Data documentary on soil nutrient and yield evaluation comparison for coconut varieties in four soils of coconut belts

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**ABSTRACT

This experiment documents and evaluates the nutrient status in four soils in the coconut belts of Nigeria. It also studies the info-yield and nutrient data available on various soils in coconut belts of Nigeria. Data on nutrients are collated separately from four specific soils, sampled and tested for nutrient elements and physical parameters; these include Coastal marine soil, Inland forest soil, Inland savannah soil and Coastal alluvium soil. Other parameters compiled in this study are the progeny yield performances of indigenous and exotic hybrids of coconuts and nutrient uptake from soils by the palm. This work statistically compares the nutrients in the four soils to ascertain the soil-nutrient adequate for coconut cultivation and distribution using regression analysis. It was established from the results that nutrients in the four soils were in the order of coastal marine soil > inland savannah soil > coastal alluvium soil > inland forest soil. The distribution of clay fraction was in the order of coastal alluvium soil > inland savannah soil > coastal marine soil > inland forest soil. For nutrient such as Available phosphorus, Exchangeable Magnesium, and Potassium, were higher in the inland savannah soil, while Exchangeable sodium, (Exch.Na) and Total Sulphur were higher in coastal marine soil. The results on nutrient uptake revealed that Exch. Na and total soil Sulphur affects yield of coconut significantly. And a correlation of Sodium (Na) across the four soils revealed a significant positive correlation with inland forest soil r=0.961 and negatively with coastal alluvium soil r=-0.814. The distribution of calcium was in the order of coastal alluvium soil > coastal marine soil > inland savannah soil > inland forest soil. Calcium is indeed a very vital element for coconut development and rates of uptake was high and tend to be higher in soils of the coastlines (coastal alluvium and marine sand soils). Although the nutrients in the four soil varied, but on the average the correlation result from the soil nutrient suitability index revealed that coaster marine sand and inland savannah soils contains the highest nutrients for coconut development. While coaster alluvium and inland forest soils though may have vast population of coconut palms does not contain as much nutrients as the former. All findings however are without prejudice to earlier results of other literatures on soils of coconut palms in Nigeria.

