

Article

Improving the growth traits and yield of several varieties of sesame by the effect of planting distances between the lines

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Available from: <http://dx.doi.org/10.21931/RB/CSS/2023.08.02.7>

ABSTRACT

A field experiment was carried out using Design (RCBD) in the arrangement of split-plot design with three replications. The plants of the Hade variety outperformed significantly in giving the highest means for traits of plant height, number of branches per plant, number of capsules per plant, and seed yield. While Rafedain variety plants achieved the highest average weight of 1000 seeds, and Sumer variety plants took the least number of days to reach the 50% flowering stage, The highest mean of the plants planted at a distance of 80 cm between rows was in the traits of plant height and plant yield, while at a distance of 40 cm between the rows achieved the highest means of the traits of the number of branches, the number of capsules, and the weight of 1000 seeds. The highest average for interaction between plants of the Hade cultivar at a distance of 80 cm was in plant height and seed yield traits. Compared to other interactions, the highest mean for a distance of 40 cm for the number of capsules.

Keywords: sesame, planting distances, growth, varieties (*Sesamum indicum* L.)

INTRODUCTION

Oil crops directly occupy an important place in human food by entering most food industries. The remnants of their oil seeds are also used as animal fodder, including the sesame crop, whose seeds contain 50-60%oil, 18-20% protein, and carbohydrates in a ratio of 16-18, and minerals such as calcium, phosphorous, and vitamins^{1,2}. The oil of this crop is considered one of the best types of oils, characterized by its yellow color and linoleic acid content. It is stable when stored for a long time without changing color or taste due to its content of antioxidant compounds³. And despite its nutritional importance. In the industrialization of this crop, however, we find a decline in the cultivated areas and the reluctance of the Iraqi farmer to cultivate it due to the lack of productivity, foremost of which is the drop of the seeds of the varieties and their infection with many diseases that ultimately lead to a significant decrease in the yield. It was necessary to seriously search for all possible means to increase the yield and improve its quality per area unit, including developing new varieties of sesame, testing their suitability for the environmental conditions in Iraq and applying crop service operations according to the correct scientific principles, including agricultural dis-

tances between lines or pits in order to reduce competition for water. Furthermore, light and essential nutrients to feed the sesame crop. 4 showed in their study conducted in Sudan that there are significant differences between the varieties included in the study, as the variety (Promo) was superior in several traits, including plant height, number of capsules, and number of seeds per capsule compared to other varieties. In the same field, ⁵ found in his study that was conducted in Syria, which included four varieties of sesame (mahalo, Zori, Hourani and Sudany), that the local variety achieved the highest means in most of the studied traits, including seed yield, and it was 3.45 tons. ha⁻¹ compared to other varieties. He also found in his experiment, which included four varieties (Ishtar, Babylon, Rafedain, and Mahaly), that the Rafedain variety had superior plant height and 1000 seed weight, while Ishtar surpassed in the number of capsules and plant yield compared to other varieties. As for the agricultural distances, it was found⁷ in his experiment that he conducted in Iraq on the sesame crop, which included three distances (10, 20, 30) cm, and that the increase in the distance between the pits led to high yield rate and compared to other treatments. In a study conducted in Antalya (2009) that included several agricultural distances between the lines on the sesame crop, the agricultural distance (30×5) cm achieved the highest average for the seed yield, and the amount was 1115 kg. H⁻¹ compared to the agricultural distances (70×30) cm that achieved The lowest average for the above trait was 667 kg. H¹⁸. In the same direction, ⁹ found in their study conducted in Yemen and included three different plant densities that the low density by other treatments. Therefore, this study was conducted to determine the effect of planting distances on the growth and productivity of four varieties of sesame to select the best varieties and planting distances to achieve the highest productivity per unit area.

