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EVALUATION OF NITRATES, SULPHATES AND PHOSPHATES LEVELS IN SOIL OF TOMBIA AND GBARANTORU FARMLANDS IN YENAGOA L.G.A, BAYELSA STATE, NIGERIA

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Abstract: Soil samples were used to assess the quantities of accessible phosphate, nitrate, and sulphate. A range of sites and depths were used to collect samples. At various depths, samples were obtained with an auger (from 10 cm to 30 cm). A standard spectrophotometer was used to detect NO_3^-, SO_4^{2-}, and PO_4^{3-} in soil samples and controls at 470nm, 420nm, and 660nm, respectively. Using Microsoft Excel, the mean and standard deviation of the soil samples tested in various batches were computed. A one-way ANOVA was used to examine the significant difference between the samples and the control with a probability of 0.05 acceptance. The findings showed nitrate (2.74ppm–6.60ppm), sulphate (2.93ppm–5.86ppm), and phosphate (0.45ppm–2.60ppm) ranges for both farmlands and control in the Tombia and Gbarantoru communities. These nutrients' concentrations were found to be below standard, and fertilizer application is recommended to increase nutrient availability in farmlands.

1. INTRODUCTION

Soil is a non-renewable, dynamic natural resource that is required for life to exist. It is required for the survival of life on Earth (Jon and Jackie, 2015). It's typically made out of partially decayed and damaged parent rock. Minerals, organic matter, water, air, and life are all part of the soil system. in the year 2014 (Doreen, Godfred, and Henry). Soil is one of the most significant resources on earth, influencing air and water quality, plant and food development, and overall health. Soil is essential for preserving life and impacting air, water, and soil quality, even though it is just a meter deep above the earth's surface, Bohn, McNeal, and O'Connor (2001). Nitrate (NO_3^-) and ammonium (NH_4^+) are the sources of the remaining nitrogen that plants can utilise (Hope, Zhu, Gries, Oleson, Kaye, Grim, & Baker, 2005). Plants use 50–70% of nitrogen from fertilizers, with the remaining 2–20% evaporating and mixing into the atmosphere after decomposition. (Antonopoulos & Wyseure, 1998; Akkurt, Alclar, 2002). Most farmers are also unaware of the importance of nitrogen, sulphur, and phosphorus fertilizers in crop nutrition. The aim of this study is to analyse the Nitrate, Phosphate and Sulphate levels in the farmland of Gbarantoru and Tombia communities.

Crop productivity and field management are both influenced by the texture of the soil. A soil's textural class is determined by the quantity of sand, silt, and clay it contains (Wayne, Quirine, Steve, Steve, Jonathan, Renuka and Steve, 2007). Individual soil particles and clusters' form, size, and spatial arrangement, as well as "the mix of different types of pores with solid particles" are two approaches to define soil structure (Marcello, 2010). Fig 1 below present different colours and forms soil appears to have.

(a) *(b)* *(c)*

Figure 1 Structure of the soil

The number, size, arrangement, and distribution of soil pores may all be utilized to determine the soil's physical state and structure. According to Carter and Ball, pore-size distribution (Cary and Hayden 1973) and soil structure categorization can predict water penetration rates, plant water availability, water storage capacity, and aeration status (1993). Thomasson (1978); McKeague, Wang, and Coen (1986). When the ground is moist, macropores help water flow. Calcium, magnesium, and sulfur are classed as supplemental nutrients since they are seldom limiting nutrients (Schoonover and Jacki, 2015). Salts in soil include calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), potassium (K^{+}), chloride (Cl^{-}), bicarbonate (HCO_3^{-}), and sulphate (SO_4^{2-}), which are generated by the weathering of primary minerals or salts brought by wind or water from other locations (Ann McCauley and Clain Jones 2005). Soil acidity and alkalinity are measured in pH units and fluctuate over time (Belinda Lake 2000). Organic soil elements typically include living animals (Kwazulu – Natal 2018). Plants fight for water and nutrients in the soil, which may be viewed as a complex system (Melo, 1994). Microbial biomass is a collection of labile organic molecules that serves as a major source of nitrogen and phosphate for plants (Jenkinson and Ladd, 1991; Marumoto, Anderson, Domsch, 2003). (1982). Soil biodiversity (USDA 1998) reflects the diversity of living things in the soil, as seen in Fig 2 below.