**Keywords:** Soil nutrients status, Regression, Data Documentary, Four soils. Na; sodium

**INTRODUCTION/BGACKGROUND**

Past and current records have revealed and predicated coconut poor outputs to the rapid rate that the crop exhaustively utilizes some essential soil nutrients; coupled with the poor fertilization of soils on the part of coconut farmers. It is evident from various works done by soil and crop scientists that the bulk of problems encountered in
coconut production in Sub-Sahara West Africa are nutrient base and partly vagaries in climatic elements (Amalu and Obigbesan, 1999). This problem is solvable with a coherent research plan that will assimilate data from different regions that will include parameters or variables relevant to the growth and distribution of the coconuts. This work therefore is purposed to build an assimilator; an assimilator is a model designed to address a particular problem. In this case a regression model for addressing future coconut nutritional problems using soil and growth indicators as inputs to the model is envisaged. Henson et al., (2007) reported that a model is workable and computed only when data on various parameters are sufficient for evaluation. Following this premise, this study is a data documentary on coconut that will facilitate future modeling of coconut palm parameters and soil nutrient status in the coconut belts of Nigeria. The findings in this experiment will spur researchers to develop a researchable mathematical model in the long run, appropriate fertility management procedures needed to increase yield and output of coconut palm in the world. In Nigeria Coconut palm is at present grown in few states of the south predominantly in coastal states such as Rivers, Delta, Lagos, Edo, Ondo, and Bayelsa, others are in the inland soils and waters across the country. Under natural environments the coconut yield pattern has been found to follow seasonal cycles just like the oil palm. Climatic elements such as rainfall and drought are among the climatic factors that influence coconut yield pattern by initiation of high abortion rate. (Tenakoon, 1998, Tenakoon, 2003) In previous studies on coconut, the nutrition of the crop is a major aspect that have produce abundant evidences of how successful the crop can be in the tropics. The increase in growth and yield in various plantations as well as in the groves is traced to efficient and proper use of fertilizer recommendation as well a supportive and appropriate cultural practices, NIFOR Annual Report, (NAR 1997). Considerable efforts have been devoted to the study of nutrient status of soils supporting coconut and also the nutritional requirement of coconut in the crop producing belt. Amalu and Obigbesan (1999) carried out studies on soils fertility status and their attendant influence on coconut leaf nutrient composition. They worked on several soils in the coconut producing areas of Nigeria establishing various nutrient statuses for numerous elements needed by the crop. Henson, et al. (2007) gave detailed methodological procedures to nutrient data sourcing, collation and modeling in an oil palm setting. In recognition of this fact, there has not been serious efforts in the areas of nutrient budgeting, either from the knowledge drawn from previously concluded experiments or results from an on-going type. Several field trials and other experiments demanding the nutrient need of coconut in soils of coconut belts had been conducted by crop and soil scientists in NIFOR, (NAR , 1998, 2004, 2005), but the results from these experiment had not always synchronized the prevailing climatic factors into articulating an all round findings. A coconut research that provides working data for an upgrade satisfactory nutrient turnover and yield performance in coconut production is required. There is therefore the need to investigate and assess previous field experiments, developing them and conducting fresh ones in areas where regular application of fertilizer with recommended doses had been effected. The results will form inputs of a mechanistic modeling approach towards simulating high productivity of the crop, and likely yield results from other coconut producing areas and possible data accumulation for coconut palm in Country. Therefore concerned West Africa countries whose soil nutrient and Agro-climatic factors could fit as variables for model that have been successfully articulated in this regard stands beneficiary. In order to expand and popularize coconut palm cultivation in Nigeria, attempts are made to introduce soil info- nutrient data gathering techniques with climatic variable synchronization. This is to expand the cultivation and production of coconut palm in the sub region and meet both the nutritional and economic need of the world’s population. To achieve this goal, it is necessary to have a more comprehensive approach to solving the soil nutritional needs and moisture requirement in justifying the soil importance to the survival of the crop. The study will also establish a balance in water-climate relationship of the plant and the need to evaluate and compare the soil-water climatic relationship of existing coconut palms growing in Nigeria. The info crop coconut nutrient modeling is a development concept to actualize the goal of transforming the wetlands and every other areas of the country that could support the growth and development of the crop.

MATERIALS AND METHODS

This experiment involves collection, collation, transformation and calculation of data using conventionally recognized Statistical package such as SPSS for data sourced from works on coconut studies in the main station, NIFOR. Coconut palms planted with hybrid progenies, the green dwarf of Malaysia (Green Malayan dwarf) Indian Green dwarf, Malayan Orange and Yellow dwarf nuts and other indigenous cultivars are compared in terms of yield performance and soil nutrient compositions. The data accumulated were processed using regression analysis to formulate a data bank for coconut in the coconut growing belts in Nigeria for the purpose of furthering research in coconut palms info-nutrient modeling. This statistical researachable plan uses the statistical package SPSS version 16, currently on sourced coconut data and comparative crop evaluation from the region. Variables such as, soil nutrient data for Nitrogen, Phosphorous, Potassium, Magnesium, Sodium, Calcium and Sulphur were utilized; see table 1-6 below.
Other parameters used were yield outputs of coconut. The nutrient data computed were collated along side yields of coconut applicable for all research experiments with related titles reported. Here are the compiled and collated, data for four soils of coconut belts of Nigeria that have been statistically processed into research information in this work for use. Table 2; represents data recorded from field trial in the main station soil and it shows comparison of soil nutrient status of elements in percentages and cmol kg\(^{-1}\) with their uptake by the palm on soils of Rhodic paleudult. Table 3 represents data from open pollinated hybrids of both indigenous and exotic cultivars planted on soils of the main station, it reveals comparison of yield performances of existing dwarf coconut hybrids planted on soils of Rhodic Paleudults /coastal plain sand (Open Pollination). Table 4 are data sourced from six exotic cultivars planted under the main station climate and soils the table shows comparison of yields performance of six exotic coconut hybrids planted on soils of Rhodic paleudults (Open Pollination). Table 5 is representing data on five indigenous cultivars; it shows the comparison of yields performance of five indigenous dwarf coconut hybrids planted on soils of Rhodic paleudults. (Open Pollination). While table 6 is on data computed on evaluation of mineral composition of physiologically mature coconut palm planted and harvested from soil of the main station (Rhodic paleudults).

