



EFFECT OF NITROGEN FERTILIZER AND SOWING METHODS ON YIELD OF SESAME (*Sesamum indicum* L.) VARIETIES IN BAUCHI STATE, NIGERIA

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ABSTRACT

Field experiment was conducted at the Abubakar Tafawa Balewa University Teaching and Research farm, Bauchi in 2018, 2019 and 2020 rainy seasons to study effect of nitrogen fertilizer and sowing method on growth and yield of sesame (*Sesamum indicum* L.) varieties. The treatments consisted of four levels of nitrogen fertilizer rates (0, 30, 60 and 90 kg N/ha), three sowing methods (dibbling, drilling and broadcasting) and two varieties of sesame (Ex-Sudan 1 and NCRI BEN 01M). The experiment was factorially combined and laid out in a Randomized Complete Block Design, replicated three times. The result of the experiment revealed that, nitrogen fertilizer had significant ($P \leq 0.05$) effect on yield characters of sesame. Application of nitrogen fertilizer at 60kg/ha significantly ($P \leq 0.05$) increased number of flowers, total ash, crude fibre, crude protein, ether extract, number of capsules per plant, number of seeds per capsule and yield/hectare in the 3-year study. It was also observed that, sowing method had significant ($P \leq 0.05$) influence on the performance of the crop. Dibbling method of sowing significantly ($P \leq 0.05$) produced higher number of flowers, number of capsules per plant, number of seeds per capsule and yield/hectare than the other two sowing methods. Studies carried out during the 3 years investigation revealed that 2020 rainy season produced significantly ($P \leq 0.05$) higher numbers of flowers, capsules per plant, seeds per capsule and grain yield/hectare than 2018 and 2019 seasons. Based on the results obtained, it can be concluded that the application of 60kg N/ha and dibbling method of planting can be adopted by farmers in the study area for optimum yield.

Keywords: Dibbling, Experiment, Growth, Seeds, Yield characters.

INTRODUCTION

Sesame (*Sesamum indicum* L.) belongs to the family Pedaliaceae, and is one of the most ancient crops and oilseeds known and used by mankind. It is also known as *benniseed*, *gingerly*, *simsim*, *ajonjoli*, sesame and til. It was a major oilseed crop in the ancient world due to its easiness of extraction, great stability and resistance to drought. Sesame was cultivated and domesticated on the Indian subcontinent during Harrapan and Anatolian eras (Bedigian and Van der Maesen, 2003). This is evidenced by the presence of archaeological remnants of crop dating back to 5500 BC in the Harappa Valley in the Indian subcontinents (Weiss, 2000; Ashri, 2007).

Sesame is considered to have both nutritional and medicinal values. The seeds are used either decorticated or whole in sweets such as sesame bars and halva, in baked products, or milled to get high-grade edible oil or tahini, an oil paste (Bedigian, 2004). Sesame seed contains two lignans, sesamin and *sesamolin*. After roasting sesame seeds, *seasmolin* is converted to *sesamol*. *Sesamol* has been found to have anti-oxidative effects to induce growth arrest and apoptosis in cancer cells.

Nitrogen is a basic constituent of many other compounds of primary physiological importance to plant metabolism, such as chlorophyll, nucleotides, proteins, alkaloids, enzymes, hormones and vitamins (Marschner, 2005). Nitrogen is a nutrient required by plants in comparatively larger amounts than are other soil borne elements; endogenous application to crops often results in yield improvement. Nitrogen is obtained from the soil through mineralization of soil organic matter and from external sources, both organic and inorganic. For an optimal yield, the N supply must be available according to the needs of the plant, matching its pattern and total amount. One of the veritable tools that could be used to boost the production of sesame by farmers in the tropics is to develop high yielding varieties that can produce very well in a wide range of agro-ecological zones. Hence, the choice of these varieties; Ex-Sudan, an exotic variety from Sudan which was evaluated for its high yield performance and National Cereal Research Institute Badagry Nigeria (NCRI BEN) developed new varieties (NCRI BEN-01M and NCRI BEN-02M) which were released in 2002. The objective of the study was to determine the effect of nitrogen fertilizer and sowing methods on yield characters of sesame varieties.