Figure 2 How earth worm aerates the soil. (Source: European Commission, 2010)

Soil contamination has the potential to substantially impair the core ecological processes of soil, as well as a number of downstream impacts that are difficult to identify and detect (Karuna and James, 2020). The most concerning of the plant nutrients that crops require in considerable quantities is

phosphorus (Syers, Johnston, and Curtin, 2008). Phosphorus is found in the form of phosphorus phosphate in the soil (PO_4^{3-}). For growth and reproduction, plants utilize phosphorus to store and transport the energy created by photosynthesis.
Plants need a lot of phosphorus in their young cells, such shoots and root tips, since their metabolism is high and cell reproduction is fast (Silva and Uchida, 2000).
The visual implications of phosphorus deficit in crops are shown in Figures 3 and 4.

(a) *(b)*

Figure 3 Phosphorus-deficient corn characterized by purple colour on lower leaves.

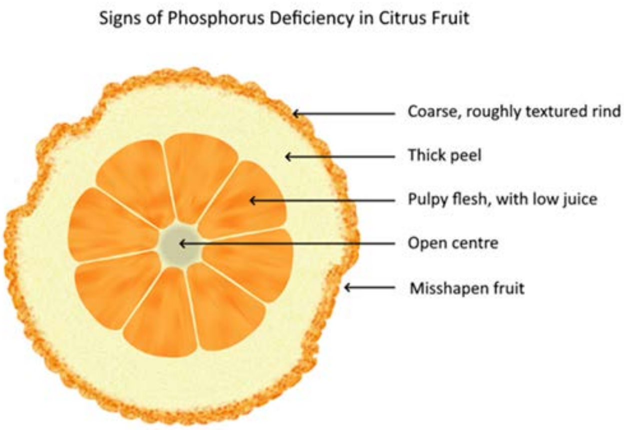

Figure 4 Phosphorus deficiency in citrus fruit.

Plant growth, development, disease resistance, and performance, as well as crop nutritional quality, are all affected by sulphur shortage. Sulphur deficiency symptoms are similar to nitrogen deficiency symptoms, and they are most frequent in sandy soils with low organic matter and moderate to heavy rainfall (Silva and Uchida, 2000).

Figure 5 Sulphur deficiency in corn.

Plants can get nitrogen (N) in the form of nitrate (NO_3^-) and ammonium (NH_4^+) ions and its deficiency results to a reduction in cell division, growth may be slowed, the protein content of seeds and vegetative portions decreases when nitrogen levels are reduced (Silva and Uchida, 2000). Fig 6 presents the image of nitrogen deficiency on crops.

Figure 6 Nitrogen deficiency of corn

2. MATERIALS AND METHODS

2.1 SAMPLE COLLECTION

Soil samples were collected from different depths in the farmland from Tombia community and Gbarantoru community all in Yenagoa Local Government Area, Bayelsa State, Nigeria. Both communities are located close to the Nun River as shown in Fig 7. Below.

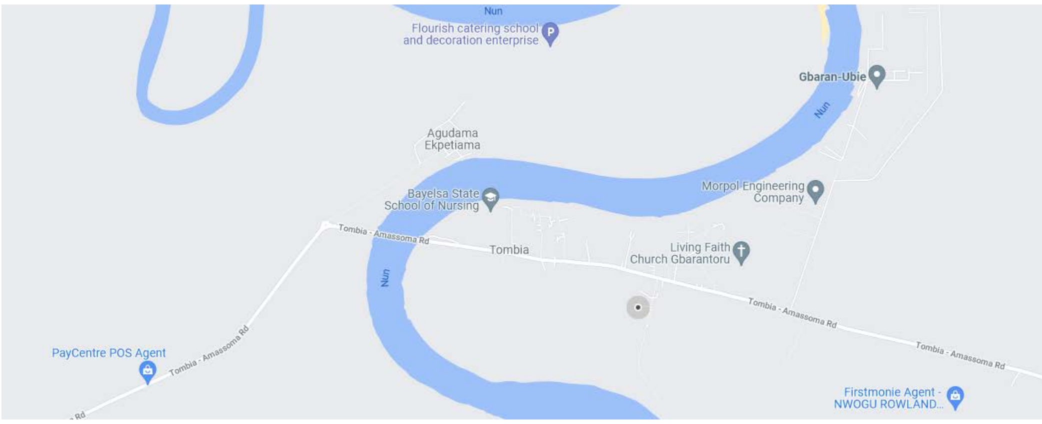

Figure 7 Tombia community and Gbarantoru community (Source: Makar Technologies; Map data ©2021

The samples were collected by using auger at different depths (from 10 cm to 30 cm). The auger is suitable for sampling hard soils. It consists of a sharpened spiral blade attached to a central metal rod which can be screwed into the soil. The auger was screwed to the desired depth and the sample was withdrawn. Soil samples were transferred to plastic bags and were labeled. The symbol T_a, T_b, and T_c were given for soil samples gotten from Tombia community with a, b and c, representing soil depth at 10 cm, 20 cm and 30 cm respectively. Also, another symbol G_a, G_b and G_c were given for soil samples gotten from Gbarantoru community with a, b and c, also representing soil depth at 10 cm, 20 cm and 30 cm respectively.

