



Effect of Sowing Methods, Seed Rate and Variety on Yield and Seed Quality of Sesame (*Sesamum indicum* L.) and Its Implication on Returns in Sudan Savanna of Nigeria

Y. N. Katanga^{1*}, O. Danmaigoro² and Y. Buba³

¹Department of Agricultural Economics, Federal University Dutse, Nigeria.

²Department of Crop Science, Federal University Dutse, Nigeria.

³Department of Extension Services, Jigawa Agricultural and Rural Development Authority, Dutse, Jigawa State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Author YB designed the study, wrote the protocol and wrote the first draft of the manuscript. Author OD reviewed the experimental design and all drafts of the manuscript. Authors YNK and YB managed the analyses of the study. Author YB identified the plants. Authors YNK performed the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

An experiment to determine the effect of sowing method, seed rate and variety on the yield and seed quality of sesame (*Sesamum indicum* L.) and its implication on returns was conducted at Kano and Dutse, in the sudan ecological zone of Nigeria during 2009 rainy season. The treatments evaluated consisted of three sowing methods (broadcasting, dibbling and drilling), four seed rate (2.5/ha, 5.0/ha, 7.5/ha and 10.0/ha Kg⁻¹) and two varieties (Ex-Sudan and E8). The result shows that, 1000-seed weight was significantly affected by the treatments at both locations where dibbling

*Corresponding author: E-mail: yaunuhu@yahoo.com;

method produced heavier seed weight, seed rate of 2.5 kg/ha resulted in more seed per plant while 5.0 kg/ha of seed produced significantly more yield per hectare. Proximate analysis of the seeds was carried out. Crude protein and oil content of the seed were not significantly affected by the sowing method and variety. It is therefore recommended that, adopting drilling method of planting with the seed rate of 5.0 kg/ha would increase the yield per unit that could increase the returns accrued to the sesame growers.

Keywords: Sesame; sowing method; variety; yield and returns.

1. INTRODUCTION

Sesame (*Sesamum indicum* L.) is an important oil seed crop that belongs to the family Pedaliaceae and genus *Sesamum* [1]. The genus consists of about 36 species of which 19 species are indigenous to Africa. It is one of the ancient crops grown for its edible oil by man [2]. The crop also is known as “gingerlly” and “til” in India, “Simsim” in Arabian countries and East Africa, and “Benniseed” in West Africa [3]. In Nigeria, it is known as “Ridi” by the Hausas, “Etuku” by the Yorubas and “Isasa” by the Igbos.

In Nigeria the sesame is mostly cultivated in the derived and Guinea savanna of Arid and Sahel zones with large portions in Jigawa, Kaduna, Katsina, Taraba, Benue, Kogi and in Nasarawa states and also in the Federal Capital Territory Abuja, [4]. Sesame ranked sixth in the world's production of oil seeds and twelfth in the world's vegetable oil production [5]. Sesame is an important export crop in Nigeria and has a substantial role in the sesame trade worldwide. The annual export of the commodity in Nigeria was valued at about 20 million U.S. dollars and Nigeria is the primary supplier of sesame seed to the world largest importer Japan. The trend in production of sesame in Nigeria is increasing annually, considering total production of 44,000 metric tons in 1990 which rose to 69,000 metric tons in 2001. Sesame seed production in the country was recently put at 100,000 metric tons annually [6].

Despite the importance of sesame as a source of vegetable oil and foreign exchange earner in this country, there is a dearth of information on its sowing method and variety especially in the Sudan savannah where production potentials are high. Sesame yields are generally very low 300-350 kg ha⁻¹ [7] when compared to Venezuela (1960 kg/ha) and Saudi Arabia (1083 kg ha⁻¹). Use of inappropriate sowing method is one of the major causes of low sesame yield in the country, for the fact that improved and high yielding

cultivars of sesame can give 15-40% more yield than local traditional cultivars when sowed better and adding that most farmers lack access to improved agronomic practices and varieties [8, 9]. Sowing method had greater influence on sesame yield yet most farmers adopt the popular dibbling method.

