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Physicochemical Parameters in the Soil of Farin Gada Farm Jos North Local Government, Plateau

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Abstract

Soil is a part of the earth that is made up of various mixtures, including organic matter, minerals, gases, liquids, and organisms that together support life. Because soil is used to cultivate foods for animals worldwide, it plays a critical role in the global cultivation of wheat, rice, mustard, vegetables, and fruits, among other crops. Nigerian agriculture uses this soil, and the physical and chemical conditions of the land make it necessary to implement other management practices properly. For this reason, the physicochemical study of soil is very significant because it considers both the physical and chemical properties that affect soil productivity. This study the parameters of soil in order to improve the agricultural activities. The result of study shows that the Physicochemical properties of the soil samples at Farin Gada reveals that temperature of soil were found to be 27°C, pH ranges from 6.38±0.09 to 7.47±0.50, conductivity ranges from 0.15±0.01 to 0.42±0.08, Moisture Contents ranges from 0.48±0.82 to13.17 ±0.8, Cation Exchange Capacity (CEC) ranges from0.53±0. to 0.54±0.86 and the organic matter ranges from 13.51±0.79 to 43.24±0.82, respectively.

Keywords: Soil, CEC, pH, Temperature, Conductivity, Organic matter, Moisture contents

INTRODUCTION

Soil is a natural resource that constitutes the Earth's outermost layer. It is composed of minerals, organic matter, water, and air, and it promotes plant life by supplying nutrients, water, and a substrate for root growth. Understanding and protecting soil health is critical for environmental sustainability, agricultural output, and climate change mitigation. Soil is vital for the environment as it supports plant development, water filtration, carbon sequestration, and provides habitat for numerous organisms. Soil is classified based on its primary particle size, which can be sandy, clay, silty, or loam. Soil properties include texture, structure, pH, and fertility(Abubakar M.Y, *et al.,* 2024) . It is usually considered as the fine earth which covers land surfaces as a result of the unaltered weathering of rock materials or the aggregation of mineral matter transported through the medium of water, wind, or ice. The typical feature of soil is weathered mineral material is added organic material. This organic material may be both living and dead. The dead organic matter will include little altered and freshly added dead plant roots and leaf and other plant litter, dead fauna, and organic material in various stages of decomposition from little modify relatively fresh materials to the complex decomposed material called humus. It is mixture of mineral and organic material that gives the soils their distinctive characteristics. There are many different types of soil across the surface of the earth which reflect, at least in varying combinations of mineral and organic matter and their equal responses both separately and often in complex association to different environmental conditions. Indeed both soil and their constituents together with the plant and rock on which it lies, the climate it experiences, form a finely balanced system. Soil is essential for many human activities. It is also a basic part of the natural environment. (Stephen *et al,* 2017)

The types of soil and parameters of the soil used for agriculture will determine the physio-chemical soil and agricultural production.These days, the demand for soil testing has increased because of certain components of the soil, such as pH, textures, moisture, and other elements, which in turn reduce the quality of the soil across the board.The ability of the soil to retain water, sequester carbon, support plant growth, remediate waste, and perform other functions can all be considered aspects of its quality, or it can be more specifically described. The evolution of the idea of land quality is examined in this paper, along with the application of soil chemical and physical characteristics to the assessment of soil quality. For farming soil scientist to play a major role in the assessment and advancement of sustainable soil management in making the concept of soil quality as indicator of sustainability .After doing all these things the specific process or properties that changes in the dependent to each other by combined actions of physical and chemical attributes. Vegetables, especially leafy crops, cultivated in heavy metal-contaminated soils have been found in several studies to contain greater amounts of heavy metals than vegetables produced in uncontaminated soil (Guttormsen et al. 1995; Dowdy and Larson 1995).

