

Performance of Sesame (*Sesamum indicum* L) Varieties as Influenced by Nitrogen Fertilizer Level and Intra Row Spacing.

U.A. Umar^{1*}; M. Mahmud²; I.U. Abubakar²; B.A. Babaji²; and U.D. Idris³

¹Agricultural Resource Council of Nigeria (ARCN) Plot 223D, Cadastral Zone B6, Mabushi, Abuja, Nigeria.

²Department of Agronomy, Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria.

³Samaru College of Agriculture, Ahmadu Bello University, Zaria, Nigeria.

E-mail: umarabdullahi2003@yahoo.com *
umarumar@arcnnigeria.org

ABSTRACT

A field study was conducted to evaluate the performance of two sesame varieties in response to nitrogen fertilizer level and intra row spacing at the Research Farm of Institute for Agricultural Research, Samaru in the Northern Guinea Savanna of Nigeria, during the wet seasons of 2009 and 2010. The treatments consisting of four nitrogen levels (20, 40, 60 and 80kgN/ha), three intra row spacing (5,10 and 15cm) and two varieties (NCRIBen001M and NCRIBen002M), were arranged in a split plot design with three replications. The factorial combinations of N level and variety was assigned to the main plots, while intra row spacing was placed at the sub plots.

The result indicated that, application of up to 80kgN/ha resulted in the significant increase in the number of leaves (NL), number of secondary branches (NSB), shoot dry matter(SDM), leaf area index(LAI), crop growth rate(CGR), capsules yield(CY), grain yield per plant(GYP) and grain yield per hectare(GY/ha). But the number of primary branches (NPB) showed no significant response to nitrogen level above 60kgN/ha. Narrow intra row spacing of 5cm between plants significantly decreases NL, NPB, NSB, TDM, CY and GYP but showed increased LAI, CGR and GY/ha. The two varieties produced same NL, NPB and NSB statistically, however NCRIBen001M produced significantly higher values for TDM, LAI, CGR, CY, GYP and GY/ha. The study recommend that, application of 80kgN/ha and narrow intra row spacing of 5cm gave the highest grain yield of both varieties. However NCRIBen001M produced significantly higher grain yield than NCRIBen002M under the same conditions.

(Keywords: Nitrogen level, intra row spacing)

INTRODUCTION

In Nigeria, sesame has been recognized as a crop with high economic potential, both as a source of raw material for industries and a reliable foreign exchange earner (Alegbejo, 2003). Nigeria has about 3.5 million hectares suitable for sesame production but only about 300,000 hectares were being cultivated largely by small holder farmers who cannot afford the ever increasing cost of farm inputs such as fertilizers, improved seeds, chemicals and lack access to information on improve farm practices that can boost yield of the crop (Anon. 2009).

The potential for commercial processing of sesame in Nigeria is also great because sesame can be processed into a number of forms for various uses such as oil, meal, paste, confectionaries, and bakery products (Anon. 2009). Despite these potentials Nigeria's sesame yield remained very low (367/ha) compared with Egypt and Ethiopia, 1323kg/ha and 825kg/ha, respectively (FAO 2009). This was attributed to the Nigeria's farmers' lack of access to improve seeds, in addition to ignorance and reluctance on the part of the sesame farmers to adopt improved agronomic practices that can enhance the yield of the crop.

Survey reports by various workers in Nigeria showed that fertilizer are not applied to sesame crop even in major sesame growing areas (Ugbani, 2008; Babaji, 2008; Idowu, 2002). Studies conducted revealed that farmers in savanna areas of Nigeria have no definite fertilizer recommendation for sesame as a sole crop as most crops are grown in mixture with other crops mostly cereals (Olowe, 2004). Low fertility status of savanna soils particularly nitrogen associated with continuous cropping and

intensive over grazing by livestock that left little or no crop residues to be incorporated into these soils warranted the use of fertilizers particularly nitrogen fertilizers to improve growth and yield of crop plants (Brady, 1984). Research earlier conducted showed great yield improvement with fertilized sesame compared to unfertilized ones (Anon, 2006; Malik, 2003).

