Journal of Agripreneurship and Sustainable Development (JASD)
www.jasd.daee.atbu.edu.ng; Volume 5, Number 3, 2022
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

EFFECT OF NITROGEN AND PHOSPHORUS FERTILIZER ON THE PERFORMANCE OF SESAME (*SESAMUM indicum* L.) VARIETIES IN SUDAN SAVANNAH

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ABSTRACT
Field experiment was conducted at the Lake Chad Research Institute, research station Maiduguri (Lat: 11^0 $50^{'}$ N; Long: 13^0 $10^{'}$ E) during 2014 cropping season to determine the effect of Nitrogen (N) and Phosphorus (P) fertilizer combinations on sesame varieties. Treatments comprised of five sesame varieties (NCRIBen-02M, NCRIBen-03L, NCRIBen -04E, NCRIBen -05E and Gwoza local) and three fertilizer treatments: control and two levels of Nitrogen (N) and Phosphorus (P) fertilizers combinations (25 kg N + 20 kg P_2O_5 ha^{-1} and 50 kg N + 40 kg P_2O_5 ha^{-1}). The experiment was laid out in a split plot design with varieties on the main plots and fertilizer on the sub-plots and replicated four times. Data was collected on plant height, days to 50% flowering and capsule formation, capsule length, Number of capsules per plant, number of seeds per capsule and yield. Data collected were subjected to analysis of variance and the results showed significant differences among the characters studied. The varieties NCRIBen-04E and NCRIBen-02M fertilized with 25 kg N + 20 kg P_2O_5 ha^{-1} produced over 600 % higher yield than Gwoza local grown under control fertilizer. The growing of varieties NCRIBen -04E or NCRIBen-02M under 25 kg N + 20 kg P_2O_5 ha^{-1} is suggested for farmers in the Sudan Savannah for high yield of sesame.

Keywords: Grain yield, N and P fertilizer, Performance, Sesame variety, Sudan Savannah.

INTRODUCTION
Sesame (*Sesamum indicum* L.) also known as beniseed in different parts of the world has been recognized as a crop with a high economic potential in Nigeria, both as a source of raw materials for industries and a reliable foreign exchange earner (NCRI, 2008; Ikwuakam *et al*., 2016). It belongs to the family pedaliaceae and is an erect branched annual plant, growing to a height of 1.0 m. It is a crop of the drier areas of the tropics and sub-tropical regions and can grow on poor soils and thrives well where rainfall is as low as 100 mm and soil of medium texture that is well drained and free from salt, with neutral to alkaline P^H (Doko and Enwere 2014). The crop is sensitive to excessive rainfall and waterlogged conditions (Sarkar *et al*., 2016). In Nigeria, sesame is locally called *Ridi*, *Ekuku*, and *Isasa* by Hausas, Yorubas and Ibos, respectively. The crop is grown mainly for consumption purposes, as confectioneries, cookies, cake and in bread making with high market value (Azad *et al*., 2020). According to FAO (2019), the world production of sesame exceeded 5.5 million tonnes in 2017 with Myanmar, India, Tanzania, Nigeria and China as the world's largest producers. In Nigeria, 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). Survey reports by various researchers in Nigeria have shown that fertilizers are not applied to sesame even in major sesame growing areas (Babaji *et al*.,

2005; Ugbani *et al.*, 2008; Eifediyi *et al*., 2018). These coupled with the low fertility status of the savanna soils and low levels of management are responsible for low grain yield (400 – 530 kg ha^{-1}) of sesame in Nigeria. Researches conducted earlier have shown tremendous improvement in grain yield increase due to nitrogen and Phosphorus fertilization compared to unfertilized fields (Arslan and Gur, 2018; Jahan *et al*., 2019; **Girma, 2019**) and that adequate nitrogen nutrition is beneficial to improve uptakes of other nutrients, particularly P and K and some micronutrients (Gebregergis and Amare, 2019). However, the degree of response to fertilization varies with variety. Therefore, the objective of this study was to identify the best sesame variety and optimum N and P fertilizers combinations for sesame production.

MATERIALS AND METHODS

Field study was conducted in 2014 wet season (July-October) at Lake Chad Research Institute, Research Farm, Maiduguri (Lat. 11^0 50' N; Long. 13^0 10' E) in the Sudan Savannah zone of Nigeria. Maiduguri is a semi-arid town; characterized by distinct annual long dry season (9 months or more) and short raining season (3 months or less) with annual rainfall of 234 – 722 mm and a mean of 533 mm over the past 10 years (Waziri, 2012). The experimental field was cleared and harrowed to a fine tilt. Plots were marked out 6 m x 5 m dimensions with inter-row spacing of 0.50 m. The physico-chemical analysis of the soil of the experimental site showed that the texture was sandy loam with 72% sand, 19% silt and 23 % clay. Total N (0.038%) and available P (11.20 ppm) were moderate, available Ca (6.8 meq/100g) and Mg (2.6 meq/100g) was high, and K (540 ppm) was low, while organic carbon (0.80%) and organic matter (3.7%) were very low. Thus, the nutrient content of the soil was low according to the FAO rating. The treatments comprised of five sesame varieties (NCRIBen-02M, NCRIBen-03L, NCRIBen-04E (Ex-Sudan), *NCRIBen-05E* (Kenana-4) and Gwoza local as check) and three fertilizers (control, N and P fertilizers combinations at 25 kg N + 20 kg P_20_5 ha^{-1} and 50 kg N + 40 kg P_20_5 ha^{-1}). The experiment was laid out in a split plot design with varieties assigned to main plots while fertilizer was allocated to sub-plots and replicated four times. The experimental plots received basal application of P fertilizer as per treatment at sowing while nitrogen fertilizer treatments were applied in two split doses; half at sowing and the other half N dose at four weeks after sowing (WAS).

