KIU Journal of Social Sciences Copyright©2021
Kampala International University ISSN: *2413-9580*; 7(2): 275–279

Diagnostic Analysis of Physicochemical Properties of Soil in Ago-Iwoye Farm Settlement

A.M. HASHIMI
Olabisi Onabanjo University, Ago-Iwoye, Nigeria

Abstract. Knowledge of soil nutrients is a basis requirement for fertilizer application to achieve high yield in food production. A situation where soil has low fertility, fertilizers are applied to supply nutrients needed for crop growth. However, some seeds respond to fertilizers than others, while some crops need greater amount of fertilizers, other seeds need less, therefore when a blanket application of the major fertilizer elements is applied, seeds give inadequate positive response. This study therefore, focuses on the status of soil nutrients in Ago-Iwoye farm settlement. The soil samples were taken randomly across the farmland and marked in the 0-15cm layer as top soil and 16-30 cm layer as sub-soil as shown in Table 1 and Figure 1. The soil samples collected were taken to the laboratory of Moor plantation, Ibadan, where the soil particles, composition and other characteristics and pH level are analyzed. The results of soil chemical analysis are presented in Table 2. The findings show that the textural compositions of the soils are sandy, clay and silt. In the surface layer of 0-15cm the proportions of % sand is 70.00, the % clay is 9.36 and % silt is 20.64. While the proportions sub-soil layer of 16-30cm are % sand is 72.2, % clay is 9.56 and % silt is 18.34. The results show further that soil organic matter, total nitrogen, exchangeable calcium, magnesium, potassium, soil cation exchange capacity (CEC) in the 0-15cm and 16-30cm layers are differed in the percentage of properties. It is evident from the results of the soil analysis that the representative area is not fertile enough to produce high yield therefore, fertilizer is required to be added to the soil to improve the soil nutrients for production of high yield.

Keywords: Diagnostic analysis, physicochemical properties, Fertilizers, Ago-Iwoye, Farm Settlement.

1. Introduction

Research has revealed that production of food plays significant roles in the evolution of human society and civilization. The role of food is vital as basic need of life. It supports the process of development. According to Ukoha and Nyong (2002), food is the first requirement for life that we must acquire after oxygen and water. Planting activities provide food stuffs, feed stuffs, fibers and herbals. These four items are crucial for human survival on earth. Food stuffs contain nutrients and medicine for human growth, repair and protection. Food is the most important form of security to mankind. Its import of security to any nation is to ensure that its provision is on a continuous basis to feed all citizens, rich or poor, young or old, gainfully employed or unemployed, in adequate quantity. Provision of food enhances peaceful co-existence at family, community and national levels and promotes nutritional well beings of people. Despite the importance of food for mankind, more than half of the world's population still goes to bed hungry. Hence, the ceaseless activity of man of sowing and reaping constitutes the major activity that controls the live of the overwhelming majority of people worldwide. Most human beings are farmers across the 195 nations on earth (Akoroda, 2009). This is the fact of life till date and would be in the foreseeable future.

The resultant effect of the world population has become a global concern. (Lucas, 2007: 3). The recent global population of over 7 billion will definitely increase with the passage of time; and the demand for more food is expected to increase. The population of the world first estimated in 1650 to be about 500 million, rose to 1 billion in 1850 and 2.5 billion in 1950. Between 1950 and 1980 the

population increases to 4.5 billion and by the year 2000 there were 3.6 billion people on the surface of the earth and this is expected to be more than 10 billion by year 2050. (Oyesiku, 2002:13). Coming home, Nigeria as a nation has over 200 million people, and over 120,000 rural communities, 83.7% of the population reside and earn their living in these communities, where agricultural enterprise is the dominant work. (Adedoyin, 2004) Despite our dependence on petroleum as our foreign exchange earner, agriculture still plays a major part in our economy. At present it contributes to about 40% of our gross domestic product which is less than its contribution of almost 60% at independence. (Lucas, 2007, Akoroda, 2009, Akinyemi, 2009).

