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## Preliminary Investigation into the Suitability of Some Selected Soils in Lagos Farming Zones for Tigernut Production, Nigeria

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### **Abstract:**

*Cultivating crops on land that is not suitable for certain crop will face limited yield potential in spite of the use of improved inputs. However, there is inadequate data on soil nutrients and fertility status of these farming zones in Lagos state for a crop like tigernut. Its production has not been a common state. Therefore, this research focused on assessing the fertility status and suitability for tigernut production of these selected soils from three farming zones of Lagos state of Nigeria.*

*Thirty- six (36) composite soil samples were collected from three farming zones (twelve samples per zone; Badagry, Epe and Ikorodu) and were analyzed for chemical and physical properties. Eighteen soil samples were used for the screen-house experiment to assess the growth and yield of tigernut. All data collected were analyzed using ANOVA ( $\alpha_{0.05}$ ).*

*The laboratory and screen-house results revealed that the soils were suitable for tigernut production. Nuts yields observed under no fertilizer application treatments were  $16.3\pm 0.8$ ,  $20.5\pm 2.0$  and  $13.1\pm 2.2$  g and  $25.2 \pm 4.1$ ,  $41.4\pm 7.3$  and  $35.7\pm 3.0$  g/pot under fertilizer application for Badagry, Epe and Ikorodu, respectively. Therefore, it is recommended that tigernut should be cultivated in these three farming zones of the state.*

**Keywords:** ANOVA, yield potential, Tigernut Production

### **1. Introduction**

Successful crop management relies on selecting suitable crops to the type of soil present in that region. Most of crops prefer well drained medium textured soils with optimum physical properties and neutral pH. However, optimal crop growth and productivity is based amongst other factors on soil conditions, the climate and agricultural practices (Sessato, 2013). However, Ogunkunle (2004), enumerated soil parameters such as; cation exchange capacity; soil organic matter content expressed by the organic carbon content; soil depth and stoniness as the main factors that influence crop adaptability to a given land area for crop production. Some conservative farming practices accelerate soil chemical and physical degradation and create some of the unfavorable soil crop production (Olugbemi and Falade, 2014).

However, continuous crop production on the available farmland leads to decline in soil fertility, which on the other hand may be due to nutrient loss or imbalance by erosion and crop removal (Senjobi, 2007; Ogunkunle, 2004). The starting point toward sustainable management is adequate information on the land resources and suitability evaluation but these are not in proper form in Lagos even in Nigeria in spite of several researches on soils and crop sciences in our renowned institutions (Olugbemi and Falade, 2014).

The soil is an important factor in food production and the central problem of our agriculture is the inability of the available farmlands to sustain annual food crop for more than a few years at a time. Agegnehu (2014), asserted that the soil is a medium and source of nutrition for both plant and animal life, therefore the neglect of managing soil fertility will eventually lead to food crisis. Many efforts to achieve self-sufficiency in food production failed due to minor consideration given to the role of soil in crop production. Olugbemi and Falade, (2014) enumerated the following as soil constraints: erosion, poor maintenance of soil fertility and lack of data on soil tests.

According to Ogunkunle (2004) and Ation (2013), tropical soils are full of low clay activity, such as in Alfisols and Ultisols. They are so called low activity clay because of their limitations, unique management requirements and other distinctive feature that adversely affect their potential for crop production. These limitations include acidity and Aluminum toxicity, low nutrient reserves, nutrient imbalance and multiple nutrient deficiencies. In spite of these factors, the required nutrients elements in right proportion solve these and make a given soil suitable for specific or groups of crops production

Furthermore, the roles of essential elements in crop growth and yield cannot be over emphasized. These elements and their functions include; nitrogen (N) which is necessary for the formation of amino acids, proteins, DNA and RNA. It is

essential for plant cell division and vital for plant growth. Phosphorus (P), promotes early root formation and growth, and is involved in photosynthesis, respiration, energy storage and transfer, cell division and enlargement and potassium (K) is involved in carbohydrate metabolism and the break down and translocation of starch and enhances disease resistance (Ation, 2013; Olugbemi and Falade, 2014). The secondary elements include; calcium (Ca), increases fruit set and quality and is important for continuous cell division and formation (regulates hormonal activity). Magnesium (Mg), and sulfur (S) are required in lesser amounts than macronutrients, but each is equally important to the crop as well as magnesium (Mg), the center molecule of chlorophyll, improves utilization and mobility of phosphorus. It helps develop enzymes, vitamins and oil contents, and aids in seed formation (Olugbemi and Falade, 2014).

