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Full Length Research Paper

Sesame (*Sesamum indicum L.)* weed infestation, yield and yield components as influenced by sowing method and seed rate in a Sudan Savanna agro-ecology of Nigeria

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An experiment on the influence of seed rate and sowing method on sesame *(Sesamum indicum* L.) weed infestation, yield and yield components was conducted at Maiduguri, Nigeria, during the 2001 and 2002 rainy seasons. A split-plot design was used such that method of planting was allocated to main plots and seed rate was assigned to sub-plots and replicated three times. The site was harrowed, leveled properly using a hand hoe and then marked out. The size of each sub-plot measured 6 x 8 m leaving a distance of 1 m between replications and 0.5 m between sub-plots. Seeds variety Gwoza Local were planted as broadcast and drill at the rate of 3, 6, 9, 12 and 15 Kg/ha respectively. Fertilizer Urea (46% N) and Single Superphosphate (18% P_2O_5) were used to supply 75 Kg N/ha and 50 Kg P/ha first at planting and the second dose at 6 weeks after sowing (WAS). Weeding was carried out using a hand hoe. Data taken included soil analysis of the experimental site, plant height, number of flowers per plant, weed cover score, weed dry matter, number of pods per plant and grain yield respectively. Results showed that broadcasting method of sowing produced taller plants in 2002 and greater number of flowers and pods per plant in both years and the average of two years data significantly higher weed cover and weed dry matter in 2001 and 2002 and their combined data compared with drilling method. Plant height, number of flowers and pods per plant decreased with increase in seed rate with 15 kg/ha producing significantly lowest of these characters in 2001 and the average of two years data. The amount of weed dry matter and weed cover decreased with increase in seed rate up to 12 Kg/ha with 15 Kg/ha producing the highest in 2001, 2002 and the average of two years data. Similarly, seed rate of 6 Kg/ha produced the highest seed yield compared with higher seed rates in the two years and only in the data on the average of the two years that differences in yield were significant. From this study, best weed suppression and highest yield was obtained from drilling method at seed rate of 6 Kg/ha.

Key words: Sesame production, sowing methods, seed rates, weed control, seed yield.

INTRODUCTION

Sesame (*Sesamum indicum* L.) is an oil crop grown in 15 States of Nigeria stretching from the north east, north central, the middle belt and Federal Capital Territory of the Sudan and Guinea Savannas (Philips, 1977; Ingawa et al., 1986). It is an important crop because the seed contains about 51% oil, 17 - 19% protein and 16 - 18 % carbohydrate (Yermanos et al., 1972). Sesame oil is used for the manufacture of margarine, salad oil, cooking oil, soap, paints, lubricants and lamp fuel. Ryu et al. (1972) reported that sesame oil contains sesamoline and sesamine which is used as synergist for insecticides. The effect of plant population on yield and yield components have been reported by several workers. For example, seed yield per unit area increases with increased population density from 80,000 to 160,000 plants / ha and beyond this density it becomes counter productive (Delgado and Yermanos, 1975). Also, increased number of seeds per capsule, number of capsules per plant, and dry matter production increased when the intra–row spacing in-

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Table 1. Physico - chemical properties of the soil collected from the experimental sites in 2001 and 2002.

Soil Characteristics	Composition	
% Sand	2001	2002
% Silt	64.90	57.80
% Clay	19.65	25.70
Textural class	15.45	16.50
Chemical properties	sandy loam	sandy clay loam
pH (H_20)	5.37	5.66
Carbon (%)	0.29	0.61
Organic matter (%)	0.50	1.05
Available P_20_5(p.p.m)	143.5	112
Total nitrogen (%)	0.056	0.06
Exchangeable cations meq/100 g soil		
Ca	1.65	1.14
Mg	1.08	1.42
K	0.27	0.26
Na	4.40	3.78
CEC	8.22	7.45

creased from 30 to 90 cm (Weiss, 1983; Olowe and Busari, 1994). As regards weed control, row planting is superior to broadcasting, resulting in increased yield (Weiss, 1971), while wide spacing favour higher weed competition in crops (Akobundu, 1987).

