Adaptability of Bambara groundnut (Vigna subterranea (L.) verdo) to sub-humid environment of Epe Local Government of Lagos State

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ABSTRACT

A field trial was conducted at four locations; (A, B, C, D) within Michael Otedola College of Primary Education (MOCPED) Teaching and Research Farm. The trial was replicated three times between the months of June 2010 and October, 2010 using bambara groundnut (Vigna subterranean (L.) verdo). The four sites were with similar soil physiochemical properties that were described as fairly fertile soil based on the soil analysis result. The bambara groundnut was established on 2.5 m² micro plots in sub-humid environment of Epe Local Government in Lagos State. The trial was subjected to all agronomic practices with exception of fertilizer application. The trial was subjected to all agronomic practices with exception of fertilizer application and the yield parameters were observed, analysed and cost analysis was determined. It can then be said that the yield of bambara groundnut in spite of climatic conditions that was different from northern parts where is generally cultivated. The yield then follows the pattern as follow: B > C > D > A, with location A given the least yield of 1110 g per 2.5 m² land area. The results showed that like other legumes, bambara groundnut can be produced in Epe Local Government Area, with promising yield as seen in the Northern parts of Nigeria (the major producing region of the country) with dried seeds yield given a profit of thirty five thousand, one hundred and two Naira fifty kobo (N35, 102.50) per hectare at a planting season. From the result it can also be deduced that with little or no fertilizer applications on arable land practices bambara groundnut production is profitable.

Key words: Vigna subterranea, sub-humid, environment, soil fertility, yield.

INTRODUCTION

Bambara groundnut Vigna subterranea (L.) verdo is an Africa legume valued for it drought tolerance and resistance to pests and diseases (Ehleringer and Osmond, 1989). It consists of two botanical forms: var spontanea comprising the wild forms and var subterranea comprising the cultivated forms found in many parts of the tropics particularly sub-Saharan Africa (Shravani et al., 2004; Hepper, 1963).

Bambara groundnut is a commonly called earth pea, Congo groundnut among other names (James, 2009). It is a leguminous plant that is grown for its underground seeds only. The plants originated in West Africa, according to some Scholars (NRC, 2006), it is regarded as traditional food plant in Africa. Bambara groundnut ripens its pods underground, much as the groundnut. They can be eaten fresh or boiled after drying or be roasted fresh (NAP, 2008).

It is an annual leguminous plant with underground pods or seeds. The entire plant is similar to the common groundnut, being a low, flat annual with compound leaves of three leaflets. It can be erect or spreading types, it forms pods and seeds on or just below the ground. To achieve this, the flower stalk elongates and penetrates the soil. The bulbus tip creates a tunnel through which the fertilized flower, attached just behind the tip is drawn into the soil.
Bambara groundnut grows best in well drained soils with moderate nutrients, high temperatures at least for four months free from frost and frequently rains to grow best (James, 2009). The plant is highly adaptable and tolerates harsh conditions better than most crops. It matures between three to four months, depending on cultivars and the climatic conditions.

Protein from both field beans and bambara groundnut are nutritionally complete but needs to be supplemented with methionine (Ocran, 1998). It contains relatively high amount of vitamins that the human body systems required. Therefore, cereals are also required as supplement for full satisfaction for a balanced cereal-legume diet or with legume diet supplemented with specific amino acids (Onwuene and Sinha, 1999).

The seeds contain 14 to 24% protein and, about 60% carbohydrate and oil within the range of 6 to 12% (NRC, 2006; NAP, 2008). The immature seeds may be eaten raw. Because the seeds become hard when mature, they have to be prepared. When roasted, or boiled, even the matured seeds are sweet and pleasant tasting. The seeds are often roasted and milled into nutritious flour (Yamaguchi, 1983). One peculiar attribute about this bean; is that the protein is reported to be high in the essential amino acid, even methionine, than other grains legumes. While the oil content is within the range of 6 to 12% and this is less than half the amount of oil found in groundnut; this made it not useful as an oil seed crop (James, 2009).

However, due to the rare cultivation practice of bambara groundnut in the southern humid forest zone area of Lagos state, it is a point of interest of research. Hence, the main objective of this trial is to evaluate the performance of bambara groundnut on sand-loam soil of Epe Local Government Area of Lagos state as influenced by the humid environment coupled with fairly nutrient depleted soil.

**METHODOLOGY**

**Experimental site**

The trial was conducted at Michael Otedola College of Primary Education, Department of Agricultural Education, Teaching and Research Farm, Noforija Epe. Four different areas within the College Campus were sited to evaluate the response of bambara groundnut to the effect of the same climatic conditions but different soil fertility status; ranging from Low, Medium and High nutrient levels.