There are number of constraints including less access improved varieties, appropriate agronomic practices, drought and low soil productivity that affect the productivity of sesame. In Nigeria, most studies conducted with sesame were related to agronomic practices plant population, fertilizer rate, sowing dates, row spacing [9]. However, research on sowing methods has been scanty particularly in the Sudan savanna. Thus, there is need to identify appropriate sowing method, variety and seed rate for high production and higher earnings of sesame investment in Nigeria. The objective of the study is to determine the appropriate sowing method, rate and variety that impact best on sesame growth, yield, seed quality and its implication on return to the investment.

2. MATERIALS AND METHODS

The experiment was conducted at two locations during the 2009 cropping season. Location 1 was the Teaching and Research Farm of the Faculty of Agriculture, Bayero University, Kano. This study area lies at latitude 11°58'N and longitude 8°25'E with annual rainfall of 834.5 mm and mean minimum temperature range of 19.4°C and a mean maximum temperature range of 35.1°C [10]. While location 2 was Dutse in Jigawa state which lies at latitude 11°45'N and longitude 9°20'E with a mean annual rainfall of 958.5mm [11]. The two sites lie within the Sudan Savannah ecological zone of Nigeria.

The treatment consists of three sowing methods (broadcasting, dibbling and drilling), four seed rates (2.5 kg/ha, 5.0 kg/ha, 7.5 kg/ha and 10.0 kg/ha) and two varieties of sesame (Ex-Sudan

and E8). The treatments were randomized and laid out in a split-Split plot design with three replications. Variety (V) was assigned to the main plot, sowing method (M) to sub-plots and seed rate (s) to the sub-sub-plots. The field was harrowed to a fine tilt and then ridged 75 cm between rows and then marked into plots and replications with 1.0 m gap between blocks and one ridge between plots. A soil sample of the experimental site was collected randomly at 0-15cm and 15-30 cm using soil auger. The physical and chemical properties of the soil were determined using standard procedures.

Seeds were sown using the three sowing methods of broadcasting, drilling and dibbling according to treatment. Each plot received 60 kg N, 30 kg P₂O₅ and 30 kg K₂O ha⁻¹. Half dose of N (Nitrate fertilizer) and full doses of P₂O₅ and K₂O (phosphate fertilizer) were applied in form of N.P.K 15:15:15 (compound fertilizer) at three weeks after sowing while remaining half dose of N was applied in form of urea (46% a i) at six weeks after sowing. Two hoe weedings were carried out at 3 and 6 weeks after sowing (WAS) to control weed. Infestation of sesame by web worm (*Antigastra catalaunalis* Dup.) was observed and controlled using cypermethrin and dimethoate at the rate of 1 litre in 200 litres of water per hectare.

The crop was harvested manually using sickles by cutting the plants at the base close to the ground and putting them in sacks and then allowed to sundried for 2-3 weeks. Two inner rows (5 m²) were harvested for seed yield per hectare in the drilled and dibbled plots while for broadcast plots a margin of 1m was discarded along the ridges on both ends and 0.75 m along the width to give same net plot area (6 m²) as in drilling and dibbling. Same net area (6 m²) was marked within the interior of the plots. Data were collected for the following characters;

2.1 1000-Seed Weight

One thousand seeds of sesame were counted from each plot and then weighed using a sensitive balance and the values recorded.

2.2 Seed Yield per Plant

Five sampled plants were harvested and sun dried for 2-3 weeks. They were later threshed and weighed to determine yield per plant for each plot.

2.3 Seed Yield per Hectare

Plants were harvested from each net plot and sun dried for 2 weeks. The plants were threshed and weighed then converted to yield per hectare and recorded. The plants were threshed.

2.4 Seed Oil and Protein Content

A 20 g sample of seed was collected for each plot and subjected to laboratory analysis for ether extract and crude protein analysis. Using kjeldahl method as described by [12] and soxhlet fat extraction method described by [8]. The results obtained were recorded for each plot.

Data collected were subjected to analysis of variance (ANOVA) using SAS system for windows (S.A.S, V8, 2000) and the means separated using Duncan's Multiple Range Test (DMRT), [13].

