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

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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}, 1.95tonnes ha^{-1} and 1.83 tonnes ha^{-1} were obtained in 2012, 2013 and their combined to give 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 hecterage 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 R^2 Value of 1 indicated that the graph best described the relationship between poultry manure rates and the yield and therefore, it is adequate to use these equations to calculate the optimum yield. The polynomial equations which best described the relationship between yield and poultry manure rates are shown below:

$y = -368.4x^2 + 1256x + 1654$ ----------2012

$y = -236.8x^2 + 921.3x + 1576$----------2013

$y =-284x^2 + 1040.x + 1615$ -----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}.

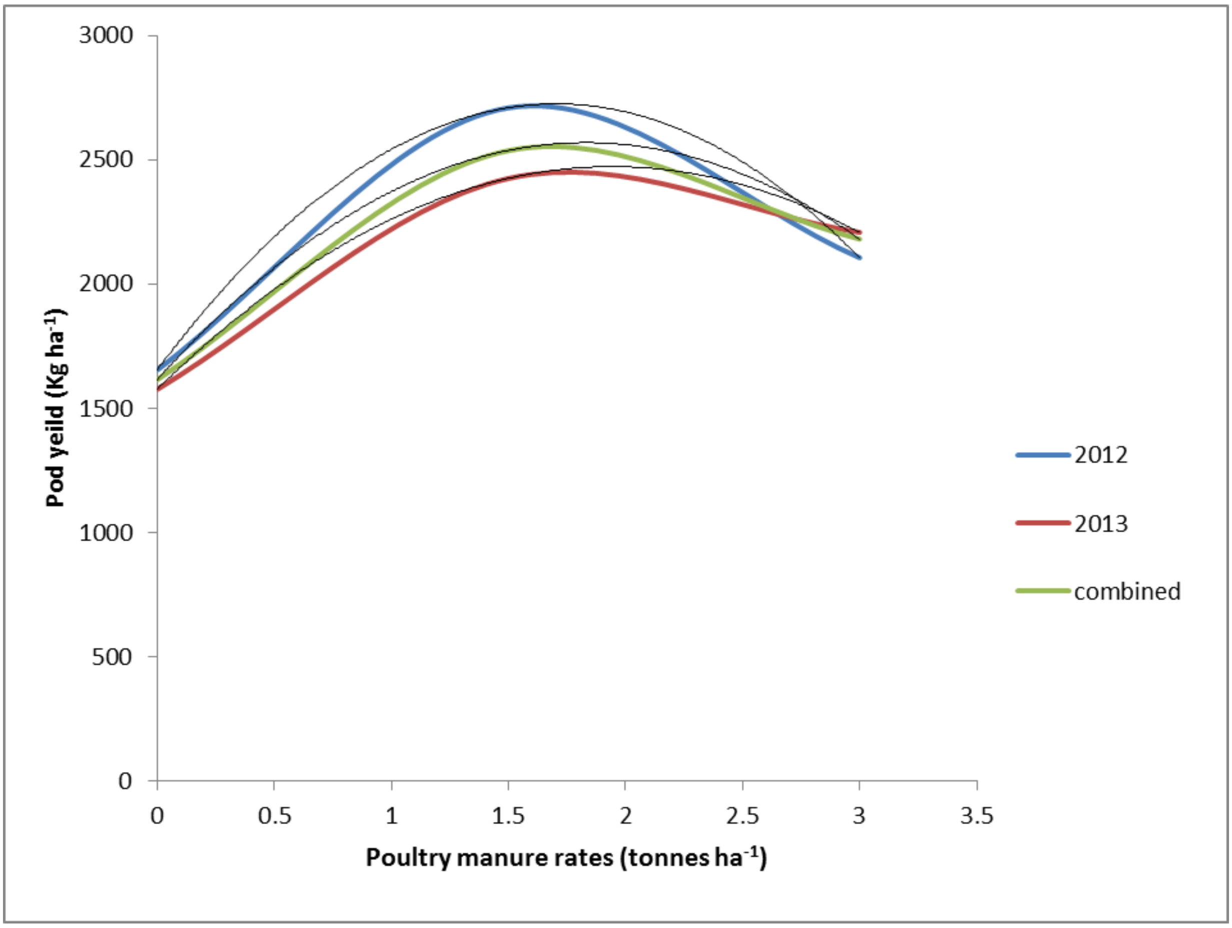

Figure 1: Polynomial response of pod yield to poultry manure rates at Samaru during the 2012, 2013 wet seasons and wet seasons combined analysis.

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 1.5tonnes 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 1.5tonnes 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

Anonymous(2002).Tropical Agriculturalist. Groundnut. G. Schilling and R. Gibbons. Macmillian Publishers Netherlands pp 146.

Adeleye, E.O., L.S. Ayeni and S.O. Ojeniyi,(2010). Effect of poultry manure on soil physico-chemical properties, leaf nutrient contents and yield of yam (*Dioscorea rotundata*) on Afisol soil in South Western Nigeria *Journal of American science,* 6(10):871-878.

Deksissa, T., Short, I. and Allen, J. (2008). Effect of soil amendment with compost on growth and water use efficiency of Amaranth. In proceedings of the UCOWR/NIWR Annual conference: International water Resources: Challenges for the 21st Century and water resources education, July 22-24, 2008 Durham.

Gomez. K.A and Gomez A.A. (1984). Statistical Procedures for Agricultural Research. An international Rice Research Institute Book. A Wiley –Inter science Publication John Wiley and Sons 680Pp.

Ibrahim, U., Ayinde, B.T., Dauda H., and Mukhtar, A.A. (2013) Socio-Economic factors affecting groundnut production in Sabongari Local Government of Kaduna State*International Journal of Food and Agricultural Economics 1(1):41-48*

Mitchell, C.C. and Donald, J. 0. (2012).The Value and Use of Poultry Manures as Fertilizer Alabama cooperative extension system Circular ANR-244 (11/95).Alabama A & M and Auburn Universities.

Rahman, S.A. (2006). Micro Level Analysis of Maize Yield Response to Fertilizer Application in Soba Area of Kaduna State, Nigeria. *Journal of Crop Research, Agro Forestry and Environment* 1: 59-64.

Table1: Profitability analysis of groundnut under the influence of poultry manure rates at Samaru during the 2012 wet season

Treatments	Pod yield	Revenue (pod)	Total variable cost	Gross margin	Cost benefit ratio
Poultry manure (tha^{-1})					
0.0	1,654	165,400	51,000	134,095	2.62
1.5	2,709	270,900	71,000	241,405	3.40
3.0	2,106	210,600	86,000	176,335	2.05
1.7	2,725	272,500	73,000	199,500	2.73

Table2: Profitability analysis of groundnut under the influence of poultry manure rates at Samaru during the 2013 wet season

Treatments	Pod yield	Revenue (pod)	Total variable cost	Gross margin	Cost benefit ratio
Poultry manure (t ha^{-1})					
0 .0	1,576	157,600	51,000	124,690	2.44
1.5	2,425	242,500	71,000	217,925	3.06
3.0	2,208	220,800	86,000	193,600	2.25
1.95	2,472	247,200	75,500	171,700	2.27

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

Treatments	Pod yield	Revenue (pod)	Total variable cost	Gross margin	Cost benefit ratio
Poultry manure (t ha^{-1})					
0.0	1,615	161,500	51,000	129,400	2.53
1.5	2,537	253,700	71,000	226,650	3.19
3.0	2,181	218,100	86,000	187,360	2.18
1.83	2,567	256,700	74,300	182,400	2.46