 Organic Carbon

Organic carbons were determined using Walkley-Black wet oxidation methods (Walkley and Black (1934).

1g of soil sample was weighed into 250 ml conical flask.

10 ml of 1N $K_2Cr_2O_7$ solution was added and the mixture swirl for proper mixing.

20 ml of concentrated H_2SO_4 was added carefully.The mixture was again swirl to mix up and was left for 30 minutes and thereafter 100 ml of distilled water was added.

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The mixture was again swirl round.

Add 5 drops of ferroin indicator

The excess chromic acid was titrated with 0.5 N ferrous sulphate to dirty brown end-point (Tml).

A blank was run, using the sample procedure, but without soil sample (Bml).

The blank will measure the amount of reducing substance present in the reagents as impurities.

-% organic carbon was calculated as follows:

3.5.4 Organic Matter

The organic matter was computed by multiplying the value of the organic carbon by a standard value of 2.0 by Douglas W. Pribyl (2010).

3.5.5 Exchangeable Bases

Exchangeable cations, Ca, Mg, K and Na were extracted with 1N ammonium acetate solution (1N NH_4OAc) buffered at pH 7.0 the Ca and Mg were determined from the extract using 0.01m EDTA (ethylenediaminetra-acetic acid) titration method as described by Black (1965), while K and Na were determine using flame photometer (Jackson, 1962).

10 g of soil sample was weighed into 250 ml soil shaking bottle and left overnight after adding 1M NH_4OAC,

The mixture was filtered using Whatman No. 1 filter paper into 100ml volumetric flask and was made up to mark with NH_4OAC. From the leachate, Ca and Mg were determined titrimetrically, while Na and K were read in a flame photometer, and each element is expressed in cmol/kg.

3.5.6 Determination of Ca and Mg (EDTA Titration Method)

10 ml of the 1MNH_4OAC extracted Leachate was pipetted into a 250 ml conical flask (V_2).

50 ml of distilled water was added.

8ml of NH_3 solution (conical) was added.

5 drops of 2 % KCN was also added; followed by 5 drops of 5% hydroxyl ammonium chloride ($OHNH_3Cl$).

3 drops Eriochrome Black T indicator (EBT) was added. The mixture was then titrated with 0.01M EDTA, from red-wine-blue.

3.5.7 Ca Determination

10 ml of extract was pipetted into 250 ml conical flask (V2)

50 ml of distilled water was added.

2 ml 2 % KOH was also added.

5 drops of % KCN followed by 5 drops of $OHNH_3Cl$.

5 drops of calgmit was added and the mixture titrated also using EDTA (0.01M).

Calculation:

Ca in mmol / 100 subscript 5 = $M \times T$ (EDTA) $\times V1/V2 \times 100/$wt of sample $\times 40$

Where:

T- Titre value

M (EDTA) - Molarity of EDTA

V_1- Volume of extract

V_2- Volume of aliquot

40- Molecular weight of Ca

While that of Mg go with same.

3.5.8 Total Nitrogen

Total Nitrogen was determined using the regular macro Kjeldahl method as reported by Bremmer and Mulvaney (1982)

0.5 g of fine air dry soil was weighed into 10 ml conical flask**.**

A catalyst mixture of K_2SO_4 + $CUSO_4$ + ScO_2 was added to aid quick digestion.

15ml of conc.H_2SO_4 was added and a glass curved funnel (specially made to prevent direct escape of ammonia (NH_3) the heating was done on an electric cooker till the solution became very clear.

It was left to cook down to room temperature.

The digested soil was filtered into 100ml volumetric flask and was made up to mark.

The mixture was turned thoroughly and severally and was kept waiting for distillation.

During distillation, 10 ml aliquot was taken into a 500 ml Kjeldahl flask.

30 ml of distilled water was added.

15 ml of 10 N NaOH was added and it was set-up in the distillation apparatus.