3. RESULTS

3.1 1000 Seed Weight

The effect of sowing method, variety and seed rate on 1000-seed weigh, yield per plant and yield/ha is presented on Table 1. Dibbling (3.42) method produced significantly heavier seeds compared with broadcasting method. However, the differences between dibbling and drilling as well as between broadcasting and drilling (3.25) methods were not significant.

Variety and seed rate had no significant effect on 1000-seed weigh. However, sowing method had a significant effect on 1000-seed weigh where dibbling produced heavier 1000-seed weight which was statistically similar to drilling method. All interactions on 1000 seed weight were not significant.

3.2 Seed per Plant

Sowing method and variety had no significant effect on seed yield per plant (Table 1). Sowing at 2.5 kg/ha produced significantly higher seed yield per plant compared with 7.5 and followed by 10.0 kg/ha. However, the difference between sowing at 2.5 and 5.0kg/ha was not significant. The V x S interaction was highly significant on seed yield per plant. Drilling method produced the highest seed yield followed by broadcasting and then dibbling.

Table 1. Effect of sowing method, variety and seed rate on yield parameters, % oil content and % crude protein of sesame at BUK and Dutse in 2009 farming season

Sowing method (M)	BUK					DUTSE				
	Oil content (%)	1000 seed weight	Seed per plant	Seed/ hectare	Crude protein (%)	1000 seed weight	Crude protein (%)	Seed/ hectare	Oil content (%)	Seed per plant
Broadcasting	55.79	3.32	12.37a	662.0ab	21.47	3.29b	7.79	405.7ab	52.62	20.92
Dibbling	54.75	3.42	6.88b	602.0b	21.97	3.56a	6.38	345.3b	52.33	22.19
Drilling	53.29	3.25	9.37ab	753.0a	21.47	3.34ab	5.83	466.5a	55.46	21.88
SE±	1.02	0.12	1.09	33.40	1.41	0.069	0.64	15.71	2.17	0.96
Variety (V)										
Ex-sudan	54.22	3.42	10.69	782.0a	21.66	3.37	6.85	452.8a	54.28	20.78
E8	55.00	3.24	8.39	562.0b	21.60	3.42	6.49	358.7b	52.67	21.94
SE±	1.15	0.097	0.700	29.4	1.15	0.092	0.53	17.98	1.16	.057
Seed rate (kg/ha) (S)										
2.5	55.28	3.56	13.61a	704.0a	21.63	3.35	8.18a	400.2b	54.89a	22.0a
5	53.22	3.30	9.37ab	732.0a	21.27	3.43	7.10ab	454.9a	55.33a	21.69a
7.5	56.44	3.31	8.48b	651.0ab	21.75	3.43	6.67b	401.3b	50.39b	21.88a
10	53.50	3.14	6.71b	602.0b	21.88	3.67	4.71c	360.6c	53.28ab	19.87b
SE±	0.99	0.150	0.910	33.3	1.15	0.092	0.52	11.57	1.47	0.67
Interaction										
M xV	NS	NS	NS	NS	NS	NS	NS	*	NS	NS
MxS	NS	NS	NS	NS	NS	NS	NS	*	NS	NS
VxS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MxVxS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Mean followed by the same letter within a column of each treatment group are not significantly different at $P \leq 0.05$ using DMRT 3=NS: No significant, *= Significant @ 5%

Table 2. Interaction of sowing method and variety on seed yield per hectare (kg/ha) of sesame at Dutse, 2009

Treatments	Varieties	
	Ex-Sudan	E8
Sowing methods		
Broadcasting	352.1bc	459.2a
Dibbling	354.9bc	335.7bc
Drilling	369.3ab	563.3a
S.E ±	27.06	

Means followed with the same letter (s) within a treatment are not significantly different at 1% level of probability using DMRT

Table 3. Interaction of sowing method and seed rate on seed yield per hectare (kg/ha) of sesame at Dutse, 2009

Treatments	Seed rate (Kg/ha)			
	2.5	5.0	7.5	10.0
Methods				
Broadcasting	389.1 abc	458.0 a	417.7 ab	357.8 abc
Dibbling	347.7 abc	426.1 a	342.0 bc	265.4 bc
Drilling	463.8 a	480.6 a	444.2 a	476.7 a
S.E ±	23.41			

Means followed with the same letter (s) within a treatment are not significantly different at 1% level of probability using DMRT

Interaction between variety and seed rate on seed yield per plant were presented in Table 1. Statistically, similar yield per plant was obtained with increase seed rate on Ex-Sudan variety from 2.5 kg/ha to 5.0 kg/ha but with further increase to 7.5 and 10.0 kg/ha yield per plant the yield was reduced. For E8 variety significantly higher seed yield was recorded with 2.5 kg/ha and 7.5 kg/ha seed rates statistically similar to 10.0 kg/ha. The interaction effect of M x V is significant on seed yield/ha.

