Influence of Seeding Rate on Nut Yield and Soil Fertility Improvement Ability of Groundnut (Arachis hypogae)

By

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Research Article

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ABSTRACT

Field experiments were carried out in 2011 and 2012 late planting seasons to investigate the effect of seeding rate on nut yield and soil fertility improvement ability of groundnut on low fertile soils of southern Nigeria. Treatment consisted of four seeding rates; 1, 2, 3, and 4 plants per stand on a 1 m$^2$ plot size to obtain population densities of 160,000, 320,000, 480,000 and 640,000 plants per hectare which were planted on the soil without applying fertilizer. Results showed that groundnut planted at one and two seeds per stand significantly produced more number of leaves, branches, weight of pods and nuts per plant. Soil chemical properties per plot also showed improved fertility status of the soil despite the fact that the groundnut has utilized the nutrient for yield production. Therefore for optimum nut yield and sustainable crop production, groundnut should be planted at one or two seeds per hill.

Keywords: Soil Fertility, Groundnut, Seeding rate, Legumes.

INTRODUCTION

Maintenance of soil fertility is an important aspect of increasing output of crop in creating sustainable practices. Various practices available to achieve these objectives include; bush fallowing, use of compost, green manure, farmyard manure, mineral fertilizer and leguminous crops (Adediran et al., 2009). Legume has been found to improve the fertility of the soil and suppresses weed which aid continuous cultivation of crop (Makinde and Akande, 2001; Mohammad, et al., 2004). Legumes are notable for their ability to fix atmospheric nitrogen through a symbiotic relationship with bacteria (*rhizobium*) found in the root nodules of the plant (Singh and Tarafdar, 2001). Legume species were being cultivated to be tilled back into the soil in order to exploit the high levels of captured atmospheric nitrogen found in their roots. Groundnut; a species in the leguminous family is rich in essential and phyto nutrients and are good sources of niacin, fiber, magnesium, vitamin E, manganese and phosphorus among others (Michael and Halmer 2006; Bertioli and Moscone, 2007). Groundnuts provide nutritive biomass in form of green fodder which after producing yield can be incorporated into the soil to improve its fertility status. Seeding rate is one of the important factors in achieving optimum level of plant density so that plants make efficient use of the resources (Tsigewon et al., 2003). The number of plant required per unit area (plant population) is one of the prime considerations for higher biomass production which definitely have influence on yield performance also, seeding rate, number of plants per stand and special arrangement are ways of manipulating plant population per unit area to achieve desired optimum growth yield. This study was carried out to evaluate the seeding rate effect on growth and nut yield of groundnut and also its effect on post harvest chemical properties of the soil.

MATERIALS & METHODS

The field experiments were carried out in Federal College of Agriculture (Latitude 7° 30′N and Longitude 3° 54′E) Ibadan, southwestern Nigeria. The study site is a Rainforest – Derived savannah transitional zone with a mean annual rainfall of 1256 mm per annum with bimodal distribution which commences in April to July and in September to November with a short dry spell in August. The mean monthly maximum temperature ranges between 30 - 33°C.
while the mean monthly minimum temperature ranges from 24 - 28 °C and relative humidity range between 46 - 86% (IITA, 1997). The soil in the area belongs to Iwo series which has been classified as an Alfisol with sandy loam texture. Details of the pre cropping soil characteristics are presented in Table 1. A local variety of groundnut known as “Bororo” was planted at 25cm x 25 cm and different seeding rates of 1, 2, 3, and 4 plants per stand on a 1 m² plot size to obtain population densities of 160,000, 320,000, 480,000 and 640, 000 plants per hectares. These were arranged in a randomized completely block design with four replications. The experimental plot was prepared mechanically by ploughing and harrowing after which the plot was raised into 20 cm height. No fertilizer was applied to the crop and weeding was done manually at 2 and 4 weeks after planting. Data were taken on number of leaves, number of branches number of pods, weight of pods and weight per plant. Post- harvest soil sample were taken randomly from each plot and the samples were analyzed in the laboratory to assess its nutrient status.

**Soil Sampling and analysis**

Soil samples were randomly collected at 0-15 cm depth using 8.5 cm diameter soil auger. The samples were thoroughly mixed to obtain a composite sample which was put into polythene bags and labeled for identification. Each bulked sample was spread to air dry, crushed with wooden rolling pin and passed through 2 mm sieve and stored in air- tight container for physical and chemical analysis.

The samples were analyzed for physical and chemical properties. The pH was determined by glass electrode pH meter. Particle size was determined by hydrometer method (Bouyoucous, 1957). Organic carbon was determined by wet dichromate method (Walkey and Black, 1934). Total nitrogen was determined by the microkjedhal method. Extraction of available phosphorus was done by Bray’s P1 method. Exchangeable cations (Ca²⁺, K⁺, Mg²⁺ and Na⁺) were extracted by 1N neutral ammonium acetate, K and Na in the extract were determined by flame photometry while Ca and Mg were determined by Atomic absorption spectrophotometry. Effective cation exchange capacity was by summation method (Braize, 1998).

**Statistical Analysis**

The data were subjected to Analysis of variance (ANOVA) while significant means were separated using the least significant difference (LSD) at 5% level of probability (SAS, 2008).

