PIONEER
ACADEMIC PUBLISHING LIMITED

Journal of Progress in Engineering and Physical Science
ISSN 2709-4006
www.pioneerpublisher.com/jpeps
Volume 4 Number 1 February 2025

Nitrogen Status of the Soil in the Captain Elechi Amadi Polytechnic Demonstration Farm

Dr. Roland Gbarabe[1] & Engr Daye O. Barango[1]

[1] Department of Agricultural Technology, Captain Elechi Amadi Polytechnic, Rumuola, Port Harcourt, Nigeria
Correspondence: Engr Daye O. Barango, Department of Agricultural Technology, Captain Elechi Amadi Polytechnic, Rumuola, Port Harcourt, Nigeria.

doi:10.56397/JPEPS.2025.02.06

Abstract

This study evaluates the nitrogen status of soil in the Captain Elechi Amadi Polytechnic demonstration farm, aiming to determine nitrogen levels, identify causes of nitrogen depletion, and propose remediation strategies. Soil samples were collected from five geo-referenced points and analyzed using the Kjeldahl method. Results indicated a mean total nitrogen content of 0.036% (360 ppm), exceeding optimal levels for most crops. Excessive nitrogen can suppress flowering and negatively impact crop yield and quality. Recommendations include planting nitrogen-demanding crops, reducing nitrogen-rich fertilizer application, and using agricultural lime to balance soil nutrients.

Keywords: soil Nitrogen content, Nitrogen excess, crop yield, soil fertility, Nitrogen management

1. Introduction

Determining the nutrient concentration of nitrogen can reveal how a soil is functioning in regards to its intended use and how nutrients are recycled within the soil. Knowing the concentration of nutrients can help us to know when to add fertilizer, how much to add, and which nutrients needed supplement and in what amount (Jove, 2019; Food & Agriculture Organization, 2021).

Consistently high nitrogen soil, for instance, would be good for growing nitrogen demanding crops such as fluted pumpkin and other vegetative. High nitrogen levels are also particularly useful for non-flowering plants because nitrogen is required for any green part of plants. High nitrogen levels can suppress flowering however, if they remain higher than phosphorus level.

Since for the soil to produce sufficient nutrients and also have an access to these nutrients is a key factor, that means, the nutrients of the soil can be locked away from plants and soil organisms because of various soil conditions. The condition that can influence availability and accessibility of soil nutrients includes; soul moisture content, soil porosity, soil conductivity, soil PH, temperature and competitive demand between organisms (Kim & Jeong, 2020).

Apart from providing adequate nutrient and having access to those nutrients of the soil, the soil also depends on proper balance of these nutrients. Phosphorus is known to help in root growth, seed formation and quick ripening of

fruits while calcium helps in pectate formation and tuberization (Anonymous, 1993). Calcium may antagonize the available phosphorus if they are not in balance proportion. Though nitrogen helps in chlorophyll formation and plant growth, it's excess in relation to other nutrients, such as potassium, phosphorus and Sulphur can delay crop maturity (Mason, S. C. & Pavlista, A. D., 2020). Also, sodium and potassium have negative interactions. Change in soil PH will result in numerous interactions where an ion or nutrient interferes with or compete with the uptake and utilization of other nutrients by plants (Ayeni & Adeleye, 2011).

2. Aims of the Study

This study is aimed at identifying the exact nitrogen level in the Captain Elechi Amadi polytechnic demonstration farm.

2.1 Specific Objectives

1) Examine the problems caused by the absence of nitrogen in the school demonstration farm.

2) Identify what causes the depletion of nitrogen in the soil.

3) Proffer solutions on how to reclaim nitrogen depleted or damaged in the school farm.

2.2 Sampling Procedure

The following procedure was used in collecting the soil samples.

Procedure for collection of soil samples:

1) Using the auger bit, made a boring of about 6 inches and pull it up, the soil collected forms the sample.

2) I took 10 samples of soil from each area of the farm.