2.2 SAMPLE PREPARATION

The samples were air-dried after being transported to the lab, and any grass or other items were removed. After rolling the samples to break up big clumps of soil particles, sifting was performed using a mechanical sieving system with various mesh sizes. For further investigation, the sieved samples were placed in their respective cleaned and labeled plastic bags.

2.3 METHOD FOR SOIL ANALYSIS

2.3.1 Determination of pH

10 g of air-dried soil sample was put in a 100 mL beaker, and 20 mL of distilled water was added. If the soil sample was allowed to settle, a glass rod was used to stir up the mixture and break up the lumps, and the supernatural was filtered and the pH of the filtrate was determined. The pH of the soil sample was determined by taking a constant measurement from the water.

2.3.2 Determination of Electrical Conductivity of the Sample Soil: Into the filtrate in 2.3.1 above, the conductivity probe was inserted and the meter switched over to the conductivity mode. A steady read out from the meter is recorded as the conductivity of the soil sample.

2.3.3 DETERMINATION OF NITRATE (NO3-)

50 g sodium acetate was dissolved in 250 mL distilled water in a 1 L flask to make the extracting solution. The solution was then given 30 mL of strong acetic acid. This was created using distilled water up to 1 liter. In a shaking container, 5 g of salt was weighed. The container was filled with 1/2 spatula full of activated charcoal and 20 mL of extracting solution. After shaking for two minutes, the bottle was filtered.

1 mL of the filtrate was transferred to a test tube, which was then filled with 0.5 L of NO_3 reagent (brucine) and 2 mL of H_2SO_4. These were mixed for 30 seconds and allowed to stand for 5 minutes. A further 2 mL of distilled water was added and mixed again. The test-tube was allowed to cool for 15 minutes. The spectrophotometer was set at 470 nm and the absorbance by extrapolation from a standard nitrate curve.

2.3.4 DETERMINATION OF SULPHATE (SO42-)

Preparation of extracting solution 0.5g of $KH_2PO_4.2H_2O$ and make up to 1 L. 5 g of dried and sieved (2 mm) soil samples were weighed into 250 mL conical flask and 25 mL of extracting solution was added. This agitated on the mechanical shaker for 10 mins. The suspension was filtered and 10 mL of the filtrate was transferred into a 25 mL of volumetric flask, some distilled water was added to bring the volume to 20 mL. 1 mL of 10% $BaCl_2$ was then added and the final volume was made up to the mark. The mixture was shaken for 30 mins. The spectrophotometer was set at 420 nm, and the % transmittance was determined and the concentration SO_4 was obtained by extrapolation of a standard SO_4 laboratory graph.

2.3.5 DETERMINATION OF PHOSPHATE (PO43-)

Extracting solution; for phosphate determination was prepared by adding, 15 mL of 1.0 m Ammonium fluoride solution into a 500 mL volumetric flask, 460 mL of distilled water was added to the flask and made up to the mark.

1 g of air-dried soil sample was weighed into a centrifuge tube, and 7 mL aliquots of the extraction solution were added into the tubes, which were then agitated for 5 minutes on the orbital shaker. The tubes were then placed in the centrifuge machine and centrifuge machine, where they were centrifuged for 10 minutes at 2000 rpm. 2 mL of clear supernatant aliquots were put into boiling tubes, along with 5 mL of distilled water and 2 mL of ammonia solution, and the tubes were shaken to mix. Finally, 1 mL aliquots of stannous chloride were added to the tubes and mixed. The spectrophotometer was set at 660 nm. Absorbance values were taken. The amount of phosphate in the soil was determined from the standard curve was preferred with standard phosphate solutions. (Bray and Kurtz; Jackson, 1965, 1962).

2.4 STATISTICAL ANALYSIS

Data analysis was carried out using Microsoft Excel 2007 Software to calculate the mean and standard deviation, while One-way ANOVA of Stats Tester software was used in assessing the significant differences among the control and soil samples. Significance was accepted at 0.05 level of probability.

3.0 RESULT AND DISCUSSION

3.1a SOIL SAMPLE RESULT FOR TOMBIA COMMUNITY

Tables 3.1a, 3.2a and 3.3a below show soil sample test result for three months at different soil depths in Tombia community control (uncultivated land) and farmland. Figure 3.1a, 3.2a and 3.3a also show a graphical representation of soil sample test for control (uncultivated land) and farmland in Tombia community from September to November.

