Original Research Article

Investigation of Physical and Chemical Soil properties for Two Selected Sites in Khartoum State (Umm Dom Island) and River Nile State (Al Oteib Area).Sudan

Abstract

The aim of this study is to determine physical and chemical soil properties in addition to compare between two sites (Aloteib area) River Nile state and (Umm Dom Island) Khartoum State in soil composition. Two different soil samples were collected from the surface (0-30m) of the two locations (Aloteib area) and (Umm Dom Island). Standard analytical methods were used. Results revealed that the soil texture were sand to sandy loam in the two sites. Chemical analysis of the soil showed that Al oteib area and Umm Dom Island were of neutral reaction pH (7.24, 7.27), Electical Conductivity and the amount of salt was non Saline (0.766 ds/m) in Al oteib and saline (3.42ds/m) in Umm Dom Island. Exchangeable calcium concentration ranged from low (3.5megl/L) in Al oteib to high (17.5meg/L) in Umm Dom Island, Exchangeable magnesium concentrations ranged from medium (1.5 meg/L) to high (13.5meg/L) soluble sodium concentration was very low (2.24meg/L and (20meg/L) respectively. Soluble Potassium concentration was ranged from high to excessive (1.86meg/L and 7.83meg/L). Both soils were bicarbonated (4 meg/L and 6.5 meg/L), the available organic matter were low to desirable amount (0.21% and 0.75%), the Percentage of Calcium Carbonate was high (22.05 and 22.3meg/L).Total nitrogen percentage were very low (0.0.014% and 0.028%).The available phosphorus

was very low (0.4 ppm and 1.6ppm). The Comparison showed that the amount of Exchangeable Ca and Mg, Soluble Na and K, total N, available P, O.M and O.C, and The amount of HCO_3, CO_3, Cl were greater in Umm Dom area while the percentage of sand (98.2%) and $CaCO_3$ (22.05meg/L) were higher in Aloteib area. From the field observations and laboratory analysis we concluded that Umm Dom Island soil was more fertile than Al Oteib soil and more suitable for agricultural practice without the need for the addition of external fertilizers.

Keywords: Soil properties, Sudan, Physical, Chemical.

1. Introduction:

The importance of soil coming from that, soil is a natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface. Soil occupies some space. Soil is characterized by both horizons, or 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. Properties of soil vary due to several soil forming factors. Properties vary very widely. Soil types are many. To identify, understand, and manage soils, soil scientists have developed a set of soil classification or taxonomy systems (Rayne, *et al.* 2003).Among the studies which cover the whole of Sudan, one (Purnell and Venema, 1976) identifies 16 soil regions. Each is described by particular topographical features or by soil associations. The main areas of soil distribution are also marked on the climatic map as this allows an analysis of soil formation in relation to climate. Some soil regions have, in fact, been delimited in relation to climatic factors and it can be seen that the desert soils approximate to the 75

mm Isohyets at about 17°N, from the frontier with Chad in the west to Atbara on the Nile in the east. Semi-desert soils and those of the Red Sea correspond, in a similar manner, to the area between the 75 mm and 200 mm isohyets. The semi-desert and Red Sea soils differ in respect of the particular topography found at the extreme east of the zone: the shallow Red Sea soils on steep slopes are calcareous and sandy fluvisols and are found in the numerous steep valleys descending from the hills towards the eastern run-off areas (Fald and Isolde, 1993).

Classification is basically important to any science. Classification provides the avenue through which research can be addressed in a rigorously systematic manner. Classifications also have more practical applications. Classification of soils is necessary for all soil survey program and mapping the soils of any region. Soil surveys employ the principles, functions of soil science to agriculture, forestry and engineering to predict soil behavior for different use, management or manipulation.

Rossiter, (2001) reported that the purpose of any classification is so to organize our knowledge that the properties of objects may be remembered and their relationships may be understood most easily for a specific objective .The process involves formation of classes by grouping the objects on the basis of their common properties. “In any system of classification, groups about which the greatest number, most precise, and most important statements can be made for the objective serve the purpose best. Another advantage of classification that helps us deals with complexity. The objectives of this study are to analyze physical and chemical soil properties and to compare between two sites in soil composition.

2. Materials and Methods:

Soil Samples used in this study were collected from two different sites in Khartoum state (Umm Dom Island) and River Nile state (Al oetib area) Northern Sudan from the surface area (0 - 30cm) and analyzed physically and chemically according to the method of Marc (2006) to obtain soil texture, pH, electrical conductivity, Calcium and Magnesium, Sodium and Potassium, Calcium carbonate, Bicarbonate, Carbonate and Chloride, Organic matter, Total Nitrogen, and Phosphorus.