MATERIALS AND METHODS

Experimental Design

Field trial was conducted during the 2018, 2019 and 2020 rainy seasons at the Abubakar Tafawa Balewa University, Teaching and Research Farm, Bauchi. The experiment was laid out in a Randomized Complete Block Design (RCBD) in three replications with net plot size of 3m x 4m with a border row of 0.5m between plots and 1m between replications. The treatments consisted of four levels of nitrogen; 0, 30, 60, and 90 kgN/hectare applied as urea (46%N), three sowing methods (dibbling, drilling and broadcasting) and two varieties of sesame; Ex-Sudan 1 and NCRI BEN 01 M. Nitrogen fertilizer was applied as a single dose at four weeks after emergence. Yield characters such as number of flowers, total ash, crude fibre, crude protein, ether extract, number of capsules per plant, number of seeds per capsule and yield/hectare were recorded. The data collected were subjected to analysis of variance (ANOVA) treatments means were compared by using Duncans Multiple Range Test (DMRT) as said by Fasino (2003).

RESULTS AND DISCUSSION

Number of Flowers

Effect of nitrogen, sowing method, variety and year on number of flowers at all sampling periods is presented in Table 1. Nitrogen significantly ($P \leq 0.05$) affected number of flowers at all growth stages. The result showed that the application of 60 kgN/ha consistently and significantly ($P \leq 0.05$) produced higher number of flowers except at 8 WAS where 90 kgN/ha was at par with 60 kgN/ha. This could be due to the fact that nitrogen is an essential element and important determinant of plant growth and development which enhanced flower formation and capsule production thereby increasing the final yield. The result agrees with the findings of Bonsu (2003) who reported an increase in number of leaves, number of branches, number of flowers and yield of sesame with the application of nitrogen.

Table 1: Effect of nitrogen fertilizer, sowing method and year on number of flowers of sesame varieties in 2018, 2019 and 2020 rainy seasons

Treatment	Weeks after sowing			
	6	8	10	12
N fertilizer (kg/ha)				
0	15.33 ^d	31.06 ^c	44.00 ^c	57.17 ^d
30	15.72 ^c	32.07 ^b	42.15 ^d	58.24 ^c
60	17.23 ^a	34.04 ^a	46.91 ^a	62.83 ^a
90	16.54 ^b	33.94 ^a	46.35 ^b	61.78 ^b
LS	**	**	**	**
SE±	0.24	0.34	0.50	0.72
Sowing method (SM)				
Dibbling	17.31 ^a	33.63 ^a	46.96 ^a	62.26 ^a
Drilling	16.13 ^b	32.72 ^b	43.08 ^c	58.07 ^c
Broadcasting	15.24 ^c	31.99 ^c	44.51 ^b	59.68 ^b
LS	**	**	**	**
SE±	0.21	0.30	0.42	0.62
Variety (V)				
Ex-Sudan	16.23	32.67	44.72	60.08
01M	16.18	32.88	44.98	59.93
LS	NS	NS	NS	NS
SE±	0.17	0.24	0.35	0.51
Years (Y)				
2018	10.78 ^b	29.07 ^c	40.28 ^b	62.13 ^b
2019	9.46 ^c	30.71 ^b	36.50 ^c	53.68 ^c
2020	28.43 ^a	38.57 ^a	57.68 ^a	64.21 ^a
LS	**	**	**	**
SE±	0.21	0.30	0.42	0.62
Interaction				
N x P	**	**	**	**
N x V	NS	NS	NS	NS
P x V	NS	NS	NS	NS
Y x N	NS	**	NS	**
Y x P	NS	NS	**	NS
Y x V	NS	NS	NS	NS
Y x N x P x V	NS	NS	**	NS

** = significant at 1% level of probability, respectively. NS = Not Significant. Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of probability (Duncan's New Multiple Range Test).