Wide genetic and phenotypic variations of sesame crop and its adaptability to many soils and climatic conditions created serious discrepancies on its suitable intra row spacing and its optimum plant populations for good yield of the crop (Adebisi, 2004; Bonsu, 2003).

MATERIALS AND METHODS

The field trials were conducted during the rainy seasons of 2009 and 2010 at the Institute for Agricultural Research (IAR) farm Samaru (Latitude 11° 11'N, Longitude 7° 38'E and 686m above sea level) in the Northern Guinea Savanna ecological zone of Nigeria. The treatments consisted of two sesame varieties (NCRIBen001M and NCRIBen002M), four nitrogen levels (20, 40, 60, and 80kgN/ha), and three intra row spacings (5, 10, and 15cm). The treatments were arranged in a split plot design with three replications. The factorial combination of N levels and varieties were assigned to the main plot while intra row spacing was placed at the sub plot. The gross plot size was 3.0m x 3.0m (9m²) and the net plot was 1.5m x 3.0m.

The experimental field was ploughed, harrowed and ridged 75cm apart. A mixture of one part of sesame seed and two parts of course river sand was sown manually at a shallow depth of about 1cm, by dibbling at an intra row spacing of 5, 10, and 15cm as per treatments. The emerged plants were thinned to one plant per stand at two weeks after sowing. This arrangement gave population densities of 266, 667, 133,333, and 88,889 plants per hectare for 5, 10, and 15cm intra row spacings, respectively.

Phosphorus and potassium fertilizer was applied at planting to all the plots at the rate of 19.7kgP/ha and 24kg K/ha using SSP(16%P₂O₅) and MOP (60% K₂O) respectively. Nitrogen fertilizer was applied in two equal split doses at two and six weeks after sowing, at the rates of 20, 40, 60, and 80kgN/ha as per treatments using Urea (46%N). Glyphosate at the rate of 5 liters per ha was applied before land preparation to control weed, this was followed by hoe weeding at three and six weeks after sowing. No serious insects pest and diseases attack were encountered during the experimental period.

Data were collected from five randomly sampled plants from each plot at 12WAS. NL was determined by counting the leaves, SDM by oven drying the 5 sampled plants to constant weight, LA by leaf disc dry weight relationship as was described by Rhoads and Bloodworth (1964), LAI using the relationship as described by Watson (1952) and CGR was determined as suggested by Radford (1967).

$$LAI = \frac{\text{Leaf area per plant}}{\text{Ground Area}}$$

$$CGR = \frac{W_2 - W_1}{t_2 - t_1} \cdot \frac{1}{GA} \quad \text{g/m}^2/\text{wk}$$

CGR = Crop Growth Rate

W₁ and W₂ = Total dry weight at time t₁ and t₂.

GA = Ground Area

While NPB and NSB was determined by counting each from five randomly sampled plants at harvest. The CY was determined by weighing the fully dried harvested capsules from the five randomly sampled plants. The capsule yields were threshed and the realized clean seed was weighed to determine GYP. The GY/ha was determined from the harvest of each net plot and converted to per hectare. Data collected were subjected to analysis of variance (ANOVA) using

Statistical Analysis Agricultural Sciences (SAS) and the means were compared using Duncan Multiple Range Test (DMRT) (Duncan, 1955).

RESULT AND DISCUSSIONS

The pretreatment soil nutrient analysis revealed that the soils were sandy loam (560 and 520g/kg sand); the pH of the soils were slightly acidic (5.6

and 6.5); very low total Nitrogen (0.21 and 0.18%); low organic carbon (1.1 and 0.98g/kg), low cation exchange capacity (5.2 and 6.2cmol/kg) for 2009 and 2010, respectively (Table 1). The low organic carbon, low total nitrogen and low cation exchange capacity of these soils must have been responsible for its poor water and nutrient holding capacity especially for those nutrients that are subject to leaching particularly nitrogen as was earlier reported by Brady (1984).

