OPTIMUM RETURNS IN GROUNDNUT PRODUCTION UNDER THE INFLUENCE OF POULTRY MANURE RATES AT SAMARU IN THE NORTHERN GUINEA SAVANNAH OF NIGERIA

Ibrahim, U.1, Mohammed, R.2, Danmaigoro, O.2 and Haliru, I.1

1Samaru College of Agriculture, Ahmadu Bello University, Zaria, Nigeria
2 Department of Agronomy, Institute for Agricultural Research, Ahmadu Bello University, Zaria
Email: ibrusman2007@yahoo.com
Phone: +2348053663718

Abstract
Groundnut plays an important role in the diets of rural populations, livestock feeding and soil fertility improvements. Poor soil fertility, availability and affordability of inorganic fertilizer have been identified as major constraints to groundnut production. These constraints can be addressed by the use of poultry manure, but there is the need to determine the optimum level of poultry manure that will give the best yield. To achieve this objective, field trials were conducted at Teaching and Research farm of Samaru College of Agriculture, Ahmadu Bello University Zaria located in the northern Guinea savannah ecological zone of Nigeria during the 2012 and 2013 rainy seasons. The treatments consisted of three levels of poultry manure (0, 1.5 and 3 tonnes ha⁻¹) and three varieties of groundnut (SAMNUT 11, SAMNUT 22 and SAMNUT 23). The treatments were laid out in a split-plot design with poultry manure occupying the main plot while the variety was allocated to the subplots. The data collected were subjected to analysis of variance, where significant differences existed, the Duncan multiple range tests was used to separate the means. In order to determine optimum yield as a result of poultry manure application rates, the data were subjected to regression analysis. Both the yield data and the results obtained from regression analysis were subjected to economic analysis using the gross margin and the cost benefit analysis. The yield data obtained from the trials showed that application of 1.5 tonnes ha⁻¹ resulted to highest pod yield (2709 kg ha⁻¹, 2425 kg ha⁻¹ and 2537 kg ha⁻¹ in 2012, 2013 and the combined). Using the regression analysis, the optimum rates of 1.70 tonnes ha⁻¹, 1.95 tonnes ha⁻¹ and 1.83 tonnes ha⁻¹ were obtained in 2012, 2013 and their combined gave a yield of 2725 kg, 2472 kg and 2567 kg ha⁻¹, respectively. The economic evaluation showed that application of 1.5 tonnes ha⁻¹ of poultry manure gave the highest gross margin (₦241,405, ₦217,925 and ₦226,659 in 2012, 2013 and combined) and cost- benefit ratio (₦3.40, ₦3.06 and ₦3.19 in 2012, 2013 and combined). While the optimum rates of 1.70 tonnes ha⁻¹ obtained from the regression analysis had a gross margin of ₦199, 500, ₦171,700 and ₦182,400 in 2012, 2013 and combined, respectively. The cost benefit ratio of ₦2.73, ₦2.27 and ₦2.46 were obtained in 2012, 2013 and combined, respectively. It can be concluded that the application of 1.5 tonnes ha⁻¹ gave higher yield and appeared more profitable to farmers in the study area, hence, recommended for use.

Key words: Groundnut, Poultry manure, Regression, Economic analysis,

INTRODUCTION:
Groundnut (Arachis hypogaea L.) plays an important role in the diets of rural populations, particularly children, because of its high protein and carbohydrate contents (Anon., 2002). It is also rich in calcium, potassium, phosphorus, magnesium and vitamin E. Groundnut meal, a by-product of oil extraction, is an important ingredient in livestock feed. Groundnut haulms are nutritious and widely used for feeding livestock (Anon., 2002). The production of groundnut is concentrated in Asia and Africa, where the crop is grown mostly by smallholder farmers, under rain-fed conditions with limited inputs and low income, making it difficult for them to buy inorganic fertilizers (Anon., 2002). Fertilizer has been recognized as one of the most important agrochemical input responsible for about 60% increment in
output to crops, while 40% was expected from hectareage expansion (Rahman, 2006). However, the use of inorganic fertilizer has been declining because of scarcity and high cost, making it unaffordable to most peasant farmers. Furthermore, the increasing concern about the effects of inorganic fertilizers on the environment makes organic manure a safer and better available alternative source of nutrients to crop. Adeleye et al. (2010) reported that inorganic fertilizer has not been helpful under intensive agriculture because it is often associated with reduced crop yield, acidity, and soil nutrient imbalance. It is a known fact that achieving global food security whilst reconciling demands on the environment is the greatest challenge faced by mankind; therefore there is the need to source for a safer and available alternative nutrients like the poultry manure. Poultry manure is an excellent source of organic manure, as it contains high amounts of nitrogen, phosphorous, potassium and other essential nutrients (Mitchell and Donald, 2012). In contrast to inorganic fertilizer, it adds organic matter to soil which improves soil structure, nutrient retention, aeration, soil moisture holding capacity and water infiltration (Deksissa et al., 2008). However, in areas of intense poultry production, over fertilization of agricultural land with poultry manure may occur. To obtain maximum economic value of plant nutrients in poultry manure, it should be applied to match nutrient needs of crops (Mitchell and Donald, 2012). Rahman (2006) concluded that in order to boost crop production poultry manure has to be adequately supplied to meet its demand by the crop. The need to avoid wastage and over fertilization is also important, considering the fact that poultry manure is used for other purposes such as in feeding animals such as cattle, pigs and fishes and most recently for biogas production. Poultry manure is available to farmers in the study area but it is usually used without any scientific recommendation (Ibrahim et al., 2013). Thus, it is important to avoid wastage by ensuring that only the required quantities of poultry manure are applied to the crop. This work was therefore undertaken to determine optimum level of poultry manure needed for groundnut production.