RESULTS

The results of the various tables are explained below;

DISCUSSION

The Particle Size and Nutrient Distribution Pattern in the Four Soils Supporting Coconut in Southern Nigeria (Coastal Marine Sand, Coastal Alluvium, Inland Forest and Inland Savannah Soils)

The particle size distribution in the soil ranged from 12.6 to 36.7 % for clay fraction, 0.90 to 3.50% silt, and 76.1 to 88.4% for sand fraction. In the inland forest soils which forms the largest part of the country's land mass had the following; the total N% ranged from 0.13 to 2.10%, available P ranged from 0.90 to 13.8 ppm, exchangeable K, ranged from 0.15 to 3.8 cmolkg\(^{-1}\), Mg is 0.05 to 1.43 cmolkg\(^{-1}\), Na was 0.01 to 0.04 cmolkg\(^{-1}\). Total S % ranged from 0.06 to 0.47%, while Exch. Na was between 0.01 to 0.04 cmolkg\(^{-1}\) while total S ranged from 0.06 to 0.47%. The particle size distribution ranged from 10.3 to 26.4% for clay and 3.2 to 7.1% for silt fraction while 44.4 to 94.3% was recorded for sand fraction. Table 1 above outlined the nutrient status and particle size distribution of four soils supporting coconut in Nigeria. It has also been proven in past experiments conducted in the Institute that the micro nutrients are also of great relevance in the growth and development of coconut palm in soils of Nigeria. Results in table 1 spelt out the nutrient recorded from the various depths in the four soils evaluated In coastal marine sand soils, the nutrient elements were distributed as follows, Total N ranged from 0.07 to 0.16%, available P ranged from 4.80 to 13.8 ppm, Exchange K, Mg, Na and Ca were 0.98 to 1.21 cmolkg\(^{-1}\), 0.29 to 0.38 cmolkg\(^{-1}\), 0.01 to 0.05 cmolkg\(^{-1}\), and 0.15 to 1.81 cmolkg\(^{-1}\). While total S in the soil ranged from 0.04 to 1.29%. The particle sizes were distributed as follows; Clay fraction ranged from 9.60 to 21.9%, Silt 1.90 to 2.9% and 75.5 to 96.5% for sand fraction only. It should be noted that the coastal marine hold large population of wild coconut stands in the groove than most other soils in Nigeria. In Coastal alluvium soils which is a very close allied to marine sand soil in most parts of the country had its fertility distributed as follows; total N ranged from 0.09 to 0.19%, available P, 3.90 to 12.5 ppm, exchangeable K, Mg, Na and Ca were 0.08 to 0.47 cmolkg\(^{-1}\), 0.10 to 0.93 cmolkg\(^{-1}\), 0.9 to 0.01 to 0.04 cmolkg\(^{-1}\) and 1, 34 to 2.28 cmolkg\(^{-1}\). While total S ranged from 0.05 to 0.29%. Table 2 represents coconut response to nutrient uptake for first year planting season and third year consecutively given the nutrient status records for some basic macronutrients such as total soil N%, Available P, total soil K, total soil Mg, total soil Ca, and total soil Na respectively. From the results on table above palm response to the various nutrients increased from the first season to the third, as shown in values of total soil N of 0.44%, palm uptake of N rouse from 0.02 to 0.066% indicating an increment of about 0.046% and a rate of about 35%. Available P revealed 36.9 ppm as soil status of P, the palm uptake of P also indicates an upward increment from 0.17% in the first year to 0.45% of P in the third year of application this represents about 62% rate of absorption or uptake of P by coconut palm. Maintaining, there is constant utilization of P by coconut palm for growth. The soil status of Mg indicates 4.53 cmolkg\(^{-1}\) while the palm uptake of Mg in the first year was 0.08% this rouse to 1.77% in the third year, this also indicates an increment of about 0.69% representing uptake rate of 39.5%. The total soil Mg was 1.33 cmolkg\(^{-1}\).

