International Journal of Agriculture and Earth Science (IJAES) E-ISSN 2489-0081
P-ISSN 2695-1894 Vol 10. No. 8 2024 www.iiardjournals.org Online Version

Effect of Nitrogen Fertilizer on the Performance of two Sesame (*Sesamum indicum* L.) Varieties in Wukari, Taraba State, Nigeria

Ahmadu, R., Bello, I.H and Balogun, K
Department of Crop Production and Protection, Faculty of Agriculture and Life Sciences,
Federal University Wukari, PMB 1020 Wukari, Taraba State, Nigeria
*Corresponding author's E-mail: rimandeahmadu@yahoo.com
DOI: 10.56201/ijaes.v10.no8.2024.pg.29.35

Abstract

Field experiment was conducted in 2019 and 2020 cropping seasons at the Teaching and Research Farm, Federal University Wukari, Taraba State, Nigeria to evaluate the effect of nitrogen fertilizer on the performance of two sesame varieties. The experiment involved two sesame varieties (Ex-Sudan and local) and four nitrogen fertilizer rates (0, 50, 100 and 150 kg ha^{-1}) which was laid out in 2 x 4 factorial arrangements fitted into a randomized complete block design (RCBD) and replicated three times. Data were collected on growth characters and at harvest on seed yield components. The results showed that both varieties had similar growth characters except the number of branches per plant which was higher in plants produced from the local variety. Nitrogen fertilizer had significant effect on growth characters. Plant height, number of branches and leaves increased with increasing the application rate. Higher number of capsules were observed on plants produced from local while plants from Ex-Sudan variety had higher 1000-seed weight. However, both sesame varieties had comparable seed weight and yield. Nitrogen fertilizer application enhanced seed yield components. The application of nitrogen fertilizer at 150 kg ha^{-1} had the highest seed yield but comparable with the application rates of 50 and 100 kg ha^{-1}. The Local variety is suggested for sesame farmers due to higher number of branches and capsules fertilized with 50 kg N ha^{-1} for sustainable production of the crop in Wukari, Taraba State, Nigeria.

Keywords: *Application rates, Ex-Sudan, growth characters, local, nitrogen fertilizer, sesame varieties, yield components*

Introduction

Sesame (*Sesanum indicum* L.) is a member of Pedaliaceae family usually cultivated in the savannah zone for its nutritious and edible seeds (Ahmadu *et al*., 2022). All parts of the plant are useful. Leaves are used in preparation of vegetable soup while the seeds are consumed when fried and mixed with sugar in most African countries and the stems are used for making paper, fuel wood and as source of potash after burning. Quality oil can be extracted from the seed and used in the preparation of food, cosmetics, perfumes, insecticides, lubrication, and medicine (Babaji *et al*., 2006). Due to the importance of sesame seed to human, its demand is high yet its productivity in Nigeria is low being an average of about 0.42 t ha^{-1} compared to 1.96 t ha^{-1} in Venezuela, 1.08 t ha^{-1} in Saudi Arabia, 0.52 t ha^{-1} in Ivory Coast and 0.51 t ha^{-1} in Ethiopia (Abubakar *et al.*, 1998).

The low productivity could have been caused mainly due to low nutrient status of most tropical soils and the use of unimproved varieties among other factors. The productivity of the crop could be raised by screening of the appropriate variety and management of the soil fertility through nitrogen application. Nitrogen application not only improved the yield but also improved the quality of crops (Tiwari and Gupta, 2006). Leaf area, crop growth rate, net assimilation rate index and yield components (number of capsules per plant, seeds per capsule, and 1000 seed weight) were improved with nitrogen fertilizer in sesame (Thakur and Patel, 2004). The objective of this study was to evaluate the effect of nitrogen fertilizer application rates on the performance of two sesame varieties in wukari, Taraba State, Nigeria.

Materials and Methods

Experimental site

The experiment was conducted at the Teaching and Research Farm of the Faculty of Agriculture and Life Sciences, Federal University Wukari, Taraba State is situated between latitudes 7.850^0 and 7.51^0 N and longitudes 9.47^0 and 9.783^0 E. It is located within the Guinea savannah with annual rainfall and temperature range of 1200 -1800 mm and 28 and 30 ^{0}C, respectively. The soil is sandy loam enriched with subsoil that has relatively high native fertility suitable for the cultivation of many crops (Franke and Rufino, 2011).