Osakwe, SA (2014) The physicochemical characteristics of soils from regions of Delta State, Nigeria's Isoko Region that were impacted by a natural flood disaster were examined. The overall pH (5.425±0.313), phosphorus (7.47±6.34mgkg-1), and nitrate (0.34±0.07mgkg-1) contents of the soil were found to have decreased, along with the exchangeable calcium (1.97±0.31mgkg-1) and potassium (0.09±0.01mgkg-1) levels, as well as the effective cation exchange capacity (5.076±1.532 (cmolkg-1)) and related parameters (base exchange capacity, base saturation, and soil buffering capacity, respectively. Exchangeable magnesium (1.50±0.25 mgkg-1), exchangeable sodium (0.28±0.004 mgkg-1), and exchangeable acidity (0.43+0.08 and 0.42±1.02 mgkg-1 for hydrogen and aluminum, respectively) values, on the other hand, were all higher. The levels of total organic carbon (0.40±0.096%), total nitrogen (0.025±0.035%), and sulphate (0.10±0.02mgkg-1) did not significantly alter. Overall, the data show that while the flood had no discernible impact on the biodegradable and compostable materials, it did raise soil acidity and reduce soils' capacity to absorb metals. The government should take the initiative to plan precautions against future flood disasters in the nation.

The development of humans and society since prehistoric has been closely linked with an increasing ability to manage the soil to human benefit. This progress has been achieved by adjusting the balance between the soil and its natural environment. These adjustments have not always resulted in positive responses and benefits, there are records throughout history describing soil destruction as a result of mismanagement and misuse of the soil, often as a result of the failure to understand the nature and complex of the soil environment relationships. (Shittu *et al,* 2024) Soil is very important to human being; soil contamination affect not only crop production but also affect human being indirectly through the cultivated crops. Heavy metals are those elements that have relatively high density and are poisonous even at low concentrations. Industrial influence is one of the problems facing most of our rivers and water bodies. During irrigation farming, some of the heavy metals that are toxic to plants as well as a human health are used spatially in water that has a linkage with industries and urban areas. (Shittu, 2015).

One important route for heavy metals to enter soil through air deposition is through point sources such industrial operations and the smelting of metaliferous metals. Inputs like fertilizers, pesticides, sewage sludge, and organic matter are additional non-point sources of contamination that impact agricultural soils (Singh 2001). Furthermore, Salim *et al.* (1992) have identified foliar uptake of air heavy metal emissions as a significant mechanism of heavy metal contamination in vegetable crops. Growing regions for vegetables are frequently located in or close to deposit sources, which increases the danger of possible contamination.

Numerous research projects have looked into atmospheric deposition in soil and/or crops growing close to industrial regions (Gzyl 1990). These studies show that vegetables cultivated close to industry and polluted areas have high concentrations of heavy metals, and they also show that leafy vegetables are most at risk of developing higher concentrations. Every species of plant has different nutritional needs from one another. As a result, various plants grown in the same solutions will have variable amounts of macro and minor components. Vegetable budding and growth rates are slowed down by the application of industrial effluent (Ihekeronye and Ngoddy 1985).

MATERIAL AND METHODS

100ml of 5% sodium hexametaphosphate solution, $Mg(CH_3COON)$.

Sampling Area

The Farin Gada vegetable garden is located at Jos North Local Government, Plateau State. The vegetable garden is situated along the river band from river Dilimi. Jos North local government is located at the extreme north of Plateau State on Latitudes 09^0 53^1 and 09^0 59^1 North, and Longitudes 08^0 51^1 and 09^0 02^1 East. It shares a boundary to the North with Toro Local Government Area of Bauchi State; to the South with Jos-South Local

Government area; to the North-East with Jos-East Local Government Area; and to the West with Bassa Local Government Area. Jos-North Local Government enjoys a temperate climate with average temperatures of between 28^{0}C (81.7^{0}F) maximum and 11^{0}C (51.7^{0}F) minimum. It covers a total land area of 291 km^2 (112 sq mi) with the 2006 provisional population census figure of 429,300 people. The warmest temperatures usually occur in the dry season months of March and April. Similarly, Jos-North Local Government is characterized by a mean annual rainfall of between 1317.5mm (131.75cm) and 1460.00mm (146.0cm), mostly from May to August. The Onset and Cessation of rainfall in Jos-North are experienced in April (±15 days in April), and October (±15 days in October) respectively. The relative humidity is characterized by a marked seasonal variation (Shittu *et* al, 2023)

map of the study area (google map)

Collection of Samples

Three soils from three different locations were obtained from farms within the Farin gada vegetable Garden. The samples were spread in for air drying at room temperature.

