Soils types based their physical and chemical behaviour and their formation in relation to agro ecologies and their ages based on their horizons

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Abstract

Soil is often the most important asset of small holder farmers in Sub-Saharan Africa. This technical reference presents the different types of soil, their characteristics and the simple indicators for recognizing them.Spodosols are the second most abundant soil order in Wis- consin, accounting for 17% of the land area and 15% of the soil series in the state. Spodosols occur to the north of the tension zone. Of the 105 Spodosol soil series, 69% are Orthods and 31% are Aquods. Key properties of Spodosols are the sandy parent materials and textures, the accumulation of soil organic C in the upper spodic horizon, the low cation-exchange capacities and base saturation, the acid conditions, and especially the accumulation of oxalate- and pyrophosphate-extractable iron and aluminum in the spodic horizon. The dominant soil-forming processes in Spodosols are podzolization, base cation leaching, with gleization occurring in Aquods. Spodosols primarily are used for growing pulpwood and a firewood.All soil contains four major elements. Air (20-30%), soil solution, (20-30%), mineral fraction (45%) and organic matter (5) of their volume. Fertility and color of the soil is affected by many things like organic material they made of, climatic condition in which that soil was formed, age the of soil based their horizons and topography. Soil fertility declines following continuous cultivation along with the use of fertilizers causing concern for sustainable food productivity. This study assessed chemical properties of degraded Alfisol, and also evaluated potential of organic residues and fertilizers in improving them.Classification is basically important to any science. Classification provides the avenue through which research can be addressed in a rigorously systematic manner and also have more practical applications for all soil survey program and mapping the soils of any region

Background and justifications

Soil is a natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface. Soil is characterized by both horizons, and layers. These are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter or the ability to support rooted plants in a natural environment. Soil is not uniformly distributed(Balasubramanian, 2017).Soil is a natural body and develops from the parent material through time under the effect of climate, vegetation, and topography. These factors of soil formation are interdependent(Article, 2012). Soil is normally considered as the fine earth which covers land surfaces as a result of the in situ weathering of rock materials or the accumulation of mineral matter transported by water, wind, or ice (Redemeier, 2006). Weathering process is intense resulting in low cation retention (Ca, Mg and K) which has significant role to play in crop growth and development(Zannah *et al.*,2018).

Twenty-six soil profiles were characterized and classified as Ultisols in the middle-upper watershed of Pirrís River(Santos & Rica, 2011). Latosols are strongly weathered soils that often occur on more developed surfaces of the landscape. They are typically found in equatorial and tropical regions of Earth(Henrique & Bispo, 2013). Soil is important as a medium for plant growth and for the support of much animal and human activity. The soil acts as a reservoir for nutrients and water providing the plants' needs for these requirements throughout their growth(Redemeier, 2006). The definition of a Vertisol varies with the classification systems. 'Vertisols are mineral soils that have a mesic, isomeric or warmer soil temperature regime; that do not have a lithic or paralithic contact or petrocalcic horizon or duripan within 50 cm of the soil surface; that, after the upper soil to a depth of 18 cm has been mixed, have 30% or more clay in all horizons down to a depth of 50 cm or more; that at some period in most years have cracks that are open to the surface or to the base of a low layer or surface crust and are at least 1 cm wide at a depth of 50 cm unless the soil is irrigated; and that have one or more of characteristics(Sahrawat, 2014).

In Malaysia, Ultisols and Oxisols occupy about 72% of the country's land surface that are scattered in the upland area with flat to undulating terrains, with kaolinite, hematite, goethite and gibbsite as major minerals

present in these highly weathered soils(Zannah *et al.,*2018) .The dominant clay mineral in most, of the Vertisols appears to be montmorillonite. This, plus the high clay content, appears to be the main reason for the high water-holding capacity of Vertisols(Sahrawat, 2014). The mineralogy of the silt fraction of a 1.5 m-deep, well developed, intensely weathered, greyish soil profile from a toposequence on a tableland covered by agricultural crops in the upper valley of the Jequitinhonha river basin, Minas Gerais, Brazil, has been studied by X-ray powder diffraction,57Fe Mo¨ssbauer spectroscopy at 298 K and 80 K, and vibrating sample magnetometry(Henrique & Bispo, 2013).