3) After which it was mixed thoroughly and half of it used to fill polythene bags.

4) The bags were closed and paper-tagged.

2.3 Sample Size

Five (5) polyethylene bags of soil samples were tested for Nitrogen.

3. Procedures for Soil Test

3.1 Nitrogen

Soil nitrate (NO3) and ammonium (NH4) are both forms of inorganic nitrogen that are readily available for use by plants. They are formed from the mineralization (by microorganisms) of organic forms of nitrogen such as soil organic matter, crop residue and manure (Zhang, Davidson & Mauzerall, 2020). The following was the procedure used for testing nitrogen in the soil;

1) Filled a test tube to 7ml with nitrogen extracting solution.

2) Used 0.5g spoon to add two measures of soil sample.

3) Cap and gently shake for one minute.

4) Remove cap and allow soil to settle.

5) Use a clean Piper / dropper to transfer the clear liquid to a second clean test tube. To avoid agitation of soil, squeeze the bulb of the Piper before inserting the tip into the liquid. Then release the bulb slowly to draw clear liquid into the Piper. Fill a second tube to 3ml with liquid.

6) Use the 0.25 (smaller) spoon to add two measures of nitrogen indicator powder to the soil extract in the second tube.

7) Cap and gently shake to mix. Then wait for 5 minutes for the pink colour to develop above the powder.

8) Match the test colour with nitrogen colour chart and used the reading to analyze.

4. Result, Analysis and Discussion

The soil samples were taken from five points in the crop demonstration farm in the Captain Elechi Amadi polytechnic with a measurement of ten meters apart from each other. The geo-reference point for the five points is;

1) N 4.83395°, E 6.99545°

2) N 4.83311°, E 6.99534°

3) N 4.83380°, E 6.99547°

4) N 4.83387°, E 6.99561°

5) N 4.83384°, E 6.99549°

These samples were divided into 15 portions and were used to test for the needed parameters (N. P. K) in order to get the exact amount of these nutrients in the soil. The following result was obtained from the soil test carried out on the samples of soil taken from the crop demonstration farm in the Captain Elechi Amadi polytechnic, Rumuola, Port Harcourt.

S/N	Parameters	Unit of measurement	A Top	B Top	C Top	D Top	E Top
1	Total Nitrogen	%	0.06	0.05	0.04	0.02	0.01

Source: Roland and Daye, 2020.

4.1 Analysis

From the above result the mean value of the various parameters can be deduced to know / estimate the nitrogen status of the soil in the crop demonstration farm in the Captain Elechi Amadi polytechnic.

Mean =ΣFx/ x

Where: Σfx is the summation of all the result gotten at the different points.

X is the number of values.

Therefore, the mean value of Nitrogen is:

Total N= (0.06 +0.05+0.04+0.02+0.01)/ 5

Total N= 0.036%

The nutrient status of nitrogen in the crop demonstration farm in the Captain Elechi Amadi polytechnic is 0.

STEP1: Converting all the mean values to a common measuring unit i.e. PPM (part per million).

Key: 1%= 10 000 ppm or 0.0001%= 1ppm

1mg/kg= 1ppm

1cmol/kg= 1ppm

Total N=0.036% *10000= 360ppm

STEP2: Addition of the value of N.

360+4.436+0.292= 364.728

STEP3: Find the percentage of each parameter.

N= 360/364.728 * 360/1= 355.33%

4.2 Discussion

4.2.1 Nitrogen

The Normal background level of nitrate in soil not fertilized or used for commercial crops ranges from 5 to 10 parts per million (PPM) (Liu, Zhang & Han, 2021). The total nitrogen content of a soil ranges from <0.0207% in topsoil which is 207ppm.

From my soil test result, the soil in the crop demonstration farm in the Captain Elechi Amadi polytechnic has 0.036% or 360ppm. Meaning, the soil has a high level of nitrogen.