Results and discussion:

Physical and chemical soil properties for two selected sites in Khartoum State (Umm Dom Island) and River Nile State (Al oteib area) were analyzed and the results were shown in Table (1).

3.1. Physical properties:

3.1.1 Particle size distribution: (Soil Texture)

The soil texture was determined using the soil texture triangle. The soil Texture of the Al Otieb area and Umm Dom Island were sand and sandy loam and were shown in Fig. (1) and (2).

The percentage of silt sand and clay in Alotieb area and Umm Dom Island were: 1.8%, 92.26%, 5.94% in Aloteib and 19.8%, 54.5%, 25.7% in Umm Dom Island.

Table (1): Soil properties in the study areas Aloetib and Umm Domm Island.

Soil parameter	Ca meg/L	Mg meg/L	Na meg/L	K meg/L	HCO_3 meg/L	CL meg/L	O.C %	O.M %	$CaCO_3$ meg/l	N %	P ppm	Clay %	Silt %	Sand %
Aloteib Soil	3.5	1.5	2.24	1.86	4	5.75	0.12	0.21	22.05	0.014	0.4	5.94	1.8	92.26
Umm Dum Soil	30.5	13.5	20.96	7.83	6.5	13	0.44	0.76	22.3	0.028	1.6	25.7	19.8	54.5

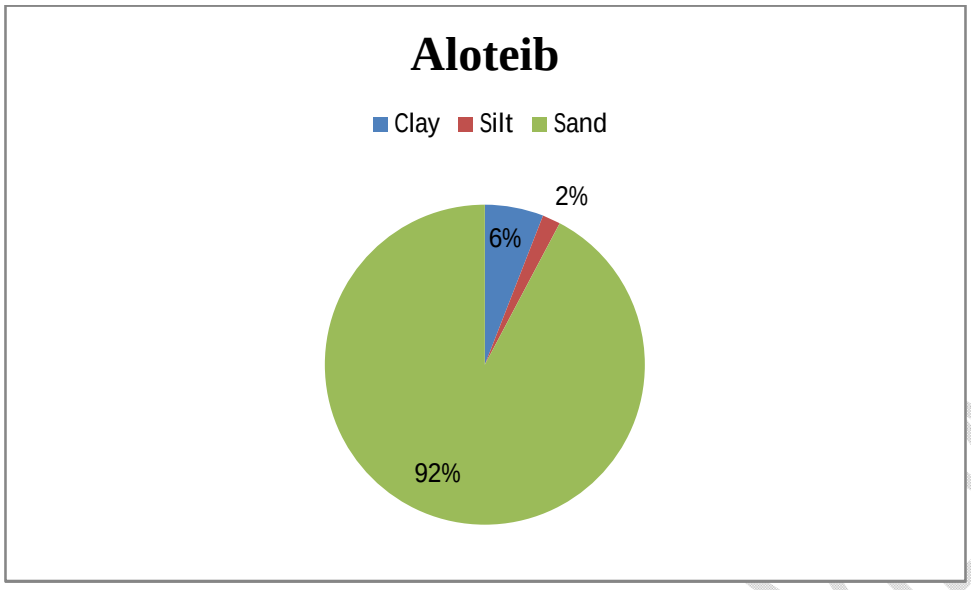

Fig. (1) The percentage of silt, sand and clay in Aloteib area.