25 ml distillate was collected and titrated back with 0.01 N HCl.

Total % nitrogen was calculated as follows:

$M \times T \times 14/100 \times V1/V2 \times 100/\text{wt of sample}$

Where:

M -Molarity of acid

T- Control titre value

V_1- Final Volume of digest.

V_2- Volume of digest used for distillation

3.5.9 Available Phosphorus

The available phosphorus was determined by colorimetric method after extracting with Bray 1solution (Murphy and Riley 1962).

Weigh 5 g of soil was weighed into a 250 ml shaking bottle.

Add 35 ml of extracting solution (1M NH_4F).

The mixture was shaken for 3 minutes and was filtered into 100ml volumetric flask and the leachate determined in a spectrometer.

Calculation:

Weight of sample used – 5 g

Volume of extract used (V) – 35 ml

Volume of extract used - 250 ml diluted to 50ml

Therefore ppm soil = ppm graph × 35 / 35 × 50 / 2.5

3.6 Oxides Determination

3.6.1 Total Free Oxides by Citrate –Bicarbonate Dithionite Extraction (Fe_d) and (Mn_d) (Crystalline Form)

Dithionite –citrate (Fe_d) and (Mn_d) were determined by Mckeague (1966) method. Soil sample was ground to pass a 35-mesh sieve and 1g was weighed into a 50ml plastic centrifuge tube. 25ml of sodium citrate (0.3M, $Na_3C_6H_5O_7.2H_2O$), 0.68 M solution was added. 0.4g of dithionite sodium hydrosuphite was also added. The centrifuge tube was covered tightly and put in an end –over end shaker overnight and centrifuged for 20minutes. The supernatant was filtered using No. 42 filter paper into a 100ml volumetric flask and make up to mark. Fe and Mn concentration in the extract were determined using the atomic absorption spectrophotometer.

3.6.2 Ammonium Oxalate Extraction Method Fe (Fe_{ox}) and Mn (Mn_{ox}) (Amorphous Form)

Ammonium oxalate extractable Fe (Fe_{ox}) and Mn (Mn_{ox}) were determined by shaking 1 g of soil with 20 ml of ammonium oxalate extracting solution for 4 hours in a dark and then filtered using No. 42 filter paper into a 100ml volumetric flask and made up to mark. Fe and Mn concentration in the extract were determined using the atomic absorption spectrophotometer. (Mckeague and Day 1966).

3.6.3 Pyrophosphate Extraction Method Fe (Fe_p) and Mn (Mnp) (Organic Form)

Tetra-sodium pyrophosphate solution of 0.1 M were used to determined concentration in the extract Fe (Fe_p) and Mn (Mnp) by shaking 1 g of soil with 50ml of the extracting solution for 16 hours then filtered using No. 42 filter paper into a 100ml volumetric flask and make up to mark. Fe and Mn concentration in the extract were determined using the atomic absorption spectrophotometer. (Mckeague,1966). While Total iron (Fe_t) was extracted with double acid (mixture of 3 parts of HCl to 1 part of HNO3)

3.7 Monosaccharide Determination

Contents of the soils were determined using the following procedures: Sub sample of the fine earth soil fraction was weighed (1 g) into a boiling tube and 25 ml of 80% hot ethanol added and shaken on a vortex mixer for 45 minutes. The tube was allowed to settle for 30 minutes and the contents filtered into a beaker using Whatman No. 41 filter paper. The above step was repeated three times to ensure complete extraction. The extracts were then evaporated to dispel all the ethanol and 10 ml de-ionized water added to dissolve the contents before transferring into a 100 ml volumetric flask. The beaker was washed three times and transferred into the 100 ml flask and then made up to mark with de-ionized water. The sugars were subsequently determined as follows:

Glucose content was determined using the Anthrone method (Browne and Zerbon, 1981). In this, about 1ml aliquot of the sugar extract was pipetted into a test tube and 6mls of anthrone-sulphuric acid (Prepared by dissolving 1g of Anthrone in 760 ml of concentrated H2SO4 and made up to mark using 240 mls of de-ionized water) added and shaken vigorously for 2 minutes on a reciprocating shaker. A blank solution was also prepared as above but using de-ionized water instead of sugar concentration. Standard glucose solution of concentrations10-50µg/ml was prepared. Absorbance of the bluish coloured solutions of sample and the glucose standards were read on a Spectronic 21D Spectrophotometer at a wavelength of 595nm against the blank.

