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PERFORMANCE OF SESAME VARIETIES (*Sesamum indicum L.*) TO SOWING DATES ON GROUNDNUT (*Arachis hypogaea*) BASED INTERCROPPING IN MAIDUGURI, BORNO STATE, NIGERIA

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ABSTRACT

A field study conducted during the 2017 and 2018 cropping seasons at the Lake Chad Research Institute, Maiduguri, Nigeria, evaluated the performance of sesame varieties under varying sowing dates in a groundnut-based intercropping system. The objective was to determine the optimal sowing date for sesame and varietal suitability using yield parameters and Land Equivalent Ratio (LER). The experiment adopted a Randomized Complete Block Design (RCBD) with three replications and nine treatment combinations, involving two sesame varieties (Ex Sudan and Kenana) and two sowing dates on groundnut based intercrop. Results revealed significant varietal and temporal differences. Ex Sudan outperformed Kenana, recording higher mean yields of 1551.9 kg (2017) and 2840.7 kg (2018), compared to Kenana with 1335.2 kg and 2320.4 kg, respectively. Early sowing (first date) produced higher yields in 2017 (1585.2 kg), while late sowing exhibited competitive yields in 2018 (2535.2 kg), suggesting seasonal variability in sowing date efficacy. Sole groundnut plots consistently yielded higher than intercropped systems. However, intercropping enhanced land productivity, with LER values exceeding 1.0 in both seasons. Kenana sown late in the intercropping system demonstrated the highest land-use efficiency, achieving LERs of 1.24 (2017) and 1.17 (2018), indicating a 24% and 17% land advantage, respectively. The study concludes that while sole groundnut maximizes individual crop yield, intercropping with Kenana under delayed sowing optimizes land productivity in semi-arid environments. These findings is signifying for selective sowing schedules and varietal choice to improve resource efficiency for subsistence farmer.

Keywords: Intercropping; Sowing date; Land Equivalent Ratio (LER); Varietal performance.

INTRODUCTION

Sesame (*Sesamum indicum*) and groundnut (*Arachis hypogaea*) are key cash and food crops cultivated by smallholder farmers due to their adaptability to drought-prone environments and their role in income generation and food security. Sesame, valued for its oil-rich seeds and export demand, thrives in well-drained soils and requires minimal rainfall. Groundnut, a nitrogen-fixing legume, enhances soil fertility while providing protein-rich nuts and oil. Despite their individual benefits, monocropping practices dominate, often leading to soil nutrient depletion, pest proliferation, and vulnerability to climate shocks (Mihrete and Mihretu, 2025).

Intercropping is the simultaneous cultivation of two or more crops on the same field is a traditional practice in the north east region of Nigeria especially in Maiduguri, Borno State. Intercropping offers ecological advantages such as efficient resource use (light, water, and nutrients), pest suppression, and risk diversification (Gebru 2015). However, the specific agronomic and economic benefits of sesame-groundnut intercropping in Maiduguri remain understudied (Azraf-ul-Haq *et al*. 2006) several research in other semi-arid regions highlights the potential of intercropping in improving land output and resilience, however the data on optimal yield compatibility, and timing of sowing for specific sesame variety are scarce.

Furthermore, need to explore additional land productivity considering the accelerated population growth and limited cultivable land area, this study addresses these gaps by investigating the synergies between sesame and groundnut in Maiduguri and its unique agro-climatic background, targeting to promote sustainable livelihood resilience for smallholder farmers. The work is aim to evaluate the agronomic performance, and best sowing time of sesame in a groundnut based systems in Maiduguri for generating actionable insights of enhancing food security, and income diversification.

MATERIALS AND METHOD

Study area

Maiduguri, located in Borno State, northeastern Nigeria, lies within the Sudan-Sahelian agro-ecological zone characterized by a semi-arid climate, erratic rainfall (500 - 700 mm annually), and high temperatures (28 - 42°C). These conditions pose significant challenges to agricultural productivity, which is critical for the region's economy, as over 80% of the population depends on subsistence farming (James *et al*. 2021).The experiment was carried out at the demonstration farm of Lake Chad Research Institute (LCRI), located between latitude $11°85'8075^0$ - $11°85'7905^0$ N, and longitude $13°23'5685^0$ – $13°23'5625^0$ E Maiduguri in two consecutive cropping seasons 2017 and 2018, to find out the suitable sowing

date for sesame intercropped in groundnut based system for increasing land productivity and profitability of sesame groundnut intercropping system.