consequent risks to soil fertility deterioration that could be limited by the efficient utilization of fertilizer inputs and by the inclusion of legumes within cropping systems, to restore the natural fertility of these soils.(Ahmad *et al.,*2014). The soil usually consists of a vertical sequence of layers or horizons differentiated by physical, chemical, or biological characteristics. This sequence of layers is normally described as the soil profile. Surface horizons are usually characterized by accumulations of organic materials as a result ofthe addition of plant and animal residues(Redemeier, 2006).There are two intensities of deficiency: (i) latent deficiency without any visual foliar symptoms but with lower nutrient levels and some lower growth than under optimal conditions (the observation of foliar deficiency symptoms is a simple method to detect mineral disturbances) and (ii) visual deficiency with reduced or stunted growth and/or foliar discoloration and in severe cases shoot dieback and mortality. Latent as well as visual mineral deficiency could be best seen and verified by a positive response after some months to controlled fertilization experiments(Alvarado, 2018)

Soil Taxonomy:

Soil Taxonomy is a basic system of soil classification for making and interpreting soil surveys. This system helps to classify soils into various classes. The taxonomic classes defined in Soil Taxonomy group soils that have similar properties and that formed as a result of similar pedogenic processes. Rather than define classes based directly on theories of soil genesis, however, the classes are based largely on the presence of diagnostic horizons and characteristics. These diagnostic horizons and characteristics reflect the important pedogenic processes that are either occurring now, or have occurred in the past, to produce the kinds of soil profiles we see today(Balasubramanian, 2017).

Classification of soil:

Classification of soil is the separation of soil into classes or groups each having similar characteristics and potentially similar behaviour. A classification for engineering purposes should be based mainly on mechanical properties: permeability, stiffness, strength. The class to which a soil belongs can be used in its description. A number of systems of classification have been evolved for categorizing various types of soil. The World Reference Base (WRB) is the international standard for soil classification system endorsed by the International Union of Soil Sciences(Balasubramanian, 2017). It is generally agreed that it is possible to group soils together into classes, within which many properties of the soil may be expected to be similar(Article, 2012).

The more common classification systems are enlisted below:

a) Geological Classification

b) Classification by Structure

c) Classification based on Grain-size

d) Unified Soil Classification System

e) Preliminary Classification by soil types.

Standard Class. Systems:

Australian Soil Classification./ Canadian system of soil classification./ French soil classification./ FAO soil classification (1974-1998)/International Committee on Anthropogenic Soils (ICOMANTH) / Unified Soil Classification System. USDA soil taxonomy/ Indian Standard Classification (IS: 1498- 1970)

Geological Classification:

Soil types may be classified on the basis of their geological origin. The origin of a soil may refer either to its constituents or to the agencies responsible for its present status. Based on constituents, soil may be classified as:

Inorganic soil/ Organic soil. Based on the agencies responsible for their present state, soils may be classified under following types: Residual Soils. Transported Soils: Alluvial or sedimentary soils/Aeolian soils /Glacial soils/Deposited Soils=Lacustrine soils/Marine soils. A soil family category is a group of soils within a subgroup that has similar physical and chemical properties that affect response to management and manipulation. The principal characteristics used to differentiate soil families are texture, mineralogy and temperature. Family textural classes, in general, distinguish between clayey, loamy and sandy soils(Balasubramanian, 2017) .

Soil Orders:

To identify, understand, and manage soils, soil scientists have developed a soil classification or taxonomy system. Like the classification systems for plants and animals, the soil classification system contains several levels of detail, from the most general to the most specific. The most general level of classification in the United States system is the soil order,. There are 12 orders of soils categorized by the U.S. Department of Agriculture. Each order is based on one or two dominant physical, chemical, or biological properties that differentiate it clearly from the other orders. Each order is based on one or two dominant physical, chemical, or biological properties that differentiate it clearly from the other orders. The soil orders all end in "sol" which is derived from the Latin word "solum" meaning soil or ground. Most of the orders also have roots that tell you something about that particular soil. For example, "molisol" is from the Latin "mollis" meaning soft(Balasubramanian, 2017).

Histosols:

Histosols (from the Greek histos – tissue) are dominantly composed of organic material in their upper portion. The Histosols order mainly contains soils commonly called bogs, moors, peat lands, muskegs, fens, or peats and mucks. These soils form when organic matter, such as leaves, mosses, or grasses, decomposes more slowly than it accumulates due to a decrease in microbial decay rates. This most often occurs in extremely wet areas or underwater; thus, most of these soils are saturated year-round. Histosols can be highly productive farmland when drained; however, drained Histosols can decompose rapidly and subside dramatically. They are also not stable for foundations or roadways, and may be highly acidic. Histosols make up about 1% of the world's glacier-free land surface(Balasubramanian, 2017). Histosols occur extensively in boreal, arctic and subarctic regions. Elsewhere, they are confined to poorly drained basins, depressions, swamps and marshlands with shallow groundwater, and highland areas with a high precipitation / evapotranspiration ratio(Fairbridge, 2006).