The NL, NSB, SDM, LAI, CGR, CY and GY/P were all increases with increase in nitrogen fertilization up to 80kgN/ha. However NPB did not responded to nitrogen fertilization beyond 60kgN/ha (Table 2). This could be attributed to

the ability of nitrogen in promoting growth and to the fact that, nitrogen is an important constituent of chlorophyll, amino acid, and nucleic acid. Nitrogen played a key role in carbohydrates and protein metabolism, hence it is essential in plant growth and development. Nitrogen fertilization promoted cell division and enlargement that ultimately enhanced vegetative growth through increased number and size of leaves that resulted in increased leaf area. Large leaf area enhanced the capacity of the sesame plants to intercept adequate sunlight, which might have resulted in the production of more assimilate thereby enhancing growth and development of the crop. This finding was earlier observed by (Loomis *et al.*, 1971 and Shehu *et al.*, 2010).

Table 1: Physico – Chemical Characteristics of Soils of the Experimental Site in 2009 and 2010 Wet Seasons at Samaru.

Soil composition	Soil depth 0-30cm	
	2009	2010
Particle size		
Sand g/kg	560	520
Silt g/kg	320	320
Clay g/kg	120	160
Textural class	sandy loam	sandy loam
Chemical properties		
P ^H in water	5.6	6.5
P ^H in 0.1ml CaCl ₂	4.7	5.2
Organic carbon g/kg	1.2	0.98
Total nitrogen	0.21	0.18
Available P (mg/kg)	8.4	7.4
Exchangeable cation (cmol/kg)		
K	0.09	0.2
Mg	0.34	1.25
Ca	2.4	2.5
Na	0.45	0.25
CEC	5.2	6.2

Table 2: Effect of Nitrogen Levels on Growth and Yield of Two Sesame Varieties during the 2009 and 2010 Wet Seasons at Samaru.

Nitrogen Kg/ha	Growth and yield characters of sesame crop								
	NL	NPB	NSB	SDM(g)	LAI	CGR(g/m ²)	CY(g)	GY/P(g)	GY/ha(kg/ha)
20	55.08d	2.04c	0.75d	9.50d	3.20d	59.7d	11.9d	4.1d	563.2d
40	58.09c	3.06b	1.44c	9.61c	3.36c	60.5c	13.2c	4.9c	653.7c
60	62.43b	3.80a	1.57b	9.68b	3.49b	61.3b	15.0b	5.8b	727.3b
80	63.55a	3.94a	1.86a	9.78a	3.58a	61.9a	15.8a	6.1a	751.8a
SE _±	0.25	0.057	0.049	0.007	0.032	0.270	0.090	0.060	2.400

Mean followed with the same letters within columns are not statistically different at 5% level of significance

Table 3: Effect of Variety on Growth and Yield of Two Sesame Varieties during the 2009 and 2010 Wet Seasons at Samaru.

Variety	Growth and yield characters of sesame crop								
	NL	NPB	NSB	SDM(g)	LAI	CGR(g/m ²)	CY(g)	GYP(g)	GY/ha(kg/ha)
NCRIBen001M	60.0	3.25	1.38	9.65a	3.43a	60.9a	14.1a	5.3a	698.1a
NCRIBen002M	59.4	3.17	1.29	9.64b	3.38b	60.9b	13.6b	5.2b	649.9b
SE _±	0.170	0.040	0.037	0.007	0.032	0.010	0.090	0.040	1.700

Mean followed with the same letters within columns are not statistically different at 5% level of significance

The performance of the varieties showed that NCRIBen001M produced significantly higher values for SDM, LAI, CGR, CY, GYP and GY/ha compared to NCRIBen002M (Table 3). The large leaves rather than the number produced by NCRIBen001M might have help it to intercept and convert more solar radiation which could have led to increased assimilate production and consequently increased its yield and yield characters compared to NCRIBen002M. Similar varied responses of sesame varieties were earlier reported by (Olowe, *et al.*, 2009 and RMRDC, 2004). However the two varieties produced the same NL, NPB and NSB statistically for the two year trials.