The production of sesame has been remarkable in the middle belt of the southern Guinea Savanna of Nigeria, but not much work apart from Imoloame (2004) had been carried out on sesame either as a sole or intercrop in Maiduguri situated in the Sudan Savanna agro- ecology of Nigeria. The decline of groundnut (an oil seed crop) pro-duction in the area has given sesame a place as an alternative crop useful as raw material in agro-allied and other industries. Since there is paucity of research on sesame in the Sudan Savanna agro-ecology, it was necessary to conduct this study with the objective of determining the influence of sowing methods and seed rates on sesame yield, yield components and weed infestation.

MATERIALS AND METHODS

The experiment was conducted during the 2001 and 2002 rainy seasons (July – October) on Teaching and Research Farm, Faculty of Agriculture, University of Maiduguri, Nigeria (11^0 51'N, $13^0$15'E). The total amount of rainfall for 2001 and 2002 were 727.7 and 494.7 mm respectively.

The experiment consisted of 10 treatments which included two sowing methods (Broadcast and Drilling at 90 cm inter-row) and 5 seed rates (3, 6, 9, 12 and 15 kg/ha). The experiment was laid out in a split-plot design such that the method of planting was allocated to main plots, and seed rate was assigned to sub plots and replicated three times. The experiment site was harrowed, leveled properly using a hand-hoe and marked out. The size of each sub plot measured 6 x 8 m leaving a distance of 1 m between replications and 0.5 m between main and sub plots. Fertilizers Urea (46 % N) and Single Superphosphate (18 % P_2O_5) were used to supply 75 KgN/ha and 50 KgP/ha respectively to each plot in two equal split doses, first at planting and at 6 weeks after sowing (WAS). For the second dose, fertilizer was broadcast on the plots of the broadcast seeds, while it was placed 15 cm away from the stand in a continuous band in the drilled plots respectively in line with the two sowing methods. Sesame variety Gwoza local was sown on 20^{th} and 27^{th} of July 2001and 2002. Weeding of the plots by a hand hoe was carried out at 3 and 6 WAS, while thinning was not carried out.

Only the four inner rows of each plot in the drilled method of planting were harvested, while in the broadcast method a margin of 1.65 m was left out on either side of each plot and the inner crop was harvested. Observations taken included, plant height, number of flowers/plant, weed cover by visual observation on a scale of 0 to 10, where 0 represent no weed cover and 10 complete weed cover, weed dry matter production and seed yield. All data were subjected to analysis of variance (ANOVA), and the Duncan's Multiple Range Test (DMRT) was used to compare means at 5% level of probability as reported by Gomez and Gomez (1984).

RESULTS

Table1 shows the physico-chemical characteristics of the soil of the experimental site. The soil was sandy loam, moderately acidic with medium organic matter content and low exchangeable cations. Sowing method did not significantly affect plant height of sesame in 2001 and 2002 (Table 2).

In 2001 and the average of the two years data, plant height decreased with increase in seed rate with 3 Kg /ha producing the tallest plants (Table 2) . However, in 2002 plant height increased with seed rate up to 6 kg/ ha and further increase led to decrease in plant height. The 15 Kg/ha seed rate produced the shortest sesame plants in the two years of study and their average data which was significant in 2002 and the average of two years data compared with the lower seed rates (Table 2). The interaction between seed rate and sowing method on sesame plant height was not significant (Table 2). In 2001 and 2002 the average of the two years data, broadcasting

Table 2. Effect of sowing method and seed rate on Sesame plant height (cm) at harvest and number of flowers /plant at 10 WAS in 2001 and 2002.

