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Yield and economic returns of sesame (*sesamum indicum* L.) as influenced by poultry manure, nitrogen and phosphorus at samaru, Nigeria

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ABSTRACT

Field trials were conducted during the rainy seasons of 2005, 2006 and 2007 at the Research Farm of Institute for Agricultural Research Samaru (11^0 $11^/$ N, 07^0 $38^/$E, and 686m above sea level) to study the yield and economic returns of sesame as influenced by poultry manure, nitrogen, and phosphorus. The experiment consisted of four rates of poultry manure (0, 5.0, 10.0, and 15.0 t ha^{-1}), three levels of nitrogen in the form of urea (0, 60, and 120 kg N ha^{-1}) and three levels of phosphorus in the form of single super phosphate (0, 13.2 and 26.4 kg P ha^{-1}). The thirty six treatment combinations were laid out in a split-plot design with three replications. The factorial combinations of N and P were assigned to the main plot while poultry manure was assigned to the sub-plot. Yield of sesame per unit area and economic returns were better at 5 t ha^{-1}, 60 kg N ha^{-1} and 13.2 kg P ha^{-1} of poultry manure, nitrogen and phosphorus respectively. Applications of 5 t ha^{-1} of poultry manure, 60 kg ha^{-1} of nitrogen and 13.2 kg ha^{-1} of phosphorus seems to be the ideal rates for sesame production in this agro ecology and is therefore recommended.

Introduction

Sesame (*Sesamum indicum L.*) also known as beniseed in West Africa, Sim-sim in East Africa, is a crop belonging to the family *Pedaliaceae*. It is grown in both tropical and sub-tropical regions of Africa, Asia and Latin America. It is the most important crop from which semi-drying vegetable oils are obtained and perhaps the oldest crop cultivated for its oil (Onwueme and Sinha, 1991).

The importance of sesame lies in its high quality oil which is often referred to as the "queen" of vegetable oil. The outstanding characteristics of sesame oil, is its stability and keeping quality as well as resistance to rancidity. Sesame oil is used in making paints, soaps, cosmetics, perfumes, insecticides, canned sardine, canned beef as well as for pharmaceutical and ethno botanical uses (FAO, 2002; RMRDC, 2004).

The whole seed contains meals which are high in calcium, phosphorous, iron and are well supplied with vitamins- thiamin, riboflavin and niacin.

The whole seed is used on top buns and snack foods, fried and eaten with sugar, un-fried or ground and used in making soup. The leaves are used for vegetable soup (Onwueme and Sinha, 1991). It is a foreign exchange earner.

High productive potential has been reported for sesame through various agronomic practices such as spacing and fertilizer (Bonsu, 2003), nitrogen and phosphorus (Osman, 1993; Mankar *et al.*, 1995; Olowe and Busari, 2000; Hossein *et al.* 2007; Okpara *et al.* 2007; Haruna *et al.*, 2010), organic and inorganic fertilizers (Mondal *et al.* 1992; Duhoon *et al.*, 2004; Vaiyapuri *et al.*, 2004; Haruna et al., 2011), but work on the yield and economic returns of sesame as influenced by organic and inorganic fertilizers in this agro-ecology is lacking. This study, therefore, seek to evaluate the yield and economic returns of sesame as influenced by poultry manure, nitrogen and phosphorus.

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Materials and Methods

Field Experiments were conducted during the rainy seasons of 2005, 2006 and 2007 at the Institute for Agricultural Research (IAR) Farm, Ahmadu Bello University, Samaru, (11^o $11^/$ N; 07^o $38^/$E, 686m) above sea level, located in the northern Guinea savanna agro-ecological zone of Nigeria. The experiment consisted of factorial combinations of four levels of poultry manure (0, 5.0, 10.0 and 15.0 t ha^{-1}), three levels of nitrogen (0, 60 and 120 kg N ha^{-1}) in the form of Urea and three levels of phosphorus (0, 13.2 and 26.4 kg P ha^{-1}) in the form single super phosphate. The thirty six (36) treatment combinations were laid out in a split-plot design with nitrogen and phosphorus levels assigned to the main-plot, while poultry manure was assigned to the sub-plot. The gross plot size was 13.5m^2 (4.5m x 3m) while the net plot size was 9m^2 (3m x 3m).

