Estimation of The Combining Ability and The Gene Action for Several of Genotypes for Flax (*Linum usitatissimum* L.)

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Abstract. In this study, eight Flax genotypes (*Linum usitatissimum* L.) and their half diallel crosses were used to estimate the combining ability and its general and specific effects for parents. The parents planted their twenty-eight hybrids at the research station of the Field Crops Department of the College of Agriculture - Tikrit University in the 2019-2020 season. In mid-November, the complete random sector design was used with three replications. to study the traits the duration to 50% flowering, plant height, number of vegetative branches, number of plant capsules, number of seeds per capsule, seeds yield by plant and weight 1000 seeds, average leaf weight, biological yield, leaf percentage, seed yield, and harvest index. The results showed by analyzing the second method of Griffing (b1956), the static model, That the percentage between the components of the combining ability general to the specific was greater than the correct one in the traits, duration to 50% flowering, plant height, duration to maturity, number of seeds per capsule, number of capsules per plant, weight of 1000 seeds and average weight of leaves, while the percentage was less than the correct one in the traits of the number of vegetative branches. Plant seed yield, leaf percentage, biological yield, seed yield, harvest index and that the best parents were significantly desirable due to the effect of their general combining ability to mix the parent (Sakha 2) and the traits of the number of vegetative branches, the number of capsules per plant, the seed yield per plant, the average leaf weight, the total seed yield, and the parent (Giza 8) for plant height, number of capsules per plant, average leaf weight, biological yield, and total seed yield and that the highest hybrids were significantly desirable for the effects of the special combining ability in the hybrid (Sakha 2 × Syrian), the trait of the number of capsules per plant, the number of seeds per capsule, the weight of 1000 seeds, the yield of seeds per plant, the total seed yield and the harvest index, The values of the dominant genetic variance were higher than the additional genetic variance in all traits except for plant height, duration to maturity, and number of seeds per plant, indicating the importance of the dominant gene action in controlling these traits. The values of the broad sense heritability were high in traits, duration to 50% flowering, number of capsules by plants, yield of seeds by plants, weight of 1000 seeds, seed yield and harvest index. The average for the traits was plant height, duration to maturity, average leaf weight and biological yield, and a narrow sense heritability was the average for the traits of the duration to 50% flowering, plant height, duration to maturity, number of capsules per plant, weight of 1000 seeds, average leaf weight. Regarding the average of the degree of dominance, it is noted that the duration to 50% flowering, plant height, number of capsules per plant, weight of 1000 seeds, average leaf weight, biological yield, seed yield, harvest index and the number of capsules per plant were the most desirable traits for the degree of dominance.
lowering, the number of capsules by the plant, the yield of the seeds by the plant, the weight of 1000 seeds, the average leaf weight, the biological yield, the percentage of the leaves, the seed yield and the harvest index, were greater than the correct one, which indicates the existence of suppression segregates with the importance of the Dominant gene action. When estimating the genetic improvement as a percentage of the general average for each traits, it becomes clear that it was low for to most the studied traits except for the number of capsules in the plant. It was average.