Table 3.1a: Mean and Standard Deviation (±) of Control, NO_3^-, SO_4^{2-} and PO_4^{3-} of Soil Samples Collected From Tombia Farmland in September

Parameters	10cm	20cm	30cm	Control
NO_3	2.74 ± 0.02	3.65 ± 0.02	5.44 ± 0.01	4.54 ± 0.02
SO_4	4.5 ± 0.02	3.82 ± 0.02	5.78 ± 0.02	4.56 ± 0.01
PO_4	0.66 ± 0.01	0.54 ± 0.02	0.45 ± 0.01	1.25 ± 0.02

Mean and Standard Deviation (±) of three replicate analysis.

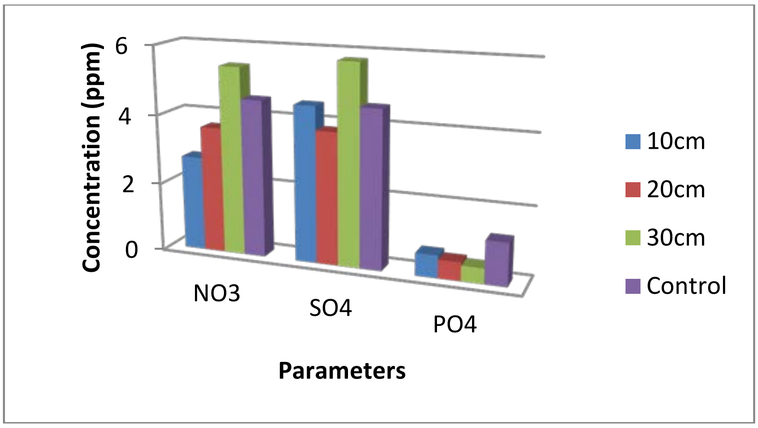

Figure 3.1a Soil sample test for control (uncultivated land) and farmland in Tombia Village in September.

Table 3.2a: Mean and Standard Deviation (±) of Control, NO_3^-, SO_4^{2-} and PO_4^{3-} of Soil Samples Collected From Tombia Farmland in October

Parameters	10cm	20cm	30cm	Control
NO_3	4.52 ± 0.03	3.75 ± 0.02	5.35 ± 0.02	5.30 ± 0.05
SO_4	4.7 ± 0.02	5.86 ± 0.02	3.48 ± 0.02	3.5 ± 0.02
PO_4	0.64 ± 0.01	0.69 ± 0.10	1.3 ± 0.02	2.57 ± 0.60

Mean and Standard Deviation (±) of three replicate analysis.

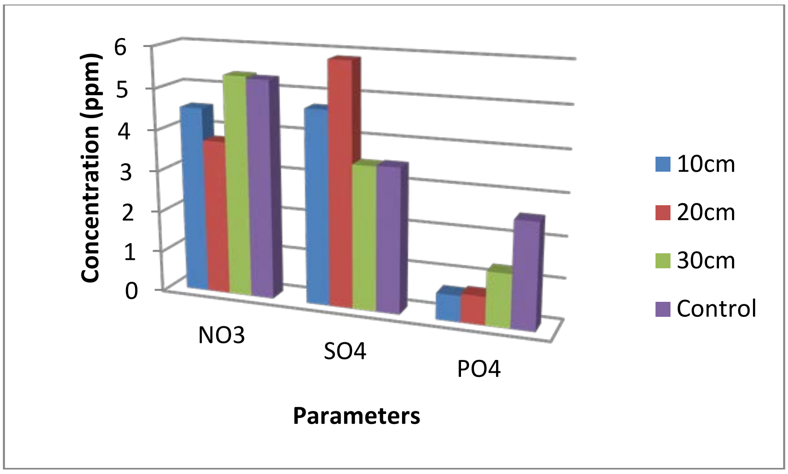

Figure 3.2a Soil sample test for control (uncultivated land) and farmland in Tombia Village in October

Table 3.3a: Mean and Standard Deviation (±) of Control, NO_3^-, SO_4^{2-} and $PO_4^{3-}$of Soil Samples Collected From Tombia Farmland in November

Parameters	10cm	20cm	30cm	Control
NO_3	4.97 ± 0.01	3.94 ± 0.02	3.87 ± 0.01	4.9 ± 0.02
SO_4	2.93 ± 0.01	4.84 ± 0.02	5.28 ± 0.02	4.05 ± 0.02
PO_4	1.2 ± 0.02	0.84 ± 0.02	0.7 ± 0.02	1.6 ± 0.02

Mean and Standard Deviation (±) of three replicate analysis.