It is worthy of note that as production of food constitutes the basic need of life for human beings and animals, the production of food depends on fertility of soils. In a situation where the soil has low fertility, the organic and inorganic fertilizers are applied to supply nutrients needed for crop growth, hence the knowledge of the status of the soils is a prerequisite for application of fertilizers to crops. This is achievable through a rational and systematic analysis of soil nutrients, when nutritional problems are diagnosed. Therefore, this research work intends to determine the soil properties of the study area for appropriate fertilizers application to improve the condition of soil for food production.

2. Literature Review

Literature is replete with various research works carried out by scholars in various fields and allied disciplines related to soil sciences especially on how food sufficiency can be achieved through application of scientific methods. In all these research works, the general focus is on soil qualities and application of chemical fertilizers. Consequent to the above some of the works related to the present research study were consulted and reviewed one after the other.

The first to be considered is Duncan, (1974), titled *A role for the University of Ife in increasing Agricultural Production*. Another related research work is Aboaba, (1976) titled *Engineering in the production of food*. This is followed by Udo (1977), titled *Land policy for effective management of the National Economy*, and Ashaye (1978), titled *Soils, civilization and the march of time*. This is followed by another research work by Patel (1983), titled *Adapting Agricultural Extension to the Development needs of Nigeria.* Also related research work is Obigbesan, (1999). *Fertilizers: Nigerian Farmers Dilemma*. The thrust of the work is fertilizer: According to Obigbesan a sound knowledge of plant nutrition provides the basis for fertilizer application. The author defined nutrition as the supply and absorption of chemical compounds needed for growth and metabolism, while the chemical compounds required by an organism are termed nutrients. He went further that plant nutrition is concerned with the nutrition of cultivated crops with a view to influencing their quantitative and qualitative yield. He pointed out that fertilizer use has dual purpose of feeding crop plants with nutrients and replenishing the soil, to maintain soil fertility and environment to make up for nutrient losses due to leaching, fixation and surface wash. He asserted further that incomplete nutrient application (nutrient-imbalance) adversely affects yield and quality. While some plants are depleters of soil nutrients than others, some crops are reputed to be voracious depleters of soil nutrients. He concluded that nitrogen is an essential nutrient that is most limiting in crop production and proves to be indispensable for high yields.

Another work under review is Agboola (1977), titled *The spatial Dimension in Nigerian Agriculture Development*. The researcher mentioned the main factors that are essential for crop production. He regarded land as the most fundamental to crop production, while the quality of land is measured in term of soil structure, fertility and moisture status, its locational characteristics in regard to its ecological and human environments. He drew attention to environmental factors such as its productivity, potentialities of soil types, climate and planting of crops within the appropriate ecological zones. More importantly, he remarked that change in ecological zones leads to remarkable decline in crop yield. He concluded that high yield in crop production can only be attained through multi-disciplinary approach which can cope with its multi-faceted problems and geography has a contribution to make to the solution of these problems. Also important are Fayemi (1966), "*Effects of time of nitrogen application on yield of maize in the tropics"*. This research work discusses various issues relevant to food production. It laments on the increased population in Nigeria than food production. He brought into focus suggested modifications of the basic factors to increase food stuffs where he considered land as essential factor for food production because there is no possible alternative now. In conclusion, he said the Nigerian soils are deficient of necessary nutrients, and nitrogen fertilizer is required.

It is obvious from the above discussion that researchers have conducted several research works

on related issues such, as soil nutrients, application of fertilizers, food production and nutrient degradation.