Spodosols:

Spodosols (from the Greek spodos – wood ash) are among the most attractive soils. They often have a dark surface underlain by an ashy gray layer, which is subsequently underlain by a reddish, rusty, coffee-colored, or black subsoil horizon. These soils form as rainfall interacts with acidic vegetative litter, such as the needles of conifers, to form organic acids. These acids dissolve iron, aluminum, and organic matter in the topsoil and ashy gray (eluvial) horizons. Spodosols most often develop in coarsely textured soils (sands and loamy sands) under coniferous vegetation in humid regions of the world. They tend to be acidic, and have low fertility and low clay content. Spodosols occupy about 4% of the world's glacier- free land surface(Balasubramanian,2017).Spodosols are acid soils characterized by a subsurface accumulation of humus that is complexed with Al and Fe.These soils usually have a light-colored albic or E horizon overlying a reddish brown spodic horizon. Spodosols There is a common notion that Spodosols have a sandy texture(Hartemink, 2017).

Andisols:

Andisols (from the Japanese ando – black soil) typically form from the weathering of volcanic materials such as ash, resulting in minerals in the soil with poor crystal structure. These minerals have an unusually high capacity to hold both nutrients and water, making these soils very productive and fertile. Andisols include weakly weathered soils with much volcanic glass, as well as more strongly weathered soils. They typically occur in areas with moderate to high rainfall and cool temperatures. They also tend to be highly erodible when on slopes. These soils make up about 1% of the glacier-free land surface(Balasubramanian, 2017).

Oxisols:

Oxisols (from the French oxide – oxide) are soils of tropical and subtropical regions, which are dominated by iron oxides, quartz, and highly weathered clay minerals such as kaolinite. These soils are typically found on gently sloping land surfaces of great age that have been stable for a long time. For the most part, they are nearly featureless soils without clearly marked layers, or horizons. Because they are highly weathered, they have low natural fertility, but can be made productive through wise use of fertilizers and lime. Oxisols are found over about 8% of the glacier-free land surface(Balasubramanian, 2017).

Vertisols:

Vertisols (from the Latin vertoturn) are clay-rich soils that contain a type of "expansive" clay that shrinks and swells dramatically. These soils therefore shrink as they dry and swell when they become wet. When dry, Vertisols form large cracks that may be more than one meter (three feet) deep and several centimeters, or inches, wide. The movement of these soils can crack building foundations and buckle roads. Vertisols are highly fertile due to their high clay content; however, water tends to pool on their surfaces when they become wet. Vertisols are located in areas where the underlying parent materials allow for the formation of expansive clay minerals. They occupy about 2% of the glacier- free land surface(Balasubramanian, 2017). Alfisols and Vertisols are the major soil orders in the semi-arid tropics (SAT).Vertisols when the top 30 cm soil profile was unsaturated. The high initial infiltration rate good surface retention storage due to rough soil surface and the presence of abundant large and micro-cracks under dry soil conditions, are mainly responsible for the low runoff under dry soils. This suggests that on Vertisols, the benefits of improved soil and water management practices due to additional infiltration of water are expected to be low(Pathak *et al.*,2013)

Aridisols:

Aridisols (from the Latin aridus – dry) are soils that occur in climates that are too dry for "mesophytic" plants (plants adapted to neither too wet nor too dry environments)to survive. The climate in which Aridisols occur also restricts soil weathering processes. Aridisols often contain accumulations of salt, gypsum, or carbonates, and are found in hot and cold deserts worldwide. They occupy about 12% of the Earth's glacier-free land area, including some of the dry valleys of Antarctica(Balasubramanian, 2017).

Ultisols:

Ultisols (from the Latin ultimus – last) are soils that have formed in humid areas and are intensely weathered. They typically contain a subsoil horizon that has an appreciable amount of translocated clay, and are relatively acidic. Most nutrients are held in the upper centimeters of Ultisol soils, and these soils are generally of low fertility although they can become productive with additions of fertilizer and lime. Ultisols make up about 8% of the glacier-free land surface(Balasubramanian, 2017).Twenty-six soil profiles were characterized and classified as Ultisols in the middle-upper watershed of Pirrís River(Santos & Rica, 2011)

Mollisols:

Mollisols (from the Latin mollis – soft) are prairie or grassland soils that have a dark colored surface horizon, are highly fertile, and are rich in chemical "bases" such as calcium and magnesium. The dark surface horizon comes from the yearly addition of organic matter to the soil from the roots of prairie plants. Mollisols are often found in climates with pronounced dry seasons. They make up approximately 7% of the glacier-free land surface(Balasubramanian, 2017). Mollisols are extensive in sub-humid to semiarid areas at mid-latitudes, but they also occur at high latitudes and high altitudes and in tropics. Many of these soils developed under grass at some time, although many apparently were forested at an earlier time(Article, 2012).In the Mollisols of Santa Fe, one of the main productive regions in the humid Pampas in Argentina, neither were the above mentioned indicators studied nor a WRC of reference determined, both of which could have been used to distinguish which management techniques promote the improvement or degradation of soil(Ghiberto *et al*.,2015).