MATERIALS AND METHODS

A field experiment was carried out in Al- the Saqlawiya district, which belongs to Anbar Governorate, located at 43° longitude and 33° latitude during the year 2019 to study three planting distances between the lines on some growth traits and yield of four sesame cultivars. The experiment was set up as a design (RCBD) with a Split Plot design arrangement with three replicates. The experiment included a study of two factors; the first factor included three agricultural distances between the rows, i.e., 40, 60 and 80 cm, taking the symbols of D1, D2 and D3, respectively. In contrast, the second factor included four types of sesame, i.e., Wadaa, Sumer, Rafedain and Hade, which are symbolled as S1, S2, S3 and S4, respectively. The sesame variety occupied the subplots. The land preparation, such as plowing, smoothing and leveling, was done before planting. Then, the field was divided into experimental units with dimensions (3×3) m. The seeds were planted by hand manually on (15/5/2019) at a depth of 2-3 cm and a distance of 25 cm between the pits and three agricultural distances between the lines (40,60 and 80) cm. The triple superphosphate fertilizer (46% P₂O₅) was supplied as a source of phosphor with rate of 80 kg.h⁻¹ before planting, while urea fertilizer was added as a source of nitrogen with rate of 40 kg.h⁻¹ when the plant height reached 25cm¹⁰. The experiment land was irrigated immediately after planting and then repeated irrigation after that depending on As needed; after the integration of germination, it was reduced to one plant in the pit, and the weeding process was performed twice during the growing season and when the plants reached the stage of maturity, Data were taken from ten plants per experimental unit to study the following traits: "days from planting to 50% flowering, plant height, number of branches, number of fruiting capsules, the weight of 1000 seeds and seed yield." The data were analyzed statistically using the Gene state program, and the means were compared using (L.S.D.) at the 5% ¹¹.

RESULTS

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, and the experimental conclusions that can be drawn.

Days to 50% flowering

The flowering trait is one of the most important growth traits because they are directly related to the yield. The length of the flowering period may lead to a shortage of the period required for the seed to fill, which will be reflected in the crop yield. The results listed in Table 1 show the effect of varieties, the distance between the lines, and the interaction between them on this trait, where the Sumer variety needed the fewest days to reach this stage, amounting to 51.33 days. It did not differ significantly from the two tributary varieties compared to others, which needed the longest period to reach the stage of 50% flowering. It reached. Its means are 51.77 and 53.22 days for Wadaa and Hade, respectively. This difference between varieties is due to their genetic and environmental nature. The results of the above table also showed that the cultivation distances did not significantly affect this trait. As for the bilateral interaction between the study workers, the results showed in Table 1 that the plants of the Sumer variety, which were planted with a distance of (80) cm between the adjacent rows, took the least time to reach this stage (51) days compared to other interactions. While the plants of the Hade variety, planted with a distance of 40 cm between the adjacent rows, took the longest period to reach the 50% flowering stage, which reached 53.33 days.

	varieties	distance between the lines (cm)			Mean
		D1:40	D2:60	D3:80	
	Wadaa	52.00	51.66	51.66	51.77
3	Summer	51.33	51.66	51.00	51.33
2	Rafedain	51.66	51.33	52.00	51.66
	Hade	53.33	53.33	53.00	53.22
	Distance Mean	52.08	52.00	51.91	
P I a	LSD 0.05	S		D	S*D
		0.656		N.S.	0.905

Table1. effect of varieties and the distance between the lines and the interaction between them on the number of days from planting to 50% flowering

Table 2 shows the preponderance of Hade in this trait compared to other varieties; the highest mean was in the trait of plant height for the Hade variety, as it reached 174.22 cm, while the Wadaa variety recorded the lowest mean for this trait, which reached 163.22 cm. Increasing the planting distance between rows from 40 to 60 and 80 cm also led to a significant increase in the mean plant height, as the plants planted at the two planting distances (60 and 80) cm recorded the highest means for this trait, with values of 167.92 and 167.75 cm sequentially, which recorded the lowest mean for this trait up to 166.42 cm. The reason could be attributed to the increase in the distance between the lines, which reduced competition between growing plants for water, nutrients and light, leading to improved plant growth. This result was in agreement with the results

of several researchers¹⁵; the Hade variety plants grown in the largest planting distance between the lines recorded the highest mean plant height of 175.33 cm, while the lowest mean for this trait is 159.33 cm in the plants of the water variety planted in the smallest distance between the lines.

varieties	distance between the lines (cm)			Mean
	D1:40	D2:60	D3:80	
Wadaa	159.33	169.67	160.67	163.22
Summer	162.00	166.67	163.33	164.00
Rafedain	170.33	162.00	171.67	168.00
Hade	174.00	173.33	175.33	174.22
Distance Mean	166.42	167.92	167.75	
LSD 0.05	S		D	S*D
	2.29		1.18	2.76

Table 2. Effect of varieties and the distance between the lines and the interaction between them on plant height (cm)