3.7.1 $$\%\ \text{Glucose} = \frac{\text{Absorbance of sample} \times \text{Av. Gradient} \times \text{Dilution factor}}{\textit{Weight of sample} \times 10{,}000}$$

3.7.2 Mannose content was determined using the same method as for the glucose but with the absorbance read at a wavelength of 615nm.

$$\textbf{\% Mannose} = \frac{\text{Absorbance of sample} \times \text{Av. Gradient} \times \text{Dilution factor}}{\textit{Weight of sample} \times 10{,}000}$$

(2)

3.7.3 Galactose concentration was determined by reading the absorbance of the standard and raffinose sample at a wavelength of 528 nm on a Spectronic 21D Spectrophotometer.

$$\textbf{\% Galactose} = \frac{\text{Absorbance of sample} \times \text{Av. Gradient} \times \text{Dilution factor}}{\textit{Weight of sample} \times 10{,}000}$$

3.7.4 Arabinose determination was achieved by reading the bluish colour solutions of arabinose standard and sample at a wavelength of 595nm on the 21 D spectrophotometer.

$\textbf{\% Arabinose} = \underline{\text{Absorbance of sample} \times \text{Av. Gradient} \times \text{Dilution factor}}$

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Weight of sample ×10,000

(4)

3.7.5 .The Xylose concentration of the sugar extract was determined as the glucose above with the bluish colour solutions of xylose standard and sample read at a wavelength of 595nm.

$$\textbf{\% Xylose} = \frac{\text{Absorbance of sample} \times \text{Av. Gradient} \times \text{Dilution factor}}{\textit{Weight of sample} \times \textit{10,000}} \qquad (5)$$

3.8 Micronutrients and Heavy Metals Determination

The double acid extraction method was used to determine the micronutrients, One gramme (1.0 g) of the soil sample was digested with 15 mL of (0.05N HCl in 0.125N H_2SO_4) The extract was filtered through Whatman No 1 filter, the samples were subsequently analysed for Cl, Zn, Cr, Fe, Mn, Cd, Pb, Ni, and Cu, using flame atomic adsorption spectrophotometry. (Udo *et al*., 2009).

3.9 Statistical Analysis

The data obtained were analyzed by Genstat computer package. The difference between the means were separated using Duncan multiple range test at 5% level of probability while the relationship between some soil physical and chemical properties, Micronutrients, and monosacrides and the extractable forms of oxides shown by correlation coefficient.