Alfisols:

Alfisols (from the soil science term Pedalfer – aluminum and iron) are similar to Ultisols but are less intensively weathered and less acidic. They tend to be more inherently fertile than Ultisols and are located in similar

climatic regions, typically under forest vegetation. They are also more common than Ultisols, occupying about 10% of the glacier-free land surface(Balasubramanian, 2017).Sandy Alfisols with higher saturated hydrological conductivity generated higher runoff and soil loss compared to the clayey Vertisols with extremely low saturated hydraulic conductivity. On the other hand, the peak runoff rate was higher on the Vertisols compared to the Alfisols. The highly undesirable early season runoff from the Alfisols was substantially higher compared to that from the Vertisols. The surface seal hardens into crusts during intermittent dry periods, which further influence the runoff behaviour of the Alfisols. Also because of low structural stability, the smoothing of the soil surface roughness following rainfall events was found to much quicker in the Alfisols (Pathak *et al.,*2013).

Inceptisols:

Inceptisols (from the Latin inceptum beginning) exhibit a moderate degree of soil development, lacking significant clay accumulation in the subsoil. They occur over a wide range of parent materials and climatic conditions, and thus have a wide range of characteristics. They are extensive, occupying approximately 17% of the earth's glacier-free surface(Balasubramanian, 2017).

Entisols:

Entisols (from recent – new) are the last order in soil taxonomy and exhibit little to no soil development other than the presence of an identifiable topsoil horizon. These soils occur in areas of recently deposited sediments, often in places where deposition is faster than the rate of soil development. Some typical landforms where Entisols are located include: active flood plains, dunes, landslide areas, and behind retreating glaciers. They are common in all environments. Entisols make up the second largest group of soils after Inceptisols, occupying about 16% of the Earth's surface(Balasubramanian, 2017).

SOIL HYDROLOGY: WATER FOR SUSTAINABILITY

The soil must store and release water for plants satisfying its demand in order to have maximum plant development and growth. Infiltration determines how much water enters the soil and is controlled by pore size distribution, particularly by pores open up to the soil surface one important point, not always considered, is the profile water .Water also decreases soil temperature, by increasing soil thermal conductivity and heat capacity. These soil physical factors may interact and regulate root growth and function working in a limiting mode fashion and may have final effects on plant growth and productivity(Reichert *et al.,*2015).

Management of Vertisols i n Relation to their Physical l and Chemical Properties

From the foregoing listing of some of the properties of Vertisols, it is obvious that this order of soils is potentially one of the most productive in semi-arid regions because it possesses one attribute high moisture-storage capacity that is very important in an environment that has unreliable and heavy rains. This has been overcome by identifying the above problems and by developing management innovations to minimize them: sowing into a dry seedbed ahead of the rains, growing crops on a raised bed to provide drainage and using furrows and waterways to conduct excess water from a watershed(Sahrawat, 2014). As all physical soil factors are affected by soil structure, there is a dynamic variation of LLWR for each soil as soil bulk density changes over time, implying variation of root growth and function with temporal variation and variations related to soil management. Physical conditions of the soil surface are strongly affected by soil, residue, and plant management. Water, oxygen, temperature, and mechanical impedance all affect directly plant growth, on the plant different developing stages, from seedling emergence to root penetration(Reichert *et al.*,2015).

The large increase in bulk density in more minerogenous sites also has important consequences, because plant roots and microbes exploit a volume and not a mass of soil(Scott, 2016). Spodosols are used primarily for forestry, particularly for pulpwood and firewood production. The more productive series for forestry include Haplorthods (Croswell *et al.,*2017). Agricultural technicians and even soil scientists have sometimes difficulties in evaluating plant responses to limiting conditions to plant growth, particularly those below ground factors(Reichert *et al.*, 2015). Understanding nutrient removal by a crop may provide information for soil fertility management by comparing the plant total accumulation to the application from all sources(Ogunjinmi *et al.*,2017). The traditional measured soil physical properties mentioned before may not be very useful in evaluating crop production potential, if considered separately. Alternate concepts and quantification means, which integrate soil factors that affect directly and indirectly plant growth, must be developed and adopted by technicians and farmers(Reichert *et al.*,2015).This technique provides detailed information about the atomic

structure of crystalline substances in soils. X-ray diffractometry is qualitative/quantitative method of mineralogical assessment in the form of relative diffraction intensities; the detection limit varies with the kind of mineral and degree of crystallization(Zannah *et al.,* 2018). Similar to soil temperature in the fallow field, all main effects and their interaction were significant for soil water content. Even though switch plow tended to have less water 13 d after tillage(Morris *et al.,* 1997).

