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Impact of planting dates on growth traits, yield, and yield components of selected sesame genotypes *(Sesamum indicum* L.*)*

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ABSTRACT

This experiment was conducted during the 2025 summer growing season in Shmeit village, Kirkuk province. The field was plowed and divided into four replicates, each containing five standard units, to evaluate five sesame varieties (Wadaa, Sumer, Rafidain, Had, and Giza) under three planting dates (10/May,25/May and 9/June).

Results showed significant effects on vegetative growth ,the highest number of branches were recorded at the planting date of 25/MAY and Rafidain variety, with averages of 7.19 and 6.86 (plant^{-1})respectively ,the tallest plants (157.42 cm) resulted from the interaction between the 10/5 planting date and Rafidain variety, For yield components, planting date at 10/ May produced the highest number of capsules per plant (251.68) capsule.plant^{-1}, while the Sumer variety achieved the highest average (258.72) capsule.plant^{-1} ,Planting date had no significant effect on seeds per capsule, but Giza recorded the highest value (59.98) seed capsule^{-1} , Capsule length was highest at 25/5 (2.41)cm and for Wadaa (2.53)cm , Sumer outperformed other varieties in 1000-seed weight (3.58 g), while The date of planting 9/June showed the same value. The highest interaction reached 3.94g for Sumer at Planting date 25/May , Sumer also achieved the highest seed yield (13.53 g plant^{-1}), while planting date at 10/May recorded 13.76 g. Total yield was the highest for Sumer (1353.66 kg ha^{-1}), and with the interaction reaching 1612.25 kg ha^{-1}.

KEYWORDS: Sesame, planting dates, genetic makeup, growth yield.

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تأثير مواعيد الزراعة في صفات النمو والحاصل ومكونات الحاصل لتراكيب وراثية مختارة من السمسم (*Sesamum indicum* L.)

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الملخص

أُجريت هذه التجربة خلال الموسم الصيفي لعام 2025 في قرية شميط بمحافظة كركوك. حُرثت الأرض وقُسمت إلى أربع مكررات، احتوى كل منها على خمس وحدات تجريبية، بهدف تقييم خمسة أصناف من السمسم هي **:**وداع، سومر، الرافدين، هاد، وجيزة، تحت ثلاثة مواعيد للزراعة هي **10** أيار، 25 أيار، و9 حزيران.
أظهرت النتائج وجود تأثيرات معنوية في صفات النمو الخضري، إذ سجل موعد الزراعة **25**أيار وأصنف الرافدين أعلى متوسط لعدد الأفرع بلغ **7.19** و**6.86**فرع نبات$^{-1}$ على التوالي، في حين نتجت أطول النباتات (**157.42**سم) من التداخل بين موعد الزراعة **10**أيار وصنف الرافدين .وفيما يتعلق بمكونات الحاصل، أعطى موعد الزراعة **10**أيار أعلى عدد من الكبسولات بلغ **251.68**كبسولة نبات$^{-1}$، بينما حقق صنف سومر أعلى متوسط بلغ **258.72**كبسولة نبات$^{-1}$.ولم يكن لموعد الزراعة تأثير معنوي في عدد البذور لكل كبسولة، إلا أن صنف جيزة سجل أعلى قيمة بلغت **59.98**بذرة كبسولة$^{-1}$.كما سجل موعد الزراعة **25**أيار أعلى طول للكبسولة بلغ **2.41**سم، في حين حقق صنف وداعة أعلى متوسط لطول الكبسولة بلغ **2.53**سم .وتفوق صنف سومر في وزن ألف بذرة بمتوسط **3.58**غم، وهو نفس المتوسط الذي تحقق عند موعد الزراعة **9**حزيران، بينما بلغ أعلى تداخل **3.94**غم لصنف سومر عند الزراعة في **25**أيار .كذلك حقق صنف سومر أعلى حاصل للبذور بلغ **13.53**غم نبات$^{-1}$، في حين سجل موعد الزراعة **10**أيار أعلى متوسط بلغ **13.76**غم نبات$^{-1}$.أما بالنسبة للحاصل الكلي، فقد سجل صنف سومر أعلى قيمة بلغت **1353.66**كغم هكتار$^{-1}$، في حين بلغ أعلى تداخل **1612.25**كغم هكتار$^{-1}$.

