The International Journal of Agriculture, Management and Technology, Vol 3, No. 1, 2019

IJAMT

www.ijamt.com.ng

ISBN: 978-978-54468-2-7

N-CONTENT OF SOME SOILS AS INFLUENCED BY SELECTED BIOFERTILIZER PLANTS.

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ABSTRACT

The study investigated nitrogen content of some soils supporting biofertilizer plants in Ohafia area of Southeastern Nigeria. Three plants namely cowpea, groundnut and soybean were chosen for the study. Soil samples were collected at 0-15, 15-30, 30-45 and 45 - 60 cm depths using an auger. Soil samples were airdried and sieved using 2-mm sieve preparatory to routine laboratory analysis on total nitrogen and particle size distribution. Data were subjected to descriptive statistics. Results showed that cowpea had the highest mean value of total nitrogen (3.30 g kg⁻¹) followed by soybean (3.14 g kg⁻¹) and groundnut (2.90 g kg⁻¹) at 0-15 cm soil depth. These values decreased with depth up to 45 cm but higher value of total nitrogen (0.12 g kg⁻¹) was reported for groundnut supporting soils at 60 cm soil depth. Generally, from the results, cowpea and soybean are recommended biofertilizer plants.

Keywords: Biofertilization, Legumes, Total nitrogen, Soil depth

INTRODUCTION

Soil fertility is a major concern in tropical agriculture (Dania and Fagbola, 2013). Soils are continually evolving and transforming within anthropogenic timescale (Richter *et al.*, 2011). It becomes necessary to assess soil quality with time especially in clusters in relation to land use (Steveson*et al.*,2015). The study of dynamic properties of soils which are sensitive to land use is relevant in oil quality, general ecology, agronomy, soil biology and soil quality (Stevenson *et al.*,2015).

One of such dynamic properties is the soil nitrogen content. Biofertilizers or microbial inoculates are commonly used in some countries for soil fertility regeneration and enhancement. Biofertilizers are capable of nitrogen fixation, phosphate solubilizing and organic matter decomposing at a faster rate (Singh, 2012).

Some of the biofertilizers are not intentionally cultivated for soil fertility regeneration, and common in Nigerian agriculture either as sole or mixed crops. Outstanding in these biofertilizersare cowpea (Vignaunguiculata), Soybean (Glycine max), pigeon pea (Cajanuscajan) and groundnut (Arachis hypogea). They are widely cultivated as plant protein sources, but can help fix nitrogen to soils thereby reducing the cost of nitrate-nitrogen fertilizers. Plants influence soils (Shukla *et al.*, 2006) and this changes harvest index (Sinclair, 1998).

Soil nitrogen is one of the most intractable of soil macronutrients as it is readily soluble and easily leached by runoff and percolating soil water. Its deficiency becomes common especially rainforest areas with abundant erosive rainfall and readily erodible sandy soils. It becomes imperative to go for soil nitrogen regenerative and enhancement technologies such as the use of biofertilizers.

In this study, soils of owner – managed farm where these crops are found in mixtures or sole were investigated, thus the main objective of the research was to assess total nitrogen content of soil hosting cowpea, groundnut and soybean.

MATERIALS AND METHODS

The study was conducted in Ohafia area of Southeastern Nigeria, occupying over 50 km² with an elevation over 126 metres above sea level. Ohafia lies between Latitudes 5°30' and 5°48' North; and Longitudes 7°05' and 7°55' East. The area lies within the humid tropical climate with a bimodal rainfall pattern with peaks at July and September every year.It has a mean annual rainfall of about 2100 mm while its temperature ranges from 27 to 31 $^{\circ}$ C. Relative humidity of the area is high especially at wet seasons, and reduces within the 3 driest months of the year. Soils of the area are generally sandy; and are derived from lower coal measures, (Orajaka, 1975). It has a mix of plain, gentle sloping to undulating topography. Ohafia has an outstanding count of inland valleys of agricultural importance.

Smallholder arable farming is practiced, and farmers promote multiple cropping, where a variety of crop types are cultivated in close plant association. Land preparation is by slash and burn while crops are cultivated on mounds/heaps especially in flooded areas/lowlands. Soil fertility restoration is by fallow which has drastically shortened due to increasing population. Main crops are cassava, maize and yams but groundnut, cowpea, beans and even soybean are becoming popular.

Site Description and Sampling

Owner-managed farms were used for the study. In these farms, multiple crops were planted. Five locations were identified for each biofertilizer, and three biofertilizers, namely cowpea, groundnut and soybean were used for the study. At the end of harvest, soils supporting these crops were sampled using auger. The auger was graduated using a masking tape at 0, 15, 30, 45 and 60 cm. Each farm was divided into 20 by 20 m quadrate for sampling. Four bulked soil samples were collected on each site representing 0-15 cm, 15 – 30 cm, 30 – 45 cm and 45 – 60 cm depths. These soil samples were bagged and taken to the Laboratory where they were air-dried and sieved using 2-mm sieve preparatory to laboratory analysis.

Laboratory and Data Analyses

Particle size analysis was determined by hydrometer method (Gee and Or, 2002). Total nitrogen was

measured by microkjeldahl digestion (Bremner, 1996).SoilpH was determined using 1:2.5 soil: liquid (water) ratio (Thomas, 1996). Organiccarbon was measured by wet digestion method (Nelson and Sommers, 1996). Descriptive statistics were used in data analysis.