The different sowing method of Table 1 also significantly ($P \leq 0.05$) affected number of flowers throughout the study period. The result indicated that dibbling method significantly ($P \leq 0.05$) gave a greater number of flowers than the other methods. It is a well-known fact that broadcast sowing always resulted in non-uniform plant spacing in the field. Uniform plant stands have mostly yield advantage over non-uniform plant spacing. Significant seed yield reduction due to non-uniform plant spacing were reported in several crop species (Imoloame *et al.*, 2007).

Yearly variation significantly affected number of flowers. Among the years, 2020 cropping season significantly ($P \leq 0.05$) produced a greater number of flowers than 2018 and 2019 seasons. This could be attributed to variation in climatic conditions especially temperature, rainfall and relative humidity.

Total Ash, Crude Fibre, Crude Protein and Ether Extract

The result of the effect of nitrogen fertilizer, sowing method, variety and year on total ash, crude fibre, crude protein and ether extract is presented in Table 2.

Table 2: Effect of nitrogen fertilizer, sowing method and year on total ash, crude fibre, crude protein and ether extract of sesame varieties in 2018, 2019 and 2020 rainy seasons

Treatment	TA	CF	CP	EE
N fertilizer (kg/ha)				
0	4.36	4.16 ^c	20.47 ^c	43.96 ^c
30	4.42	4.37 ^b	21.56 ^b	47.68 ^b
60	4.48	4.70 ^a	24.06 ^a	49.25 ^a
90	4.43	4.63-a	23.73 ^a	48.12 ^{ab}
LS	NS	**	**	**
SE±	0.14	0.17	0.67	1.48
Sowing method (SM)				
Dibbling	4.67	4.58	21.20	48.80
Drilling	4.57	4.41	20.81	46.08
Broadcasting	4.38	4.28	19.82	45.87
LS	NS	NS	NS	NS
SE±	0.34	0.40	1.55	3.45
Variety (V)				
Ex-Sudan	4.43	4.42	20.82	47.23
01M	4.40	4.43	20.79	47.28
LS	NS	NS	NS	NS
SE±	0.14	0.15	0.58	1.30
Years (Y)				
2018	4.69	4.54	21.97	47.66
2019	4.30	4.44	21.53	46.56
2020	4.48	4.50	22.06	48.22
LS	NS	NS	NS	NS
SE±	0.45	0.36	1.42	3.20
Interaction				
N x P	NS	**	NS	**
N x V	NS	NS	NS	NS
P x V	NS	NS	NS	NS
Y x N	NS	NS	NS	NS
Y x P	NS	NS	NS	NS
Y x V	NS	NS	NS	NS
Y x N x P x V	NS	NS	NS	NS

** = significant at 1% level level of probability, respectively. NS = Not Significant. Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of probability (Duncan's New Multiple Range Test).

Nitrogen fertilizer as resented in Table 2 significantly ($P \leq 0.05$) affected the rate of increase in crude fibre, crude protein and ether extract. Application of 60 and 90 kgN/ha produced similar crude fibre, crude protein and ether extract which were significantly ($P \leq 0.05$) higher than the other levels. However, total ash was not significant. This clearly revealed the effect of nitrogen in providing a conducive environment for better nutrient up take. This is in agreement with the findings of Nweke *et al.* (2011) who reported that application of nitrogen fertilizer increased seed yield and oil content of sesame cultivars.

The effect of sowing method, variety, year and interaction on total ash, crude fibre, crude protein and ether extract was not significant. They all produce similar results which were statistically at par.