الكلمات المفتاحية :السمسم، مواعيد الزراعة، التراكيب الوراثية، النمو، الحاصل.

INTRODUCTION

Medicinal plants currently occupy a significant space in agricultural production. Recently, there has been a growing interest in expanding their cultivation and distribution due to their strategic importance in the pharmaceutical industry, stemming from their active compounds and antioxidants. This has led to increased industrial demand for large quantities of these plants, contributing to a rise in interest in their production in many parts of the world(Meena et al. 2010) , Sesame seeds *(Sesamum indicum* L.*)* are one of the most important oilseed crops belonging to the Pedaliaceae family. They are widely cultivated in tropical and subtropical regions around the world, and sesame seeds rank fourth among the major oil-producing crops globally (Mamatha et al. 2015) , Sesame seeds are characterized by their high nutritional value, as they contain a high percentage of oil ranging from 45% to 60%, protein at 20% to 25%, and carbohydrates that reach 15%. They also contain minerals at 5% to 7%, and are particularly rich in calcium and phosphorus, in addition to vitamins such as vitamin B12 (Musa, 2005), It is worth noting that the lack of precise planting dates is one of the most significant obstacles facing farmers cultivating sesame. This crop suffers from not having the necessary period for full growth and maturity before the rains. Planting date is one of the most important field practices affecting the germination, emergence, growth, development and maturity of the crop, as it is not chosen randomly, but is determined within a carefully studied agricultural program before the planting process is carried out , Sesame cultivation in Iraq faces numerous challenges that hinder its expansion, foremost among them the scarcity of improved varieties that are resistant to diseases and wilt while also possessing high productivity. This situation has prompted many researchers to study promising varieties that could positively impact growth characteristics and yield (Al-Sulagh, 2007) ,

Evaluate the effect of a group of sesame genotypes (varieties) and planting dates on the production of active compounds and (Reactive compounds) Determine the effect of the interaction between genotypes (varieties) and planting dates

MATERIALS AND METHODS:

A field study was conducted during the summer season of 2025 in Kirkuk Governorate, Hawija District, Shmeit Village. The aim was to study the effect of planting dates on the production of active compounds in several sesame genotypes. The land was plowed, leveled, and smoothed, and a Jordanian DAP fertilizer, also known as diammonium phosphate, containing 46% P2O2 and 18% N, was added. The land was divided into four replicates, totaling 60 experimental units. Each experimental unit measured 4 m² (2 x 2 m), with a distance of 1 m between replicates. Seeds were sown in rows in each experimental unit, with four rows spaced 40 cm apart and 25 cm between plants. Three to four seeds were sown per hole to ensure a germination rate, The plants were planted on the first date 10/may, the second date 25/may, and the third date 9/June, Crop service operations such as watering, thinning, and weed removal were carried out as needed. Before planting, random samples were taken to study some of the physical and chemical properties of the soil.

Study Factors:

The study includes two factors:

Factor 1: Three planting dates as follows:: 10 may, 2025, 25 may, 2025, 9 June, 2025

Factor 2: Five sesame seed varieties: Wadaa , Sumer , Rafidain , Had and Giza

Statistical analysis: The experiment was conducted using the RCBD factorial experiment with a split-plot design based on Duncan's multiple range test at a level of 5% with four replicates. The planting dates were in the main plots and the genotypes in the subplots. There were five experimental units per replicate, for a total of 60 experimental units.