<table>
<thead>
<tr>
<th>Table 1: Physical and Chemical properties of pre-cropping soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
</tr>
<tr>
<td>pH (H₂O)</td>
</tr>
<tr>
<td>Exchangeable bases (c mol kg⁻¹)</td>
</tr>
<tr>
<td>Ca²⁺</td>
</tr>
<tr>
<td>Na⁺</td>
</tr>
<tr>
<td>K⁺</td>
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<tr>
<td>Mg²⁺</td>
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<tr>
<td>Ex. acidity (H⁺)</td>
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<tr>
<td>ECEC(c mol kg⁻¹)</td>
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<tr>
<td>Organic carbon (g kg⁻¹)</td>
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<tr>
<td>Organic matter (g kg⁻¹)</td>
</tr>
<tr>
<td>Total N (g kg⁻¹)</td>
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<tr>
<td>Av. P (mg kg⁻¹)</td>
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<tr>
<td>Silt (g kg⁻¹)</td>
</tr>
<tr>
<td>Clay (g kg⁻¹)</td>
</tr>
<tr>
<td>Sand (g kg⁻¹)</td>
</tr>
<tr>
<td>Textural class</td>
</tr>
</tbody>
</table>
RESULTS AND DISCUSSION

The chemical analysis of the pre-cropped soil of the experimental plot were presented in Table 1. The textural class of the soil is sandy loam with a pH of 5.20 and 6.06 for 2011 and 2012 respectively which indicates that the soil is moderately acidic and appropriate for cultivation of groundnut (Tsigewon et al., 2003). The organic matter, total N, exchangeable bases and available P were low indicating that the soil is poor in low fertility status. The effect of seeding rate of groundnut on number of leave and branches per plant for both 2011 and 2012 planting season presented in Table 2 showed significant differences among the seeding rate. Groundnut planted at the lowest seeding rate (1 seed per stand) and population density 160,000 plants per hectare resulted in higher number of leaves and branches per plant in both years. This is as a result of lack of competition with any other plant as it happened in other seeding rates of 2, 3, and 4 plants per stand. Hence there were more space and nutrient available to support the growth of plant as it had been reported earlier by Thorave and Dhonde (2007) in a research carried out to check the nutrient management for sustainable groundnut productivity; where planting at one plant per stand recorded the highest value (166.70) in number of leaves and branches per plant. This had earlier been observed by Mohammed et al. (2004); who reported that there was increase in number of pods per groundnut plant. The mean weights of both pods and nuts per plant recorded no significant differences in 2011 as presented in Table 3. Although one seed per plant with plant population density 160,000 plant per hectare recorded the highest weight of groundnut pods and nuts (5.47 & 3.60 g) respectively. Santiesteban et al. (2002) in his earlier report was in support to this finding which says that the yield components of cowpea decreased with increasing plant density. But recorded the lowest significant weight of pods and nut per hectare (1.16 & 0.72 tons) in 2011 as well as in 2012 (1.00 & 0.70) respectively. This could be attributed to the increase 2, 3 & 4 seeds per hill as confirmed by. Prasad et al. (1998) who reported that the grain yield of Valencia groundnut increased with two seeds per hill than one seed per hill. Santiesteban et al., (2002) was also in support to this finding; he said in his report that the yield components of cowpea decreased with increasing plant density.

The effect post harvest soil sample obtained from all plots where groundnut were planted increased significantly compare to pre cropping soil samples for both years (Table 4). The seeding rate effect on the soil also showed that soil on one seeding rate per plant had higher nutrient status compare with the soil of other seeding rate and this is due to the balance proportion of competition for space, nutrient oxygen and all other essential requirements needed for growth and production as reported by Kandil (2007); Chitdeswari, et al., (2007). There was increment in percentage nitrogen of soil after harvesting and that nitrogen levels increases in soil after harvesting from one to four plants per stand, this is in line with the findings of Sukanya and Hegde in (1995); Kurlovich and Repvey (1995) which reported that increasing level of nitrogen due to increased nodules number, nodules mass, total dry mass, total nitrogen, pod yield and harvest index in groundnut as a leguminous plant. This truly affirm that groundnut as a leguminous plant aid in Nitrogen fixation, utilized the nitrogen for yield production and also improve the fertility status in accordance to the seeding rate utilized.

CONCLUSION

This study shows that groundnut planted at one and two seeds per hill increased the growth and nut yield of groundnut, it also impacted positively on soil chemical properties hence improved the fertility status of soil.
### Table 2: Effect of seeding rate on growth of Groundnut at 4 and 8 weeks after planting in 2011 and 2012

<table>
<thead>
<tr>
<th>Plant/stand</th>
<th>2011</th>
<th>2012</th>
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<tr>
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<td>4WAP</td>
<td>8WAP</td>
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<tr>
<td>1</td>
<td>101.90</td>
<td>264.60</td>
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<td>2</td>
<td>89.75</td>
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<td>LSD</td>
<td>10.26</td>
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WAP – Weeks after planting

### Table 3: Effect of Seeding rate on Weight of nuts and Pods of Groundnut per plant and per hectare in 2011 and 2012 planting season

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<th>Plant/stand</th>
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<th>2012</th>
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<tr>
<td></td>
<td>Weight of pod (g/plant)</td>
<td>Weight of pod (ton/ha)</td>
</tr>
<tr>
<td>1</td>
<td>5.47</td>
<td>1.16</td>
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<tr>
<td>2</td>
<td>5.66</td>
<td>1.61</td>
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<tr>
<td>3</td>
<td>4.19</td>
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<td>4</td>
<td>3.58</td>
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<tr>
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WAP – Weeks after planting
### Table 5: Chemical properties of Post-cropping soil

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<tr>
<th>Plant/stand</th>
<th>pH (H2O)</th>
<th>O C (g Kg⁻¹)</th>
<th>Av. P (mg Kg⁻¹)</th>
<th>Total N (g Kg⁻¹)</th>
<th>Ex. K⁺ (cmol Kg⁻¹)</th>
<th>Ex. Na⁺ (cmol Kg⁻¹)</th>
<th>Ex. Ca²⁺ (cmol Kg⁻¹)</th>
<th>Ex. Mg²⁺ (cmol Kg⁻¹)</th>
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<th>ECEC (cmol Kg⁻¹)</th>
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