The productivity of Nigerian soils in general is decreasing; therefore, the fragile soils of available farmlands calls for investigation and the results must be used in a sustainable way to avoid soil degradation. Lands have been utilized intensively for all purposes at the expense of its suitability capability thereby resulting in land degradation and altering of the natural ecological conservatory balances in the landscape (Senjobi, 2007). Land evaluation provides avenue for sustainable land use since land will be used according to its capability (Singh, 2008). This therefore makes it mandatory to carry out land suitability in order to ensure that the selected farmlands are suitable and capable of sustaining long term production of crops (Ogunkunle, 2004). The need for sustainable increase in crop production per unit area in Lagos should have resulted to more soil being opened up for large scale crop production, rather than for housing and estate businesses (Agegne, VanBeek and Bird (2014).

However, not all soils can meet these requirements for food production; hence such soils are considered to be constrained or infertile (Senjobi, 2007; Ation, 2013). The primary constraints of soil may be classified into nutrient toxicities, nutrient accessibility and preservation, physical degradation and water availability due to erosion (Sesato, 2013). In the constrained soils, the inborn fertility of soil is connected with mineralization of organic matter in the soil (Sesato, 2013; Agegnehu *et al*, 2014).

Some backlog of improved soil management technologies which aimed at increasing the productivity levels of crop include the use of organic fertilizers in blend with inorganic fertilizers, the use of inorganic fertilizers based on soil test values to avoid nutrients imbalance and abuse, the use of light implements for land preparation or bush slashing and manual removal of the total plant weight to avoid soil compaction (Fagbola and Ogungbe, 2007; Singh, 2008). Besides, the use of zero tillage and multiple cropping through inclusion of legumes and appropriate use of crop rotation is very promising (Osiname, 2000).

Deterioration in total organic materials in the soil may often be a core cause of nutrient use up, and nutrient unavailability and retention for farming systems. This can be amended with external nutrient inputs. Ation (2013) asserted that soil fertility can be improved through application of organic and inorganic fertilizers. However, application of organic residues is an important management practice that plays important roles in regaining the lost plant nutrients and soil organic matter (Ogungbe and Fagbola, 2008). Aiyelari, Ogunesin, and Adeoluwa (2011) stated that many physical, chemical and biological soil properties of surface horizon (soil) depend largely on the soil organic matter.

As indicated by Bamishaiye (2011) and Adgidzi (2010), tigernut endure numerous unfavorable soil conditions including times of dry season. Tigernuts plant develops best on sand loamy soil. Planting is typically done on worked level land or ridges or beds and nuts are the planting materials which are sown directly. According to Agbabiaka *et al*, (2012) a portion of the wholesome nutritional and medical advantages explored of tigernuts are detailed as; non acidic and unsaturated oil, great quality dietary fibre and sugar, wealthy in minerals such as sodium, calcium, potassium, magnesium, zinc and fundamental amino acids. The nuts are likewise said to be sexual enhancer, carminative, diuretic, stimulant and tonic (Adejuyitan, 2011). Regardless of monetary significance of tigernut, for example, provision of job, fills in as crude material in most confectionary businesses, as animals feed particularly the waste after extraction of among others.

In conclusion, soil chemical and physical properties determine its quality in aspect of root growth, infiltration, water and nutrient holding capacity. Hence, the monitoring of soil chemical and physical properties is important for sustainable crop production. However, there were few studies on the available farmlands in the cropping zones of Lagos state. Besides, there is inadequate data on soil capability and suitability of agro-ecological zone of Lagos state. Hence, this study was conducted to investigate the condition of soil chemical and physical properties of three selected arable farmlands or farming zones use across the (Epe, Badagry and Ikorodu) the state.