Land Preparation and Agronomic Practices

The experimental area was disc-ploughed and harrowed to a fine tilt. And the field marked into plots of 1.5 m x 3.0 m and separated by 0.5 and 1.0 m unplanted boarder between plots and replications respectively.

Manual hoe-weeding were done at 3, 6 and 9 weeks after first sowing to keep the experimental field weed free. All other agronomic practices (thinning, fertilizer application and pest control) were kept normal and uniform for all the treatments.

Experimental Design

The experiment was laid out in a Randomized Complete Block Design with three (3) replications. The seeds of both groundnut and sesame were sown in 30 cm apart inter and intra raw in both sole and intercropped plots. The spacing was maintained throughout the experimental plots, the plant population of groundnut and sesame in both sole and intercropped plots remained the-same.

The treatments were obtained by combination of two (2) varieties of Sesame (Kenana and Ex-sudan) in two (2) sowing dates and a variety of groundnut (Bomboy) as follows; Kenana + groundnut 1st sowing, Ex-sudan + groundnut 1st sowing, Sole Kenana 1st sowing, Sole Ex-sudan 1st sowing, Kenana + groundnut last sowing, Ex-sudan + groundnut last sowing, Sole Kenana last sowing, Sole Ex-sudan last sowing and Sole groundnut. All plots were planted with groundnut at first sowing except plots of sole sesame, second sowing of sesame varieties took place after 2 weeks, giving a total of nine treatment combination.

Data collection and Analysis

Sesame data were collected on number of branches per plant at six weeks after sowing, number of capsule per plant at harvest, plant height at harvest and Yield converted to Kg/ha, whereas, on groundnut the yield of both grain and haulm were measured and converted to Kg/ha. Data collected were subjected to analysis of variance (ANOVA) and the differences among the means were separated at 5% level of probability using Duncan's Multiple Range Test (DMRT) with the help of statistical software Statistix 8.0. The competitive behaviors of groundnut in sesame/groundnut association is determined using Land Equivalent Ratio (LER).

$$\text{Land equivalent ratio} = \frac{Yab}{Yaa} + \frac{Yba}{Ybb}$$

Where, Yaa and Ybb = sole yield of crops 'a' and 'b'

Yab and Yba = mixture yield of crops 'a' and 'b'

RESULTS AND DISCUSSION

Table 1 compares the number of branches at 6 WAS, Number of capsule per plant, plant height at harvest and yield per hectare of the two sesame varieties with groundnut as a based crop component within and between two years of assessment. The varietal performance in both 2017 and 2018 showed that Ex-sudan had significantly ($p<0.05$) higher number of branches while Kenana produced the least in both years. This disputed the findings of Islam (2017), which indicate genetic differences in branching patterns, and described Ex-Sudan generally having fewer branches compared to local or other varieties, which may influence capsule production.

For number of capsules Kenana had produced the highest numbers (45.25 and 68.67) whereas Ex-sudan had the least (30.92 and 36.25) in 2017and 2018 respectively, this might be as result of differences in varietal suitability to sowing dates, however the findings opposed the report of Ibrahim *et al*. (2016), which stated that Ex-Sudan recorded a significantly higher number of capsules per plant (190.3 on average), compared to Kenana.

Plant height significantly varies in 2017 and 2018, Ex-sudan having the highest mean values of 151.83cm and 160.25cm, the variation in plant height is attributed to genetic backgrounds of the varieties as buttressed in the report of Ibrahim *et al*. (2016), which stated that generally Ex-Sudan is Taller than Kenana with heights of 183.08 cm (2012) and 171.97 cm (2013) in trials conducted in Maiduguri, and also opined to (Zhang et al. (2021), that confirmed Kenana as short with heights of 163.22 cm (2012) and 161.28 cm (2013) compared to other local sesame varieties.

The yield in kg/ha of sesame did not differ significantly however, Ex-sudan had the highest mean yield of 1551.9kg and 2840.7kg in comparison to Kenana with 1335.2kg and 2320.4kg in 2017 and 2018 seasons respectively. This agreed with the work of Ju *et al*. (2021), that Ex-Sudan outperforms Kenana in terms of plant height and capsule production, making it more suitable for higher yields under optimal conditions. However, the work suggest that branching patterns may vary based on genetic and environmental factors.