3. Research Materials and Methodology

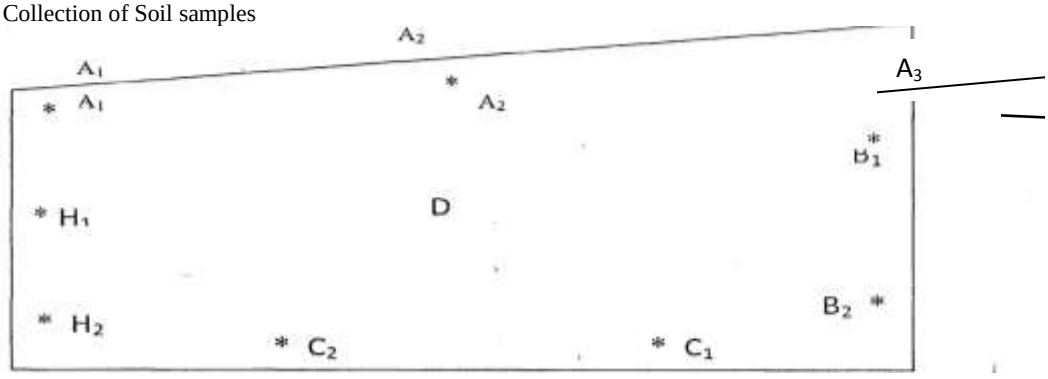
3.1 Descriptions of Study Area

The research was conducted at Ago-Iwoye farm settlement, Ogun state, Nigeria. The study area is located between latitude 6°55' and 7°N and between longitude 3°45'and 4°05'E. Ago-Iwoye is only 2km from Oru and 5km from Ijebu-Igbo, in Ijebu-North Local Government Area. The town is about 100km south-east of Abeokuta, the Ogun State capital. The site lies to the south-west of Ago-Iwoye. It is approximately 3.50 km from the centre of the town, and is bounded by the north by Ijebu-Igbo/Oru/Ago-Iwoye/Ilesa-Ijebu/Ilisan road and on the east by AgoIwoye/Imodi-Imosanl Ijebu-Ode road. The perimeter road are connected to the Lagos Benin Expressway and the Ijebu-Ode/Ibadan road

3.2 Data Collection and Sampling Techniques:

Soil samples were taken from the representative area of the farmland of 1 hectare in size. The farm was divided into small units or sampling units. Within each unit, a profile pit was dug. Each pit comprises surface (0-15cm), sub-surface soil (16- 30cm). The soil samples were taken randomly across the farmland. The bulk samples that consisting of surface (0-15cm) and subsurface (16-30cm) were collected randomly at ten (10) different sports from Ago-Iwoye farm settlement, using an auger and tape rule for measuring the depths. The twenty (20) different samples of the soil collected at these different depths were packed, labelled and carried out to the laboratory for subsequent analysis.

Fig.1. Collection of Soil samples



From the above data of land employed in the representative area A_1, A_2, A_3 and C_1, C_2 are in opposite land, represent the length of the land. While H_1, H_2, and B_1, B_2 are also in opposite line, represents the breadth of the land. The D pit represents the centre of the land.

Table1: Soil properties of the 0-15 cm Layer (Top Soil) and 16-30cm Layer (sub-soil)

SURFACE SOIL	SUB SOIL
0 – 15cm	15cm – 30cm
A_1 = 0 – 15cm	15cm – 30cm
A_2 = 0 – 15cm	15cm – 30cm
A_3 = 0 – 15cm	15cm – 30cm
B_1 = 0 – 15cm	15cm – 30cm
B_2 = 0 – 15cm	15cm – 30cm
C_1 = 0 – 15cm	15cm – 30cm
C_2 = 0 – 15cm	15cm – 30cm
D = 0 – 15cm	15cm – 30cm
H_1 = 0 – 15cm	15cm – 30cm
H_2 = 0 – 15cm	15cm – 30cm

Source: *(Field Survey, 2020)*

Soil samples were taken in the study area to have the most accurate measurements of elemental nutrients and soil types. This is followed by mixing soil samples of different locations to have an average or composite. Sample depth is also a crucial factor for various nutrients and soil components. The physical and chemical parameters of soil determined were carried out by mechanical analysis. The soil samples collected were taken to the laboratory of Moor plantation, Ibadan. It was at Moor plantation Laboratory that elemental nutrients present in the soil of the representative area were determined and analyzed. The results of the mechanical analysis of the representative area

are presented in Tables 1 and 2. The soil analysis gives an index of nutrient availability which indicates that fertilizer is required for the soil in the study area. Soil analysis is done to facilitate fertilizer composition and dosage selection for land employed. Laboratory tests are more accurate than other method.

The soil samples collected were taken to the laboratory of Moor plantation, Ibadan. It was at Moor plantation Laboratory elemental nutrients present in the soil of the representative area were determined and analyzed. Thus, the soil particles, composition and other characteristics and pH level are analyzed.