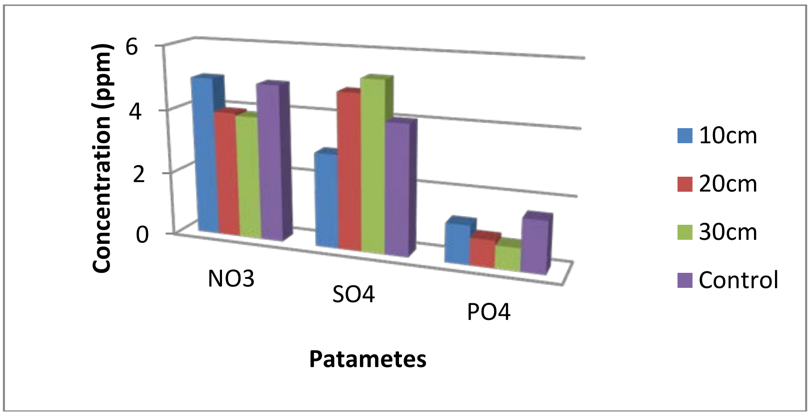

Figure 3.3a: Soil sample test for control (uncultivated land) and farmland in Tombia Village in November

3.1b SOIL SAMPLE RESULT FOR GBARANTORU COMMUNITY

Tables 3.4, 3.5 and 3.6 below show soil sample test result for three months at different soil depths in Gbarantoru community control (uncultivated land) and farmland. Figure 3.4, 3.5 and 3.6 also show a graphical representation of soil sample test for control (uncultivated land) and farmland in Gbarantoru community from September to November at different soil depths.

Table 3.4: Mean and Standard Deviation (±) of Control, NO_3^-, SO_4^{2-} and $PO_4^{3-}$of Soil Samples Collected From Gbarantoru Farmland in September

Parameters	**10cm**	**20cm**	**30cm**	**Control**
NO_3	6.6± 0.02	5.88± 0.02	6.02± 0.01	5.37 ± 0.20
SO_4	3.41± 0.01	3.95± 0.02	3.66± 0.02	4.5 ± 0.02
PO_4	1.76± 0.02	2.1± 0.02	2.15± 0.02	2.12 ± 0.02

Mean and Standard Deviation (±) of three replicate analysis.

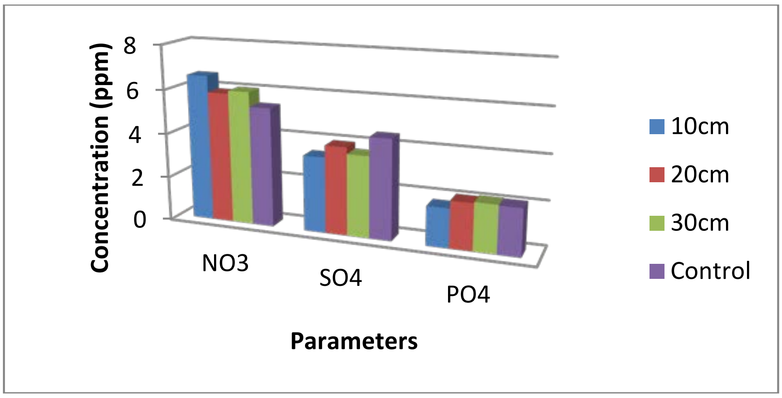

Figure 3.4 Soil sample test for control (uncultivated land) and farmland in Gbarantoru community in September

Table 3.5: Mean and Standard Deviation (±) of Control, NO_3^-, SO_4^{2-} and $PO_4^{3-}$of Soil Samples Collected From Gbarantoru Farmland in October

Parameters	10cm	20cm	30cm	Control
NO_3	4.64± 0.01	5.6± 0.01	4.44± 0.01	4.94 ± 0.02
SO_4	4.3± 0.02	3.96± 0.02	3.50 ± 0.02	3.48 ± 0.02
PO_4	1.8± 0.02	1.84± 0.02	2.00 ± 0.02	1.9 ± 0.02

Mean and Standard Deviation (±) of three replicate analysis.