RESULTS AND DISCUSSION

Particle size distribution of soils in the area shows high sand content, and this could imply low retentivity of total nitrogen in studied soils. Clay content ranged from 250 to 330 g kg⁻¹ (Cowpea), 150 to 210 g kg⁻¹ (Groundnut) and 190 to 250 g kg⁻¹ (Soybean) (Table 1). It is possible that lowest clay content in groundnut supporting soils was responsible for more total nitrogen at 45 - 60 cm depth.

Table 1. Particle size distribution of soils (g kg⁻¹) (mean values)

| Depth | Cowpea | Groundnut | Soybean |
|---------|----------------|----------------|----------------|
| (cm) | Sand silt clay | Sand silt clay | Sand silt clay |
| 0 -15 | 700 50 250 | 750 40 210 | 800 10 190 |
| 15 - 30 | 680 20 300 | 800 50 150 | 790 20 190 |
| 30 - 45 | 660 40 300 | 770 30 200 | 750 20 230 |
| 45 - 60 | 750 20 330 | 810 20 170 | 820 30 250 |

Table 2 shows higher values of total nitrogen in epipedons supporting cowpea followed by soybean supporting soils and least value was obtained in soils under groundnut. Mean values were as follows: cowpea (3.30 g/kg) > Soybean (3.14 g/kg) Groundnut (2.90 g/kg). Similar trend was

followed in the distribution of N-values at 15-30 cm soil depth. Of the total N content captured at this depth, cowpea soil had 41.39 % while soybean occupied 30.13 % with the rest being the contribution of groundnut to the outermost endopedon.

Table 2. N. Content $(g kg^{-1})$ at 0 - 15 cm soil depth.

| Location | Cowpea | Groundnut | Soybean | |
|----------|--------|-----------|---------|--|
| 1 | 3.5 | 2.8 | 3.1 | |
| 2 | 3.6 | 3.0 | 3.3 | |
| 3 | 2.9 | 2.9 | 3.2 | |
| 4 | 3.2 | 3.1 | 3.4 | |
| 5 | 3.3 | 2.7 | 2.7 | |
| Mean | 3.30 | 2.90 | 3.14 | |

| Table 3.N. content (g kg ⁻¹) at 1: | 5-30 cm soil depth | |
|--|--------------------|--|
|--|--------------------|--|

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|----------|-----------------------------|-----------|---------|
| Location | Cowpea | Groundnut | Soybean |
| 1 | 2.5 | 2.0 | 1.9 |
| 2 | 2.6 | 1.8 | 1.9 |
| 3 | 2.4 | 1.7 | 1.8 |
| 4 | 2.5 | 1.6 | 1.7 |
| 5 | 2.5 | 1.5 | 1.8 |
| Mean | 2.50 | 1.72 | 1.82 |

At 30-45 cm soil depth, soil nitrogen decreased sharply although the distribution was similar to trend showed in upper horizons (Table 4). But, there was a change at 45-60 cm soil depth when soil nitrogen was numerically higher in soils supporting groundnut (Table 5). This suggests that leaching was most

intense in groundnut supporting soils. This would be attributed to poor canopy cover of soils by groundnut compared with cowpea and soybean. Presence of N in soil at this depth suggests high solubility and mobility of the element in the soil system.

| Table 4.N. content | (g | kg ⁻¹ |) at | 30-45 | cm soil | depth |
|--------------------|----|------------------|------|-------|---------|-------|
|--------------------|----|------------------|------|-------|---------|-------|

| Location | Cowpea | Groundnut | Soybean |
|----------|--------|-----------|---------|
| 1 | 0.8 | 0.2 | 0.5 |
| 2 | 1.1 | 0.3 | 0.8 |
| 3 | 0.9 | 0.7 | 0.5 |
| 4 | 0.8 | 0.6 | 0.8 |
| 5 | 0.7 | 0.2 | 0.5 |
| Mean | 0.86 | 0.40 | 0.62 |

Table 5.N - content (g kg⁻¹) at 45-60 cm soil depth

| Tuble 5.11 | content (g kg) at 45 00 cm son depth | | |
|------------|---------------------------------------|-----------|---------|
| Location | Cowpea | Groundnut | Soybean |
| 1 | 0.1 | 0.1 | 0.1 |
| 2 | 0.1 | 0.2 | 0.1 |
| 3 | 0.1 | 0.1 | 0.1 |
| 4 | 0.1 | 0.1 | 0.1 |
| 5 | 0.1 | 0.1 | 0.1 |
| Mean | 0.10 | 0.12 | 0.10 |

Organic matter followed similar trend with total nitrogen. Organic matter content of the soils was high at the surface (0-15, 15-30 cm) across the locations (Fig. 1). Generally, cowpea had the highest mean organic matter, followed by soybean while

groundnut had least value. The significant influence of organic matter on soil nitrogen has been reported (Ahukaemere, 2016). Organic matter content of the epipedon is directly related to the organic matter deposited on the soil surface.



Fig. 1. Organic matter content (g kg⁻¹) of the soils.

The pH of the soils ranged from very strongly acidic to moderately acid (Fig. 2). Generally, the pH values obtained in this study across all the locations fall within the range reported in some soils of South-eastern Nigeria.



CONCLUSION

The study investigated nitrogen content of three biofertilizer plants: cowpea, groundnut and soybean. It was found that the distribution of total N varied with legume type and depth of soil. From the results, cowpea and soybean; 0-15 are the recommended legume types and depth of soil.

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