The study further revealed that wide intra row spacing of 15cm between plants significantly increase NL, NPB, SDM, CY, and GYP (Table 4). This might be due to the fact that, sesame plants grown at wide intra row spacing are less exposed to intra specific competition for light, nutrient, moisture and space, therefore tend to grow more vigorously. In other words, high plant population associated with narrow intra row spacing tend to exert pressure on scarce growth resources such as light, space, moisture and nutrients, thereby reduced growth and development of individual plants. In contrast sesame crop planted at wide intra row spacing of 15cm produced significantly lower values for LAI, CGR and GY/ha (Table 4).

Table 4: Effect of Intra Row Spacing on Growth and Yield of Two Sesame Varieties during the 2009 and 2010 Wet Seasons at Samaru.

Intra row Spacing (cm)	Growth and yield characters of sesame crop								
	NL	NPB	NSB	SDM(g)	LAI	CGR(g/m ²)	CY(g)	GY/P(g)	GY/ha(kg/ha)
5	47.60c	2.32c	0.56c	9.27c	5.32a	78.6a	12.2c	4.3c	828.4a
10	61.39b	3.34b	1.45b	9.68b	2.90b	56.5b	14.2b	5.4b	666.1b
15	67.60a	3.96a	1.99c	9.98a	2.00c	47.4c	15.6a	6.0a	541.0c
SE±	0.210	0.052	0.042	0.005	0.013	0.010	0.210	0.050	3.900

Mean followed with the same letters within columns are not statistically different at 5% level of significance

This might be due to wide ground area subtended by the individual plants. In contrast, narrow intra row spacing enhanced LAI and CGR by ensuring early canopy ground cover, thus capturing sunlight more efficiently and utilizing soil moisture and nutrient more effectively. This agreed with the finding of Caliskan (2004).

The high grain yield obtained at 5cm intra row spacing may be attributed to higher number of harvestable capsules per unit area observed with sesame planted at narrow intra row spacing or at high population density as compared to fewer at wide intra row spacing or low population densities. Therefore, the higher CY and GYP recorded at wide intra row spacing of 15cm was unable to compensate for higher number of threshed capsules obtained at higher plant density of 5cm intra row spacing. This agreed with the finding of Adebisi, *et al.*, (2005).

CONCLUSION

Increasing nitrogen application from 20 to 40kgN/ha increases sesame grain yield by 16%, further increase to 60 and 80kgN/ha resulted in 12.6 and 3.3% more grain yield per hectare, respectively. The performance of the varieties showed that, NCRIBen001M produced 7.5% more grain yield compared to NCRIBen002M. Narrow intra spacing of 5cm gave 20% and 31% more grain yield than 10cm and 15cm respectively. This study concluded that, application of 80kgN/ha and narrow intra row spacing of 5cm gave the highest grain yield of

both varieties. However NCRIBen001M produced significantly higher grain yield than NCRIBen002M under the same conditions.

REFERENCES

1. Adebisi, M.A., M.O. Ajala, D.K. Ojo, and A.W. Salau. 2005. "Influence of Population Density and Season on Seed Yield and its Component in Nigerian Sesame Genotypes". *Journal of Tropical Agriculture*. 43(1-2):13-18.
2. Adedisi, M.A. 2004. "Variability, Stability and Correlation Studies in Seed Quality and Yield of Sesame (*Sesamum indicum* L)". An unpublished Ph.D. Thesis. University of Agriculture, Abeokuta, Ogun State, Nigeria.
3. Alegbejo, M.D. 2003. "Sesame: A Potential Industrial and Export Oilseed Crop in Nigeria". *Journal of Sustainable Agriculture*. 23(1):59-76.
4. Anonymous. 2006. "Fertilizer Use by Crops in Zimbabwe". FAO/UN: Rome, Italy. 55pp.
5. Anonymous. 2009. "Small Seed Provides Large Income". USAID/MARKETS. Nigeria's Harvest Markets. *Agbiz Update*. October 21, 2009.
6. Babaji, B.A., I.M. Haruna, and A.A. Muktar. 2005. "Sesame (*Sesamum indicum* L): An Oil Boom for Northern Nigeria". Paper presented at the National Conference on Development of Agriculture in Northern Nigeria organized by Institute for Development Research (IDR). Ahmadu Bello University: Zaria, Nigeria.
7. Bonsu, O.K. 2003. "Effect of Spacing and Fertilizer Application on the Growth, Yield and Yield