Number of branches per plant

Table 3 had the highest mean in the Wadaa variety in the trait of the number of branches for each plant, and it was not different from the Hade variety for the same trait, giving the highest average reaching 7.44 and 6.78 branches. plant⁻¹ for the Wadaa and Hade varieties, respectively, while Sumer recorded the lowest average number of branches (4.67) Branch.Plant⁻¹. The results also indicated a significant difference between planting distances in the trait of the number of branches, as the plants planted at a planting distance of (40) cm were recorded between the lines. The highest average for this trait was 8.00 branches. At a distance of 80 cm between the adjacent rows, the average is less than 4.58 branches. This result was consistent with what he found¹⁸ in his study of the sesame crop. A major influence on this trait was by the binary interference [Table 3], as the distance of (40) cm between the lines was the highest value for the number of branches (9.67). In contrast to other interactions, the plants of the variety were planted in Sumer. At a distance of (80) cm between the lines, the lowest values for this trait are (4.00) branches.

varieties	distance between the lines (cm)			Mean
	D1:40	D2:60	D3:80	
Wadaa	9.67	7.33	5.33	7.44
Summer	5.33	4.67	4.00	4.67
Rafedain	7.67	5.33	4.33	5.78
Hade	9.33	6.33	4.67	6.78
Distance Mean	8.00	5.92	4.58	
LSD 0.05	S		D	S*D
	0.83		0.63	1.24

Table 3. Effect of varieties, the distance between the lines, and the interaction between them on the number of branches per plant

Number of capsules per plant

The results show significant differences in the trait of the number of capsules per plant [Table 4], where the Hade variety had the highest mean value of 206.1 capsules. plant⁻¹. while the variety Sumer gave the lowest average number of capsules, at 110.9 capsules. Plant⁻¹, compared to the other varieties under study. The superiority in some growth traits, such as plant height and number of branches, is reflected in the superiority of this variety in this trait, Table 3, 8. As for planting distances, the highest average number of capsules was at a distance of 40 cm. Table 4 shows that the distance of 40 cm between the adjacent rows gave the highest average number of capsules (158.2). Plant⁻¹, compared to other treatments, while the plants grown at a distance of 80 cm between the lines, gave the lowest average for this trait of 117.9 capsules. plant⁻¹, probably because plants cultivated at a distance of 40 cm between the adjacent rows have the largest number of branches Table 3, thus increasing the efficiency of light interception and spreading it over most plant leaves, which leads to an increase in the rates of photosynthesis. This was reflected positively in feeding the new phylogeny sites with adequate growth requirements, thus increasing the number of capsules in the plant. Regarding the interaction between the two study factors, there was a significant effect of varieties and planting distances on this trait Table 4; The Hade variety had the highest average of a distance of 40 cm for this trait, where the value of (251.7) capsules. Plant⁻¹, while the lowest average was for the Wadaa variety planted at a distance of 80 cm, which reached 98.3 capsules. Plant⁻¹.

varieties	distance between the lines (cm)			Mean
	D1:40	D2:60	D3:80	
Wadaa	131.3	111.7	98.3	113.8
Summer	116.7	106.0	110.0	110.9
Rafedain	133.3	121.7	105.0	120.0
Hade	251.7	208.3	158.3	206.1
Distance Mean	158.2	136.9	117.9	
LSD 0.05	S		D	S*D
	5.42		8.78	14.89

Table 4. Effect of varieties, distance between lines, and interaction between them on the number of capsules per plant

Weight of 1000 seeds (g)

We note from Table 5 that factors in the study, the varieties and cultivation distances, did not significantly affect this trait. Despite this, there is an increase in the weight of seeds. However, it did not reach the limits of significance, as the plants of the two varieties (Rafedain and Wadaa) gave the highest means for the weight of 1000 seeds (3.80, 3.79) g, with an increase of 12.8% and 12.5%, respectively, in addition, the lowest average of Hade variety was 3.37 g. This increase in seed weight may be due to the nature of the genetic varieties, which was reflected in showing this superiority, in addition to the small number of fruit capsules of the varieties, which was reflected in providing a greater amount of representative materials to be transferred to the seeds for its fullness. As for the bilateral interaction, the Sumer variety plants planted at a distance of 40 cm between the rows recorded the highest values for this trait (4.27 g) compared to

the other interactions, while the plants of the Hade variety planted at a distance of 80 cm between the rows recorded the lowest values for the weight of 1000 seeds amounted to 2.97 g Table 5.