**Collection and preparation of soil**

Top soil (0-15b cm) depth was collected from Michael Otedola College of Primary Education, Teaching and Research Farm, Noforija Epe, the soil samples were air dried for seven days and crushed to pass through 2 mm sieve mesh for laboratory analysis.

**Experimental treatments**

The four locations soils served as the main treatments and were designated based on the physio-chemical properties assessment obtained from laboratory as follows: A = Highly fertile. B = Fairly fertile C = Moderately fertile and D = Low fertility status.

**Experimental set up and procedures**

Each location was manually cleared and tilled and *bambara* groundnut seeds were sown at two seeds per hole at 30 by 60 cm on micro plot of 2.5 m² given plant density of fourteen (14) stands per micro plot. The seedlings were thinned to one per stand two weeks after sowing. The experiment was laid in complete randomize design (CRD), with three replicates.

**Cultural practices**

The experiment was a rain-fed and no irrigation was carried out and all other cultural practices were regularly carried out with exception of fertilizer application. In conclusion, the experiment was established in mid June 2010 and *bambara* groundnut was harvested early October 2010.

**Data collection and analyses**

The following yield parameters were taken from ten (10) stands per micro plot per location, these include:

(i) Fresh pods weight  
(ii) Dry pods weight  
(iii) 100 seeds weight  
(iv) Cost analysis for dry seed production per hectare.  

The cost and return analysis was calculated using whole farm analysis equation. This equation is one major method of estimating the profitability or otherwise of a farm enterprises. The cost and return analysis was calculated using whole farm analysis equations (Samson and Earl, 1982). This is one major method of estimating the profitability or otherwise of a farm enterprises.

Mathematically,  
\[
\Pi = TR - TC 
\]

Equation 1

Where; \(\Pi\) = Profit, \(TC\) = Total cost, \(TR\) = Total revenue
Table 1. Physical and chemical properties of soils used for bambara groundnut production.

<table>
<thead>
<tr>
<th>Soils samples</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (H2O)</td>
<td>5.4</td>
<td>5.1</td>
<td>5.3</td>
<td>6.7</td>
</tr>
<tr>
<td>Organic C (g/kg)</td>
<td>3.6</td>
<td>2.5</td>
<td>3.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Total N (g/kg)</td>
<td>1.1</td>
<td>0.9</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Av. P (Mg/kg)</td>
<td>19</td>
<td>19</td>
<td>19.3</td>
<td>15.2</td>
</tr>
<tr>
<td>K (Cmol./kg)</td>
<td>1.0</td>
<td>0.3</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Ca (Cmol/kg)</td>
<td>1.5</td>
<td>1.4</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Mg (Cmol/kg)</td>
<td>1.5</td>
<td>1.0</td>
<td>0.6</td>
<td>0.5</td>
</tr>
<tr>
<td>Na (Cmol/kg)</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Sand</td>
<td>79.2</td>
<td>79.4</td>
<td>80</td>
<td>79.2</td>
</tr>
<tr>
<td>Silt</td>
<td>12</td>
<td>12</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Clay</td>
<td>8.8</td>
<td>8.6</td>
<td>9</td>
<td>10.8</td>
</tr>
<tr>
<td>Textural Class</td>
<td>Sandy loam soil</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


which is represented as p,q and where p = Price per unit of output and q = quantity of output.

\[ TC = TVC + TFC \]  
Equation 2

\[ TVC = \text{Total Variable Costs}, TFC = \text{Total Fixed Costs}. \]

All other data collected were analyzed using Analysis of Variance (ANOVA) Pr < 0.05 and where F-ratio is significant Duncan Multiple Range Test (DMRT) at 0.05 was used to separate means.

RESULTS

The Table 1 showed the chemical and physical properties of both locations (A, B, C and D) soil used for the experiment. The soil textural class is sandy loam soil with total Nitrogen ranging from 0.8 to 1.1 g/kg which is moderately good for legume production (Table 1). In all the soils used the sand particle percentages are high and the Nitrogen (N), Phosphorus (P) and Potassium (K) are moderate for crop production with the exception of samples A and D that are high and low in Nitrogen respectively (Table 1 and Figure 1).

The fresh pod yield at location B gave the highest value followed by the yield obtained from location C, however, in all the Locations the yields were significantly different (Pr<0.05).

Similar trend was observed in the dry Pod weight with location D given the least value; 394.7 g per 2.5 m². However, the quality of the dry seeds (weight), showed that the weights of the seeds obtained at locations C and D with values of 77.5 and 75.9 g per 100 seeds respectively (Pr<0.05), were not significantly different but significantly different compared to other two locations.