Number of Capsules per Plant

Effect of nitrogen, sowing method, variety and year on number of capsules per plant is presented in Table 3. Nitrogen significantly ($P \leq 0.05$) affected number of capsules at all growth stages. The result of Table 3 showed that the application of 60 kgN/ha consistently and significantly ($P \leq 0.05$) produced higher number of capsules except at 10 and 12 WAS where application of 90 kgN/ha was at par with 60 kgN/ha. This could be due to the fact that nitrogen is one of the limiting nutrients in savannah soils and plays an important role in rapid vegetative growth. Nitrogen is also important in photosynthesis, formation of chlorophyll, nucleic acid and amino acid resulting in tall plants and heavily branched plant. This in turn enhanced flower formation and capsule production thereby increasing the final yield. This result is in conformity with the findings of Parwar *et al.* (1993) who reported that yield characters of sesame increased with increase nitrogen fertilizer application.

The different sowing methods also significantly ($P \leq 0.05$) affected number of capsules throughout the study period. The result indicated that dibbling method significantly ($P \leq 0.05$) gave a greater number of capsules than the other methods. This could be so because Sowing method determines the canopy structure which affect the crop in two important ways: first through light interception and distribution' secondly, through correlated physiological development and morphological changes (Jan *et al.*, 2015).

Yearly variation significantly ($P \leq 0.05$) affected number of capsules at all growth stages. Plants grown in the year 2020 significantly gave higher number of capsules than those sown in 2018 and 2019 seasons.

Table 3: Effect of nitrogen fertilizer, sowing method and year on number of capsules per plant of sesame varieties in 2018, 2019 and 2020 rainy seasons

Treatment	Weeks after sowing			
	6	8	10	12
N fertilizer (kg/ha)				
0	8.87 ^c	18.37 ^c	26.32 ^c	36.33 ^c
30	8.63 ^d	18.41 ^c	28.48 ^b	37.07 ^b
60	9.83 ^a	19.78 ^a	28.82 ^a	38.48 ^a
90	9.33 ^b	19.04 ^b	28.80 ^a	38.43 ^a
LS	**	**	**	**
SE±	0.22	0.24	0.31	0.48
Sowing method (SM)				
Dibbling	9.58 ^a	20.14 ^a	28.64 ^a	38.26 ^a
Drilling	9.47 ^a	18.90 ^b	28.29 ^b	38.01 ^a
Broadcasting	8.44 ^b	17.65 ^c	27.35 ^c	36.46 ^b
LS	**	**	**	**
SE±	0.19	0.21	0.27	0.42
Variety (V)				
Ex-Sudan	9.18	18.95	27.92	37.72
01M	9.15	18.84	28.07	37.44
LS	NS	NS	NS	NS
SE±	0.15	0.17	0.22	0.34
Years (Y)				
2018	7.38 ^c	17.72 ^c	26.47 ^c	33.14 ^c
2019	9.85 ^b	19.01 ^b	27.44 ^b	38.26 ^b
2020	10.28 ^a	19.96 ^a	30.36 ^a	41.33 ^a
LS	**	**	**	**
SE±	0.19	0.21	0.27	0.42
Interaction				
N x P	**	**	**	**
N x V	NS	NS	NS	NS
P x V	NS	NS	NS	NS
Y x N	NS	NS	NS	**
Y x P	NS	NS	**	**
Y x V	NS	NS	NS	NS
Y x N x P x V	NS	NS	NS	NS

** = significant at 1% level of probability, respectively. NS = Not Significant. Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of probability (Duncan's New Multiple Range Test).