The Zinc is essential for the growth in animals, human beings, and plants it is vital to the crop nutrition as required in various enzymatic reactions, metabolic processes, and oxidation-reduction reactions(Hafeez *et al.,*2013).Sodium accumulation commonly decreases soil aggregation and wet-aggregate stability by increasing particle repulsion during wetting that, in turn, facilitates soil swelling and dispersion(Pilatti *et al.*,2006).A major role of nutrient management is to find the best compromise between ecological and silvicultural rotation in view of perpetuit (Alvarado, 2018).The definition of a Vertisol varies with the classification systems used, but for convenience we have used the one adopted in India (U.S. Soil Taxonomy): 'Vertisols are mineral soils that have a mesic, isomeric or warmer soil temperature regime(Sahrawat, 2014). When soil water content is low and roots are not able to extract enough water to satisfy plant demand, there still is soil moisture but roots can no longer overcome water retention forces and plants starts to wilt(Reichert *et al.*,2015).

Vertisols are widespread in India and are generally used to grow annual crops. In many areas Vertisols are fallowed during the rainy season, which subjects them to soil erosion(Ilca & Ababa, 1988). Continuous cultivation of arable crops even with the use of external inputs of mineral fertilizers results in depletion of soil nutrient elements in the long run. This makes amelioration of the soil inevitable to improve soil fertility and increase crop productivity. Application of organic residues or in combination with mineral fertilizer may have potential to restore lost nutrients(Ogunjinmi *et al.,* 2017). Vertisols are differentiated with respect to the soil moisture and temperature conditions; the duration of the open state of soil cracks is also taken into account(Kovda & Wilding, 2016). Oxygen supply to roots has been considered zero when the soil space occupied by air is around 10%. However, plants such as corn are known to require values near 15% and others gramineaes values lower than 10%(Reichert *et al.,* 2015).

The name Vertisol derives from the fact that soil movement with changes in moisture content does not occur only in pressures and movements in the horizontal and vertical planes, but also occurs in directions between these planes(Sahrawat, 2014). Zinc is essential for the growth in animals, human beings, and plants it is vital to the crop nutrition as required in various enzymatic reactions, metabolic processes, and oxidation- reduction reactions. In addition, Zn is also essential for many enzymes which are needed for nitrogen metabolism, energy transfer and protein synthesis. Zinc deficiency not only retards(Hafeez *et al.,* 2013). The inherent limitations of Vertisols are largely a function of the moisture status of the soils and the narrow range of moisture conditions within which mechanical operations can be conducted(Moussadek *et al.,*2017).The legend for the international soils map required much consultation and compromise, but with patience and diplomacy was eventually achieved by bringing in the less politicized FAO, the U.N. Food and Agriculture Organization, with its headquarters in Rome (FAO-UNESCO, 1974) ,(Fairbridge,2006).Soil Taxonomy was the first classification system to introduce the clear concept of Vertisols and suggest their current name from 1960, after the appearance of the Seventh Approximation , numerous local names of these soils have been replaced by the name “Vertisols” in different parts of the world.(Kovda & Wilding, 2016). Vertisols have a, relatively high water storage capacity in the root zone because of their usually high content of clay dominantly a 2:1 type and have a relatively deep soil profile(Sahrawat, 2014).Due to the low pH some H and Al find their way onto the surface of the soil mineral and organic particles and that drops the base saturation to less than 100. It is important to note that, base saturation is not a soil testing index and does not necessarily imply nutrient fertility of a soil (Zannah *et al.,*2018).

Following the presentation of Vertisols in soil taxonomy and the French classification, it would be judicious to focus on Tirs to compare their analytical characteristics with those of the typical Vertisols. The Tirs are usually dark-colored clay soils. The upper part of their profiles, uniformly colored, can reach over a meter. The dark color varies from light gray, frank black to dark brown(Moussadek *et al.*,2017). In Vertisols with their characteristic gilgai microtopography and redistribution of moisture between microhighs and microlows, this heterogeneity has a regular character and is referred to as soil micro- variability. In fact, the microvariability of Vertisols is often seen even in the case when the distinct gilgai microtopography is absent(Kovda & Wilding, 2016).In spite of the great homogeneity found in the morphological characteristics of Oxisols, there is great chemical diversity in subsurface layers of these soils. Studies indicate that crop yield presents significant correlation with the chemical attributes of the subsurface, which are more stable than attributes found in the plough layer, subject to greater alterations as a consequence of agricultural exploration(Perecin *et al.*, 2003).