Data was collected on plant height, days to 50% flowering, days to 50% capsule formation, number of capsules per plant, capsule length, number of seeds per capsule and grain yield kg/ha. All data collected were subjected to Analysis of Variance (ANOVA) using statistical software, Statistix 8.0. The treatment means were compared using least significant difference (LSD) at 5% level of probability when F –Value were significant (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Table 1 shows the effect of fertilizer on growth characters of sesame varieties at Maiduguri during the 2014 cropping season. The varieties (NCRIBen-02M and NCRIBen-04E) took significantly a smaller number of days to attain 50% flowering compared with the local check. The variety NCRIBen-03L significantly differed in number of days to 50%, Capsule formation and plant height compared with other varieties. The early flowering could be attributed to genetic composition of the improved varieties compared with the local check. The number of days to 50% flowering, capsule formations and plant height increased with increase in fertilizer application however, there was no significant difference between 25 kg N + 20 kg P_20_5 and 50 kg N + 40 kg P_20_5. This shows response of the crop to N and P fertilizer even at lower rates. Similar observation was made by (Muhamman *et al.*, 2009; Ibrahim *et al*.,

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www.jasd.daee.atbu.edu.ng; Volume 5, Number 3, 2022
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

2016; Mizan *et al*., 2019). There was significant interaction between variety and fertilizer on days to 50% flowering.

Table 1: Effect of nitrogen and phosphorus combinations on growth characters of sesame variety at Maiduguri during the 2014 cropping season

Treatment	Days to 50% flowering	Days to 50% capsule formation	Plant height (cm)
Variety (V)			
NCRIBen -02M	42.7	51.8	162.6
NCRIBen -03L	44.8	56.4	175.7
NCRIBen -04E	42.7	51.3	158.9
NCRIBen -05E	43.3	52.2	160.0
Gwoza local	54.8	66.5	172.2
Mean	45.6	55.6	165.9
LSD (0.05)	0.90	0.90	2.04
Fertilizer (F)			
Control	43.6	54.9	160.0
25 kg N + 20 P_2O_5	46.6	55.0	166.4
50 kg N + 40 kg P_2O_5	46.7	57.0	171.3
Mean	45.6	55.6	165.9
LSD (0.05)	0.78	0.72	1.60
Interaction			
V x F	**	Ns	Ns

Ns = Not significant 5%, ** = Significant at 1%

Table 2 shows the interaction between variety and fertilizer on number of days to 50% flowering. The variety NCRIBen 02M took a smaller number of days to attain 50% flowering at zero fertilizer application while Gwoza local took more number days to attend 50% flowering at 50 kg N + 40 kg P_20_5. Influence of interaction of N and P on flowering of sesame has been reported by (Mizan *et al*., 2019).

Table 2: Interaction of variety x fertilizer on days to 50% flowering at Maiduguri, during the 2014 cropping season

	Fertilizer rates		
Variety	**Control**	**25 kg N + 20 kg P_20_5**	**50 kg N + 40 P_20_5**
NCRIBen -02M	41.8	44.3	42.0
NCRIBen -03L	44.0	44.8	45.5
NCRIBen -04E	43.0	42.5	42.5
NCRIBen -05E	43.3	42.8	43.8
Gwoza local	46.0	58.8	59.6
LSD (0.05)		1.18	

Table 3 shows the effect of fertilizer on capsule length, number of capsules per plant, number of seeds per capsule and grain yield of sesame varieties at Maiduguri. Capsule length varied from 2.3 to 2.5 with a mean of 2.46 with the improved varieties producing statistically similar and significantly longer capsules compared to local check. Similar observations were made by (Mankar and Santao, 1995; and Owuna, 2006). Number of capsules per plant varied from 68.1 to 124.4 with a mean of 98.9 with the variety NCRIBen-04E significantly producing the highest number of capsules per plant compared with other varieties. The variety (NCRIBen-

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02M significantly recorded the highest number of seed per capsule compared to other varieties tested. Grain yield ranged from 308 to 1594 with a mean of 922 kg ha^{-1} with the variety NCRIBen-04E having the highest grain yield (1594.4 kg ha^{-1}) and was followed by NCRIBen-02M, NCRIBen-03L, NCRIBen-05E and Gwoza local. The high yield recorded by NCRIBen-04E could be attributed to number of seed per capsules and number of capsules per plant. It may also due to genetic and environmental factors that favoured its performance as reported by (Girma, 2019**;** Amaza, 2016).