3.3 Seed per Hectare

The difference between drilling and broadcasting was not significant. Variety Ex-Sudan was superior in terms of seed yield per hectare as compared to E8 (Table 1). Seed rate 5.0kg/ha produced significantly higher yield per hectare than other rates. Interactions between M x V and M x S were significant on seed yield per hectare.

Ex-Sudan produced higher yield per hectare with drilling as compared to broadcasting and drilling which were at par. However, E8 varieties give similar and superior yield per hectare with drilling and broadcasting method.

For broadcasting, increasing the seed rate from 2.5 to 5.0 kg/ha gave higher seed yield per hectare which was statistically similar to 7.5

kg/ha. But further increase to 10.0 kg/ha produced lower seed yield per hectare. Similarly, with dibbling higher yield was recorded with increase in seed rate from 2.5 to 5.0 kg/ha. But further increase to 7.5 and 10.0 kg/ha produce lower seed yields. However for drilling method increasing seed rate from 2.5 to 10.0 kg/ha did not affect seed yield for hectare.

3.4 Crude Protein and Oil Content of Sesame Seed

The effect of sowing method, variety and seed rate on oil and protein contents of sesame is shown in Table 1. Sowing method and variety did not show any significant effect on seed oil content. Sowing at 7.5 kg/ha produced significantly lower oil compared to other rates which were similar. However, the difference between 5.0 and 7.5 kg/ha was not significant. Similarly, sowing method and variety did not affected protein content of the sesame seed. However, sowing at 10.0 kg/ha rate gave lower protein compared to other rates which were at par. All the interactions were also not significant on oil and protein contents of sesame. At Dutse, it was observed that all the treatments did not have significant effect on oil and protein contents of sesame. Similarly, all the interactions were non-significant on oil and protein contents.

4. DISCUSSION

Seed rate was observed to have non-significant effect on 1000-seed weight at both sites. [14] reported a similar observation that increase in plant population from 100,000 to 400,000 gave a corresponding decreases in yield characters that includes 1000-seed weight. Higher numbers of seeds per plant was obtained when sesame seeds were sown at 2.5 or 5 kg ha⁻¹. At low plant population there was minimal competition for space, light, moisture and nutrients which could have suggested enhanced dry matter production and seed yield hence higher output per hectare and this entails more returns. The decreased oil and protein contents of the seed at higher seed rates could be due to poor growth of plants. This must not be unconnected with the fact that rate beyond 5 kg ha⁻¹ suffered high intra and inter plant competitions for growth resources. Thus, the superior yield at 5 kg ha⁻¹ appeared to have been accounted by the high number of pods and seed yield/plant which is synonymous to increased output. Similar results were reported by [8] and [12]

The interaction between sowing method and seed rate on number of pods and seed yield per hectare was an indication of differential response of sesame to seed rate irrespective to sowing methods. Highest yield/ha was obtained at 5 kg ha⁻¹ seed rate for all the sowing methods. This could have resulted from higher inter and intra plant competitions for moisture, light and nutrients beyond optimum plant population. The work of [8] gave a similar results.

5. CONCLUSION

The result of this research it can be concluded that drilling is the best sowing method, sowing at seed rate of 5 kg ha⁻¹ gave better growth characteristics which will in turn enhance the yield of the crop hence an increased in return on investment. Similarly, there were differences in the growth parameters among the varieties where Ex-Sudan performs better than the E8.

Therefore, farmers are recommended to adopt these agronomic practices of using Ex-Sudan variety, sowing at seed rate of 5 kg ha⁻¹ and using drilling as the sowing method for increased sesame production and higher profitability in the Sudan Savannah of Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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