Simply indicates that in a short run the total soil magnesium status will be depleted and there is likely to be magnesium deficiency symptoms manifesting on the palm. The total soil Ca was 4.91 with the plant uptake at the first year being 0.01%, this rouse to 0.17% in the third consecutive year with an increment of 0.16% at a rate of
Table 1. Soil Nutrient Status of Coastal Sand Marine, Coastal alluvium, Inland Forest and Savannah Soils of Coconut Belt in Southern Nigeria.

<table>
<thead>
<tr>
<th>P.M/Soils</th>
<th>Depth</th>
<th>N (%)</th>
<th>P(ppm)</th>
<th>K</th>
<th>Mg</th>
<th>Na</th>
<th>S</th>
<th>Ca</th>
<th>Clay</th>
<th>Silt</th>
<th>Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal S</td>
<td>20-45</td>
<td>0.16</td>
<td>7.80</td>
<td>1.15</td>
<td>0.38</td>
<td>0.05</td>
<td>1.02</td>
<td>1.81</td>
<td>10.8</td>
<td>1.9</td>
<td>86.3</td>
</tr>
<tr>
<td>Plain S</td>
<td>45-75</td>
<td>0.08</td>
<td>10.5</td>
<td>1.19</td>
<td>0.29</td>
<td>0.01</td>
<td>0.15</td>
<td>1.54</td>
<td>17.8</td>
<td>2.5</td>
<td>77.3</td>
</tr>
<tr>
<td>Inland</td>
<td>0-20</td>
<td>0.09</td>
<td>3.90</td>
<td>0.08</td>
<td>0.10</td>
<td>0.04</td>
<td>0.09</td>
<td>1.37</td>
<td>12.6</td>
<td>0.9</td>
<td>88.4</td>
</tr>
<tr>
<td>Soils</td>
<td>75-120</td>
<td>0.15</td>
<td>12.5</td>
<td>0.18</td>
<td>0.93</td>
<td>0.01</td>
<td>0.29</td>
<td>1.34</td>
<td>36.7</td>
<td>3.5</td>
<td>76.1</td>
</tr>
</tbody>
</table>

Source: NIFOR Annual Report, NAR, Benin City, Nigeria

Table 2. Comparison of Soil Nutrient Status of Elements in Percentages and c mol kg⁻¹ And their Uptake by Coconut Palm in Soils of Rhodic paleudult.

<table>
<thead>
<tr>
<th>Initial status</th>
<th>Units</th>
<th>1st year</th>
<th>3year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Soil N</td>
<td>%</td>
<td>0.02</td>
<td>0.066</td>
</tr>
<tr>
<td>Available P</td>
<td>ppm</td>
<td>0.17</td>
<td>0.450</td>
</tr>
<tr>
<td>Total Soil K</td>
<td>c molkg⁻¹</td>
<td>0.08</td>
<td>1.770</td>
</tr>
<tr>
<td>Total Soil Mg</td>
<td>c molkg⁻¹</td>
<td>0.01</td>
<td>0.440</td>
</tr>
<tr>
<td>Total Soil Ca</td>
<td>c molkg⁻¹</td>
<td>0.01</td>
<td>0.170</td>
</tr>
<tr>
<td>Total Soil Na</td>
<td>c molkg⁻¹</td>
<td>0.00</td>
<td>0.340</td>
</tr>
</tbody>
</table>