Treatments and experimental design

The experiment involved two sesame varieties (Ex-Sudan and local variety) and four nitrogen fertilizer rates (0, 50, 100 and 150 kg ha^{-1}) laid out in 2 x 4 factorial arrangements fitted into a randomized complete block design (RCBD) and replicated three times. Each of the subplots measured 2 x 2 m (4 m^2) with a spacing of 0.5 m apart between plots and 1 m space between blocks. Soil collected from the experimental site was made into composite soil sample, air-dried, sieved through a 2 mm mesh and analyzed for its physical and chemical properties. The soil on the laboratory analysis had pH, organic carbon, total nitrogen, exchangeable Ca, Mg, K, Na and exchangeable acidity of 7.70, 23.00 g kg^{-1}, 0.18 g kg^{-1}, 3.06 mg kg^{-1}, 2.07 cmol kg^{-1}, 0.70 cmol kg^{-1}, 0.24 cmol kg^{-1} and 0.18 cmol kg^{-1} respectively.

Cultural practices

The seeds were mixed with fine soil in 1:4 proportion and sown at a spacing of 30 x 30 cm inter and intra row making a plant population of 44 plants per plot and 111,111 per hectare. Two weeks after sowing, they were thinned down to one plant per stand. Four levels (0, 50, 100 and 150 kg ha^{-1}) of Nitrogen fertilizer (urea) were applied to the designated plots as per treatment in two equal splits two and five weeks after sowing by drilling method. Weeding was carried out manually with hoe, first at four weeks after sowing and subsequently as at when due.

Data collection

Five plants were selected randomly and tagged from each plot for the data collection. Data were collected on growth characters (plant height, number of leaves and numbers of branches) at 10 weeks after sowing (WAS). At harvest, data were collected on seed yield components (number of capsules per plant, 1000 seed weight, seed weight per plant and seed yield.

Data analysis

Analysis of variance was carried out on growth and yield component data recorded for each year of study, followed by combined analysis over two years. Least significant differences (LSD) test was used for detecting significant differences between treatments at 0.05 level of probability using GENSTAT statistical programme.

Results and Discussion

Growth of sesame

The effect of nitrogen fertilizer on the growth of sesame varieties are presented in Table 1. Significant ($P < 0.05$) effect was only observed on number of branches for variety, while nitrogen fertilizer application had significant effect on all growth characters as plants without its treatment had the lowest values for all the growth attributes. The growth characters increased with increase in its application rate and peak at the highest rate. Variety had no significant effect on plant height. The tallest plants were observed in plants treated with 150 kg N ha^{-1}. The local variety produced plants with higher number of branches than Ex-Sudan plants. Only plants fertilized with 100 and 150 kg N ha^{-1} had more branches than plants without fertilizer treatment. Local and Ex-Sudan varieties gave rise to plants with comparable number of leaves. Only plants which received 100 and 150 kg N ha^{-1} had higher number of leaves than plants without N fertilizer treatment.

Fruit yield components of sesame

The results of the effect of nitrogen fertilizer on seed yield components of sesame variety are presented in Table 2. The Local variety produced plants with higher number of capsules but less 1000-seed weight than plants produced from Ex-Sudan variety. However, both varieties had plants with similar seed weight and yield. Nitrogen fertilizer application influenced fruit yield components positively. Plant without nitrogen fertilizer treatment had the lowest values in all the yield characters. The yield characters increased with increase in fertilizer rate. Plants which received 50 kg N ha^{-1} had number of capsules similar with control plants. 150 kg N ha^{-1} fertilized plants had the highest number of capsules but similar with plants which received 100 kg N ha^{-1}. Only plants treated with 150 kg N ha^{-1} had higher 1000-seed weight than unfertilized plants. Plants treated with N fertilizer rates of 50 – 150 kg ha^{-1} had similar seed weight but significantly higher than unfertilized plants. This trend was also repeated for seed yield.

Varieties used in this study showed differences in number of branches, number of capsules and 1000-seed weight. This observation agrees with Oplinger *et al.* (1990) who stated that sesame varieties significantly differ in seed yield, plant characteristics, and oil content as their fertilizer requirements and genotype differ. The differences between the two varieties could have arisen as