Characteristics studied:

Five plants were randomly selected from the midlines after excluding the terminal lines from each experimental unit, and the following analyses were performed on them: Number of branches (branch plant $^{-1}$), Plant height (cm), Number of capsules in the plant (capsule plant^{-1}), Number of seeds in the capsule (seed capsule^{-1}), Capsule length (cm), Weight of 1000 seeds (g), plant Yield (g plant^{-1}), Total plant yield (kg ht^{-1})

RESULTS AND DISCUSSION

Number of branches (branch plant $^{-1}$)

The results of the statistical analysis of the planting dates (table1) showed that the average planting dates were significant, with the second planting date showing a delay of (7.19) branches per plant, while the third date had a lower average growth rate of (4.99) branch plant-1 ,this is due to quasi-periodic fluctuations that cause variations in the growth rate of the data, both seasonal and otherwise, a difference in the number of branches depending on the time, and this result is consistent with the findings of Elmi (2025) and Aroma et al. (2025), who reported significant differences in the number of branches between planting dates , The results in the same table show that plants with the Rafidain genotype outperformed other genotypes in this trait, recording the highest average of (6.86) branches per plant, while plants with the Wadaa genotype recorded the lowest average of (4.74) branches per plant the difference in the number of branches between the genotypes is attributed to differences in genetic nature and its ability to interact with environmental factors, which affects vegetative growth characteristics, including the number of branches. Alternatively, the genotype may have exploited environmental conditions more efficiently, leading to an increased number of branches per plant. This result aligns with the findings of Geserto et al. (2023) and Khattab and Al-Bayati (2023), who reported statistically significant differences between the genotypes in the number of branches. However, these results do not agree with those of Elmi (2025), who indicated no statistically significant differences between the genotypes in the number of branches , While the interaction between dates and genotypes did not record any significant differences in the trait of number of branches, these results did not agree with the results of (Debela et al. 2023), who indicated that there were significant interaction between dates and genotypes in this trait.

Table (1) The effect of planting date, genotypes and their interaction between them on the number of branches (branch.plant^{-1}).

Genotypes	**Planting dates**			**Genotypes Mean**
	10/May	**25/May**	**9/June**	
Wadaa	5.03 a	5.75 a	3.45 a	4.74 b
Sumer	5.21 a	7.85 a	5.50 a	6.18 a
Rafidain	7.70 a	7.30 a	5.60 a	6.86 a
Had	6.90 a	7.10 a	5.65 a	6.55 a
Giza	6.92 a	7.95 a	4.75 a	6.54 a
Means planting dates	**6.35 a**	**7.19 a**	**4.99 b**	

Different letters within the same row and column indicate significant differences at the 5% probability level and overlap between the two factors.

Plant height (cm)

The results in Table (2) show no significant differences in plant height between planting dates this finding contradicts the results of Elmi (2025), who found significant differences in this trait ,The data in the same table also shows no significant differences between genotypes in this trait. This finding contradicts the results of Al-Qaisi's (2025) study, which found statistically significant differences in this trait , The interaction between the two study factors, as shown in Table (2), resulted in significant differences in plant height. The greatest increase was observed in plants with the Rafdain genotype, which were planted at the first planting date, with an average height of 157.42 cm. Conversely, plants with the Giza genotype, which were planted at the second planting date, showed the lowest average height of 117.35 cm. This result is consistent with the findings of Sabikunnahar et al. (2025) and Ali et al. (2025), who indicated statistically significant differences between the interaction factors in plant height.

Table (2): The effect of Planting Date, genotypes and Their Interaction on Plant Height

Genotypes	Planting dates			Genotypes Mean
	10/May	25/May	9/June	
Wadaa	128.90 bc	132.09 bc	137.02 bc	132.67 a
Sumer	135.75 bc	132.10 bc	128.80 bc	135.06 a
Rafidain	157.42 a	140.65 ab	138.65 b	140.64 a
Had	135.22 bc	125.85 bc	133.70 bc	128.75 a
Giza	139.35 b	117.35 c	128.55 bc	135.21 a
Means planting dates	**139.33 a**	**137.75 b**	**133.34 a**	

Number of capsules in the plant (capsule.plant^{-1})