In respect to sowing date first sowing consistently produce the highest values across the parameters and in both seasons, although the result did not showed significant ($p<0.05$) variation in yield between the first and the last sowing, yet the first sowing had 1585.2kg and 2320.4kg in 2017 and 2018 seasons in contrast to last sowing which produced 1301.9kg and 2535.2kg in 2017 and 2018 respectively. This could be because the first sowing matches with the required sowing date for sesame and the findings is in line to the report of Sabag *et al*. (2021), Optimal sowing dates significantly influence flowering time, plant architecture, and yield components as often late sowing dates shortened days to flowering but negatively impacted traits like plant height and capsule

number under short-day conditions. Similarly, Gebremariam (2015), reoprted that response of sesame (*Sesamum indicum*) varieties to sowing dates has significant impacts on growth, flowering, and yield. And confirmed by Ibrahim *et al*. (2016), That Ex-sudan variety performed best when planted in the second week of August, achieving the highest grain yield (3.42 kg/ha), and capsules per plant (190.3),

The interaction effect of sesame varieties x sowing dates on number of branches in 2017 and 2018 and number of capsules per plant in 2018 is presented on (Table 2) from the results Kenana at first sowing has the highest number of branches in both years with the average values of 6.50 and 8.50 whereas, the least was recorded in Ex-sudan in the first sowing with 3.50 and 4.50 branches in 2017 and 2018 seasons respectively. For number of capsules per plant Kenana first sowing had the highest mean value of 99.67 capsules and followed by the last sowing of the same variety with 50.83 capsules while the least in number of capsule among the interactions is Ex-sudan in last sowing with 21.67.

Table 3. Present the performance of groundnut on grain yield kg/ha and haulms yield within the treatment combinations and between years under assessment. Generally the yields of groundnut showed better performance in 2018 than 2017 both in grain and haulms yields.

Yield of sole plots across the seasons is higher than that of intercropped plots grain and haulms yield. Groundnut yield ranged from 198.52 – 467.41 and 251.85 – 533.34 in 2017 and 2018 respectively. The haulm yield ranged from 3259.30 – 6111.15 and 3881.50 – 6740.75 in 2017 and 2018 respectively. Sole plots are significantly ($p<0.05$) higher than the intercropped plots within each cropping seasons.

Table 1. Growth and yield parameters of sesame varieties intercropped with groundnut

Variety (V)	Number of branches		Number of capsules per plant		Plant height (cm)		Yield (kg/ha)	
	2017	2018	2017	2018	2017	2018	2017	2018
Kenana	5.00^{b}	6.50^{a}	45.25^{a}	68.67^{a}	113.42^{b}	121.67^{b}	1335.2^{a}	2320.4^{a}
Ex-sudan	6.00^{a}	7.00^{a}	30.92^{b}	36.25^{b}	151.83^{a}	160.25^{a}	1551.9^{a}	2840.7^{a}
SE±	0.351	0.426	4.242	3.074	5.919	6.864	137.01	296.47
Sowing (S)								
1st Sowing	6.42^{a}	8.00^{a}	51.83^{a}	75.25^{a}	151.25^{a}	163.75^{a}	1585.2^{a}	2625.9^{a}
last Sowing	4.58^{b}	5.50^{b}	24.33^{b}	29.67^{b}	114.00^{b}	118.17^{b}	1301.9^{a}	2535.2^{a}
SE±	0.351	0.426	4.242	3.074	5.919	6.864	137.01	296.47
Interaction								
V x S	*	*	Ns	**	Ns	Ns	Ns	Ns

Means followed by same letter(s) in the same column are statistically similar using Duncan's Multiple Range Test (DMRT)
* = Significant at 5% probability level, Ns= Not significant at 5% probability of F-test

Table 2. Interaction effect of varieties x sowing date on two varieties of sesame

		Number of branches 2017	Number of branches 2018	Number of capsules per plant 2018
Kenana	1st sowing	6.50a	8.50a	99.67a
Ex-sudan	1st sowing	6.33a	7.50ab	50.83b
Kenana	Last sowing	3.50b	4.50c	37.67c
Ex-sudan	Last sowing	5.67a	6.50b	21.67d
	SE±	0.497	0.603	4.347

Table 3. Groundnut yields in sesame - groundnut intercrop in 2017 and 2018 rainy seasons

Treatment	Yield (Kg/ha)		Haulms Yield (Kg/ha)	
	2017	2018	2017	2018
Kenana + Groundnut 1st sowing	198.52d	318.52b	4222.2bc	4888.9b
Ex-Sudan + Groundnut 1st sowing	218.52c	288.89bc	3925.9bc	4185.2c
Kenana + Groundnut last sowing	237.04b	259.26cd	3259.3c	3881.5c
Ex-Sudan + Groundnut last sowing	211.85c	251.85d	3407.4c	5370.4b
Sole Groundnut	467.41a	533.34a	6111.15a	6740.75a
SE±	13.54	11.63	524.66	164.08

