EVALUATION OF SOIL NUTRIENT AND FERTILIZATION PLAN OF CASSAVA FARM, NAOC (NIGERIANAGIP OIL COMPANY), OMOKU, RIVER STATE.

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ABSTRACT

The impact of oil exploration on soil fertility in Nigeria is hindering the efforts toward soil improvement. Crude oil induced pollution on soil environment is an increasing trend into the environment. There is the need to evaluate soil nutrient and fertilization plan for the cassava farm of NAOC (Nigerian AgipOil Company)in omoku, River State,Nigeria. Three cassava farms, largely cultivated was purposely chosen. Soil samples were taken from 0-30 cm depth at 12 meters intervals along transverses cut at 120 m apart. The samples were air-dried at room temperature, crushed and made to pass 2 mm sieve. Soil pH, organic matter (OM), total nitrogen (TN), available phosphorus (P), Exchange potassium (K), electric conductivity (EC) and Acidity (H + AI) were measured.The result obtained from soil in farm 1, 2 and 3 shows that the soil type is loamy (49%) silt (58%) and sandy (53%) respectively. soil from farm 1, has high OM (3.020) and total nitrogen (0.151%), low available P (11.00ppm) and K (70.00ppm), normal in EC (0.011 Ms/cm/), with a pH (6.4) partly salty and acidic. Farm 2 recorded low OM (1.590), TN (0.080%), P (12.00ppm) and K (90.00ppm) and normal EC (0.086 Ms/cm/), and a pH (6.2) partly salty and acidic. Soil from farm 3, was almost similar with farm 1, except having pH (6.600) neutral. It recorded high OM (3.090), high TN (0.155%), low P (10.00ppm), low K (66.00ppm) and normal EC (0.065 Ms/cm/). The fertilization status and plan for a standard application of NPK at 15:15:15 at the rate of 333kg/ha, at about 8 WAP, in a ring of about 10cm away from the cassava plant 6 cm deep required a fertilizer plan of 111kg of SSP/83kg MOP, 65kg of SSP/50kg MOP and 111kg of SSP/50kg MOP to meet up N and K recommended plan to farmer in the studyarea for farm 1, 2 and 3 respectively.

Key words: Soil nutrient, Fertilizer plan, Cassava farm

Introduction

Cassava tuber and its derivatives are the primary food in Sub-Saharan Africa, accounting for 50% of food intake and approximately 1000 calories per capita per day. Ojeniyi et al. (2009) state that it is also an industrial crop. Nigeria produced more than 31 million tons of cassava in 1996, making it the world leader in this regard. However, the fertility quality of the soil limits the amount of cassava that can be produced, which means that both organic and inorganic fertilizers must be used (Ojeniyi et al., 2009). This is particularly true in Southeast Nigeria, where a lack of land space makes bush fallowing impractical. About 55 kg/ha N, 132 kg/ha P, and 112 kg/ha K are removed by cassava (Howeler, 1991). According to studies by Ezekiel et al. (2009a; 2009b) and Ojeniyi et al. (2009), N, P and K fertilizer boost the yield of cassava productionand output.It was also observed that farmyard manure with NPK fertilizer increased yield of cassava relative to manure or fertilizer alone (Agbaye and Akinlosotu, 2004). It was recorded that cassava fertilization practice depends on soil type and season.

One of the most important natural resources for farming is soil, which is also the most impacted by human activity. Due to modifications in its biological, chemical, and physical characteristics, human use of land degrades its quality. Oil drilling has rendered fertile fields that were used to produce enough food crops barren, which has made farming extremely difficult and endangered the communities' ability to produce food sustainably (Godson-ibeji et al., 2016). (O Rourke and Connolly, 2003). Hydrocarbon contamination from oil and gas exploration and exploitation is one of the biggest environmental issues facing society today.As the demand for liquid petroleum increases, the release of this essential energy source into the environment becomes inevitable and has caused devastating consequences to marine/coastal waters, shorelines and land as well (Macaulay and Rees, 2014). Pipelines that travel through farming villages carry large amounts of oil, and leakage do occur. According to Ewetola (2013), the oil has the ability to block soil particles, limiting water infiltration and raising bulk density, both of which prevent root penetration. In addition to inhibiting the activities of starch phosphorylase, which lowers starch assimilation, it can build a film on planting materials that delays the absorption of water and oxygen (Oyem&Oyem, 2013).

One of the phases of oil exploration, gas flaring, produces a great deal of heat, scorching the nearby soils and leaving the flora looking parched (Giwa et al., 2014). Crops growing in this kind of environment would undoubtedly exhibit signs of dryness and chlorosis in the leaves. Ukegbu and Okeke (2007) claim that the flow stations in the area caused a decrease in crop growth and yield. Changes in soil composition brought about by substances put into the surrounding environment during oil exploration can significantly lower the soil's potential for productivity (Achi, 2003). Crude oil might hinder metabolic activities by decreasing microorganisms' ability to mineralize carbon.It can alter soil chemical properties by increasing acidity and in this condition, nitrogen fixation and organic matter decomposition are hindered (Osuji and Nwoye, 2007).