Table 2: Physicochemical propertiesAnalysis

Soil Parameter	PIT SOIL		Mean
	Top Soil A (0-15cm)	Sub Soil A (15-30cm)	
pH (H_2O)	5.71	5.95	5.83
pH (KCl)	5.09	5.01	5.05
% Sand	70.00	72.2	71.10
% Clay	9.36	9.56	9.46
% Silt	20.64	18.24	19.44
Na (cmol/kg)	0.31	0.29	0.30
Mg (cmol/kg)	0.59	0.62	0.61
K (cmol/kg)	0.089	0.072	0.080
Ca (cmol/kg)	0.65	0.66	0.65
H^+ (cmol/kg)	0.1246	0.1123	0.1184
CEC (cmol/kg)	1.7552	1.7502	1.7527
% B. Sat	92.83267	93.44029	93.14648
% C	0.82	0.64	0.73
OM (%)	1.41	1.10	1.25
Av. P. (ppm)	0.78	0.81	0.79
Zn (mg/kg)	2.12	2.85	2.49
Cu (mg/kg)	1.22	1.53	1.37
Mn (mg/kg)	1.33	1.51	1.42
% N	0.082	0.064	0.073

Source: *Soil Analysis; (Moon plantation, 2019)*

4. Results and Discussion

The analysis of soil properties were in the 0-15cm layer as top soil and 16-30cm layer as sub-soil. Fig.1 shows that soil samples were taken from the representative area of the farmland of 1 hectare in size. The farm was divided into small units or sampling units. Within each unit, a profile pit was dug. Each pit comprises surface (0-15cm), sub-surface soil (15- 30cm). The soil samples were taken randomly across the farmland. The area where soil samples were taken labelled as A_1, A_2, A_3 and C_1, C_2 are in opposite land, represent the length of the land. While H_1, H_2, and B_1, B_2 are also in opposite line, represents the breadth of the land. The D pit represents the centre of the land.

Table 2 shows the textural compositions of the soils are sandy, clay and silt. In the surface layer of 0-15cm the proportions of % sand is 70.00 the % clay is 9.36 and % silt is 20.64.While the proportions sub-soil layer of 16-30cm are % sand 72.2, % clay 9.56 and % silt is 18.34.This confirms the constraint of soil acidity, according to the ratings of Tekalign et al. (199) and Okalebo et al. (2020). The results show that soil organic matter, total nitrogen, exchangeable calcium, magnesium, potassium, soil cation exchange capacity (CEC) in the 0-15cm and 16-30cm layers are differed in the percentage of properties. The differences in organic matter levels in the soil were largely due to disruption of litter supply to the soil during cultivation, also on account of rapid decomposition of organic matter in the soil of the study area as a result of elevated soil temperature before planting. Leaching of soil is also a major factor of soil organic matter and nutrient decline. In this study, Sodium is considered a non- essential nutrient, but the level of exchangeable in the study area is 0.3 in Top Soil (0-15cm) and 0.29 in Sub-soil (16-30cm) The attendant reason for decline in sub soil is downward leaching of Sodium into the sub-soil, this due to increased leaching as nutrient capacity of soil is reduced. This is in line with the observation made by Aweto and Bongten. (1994) It is observed from the result that soil organic matter (SOM) is the major contributor to soil CEC, and a decline in soil organic matter results to a decline in soil nutrient-adsorbing capacity and increased leaching. It is also observed that nutrient diminution in the soil is due to nutrient immobilization and removal as a result of harvesting crops. The results also show that the levels of exchangeable calcium

and magnesium in the sub -soil (16--30cm) were significantly higher than top-soil (0-15cm), this conformed with the earlier observation made by Aweto and Obe. (1993) It is also found in the results that the levels of magnesium, calcium and Potassium in sub-soil layer of 16-30 cm are higher than the top-soil layer of 0-15cm.

In conclusion, the findings of of the study indicated that both the Top soil and sub-soil were differed in SOM, total nitrogen, exchangeable calcium, Magnesium, Potassium, Sodium and in CEC and pH levels.

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