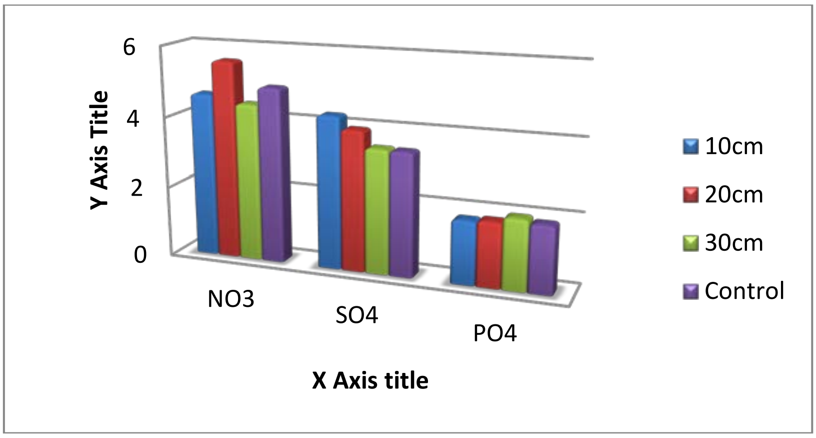

Figure 3.5 Soil sample test for control (uncultivated land) and farmland in Gbarantoru community in October

Table 3.6: Mean and Standard Deviation (±) of Control, NO_3^-, SO_4^{2-} and $PO_4^{3-}$of Soil Samples Collected From Gbarantoru Farmland in October

Parameters	10cm	20cm	30cm	Control
NO_3	5.3± 0.01	4.90 ± 0.02	4.60 ± 0.01	5.09 ± 0.02
SO_4	4.77 ± 0.01	4.45 ± 0.02	4.26 ± 0.02	4.08 ± 0.02
PO_4	2.25 ± 0.02	2.44 ± 0.02	2.60 ± 0.02	2.04 ± 0.02

Mean and Standard Deviation (±) of three replicate analysis.

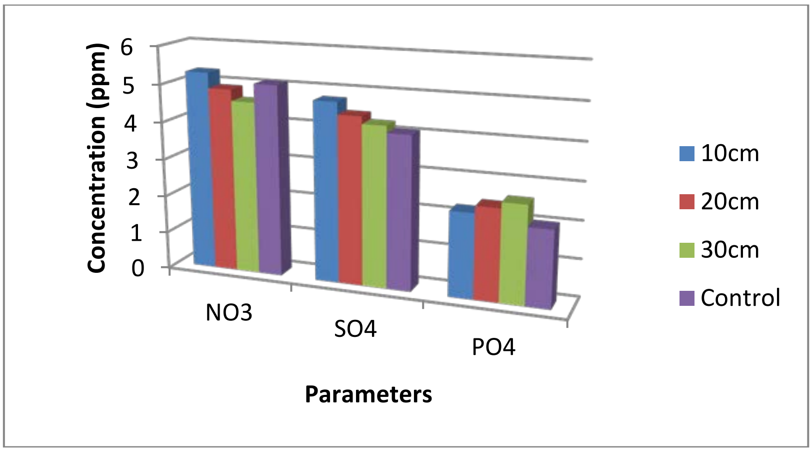

Figure 3.6 Soil sample test for control (uncultivated land) and farmland in Gbarantoru community in October

3.3 DISCUSSION

3.3.1 Control and Farmland soil Sample Analysis in Tombia Community from September to November

The results in table 3.1 and figure 3.1 show a significant difference (p.05) between the means of nitrate concentration in the control and soil samples from Tombia farmland at various depths (i.e., 10, 20, and 30 cm). At 30 cm depth, the nitrate concentration was seen to be highest (5.44 ± 0.01 ppm) in September, as the results showed an increase in the concentration of nitrate as the depth increased. The results also revealed statistically significant (p.05) differences in the means of sulphate concentration between the control and soil samples at 10, 20, and 30 cm. It was also observed that the Sulphate level increased (5.78 ± 0.02 ppm) at 30 cm in the month of September. However, the Sulphate concentration at 20 cm was seen to be the least in the month. The phosphate concentration in the control and soil samples also showed significant differences ($p<.05$) in the means at various depths. However, the concentration in the soil samples showed a decrease as the depth increased. The highest value (1.25 ± 0.02 ppm) of phosphate in soil was found in the control (i.e. uncultivated land). The Nitrate composition in the control and soil samples as shown in table 3.2 and figure 3.2 reveals a significant difference (p=.01) in the means between them at 10cm, (p=.000001) at 20 cm. However, there was no significant difference (p=0.2) in the means of nitrate concentration between the control and soil sample at 30cm. The nitrate concentration at 30cm was seen to be the highest (5.35 ± 0.02 ppm) and slightly above the control value. As seen in figure 3.2 the Sulphate concentration in the control and soil samples in the farmland showed significant difference ($p<.05$) between them at 10 and 20 cm. However, there was no significant difference (p=0.29) in the means of Sulphate concentration between the control and soil samples in the farmland. Sulphate concentration at 20 cm was seen to be the highest (5.86 ± 0.02 ppm). The result showed significant differences (p=.02) in the means of phosphate concentration between the control and the soil sample at 10 cm and 20 cm. However, there was no significant difference (p=.053) between the means of phosphate concentration between the control and soil sample at 30 cm. The concentration of phosphate in the farmland increased as the depth increased. It was also observed that phosphate concentration was the least (0.64 – 1.3 ppm) in the month of October compared to Sulphate and nitrate levels in the farmland.