- Components of Sesame (*Sesamum indicum* L)". *Journal of Sustainable Agriculture*. 23 (1):40-49.
8. Brady, N.C. 1984. *Nature and Properties of Soil*. 7th edition. Macmillan: New York, NY. 456-475.
 9. Caliskan, S., M. Arstan, H. Atiogle, and N. Isler. 2004. "Effect of Planting Method and Plant Population on Growth and Yield of Sesame (*Sesamum indicum* L) in a Mediterranean type of Environment". *Asia Journal of Plant Sciences*. 3(5): 610-613.
 10. Duncan, B.D. 1955. "Multiple Range and Multiple F Test". *Biometrics*. 11:1-42.
 11. FAO. 2009. Food and Agricultural Organisation of the United Nation: Faostat Database". Available on line. <http://faostat.fao.org/site/567/default.aspx> (05/12/2011).
 12. Idowu, A.A., G.A. Iwo, S.A. Tihamiyu, and J.C. Anuonye. 2002. "Baseline survey on Beniseed Production: Processing and Utilization in Kebbi State". In: *Oilseed Research Programme Report*. NCRI Annual Review Meeting. 25-28 June 2002. 32-33.
 13. Loomis, M.S., W.A. William, and A.E. Hall. 1971. "Agricultural Productivity". *Ann. Rev. of Plant Physiology*. 22:4311 – 468.
 14. Malik, A.M. M.F. Salem, M.A. Cheema, and S. Ahmed. 2003. "Influence of Nitrogen Levels on Productivity of Sesame (*Sesamum indicum* L) under Varying Planting Patterns". *International Journal of Agriculture and Biology*. 4:490-492.
 15. Olowe, V.I.O. 2004. "Production Potential for Sesame in Savanna Regions of Nigeria. *MUARIK Bulletin*. 7: 20-29.
 16. Olowe, V.I.O., Y.A. Adeyemo, and O.O. Adeniran. 2009. "Sesame: The Underexploited Organic Oil Crop". Research and Development Centre (RESDEC). Available on line at [www.unep-unctad.org/cbtf/events/sesame seed crop](http://www.unep-unctad.org/cbtf/events/sesame%20seed%20crop).
 17. Radford, P.J. 1967. "Growth Analysis Formula, their Uses and Abuses". *Crop Science*. 3:171-173.
 18. RMRDC. 2004. "Reports on Survey of Agro-Raw Materials in Nigeria". Raw Materials Research and Development Council: Abuja, Nigeira.
 19. Rhoads, F.M. and M.E. Bloodworth. 1964. "Area Management of Cotton Leaves by Dry Weight Method". *Agronomy Journal*. 56:520-552.
 20. Shehu, H.E., J.D. Kwara, and M.K. Sandabe. 2010. "Effect of NPK Fertilizer on Yield, Content and Uptake of NPK by Sesame". *International Journal of Agriculture and Biology*. ISSN print 1560-8530; ISSN on line 1814-9596. 01-060/DNK/2010/12-6-845-850.
 21. Ugbanu, U., S. Momoh, A. Ayinde. 2008. "Resources Use Efficiency in Beniseed Production in Obi and Doma Local Government Areas of Nasarawa State". In: *Oilseed Research Division Report*. NCRI Badeggi. 2008 Research Review and Planning Workshop. 26-30 May 2008. 29-30.
 22. Watson, D.J. 1952. "The Physiological Basis of Variation in Yield". *Advances in Agronomy*. 4:101-104.

SUGGESTED CITATION

Umar, U.A., M. Mahmud, I.U. Abubakar, B.A. Babaji, and U.D. Idris. 2012. "Performance of Sesame (*Sesamum indicum* L) Varieties as Influenced by Nitrogen Fertilizer Level and Intra Row Spacing". *Pacific Journal of Science and Technology*. 13(2):364-369.



[Pacific Journal of Science and Technology](http://www.pacificjournalofscienceandtechnology.com)