Treatment	Plant height(cm)			Number of Flowers/plant		
	2001	2002	Mean[1]	2001	2002	Mean
Sowing Method (SM)						
Drilling	138.4a	133.8a	136.1a	34.3a	30.0a	32.2a
Broadcast	133.4a	145.9a	140.0a	35.8a	46.7a	41.3b
SE (+)	3.06	3.03	1.45	3.63	5.18	1.90
Seed Rate (SR) kg/ha						
3	141.4a	145.3ab	143.3a	35.7a	45.5ab	40.6a
6	139.7a	146.2a	143.0a	34.1a	48.9a	41.5a
9	136.2a	133.3bc	140.8a	39.0a	34.7bc	36.9b
12	137.1a	144.5ab	134.8ab	36.6a	36.4bc	36.5ab
15	125.2a	129.7c	127.5b	29.9a	26.3c	28.1b
SE(+)	6.39	5.68	4.32	5.75	5.16	4.84
Interaction						
SM x SR	NS[3]	NS	NS	NS	4	NS

[1]Average of two years data. 2. Means followed by the same letters are not significantly different at 5% level of probability using Duncan's Multiple Range Test. 3. Not significant. 4. Significant at 5% level of probability.

Table 3. Interaction between sowing method and seed rate of sesame on number of flowers per plant in 2002.

Sowing method/seed rate	Number of flowers/plant at 10 WAS[1]
Drilling x 3 kg/ha	33.1 b
Drilling x 6 kg/ha	39.4b
Drilling x 9 kg/ha	36.8b
Drilling x 12 kg/ha	20.9c
Drilling x 15 kg/ha	19.9cd
Broadcast x 3 kg/ha	57.9a
Broadcast x 6 kg/ha	58.4a
Broadcast x 9 kg/ha	32.7b
Broadcast x 12 kg/ha	51.9a
Broadcast x 15kg/ha	32.7b
S.E (+)	5.15

[1] = Weeks after sowing Means followed by the same letter (s) within a column are not significantly different at 5% level of probability using Duncan's Multiple Range Test

method of sowing produced higher number of flowers at 10 WAS compared with drilling method (Table 2). The number of flowers produced by broadcasting method in the average of the two years data was significantly higher compared with drilling method. The number of flowers produced per sesame plant decreased with increase in seed rate in 2001 with 9 Kg/ha producing the highest number of flowers. However, the difference in the number of flowers produced at different seed rates was not significant. In 2002 and the average of the two years data, the number of flowers per plant increased with increase in seed rate peaking at 6 Kg/ha and declining with further increase in seed rate with 15 K/ha producing significantly fewer number of flowers per plant compared with the 3 kg and 6 Kg/ha seed rates (Table 2).

The interaction between sowing method and seed rate on number of flowers/plant was significant in 2002 (Table 3). Broadcast method at 6 Kg/ha seed rate produced significantly highest number of flowers compared with drilling method at all the tested seed rates. It also pro-duced significantly higher number of flowers compared with other broadcast seed rates except at 9 and 15 Kg/ha seed rates (Table 3).

In 2001 and 2002 their combined data, broadcast method of sowing produced more weed cover than the drilling method. However in 2002, the weed cover under broadcast method was significantly more than under drilling the seeds (Table 4).

In the two years and the average of two years data weed cover decreased with increase in seed rate at harvest up to 9 Kg/ha (Table 4). The seed rate of 15 Kg/ha produced the highest weed cover in both years and in the average of the two years data compared with lower seed rates. The interaction between seed rate and sowing method on weed cover was not significant at harvest (Table 4).

Similarly, in 2001 and 2002 their mean data broadcasting the seeds produced the highest weed dry matter compared with drilling method. Also, weed dry matter decreased with increase in seed rate up to 12 with 15 Kg/ha producing the highest in 2002 and the average of the two years data (Table 4). The interaction between seed rate and sowing method on total weed dry matter yield was not significant (Table 4). There was no significant difference in the number of pods produced by the two sowing methods at 12 WAS (Table 5). However, broadcasting method of sowing produced higher number

Table 4. Effect of seed rate and sowing method on weed cover and total weed dry matter in 2001 and 2002