The experimental area was disc-ploughed and harrowed twice to a fine tilt. This was then followed by ridging at 75cm apart (between rows) and the field marked into plots and replications. The plots were separated by 1.0m unplanted boarder while replications were separated by 2.0 m unplanted boarder. The three levels of phosphorus and the four levels of poultry manure were incorporated into the ridges according to field plan after land preparation and left for two weeks before sowing. Half of the nitrogen levels were applied at 3 weeks after sowing (WAS) while the remaining half was applied at 6 WAS. The planting material used was Ex-Sudan, it is white in colour, of medium in height (80 to 100cm) and medium maturity (85 to 90 days) (RMRDC, 2004). Sesame was planted on the 16th, 19th and 20th July in 2005, 2006 and 2007 respectively. Sesame seeds were sown at 15cm intra-row spacing on ridges spaced 75cm apart. Manual hoe weeding was done at 3, 6, and 9 WAS to keep the experimental plots weed-free.

The crop was harvested on the 23rd, 27th and 28th of October 2005, 2006 and 2007 respectively, when the leaves and the stems changed colour from green to yellow. Harvesting was manually done with the aid of a sickle by cutting the plants at the base close to the ground. Plants from each plot were put in a sack to dry so as to minimize seed loss when capsule dehisces. When the harvested plants were adequately dry, the sacks were gently beaten with sticks in order to release all the seeds from the capsules. The seeds were then separated from the chaff by winnowing. The entire plants in the net plot were used to obtain the seed yield per hectare.

The data collected were subjected to analysis of variance using the 'F' test to estimate the significance in the effects of the treatments as described by Snedecor and Cochran (1967).

Comparison of treatment means were done using the Duncan's Multiple Range Test (Duncan, 1955). To examine the economic implications of varying the rates of poultry manure, nitrogen and phosphorus, revenues were computed based on the pooled means of yield from all levels of nitrogen and phosphorus using farm gate price of two hundred naira (₦200 kg $^{-1}$). The pooled total revenue estimates were expressed in Naira per hectare (during the study, one US Dollar equals to one hundred and forty naira).

Results

Seed yield (kg ha^{-1}) of sesame in 2005, 2006, 2007 and the mean as affected by treatments are shown in Table 1. Application of 5 t ha^{-1} of poultry manure produced significantly higher grain yield compared with other level of applied manure. Increasing the rate of poultry manure from 5 to 10, and 10 to 15 t ha^{-1}, significantly depressed seed yield in all the years. In all the years and the mean of the three years, application of 60 kg N ha^{-1} produced significantly higher grain yield compared with other levels of N application. Yield was decreased by increasing N rate from 60 to 120 kg N ha^{-1}.

Application of 13.2 kg ha^{-1} of phosphorus produced significantly higher grain yield per hectare compared with other levels of applied P. Application of 26.4 kg P ha^{-1} significantly decreased seed yield in all the years and the mean of the three years.

The profitability of sesame in this study was measured using gross-margin analysis and the result is presented on Table 2. The change in gross margin as a response to treatment was in consonance to the yield obtained under the treatments.

Under the poultry manure treatment, application of 5 t ha^{-1} gave the best gross margin of N142, 137.00 (one hundred and forty two thousand one hundred and thirty seven naira). For the nitrogen treatment, application of 60 kg ha^{-1} gave the best gross margin of ₦ 133,540.00 (one hundred and thirty three thousand, five hundred and forty naira) while application of 13.2 kg ha^{-1} of phosphorus gave the best gross margin of ₦ 126,148.80 (one hundred and twenty six thousand, one hundred and forty eight naira, eighty kobo).

From the above, the weeding cost constituted the highest proportion of total variable cost. The cost of fertilizer or manure increased with increase in the rate of application. However, production in this study was profitable at all levels of applied nutrients as reflected by the positive values of gross margin.

Discussion

Yield of sesame was highest at moderate rate of applied poultry manure and nitrogen (5 t ha^{-1} and 60 kg N ha^{-1}) and not the highest doses. This could be because excessive nitrogen has been reported to reduce fruit number and yield but enhances plant growth (Aliyu et al., 1996). This finding corroborated those of Bonsu (2003), Fathy and Mohammed (2009).

Yield of sesame was significantly increased by the application of 13.2 kg P ha^{-1}. The application of 13.2 kg P ha^{-1} seems to be sufficient to meet the crop nutrient requirement as further increase in the phosphorus level did not confer any beneficial effect on the yield. The beneficial effect of phosphorus application on the yield in this study could be due to the fact that phosphorous is a component of nucleic acids, so it plays a vital role in plant reproduction, of which seed production is an important result (Douglas and Philips, 2008). This finding is in harmony with those of Mankar et al. (1995), Olowe and Busari (2000), Okpara et al. (2007) and Haruna et al. (2010).