Vertisols are particularly subject to soil loss by water erosion under the traditional systems of bare -fallowing during the rainy season. Losses are promoted by the combination of intense storms and lack of plant cover(Ilca & Ababa, 1988).The high moisture-storage capacity ensures much safer and more productive cropping; it can

assist crops to survive and perhaps even to grow during prolonged dry spells, whereas failures would have resulted on soil not so well endowed (Sahrawat, 2014). Organic soils in the Everglades Agricultural Area (EAA) of southern Florida, USA, are subsiding due primarily to oxidation by aerobic microorganisms(Morris *et al*.,1997). This contrasts with the much lower capacity to hold water of nearby related shallower soils (Vertic Inceptisols and Inceptisols) and nearby deep Alfisols, which can rarely store more than 150 mm (Sahrawat,2014).

The main difficulties are associated with the micro-variability of Vertisols and their large-scale mapping. The problem of correct representation of the complicated spatial organization of Vertisols is a topic for the following discussion (Kovda & Wilding, 2016).The current level of crop production in these harsh environments is inadequate to meet the needs of rapidly increasing populations. Of the major soils of the SAT, Vertisols are some of the most productive for rainfed agriculture(Ilca & Ababa,1988).Spodosols (from Greek spodos, "wood ash") are acid Soils characterized by a subsurface accumulation of humus that is complexed with Al and Fe horizon (Hartemink, 2017). Most of the guidelines of water quality were developed for arid areas, where crop growth is based on the application of saline-sodic waters(Pilatti *et al.*, 2006). The progress of soil studies have enabled to realize that Vertisols can be assimilated into a large family of land described in various parts of the world However, the description of profiles and their laboratory studies differ from one author to another(Moussadek *et al.,*2017).Response to population pressure during recent years, main attention has been focused on yield maximization purpose, farmers in Pakistan have been using only nitrogenous(Ahmad *et al.*,2014). Eight soil profiles were described and classified on volcanic ash deposits at the upper Pirrís River watershed. The soils were classified as Andisols and Inceptisols of the suborders Ustands, Udands and Ustepts; at the great group level the soils were classified as Haplustands, Placudands and Dystrustepts, belonging to the subgroups Dystric Haplustands, Humic Haplustands, Aquic Haplustands, Typic Placudands and Andic Dystrustepts(Rica *et al.*, 2011). As a result, they have low ash and basic cation content and low pH in their soils, and are commonly termed bogs(Scott, 2016).

In the central region of the country, known as the Deccan Plateau, the soils are derived from weathered basalts mixed to some extent with detritus from other rocks(Ilca & Ababa, 1988). Vertisols with low-contrasting geochemical structure have been studied by the senior author in the Mississippi Delta (the Lebeau soil series). These are relatively young soils developing under conditions of strong hydromorphism(Kovda & Wilding, 2016).Maintenance and enhancement of the quality of degraded soil are, in essence, dependent upon the improvement of physical, chemical and biological properties of the soil (Ahmad *et al.,* 2014).An understanding of hydrological behavior of soils is a prerequisite for developing appropriate soil and water management practices. Such information for the Alfisols and Vertisols, the two major soil in the semi and tropics (SAT), is scanty especially from a long-term perspective. (Pathak *et al.,*2013). These soils (Fairchild and Merrillan series) are derived from sandy and loamy alluvium overlying sandstone bedrock. There are several of southwest trending "bands" of Spodosols that occur on outwash in the Chippewa, Black, and Wisconsin River drainages that link with the Mississippi River(Hartemink, 2017).

Knowing the chemical, physical and morphological attributes of the subsurface is critical for studying sugarcane cropping environments, because it is part of the soil volume that will be explored by the sugarcane's root system, especially in ratoon growing cycles(Perecin *et al.,* 2003). Tirs structure is an essential element in their soil classification. The soil is grainy on the surface horizon, prismatic and developed in the underlying horizon, and tetrahedral with sliding surfaces lustrous depth(Moussadek *et al.*,2017).As water retention increases, the peatland expands above the regional water table, and often above the surrounding landscape. There are climatic limitations on this process: fens can occur in any climate because of their dependence on outside sources of water, whereas bogs can only occur in regions where precipitation exceeds evapotranspiration(Scott, 2016).