	Weed cover Scores			Total weed dry matter		
Treatment	**2001**	**2002**	**Mean[1]**	**2001**	**2002**	**Mean[1]**
Drilling	4.7a	5.5b	5.1a	106.7a	203.0a	154.9a
Broadcast	5.8a	7.2a	6.5a	118.0a	225.5a	171.8a
S.E (+)	0.73	0.37	0.40	25.04	49.79	22.31
Seed Rate (SR) kg/ha						
3	5.7a	6.8a	6.3ab	121.7a	221.1a	171.4a
6	4.7a	6.3a	5.5bc	115.0a	211.1a	163.0a
9	4.2a	5.5a	4.8c	100.0a	214.3a	157.2a
12	5.3a	5.6a	5.5bc	110.0a	166.6a	138.3a
15	6.3a	7.5a	6.9a	115.0a	258.3a	186.7a
SE (+)	1.10	0.80	0.67	39.60	59.74	141.80
Interaction						
SM x SR	NS[2]	NS	NS	NS	NS	NS

[1]On a scale of 0 to 10 where 0 = no weed cover and 10 = complete weed cover. Means followed by the same letter (s) within a column is not significant at 5% level of probability according to Duncan's Multiple Range Test. [2]= Not significant.

Table 5. Effect of seed rate and sowing method on number of pods per plant at 12 WAS and grain yield in 2001 and 2002.

	Number of pods/plant			Grain yield(Kg/ha)		
Treatment	**2001**	**2002**	**Mean[1]**	**2001**	**2002**	**Mean[1]**
Sowing Method						
Drilling						
Broadcast	124.4a	93.4a	108.9a	422.1a	311.6a	366.8a
S.E (+)	12.20	12.49	10.82	62.20	62.94	37.33
Seed Rate (SR) kg/ha						
3	127.3a	90.6ab	109.0ab	565.7a	383.4a	476.0ab
6	138.6a	103.4a	121.0a	611.4a	453.1a	532.3a
9	139.6a	56.9bc	98.3bc	475.8a	330.3a	403.0ab
12	100.2a	54.5bc	77.4cd	394.1a	201.5a	297.8b
15	95.5a	50.0c	72.8d	389.8a	406.8a	398.3ab
SE (+)	19.22	9.98	10.40	98.35a	110.77	74.50
Interaction						
SM x SR	NS[2]	NS	NS	NS	NS	NS

[1]= Average of two years data. Means in a column followed by the same letter(s) are not significantly different at 5% level of probability according to Duncan's Multiple Range Test.

of pods compared with drilling method in 2001 and 2002 the average of the two years data (Table 5)

In 2001 the number of pods increased with increase in seed rate up to 9 Kg/ha beyond which there was insignificant decline. In 2002 the average of the two years data that is, the number of pods produced per plant increased with increase in seed rate peaking at 6 Kg/ha with subsequent decline (Table 5). In 2002 the average of the two years data, 6 Kg/ha seed rate produced significantly highest number of pods compared with higher tested seed rates (Table 5). However, the interaction between the sowing method and seed rate on number of pod/plant was not significant.

There was no significant difference in the number of pods produced by sowing the crop in any of the two methods at 12 WAS (Table 5). However, broadcasting method of sowing produced higher number of pods over the drilling method in 2001, 2002 and the average of the two years data (Table 5)

In 2001, the number of pods increased with increase in seed rate up to 9 Kg/ha after which it declined with no significance difference. In 2002 and the average of the

two years data the number of pods produced per plant increased with increase in seed rate up to 6 Kg/ha and declined thereafter (Table 5). In 2002 and the average of the years data, 6 Kg/ha seed rate produced significantly highest number of pods compared with higher tested seed rates (Table 5).

The interaction between the sowing method and seed rate on number of pods/plant was not significant (Table 5).

Drilling method of sowing the seeds produced insignificant higher seed yield per hectare than broadcasting method in 2001, 2002 and the average of the two years data (Table 5).

In both years and their average, seed yield per hectare increased with increase in seed rate up to 6 Kg/ha and declined thereafter (Table 5). While the difference in seed yield per hectare in 2001 and 2002 at different seed rates per hectare was not significant, 3 Kg/ha and 6 Kg/ha under average of the two years data produced significantly higher seed yield compared to higher rates (Table 5). The interaction between seed rate and sowing method on the seed yield was not significant (Table 5).