Sesame produced with the highest levels of applied N, P, and poultry manure gave the lowest gross margin compared with those that received no treatment at all. This could be due to the fact that, at the highest level of treatment application, vegetative growth was significantly promoted to the detriment of reproductive yield. At the end, the grain produced at those levels of nutrients application was not high enough to upset the high cost of production. The low stand count at harvest could also be responsible for the low gross margin because the yield obtained from those plots, though higher than those without nutrients but because of the cost of the nutrient procurement and the labour for applying them, their gross margin was lower. The highest gross margin and highest revenue was obtained by the application of 5t/ha^{-1} of poultry manure, 60 kg N ha^{-1} and 13.2 kg P ha^{-1} respectively.

Sesame produced with the highest levels of applied poultry manure nitrogen and phosphorus gave the lowest gross margin compared with those that received no treatment at all. This could be due to the fact that, at the highest level of treatment application, vegetative growth was significantly promoted to the detriment of reproductive yield. At the end, the grain produced at those levels of nutrients application was not high enough to upset the high cost of production.

Conclusion and Recommendation

Contrary to the generally held view in this agro ecology that sesame can do better without fertilizer application, this study showed that both yield and economic returns of sesame were better with the applications of 5 t ha^{-1} of poultry manure, 60 kg ha^{-1} of nitrogen and 13.2 kg ha^{-1} of phosphorus compared with non application of fertilizer. Applications of 5 t ha^{-1} of poultry manure, 60 kg ha^{-1} of nitrogen and 13.2 kg ha^{-1} of phosphorus is therefore recommended for increased yield and better economic returns to sesame growers in this agro ecology.

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Table 1: Effect of poultry manure, nitrogen and phosphorus on the grain yield (kg ha^{-1}) during the rainy seasons of 2005-2007 at Samaru

Treatments	005	006	007	ombined
Nitrogen (kg ha^{-})				
0	699.68c	732.29c	582.29c	671.39c
60	998.70a	773.36a	831.43a	934.50a
120	872.22b	753.15b	732.28b	788.22b
SE$\pm$	4.847	4.303	4.164	5.233
Phosphorus(kg a^{-1})				
0	777.70c	738.51c	678.93c	746.71c
13.2	946.47a	880.39a	766.82a	864.56a
26.4	853.42b	794.91b	700.17b	782.83b
SE$\pm$	4.847	4.303	4.164	5.233
Manure (t ha^{-1})				
0	696.23d	682.92d	647.95d	675.70d
5.0	1066.83a	900.73a	835.32a	960.96a

Table 2: Economic analysis of sesame production at Samaru (Three years combined data i.e. 2005 to 2007)

	Poultry manure (t ha^{-1})				Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})	
Variable cost	0	5	10	15	0	60	120	0	13.2	26.4
Cost of seed ₦ ha^{-1}	1,050.00	1,050.00	1,050.00	1,050.00	1050.00	1,050.00	1,050.00	1050.00	1,050.00	1,050.00
Cost of fertilizer ₦ ha^{-1}	0	5,000	10,000	15,000	0	6,250.00	12,500	0	2,700.00	5,400.00
Land preparation ₦ ha^{-1}	6,000	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00
Planting ₦ ha^{-1}	3,000	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00
Weeding ₦ ha^{-1}	14,000.00	14,000	14,000	14,000	14,000.00	14,000.00	14,000.00	14,000.00	14,000.00	14,000.00
Fertilizer application ₦ ha^{-1}	0	6,000	7,000	8,000	0	8,000.00	8,000.00	0	5,000.00	5,000.00
Harvesting ₦ ha^{-1}	8,000.00	8,000	8,000	8,000	8,000.00	8,000.00	8,000.00	8,000.00	8,000.00	8,000.00
Threshing and winnowing ₦ ha^{-1}	7,000.00	7,000	7,000	7,000	7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	7,000.00
Total variable cost ₦ ha^{-1}	39,050.00	50,055.00	56,060.00	62,065.00	39,050.00	53,360.00	59,670.00	39,050.00	46,763.20	49,476.40
Revenue ₦ ha^{-1}	135,140.00	192,192.00	163,674.00	147,420.00	134,278.00	186,900.00	157,644.00	149,342.00	172,912.00	156,566.00
Gross margin ₦ ha^{-1}	96,090.00	142,137.00	107,614.00	85,355.00	95,228.00	133,540.00	97,974.00	110,292.00	126,148.80	107,089.60

NB: During the study, one US Dollar equals to one hundred and forty naira.