Implication of Reduced Soil pH on Sustainable Food Production in Omoku Community of Rivers State, Nigeria: A Comparative Analysis of the pH of Natural and Chemical Fertilizer-enriched Soils

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ABSTRACT

An experimentat was conducted to examine the implication of pH of Natural and Fertilizerenriched Soils on sustainable food Production in Omoku, an Oil Pruducing Community in Rivers State, Nigeria. 1.0g each of three soil samples collected at three different locations in Omoku oil producing community in Rivers State was diluted with 1.0ml distilled water. The pH of the soil slurry was determined using an automated pH meter after calibrating with known standard K_2PO_4 buffer solution. A mean pH of 6.03 and 5.4 were recorded for natural and fertilizer-enriched soils respectively. The findings revealed that natural soils in Omoku have low pH indicating slight acidity, mean pH of 6.03; while fertilizer-enriched soils is strongly acidic with a mean pH of 5.4. It was recommended among others that Organic fertilizers should be used as these nourish soil organisms, which in turn slowly and steadily make minerals available to plants.

Keywords: *pH, fertilizer, soil, pH meter, Omoku*

INTRODUCTION

Fertilizer is a natural or synthetic substance or mixture used to enrich soil so as to promote plant growth. Plants do not require complex chemical compounds as animals do because they are able to synthesize whatever compounds they need. They are added to soils to supplement the supply of inorganic nutrients required for plant growth in amount necessary to eliminate the deficiencies that limit profitable crop and livestock production (IFA, 2001). Fertilizers are useful because they supply soil nutrients that are deficient in them. The three principal nutrients required for plant growth are nitrogen, phosphorus and potassium.

Synthetic fertilizers are concentrated salts or minerals, some of which are produced as by-products of petroleum processing. They include nitrogen (N), phosphorus (P), and potassium (K) and are listed on package labels as N-P-K. Examples of inorganic fertilizers are ammonium nitrate (NH_4N0_3), potassium sulphate (K_2SO_4) and superphosphate or triple superphosphate (Arsova, 1995). Organic fertilizers originate in plants, animals or minerals and include compost, seaweed, and ground bone and dried excrement of certain vertebrates, particularly seabirds (known as guano) (Hynes, 2006; Wikipedia, 2007a). Human activities have affected productivity of soil through soil pollution by altering its pH. According to Montgomery (2000), some of these activities include domestic, industrial and agricultural practices.

These lead to loss of soil fertility, which makes it necessary to add chemical fertilizers. Continuous application of these fertilizers makes soil acidic (Wikipedia, 2007a, b). This makes aluminum and hydrogen ions become present in excessive amount and may hinder the growth of crops. Moreover, some soil microorganisms cannot function effectively under this condition. Soil productivity is important for agricultural productivity. Many plants and soil life prefer alkaline or acidic conditions, and some diseases seem to thrive when the soil is alkaline or acidic (Jahn et al 2005, in Bickelhaupt, 2007). Also, pH can also affect the availability of nutrients. Hence, the study compares the pH of natural soil and fertilizer-enriched soil in Omoku, an oil-producing community of Ogba/Egbema/Ndoni Local Government Area [ONELGA] of Rivers State as well as implication of reduced soil pH on sustainable food production. Based on this, it was speculated that there is no significant difference between the pH of natural and chemicalenriched soils in the study area.

MATERIALS AND METHOD

This study adopted the experimental research design to assess the implication of reduced soil pH on sustainable food production: a comparative analysis of the pH of natural and chemical fertilizer enriched soils in Omoku community of Rivers State, Nigeria. Materials used include three soil samples collected randomly from different locations in Omoku in ONELGA local government area; three types of fertilizer collected from the Green River Project Office of Nigerian Agip Oil company; conical flasks, distilled water, pH phosphate buffers. Soil samples were collected from different locations and placed in bags labeled 1, 2 and 3. 1.0g soil was collected and placed in conical flask and diluted with 1.0 ml distilled water. Sample was stirred and allowed to stand for 30 minutes. The pH of the soil slurry was read using an automated pH meter after calibration with standard buffer solutions. Mean pH values were calculated. Comparison of natural and fertilizer-enriched soil pH was done using t-test.