4.0 DISCUSSION AND RESULTS

The physical and chemical properties of soils from cowpea and maize farms

The results of the physical and chemical analysis from both farms are presented in table 4.1. From cowpea farms, pH ranges from 5.07-5.30 with a mean of 5.22 showing the soils are strongly acidic in nature and this could be as a result of leaching of basic cations(Uzoho et al, 2007). The electronic conductivity ranges from 91.3-144.0nS/cm with an average of 111.33nS/cm, The organic carbon content ranges from 9.93-12.83 g/kg with an average of 9.93g/kg which shows that the Organic carbon is mostly in the top soil. For organic matter, it ranges from 15.27-23.00g/kg with an average of 19.17g/kg. The total amount of nitrogen ranges from 1.73- 2.04g/kg with an average of 1.88 which shows that Total nitrogen is sufficient in the soil when compared with the critical value. The exchangeable acidity ranges from 1.30-1.53cmol/kg with an average of 1.36 cmol/kg. The sodium content ranges from 0.14-0.55 with an average of 0.32, potassium ranges from 0.33-0.71cmol/kg with an average of 0.52cmol/kg showing it is moderate when compare with the critical values(chude et al,2011). Calcium(Ca) ranges from 0.67-1.22 with an average of 0.93 showing it is moderate compared with the critical level,Magnesium ranges from 0.68-15.27cmol/kg with an average of 4.4cmol/kg. For available phosphorus, it ranges from 1.55-8.62 with ana average of 6.85 which shows that the first two depth is sufficient in phosphorus amounts compared with the critical but low in the lower depths. (Daudu et al 2011). Sand ranges from 738.4- 898.4g/kg with an average of 800.87g/kg, clay ranges from 69.2-249.4g/kg with an average of 179.22g/kg while silt ranges from 12.40-32.40g/kg with an average of 19.92g/kg.

For maize farms, pH ranges from 5.20-5.30 with a mean of 5.33 which shows that the soil pH decreased significantly with increased soil depth which may be due to effects of cultivation, erosion and leaching of basic nutrient. The pH value decreases with depth probably because of nutrient biocycling (Ogunwale et al 2002), the electronic conductivity ranges from 47.00-97.00

with average of 62.83 nS/cm. Thr organic carbon content ranges from 2.63-8.90g/kg with an average of 4.73g/kg which shows that organic carbon is low in the soil as it decreased with increased soil depth. The organic matter content ranges from 5.20-17.80g/kg with an average of 9.46g/kg . The Total Nitrogen had values ranging from 0.23- 0.80 with an average of 0.43 which shows that decreasing with increasing soil depth at various points.The Nitrogen content at all depth fell below the critical level of 1.5 -2.0 indicating these depth are low in Nitrogen.

(Solubo and osiname,1981). The exchangeable acidity ranges from 1100-1200cmol/kg with average of 1.2cmol/kg. The sodium content ranges from 0.02-0.23cmol/kg with average of

0.08cmol/kg. For potassium (k) ranges from 0.03-0.44cmol/kg showing it is moderate with an average of 0.15cmol/kg(Chude *et al*,2011). The calcium(Ca) ranges from 0.12-0.88cmol/kg showing it's adequate with an average of 0.36 cmol/kg, the magnesium content is 0.05-0.59 cmol/kg with average of 0.22 cmol/kg. The Available phosphorus ranges from 4.55-7.51cmol/kg with an average of 5.88cmol/kg which shows that at the top layers of the soil there is sufficient amount of phosphorus present compared with lower depths which are low in phosphorus(Olayiwola et al,2011). The amount of sand ranges from 778.3- 878.4g/kg with an average of 825.87g/kg, for clay it's ranges from 79.2-199.39 g/kg with an average of 149.22 g/kg. Also, the silt content ranges from 12.40-42.40 g/kg with an average of 24.92g/kg.

Table 1: Physiochemical Properties in Soils from Cowpea and Maize Farm

	pH	**EC**	**Org.C**	**Org. M**	**T. N**	**EA**	**Na**	**K**	**Ca**	**Mg**	**Av. P**
Depth		**µS/cm**		**g/kg**				**cmol/kg**			
Cowpea Farm											
0-30	5.30a	144.0a	12.83a	25.00a	2.04a	1.20c	0.55a	0.71a	1.22a	0.94a	8.62a
30-60	5..30a	108.0b	9.60b	20.20b	1.87b	1.30bc	0.33b	0.54b	0.93b	0.72a	7..50b
60-90	5.20b	102.0c	9.60b	19.20b	1.87b	1.40b	0.28c	0.49b	0.91c	0.68a	6.74c
90-120	5.07c	91.3d	7.70b	15.27c	1.73c	1.53a	0.14d	0.33c	0.67d	15.27a	1.55d
Mean	**5.22**	**111.33**	**9.93**	**19.92**	**1.88**	**1.36**	**0.32**	**0.52**	**0.93**	**4.4**	**6.85**