Sometimes the fertility of a soil is determined by the kind of crop sown on it. Therefore, the nitrogen status of the soil in the crop demonstration farm in the Captain Elechi Amadi polytechnic will be compared to different soil requirement of different crops.

The optimum nitrate level for soil used for corn (*Zea mays*) production is about 25ppm. When corn is planted in the soil in the crop demonstration farm in the Captain Elechi Amadi polytechnic the corn will not produce the expected yield due to the excessive level of nitrogen in the soil. On the other hand, leafy green vegetables could survive but the optimum nitrate requirement of the soil is about 150ppm and above. This is mostly because nitrogen has an important effect in the growth of leaf.

Below is a table showing the fertility level of a soil in respects to nitrogen from the article written by Allan Fulton et al. (2010, April).

Fertility Level	PPM
Low	<36
Medium	36-72
High	73-108
Excessive	>109

From this table it shows that the nitrogen status of the soil in the crop demonstration farm in the Captain Elechi Amadi polytechnic is in excess and this will have a detrimental effect on crops that will be planted.

The problem of excess nitrogen in the soil is usually from the application of some sort of well-intended soil amendments such as poultry droppings (Allen, 2010).

The presence of excess nitrogen could suppress the effect of the other nutrients and that affects the plants negatively. This problem can be solved by planting high nitrogen demanding crops, reduce the application of poultry droppings used on the soil and also the use of agricultural limes.

5. Recommendation

1) The soil in the crop demonstration farm in the Captain Elechi Amadi polytechnic should be limed using agricultural lime, this helps to increase the PH of the soil in acidic soil (there by increases alkalinity), it permits improved water penetration for acidic soil and it also improves the uptake of major plant nutrients (nitrogen, phosphorus and potassium) of plants on acidic soil (Malcolm E. Summer & Yamada Tsuioshi, 2002).

2) Soil amendment such as peat which is an organic soil amendment (immature form of coal) can be used to improve soil aeration and absorbing water but confers on nutritional values to the plant.

3) Fertilizers rich in phosphorus and potassium should be used in order to increase the phosphorus and potassium level of the soil. Such fertilizers include basic slag, super phosphate, potassium sulphate, etc.

References

Allen, F. (2010). Farm advisor Tehama, Glenn, Colusa, and Shasta countries, Primary plants nutrients: nitrogen, phosphorus and potassium.

Ayeni, L.S and Adeleye, E.O. (2011). Soil Nutrient status and nutrient interactions as influenced by agro wastes and mineral fertilizer in an incubation study in southwest Nigeria. *International journal of soil science*, *6*(1), 60-68.

Colwell, M. (2005). Phosphorus interaction with other nutrients and lime in field cropping system. In Struvart, B. A. (ED). *Advances in soil science*. New York, N.Y. 201-236.

Food and Agriculture Organization of the United Nations. (2021). Standard operating procedure for soil nitrogen Kjeldahl method. Rome.

Jove science education database. Environmental science. (2019). Soil nutrient analysis; nitrogen, phosphorus and potassium. Jove, Cambridge, M.A.

Kim, H., Jeong, H. (2020). Analysis of Soil Total Nitrogen and Inorganic Nitrogen Contents. *Korean Journal of Soil Science and Fertilizer*, *53*(1), 1-10.

Liu, X., Zhang, Y. and Han, W. (2021). Effect of Different Rates of Nitrogen Fertilization on Crop Yield, Soil. *Agronomy Journal*, *113*(1), 123-134.

Malcolm E. Summer, Yamada Tsuioshi. (2002). Farming with acidity. *Communication in soil science and plant analysis*, *33*(15-18).

Mason, S. C., Pavlista, A. D. (2020). Importance and Effect of Nitrogen on Crop Quality and Health. *Agronomy & Horticulture Faculty Publications*, 200.

Zhang, X., Davidson, E. A. and Mauzerall, D. L. (2020). Fate of nitrogen in agriculture and environment: agronomic, eco. *Biological Research*, *53*(1).