## 2. Methodology

### 2.1. Description of the Study Areas

Lagos state is about 3,577 km<sup>2</sup> (0.4% of the country total land area) this territorial size is further reduced by lagoons and creeks which constitute about 22% or 787 km<sup>2</sup> of the total landmass. It shares boundary to north and in the west with Republic of Benin. The notable areas among the five original divisions of the states namely; Ikeja, Badagry, Ikorodu, Lagos Island and Epe; among which only the suburbs (Badagry, Epe and Ikorodu) are known for crop production program and fish farming. The soil is moderately comprises of different soil types and classes. The soil fertility moderate to marginal in some farming zones across the state. The annual rainfall distribution is bimodal, with first peak around months of May to July and second peak between September and October every year. Between the driest and wettest months, the difference in rainfall is 305 mm. The average temperatures vary during the year by 3.7 °C (State of the climate; Lagos - National Climatic Data Centre, 2010).

## 2.2. Soil Samples Collection and Laboratory Analyses

Twelve (12) composite soil samples were collected from the selected farmland of each zone given a total number of thirty-six (36), soil samples taken from 0 – 25 cm depth. Collected soil samples were air dried for laboratory analysis for chemical and physical properties at Department of Agronomy, Faculty of Agriculture and Forestry, University of Ibadan, Oyo state for the determination of the following parameters: soil pH, organic carbon, total nitrogen (N), available phosphorus(P), exchangeable cations, micro elements and particle size distribution for soil textural classification.

## 2.3. Data Collection and Analyses

The analyzed soil parameters were subjected to analysis of variance (ANOVA,  $\alpha_{0.05}$ ). The tigernut yields obtained from various zones soil samples under screen-house experiments were analyzed as stated above.

## 3. Results and Discussion

Parameters	Badagry	Epe	Ikorodu
pH (HCl) (1:1)	4.3±0.3	4.0±0.2	6.3±0.2
pH (H <sub>2</sub> O)	4.94	4.65	6.4
Organic C (g kg <sup>-1</sup> )	7.5±1.8	27.9±1.4	1.4±0.1
Total N (g kg <sup>-1</sup> )	1.8±0.5	6.8±0.3	0.3±0.01
Available P (mg kg <sup>-1</sup> )	44.1±18.7	19.1±11.1	55.1±3.6
<b>Exchangeable Bases (cmol kg<sup>-1</sup>)</b>			
K	1.2±0.5	0.2±0.01	0.7±0.04
Ca	1.42	2.79	26.5
Na	0.47	0.37	0.38
Mg	0.75	1.34	2.82
CEC	5.7±0.4	7.5±1.7	19.9±2.6
<b>Particle Size Distribution (G Kg<sup>-1</sup>)</b>			
Sand	930.0	805.0	726.0
Clay	6.0	72.2	140.0
Silt	64.0	99.0	134.0
Textural class	<i>Sandy soil</i>	<i>Loamy sand</i>	<i>Sandy loam</i>

Table 1: The Physical and Chemical Properties of the Soils Used for the Experiments  
Source: (2018) Department of Agronomy Soil Laboratory, University of Ibadan, Oyo State

From the above table, the soil pH of Badagry and Epe is slightly acidic while that of Ikorodu is alkaline. The nitrogen content of the three soil locations ranged from 0.34 to 6.79 g kg<sup>-1</sup> of which the soil samples from Badagry (1.82 g kg<sup>-1</sup>) and Ikorodu (0.34 g kg<sup>-1</sup>) was low in nitrogen. Both soils were high in available P ranging from 19.07 to 55.1 mg kg<sup>-1</sup>. The textural classes are sandy soil, loamy sand and sandy loam soils for Badagry, Epe and Ikorodu, respectively (Table 1).