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Maize Farm											
0-30	5.30a	97.00a	8.90a	17.80a	0.80a	1200b	0.23a	0.44a	0.88a	0.59a	7.51a
30-60	5.30a	60.00b	4.80b	9.60b	0.44b	1100c	0.06b	0.10b	0.33b	0.17b	5.92b
60-90	5.20b	47.33c	2.60c	5.20c	0.23c	1400a	0.02c	0.04c	0.12c	0.07c	5.56c
90-120	5.33a	47.00c	2.63c	5.23c	0.23c	1103c	0.02c	0.03d	0.12c	0.05d	4.55d
Mean	**5.28**	**62.83**	**4.73**	**9.46**	**0.43**	**1.2**	**0.08**	**0.15**	**0.36**	**0.22**	**5.88**

Mean value(s) with the same letters(s) in the column are not significantly different from one another at 5% level of probability.

Oxides of iron and manganese in soils of cowpea and maize farms

Table 4.2 below shows that the total form of free iron(Fed) ranges from 29.65-46.99mg/kg with an average of 36.72mg/kg for cowpea farms while for maize Farms its ranges from 37.59-109.85mg/kg with an average of 87.54mg/kg. The increase in Fed with increased soil depth was consistent with finding of Juo and Maduakor(1974). They reported that dithonite Fe (Total free iron oxides) content increase in depth amd added that oxalate extractable iron (Amorphous iron oxides) contribute less than 10% of total free oxides. The total form of manganese(Mnd) in soils ranges from 12.61-24.71mg/kg with an average of 18.66mg/kg for cowpea farms while for maize farms it ranges from 19.51-70.82mg/kg with an average of 52.84mg/kg. For amorphous inorganic forms of iron(Feox) in soils tends to be higher in maize farms compared to cowpea farms which shows that soils from maize farm is more acidic compared to soils from cowpea farm.The amorphous inorganic forms of manganese in soils tends to be higher soils of maize farms compare to cowpea farms. The amorphous organic forms of iron(Fep) and maganese(Mnp) tends to be higher in cowpea farms compared to maize farms.The mean total free form of iron(Fed) in soils of cowpea and maize farms are 36.72 mg/kg and 87.54mg/kg which shows that parent material significantly influenced the distribution of total free iron as reported by udo 1980 which shows that parent material relatively influence the distribution of free iron oxides.

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Table 4.2. Oxides of iron and manganese in soils of cowpea and maize farm

	Fe_d	**Fe_{ox}**	**Fe_p**	**Mn_d**	**Mn_{ox}**	**Mn_p**	**Fe_t**
Depth				**mg/kg**			
Cowpea Farm							
0-30	29.56d	25.70d	25.70d	24.71a	21.74a	15.71a	38.61d
30-60	34.63c	29.66c	29.66c	19.87b	16.81b	11.78b	43.70c
60-90	35.71b	30.33b	24.70b	17.46c	15.53c	10.71c	45.77b
90-120	46.99a	41.71a	33.04a	12.61d	11.94d	7.78d	59.81a
Mean	**36.72**	**31.85**	**25.52**	**18.66**	**16.51**	**11.49**	**46.98**
Maize Farm							
0-30	37.59d	32.62d	26.43d	70.82a	62.64a	43.86a	47.8d
30-60	94.21c	81.64c	65.86c	67.69b	59.55b	41.63b	116.1c
60-90	108.52b	94.16b	75.86b	53.35c	46.97c	32.83c	133.3b
90-120	109.85a	95.82a	77.18a	19.51d	16.95d	11.83d	134.7a
Mean	**87.54**	**76.06**	**61.33**	**52.84**	**46.53**	**32.54**	**107.96**

Mean value(s) with the same letters(s) in the column are not significantly different from one another at 5% level of probability.