DISCUSSION

The taller plants produced by drilling method of sowing the seeds compared with the broadcasting method in 2001 could be due to greater intra and inter plant competition for nutrients and moisture in broadcast plots while the taller plants produced under broadcast method in 2002 could be due to the change in soil texture to sandy clay loam which retained more water for the plants. Mazzani and Cobo (1956), Donald (1965), Weiss (1983), Van Rheenen (1973), Delgado and Yermanos (1975) and Ndarubu et al. (1996), reported increase in plant height with decreased intra and inter-row spacing. These workers observed that as the intra and inter-row spacing decreases, plants compete for above ground resource (light).

The reduction in plant height with increase in seed rate could be due to increased inter and intra plant competetion for growth resources such as moisture, solar radiation and nutrients. This is similar to the findings of Anon (1966) who reported a marked tendency towards stunted growth at very close intra-row spacing of sesame.

At 10 WAS, broadcasting produced higher number of flowers than drilling in 2001 and 2002 which was significantly observed in the combined analysis. This could be due to intra plant competition in the drilled crop compared with the broadcast crop (Imoloame, 2004).

Generally, the number of flowers decreased with increase in seed rate. This could be due to greater inter and intra plant competition for soil nutrient, moisture and space at higher seed rates. This agrees with the findings of Olowe and Busari (1994) who reported that plants in wide rows were exposed to less intra – specific competetion and tended to be most vigorous and productive. This could be due to intra – plant competition for growth resources and space under drilling method compared with broadcast method. The greater number of pods produced by broadcasting method compared with drilling method could be due to early intra-plant competition for growth resources of moisture and space under the drilling method compared with the broadcast method. The reason for this trend could be the intra and inter-plant competition at higher seed rate for space, soil moisture, nu-trients, light and assimilates in simple nutrient forms like sulphates, phosphates and nitrates. These assimi-lates undergo metabolic transformation to organic plant constituents which could have been made available for absorption to the plants. Plants under broadcasting me- thod had the advantage of lesser population of plants and lesser competition for the assimilate, thus benefiting more than plants under drilling method. This could have resulted in the better performance of broadcasting over drilling method for these parameters (Weiss, 1983; Katung, 1987; Olowe and Busari, 1994).

Broadcasting significantly produced higher weed cover in 2002 compared to drilling. This could be due to the difficulty associated with weeding in the plot with broadcast crop compared with drilled plots where weeding was easier and more effective. This result agrees with the findings of Weiss (1971) who showed the superiority of row planting over broadcasting in controlling weeds, and van Rheenen (1973) observed that the practice of seed broadcasting resulted in over population and posed difficulties in weeding operations.

The highest amount of weed infestation observed at 15 Kg/ha seed rate could be due to the greater difficulty of weeding. This is in line with the results obtained by Akobundu (1987) who observed that shading of weeds by the rapidly formed canopy of crop in narrow rows account for more efficient weed control than in widely spaced rows.

Drilling produced higher grain yield in 2001 and the combined analysis than broadcasting. The reason for this could be the inter plant competition for moisture and nutrients which could be more severe under broadcast crop compared to the drilled crop during the dry spell before harvesting in 2001. Also, the higher weed infestation under the broadcast crop as evident from the higher weed cover and total dry weed weight must have further reduced the amount of nutrients and water available to the broadcast crop. This agrees with the findings of Weiss (1971) and Stonebridge (1963) who reported the superiority of row planting over broadcasting to control weeds, and that this factor alone resulted in considerable yield increases.

Grain yield increased significantly up to 6 Kg/ha rate in both years. This trend agrees with the earlier findings by Mazzani and Cobo (1956), Bleasdale (1966), Menon (1967), Gerakis and Tsangarakis (1971) and Delgado and Yermanos (1975) who reported yield increase with increase in plant population up to a certain level and fur-

ther increase in plant population led to a decline in seed yield

In conclusion, on weed suppression ability and for higher yield of the two sowing methods respectively, drilling method of sowing at 6 Kg/ha is suitable for Maiduguri situated in the Sudan savanna agro-ecology of Nigeria.

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