1. Introduction
Flax or Linsseed is one of the oldest plant crops known to Human and has been cultivated since ancient times to take advantage of oil or fiber or both. Which consists of 13 genera and 300 species [1], its scientific name is \((\text{Linum usitatissimum})\) L.). Canada leads the world, followed by China, India, America, Ethiopia and Egypt at (34, 25.5, 9.8, 3.5 and 2.2%), respectively, of global production, and there are other countries whose production is less than that [2]. In Iraq, the cultivated areas in this crop are almost non-existent, for many reasons, the most important of which is the focus on producing strategic winter crops, the lack of interest of specialists in the productivity of this crop and the absence of specialized factories to extract oil and fiber from it. Given its industrial and medicinal importance, it is necessary to take care of this crop and make the necessary improvements in agricultural technology. This is achieved by working on the development for cultivars that are characterized by high productivity and the continued development and introduction of new genotypes that can be adopted in agriculture with the aim of any of them being an alternative to the cultivar that may deteriorate due to continuing to cultivate it for several seasons. Where, the phenotypic differences resulting from the genetic differences between taxa or between genotypes may decrease or increase significantly under the influence of environmental factors. Also, the phenotypic shape is determined by the participation of two factors, namely the genetic factor and the environmental factor. Therefore, the combined effect of these two factors is the most important determinant factor for selecting the desired genotypes and thus their effect on the behavior of the plant is what determines the success of its cultivation one area without the other. In addition, the non-excelled genotypes can be preserved to benefit from its stock of the gene for other new traits in the high-yield trait where it can be entered into the hybridization program, including the diallel cross, including the second method (Half Diallel), and then obtain new consortia and benefit from the phenomenon Hybrid strength and knowledge of the genetic action that controls the most important of these traits (seed yield and its components) as well as early ripening, oil yield and other qualitative traits. In this regard, [3] obtained in their study of the combining ability of ten genotypes in flax, that the ratio of the variance component of the general to specific combining ability is greater than the correct one, and this means the importance of the additional gene action in the genetics of all the seeds and the traits of their components. [4] obtained upon genetic analysis of Half Diallel between ten linseed genotypes that there is a high significant variance at the 1% level for the general and special combining ability of the traits of the number of vegetative branches, the number of capsules per plant, and the number of seeds per capsule. [5] indicated that the heritability value in the broad sense of the first season was high for the trait of plant height, duration to 50% flowering, and the number of capsules per plant, while the Broad sense heritability values were high in the second season for the traits, number of vegetative branches and number of seeds per capsule and [6] showed when Broad sense heritability in Flax, it was high for four traits, duration to 50% flowering, number of main branches of the plant, number of capsules per plant, and a weight of 1000 seeds. [7] obtained that the expected genetic Improvement values are a percentage of the general average of the trait between high plant height, number of capsules per plant, number of vegetative branches, seed yield, and average trait for the number of seeds per capsule, low for the duration to 50% flowering, days to maturity, and 1000 seed weight. [8], when conducting half diallel crossing between six cultivars of flax, concluded that the dominance was excelled to all traits studied in the first generation except for the trait of
the number of vegetative branches and the number of capsules per plant. The current study aims to estimate the general combining ability for parental cultivars and the special combining ability for half diallel crosses resulting from it to estimate the Gene Action and includes the phenotypic variance (additive, dominance and environment). The average of dominance degree and heritability in the broad and narrow sense and the expected genetic improvement as a percentage to determine the best parents as well as the excelled cross-combinations that can be used as useful genetic resources in the flax breeding and improvement programs.

2. Materials and Methods

In this study eight genotype from flax was used, Six genotypes, including an introduction and their source, are from the Arab Republic of Egypt, Cairo University, College of Agriculture, Department of Field Crops, and two cultivars from Iraqi Kurdistan, College of Agriculture, Salah Al-Din University. and its details are shown in Table (1). In the first agricultural season (2018-2019) and at the start of flowering, all possible crosses were made between them without the reciprocal hybrids according to the second curving method. Upon maturity, the plants were harvested and the seeds of the first generation were obtained for those half diallel crossing of twenty-eight hybrids. The seeds were dispersed from the capsules and preserved for cultivating in the next season. The parents were cultivated and their twenty-eight hybrids obtained in the first season (2019-2020) in mid-November after the land was prepared and the land was divided using a Randomized Complete Block Design with three replicates each replicate contained thirty-six lines, each the length of each of them is two meters (each line for one genotype) and twenty plants were planted in each line with a distance of (10 cm) between one plant and another, and (40 cm) between one line and another. The genotypes were distributed on the lines in a random method. All the necessary operations were conducted from the soil and crop service. From germination, growth and maturity during the growing season (2019-2020) to full maturity in the first week of June for the season 2020 according to the recommendations, the study was conducted on (10) plants randomly taken from each line and for each genotype, where the study included the following traits:

2.1. Plant height (cm.Plant⁻¹): The height was measured in centimeters from the base to the end of the main stem (the plant top) in the stage of maturity and its average was recorded.

2.2. Duration to 50% flowering (day): The number of days was recorded from the date of the first irrigation until 50% of the plants of the experimental unit flowered.

2.3. Duration to maturity (day): The number of days was recorded from the first irrigation until the physiological maturity of the plants of the experimental unit.

2.4. Number of vegetative branches (branch. plant⁻¹): The number of branches was counted from the base of the main stem of each plant and their average was recorded.

2.5. Number of capsules (capsule.plant⁻¹): The total number of capsules was calculated from ten randomly selected plants for each experimental unit and the average value was obtained.

2.6. The number of seeds (seedCapsule⁻¹): The total number of seeds was calculated in ten randomly selected capsules for each of the ten plants that were randomly assigned from each experimental unit and their average was calculated.

2.7. Seed yield (g.Plant⁻¹): The individual plant yield was recorded by weighing the seeds of each plant from ten randomly selected plants after the lesson and calculating their average.
2.8. Weight 1000 seeds (g): 1000 seeds were weighed in grams using a sensitive scale after seeds were taken randomly from each plant.

2.9. Average leaf weight (g): The weight of the dry leaves, after sun drying, was recorded for ten plants that were randomly taken in the stage of physiological maturity, and then the average value was calculated.

2.10. Biological yield (g): represents (weight of dry matter). Ten dried plants were weighed randomly on the sun, and then the average weight of each plant was calculated (g).