Fe_d and Mn_d = Total free form of Iron (Fe) and Manganese(Mn)
Fe_{ox} and Mn_{ox} = Amorphouse inorgainc form of Iron (Fe) and Manganese(Mn)
Fe_p and Mn_p = Amorphouse orgainc form of Iron (Fe) and Manganese(Mn)
Fe_t= Total Iron

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Table 4.3 below shows the monosaccarides in soils of cowpea and maize farms .Hence, the glucose content in soils of cowpea farm with an average of 0.38 showing it is below 0.5($p<0.5$). The galactose content in soils of cowpea farm with an average of 0.64 showing it is above 0.5($p>0.5$)while the mannose content in soils of cowpea farm with an average of 0.64 shows it is above 0.5($p>0.5$), hence both mannose and galactose are positively significant. While for xylose and arabinose it is 0.71 and 0.77 respectively that's greater than 0.5 probability.From the mean in the table below shows that Arabinose> Xylose > Mannose > Galactose> Glucose showing that the soil is in low fertility which resulted to low crop yield of both maize and cowpea in the study area.(Micheni et al ,2004).

For maize farms; Galactose ,mannose, xylose and arabinose are greater than 5% probability although they are not significant with one another.

Table 4.4 displays that in soils of cowpea farms at PH, oxides of manganese increase as PH increase but not the same as oxides of iron. At sand, oxides of manganese increase as Sand content increases. As amphorous inorganic forms of manganese increases(Mnox) silt increase. As Clay increase the oxides of iron increases, also the exchangeable cations and calcium increase as oxides of manganese increase. As sodium, potassium, Total nitrogen, available phosphorus, organic carbon increases oxides of manganese increase. While magnesium increase with increase in oxide of iron.

Table 4.3: Monosaccharide in Soils from Cowpea and Maize Farm

	Glu	**Gal**	**Man**	**Xylose**	**Arab**
Depth			mg/kg		
Cowpea Farm					
0-30	0.55a	0.82a	0.87a	0.92a	1.24a
30-60	0.43b	0.69b	0.75b	0.82a	0.79b
60-90	0.32c	0.62c	0.57c	0.59b	0.59c
90-120	0.22d	0.42d	0.38d	0.50b	0.44d
Mean	**0.38**	**0.64**	**0.64**	**0.71**	**0.77**
Maize Farm					
0-30	0.64a	0.85a	0.93a	1.04a	1.72a
30-60	0.53b	0.64b	0.73b	0.77b	1.33b
60-90	0.45c	0.38c	0.56c	0.66c	1.07c
90-120	0.35d	0.32c	0.40d	0.64c	0.70d
Mean	**0.5**	**0.55**	**0.66**	**0.78**	**1.2**

Mean value(s) with the same letters(s) in the column are not significantly different from one another at 5% level of probability.

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Table 4.4: Correlation coefficient between some soil physical and chemical properties and Forms of Iron and Manganese Oxides from Cowpea Farm

	Fe_d	Fe_{ox}	Fe_p	Mn_d	Mn_{ox}	Mn_p	Fe_t
pH	-0.899*	-0.916*	-0.922*	0.890*	0.821*	0.851*	-0.930*
Sand	-0.848*	-0.809*	-0.827*	0.956*	0.976*	0.976*	-0.830*
Silt	-0.774*	0.729*	-0.758*	-0.917*	0.922*	0.923*	-0.765*
Clay	0.843*	0.802*	0.822*	-0.955*	-0.973*	0.974*	0.826*
EC	-0.838*	-0.797*	-0.814*	0.943*	0.971*	0.970*	-0.816*
Ca	-0.951*	-0.926*	-0.935*	0.984*	0.994*	0.992*	-0.935*
Mg	0.426	0.501*	0.479	-0.406	-0.321	-0.411	0.491
Na	-0.928*	-0.897*	-0.911*	0.987*	0.998*	0.976*	-0.912*
K	-0.954*	-0.920*	-0.935*	0.982*	0.991*	0.976*	-0.933*
T-N	-0.935*	-0.897*	-0.909*	0.995*	0.980*	0.960*	-0.905*
AV.P	-0.935*	-0.936*	-0.927*	0.867*	0.873*	0.875*	-0.921*
Org/Carbon	-0.807*	-0.778*	-0.790*	0.857*	0.880*	0.875*	-0.781*

*Significantly correlated at 5% level of probability.