4.1% uptake. The total soil Na was 0.13c molkg⁻¹, the first year indicates no uptake of sodium at all but increased rapidly in the 3rd year standing to 0.34% uptake, this represents 0.34% increment with a rate of approximately 100 percent. The above results showed that some basic macronutrient is been utilized at a rapid rate by coconut palms and as such would require constant fertilization to avert soil nutrient depletion due to plant uptake only. Elements such as Phosphorus, Magnesium, Calcium and Sodium must always be in check in the soils supporting coconut as soil natural supply of these elements is grossly inadequate for the palms. This finding is predicative of the palm poor output in recent years; base on the rapid rates that coconut palm utilizes some of these essential soil nutrients and poor fertilization of the soils by coconut farmers. Table 3 below spelt out the quantities and rate of nutrients absorbed by the palm. Table 4 represents the comparison of yield performances of existing dwarf coconut hybrids varieties planted on soils of Rhodic paleudults (main station,) and
Table 3. Comparison of Yield Performances of Existing Dwarf Coconut Hybrids Planted on Soils of Rhodic Paleudults /Coastal plain Sand (Open Pollination)

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Nos of palm</th>
<th>Nos of Bunches</th>
<th>Nos of nuts</th>
<th>Weights of nuts/palm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malayan Dwarf Green</td>
<td>51</td>
<td>3.5</td>
<td>20.6</td>
<td>24.1</td>
</tr>
<tr>
<td>Malayan Dwarf Yellow</td>
<td>61</td>
<td>4.1</td>
<td>31.4</td>
<td>32.1</td>
</tr>
<tr>
<td>Malayan Dwarf Red</td>
<td>28</td>
<td>4.1</td>
<td>22.7</td>
<td>35.1</td>
</tr>
<tr>
<td>Umuahia Dwarf Green</td>
<td>58</td>
<td>3.2</td>
<td>24.5</td>
<td>21.9</td>
</tr>
<tr>
<td>Uwan Dwarf Green</td>
<td>36</td>
<td>4.0</td>
<td>34.3</td>
<td>34.9</td>
</tr>
<tr>
<td>Cameroon Dwarf Green</td>
<td>30</td>
<td>3.2</td>
<td>27.8</td>
<td>27.8</td>
</tr>
<tr>
<td>Chowghat Dwarf Green</td>
<td>13</td>
<td>3.4</td>
<td>26.1</td>
<td>29.4</td>
</tr>
<tr>
<td>Chowghat Dwarf Yellow</td>
<td>5</td>
<td>3.6</td>
<td>31.0</td>
<td>31.8</td>
</tr>
<tr>
<td>Nyler Garden</td>
<td>6</td>
<td>3.5</td>
<td>32.0</td>
<td>16.7</td>
</tr>
<tr>
<td>Badagary Tall</td>
<td>41</td>
<td>2.9</td>
<td>14.6</td>
<td>18.6</td>
</tr>
<tr>
<td>NIFOR Tall</td>
<td>37</td>
<td>2.6</td>
<td>12.2</td>
<td>12.6</td>
</tr>
<tr>
<td>Moor Plantation Tall</td>
<td>6</td>
<td>3.0</td>
<td>10.3</td>
<td>12.6</td>
</tr>
</tbody>
</table>

Source; NIFOR Annual Report, NAR, Benin City, Nigeria

Table 4. Comparison of Yields Performance of Six Exotic Coconut Hybrids Planted on Soils of Rhodic Paleudults (Open Pollination)

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Ave nos of Bunches</th>
<th>Ave nos of nuts</th>
<th>Weights of nuts/palm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malayan Dwarf Green</td>
<td>3.6</td>
<td>43.8</td>
<td>44.0</td>
</tr>
<tr>
<td>Malayan Dwarf yellow</td>
<td>2.5</td>
<td>19.7</td>
<td>21.6</td>
</tr>
<tr>
<td>Malayan Dwarf red</td>
<td>3.8</td>
<td>31.8</td>
<td>38.5</td>
</tr>
<tr>
<td>Sri Lanka Pumila</td>
<td>1.5</td>
<td>7.0</td>
<td>5.9</td>
</tr>
<tr>
<td>Sri Lanka Eburneae</td>
<td>1.8</td>
<td>6.0</td>
<td>8.7</td>
</tr>
<tr>
<td>Sri Lanka Regia</td>
<td>2.8</td>
<td>11.3</td>
<td>13.7</td>
</tr>
</tbody>
</table>