The government of Nigeria is investigating ways to increase agricultural productivity in order to end hunger as a result of the recent decline in prices. The areas of improved variety provision, fertilizer supply, and agricultural extension agent training are the focus of current efforts (Irhivben and Omonona, 2013). Despite the fact that soil fertility is the foundation of agriculture, not much research has been done on the subject. Particularly in Nigeria, where cassava is a major crop, the impact of the soil nutrient and fertilization plan of cassava farms near oil firms has not gotten enough scientific attention. Fertilizer application would replenish any form of nutrient loss and also enhances the effect of oil exploration on the soil (Kingston, 2002; Evans et al., 2004; Xia et al., 2007).

It has been well researched and established that adding nutrients can maximize the pace at which petroleum hydrocarbons degrade in soil (Sarkar et al., 2005; Agarry et al., 2013). The source of the nutrients, which are primarily inorganic forms of nitrogen and phosphorus, might be either. By encouraging the growth of remediating microorganisms, inorganic nutrient sources including NPK, K2HPO4, and NO3-N have been shown to be effective in the cleanup of crude oil on land and in water (Kingston, 2002; Evans et al., 2004; Xia et al., 2007). Nonetheless, it should be argued that using these fertilizers to treat this issue is both economical and environmentally beneficial.Ogbo and Okhuoya (2008) reported the treatment of oil-contaminated soils using direct application of inorganic fertilizers to cause soil hardening, disallowing the free movement of nutrients, oxygen and water within the soiland reduction in soil fertility.

Application plans for inorganic fertilizers should be carefully considered because of their propensity to be released quickly into the environment (likely as a result of their availability in free states). Research work has demonstrated that these fertilizers are very effective at promoting biodegradation and raising soil fertility (Akiakwo et al., 2005). In order to maximize cassava output, it is now necessary to assess the soil fertility status in oil-producing villages and to start a fertilization plan for these cassava farms. This work is acomparative study of the soil nutrient and fertilization plan of cassava farm of Agip oil company in Omoku, River State,Nigeria.

Materials and Methods

The study was conducted in three different farms in Omoku,Onelga LGA,River State. A major oil producing State in Nigeria with estimated population of 5,198,716 as of the 2006 census and 7,492,366 in 2023, Rivers State is the 7th most populous state in Nigeria(Alagoa, 2002). It lies within latitude 4° 51 and 29.0772 North and longitude 6° 55' and 15.29045°00 East Rivers. State is a diverse state that is home to many ethnic groups: Igbo, Ijaw, Ogoni, Ikwerre, Ogba, Ekpeye, and Kalabari Richard (Richard Fardon, 2002). Rivers State is the 26th largest state by area, and its geography is dominated by the numerous rivers (Alagoa, 2002). The inland part of the state consists of tropical rainforest with many mangrove swamps. Rivers State has a total area of 11,077 km2 (4,277 square miles), making it the 26th largest state in Nigeria. Surrounding states are Anambra for four km, Imo for about 122 km), and Abia for 87 km (54 miles, partly across the Imo River) to the north, AkwaIbom to the east across the Imo River and Bayelsa and Delta to the west across the Niger River for about 50 km. Total annual rainfall decreases from about 4,700 mm (185 in) on the coast, to about 1,700 mm (67 in) in the extreme north. It is 4,698 mm (185 in) at Bonny along the coast and 1,862 mm (73 in) at Degema (Jones, 2000). For Port Harcourt, temperatures throughout the year are relatively constant with little variation throughout the seasons. Average temperatures are typically between 25 and 28 °C (77 and 82 °F). Some parts of the state still receive up to 150 mm (6 in) of rainfall during the dry period. Relative humidity rarely dips below 60% and fluctuates between 90% and 100% for most of the year (Alagoa, 2002; Jones, 2000; Mitee, 2010).

Soil sample collection

Soil samples were taken from 0-30 cm depth at 12 meters intervals along transverses cut at 120 m apart. The samples were air-dried at room temperature, crushed and made to pass 2 mm sieve. The Soil sample was taken to Green River Project soil/water Testing laboratory, NAOC LTD, Endowed by PEDON NIGERIA, NAOC LTD for soil nutrient and fertilizer plan evaluation.

Soil Particulate Size Sampling

Three farms from the location were selected and cassava farm that was largely cultivated was assessed. Soil consists of an assembly of ultimate soil particles (discrete particles) of various shapes and sizes. The soil samples from these farms were collected at 12 meters intervals along transverses cut at 120 m apart. The object of a particle size analysis grouped the soil particles into separate ranges of sizes and so determine the relative proportion by weight of each size range. The method employs sieving and sedimentation of a soil/water/dispersant suspension to separate the particles.