RESULT AND DISCUSSION

The pH of three natural and fertilizer-enriched soils samples in Omoku Oil Producing Community as read from the pH meter are shown on table 1a and table 1b respectively. Table 1a shows mean of soil pH at 6.03 which indicates slight acidity while table 1b indicated a reduction in soil pH that is the acidity is increased with the the mean of 5.4. Increased acidity as shown on table 2, that is to say lower pH as a result of fertilizer application is a function of the type of fertilizer applied. According to Bickelhaupt (2007), strongly acid soils as seen in fertilizer-enriched soils are usually the result of the action of strong organic acids such as H_2NO_3 and H_2SO_4. Acidifying fertilizers such as N-P-K nitrate seem to be readily available to farmers in the area. As noted, as soil pH decrease, nutrient such as phosphorus usually decrease in availability due to reactions with aluminum and iron (Wikipedia, 2007b). Most minerals and nutrients are more soluble or available in acid soils than in neutral or slightly alkaline soils. Phosphorus is never readily soluble in the soil but is most available in soil with a pH range centered on 6.5. Highly acidic soils have high concentration of soluble aluminum, iron and manganese, which may be toxic to the growth of some plants. pH range

of between 6-7 promotes the most availability of plant nutrients. Some plants however, do well in slightly acidic to moderately alkaline soils. More over, the soil pH can influence plant growth by its effect on activity of beneficial microorganisms. Decomposers are hindered in strong acid soils. This prevents organic matter from breaking down, leading to accumulation of organic matter and tying up of nutrients.

To ascertain whether there is any significant difference between the pH of natural soil and fertilizer-enriched soil the standard deviation and T value were calculated as shown on table 2. From the result on table 3, T (critical) was greater than T (cal); therefore, the null hypothesis that there is any significant difference between the pH of natural soil and fertilizer-enriched soil is rejected. According to Bickelhaupt (2007), soils tend to become acidic as a result of rainwater leaching away basic ions such as calcium, potassium and sodium; release of carbon dioxide from decomposing organic matter and rock dissolving in soil water to form a weak organic acid as well as formation of strong organic acidic such as hydrogen trioxonitrate (V) acid (H_2NO_3) and Hydrogen tetraoxosulphate (VI) acid (H_2SO_4) from decaying organic matter and oxidation of ammonium fertilizer.

IMPLICATIONS OF REDUCED pH ON SUSTAINABLE FOOD PRODUCTION

By implication, reduced pH, which is increased acidity, will mean leaching of mineral nutrient because some nutrients become more soluble in such acidic medium (Redmond, 2005). This can be carried by rain to nearby rivers, leading to water pollution and hence death of fishes and other seafood (Mayer, 2001) which are important sources of protein. The implication is protein -deficiency malnutrition. Besides, the death of useful soil microbes due to reduced soil pH implies poor crop yield and hence food shortages.

Table 1a: Soil pH of natural soil of Omoku

Soil sample	pH	Remark
1	5.6	Slightly acidic
2	6.1	Slightly acidic
3.	6.4	Slightly acidic
Mean	6.03	

Source: Experimentation, 2009

Table 1b: Soil pH of the Fertilizer-enriched soil soil of Omoku

Soil sample	pH	Remark
1	5.0	Slight acidic
2	5.3	Slight acidic
3.	6.0	Slight acidic
Mean	5.4	Acidic

Table 2: Test of significant difference of soil pH

	pH meter readings		
	Natural soil		Fertilizer-enriched soil
Mean	6.03		5.40
Standard Deviation		0.40	0.51
Calculated T value		0.02	
Degree of freedom		4	
Tabulated T value<0.05		2.77	

CONCLUSION AND RECOMMENDATIONS

Fertilizers are added to soil to provide nutrients hitherto lost by soil as a result of over cultivation. However, excessive or wrong application of certain fertilizers results in acidification of soil. Natural soils in Omoku have low pH indicating slight acidity, mean pH of 6.03; while fertilizer-enriched soils is strongly acidic with a mean pH of 5.4. Furthermore, there is significant difference between the pH of natural and fertilizer-enriched soils respectively Based on the findings of this study, the following were recommended:

1. Organic fertilizers should be used as these nourish soil organisms, which in turn slowly and steadily make minerals available to plants.
2. There should be monitoring of soil pH
3. Soil acidity should be reduced i.e. pH increased by adding lime or wood ashes to such soils. This will replace hydrogen ions and raise the pH as well as provide two nutrients such as calcium and magnesium to the soil. Lime also makes phosphorus that is added more available for plant growth and increases the availability of nitrogen by hastening the decomposition of organic matter.

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