Table 5. Comparison of Yields Performance of Five Indigenous Dwarf Coconut Hybrids Planted on Soils of Rhodic Paleudults. (Open Pollination)

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Ave nos of Bunches</th>
<th>Ave nos of nuts</th>
<th>Weights of nuts/palm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abak dwarf</td>
<td>2.7</td>
<td>11.4</td>
<td>7.5</td>
</tr>
<tr>
<td>Abakaliki dwarf</td>
<td>1.2</td>
<td>5.2</td>
<td>3.9</td>
</tr>
<tr>
<td>Opobo dwarf</td>
<td>2.7</td>
<td>11.4</td>
<td>7.5</td>
</tr>
<tr>
<td>Uwan dwarf</td>
<td>2.1</td>
<td>12.9</td>
<td>8.9</td>
</tr>
<tr>
<td>Ughelli dwarf</td>
<td>3.6</td>
<td>22.9</td>
<td>18.3</td>
</tr>
</tbody>
</table>

Source; NIFOR Annual Report, NAR, Benin City, Nigeria

Table 6. Mineral Composition of physiologically Mature Coconut Palm

<table>
<thead>
<tr>
<th>Fruit Component;</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
<th>Potassium</th>
<th>Magnesium</th>
<th>Calcium</th>
<th>Sodium</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N%</td>
<td>P %</td>
<td>K %</td>
<td>Mg %</td>
<td>Ca %</td>
<td>Na %</td>
</tr>
<tr>
<td>Mesocarp</td>
<td>0.38</td>
<td>0.02</td>
<td>0.51</td>
<td>0.03</td>
<td>0.06</td>
<td>35.29</td>
</tr>
<tr>
<td>Endocarp (shell)</td>
<td>0.41</td>
<td>0.01</td>
<td>0.12</td>
<td>0.01</td>
<td>0.01</td>
<td>5.88</td>
</tr>
<tr>
<td>Endosperm</td>
<td>2.98</td>
<td>0.42</td>
<td>1.14</td>
<td>0.36</td>
<td>0.10</td>
<td>58.82</td>
</tr>
<tr>
<td>Total</td>
<td>3.77</td>
<td>0.45</td>
<td>1.77</td>
<td>0.40</td>
<td>0.17</td>
<td>100.0</td>
</tr>
</tbody>
</table>