The nitrate concentration difference between the control and soil sample was shown to be significant (p =.005) at 10 cm in table 3.3 and figure 3.3. It also showed significant differences in the means between the control and soil samples at 20 and 30 cm. The nitrate concentration in the farmland soil sample showed a decline as the depth increased in the month of November. It was also discovered that the sulphate concentrations in the means of soil samples from the control and farmland were significantly different (p.05) at different depths. The data also showed an increase in the concentration of sulphates as the depth increased from 10 cm to 30 cm. Phosphate levels in soil samples from Tombia farmland and control farmland were found to differ significantly (p.05) in the means at all depths. However, data showed a decline in the phosphate concentration as the depth increased.

3.3.1 Control and Farmland soil Sample Analysis in Tombia Community from September to November

The results in table 3.4 revealed that the nitrate level in the control and farmland in the Gbarantoru community has significant differences (p=.0002, *p =.005,* and *p*= .002) in the means between them at 10 cm, 20 cm, and 30 cm, respectively. The nitrate concentration at 10 cm appeared to be the highest (6.6± 0.02 ppm). The concentration of sulphates in the soil samples of the control and farmland also showed a significant difference in the means at various depths. However, the control was higher (4.5 ± 0.02 ppm) in concentration than the amount found in the farmland. The phosphate levels in soil samples from the control and farmland were found to differ significantly (*p*.05), but there was no significant difference (*p* =.14) in the means of soil samples from the control and farmland at 30 cm. The phosphate concentrations in farmland increased as the depth increased in the month of October. However, as shown in other tables, the value of phosphate in soil appeared to be smaller than that of nitrate and sulphates.

According to the results in Table 3.5 and Figure 3.5, there was a significant difference in the soil sample means (p.05) between the nitrate concentration in control and the nitrate concentration in Gbarantoru farmland at 10–30 cm. The concentration, however, was highest (5.6 ± 0.01 ppm) at 20 cm depth. At 10 and 20 cm, there was a significant difference (*p*.05) in the means of soil samples for sulphur concentration between control and farmland. However, there was no significant difference in the means (*p* =.29) between the control and Gbarantoru farmland at 30 cm. The concentration of sulphur was shown to decrease as the depth increased. Phosphate concentration at 10 cm, 20 cm, and 30 cm was shown to have significant differences (*p* =.004, *p* =.02, and *p* =.004) in the means of soil samples from control and farmland. The concentration of phosphate was shown to increase as the depth increased. However, the phosphate values in Gbarantoru farmland were lower (2.00 ± 0.02 ppm) than the values for the control on concentration at 30 cm, which was slightly higher than the control. Table 3.6 and figure 3.6 show that there were significant differences (*p*.05) in the means of nitrate concentrations in control and Gbarantoru farmland in November at 10 cm, 20 cm, and 30 cm. There was a decline in nitrate concentration at various depths, with the nitrate concentration in the control area being higher than the nitrate concentration in farmland. The results also revealed significant differences (*p*.05) in the means of Sulphate concentrations in control and Gbarantoru farmland in November at 10 cm, 20 cm, and 30 cm. As depth increased, so did the amount of sulphates. At 10-30 cm, the means of phosphorus concentrations in soil samples from control and farmland differed significantly (*p*.05). As the sulphate and nitrate decreased with increasing depth, the concentration of phosphate increased with increasing depth.

3.3.3 Comparison of Results with Similar Studies

When compared to values reported by Dennis and John (2003), Vanek, Silha, Nemecek (2003), and Heckmann (2003), the nitrate level in our research from September to November was quite low. The results obtained by Orodu and Morokowei (2022), for similar study in Adagbabiri and Ogobiri towns, was found to be lower also when compared to the results obtained is this study and previous ones.