a result of genetic factor. The higher number of branches accrued to plants arisen from the Local variety over the Ex-Sudan variety could be an advantage as it minimizes lodging and erosion. The higher number of branches can help to prevent direct impact of the rain drop on the soil surface than few number of branches thereby minimizing run-off. The higher number of capsules exhibited by Local variety plant could probably be as a result of higher number of branches than Ex-Sudan variety. Since 1000-seed weight observed on Local variety was lower than those plants produced by Ex-Sudan, it implies that seeds obtained from the local variety plants were lighter than those produced from Ex-Sudan plants. However, both varieties had similar seed weight and yield. This is contrary to the finding of Nath *et al.* (2003) who indicated that sesame varieties were significantly different in seed yield. The positive performance of most of the measured growth and yield characters to applied N fertilizer was expected. This observation has earlier been reported by Kathiresan (2002) and Ahmadu *et al*. (2022). This is due to the fact that crop is known to respond positively to N fertilizer in soil with low N content as is the case in the present study where the soil total N content is less than the critical level. N plays a key role in the plant metabolism and synthesis of essential oil (AjaiSingh *et al.*, 2000). It is also required for development of plant cell resistance and drought hardiness (Patel and Shelke, 1995) and constituent of a number of organic compounds (Shamina and Imamul, 2003), oil storage organs particularly oil glands (Jaggi *et al.*, 2000) and vitamin B1 (Thirumalaisamy *et al.*, 2001). Nitrogen is a constituent of chlorophyll, nucleic and amino acid and thus play an important role in photosynthesis; the process that produce assimilates use for the development of different plant organ and hence result in increased growth (Das, 2009). The increased growth is manifested in taller plants with higher number of branches and leaves which probably gave rise to higher seed yield components of the fertilized over unfertilized plants. The higher number of branches is a precursor to higher capsules after the pollination and fertilization of the flowers. The leaf is a photosynthetic organ and hence an organ of assimilates production. Higher number of leaves will enhance greater production of assimilates for onward translocation to the storage organ. Hence higher 1000-seed weight, seed weight and yield.

Conclusion

The study was conducted to evaluate the effect of nitrogen fertilizer on the performance of two sesame varieties in Wukari, Taraba State, Nigeria. Both varieties produced plants that had similarities in heights, number of leaves, seed weight and yield but differ in number of branches and capsules, and 1000-seed weight. Sesame plants responded very well to the nitrogen fertilizer application in terms of growth and yield. Nitrogen fertilizer rate of 150 kg ha^{-1} had the highest seed yield but comparable with rates of 50 and 100 kg ha^{-1}. Based on the results obtained in this study, it can be concluded that application of 150 kg N ha^{-1} gave the optimum seed yield per hectare of sesame in Wukari, Taraba State, Nigeria. Based on these findings, Local variety and nitrogen application rate of 50 kg ha^{-1} are thereby suggested for sesame farmers in Wukari environment for profit maximization and sustainable production of the crop.

Table 1: Influence of nitrogen fertilizer application rate on the growth of two sesame variety

Treatment	Plant height (cm)			Number of branches			Number of leaves		
	FC	SC	Combined	FC	SC	Combined	FC	SC	Combined
Variety									
Local	156.80	159.50	158.10	10.92	12.08	11.50	258.50	274.00	266.00
Ex-Sudan	157.90	158.90	158.10	10.08	6.42	8.25	218.40	310.00	264.00
$LSD_{(0.05)}$	ns	ns	ns	ns	1.216	0.815	25.830	ns	ns
Nitrogen fertilizer application rate (N kg ha^{-1})									
0	143.00	145.40	144.20	9.33	7.78	8.58	184.50	178.00	182.00
50	154.40	155.50	154.90	10.17	8.83	9.50	225.50	222.00	223.00
100	159.50	159.50	159.50	11.00	8.50	10.25	246.80	492.00	370.00
150	172.60	175.30	174.00	11.50	10.83	11.17	297.00	275.00	286.00
$LSD_{(0.05)}$	12.700	13.540	8.600	1.668	1.720	1.152	36.520	175.700	87.700
Interaction	ns	ns	ns	ns	ns	ns	ns	ns	ns

FC- First cropping, SC- Second cropping, ns- Not significant at 0.05 level of probability

Table 2: Influence of nitrogen fertilizer application rate on the yield components of two sesame variety