Means followed by the same letter(s) in the same column are not significantly different using Duncan's Multiple Range Test (DMRT)

The yields of two sesame varieties and the groundnut in the sole and intercropped plots, the partial and total LER were presented on (Table 4.) from the results sole Ex-sudan had the highest yield of 2140.7kg and 4037.0kg and closely followed by sole Kenana with corresponding 1963.0kg and 3074.1kg in 2017 and 2018 seasons respectively, Ex-sudan + groundnut in last sowing in 2017 and Kenana + groundnut first sowing in 2018 had the least sesame yield with the average values of 985.2kg and 1429.6kg respectively.

Sole groundnut produced the highest yield of 467.41kg and 533.34kg in 2017 and 2018 seasons respectively, while the Kenana + groundnut first sowing recorded the least yield of 198.52kg in 2017 and Ex-sudan + groundnut last sowing with 251.85kg in 2018 season.

The LER revealed that the combination with highest land advantage is Kenana + groundnut last sowing in both cropping seasons with LER of 1.24 and 1.17 for 2017 and 2018 respectively. Conversely, Kenana + groundnut first sowing in 2017, Ex-sudan +groundnut last sowing of both 2017 and 2018 indicated a relative land disadvantage with corresponding LER values of 0.94, 0.98 and 0.91 respectively. This suggested that the two week before second sowing gave groundnut time space to establish well and compliment the sesame yield reduction, or it might be as a result of compatibility of the combination, and the possible fixation of atmospheric nitrogen capabilities of both crops. The discovery corroborates the claims of Saad *et al*. (2022), that intercropping sesame with groundnut has consistently shown LER values greater than 1, indicating higher productivity compared to sole cropping which demonstrating the biological efficiency and resource utilization advantages of intercropping over monocropping. And validated by Panda *et al*. (2022), Sesame-groundnut intercropping is advantageous in terms of productivity and sowing date and is particularly effective under rainfed conditions and opined by report of Ram (2020), that intercropping sesame and groundnut resulted in higher net returns (54,768/ha) and benefit-cost ratios (2.54) compared to sole cropping systems. Which was attributed to better resource use efficiency and the complementary nature of the crops.

CONCLUSION AND RECOMMENDATION

The study demonstrates that sesame variety and sowing date significantly influence yield and land productivity in groundnut-based intercropping systems. Ex Sudan had produced higher yield than Kenana in 2017 and 2018, while early sowing maximized sesame productivity in 2017, and late sowing showed competitive results in 2018. Sole groundnut plots yielded higher than intercropped plots, but intercropping with Kenana lately provided the highest land-use efficiency, with LER values of 1.24 (2017) and 1.17 (2018), indicating a substantial land advantage. Based on the outcome of this work it is recommended that for optimal resource utilization, farmers in semi-arid regions like Maiduguri should adopt intercropping groundnut and delay the sowing of Kenana to maximize land productivity. However, for higher individual crop yields, sole groundnut cultivation should also be look in to. Further research in this vein should be done to explore additional varietal performance and sowing regimes to refine agronomic practices that suit each of the combination and enhance yield.

Table 4. Land equivalent ratio of sesame groundnut intercrop in 2017 and 2018 rainy seasons

Treatments	Sesame Yield Kg/ha		Groundnut Yield Kg/ha		Partial LER Sesame		Partial LER Groundnut		Land equivalent ratio	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Kenana + Groundnut 1st sowing	1007.4	1429.6	198.52	318.52	0.51	0.46	0.43	0.60	0.94	1.06
Ex-Sudan + Groundnut 1st sowing	1229.6	1963.0	218.52	288.89	0.57	0.49	0.47	0.54	1.04	1.03
Sole Kenana 1st sowing	1963.0	3074.1	-	-	1	1	-	-	1	1
Sole Ex-Sudan 1st sowing	2140.7	4037.0	-	-	1	1	-	-	1	1
Kenana + Groundnut last sowing	1000.0	1925.9	237.04	259.26	0.73	0.68	0.51	0.49	1.24	1.17
Ex-Sudan + Groundnut last sowing	985.2	1629.6	211.85	251.85	0.53	0.44	0.45	0.47	0.98	0.91
Sole Kenana last sowing	1370.4	2851.9	-	-	1	1	-	-	1	1
Sole Ex-Sudan last sowing	1851.9	3733.3	-	-	1	1	-	-	1	1
Sole Groundnut	-	-	467.41	533.34	-	-	1	1	1	1

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