The results of the statistical analysis showed in Table (3) that the plants grown on the dates (10/May) and (25/May) are superior in terms of the number of capsules per plant compared to the average of this trait for plants grown on the date (9/June), The average of this trait reached (251.68, 225.87, and 168.16 **capsule.plant^{-1}** respectively) the superiority of the average of capsules for plants grown on the planting dates (10/5 and 25/5) is attributed to the suitability of the environmental temperatures for capsule production, this result is consistent with the results of the studies of the researchers (Sabikunnahar et al., 2025) regarding the improvement in the average of this trait for plants grown or growing when the temperatures necessary for production are suitable, while the results of the studies of the researchers (Ali et al., 2025) indicated that this trait is not affected by the planting date , the results of the statistical analysis of Table (3) showed the superiority of the three varieties (Sumer, Rafidain, and Giza) in the average of this trait over the variety (Wadaa), and the average of this trait reached (166.80, 258.72, 223.51, and 221.41 **capsule.plant^{-1}**) respectively, the reason is attributed to the fact that the above genetic structures, except for the Wadaa genotypes, are among the genotypes that exploited the environmental conditions well, which led to an increase in the products of carbon metabolism, which led to an increase in the number of capsules. These results were consistent with the results of the studies of the researchers (Al-Rifai(2018)) and Al-Jumaili,(2019), who indicated the differences between the varieties, As is evident in Table. (3), the Sumer variety with the planting date (10/5) achieved the highest value reached 304.9 capsules.plant^{-1}, while the third date and the variety Wadaa gave the lowest value of interaction with an average of 112.75 capsules.plant^{-1} ,this result agreed with Ali et al.,(2025) agreed with this result, while other studies indicated that there was no effect of interaction between the planting date and the variety on the rate of this trait (Ibrahim, 2016) .

Table (3): The effect of planting date genotypes and interaction between them on the number of capsules trait in the plant.

Genotypes	Planting dates			Genotypes Mean
	10/May	25/May	9/June	
Wadaa	213.12 cde	174.55 efg	112.75 g	166.80 c
Sumer	304.93 a	286.2 ab	185.07 def	258.72 a
Rafidain	236.05 a-e	214.3 b-e	220.2 b-e	223.51 ab
Had	251.75 a-d	174.13 efg	191.3 def	205.72 b
Giza	252.6 a-d	280.17 abc	131.5 fg	221.42 ab
Means planting dates	**251.68 a**	**225.87 a**	**168.16 b**	

Number of seeds in the capsule (seed capsule^{-1})

Table (4) shows there is no significant differences between planting dates in the number of seeds per capsule trait,Table (4) also shows highly significant differences between sesame genotypes in this trait. The result needs to be rewritten as the Giza variety is superior and significantly different from the other varieties, while the Rafidain variety recorded the lowest value , This variation may be attributed to inherent genetic differences between the varieties. A study by Tana et al. (2017) on peanuts found that the number of seeds per pod varies between varieties. The researchers concluded that the number of seeds is primarily influenced by genetic factors and not by agricultural practices. This result is consistent with the findings of Elmi (2025) and Al-Qaisi (2025), who found significant differences in the number of seeds per capsule trait, Regarding the interaction between the study ,the interaction between planting dates and genotypes had a significant effect, with the second planting date and the Giza genotype resulting in the highest seeds number (63.28 seed ***capsule^{-1}***), while the interaction between the second planting date and the Had genotype resulted in the lowest seed-per-cap (47.22 seed ***capsule^{-1}***), These results are consistent with those of Elimi (2025) and Ali et al. (2025), who found a significant difference between the interaction coefficients for this trait.

Table (4): shows the effect of planting date, genotypes and their interaction on the number of seeds per capsule.

Genotypes	Planting dates			Genotypes Mean
	10/May	25/May	9/June	
Wadaa	51.97 d-f	59.15 ab	55.85 b-e	55.65 b
Sumer	57.62 a-d	58.10 a-d	49.75 ef	55.15 b
Rafidain	51.95 c-f	49.42 ef	50.33 ef	50.57 c
Had	58.80 abc	47.22 f	55.26 b-e	53.76 bc
Giza	57.75 a-d	63.28 a	58.92 ab	59.98 a
Means planting dates	**55.62 a**	**55.43 a**	**54.02 a**	

Capsule length (cm)