Vertisols cover only a small area of the world's land surface, and only a sub-dominant portion even of any geographical zone, they are an important soil order in semi-arid dry land agriculture because in this environment they are amongst the most productive soils(Sahrawat,2014).Many of the more common soil series are classified as Haplorthods, including the Sarona, Padus, Pence,, Keweenaw, Vilas, Sayner, Newood, Rubicon, Croswell, and Karlin(Hartemink, 2017). The use of yield models and the identification of the degree of importance of the several soil attributes at each crop cycle can provide assistance for nutrient-sup- ply and variety-management practices in the various crop- ping environments, and provide orientation to estimate bare land value(Perecin *et al.,* 2003) .The influence of rainfall, crop cover and typical characteristics of Alfisols and Vertisols on their hydrological behaviours is explained. The use of long term hydrological data for extrapolating the results to regions with different rainfall is demonstrated(Pathak *et al.*,2013).Fens with more minerogenous characteristics are generally described as "rich," whereas those more similar to bogs in soil chemistry and plant community composition are called "poor(Scott, 2016). Alfisols and Vertisols are the major soil orders in the semi-arid tropics (SAT). Alfisols, the most abundant soils in the semi-arid tropics, cover nearly 33% of the SAT region.

They occur extensively in southern Asia, western and central Africa, and many parts of the South America, particularly northeast Brazil(Pathak *et al.,* 2013).

This identification can also contribute toward pedotransfer function studies, which are becoming increasingly important in soil science in order to identify edaphic traits that would dependably indicate the yield potential of a given environment (Perecin *et al.*, 2003). Spodosols are the most common on glacial drift, including outwash (45% of soil series) and till (29%). The vegetation is often mixed broad-leaved and coniferous forest. Most of the Spodosols in Wisconsin occur on drift of Early Holocene or Late Wisconsin an age. Wisconsin Spodosols have either Aquic conditions(Aquods suborder), or they more or less follow the central concept of the order (Orthods)(Hartemink, 2017). Soil fertility declines following continuous cultivation along with the use of fertilizers causing concern for sustainable food productivity, Thus, on these SAT soils, new strategies and more appropriate soil and water management systems which combine the effective conservation and utilization of soil and water resources with crop production systems that increase productivity and assure dependable harvest is required (Ogunjinmi *et al.*, 2017).

Such information from the SAT Alfisols and Vertisols are scanty particularly from the long term hydrological studies. At the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) research station in Patancheru, India, long-term hydrological studies have been conducted on small agricultural watersheds on both Vertisols and Alfisols(Pathak *et al.,* 2013). There is a common notion that Spodosols have a sandy texture. However, a larger proportion of Spodosol soil series in Wisconsin are loamy (53%) rather than sandy (45%)(Hartemink,2017). The clay content of Tirs varies between 30 and 55% and can reach about 80% in Gharb because the rocks are from marl and highly altered schists. The Tirs have an almost homogeneous texture from the bottom to the top of profile with a slight enrichment in clay on the surface(Moussadek *et al.,* 2017). The Haplorthods account for an area of 18,285 km2 and are exceeded in area only by the Hapludalfs and Glossudalfs great groups(Hartemink, 2017).

The progress of soil studies have enabled to realize that Vertisols can be assimilated into a large family of land described in various parts of the world(Moussadek *et al.,* 2017).In recent years, agricultural productivity in the sub- Saharan Africa (SSA) has declined drastically due to shortened fallow periods, increasing human population, land use intensification consequently leading to decreasing size of land available to a farmer, reducing soil fertility and crop productivity in the region, to achieve high quality crop production and soil productivity without degrading the soil properties under long term use, appropriate management practices should be adopted. The combined application of inorganic fertilizer and organic residues has been proposed as a more sustainable means of alleviating the soil fertility and crop productivity constraints of the sub-Saharan Africa. Nigeria. Nevertheless, there has been reduction in yield of crops (particularly maize) over the years which may be attributed to loss of soil production(Ogunjinmi *et al.,* 2017).

Discussions:-

Differently from other chemical attributes, the pH in water was well correlated to productivities during the three harvests. This is probably related to the smaller range of pH variation in the profile, which would allow a significant correlation with crop productivities since the first harvest, when the root system is theoretically still exploring less profound layers(Perecin *et al.,* 2003). The soil profiles and the characteristics of this grassland emphasise the role of topography in the modification of soil genetic processes, in soil hydrological features, and the distribution of plant species. It is clear that topographic position governs soil variables such as pH and TOC as well as their differential distribution within the soil profile(Debelis *et al.,*2005). Microbial activity was influenced by environmental mineral soils. Our data show that even in high organic factors such as dew, rainfall, and temperature inter- matter soils, leaving organic residue on the soil surface acting with tillage treatments during the course of the is a desirable management practice to conserve organic experiment(Morris *et al.,* 1997).