2.11. Leaf percentage (%): It was measured from the dry leaf weight / dry matter weight at harvest to obtain the average value as a percentage.

2.12. Seed yield (kg.ha⁻¹): The yield per hectare of seeds was estimated according to the following equation:

\[
\text{Seed yield (Kg.ha}^{-1}\text{)} = \frac{\text{Individual plant yield} \times 10g}{\text{The area occupied by the plant}}
\]  

2.13. Harvest index = \( \frac{\text{seed yield per plant (g)}}{\text{biological yield (g)}} \times 100 \)

The (SAS) program was used to conduct statistical and genetic analyzes, the statistical analysis was performed according to the design used to knowing the differences between the genotypes. The data obtained from the parents and the diallel cross between them were analyzed according to the second method, the fixed model proposed by [9] and the effects and variances of the effect of the general and special combining ability were estimated and its significance tested. Additional genetic variance (2A) and dominant genetic variance (2D), as well as environmental variance (2E), were estimated by components of expected EMS variance and according to the fixed model.

| Cultivars number | Cultivars Name | Lineages | Source | Origin |
|------------------|----------------|----------|--------|--------|
| 1                | Sakha 1        | I.1485 x Bombay | College of Agriculture - Cairo University | Egyptian |
| 2                | Sakha 2        | Hera × 1.123 | College of Agriculture - Cairo University | Egyptian |
| 3                | Sakha 3        | (Belinka (2E) × 1.2096) | College of Agriculture - Cairo University | Egyptian |
| 4                | Sakha 5        | (Belinka (R3) ×1.2569) | College of Agriculture - Cairo University | Egyptian |
| 5                | Sakha 6        | S.420 x bombay (I. USA) | College of Agriculture - Cairo University | Egyptian |
| 6                | Giza 8         | (Giza6 × Senta Catalina) | College of Agriculture - Cairo University | Egyptian |
| 7                | Syrian local   | Imported   | College of Agriculture - University of Salahaddin | Syrian |
| 8                | Thorshansity 72 | Imported   | College of Agriculture - University of Salahaddin | Poloni |

3. Results and discussion

It is noticed from the results of the analysis of variance shown in Table (2) that the genotypes were significant at the level of probability (1%) for the duration to 50% flowering, plant height, number of capsules per plant, seed yield per plant, weight of 1000 seeds, total seed yield and harvest index, As for the duration to maturity, number of seeds per capsule, average leaf weight, biological yield, and leaf
percentage, it did not reach the significant limits. Parents were significant at a probability level (1%) for the traits, duration to 50% flowering, plant height, duration to maturity, number of capsules per plant. The 1000 seed weight and leaf percentage, and the significant at a probability level (5%) in the trait of average leaf weight and biological yield, but it did not reach the limits of significant in the rest of the studied traits. As for the hybrids, it was significant at the level of probability (1%) for the traits of duration to 50% flowering, the number of capsules on the plant, the yield of seeds by the plant, the weight of 1000 seeds, the yield of seeds, and the evidence of harvest. The probability level (1%) in the traits of the number of vegetative branches, the seed yield of the plant, the biological yield, the total seed yield, and the harvest index, While it was significant at the level of probability (5%) for the duration trait to 50% flowering and the significance limits did not reach the other traits under study, the significance of the differences between the genotypes is important for their indications of the presence of genetic differences and this requires continuing to study the genetic variation between these genotypes and studying the excelled ones in order to benefit directly from it or to enter it in a Hybridization program with other genotypes or Hybrid to transfer the desired genes. From the same table, it is noticed that the percentage between the General combining ability to the specific combining ability was greater than the correct one in the traits, duration to 50% flowering, plant height, duration to maturity, number of capsules per plant, number of seeds per capsule, the weight of 1000 seeds and average leaf weight and This results from an increase in the percentage of the components of the variation of the general ability of it, which indicates that the additional gene action is the most important in controlling the inheritance of these traits and thus can be improved by analyzing correlation coefficient and path analysis between yield and its components. These results are in line with similar results as reached by [8]; [10]. While the percentage was less than the correct one in the trait of the number of vegetative branches, the yield of seeds by the plant, the biological yield, the percentage of leaves, the seed yield and the harvest index, and This indicates that the non-additive gene action was more important than the additive effects of multiple genes on these traits and thus can be improved through Hybridization, and this is in line with [11]; [12]. In order to evaluate the parents genetically, the effects of the general combining ability of the parent's genotypes shown in (Table 3) were estimated, where the effect of the general ability to combine for the trait of duration to flowering was 50% significant at a probability level (1%) and with the desired direction of the parent (1) while it was significant and in the same direction at the level of (5%) the probability of parent (6), while the parent (3) showed a significant effect at the level of (1%) and in the undesirable direction and the parent (8) at the level of (5%) . As for the rest of the parent, it was negative and positive, but it was not statistically significant, and for the trait of plant height we find that the parent (7) gave a positive and significant value at a probability level (1%) for the effect of the general combining ability, Also a negative and significant influence, while the parent(8) was negative and significant for the level of probability (5%). As for the rest of the parent, it gave positive, negative and insignificant values for this traits, As for the rest of the parents, it was negative and positive, but it was not statistically significant, and for the trait of plant height, we find that the parent (7) gave a positive and significant value at a probability level (1%) for the effect of the general combining ability, while the same probability level gave the parent (3) also Negative and significant influence, While the parent (8) was negative and significant for the level of probability (5%), as for the rest of the parents, it gave positive, negative and insignificant values for this trait, The effect of the general ability to union was positive and significant for the level of probability (1%) for the trait of the duration to maturity for the parent (3), while the parent (1) and (2) showed a negative and significant effect at the level of probability (5%), while the rest of the parents were not significant. A significant statistic towards the duration to maturity, For the trait of the number of vegetative branches, parent (2) showed a positive and significant effect at the level of probability (5%), while the parent (7) showed a negative effect, significantly and at the same level, but in the unwanted direction, For the description of the number of capsules per plant, we note that the parents whose effect on the general combining ability
was significant and in the desired direction (1), (2) and (8), In the unwanted direction of parent (3) and (4) and (5) and at the level of probability (1%), while parents (6) and (7) did not achieve the level of significance, and from the same table we note that parent (7) and (4) is in the quality of the number of seeds in the capsule The effect of the general ability to union was significant and desirable at the level of probability (5%), while the parents (3) and (6) showed a significant effect in an unwanted direction for the same probability level. As for the trait of the seed yield of the plant, it was significant and desirable at the level of probability (5%) for the parent (2), while the parent (3) achieved an unwanted negative significant effect, while the rest of the parents had a negative and positive effect, but it did not reach the limits of significant. The trait of the weight of 1000 seeds, we
### Table 2. Estimation of the analysis of variance for the general and specific combining ability of by analyzing the second method of Griffing, the static model.