As shown in Table (5), plants planted at the second date recorded the highest average capsule length of 2.41 cm, while plants planted at the third planting date recorded the lowest average for this trait of 2.30 cm. This may be attributed to the fact that the climatic factors affecting growth coincided with the sesame's developmental stages at this planting date, resulting in statistically significant differences in capsule length. This result is consistent with the findings of Ali et al. (2025), who indicated significant differences between planting dates in capsule length, The statistical analysis results in Table (5) indicate significant differences between the genotypes. Plants with the "Wadaa" genotype recorded the highest average capsule length at 2.53 cm, while plants with the "Had" genotype recorded the lowest average at 2.26 cm. This difference is attributed to the strength of the genes possessed by the variety, which interact with environmental temperature ,This result aligns with the findings of Al-Qaisi (2025), who reported significant differences between genotypes (varieties) in capsule length ,The data in the same table showed no significant differences in capsule length when considering the interaction between planting date and genotype.

Table (5) Effect of planting date, genotypes and interaction between them on capsule length trait.

Genotypes	Planting dates			Genotypes Mean
	10/May	25/May	9/June	
Wadaa	2.49 a	2.76 a	2.35 a	2.53 a
Sumer	2.37 a	2.27 a	2.25 a	2.29 bc
Rafidain	2.41 a	2.41 a	2.42 a	2.41 ab
Had	2.29 a	2.25 a	2.25 a	2.26 c
Giza	2.35 a	2.39 a	2.23 a	2.32 bc
Means planting dates	**2.38 ab**	**2.41 a**	**2.30 b**	

Weight of 1000 seeds (grams)

As shown in Table (6), plants planted on 9/June, recording the highest average for the trait at 3.58 g plant-1 It was no different in substance from the plants planted on 25/May compared to plants planted on 10/May , which recorded the lowest average for this trait at 3.11 g/plant-1. This is attributed to the fact that crops planted on this date experienced a suitable growth period under more favorable environmental conditions, which likely contributed to heavier seed growth compared to crops planted earlier. This result is consistent with the findings of Adhikary et al. (2021), who found a significant difference between planting dates in the weight of 1000 seeds, The genotypes also showed significant differences in the 1000-seed weight trait. Sumer genotype recorded the highest average weight for this trait at 3.58 g , compared to the Giza genotype, which recorded the lowest average weight at 3.20 g ,this can be attributed to the genetic characteristics of the variety and its ability to convert the largest possible amount of nutrients and materials needed by the plant from their production sites to storage sites, which are represented by the seeds. This result is consistent with the findings of the researchers Al-Jumaili, (2019), who found significant differences between varieties in 1000-seed weight, Regarding the interaction between the two factors for the 1000-seed trait, plants with the Sumer genotype planted at the second planting date recorded the highest average interaction between planting date and genotype, reaching 3.94 g , while plants with the Had genotype planted at the first planting date recorded the lowest average, at 3.01 g these findings are consistent with the results of studies by Sabikunnahar et al. (2025), who found statistically significant differences in the interaction factors for the trait.

Table(6): shows the effect of planting date, genotypes and their interaction on the 1000-seed weight trait.

Genotypes	Planting dates			Genotypes Mean
	10/May	25/May	9/June	
Wadaa	3.10 d	3.59 abc	3.79 ab	3.49 ab
Sumer	3.06 d	3.94 a	3.73 ab	3.58 a
Rafidain	3.29 cd	3.65 abc	3.59 abc	3.51 ab
Had	3.01 d	3.24 cd	3.64 abc	3.30 bc
Giza	3.08 d	3.38 bcd	3.14 d	3.20 c
Means planting dates	**3.11 b**	**3.56 a**	**3.58 a**	

plant Yield (g plant^{-1})

Table (7) shows significant differences between the planting dates. The first date recorded the highest average yield per plant, at 13.76 *g.plant*$^{-1}$, which did not differ significantly from the second date, with an average of 12.08 *g.plant*$^{-1}$. The third date recorded the lowest average yield for this trait, at 9.69 *g.plant*$^{-1}$ This may be due to the first date's result in the number of capsules per plant. This result is consistent with the findings of the researchers (Qaddafi, 2024), who indicated significant Table (7) data showed differences between sesame genotypes in the trait. Sumer genotype recorded the highest average yield of the trait at 13.53 *g.plant*$^{-1}$, Wadaa genotype achieved the lowest average yield at 10.48 *g.plant*$^{-1}$,these differences in sesame seed yield may be attributed to variations in adaptability and genetic potential of the varieties under the soil and climatic conditions of the study area. This result is consistent with the findings of Nasreen, (2023) , who indicated statistically significant differences between genotypes in the trait of plant yield , Regarding the interaction, the same table shows that plants with the Sumer genotype planted at the first planting date recorded the highest average interaction between the two factors for this trait, reaching 16.12 *g.plant*$^{-1}$, while plants with the Wadaa genotype planted at the third planting date recorded the lowest average, at 6.68 *g.plant*$^{-1}$,this result is consistent with the findings of Mondal et al. (2022).