The result showed that location B supported the growth and yield of Bambara groundnut followed by locations C, while A giving the least showing that the fertility status of the soil significantly influenced the yield of bambara groundnut.

Similar trend was observed with the dry pod yield but no significant different (Pr ≤0.05) was shown in the seed weight per 100 seeds of the nuts.

Figures 2 and 3 showed similar pattern as seen and discussed earlier, with no distinct or clear different in the weight of the 100 dry seeds weight of bambara groundnut.

From Table 2, the items of cost were classified into two components: Fixed and Variable Cost items in the short run. The revenue generated per plot was realized from the sales of the produce by the researchers from the Teaching and Research farm of MOCPED, Norforija - Epe. The Fixed costs were depreciated using the straight line method. The revenue was determined based on the quantity realized in kilogrammes. From Table 2, it could be inferred that this bambara groundnut is profitable with a return of Thirty five thousand, two hundred and fifty naira per hectare (N35,102.50) for an hectare of land.

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

From Tables 1 and 2, it can be deduced that bambara groundnut performance followed the particular pattern of the soil fertility status with exception of 100 seeds weight at each location that showed significantly different (Pr < 0.05).

Fresh and dry pods weights

The fresh and dry pods weights at each location was
physicochemical properties of soils used with the nutrients status in numerical values. Legend: 1=pH (H₂O), 2= Organic C (g/kg), 3=Total N (g/kg),4=AV.P (Mg/kg), 5=K (Coml./kg), 6=Ca (mol/kg), 7=Mg (Coml./kg), 8=Na (Coml./kg), 9=Sand, 10=Silt, 11=Clay. Textural class is sandy loam soil.

**Figure 2.** Histogram showing yield performance of bambara groundnut at four different locations in Epe Local Government Area of Lagos state.

<table>
<thead>
<tr>
<th>Location</th>
<th>Fresh Pod wt (g)</th>
<th>Dry Pod wt (g)</th>
<th>100 Dry Seeds wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location A</td>
<td>4500</td>
<td>2000</td>
<td>75.9</td>
</tr>
<tr>
<td>Location B</td>
<td>4276.7</td>
<td>1247.7</td>
<td>77.5</td>
</tr>
<tr>
<td>Location C</td>
<td>3500</td>
<td>1000</td>
<td>75.9</td>
</tr>
<tr>
<td>Location D</td>
<td>2500</td>
<td>500</td>
<td>75.9</td>
</tr>
</tbody>
</table>

The weight of 100 dry seeds per gram per location was not significantly different from neighbouring location. As observed, location C 100 lots of seeds though gave the highest weight of 77.5 g/100 seeds followed by location D, with 75.9 g but not significantly different from each other (P < 0.05). Similar trend was observed with other two
locations.

It can then be said that the yield of Bambara groundnut in spite of climatic conditions different from northern parts where it is generally cultivated; the yield thereby follows the pattern of the locations’ soil fertility level or status: $B > C > D > A$. Location A gave the least yield as observed to be 1010 g per 2.5 m$^2$ land area (Table 2 and Figures 2 and 3).

Similar patterns were observed in dry pods weight and the weight of 100 seeds of Bambara groundnut per each location.

However, there was no significant different (Pr < 0.05) between 100 seeds obtained at Locations A and B with the weights of 63.9 and 67.6 g per 100 seeds of bambara groundnut respectively (Table 2 and Figures 2 and 3).

In conclusion, it can be deduced or inferred that that climatic conditions at humid region of Epe Local Government Area of Lagos state used for this trial; does not really affect performance of the bambara bean, especially the growth and the yield. It can also be concluded that bambara groundnut can as well be incorporated into the legume planting programme of this area for consumption as other legumes seeds.

This trial proved that the climatic requirements of bambara groundnut besides the soil and other edaphic conditions can as well be attained in this environment for bambara groundnut production. Hence, from this trial it can be recommended or suggested that:

Planting of bambara groundnut may be done between months of June and July and production of bambara groundnut can be done on soil of low to high fertility levels with little or no soil fertility maintenance practices such as fertilizer application.

<table>
<thead>
<tr>
<th>Yield parameters</th>
<th>Locations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh pods weight</td>
<td>A 1010$^d$</td>
<td>B 4276.7$^a$</td>
</tr>
<tr>
<td>Dry pods weight</td>
<td>A 296.7$^d$</td>
<td>B 1274.7$^a$</td>
</tr>
<tr>
<td>100 seeds (dry) weight</td>
<td>A 63.9$^c$</td>
<td>B 67.6$^{bc}$</td>
</tr>
</tbody>
</table>

Source: Field trial (2010). Values followed with the same letter or letters are not significantly different at DMRT Pr<0.05.

REFERENCES


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