Fe_d and Mn_d = Total free form of Iron (Fe) and Manganese(Mn)
Fe_{ox} and Mn_{ox} = Amorphouse inorgainc form of Iron (Fe) and Manganese(Mn)
Fe_p and Mn_p = Amorphouse orgainc form of Iron (Fe) and Manganese(Mn)
Fe_t= Total Iron

Table 4.5 shows that oxides of iron and manganese are negatively correlated with PH in maize soils. While sand, silt, Exchangeable cations, calcium, Magnesium, sodium, potassium, Total Nitrogen, organic carbon increase as oxides of manganese increase. Also, an increase in clay content shows an increase of iron oxides in soils of maize farms.

Table 4.6: For pH is negatively correlated and significant with Glucose(r=-0.039), mannose (r=-0.007), arabinose (r=-0.002) but Galactose(r=0.192), xylose (0.294) are positively correlated and significant. For available phosphorus is positively correlated and significant with Glucose (r=0.859*), galactose(r=0..907*), mannose (r=0.867*), arabinose(r=0.867*).

For organic carbon is positively correlated with Glucose (r=0.900*), galactose (r=0.958*), mannose(0.928*), xylose (r=0.969*), and arabinose (r=0.907*). Kuzyakov,Y. (2015)

Table4.7. Sand is positively correlated and significant with Glucose (r=0.906*), galactose (r=0.903*), mannose (r=0.904*), xylose (r=0.883*), mannose (r=0.904*) and arabinose (r=0.984*).

Silt is positively correlated and significant to Glucose (r=0.955*), galactose (r=0.859*), Mannose (r=0.904*), xylose(r=0.924*), arabinose (r=0.962*).

Clay is negatively correlated and significant with Glucose (r=-0.963*), galactose (r=-0.901*), Mannose (r=-0.907*), xylose(r=-0.891*) but Arabinose (r=-0.085*) is negatively correlated but less significant which shows that the soil is low in clay content and suggestions of biological factors especially microbial population and litter accumulation will have the most effective influence on soil monosaccaride concentration of clay content thereby increasing the fertility status. Kuzyakov,Y.(2015)

Table 4.5 : Correlation coefficient between some soil physical and chemical properties and Forms of Iron and Manganese Oxides from Maize Farm

	Fe_d	Fe_{ox}	Fe_p	Mn_d	Mn_{ox}	Mn_p	Fe_t
pH	-0.207	-0.195	-0.196	-0.254	-0.257	-0.255	-0.208
Sand	-0.908	-0.911	-0.911*	0.898*	0.900*	0.901*	0.907*
Silt	-0.828*	-0.825*	-0.825*	0.235	0.241*	0.243	0.828*
Clay	0.966*	0.968*	0.967*	-0.811*	-0.814*	-0.815*	-0.965*
EC	-0.998*	-0.998*	-0.998*	0.650*	0.654*	0.656*	-0.998*
Ca	-0.997*	-0.996*	-0.996*	0.663*	0.667*	0.620*	-0.997*
Mg	-0.999*	-0.999*	-0.999*	0.642*	0.646*	0.620*	-0.999*
Na	-0.999*	-0.998*	-0.998*	0.614*	0.618*	0.706*	-0.999*
K	-0.998*	-0.998*	-0.998*	0.614*	0.618*	0.625*	-0.998*
T-N	-0.985*	-0.986*	-0.986*	0.701*	0.704*	0.698*	-0.985*
AV.P	-0.999*	-0.999*	-0.999*	0.619*	0.623*	0.625*	-0.999*
Org/Carbon	-0.989*	-0.989*	-0.989*	0.693*	0.697*	0.698*	-0.989*

*Significantly correlated at 5% level of probability.