Also, the increasing soil depth resulted in an adverse soil environment, like reduced aeration and increased soil compaction that might have reduced soil microbes to flourish deep into the soil. Data also revealed that soil microbial biomass C decreased with increasing period of incubation, Cropping patterns containing legumes recorded a significantly higher content of microbial biomass C after 10 days of incubation (Ahmad *et al.,* 2014).Understanding nutrient removal by a crop may provide information for soil fertility management by comparing the plant total accumulation to the application from all sources. Application of Several factors are likely responsible for the relatively higher runoff from the Alfisols compared to Vertisols(Pathak *et al.*, 2013). The Alfisols have non-stable soil structure, which enhances the soil's tendency to develop surface seals that reduce infiltration and profile recharge even under moderate or mild rains. The surface seal hardens into crusts during intermittent dry periods, which further influence the runoff behaviour of the Alfisols. This TC increased nitrogen uptake and dry shoot biomass(Ogunjinmi *et al.*, 2017). Data further showed fertilizer application increased microbial biomass N, and mineralizable N in both the surface and sub-surface soils. Again, the

maximum biomass N was recorded in mixed application of farmyard manure and mineral fertilizers in both soil depths(Ahmad *et al.,* 2014).

Formation of a great mass of surface roots can compete for photo assimilates with the aerial part, while deeper roots, in spite of also competing for photo assimilates, play an essential role in the absorption of water and nutrients necessary to maintain vital processes during water stress periods(Perecin *et al*., 2003). The presence of large cracks during the early part of the rainy season and formation of micro-cracks during rainless period in the Vertisols leads to high infiltration and surface depression storage for the subsequent rains. These typical soil properties contribute significantly to reducing runoff on the Vertisols(Pathak *et al.,* 2013).These influences of subsurface attributes on productivity variations can be considered to be high, because there are many other factors which could interfere with such variations(Perecin *et al.*,2003). The silt fraction of this soil thus consists essentially of (iron-bearing) halloysite and kaolinite, anatase, quartz, rutile and maghemite. The persistence of a significant Fe2+ fraction in spite of intense soil weathering and low Fe2O3/TiO2 ratios are indicative of low oxidative conditions during pedogenesis(Henrique & Bispo, 2013).

Concluding remarks and future directions

Continuous cultivation of arable crops even with the use of external inputs of mineral fertilizers results in depletion of soil nutrient elements in the long run(Ogunjinmi *et al.,* 2017). Application of organic residues or in combination with mineral fertilizer may have potential to restore lost nutrients. Even though Histosols in the EAA are losing large amounts of C mostly because of aerobic microbial oxidation of organic matter, minimum tillage practices provides a means to reduce those losses and should be a major component in the overall management strategy for soil conservation(Morris *et al.*, 1997).It is suggested that although the recommended dose of mineral NPK fertilizers could have restored soil organic fertility, yet it could not have reached the full potential limits where the soil organic fertility level was raised by the integrated use of N sources (50% from organic and 50% from inorganic sources). Research outcome further suggested that legumes must be entered into con- ventional cereal-cereal rotation to improve the N input and microbial parameters of erosion induced degraded soils(Ahmad *et al.,* 2014). Some of the principles involved in minimum tillage availability for all microbes as indicated by an increase to conserve soil C in mineral soils also apply to organic in soil P and K across 42 d and the presence of a readily soils(Morris *et al.*,1997). Economic returns for the farm differ between locations, basically in line with the prevailing meteorological conditions(Ilca & Ababa, 1988). All the soil samples are acidic, with high acidity to moderate acidity (pH 3.5-5.5). The low pH of < 5 allows free aluminium in the soil solution to hydrolyse and consequently produces more acidity. Exchangeable aluminium were above threshold value indicating potential toxicity accompanied by P deficiency which decreases as the aluminium level increases(Zannah *et al.,* 2018). Soil formation in all studied profiles is characterized by downward movement of clay and organic matter, forming cambic and/or mollic horizons, the addition and accumulation of organic materials and leaching bases are the other soil forming factors(Article, 2012).Conservation agriculture can be a promising alternative to the sustainable management of Morocco's Tirs but the adoption of such system requires the completion of research on the behavior of these soils under conservation farming techniques taking into account local environmental conditions(Moussadek *et al.*,2017).Classification is basically important to any science. Classification provides the avenue through which research can be addressed in a rigorously systematic manner and also have more practical applications for all soil survey program and mapping the soils of any region(Balasubramanian, 2017).

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