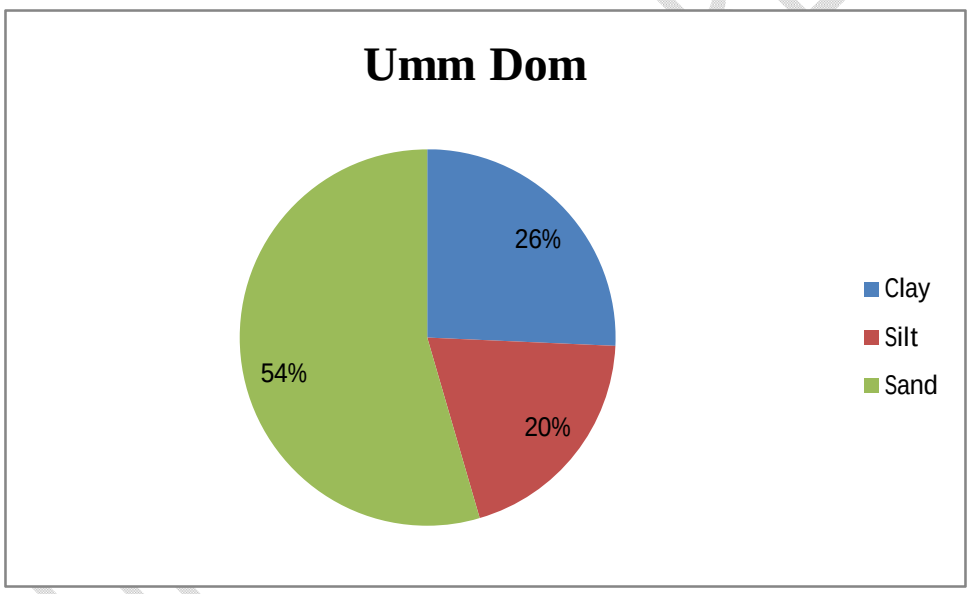

Fig.(2): The percentage of silt, sand and clay in Umm Dom Island.

3.2. Chemical properties:

3.2.1 Saturation percentage:

Calculation of the saturation percentage by the volume of water added to the Paste the saturation ratio of Umm Dom Island sample was 62 % while in Al Oteib sample was 11.25 %

pH:

To measure the negative log of the hydrogen ion activity in the soil solution, a pH meter was used.

pH = - Log H

Soils can be acidic, neutral, or alkaline: PH = 4,7,10

Al oteib soil was neutral pH was 7.24 Umm Dom Island soil was neutral pH was 7.27. Soil pH affects the amount of nutrients and chemicals that are soluble in soil water

3.2.3 Electrical Conductivity:

For measuring the concentration of soluble salts in the soil, the Electrical Conductivity meter was used.

Soil EC estimation for Al Otaib was non saline (0.76 ds/m) while Um Dom soil was moderately saline Ec (3.42 ds/m). EC affects crop yields, crop suitability, plant nutrient availability, and activity of soil microorganisms.

3.2.4 Calcium and Magnesium:

The concentrations of soluble calcium and magnesium were calculated and the results showed that the concentrations of soluble Calcium in Al-Aoteib

soil was low (3.5 meg/L) and the concentration of Magnesium was medium (1.5 meg/L)while in Umm Dom Island soil the concentrations of soluble Calcium were high (17meg/L) and high concentration of Magnesium (13.5 meg/L). Magnesium deficiencies on acid soils can be corrected by liming with dolomitic lime. Magnesium toxicity can occur on serpentine soils. Calcium deficiency can be corrected by liming with calcium carbonate (Marx1999).

3.2.5 Sodium and Potassium:

The determination of the elements Sodium and Potassium by means of a flame photometer.

In Al-Aoteib soil the amount of Sodium were very low (2.24 meg/L) and high concentration of Potassium (1.86 meg/L), while in Umm Dom Island soil the amount of Sodium were very low (20.9meg/L) and there was excessive concentration of Potassium (7.83 meg/L). Sodium is not a plant nutrient and therefore is not necessary for plant growth. High levels of sodium are detrimental to soil tilth and plant growth. Sodium levels are evaluated based on Exchangeable. ESP values above 10 percent are of concern (Marx, 1999).

3.2.6 Bicarbonate, carbonates, and chloride:

Carbonates in the soil solution often transformed into bicarbonate in the presence of water. The concentration of carbonate, bicarbonate in Al Aoteib was very low (4meg/L) and medium concentration of chloride (5.75meg/L). The concentration of carbonate and bicarbonate in Umm Dom Island were (6.5 meg/L), and high concentration of chloride (13 meg/L). Soil testing of chloride is not common practice.

3.2.7 Organic matter:

Organic matter had low concentration in Aloteib area (0.2%) and desirable concentration in Umm Dom Island (0.76%) soil.

3.2.8 Calcium Carbonate:

The percentage of calcium carbonate was calculated result revealed that the Percentage of Calcium Carbonate was high and greater in Al-Aoteb (22.05%) than (22.3%) in Umm Dom Island.

3.2.9 Total Nitrogen:

The percentage of Nitrogen were very low (0.014 %) and (0.028%). And greater in Umm Dom Island than Al-Aoteb area.

3.2.10 Phosphorus:

The phosphors were read by a spectrophotometer at the wavelength of 660 nm result showed that the amount of Phosphorus were very low (0.4 ppm) in Al-oteib and (1.6 ppm) in Umm Dom Island.