varieties	distance between the lines (cm)			Mean
	D1:40	D2:60	D3:80	
Wadaa	3.93	3.63	3.80	3.79
Summer	4.27	3.30	3.40	3.66
Rafedain	3.93	3.43	4.03	3.80
Hade	3.23	3.90	2.97	3.37
Distance Mean	3.84	3.57	3.55	
LSD 0.05	S		D	S*D
	N.S.		N.S.	1.02

Table 5. effect of the varieties, the distance between the lines, and the interaction between them on the weight of 1000 g

Seed yield (kg. dunum⁻¹)

The seed yield is one of the main goals that researchers reached, as it was shown in Table 6 that the highest average was for the Hade variety, which was 625.9 kg. dunum⁻¹, while the lowest obtained seed yield was 205 kg.dunum⁻¹. The superiority can be attributed to the genetic variety ability, which showed maximum superiority in seed yield due to its superiority in some growth traits and yield, distinguishing it from other varieties. This result agreed with the results^{5,6,17}, which found that sesame varieties differ among themselves in seed yield, as it became clear from the same table that the highest seed yield was recorded for the plant distance of 80 cm between the rows by giving 364.30 kg. dunum⁻¹ outperformed the rest of the treatments with a significant increase of 14.99% and 21.4% than the plants planted at a distance of (40 and 60) cm between the lines sequentially, where the plants grown on the narrow distance recorded the lowest average of seed yield reached 300 kg. Dunam⁻¹. Since the seed yield is the final result of the components of the yield and some other traits, its increase by expanding the cultivation distances between the lines may be due to the superiority of this treatment in the growth and yield traits, which was positively reflected in the increase in the economic yield. This result agreed with the findings of the researcher⁷, who found that increasing planting distances significantly affects the increase in seed yield. As for the binary interaction, both factors of the study significantly affected this trait [Table 6], where the plants of the Hade variety planted at 80 cm intervals distance between the rows gave the highest average seed yield, reaching 665.3 kg. Dunum⁻¹, while Sumer plants that planted 40 cm intervals distance between the rows gave the lowest average for this trait (170) kg. dunum⁻¹.

varieties	distance between the lines (cm)			Mean
	D1:40	D2:60	D3:80	
Wadaa	235.3	268.7	285.0	263.0
Summer	170.0	187.0	258.0	205.0
Rafedain	194.7	199.3	249.0	214.3
Hade	600.0	612.3	665.3	625.9
Distance Mean	300.0	316.8	364.3	
LSD 0.05	S		D	S*D
	37.75		20.90	46.82

Table 6. Effect of varieties, the distance between the lines, and their interaction on the seed yield, kg. Dunum⁻¹

DISCUSSION

This agrees with the results of 5,12, which indicated differences between varieties in their flowering dates. The result also agreed with the findings of 6,13,14, who concluded that sesame varieties differ in their genetic makeup, which is reflected in an increase in height.

The difference in genotype may be the reason for this superiority. Some researchers have found that sesame varieties differ in composition, reflected in the number of branches. The results are consistent with other researcher findings showing that sesame varieties differ in the character of the number of capsules produced by the plant^{19,20,21}. The results agree with those who found that plants grown at different agricultural distances between lines vary in the number of capsules per plant.

This result agreed with the findings of several researchers^{16,17, 22} in this field on the sesame crop.

CONCLUSION

We conclude from this study that the varieties significantly differ. The hade variety gave the highest averages for seed yield, and some other traits and plants planted at a distance of 80 cm between lines achieved the highest averages for plant height and seed yield. The interaction between the plants of this variety planted at 80 cm intervals distance between the rows gave the highest significant mean of plant height and seed yield. Therefore, this breed can be introduced into other experiments or in breeding and improvement programs to produce superior varieties.

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Received: May 15, 2023/ Accepted: June 10, 2023 / Published: June 15, 2023

Citation: Abdulkafoor, A.H.; Ramadan, A.S.A.; Ibrahim, M.M.; Alobaidy, B.S.J.; Kosaj, K.I. Improving the growth traits and yield of several varieties of sesame by the effect of planting distances between the lines. *Revista Bionatura* 2023;8 (2) 90. <http://dx.doi.org/10.21931/RB/CSS/2023.08.02.7>