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Organic Carbon Status of Lowland Area of the Research Farm, Kano University of Science and Technology Wudil, Kano State, Nigeria

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Abstract
The upland soils of the Nigerian savanna zones are low in fertility and their agricultural potentials for sustainable crops production are low. One of the most important factors in maintaining long term productivity of soils of such nature and such environment is the improvement of their organic matter content. In spite of low content of organic matter in tropical soils, organic matter is probably the life-wire of agricultural production in tropical agriculture. Research work was conducted at Kano University of Science and Technology newly established Research Farm to evaluate the status of organic content of the **lowland** area of the research farm. Walkley-Black method was used to determine the organic matter content of the soil samples Twenty soil samples were randomly collected at different depth of (0- 15 cm, 15 – 30 cm) the particle size analysis indicated that the soil of the area is sandy loam and sandy loam texture. The lowest organic matter contents obtained from the area is 1.67% and the highest is 2.01%. The results obtained indicate that the level of organic carbon content in the area is generally low as compared to standard for ratings soil fertility in the Nigerian Savanna.
Keywords: Soil organic matter, determination, **Lowland** area and Organic carbon status

Introduction

Soils are complex physical and biological systems that make up part of the earth's skin; they are therefore, one of the most valuable natural resources of a nation. In agricultural production, it is an integral part of the ecological system that plant and animal kingdoms meet and establish the dynamic relation [1]. Soils being the natural medium of plant growth are vital to life on earth through their roles in the production of food, and other needs. Soil fertility is affected by many natural phenomena; it can be improved by good management and decreased by bad management. Soil declines when its content diminishes or when it is physical, chemical and biological properties changes in ways that lower its ability to support and nourish plant growth. Nutrient availability is one of the prime factors determining crop yields and investigations of the nutritional requirements of food have been the subject of immense studies [2].

Organic matter comprises only a small fraction of the total mass of most soils, this dynamic soil component exerts a dominant influence on many soils physical, chemical and biological properties Tate [6]. The most common way of evaluating the value of organic matter is by assessing their nature and quality which determine their capability to maintain or improve the soil fertility and productivity of arable soils. Advanced analytical techniques are known to have been developed for determining the level and types of organic materials from different sources. Analytical methods of organic matter determinations are usually based on weight loss or removal of the organic matter from the mineral fraction by oxidation with H_2O_2, ignition Storer (1984) or the determination of some constituents that are found in relatively constant percentages in the [9]. The unconventional method used was based on the assumption that the suspended materials after vigorous shaking are largely organic matter and clay particles. Although these two methods work on different principles making their comparison rather difficult, the study tried to compare the values obtained from the methods as a guide to determine the organic matter content of the soil.

Materials and Methods

This research was conducted at Kano University of Science and Technology, new Research Farm. The farm is located behind the University Fence to the north in Wudil local government area of Kano state, which is situated in the savanna region of northern Nigeria between latitudes 12^0 11" N to 12^0 1411" N and longitudes 7 38 E to 8 38 E. It has an annual rainfall ranging from 850-870 mm per-annum with an annual temperature ranging from 38^oc to 43^oc and relative humidity of 40% to 51.3%. The southern part of the farm is hilly and characterized by rough topography, hence not suitable for crop production. However, the land slop down to the north where it is relatively flat.

Sampling and samples preparation

A total number of 20 soil samples were randomly collected at the **lowland** area from the research farm. Composite soil samples were collected from two depths: 0-15 cm and 15- 30 cm sing soil auger. The soil samples were conveyed to the laboratory for analysis, these soil samples were then air dried, grounded using pestle and mortar and later sieved through 2.0 mm sieve and used for analysis.

Particle size analysis

Particle size analysis was conducted using Bouyoucous hydrometer method [3] as modified by Day [4]. Sodium hexametaphosphate (Calgon solution) was used; as a dispersing agent, percentage sand silt and clay were then determined.