Table(7): Effect of Planting Date, genotypes and Interaction Between Them on Individual Plant Yield.

Genotypes	Planting dates			Genotypes Mean
	10/May	25/May	9/June	
Wadaa	13.58 abc	11.19 b-f	6.68 g	10.48 c
Sumer	16.12 a	14.79 ab	9.69 d-g	13.53 a
Rafidain	12.57 a-e	11.67 b-e	13.19 a-d	12.48 ab
Had	13.29 a-d	9.06 efg	10.98 c-f	11.11 bc
Giza	13.26 a-d	13.68 abc	7.91 fg	11.62 abc
Means planting dates	**13.76 a**	**12.08 a**	**9.69 b**	

Total plant yield (kg.ht^{-1})

It is observed from the data in Table (8) that there are significant differences between the three planting dates in the total seed yield. the planting date 10/May achieved the highest average for the trait, reaching 1376.75 kg.ha-1, while the planting date 9/June recorded the lowest average for, reaching 969.25 kg.ha-1. The reason is due to the superiority of the first date in recording the highest average for the plant yield trait. This result is consistent with the results of (Gebremedhin and Hailu 2017), who reported that early planting greatly enhanced the sesame seed yield, while late planting reduced the seed yield due to the shortening of the vegetative and reproductive stages, The results in Table (8) indicated significant effects between plants of the genetic compositions. genotype recorded the highest average for the trait of total seed yield, reaching 1353.66 kg.ha-1, while plants of the

Wadaa genotype recorded the lowest average for the trait, reaching 1048.58 kg.ha-1. The reason is due to the superiority of the Sumer genotype in the trait of individual seed yield. This result was consistent with what was obtained by Al-Rifai,(2018) ,who indicated that there were significant differences between the varieties in the trait of total seed yield , Regarding the interaction, the same table shows that plants with the Sumer genotype planted at the first planting date recorded the highest average, reaching 1612.25 kg ha^{-1}, while plants with the Wadaa genotype planted at the third planting date recorded the lowest average interaction between the two factors for this trait, reaching 668.58 kg ha^{-1}. This result is consistent with the findings of Elimi (2025), who observed Significant difference when these two factors interact in the total seed yield

Table(8): Effect of Planting Date, genotypes and Interaction Between Them on Total Yield Trait (kg ha^{-1}).

Genotypes	Planting dates			Genotypes Mean
	10/May	**25/May**	**9/June**	
Wadaa	1358.5 abc	1119.0 b-f	668.25 g	1048.58 c
Sumer	1612.25 a	1479.0 ab	969.75 d-g	1353.66 a
Rafidain	1257.75 a-e	1167.5 b-e	1319.0 a-d	1248.08 ab
Had	1329.0 a-d	906.0 efg	1098.0 c-f	1111.0 bc
Giza	1326.25 a-d	1368.75 abc	791.25 fg	1162.08 abc
Means planting dates	**1376.75 a**	**1208.05 a**	**969.25 b**	

CONCLUSIONS

Crop yield was clearly influenced by planting date and variety. The Sumer variety achieved the best performance in most yield traits, recording the highest seed yield per plant (13.53 g), total yield (1353.66 kg/ha), and 1000-seed weight (3.58 g), the May 10 planting date was optimal for productivity, giving the highest seed yield per plant (13.76 g) and number of capsules (251.68), The interaction between this date and the Sumer variety produced the highest total yield (1612.25 kg/ha), Overall, selecting a suitable variety with an early planting date significantly improves crop yield.

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