The sulphate concentrations in the Tombia and Gbarantoru farmlands, as well as the control, were significantly lower than those reported by Doreen et al. (2014), who found that the maximum value in cropped land was 43.3 ppm, while the lowest value in uncropped land was 14.8 ppm (control). However, Mesoppirr Lynda, Okongo Erick, Jackson Kiptoo, and Magoma Gabriel only reported the lowest values in this investigation (2015). Standard sulphate concentrations necessary for growth were found to be between 15 and 40 ppm in soil tests. Crops in both farmlands considered in this study may experience weakening and yellowish coloration in older leaves.
The phosphate content in this research for Gbarantoru farmland was greater than Doreen et al. (2014), who found 1.159 ppm to be the highest for cultivated land. However, as compared to Doreen et al., the concentration of phosphate in Tombia farms during the research period was quite low (2014). Phosphate levels of 12-20 ppm were found in soil tests done by research on a range of crop-growing soils, which is considered suitable for plant establishment and production. The samples showed that the farmlands considered in this study as well as the control are phosphate deficient as values are below the critical level of 5 mg/kg as stated by Rajaskhekha, Sahrawat, Wani, and Pardhasardhy (2010). Wani, Sahrawat, Sarvesh, Baburao, and Krishnapa (2011). According to the findings of this study, phosphorus concentrations in typical soil solutions are typically low when compared to nitrogen. In comparison to the nitrate and sulphate anions observed in control soil samples, this study discovered a lower level of phosphate. Photosynthesis, energy storage, and transmission can all be hampered by low phosphorus levels in the soil (Silva and Uchida, 2000).
When compared to the findings of Ben Mussa, Elferjani, Haroun, and Abdelnabi, (2009) this research found lower levels of NO_3^- and SO_4^{2-} in Tombia and Gbarantoru farmlands. Only the concentrations of sulphate (9.0–256.0 mg/L), phosphate (0.58–3.39 mg/L), and nitrate (1.24–1107.73 mg/L) were assessed. The concentrations of phosphate in this research (0.45-2.60 mg/L) matched those in this publication. The low amounts of NO_3^-, SO_4^{2-}, and PO_4^{3-} in Tombia and Gbarantoru farmlands in general indicate that farmers have not used fertilizer in the soil in the past as they do now, and that they rely on natural decay of plants and animals, which this study has shown to be nutrient deficient.

4.0 SUMMARY, CONCLUSION, RECOMMENDATIONS AND CONTRIBUTION TO KNOWLEDGE

4.1 SUMMARY

This study investigated the presence of micronutrients in Tombia and Gbarantoru communities in Yenagoa Local Government Area, Bayelsa State. The Sulphate, Nitrate, and Phosphate results in Tombia ranged from (2.93 – 5.78 mg/L), (2.74 – 5.44 mg/L), and (0.45 – 2.57 mg/L), respectively, while the Nitrate, Sulphate, and Phosphate results in Gbarantoru ranged from (4.44 – 6.60 mg/L), (3.41 – 4.77 mg/L), and (1.76 – 2. The result also showed differences in the nutrient levels between the means of the control and farmland.

4.2 CONCLUSION

Soil analysis is an inexpensive practice for the ability of plant growth. To have quality plant growth, soil analysis will enable farmers to provide solutions where the nitrate, phosphate, and sulphate levels are high or low. This study had lower values that were below the set recommended values.

4.3 RECOMMENDATION

Based on the level of micronutrients found in the area of study,

I. We recommend further studies be carried out to understand why the phosphate concentration in these farmlands is low.

II. Farmers should be enlightened by scholars in order for them to understand the need for fertilizers in farmlands and should adopt the use of fertilizer in its right proportion to increase the availability of nutrients in soil.

111.Farmers who want to grow quality crops for both domestic and commercial purposes should avoid planting on farmlands during periods of heavy rain or when floods are present. Excess water was observed inside the soil, and this could destroy any crop planted in that period.

4.4 CONTRIBUTION TO KNOWLEDGE

Awareness of this study will assist producers, extension agents, and crop advisors in understanding trends in soil nutrient concentrations. This research should also motivate crop growers to think about fertilizer control and sustainability. As a result of the research, extension agents will have a better understanding of crop nutrient requirements and consumption during each growing season. As a result, crops such as maize, corn, pumpkin leaves (known locally as "Ugu"), and water leave can be grown. The soil has a limited amount of phosphate and hence will not support good growth for plants, e.g., oranges. Fertilizer that contains phosphate can be used.

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APPENDIX

Tombia - Amassoma Rd, 569101, Nigeria
Google
Type | Degree | DMS
Latitude | 4.9971088 | 4°59'50" N
Longitude | 6.2526958 | 6°15'10" E
02 Sep 2021, 10:50 am

Ekpetiama 11, 569101, Nigeria
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02 Sep 2021, 12:01 pm

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