(Substation-Badagry) (FAO/UNESCO, 1994) which were openly pollinated. These hybrids consist of those that have been locally generated and the introduced or exotic ones that are included in the various coconut fields in the main station and those at the substations of the institute, NIFOR. Results showed that among the exotic hybrids few of them had the propensity to producing yields commensurate with their stands on ground; the Malayan green dwarf with 51 palm stands yielded 20.6 numbers of nuts and a nut weight of 24.1kg per palm. While the Maylan Yellow dwarf with about 61 palms produces 4.1 bunches with 31.4 nuts and 32.1kg per stand. The Malayan red dwarf is fewer in numbers with 28 palms 4.1 number of bunches, 22.7 and 35, 1 kgw per palm The others are Cameroon dwarf green, Chowghat dwarf green, Chowghat yellow dwarf, Nyler garden, Badagry tall, NIFOR tall and Moor plantation tall all having average yield performance less than Maylan and Umuahia to Uwan varieties (Table 4). In Table 5 lies the comparison of yields performances of six exotic coconut hybrids planted on soils of Rhodic paleudult openly pollinated. They include Maylan green dwarf, yellow and red, followed by Sri Lanka Pumila, Ebunea, and Regia. The table spelt out the average number of bunches average number of nuts and weights of nuts per palm. And revealed that the Maylan Dwarf red was consistent in yield and had a higher average yield performance of 3.8 bunches with 31.8 nuts on the bunches weighing approximately 39kgs. This was however not the highest but was more consistent in output performances than the Maylan dwarf green that was the highest in terms of output but tend to wave in outputs having 3.6 bunches with 43.8 nuts on weighing gave 44.0kgs. The least performed variety was the Sri Lanka Pumila that produced about one and half bunch with just seven nuts that were weighing 5.9kgs. These varieties are all exotic but some produced far below average output performance. Table 6 compares yields of five indigenous varieties of coconut on soils of the main station NIFOR, these varieties revealed the Ughelli dwarf as having comparably high numbers of bunches but low in numbers of nuts and weights per palm. This however does not match the required output performances compared with the varieties on table 3, 4 and 5 that registered higher performances. The other varieties lacked sufficient output attributes that could have meet with the Ughelli dwarf type. Table 7 shows the mineral composition or simply nutritional qualities of the different parts of the coconut in a mature coconut. The minerals involved are Nitrogen Phosphorus, Potassium, magnesium, Calcium, and Sodium, these mineral nutrients form the parts absorbed from the quantity uptake from the soil in table 2 and 3. From a total of 0.066% N that was absorbed by the plant from the soil only 0.38% of that amount of nitrogen represents the mesocarpous nitrogen, and of 0.45% P uptake from the soil only 0.02% P was recorded in the mesocarp. The quantity of K uptake was 1.77%, representing the highest nutrient uptake by the palms in the three seasons, only 0.51% K was found in the mesocarp. While of the 0.44% Mg uptake, only 0.03% of Mg was in the mesocarp and of the 0.17% Ca taken from the soil only 0.06% of calcium was represented in the mesocarp. The quantity of Sodium uptake was 0.34% and only 0.1% was part of the mesocarp. The endocarp of the coconut contain about 0.41% N wherein 0.066% N uptake was by the palm this was only second to K in the quantity of nutrient absorbed. 0.01% P was contained in the endocarp, 0.12% K, 0.01% Mg, 0.01% Ca and 0.07% Na was as well recorded in the endocarp. The endosperm had the highest nutrient composition with nutrient status ranging from 0.1 to 2.98%. Nitrogen had 2.98% composition, while calcium had the least with 0.10%, available P was 0.42%, and Potassium was the second highest nutrient composed in the endosperm after nitrogen. This was consistent with virtually all parts of the palm analyzed.

A Correlation of Nutrient Elements in the Four Soils with Coastal Marine and Inland Savannah Soils

A correlation of each nutrient across the four soils in Table 1 revealed some salient comparison between the soils evaluated, with some soil type showing greater soil potentials of nutrient and coconut adaptability than others this was done in line with Ebrayikn et al, (2007) and Chenu et al (2008). The mean nitrogen percentages distributions in the four soils were Inland Savannah Soil 0.173, Inland Forest Soil 0.173, Coastal Marine Soil 0.110 and Coastal Alluvium 0.135 respectively. A correlation of the inland savannah soil N with the other three soils revealed a positive significant correlation with coastal marine soil r = 0.975** and fairly with inland forest soil r = 0.517 and poorly negative with coastal alluvium soil with r = -0.330. Available P in part per million (ppm) had a mean distribution of 13.30 in the inland savannah soil, 11.30 in the inland forest soil, 9.22 in the coastal marine soil and 6.55 in the coastal alluvium soil. A Correlation of the Inland Savannah Soil with other three soils showed a significant positive correlation with coastal marine r = 0.987 coastal alluvium r =0.805 and fairly significant with inland forest soil r= 0.575. The statistical distribution of K in cmolkg⁻¹ across the four soils revealed an average mean distribution of 0.16 in the inland savannah soil, 0.24 in the inland forest soil, 1.13 in the coastal marine soil and 0.22 in the coastal alluvium. The correlation of the inland savannah soil with the other three soils in the study revealed a positive significant correlation only with coastal marine r = 0.778* and coastal alluvium soil r= 0.699 and not significant with inland forest soil r = -0.278**.