Capsule length (cm), Number of Seed/Capsule and Yield/hectare (kg)

The result in Table 4 showed the effect of nitrogen fertilizer and sowing method on Capsule length, number of seed/capsule and yield/hectare of sesame varieties during the 2018, 2019 and 2020 rainy seasons. The effect of nitrogen fertilizer significantly ($P \leq 0.05$) affected number of seeds/capsule as well as yield/hectare. The result revealed that the application of 60kg N/ha significantly ($P \leq 0.05$) gave higher number of seeds/capsule and yield/hectare respectively. The increase in number of seeds per capsule and yield per hectare of sesame could be as a result of response of the sesame plant to application of nitrogen. Nitrogen fertilizer has been found to

improve growth and yield of crop plants. This report is in line with the findings of (Malik, 2003) who reported that nitrogen fertilization has also been found to have profound effect on oilseed crops. The application of 45 kg to 80 kg N/ha increased the number of branches and number of capsules per plant in sesame. This result is also in conformity with the findings of Umar *et al.* (2012) who reported that application of 60 kg to 80 kg N/ha produced higher number of leaves, number of branches and number of capsules per plant of sesame.

Table 4: Effect of nitrogen fertilizer, sowing method and year on capsule length, number of seeds per capsule and yield per hectare of sesame varieties in 2018, 2019 and 2020 rainy seasons

Treatment	CL	NSC	Grain yield (kg/ha)
N fertilizer (kg/ha)			
0	2.99	75.99 ^d	446.53 ^d
30	3.05	77.42 ^c	484.39 ^c
60	3.06	81.65 ^a	619.12 ^a
90	3.05	79.23 ^b	551.68 ^b
LS	NS	**	**
SE±	0.08	0.55	28.18
Sowing method (SM)			
Dibbling	3.11	79.42 ^a	538.51 ^a
Drilling	3.09	78.67 ^b	507.93 ^b
Broadcasting	2.98	77.66 ^c	479.93 ^c
LS	NS	*	**
SE±	0.17	0.48	24.48
Variety (V)			
Ex-Sudan	3.04	78.66	520.38
01M	3.03	78.29	508.20
LS	NS	NS	NS
SE±	0.07	0.40	21.66
Years (Y)			
2018	2.91	77.24 ^c	464.18 ^c
2019	2.95	78.75 ^b	514.17 ^b
2020	3.02	79.75 ^a	548.02 ^a
LS	NS	**	**
SE±	0.17	0.48	24.48
Interaction			
N x P	NS	**	**
N x V	NS	NS	NS
P x V	NS	NS	NS
Y x N	NS	**	NS
Y x P	NS	NS	**
Y x V	NS	NS	NS
Y x N x P x V	NS	NS	NS

** and * = significant at 1% and 5% level of probability, respectively. NS = Not Significant. CL = Capsule length. NSC = Number of seeds/capsules. Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of probability (Duncan's New Multiple Range Test).

In Table 4, sowing method significantly ($P \leq 0.05$) affected number of seeds/capsule as well as yield/hectare. Dibbling method generally produced a greater number of seeds/capsule as well as yield/hectare which were significantly ($P \leq 0.05$) higher than the other two methods. However, drilling method significantly ($P \leq 0.05$) gave higher number of seeds/capsule as well as yield/hectare than broadcasting method. It is a well-known fact that broadcast sowing always resulted in non-uniform plant spacing in the field. Uniform plant stands have mostly yield advantage over non-uniform plant spacing. Significant seed yield reduction due to non-uniform plant spacing were reported in several crop species such as sunflower (Barros *et al.*, 2003), corn (Bavec and Bavec, 2002) and sorghum (Abunyewa *et al.*, 2010). and Snider *et al.* (2012) reported that spaced plants can gain sufficient sunlight, water and nutrient from soil which can influence healthy growth and yield of plant.

Yearly variation significantly ($P \leq 0.05$) affected number of seeds/capsule as well as yield/hectare. Plants grown in the year 2020 gave significantly ($P \leq 0.05$) higher number of seeds/capsule and yield/hectare than those sown in 2018 and 2019 seasons.

CONCLUSION AND RECOMMENDATIONS

The study concluded that, application of nitrogen fertilizer had a significant effect on yield of sesame varieties. Application of 60kg N/ha and dibbling method of sowing can be recommended for the study area. Any of the two varieties can be recommended for the study area. Further study can be carried out to include additional varieties of sesame to determine the best variety for the study area.

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