**MATERIALS AND METHODS**

Field trials were conducted at Teaching and Research farm of Samaru College of Agriculture, Ahmadu Bello University Zaria located in the northern Guinea savannah ecological zone of Nigeria during the 2012 and 2013 rainy seasons. The treatments consisted of three levels of poultry manure (0, 1.5 and 3 tonnes ha$^{-1}$) and three varieties of groundnut (SAMNUT 11, SAMNUT 22 and SAMNUT 23). The treatments were laid out in a split-plot design with poultry manure occupying the main plot while the varieties were allocated to the subplots and replicated three times. The land was harrowed twice and ridged to obtain a fine tilth. The gross and net plot sizes were 18.0 m$^2$ (4.5 m x 4 m) and 6.0 m$^2$ (1.5m x 4m), respectively, with 1.0m spacing between blocks and 0.5m spacing between plots. Poultry manure was applied three weeks before planting. It was uniformly spread on the ridge and lightly worked into soils with hoe. There were 6 ridges in gross plot and 2 ridges in net plot. The seeds were sown on 4th June in 2012 and 2013 rainy seasons. The groundnut seed was sown at a spacing of 75cm x 23cm. One seed was sown per hole. Weeds were controlled manually by hoe weeding at 3 and 6 weeks after sowing (WAS). Neem seeds were grounded to powder and sieved and was applied to the crop at the rate of 1.5 kg ha$^{-1}$. This was done at 4 and 8 WAS to prevent the incidence of pest and diseases. The use of inorganic pesticides was avoided throughout the period of experimentation. Assessment of yield component was
carried out at harvest. Weight of pods per plot was determined by measuring the
weight of the total number of pods in each net plot using E2000 electronic mettler
balance. The pod yield (kg) per net plot was extrapolated to per hectare basis and
the value obtained was then recorded and were subjected to analysis of variance,
where significant differences existed, the Duncan multiple range tests was used to
separate the means. The yield data was subjected to regression analysis using the
scatter diagram techniques as described by Gomez and Gomez (1984). Both the yield
data and the results obtained from regression analysis were subjected to
economic analysis using the gross margin and the cost benefit analysis. The gross
margin analysis is the difference between the total revenue and the total variable cost
i.e GM= TR- TV Where GM= Gross margin, TR= Total revenue and TVC= Total variable cost. The cost- benefits analysis which is also known as the
profitability index, measures the rate of return on investment. It gives the amount
of profit on any Naira invested under the factors considered. It is expressed as thus;
Cost-benefit ratio = GM/ VC, where GM= Gross margin and V.C. = variable cost of
each of the factors considered. The revenue from groundnut was obtained as a
product of farm gate price of one kilograms of the crop and the yield
measured in kilogram. Farm gate price of ₦100/Kg was used in computing the
revenue for pod yield. Total variable cost is the summation of all the cost incurred
for each treatment. In determining the profitability of groundnut, the variable
costs are the cost of poultry manure (₦10,000 per tonnes) and cost of

application (₦5000 per hectare).Where $1= ₦166 during the period under review.

RESULTS AND DISCUSSION
Polynomial response of pod yield to
poultry manure rates

The polynomial response of pod yield to poultry manure rate at Samaru during the
2012, 2013 and the two years combined are shown in Figure 1.To find out the
optimum manure rate, polynomial response of pod yield to poultry manure
rate was carried out using the scatter diagram. The second degree polynomial
regression equation was used to search for the functional forms that are most likely to
best fit the current data. Using excel package, the polynomial equation which
best described the relationship between yield and poultry manure were determined
and were used to calculate the optimum poultry manure rate that will give the
maximum yield. The R² Value of 1 indicated that the graph best described the relationship between
yield and poultry manure were determined
and were used to calculate the optimum
poultry manure rate that will give the
maximum yield. The polynomial equations
which best described the relationship
between yield and poultry manure rates are shown below:
y = -368.4x² + 1256x + 1654 -2012
y = -236.8x² + 921.3x + 1576-2013
y =-284x² + 1040.x + 1615 ----combined
From the equations above, the optimum
rates of 1.70 tonnes ha⁻¹, 1.95 tonnes ha⁻¹
and 1.83 tonnes ha⁻¹ were obtained in
2012, 2013 and the combined respectively,
to give yields of 2,725kg, 2,472 kg and
2,567 kg ha⁻¹.
Figure 1: Polynomial response of pod yield to poultry manure rates at Samaru during the 2012, 2013 wet seasons and wet seasons combined analysis.