Fe_d and Mn_d = Total free form of Iron (Fe) and Manganese(Mn)
Fe_{ox} and Mn_{ox} = Amorphouse inorgainc form of Iron (Fe) and Manganese(Mn)
Fe_p and Mn_p = Amorphouse orgainc form of Iron (Fe) and Manganese
Fe_t= Total Iron

Table 4.6: Correlation coefficient between some soil physical and chemical properties and Monosaccharides in Maize Farm

	Glucose	Galactose	Mannose	Xylose	Arabinose
pH	-0.039	0.192	-0.007	0.244	-0.002
Sand	0.976*	0.973*	0.994*	0.916*	0..985*
Silt	0.540*	0.555*	0.543*	0.739*	0.549*
Clay	-0.951*	-0.953*	-0.968*	-0.950*	-0.961*
E.C	0.878*	0.932*	0.904*	0.968*	0.885*
Ca	0.884*	0.939*	0.910*	0.970*	0.893*
Mg	0.872*	0.917*	0.895*	0.964*	0.880*
Na	0.856*	0.907*	0.880*	0.961*	0.864*
K	0.855*	0.898*	0.877*	0.957*	0.862*
T.N	0.904*	0.962*	0.932*	0.968*	0.910*
AV.P	0.859*	0.907*	0.882*	0.961*	0.867*
Org/Carbon	0.900*	0.958*	0.928*	0.969*	0.907*

*Significantly correlated at 5% level of probability.

Table 4.7: Correlation coefficient between some soil physical and chemical properties and Monosaccharides in Cowpea Farm

	Glucose	Galactose	Mannose	Xylose	Arabinose
pH	0.874*	0.883*	0.938*	0.831*	0.770*
Sand	0.906*	0.903*	0.904*	0.883*	0.984*
Silt	0.955*	0.859*	0.904*	0.924*	0.962*
Clay	-0.963*	-0.901*	-0.907*	-0.891*	-0.085*
EC	0.941*	0.890*	0.878*	0.854*	0.977*
Mg	-0.348	-0.373	-0.432	-0.206	-0.290
Na	0.974*	0.954*	0.941*	0.896*	0.973*
K	0.968*	0.968*	0.945*	0.916*	0.945*
T.N	0.956*	0.910*	0.894*	0.862*	0.928*
Av.P	0.789*	0.874*	0.797*	0.664*	0.766*
Org/Carbon	0.845*	0.814*	0.782*	0.705*	0.850*
Ca	0.957*	0.959*	0.931*	0.869*	0.950*

*Significantly correlated at 5% level of probability.

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CHAPTER5

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

Soils of cowpea and maize farms were strongly acidic with a mean pH value of 5.22 and 5.28 respectively for soils of cowpea and maize showing there is dissolution of iron and manganese oxides in the soils leading to low nutrient fertility status in the soil. The exchangeable cations present in the soil are moderately distributed in the soil but soil erosion led to leaching of nutrient in the soil with state of the parent material in the soil. The status and distribution of these oxides and soil sugars is affected by the soil parent material, pH , exchangeable actions etc.

5.2 RECOMMENDATIONS

Proper soil testing should be done to increase the nutrient status of the soil and to sustain environmental quality . Other recommendations may include planting cover crops alongside the cowpea or maize plants (sequential cropping) will helps to improve the fertility status of the soil.Examples of cover crops includes stylo, melon , centrosema, calapognium etc

Abbeverations

Aval p ----- Available phosphorus

A

Ca----------calcium
Fe---------------iron

Fed
Fet
Fep
Fe
Mn
Mnd
Mnt
Mnp
Mrt

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