Q_1

Q_2

Q_3

Determination of the soil pH

The pH of the soil was determined by measuring 20 g of 2 mm soil and placed into 100 ml beaker and 20 ml of distilled water was added and stirred. The solution allowed to stand for 30 minutes with occasionally stirring which allowed most of the segment to settle at the bottom of the beaker. The pH was determined by immersing the glass electrode into the partially settled suspension. It is also immersed in the clear solution of the soil and the pH was recorded

Moisture content

A 50 g of the moist aliquot portion of soil was weight into the aluminium dish. Hence, the moist removed the dishes from the oven and allowed to cooled. the dishes were reweighed plus the dried soil oven.

Determination of cation exchange capacity (ECE)

A 10 g of 2 mm soil sieved soil sample was weighed into 100 ml centrifuge tube. About 40ml of $Mg(CH_3COON)$ was added and shaken for five minutes at 1800 rpm. The solution was decanted and the supernatant liquid discarded. The procedure was repeated for four other treatments of CEC. About 40 ml 0f 0.50M of Magnesium Chloride ($MgCl_2$) was added again and shaken for two minutes. The tube was centrifuged at 1800 rpm for 5 minutes, and then the supernatant solution was discarded, 40ml of dilute acetone was added and shaken for another two minutes. The tube was centrifuged for 1800rpm. chloride (NaCl) was added and shaken for two minutes. The solution was again centrifuged for five minutes and the supernatant was kept into 500ml volumetric flask. Buffer solution (200ml) was added to the supernatant. Then 10 drops of Erichrome black T and 5 drops of methyl red indicator was added and the solution was titrated with EDTA. The Cation Exchange Capacity was calculated from:

$$\text{CEC (Cmolkg}^{-1}\text{)} = \text{ml of EDTA} \times N \times 10^{-2} \div \text{dry sample weight in (g)}$$

RESULTS AND DISCUSSION

Table1: Results of Physiochemical Properties of Soil Samples at Farin gada Vegetable garden

Soil Samples			
Parameters	Q_1	Q_2	Q_3
Temperature	27°C	27°C	27°C
Soil pH	7.45±0.82	7.47±0.50	6.38±0.09
Moisture contents (g/m^3)	12.56±0.81	0 .48±0.82	13.17±0.81
CEC (Cmol /kg	0.54±0.06	0.53±0.01	0.54±0.86

Key: Q_1= Soil from vegetable One, Q_2 = Soil from vegetable two, Q_3 = Soil from Farm Three

The result for the soil parameters revealed that the three samples of soil from Farin gada garden Q_1 is loamyclay, Q_2 is sandyclay and Q_3 is sandyclay. The physicochemical properties of the soil samples from table2 revealed that at at 27° C temperatures for both samples, pH range from 6.38±0.09 weak acidic to moderate alkaline 7.47±0.50, conductivity range from 0.15±0.01 to 0.42±0.08, moisture contents range from 0.48±0.82 to13.17±0.8, Cation Exchange Capacity (CEC) ranges from0.53±0. to 0.54±0.86 and the organic matter ranged from 13.51±0.79 to 43.24±0.82.

CONCLUSION

From the results obtained for the parameters of the three soil samples, the pH fall within the permissible limit(6 to 8), CEC was lower than permissible limit (below 12) and are generally considered to be poor at holding cation nutrients respectively The moisture content was lower than the permissible limit (2 to 4%) respectively (WHO). Maintaining optimal physicochemical conditions in the soil is vital for maximizing vegetable production.

Recommendation

Regular soil testing and appropriate soil management practices, such as the use of organic amendments, lime application for pH adjustment, and balanced fertilization, are recommended to ensure that the soil environment remains conducive to healthy vegetable growth. This approach not only improves yield but also supports sustainable farming practices.

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