Locations	Fertilizer treatments	Fresh nut weight (g/pot)	Number of nut per pot	
Badagry	No application	16.3±0.8	13.0 ±0.9	
	NPK	40kg/ha	25.2±4.1	16.0±1.3
		60kg/ha	20.1±2.11	13.0±0.5
Epe	No application	20.5±2.0	15±1.2	
	NPK	40kg/ha	32.0±2.0	13.0±2.9
		60kg/ha	41.4±7.3	19.0±3.4
Ikorodu	No application	13.1±2.2	12.0±0.5	
	NPK	40kg/ha	31.7±4.8	21.0±2.5
		60kg/ha	35.7±3.0	22.0±0.9

Table 2: Fresh Tiger Nut Weight and Number of Nut per Pot of 10 Kg of Soil Fewer than Three Levels of NPK Fertilizer Treatment  
Source: 2018. Pot Experiment, MOCPEd Teaching and Research Farm, Noforija, Epe

From the pot experiment, the NPK 15-15-15 fertilizer application at 60 kg/ha on Epe soil increased the tiger nut yield (41.4 kg per pot) more than the yields obtained from other locations. Under the application rate of 40 kg/ha, Banditry's soil recorded the least tiger nut yield of 25.2 kg. At the same rate, the tiger nut yields obtained from Ikorodu (31.7 kg) and Epe (32.0 kg) was not significantly different ( $\alpha_{0.05}$ ). The number of nut per pot ranged from 12 – 22; under no fertilizer application and 60 kg /ha NPK application on Ikorodu's soil (Table 2)

Locations	Treatments	Fresh nut weight (g/pot)	Number of Nut Per Pot	
Badagry	No application	16.3±0.8	13.0 ±0.9	
		40kg/ha	13.0±0.5	
		60kg/ha	16.0±1.3	
	NPK	40kg/ha	27.2±4.1	12.0±0.5
		60kg/ha	26.1±2.1	21.0±2.5
Epe	No application	20.5±2.0	22.0±0.9	
		40kg/ha	23.0±2.9	
		60kg/ha	34.0±3.6	
	NPK	40kg/ha	24.2±4.1	26.0±2.9
		60kg/ha	26.1±2.3	31.0±3.4
Ikorodu	No application	15.1±2.2	14.0±0.5	
		40kg/ha	21.0±2.3	
		60kg/ha	22.0±0.9	
	NPK	40kg/ha	27.2±3.1	14.0±2.4
		60kg/ha	30.1±2.1	19.4±3.4

Table 3: Tigernut Yield under Different Levels of Two Different Fertilizers Application  
Source: 2018. Pot Experiment, MOCPED Teaching and Research Farm, Noforija, Epe

From table 3 above, the responses of tigernut to the two mineral fertilizers at different levels were not significantly different across the three farmlands under the screen-house experiments. However, Ikorodu and Epe soils showed similar nut yields a bit above nut yields obtained from Badagry because of the total nitrogen (N) levels of the three soils. However, the fresh nut yield under NPK 15 – 15 – 15 fertilizer at 60 kg/ha is significantly higher on Epe soil compared with the fresh nut yield obtained under the same application rate of urea fertilizer on the same soil and other soil from other locations. This yield performance at this application rate do not agree with application rate as reported by Bamishaiye and Bamishaiye (2011). Similarly, there was no significant difference between the fresh tigernut yields obtained from Badagry and Ikorodu soils under both mineral fertilizers application rates.

#### 4. Summary, Conclusions and Recommendations

From this research results, tigernut growth parameters observed showed that there is no significance difference in terms of number of leaves and plant heights under the various rates of mineral fertilizers application. This is in agreement with the report from Pascual, Bautista, López, Galarza and Maroto (2012). This connote that application of mineral fertilizers (NPK 15 – 15 – 15 and urea) are promising inputs for tigernut production, especially on soil of physiochemical properties like Epe soil (loamy sand soil) with moderate nitrogen and organic matter among other fertility indicators. This agreed with the findings according to Macho (2014), that tigernut plant grows well on sandy soil with high nitrogen. The nut yields from this experiment was significance under each fertilizers application rate as influenced by the soil types of each location.

From ongoing, it can be deduced that; the selected farmlands' soils physiochemical properties are suitable for tigernut production and application of NPK 15 – 15 – 15 fertilizer at 40 - 60kg/ha on loamy sand soil with high organic matter is recommended for tigernut production. In conclusion, tigernut can be culture for more utilization rather than be seen as wild sedge or grass grouped as weed and can thrive well on these farming zones of the state. It can be recommended that application of urea and NPK fertilizers at 40 – 60 kg/ ha is ideal for tigernut production in the selected farmlands provided the soil physio-chemical properties fall within the range shown in this study.

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