Treatment	Number of capsules			1000-seed weight (g)			Seed weight (g)			Seed yield (t ha^{-1})		
	FC	SC	Combined	FC	SC	Combined	FC	SC	Combined	FC	SC	Combined
Variety												
Local	55.70	62.40	59.00	2.48	2.50	2.49	6.98	6.80	6.92	0.77	0.75	0.76
Ex-Sudan	51.80	49.20	50.50	3.40	6.20	4.80	7.34	6.75	7.04	0.81	0.78	0.80
$LSD_{(0.05)}$	ns	13.400	6.750	0.145	2.670	1.334	ns	ns	ns	ns	ns	ns
Nitrogen fertilizer application rate (N kg ha^{-1})												
0	45.80	46.70	46.20	2.74	2.70	2.72	6.03	5.45	5.74	0.66	0,60	0.63
50	50.80	52.20	51.50	2.95	3.00	2.98	7.33	7.26	7.30	0.81	0.80	0.80
100	57.20	59.20	58.20	2.99	3.10	3.05	7.54	7.55	7.54	0.83	0.83	0.83
150	61.00	65.20	63.10	3.07	8.70	5.87	7.73	6.96	7.35	0.85	0.86	0.85
$LSD_{(0.05)}$	8.64	ns	9.55	0.205	3.780	1.887	0.62	1.641	0.834	0.069	0.116	0.063
Interaction	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

FC- First cropping, SC- Second cropping, ns- Not significant at 0.05 level of probability

References

Abubakar SS, Onyibe JE & Tologbonshein EB 1998. The role of extension research and information dissemination enhancing benniseed production and marketing for resource-poor farmers. Proceedings of the first workshop on benniseed held on March 3 – 5, 1998 at the National Cereal Research Institute, Badaji, Nigeria, pp. 86 – 89.

Ahmadu R, Law-Ogbomo KE & Sunday P 2022. Response of two Sesame (*Sesamum indicum* L.) Varieties to Nitrogen fertilizer in Wukari, Taraba State. *Journal of Agriculture and Environment,* 18(2): 57-63.

Ajai-Singh SP, Singh K & Singh PP 2000. Response of nitrogen and sulphur on economic yield of Sunflower (*Helianthus annus* L.) under sodic soil condition. *Indian Journal of Agriculture Science;* 70:536-537.

Babaji BA, Ali RI, Yahaya MA, Mahdi MA & Sharifat AI. 2006. Nitrogen and phosphorus nutrition of sesame (*Sesanum indicum* L.) at Samaru. Proceedings of the 31st Annual Conference of Soil Science Society of Nigeria. 13–17 November 2006. Ahmadu Bello University, Zaria, Nigeria, p. 329 – 336.

Das NR 2009. *Practical Manual on Basic Agronomy with Theory*. Published by scientific publishers, *India.* P. 164

Franke AC, Rufino MC. & Farrow A 2011. Characterization of the impact zones and mandate areas in the N2 Africa project. Report for the N2 Africa Project. Wageningen: Wageningen University.

Iwo GA, Idowu AA & Ochigbo AA 2002. Evaluation of sesame genotype for yield stability and selection in Nigeria. *Nigerian Agricultural Journal,* 33: 76 – 82.

Jaggi R, Rakesh C, Sharma K & Paliyal SS 2000. Sulphur as second major nutrient in cruciferous oilseed. *Indian Farming,* 12:14-18.

Kathiresan G 2002. Response of sesame (*Sesamum indicum*) genotypes to levels of nutrients and spacing under different seasons. *Indian Journal of Agronomy,* 47: 537-540.

Nath R, Chakraborty P, Bandopadhyay P, Kundu C & Chakraborty A 2003. Analysis of relationship between crop growth parameters, yield and physical environment within the crop canopy of sesame (*Sesamum indicum* L.) at different sowing dates. *Archives of Agronomy and Soil Science,* 49: 677-682.

Oplinger ES, Putnam DH, Kaminski AR, Hanson CV, Oelke EA, Schulte EE & Doll JD. 1990. Sesame, Alternative Field Crops Manual. Accessed at www.hort.purdue.edu/- new crop/articles/sesame.html.

Patel JR & Shelke VB 1995. Effect of farmyard manure, phosphorus and sulphur on growth, yield and quality of Indian mustard. *Indian Journal of Agronomy*, 43: 713– 717.

Shamina F & Imamul J 2003. Mineralization pattern of added sulphur in some Bangladesh soils under submerged conditions. *Indian Journal of Agricultural Chemistry,* 36 (4):13-21.

Thakur DS & Patel SR 2004. Response of sesame to different levels of potassium and sulphur in light textured inceptisols of eastern part of Chattisgarh. *Indian Journal of Agricultural Science,* 74: 496-498.

Thirumalaisamy K, Srinivasan PS, Pangarusamy U, Thangaraj M, Mallika V & Kannaiyan S 2001. *Nutrient Deficiency and Remedial Management in Crops.* First Edition. Sigar Graphics Pub. Coimbatore, London, p.10-11.

Tiwari KN & Gupta BR 2006. Sulphur for sustainable high yield agriculture in Uttar Pradesh. *Indian Journal of Fertilizer News,* 1: 37-52.