Table (1) Shows that in both the study areas Aloteib and Umm Dom Island the percentage of clay ,silt and sand were (5.94%.1.8% and 92.26%) and (25.74%,19.8% and 54.5%) respectively .The concentrations of (Ca) ranged from low to high (3.5 meg/L) and (17 meg/L) and the concentration of (Mg) ranged from medium to high (1.5 meg/L) and (13.5 meg/L).The amount of (Na) were very low (2.24 meg/L) and (20.9meg/L) and the concentration of (K) was high to excessive (1.86 meg/L) and (7.83 meg/L.). Both sites were carbonated (4 meg/L and 6.5 meg/L), the percentage of (O.M) were low (0.21%) to desirable amount (0.76%) the concentration of $CaCO_3$

(22.05meg/L and 22.3meg/L) were very high. Total N% were (0.014% and 0.28%), the available (P) were (0.4 ppm and 1.6ppm) respectively.

All Chemical and Physical properties were demonstrated in Fig.(3) It is clear that both areas Umm Dom and Al oteib area were neutral, and were bicarbonate and the amount of organic matter were low in bothe sites, the salinity of Um Dom was more than Al oteib area and the concentration of Calcium and Magnesium, Sodium and Potassium, Carbonate and Chloride, Total Nitrogen, and Phosphorus in Umm Dom Island were higher than Al oteib area while the amount of Calcium Carbonate and sand percentage were greater in Al oteib area.

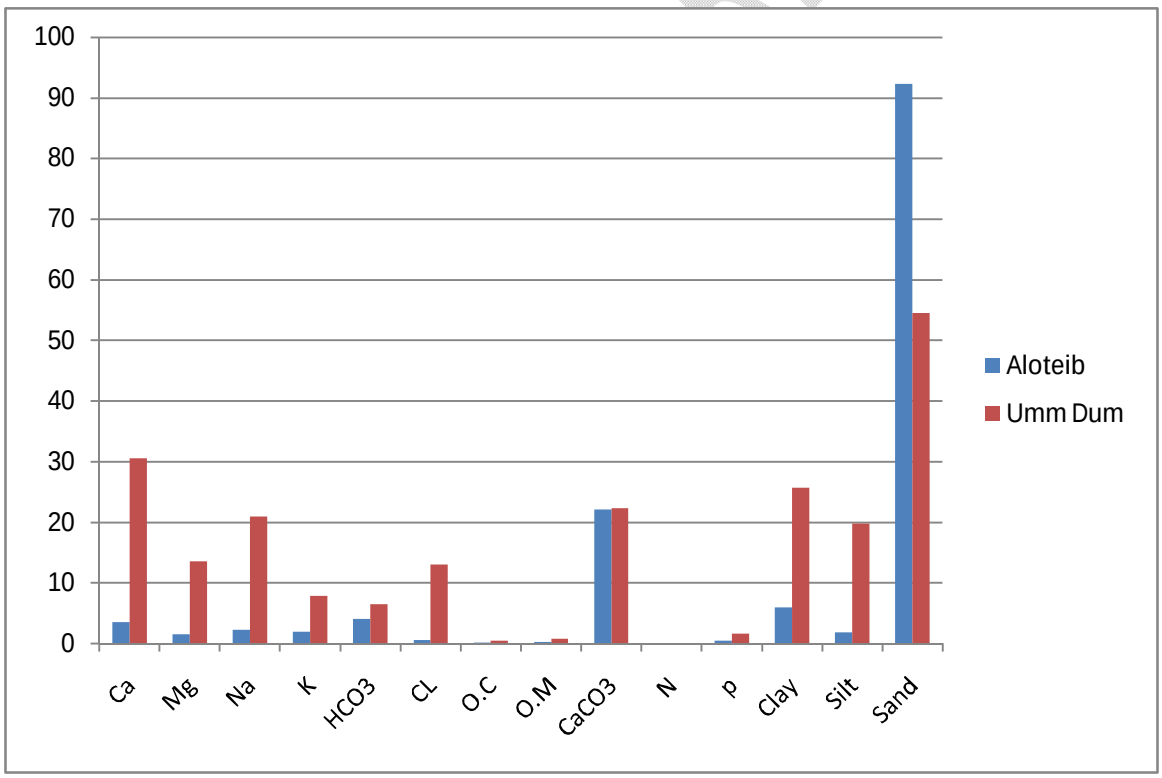

Fig. (3): Soil properties in the two sites of the study areas.

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