Measurement of Soil Parameters

The soil nutrient was carried out at 5 meters intervals along transverses cut at 50 m apart. Mini soil profile at depth of 30 cm was dug randomly for soil samples collection. Soil pH, organic matter (OM), total nitrogen (TN), available phosphorus (P), Exchange potassium (ppm) and Acidity (H + AI) (meq/100g)

Laboratory Procedures

Soil pH was on a ratio of 1:2 soil/water suspensions. Soil organic matter was analyzed by Walkley and Black method (Nelson and Sommers, 1982). Total nitrogen was determined by micro - kjeldahl digestion method (Jackson, 1962). Available phosphorus was measured with Bray (II) (Olsen and Sommers, 1982). Exchangeable bases were extracted with 1N NH4OAC, Ca and Mg were read with ethylene diamine tetra-acetic acid titration method whileacidity was tested using titration method.

Soil Testing for Fertilization Plan

This soil-test report gives recommendations for a rate and grade of fertilizer to be apply per 1,000 square feet. One grade of fertilizer can be substituted for another, but it required a few calculations. Example, to apply 1 pound of nitrogen per 1,000 squares for a 15-15-15 fertilizer. Using the following formula: One (1) pounds of nitrogen desired per 1,000 square feet ÷ Percentage of nitrogen in fertilizer a farmer plan to use divided by 100 = 1 ÷ (15 ÷ 100) = 1 ÷ 0.15 = 6. In other vane, the farm measurement is known, the square feet can be determined before calculating the amount of fertilizer to be applied. Example:If the area is 500 feet by 20 feet, and the suggested fertilizer treatment is 30M (pounds per 1,000 square feet):

500 feet × 20 feet = 10,000 square feet

Divide 10,000 square feet by 1,000 = 10 units

Multiply 30 pounds by 10 units = 300 pounds of material (fertilizer)

Statistical Analysis

Data generated were subjected to descriptive statistics and results presented independently.

Result and Discussion

The result for the soil particulate size and type is presented in Table 1. The result obtained from soil in the first farm, shown that the soil type (loamy 49%) is a loamy soil, while that of the second and third farms were silt (silt 58%) and sandy (sandy 53%) soil respectively.

Table 1: Evaluation of the particulate sizes of the tested soil sample from different cassava farm from sample area.

Cassava farm	Soil particulates	Soil particulate sizes (%)	Evaluation
Farm 1	Grave	-	
	loamy	49	Loamy soil
	Silt	48	
	Clay	13	
Farm 2	Grave	-	
	Sand	32	
	Silt	58	Silt soil
	Clay	10	
Farm 3	Grave	-	
	Sand	53	Sandy soil
	Silt	41	
	Clay	6	

The result for thephysiochemical status as presented in Table 2, shown that soil from farm 1, has high organic matter (3.020) and total nitrogen (0.151%), low available phosphate (11.00ppm) and exchange potassium (70.00ppm), normal in electrical conductivity (0.011Ms/cm/), with a pH (6.4) partly salty and acidic. Soil from farm 2 recorded low organic matter (1.590), total nitrogen (0.080%), available phosphate (12.00ppm) and exchange potassium (90.00ppm) and normal electrical conductivity (0.086Ms/cm/), with a pH (6.2) partly salty and acidic. Soil from farm 3, was almost similar with farm 1, except having pH (6.600) neutral. It recorded high organic matter (3.090), high total nitrogen (0.155%), low available phosphate (10.00ppm), low exchange potassium (66.00ppm) and normal in electrical conductivity (0.065Ms/cm/).

Table 2: Physiochemical status of the tested soil sample from different cassava farm from sample area.

Cassava farm	Physiochemical parameter	Amount	Evaluation
Farm 1	pH	6.400	Slt. acid
	Electrical conductivity Ms/cm/25^{o} C	0.011	Normal
	Organic matter	3.020	High
	Total nitrogen (%)	0.151	High
	Available phosphate (ppm)	11.00	Low
	Exchange potassium (ppm)	70.00	Low
	Acidity (H + AI) (meq/100g	-	ND
Farm 2	pH	6.200	Slt. acid
	Electrical conductivity Ms/cm/25^{o} C	0.086	Normal
	Organic matter	1.590	Low
	Total nitrogen (%)	0.080	Low
	Available phosphate (ppm)	12.00	Low
	Exchange potassium (ppm)	90.00	Low
	Acidity (H + AI) (meq/100g	-	ND
Farm 3	pH	6.600	Neutral
	Electrical conductivity Ms/cm/25^{o} C	0.065	Normal
	Organic matter	3.090	High
	Total nitrogen (%)	0.155	High
	Available phosphate (ppm)	10.00	Low
	Exchange potassium (ppm)	66.00	Low
	Acidity (H + AI) (meq/100g	-	ND