Capsule length, number of capsules per plant and number of seeds per capsule increased when 25 kg N + 20 kg P_20_5 fertilizer was applied and thereafter declined with further increase in fertilizer application. The increase in capsule length, number of capsules per plant and number of seeds per capsule could be attributed to efficient utilization of the fertilizer applied. This is in agreement with observations made by (Busari *et al.*, 2005; Umar, 2011; Hossein *et al.*, 2007; Gebregergis and Amare, 2019). Fertilizer application also significantly affected the grain yield which ranged from 835 to 1090 kg with a mean of 922 kg/ha with the highest obtained when 25 kg N + 20 P_20_5 was applied and the least was from the control. This could be attributed to efficient utilization of fertilizer applied as reported by (Okpara, *et al.*, 2007; and Haruna, *et al.*, 2009; Girma, 2019). Significant interaction exists between variety and fertilizer on number of capsules per plant, number of seed per plant and yield.

Table 3: Effect of nitrogen and phosphorus combinations on yield and components of sesame at Maiduguri during the 2014 cropping season

Treatment	Capsule length (cm)	No. of capsules per plant	No. of seeds per plant	Yield (kg ha^{-1})
Variety (V)				
NCRIBen -02M	2.53	121.9	60.0	1500.0
NCRIBen -03L	2.43	93.8	54.7	752.8
NCRIBen -04E	2.53	124.4	58.0	1594.4
NCRIBen -05E	2.50	86.5	56.3	452.8
Gwoza local	2.32	68.1	54.8	308.3
Mean	2.46	98.9	56.8	921.7
LSD (0.05)	0.20	3.15	1.47	6.37
Fertilizer (F)				
Control	2.39	93.6	51.6	835.0
25 kg N + 20 P_2O_5	2.53	112.5	63.0	1090.0
50 kg N + 40 kg P_2O_5	2.47	90.8	55.8	840.1
Mean	2.46	98.9	56.8	921.7
LSD (0.05)	0.02	2.53	0.92	2.33
Interaction				
V x F	Ns	*	*	*

Ns = Not significant at 5%; * = Significant at 5%

Table 4 shows the interaction between variety and fertilizer on the number of capsules per plant, number of seeds per capsule and grain yield. The variety NCRIBen-04E recorded the highest number of capsules per plant and grain yield at 25 kg N ha^{-1} + 20 kg P_20_5 ha^{-1} while the variety NCRIBen-02M produced the highest number of seed per capsule at 25 kg N/ha + 20 kg P_20_5 ha^{-1}. Interaction between Gwoza local and 25 kg N ha^{-1} + 20 kg P_20_5 ha^{-1} produced the least number of capsules per plant. On the other hand, Gwoza local and control fertilizer

produced least number of seed per capsule and grain yield. Mizan *et al*. (2019) reported influence of N and P on seed yield of sesame.

Table 4: Interaction of variety x fertilizer on number of capsules per plant, number of seeds per capsule and grain yield at Maiduguri, during the 2014 cropping season

		Fertilizer rates	
Variety	**Control**	**25 kg N + 20 kg $P_2 0_5$**	**50 kg N + 40 $P_2 0_5$**
		No. of capsules/plant	
NCRIBen -02M	104.5	132.0	129.3
NCRIBen -03L	97.3	108.8	75.3
NCRIBen -04E	100.0	179.5	93.8
NCRIBen -05E	91.3	79.3	89.0
Gwoza local	74.8	63.0	66.5
LSD (0.05)		3.79	
		No. of seeds/capsules	
NCRIBen 02M	55.0	65.8	59.3
NCRIBen 03L	52.3	58.0	53.8
NCRIBen -04E	55.0	64.3	54.8
NCRIBen -05E	50.3	64.8	54.0
Gwoza local	45.3	62.0	57.3
LSD (0.05)		1.38	
		Grain yield (kg/ha)	
NCRIBen 02M	1383.3	1716.8	1400.0
NCRIBen 03L	750.0	875.0	633.5
NCRIBen -04E	1400.0	1933.3	1450.0
NCRIBen -05E	366.8	550.0	441.8
Gwoza local	275.0	374.8	275.3
LSD (0.05)		8.08	

CONCLUSION AND RECOMMENDATIONS

The study indicated significant variability in response to N and P combinations on the yield of sesame varieties and are mainly attributed to genetic and environmental influence. The growing of varieties NCRIBen-04E or NCRIBen-02M under 25 kg N + 20 kg $P_2 0_5$ ha^{-1} fertilization which gave the highest yield are suggested for cultivation for farmers in Borno State, in the Sudan Savannah zone of Nigeria.

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