Profitability of groundnut at Samaru during the wet seasons
When the regression results were subjected to profitability analysis with respect to the rates used in this experiment, it was found that application of 1.5 tonnes ha$^{-1}$ gave the highest economic returns throughout the period of experimentations as presented in Tables 1, 2 and 3. The result from gross margin and cost benefit analysis also indicated that groundnut production can be made profitable by using 1.5 tonnes ha$^{-1}$. This corroborates the finding of Ibrahim et al. (2013), who found that groundnut production was not profitable among farmers in Samaru, because farmers in the study area do not use poultry manure in accordance with research recommendations. The highest gross margin obtained by the application of 1.5 tonnes ha$^{-1}$ of poultry was due to the high pod yield produced when compared to the other treatments and this was why the gross margin of plots applied with 1.5 tonnes ha$^{-1}$ was highest. Similarly, the lowest gross margin produced by the control was due to lower pod yield obtained. Cost- benefit analysis was highest when 1.5 tonnes ha$^{-1}$ of poultry was applied. This is because the cost of poultry manure was twice in plots where 3.0 tonnes ha$^{-1}$ of poultry manure was applied and this did not translate to double yield. The cost- benefit analysis for the control was higher than that of 3.0 tonnes ha$^{-1}$ even though the yield was lower; this is because there was no variable cost incurred in the control plot. The cost of investment for the control treatment was
only on fixed operations thereby minimizing its cost.

CONCLUSION
It could be concluded that the application of 1.5 tonnes ha\(^{-1}\) of poultry manure increased both yield and profitability of groundnut. Therefore farmers are advice to adopt the use of 1.5 tonnes ha\(^{-1}\) of poultry manure to improve yields and profitability of groundnut.

REFERENCES


Table 1: Profitability analysis of groundnut under the influence of poultry manure rates at Samaru during the 2012 wet season

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Pod yield</th>
<th>Revenue (pod)</th>
<th>Total variable cost</th>
<th>Gross margin</th>
<th>Cost benefit ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poultry manure (tha⁻¹)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0</td>
<td>165,40</td>
<td>51,000</td>
<td>134,09</td>
<td>5</td>
<td>2.62</td>
</tr>
<tr>
<td>1.5</td>
<td>270,90</td>
<td>71,000</td>
<td>241,40</td>
<td>5</td>
<td>3.40</td>
</tr>
<tr>
<td>3.0</td>
<td>210,60</td>
<td>86,000</td>
<td>176,33</td>
<td>5</td>
<td>2.05</td>
</tr>
<tr>
<td>1.7</td>
<td>272,50</td>
<td>73,000</td>
<td>199,50</td>
<td>0</td>
<td>2.73</td>
</tr>
</tbody>
</table>

Table 2: Profitability analysis of groundnut under the influence of poultry manure rates at Samaru during the 2013 wet season

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Pod yield</th>
<th>Revenue (pod)</th>
<th>Total variable cost</th>
<th>Gross margin</th>
<th>Cost benefit ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poultry manure (t ha⁻¹)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0</td>
<td>1,576</td>
<td>51,000</td>
<td>124,690</td>
<td>2.44</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>2,425</td>
<td>71,000</td>
<td>217,925</td>
<td>3.06</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>2,208</td>
<td>86,000</td>
<td>193,600</td>
<td>2.25</td>
<td></td>
</tr>
<tr>
<td>1.95</td>
<td>2,472</td>
<td>75,500</td>
<td>171,700</td>
<td>2.27</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Profitability analysis of groundnut under the influence of poultry manure rates at Samaru during the 2012 and 2013 wet seasons combined

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Pod yield</th>
<th>Revenue (pod)</th>
<th>Total variable cost</th>
<th>Gross margin</th>
<th>Cost benefit ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poultry manure (t ha⁻¹)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0</td>
<td>161,500</td>
<td>51,000</td>
<td>129,40</td>
<td>0</td>
<td>2.53</td>
</tr>
<tr>
<td>1.5</td>
<td>253,700</td>
<td>71,000</td>
<td>226,65</td>
<td>0</td>
<td>3.19</td>
</tr>
<tr>
<td>3.0</td>
<td>218,100</td>
<td>86,000</td>
<td>187,36</td>
<td>0</td>
<td>2.18</td>
</tr>
<tr>
<td>1.83</td>
<td>256,700</td>
<td>74,300</td>
<td>182,40</td>
<td>0</td>
<td>2.46</td>
</tr>
<tr>
<td>1.95</td>
<td>2,567</td>
<td>75,500</td>
<td>171,700</td>
<td>2.27</td>
<td></td>
</tr>
</tbody>
</table>