The result for the fertilization status and plan for the tested soil sample from the different cassava farm is represented in Table 3. Result shown that a standard applicationof NPK at 15:15:15 would be applied at the rate of 333kg/ha at about 8 WAP, in a ring of about 10cm away from the plant 6 cm deep. For farm 1, following the standard of application, a fertilizer plan of 111kg of SSP and 83kg MOP to meet up with P and K requirements would be used, while that of farm 2 and 3 would used a fertilizer plan of 65kg of SSP and 50kg MOP and 111kg of SSP and 50kg MOP to meet up with the N and K requirements respectively.

Table 3. fertilization status and plan for tested soil sample from different cassava farm from sample area.

Cassava Farms	Element substance (kg/ha)	Amount (kg/ha)	Evaluation
Farm 1	N P_2O_5 K_2O	30 50 80	1) Apply NPK 15:15:15 at the rate of 333kg/ha. Use 111kg of SSP and 83kg MOP to meet up with P and K requirements. 2) Apply fertilizer at about 8 WAP, in a ring of about 10cm away from the plant 6 cm deep.
Farm 2	N P_2O_5 K_2O	80 50 80	1) Apply NPK 15:15:15 at the rate of 333kg/ha. Use 65kg of SSP and 50kg MOP to meet up with N and K requirements. 2) Apply fertilizer at about 8 WAP, in a ring of about 10cm away from the plant 6 cm deep.
Farm 3	N P_2O_5 K_2O	30 50 80	1) Apply NPK 15:15:15 at the rate of 333kg/ha. Use 111kg of SSP and 50kg MOP to meet up with N and K requirements. 2) Apply fertilizer at about 8 WAP, in a ring of about 10cm away from the plant 6 cm deep.

Discussion

Soil pH in farms 1 and 2 is classified as strongly to mildly acidic when compared to farm 3. The range of the soil from farms 1 and 2 is 6.2 to 6.4. Higher acidity soil has been shown to lose basic cations (Abii and Nwosu, 2009). This pH may have an impact on nutritional availability, which could explain the reduced level of nutrients found in the sample. This provides strong support for the finding of Osuji and Nwoye (2007) that acidic soil conditions impeded the breakdown of organic matter and the fixing of nitrogen in soils. According to research by Oyem and Oyem (2013), low soil pH may have an impact on microbial activity and reduce the organic matter's decomposition, which releases plant nutrients and lowers the nitrogen contents in oil-producing communities. The nutrient contents that were lower in these farms may be linked to the oil exploration activities that reduced the activities of soil microorganisms in these farms.

Organic matter levels in farm 2 were lower than in farms 1 and 3. Chemicals spilled into the ground during oil drilling may disrupt the organic matter-adding metabolic processes. This matches the outcome that Osuji and Nwoye (2007) reported. This could cause an imbalance in the carbon-nitrogen ratio in the soil, as Nkwopara et al. (2012) also reported. Depletion of nitrogen may result from this. The larger impact of oil activities can be the reason for the reduced organic matter when compared to other farms with comparable temperatures.

Low levels of detected exchange potassium and available phosphorus may be related to the soils' acidic composition, which can impede phosphorus fixation, according to a paper by Nkwopara et al. (2012). Since higher pH values have been shown to maximize phosphorus solubility, lower pH levels in the soil may also decrease the amount of phosphorus that is accessible and the rate at which potassium is exchanged. When breaking down hydrocarbons in the soil, microorganisms that use total petroleum hydrocarbon as a carbon source can also make use of potassium and phosphorus (Wang et al., 2010).

The soil sample from each cassava farm was examined to determine the fertilization status and plan. The results indicated that a conventional 15:15:15 NPK treatment will be administered at 333 kg/ha at approximately 8 WAP, in a ring that is about 10 cm distant from the cassava plant and 6 cm deep. The recommended plan for farmers in the research region for farms 1, 2, and 3 was to apply a conventional fertilizer plan consisting of 111 kg of SSP and 83 kg MOP, 65 kg of SSP and 50 kg MOP, and 111 kg of SSP and 50 kg MOP to meet the N and K requirements.

Conclusion

To sum up, soil testing is crucial for farmers in the oil region to assess the fertility and health of their land. The purpose of this study was to examine the soil texture, structure, and potential fertilizer plan of farms located in Agip, Omoku River State. Using the results of this soil test, plans for fertilization and soil modification were created in order to maximize cassava yields and long-term sustainability. This strategy is a wise investment in the well-being of your farm and the profitability of your agricultural business. To stop the soil from degrading further, the oil-producing communities require nutrient amendments, particularly those containing potassium, phosphorus, and nitrogen.

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