Magnesium distribution in the four soil revealed an average mean of 0.713 in inland savannah soil, 0.558 in the inland forest soil was 0.420 while the coastal alluvium soils had 0.333 respectively (Table 1). A correlation of coastal marine soil with the other three soils revealed a
poor linearity with only the inland forest soil showing a fair positive correlation but not significant \( r = 0.595 \). The distribution of exchangeable Na in the four soils are as follows with an average mean of 0.0325c molkg\(^{-1}\) in coastal marine soil, 0.0275c molkg\(^{-1}\) in the inland forest soil, 0.0250c molkg\(^{-1}\) in the coastal alluvium soil and 0.0250c molkg\(^{-1}\) in the inland savannah soil respectively. A correlation of the content of sodium in the coastal marine with other three soils revealed a significant positive correlation with inland forest soil \( r = 0.961^{**} \) and negative correlation with \( r = -0.814 \) with coastal alluvium soil. This indicates that while there could be sufficient exchangeable Na in the coastal soils these tend to decreased significantly in the coastal alluvium soil compared to the coastal marine with the inland forest soil having significant linearity with the coastal marine soil. The total mean Sulphur distribution in the study were as follows 0.625 in coastal marine, 0.255 in the inland forest soil, 0.265 in the inland savannah soil and 0.128 in the coastal alluvium soils. A Sulphur nutrient comparison of the coastal marine soil with the three others in the study revealed a significant positive correlation with soil of the inland forest \( r = 0.918^{**} \) and \( r = 0.595 \) in the coastal alluvium soil.

The result shows that the inland soil of the savannah had a decline reserve of Sulphur nutrient in it soils and would require fertilization of Sulphur. The mean calcium distributions in the respective soil are; coastal marine soil 1.228, inland forest soil 0.705, inland savannah soil 0.848, and coastal alluvium soil 1.623. The mean shows the coastal alluvium and coastal marine soils as having highest values compared to the other soils. A correlation result revealed a significant negative correlation \( r = -0.989^{**} \) inferring a gross decline in the content of calcium in the soils of inland forest and inland savannah soils. The comparison of clay contents in the four soils revealed the percentage mean distributions as follows; coastal marine soil 15.03, the inland forest soil 14.33, inland savannah soil 18.48 and coastal alluvium soil 24.23. The result reveals that there is more clay accumulation in the coastal alluvium and coastal marine soils than in the coastal marine soil and inland forest soils wherein greater population of coconut palm stands occurs in the groove. There is the likelihood of clay accumulation in the soil being a factor for nutrient adaptation for coconut palm in the four location investigated in this work as the soils were significantly positive in correlation with the coastal marine soil \( r = 0.984 \); inland forest soil, \( r = 0.987 \) inland savannah soil, \( r = 0.774 \) coastal alluvium soil) (Hammer et al, 2010) which holds the largest population of coconut stands in Nigeria.

**CONCLUSION**

The Info-Coconut Nutrient data assessment is a project in the coconut research for development program of Nigeria Institute for Oil palm Research, Nigeria. Aim at making sufficient data available on coconut palm for the industry. In this work efforts have been made to collate some important data on yield performances, progenies varietal peculiarity and adaptability to the environment. Data had been recorded on coconut nutrient uptake and responses in soils of the main station Nigeria Institute for Oil Palm Research (NIFOR) with detailed information from four soils of the coconut belts of Nigeria. These soils had been considered in order of major macronutrients required by the palm and the nutrients were statistically compared across the four soils to ascertain the level of availability and adequacy for coconut development. The results available revealed that coconut palm have more soil nutrient potentials available in the coastal marine and inland savannah soils than the coastal alluvium and inland forest soils.

**RECOMMENDATION**

Coconut in these areas considered in this work will however require adequate fertilization program to supply some nutrient short fall identified in this research findings. These should basically include; N P K and Ca, these elements though present in the four soils, are not sufficiently distributed and available to the palm. They were poorly correlated with soil nutrients in soil with abundance of the crop and growth, these nutrient elements showed rapid rates of absorption from the four soils especially Mg and Na. Absorption by the crop should however be with limit to the crop’s optimum requirement level as coconut is a highly sensitive crop to both nutrients and climatic properties.

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