Organic carbon determination

Organic carbon was determined following the Walkley – Black methord [9]. The percentage organic carbon was calculated using the formula

$$\% \text{ O.C} = \frac{(\text{Black titre} - \text{actual titre})\ (0.3 \times m \times f)}{\text{Gram of air-dry soil}} \quad (1)$$

Where: m = concentration of ferrous ammonium sulphate; F = correction factor 1.27

Unconventional method

Ten grams 10g of soil were dissolved in 20 ml of distilled water in a conical flask; the mixture was vigorously shaken using mechanical shaker for 2 minutes. The suspended materials (organic materials and clay particles) were gently leached using filter paper. The weight of the suspended materials was then determined after drying and expressed as a percentage relative to the total weight of the soil and water (mixture). The presumed percentage organic matter present was then determined upon subtracting the value of clay content obtained using particle size analysis in the soil as follows:

$$\% \text{ P.O.M} = \frac{\text{wt. of suspended materials}(-\%\text{clay})}{(\text{wt. of soil} + \text{weight of water})} \times 100. \quad (2)$$

Results and Discussion

The particle size distribution analysis in the **lowland** area indicates that the **lowland** soils are predominantly sandy loam and sandy in texture (Table 1). Percentage sand, silt and clay in the soils generally ranged from 72 - 40%, and 38 - 16% silt and 26 - 12 % of clay. The soil texture of this **Lowland** area was found predominantly sand which agreed with findings of Day, 1995. The sandy nature of the soils could be attributed to the nature of their parent materials [7].

The organic matter content obtained using analytical method indicates that the distribution of organic carbon in various locations of the **Lowland** area of this research farm was low the highest value obtained is 2.01% and 1.45% as the lowest these values can be compared with the soil fertility rating. The results also indicate decrease in value with depth. The organic matter content determined using analytical method in comparison with the unconventional method shows a high correlation. Generally, the amount of organic matter in this **lowland** area was found to be low, although **lowland** soils were relatively higher in organic matter content than dry land soils. Several factors can be considered to contribute to this low level of organic carbon. Some of these factors include type of vegetation cover, topography and the soil parent materials. There is sparse vegetation in the area and there is little slop that runs down to the north. These affect the organic carbon and the accumulation of organic matter is high in the areas with dense vegetation cover because of rapid leaf shedding [8]. The distribution of organic carbon within the soil has a uniform trend decreasing with depth. This is directly related to the reports by various research work that organic carbon accumulation is higher on the top layer of the soil and decline sharply with increase in depth. Possible contradiction might exist when the surface of the soil is clear by bush burning leaving the root residues to build up slowly might be the reason for break of some trend within the soil profile. Deep ploughing of soil exposes the sub-surface layer to the top may also be responsible for the break of the trend.

Table 1. Mean organic matter content and particle size distribution of lowland area of research farm, KUST, Wudil

Depth cm	%OC Walkley-Black method	Unconventional Method %	Particle size distributions %			Texture
			Sand	silt	clay	
0-15	2.01	2.31	46	38	16	Sandy loam
015-30	1.95	2.22	45	29	26	Sandy loam
0-15	1.72	2.01	51	27	22	Sandy loam
15-30	1.62	1.75	44	36	20	Sandy loam
0-15	1.91	1.98	41	35	24	Sandy loam
15-30	1.83	1.77	57	25	18	Sandy loam
0-15	1.84	2.03	43	42	15	Sandy loam
15-30	1.71	1.81	60	28	12	Sandy loam
0-15	1.83	1.90	40	36	24	Sandy loam
15-30	1.67	1.71	72	18	10	Sandy loam
0-15	1.88	1.93	69	16	15	Sandy loam
15-30	1.72	1.62	48	33	19	Sandy loam
0-15	1.75	1.81	53	25	22	Sandy loam
15-30	1.62	1.52	51	32	17	Sandy loam
0-15	1.68	2.01	49	35	16	Sandy loam
15-30	1.42	1.81	50	27	23	Sandy loam
0-15	1.71	2.00	50	29	21	Sandy loam
15-30	1.55	1.92	66	21	13	Sandy loam
015	1.62	1.83	61	25	14	Sandy loam
15-30	1.45	1.67	52	32	16	Sandy loam

Conclusion

The unconventional method of organic matter determination compares favorably with usual Walkley-Black method since the values obtained from the two methods were generally closely related In view of the simplicity of the proposed method as well as affordability it could serve as an alternative to the Walkley-Black method after more thorough investigation on the liability of the proposed method.

Declaration of conflicting interests

The author declared no potential conflicts of interest.

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