| Source of variation (S.O.V) | Degrees of freedom | Plant height (cm. Plant⁻¹) | Number of branches (branch. plant⁻¹) | Number of capsules (capsule. plant⁻¹) | Weight 1000 seeds (g) | Seed yield (kg. Plant⁻¹) |
|-----------------------------|--------------------|-----------------------------|--------------------------------------|----------------------------------------|------------------------|-----------------------------|
| Blocks                      | 2                  | 118.02                      | 1.51                                 | 7.12                                  | 87.72                  | 75067.60                    |
| Genotypes                  | 35                 | n.s. 0.24                   | n.s. 0.84                            | n.s. 0.22                             | n.s. 12.39             | n.s. 21.84                  |
| Parents                    | 7                  | n.s. 0.32                   | 3.67                                 | n.s. 0.32                             | n.s. 19.08             | n.s. 46.12                  |
| Crosses                    | 27                 | n.s. 0.19                   | **31.48**                            | **3.16**                              | **6.31**               | **19960.68**                |
| P vs F1                     | 1                  | n.s. 0.19                   | **3.16**                             | **6.31**                              | **19960.68**           | **19960.68**                |
| Error                       | 70                 | 0.17                        | **4.40**                             | 0.12                                  | 18.12                  | **41188.56**                |
| The variance of General     |                    | **120.43**                  | **25.91**                            | 13.36                                 | 22.78                  | **89039.59**                |
| The variance of specific    |                    | **52.39**                   | **25.91**                            | **13.36**                             | **22.78**              | **89039.59**                |
| The percentage of the       |                    | **2.30**                    | **3.86**                             | **3.22**                              | **0.65**               | **0.50**                    |
| variance of General and     |                    |                            |                                      |                                       |                        |                             |
| specific combining ability  |                    |                            |                                      |                                       |                        |                             |
| components (SCA)            |                    |                            |                                      |                                       |                        |                             |
| The fixed model of the      |                    |                            |                                      |                                       |                        |                             |
| studied traits (***) and (*) were significant at a probability level of 1% and 5%, respectively, and (n.s.) were not significant.

### Table 3. Estimating the effects of the general combining ability for each parent of the studied traits.

| Parental genotypes | Duration to 50% flowering (day) | Plant height (cm. Plant⁻¹) | Duration to maturity (day) | Number of branches (branch. plant⁻¹) | Number of capsules (capsule. plant⁻¹) | The number of seeds (seed. Capsule⁻¹) | Seed yield (g. Plant⁻¹) | Weight 1000 seeds (g) | Average leaf weight (g) | Biological yield (g) | Leaf percentage (%) | Seed yield (kg. ha⁻¹) | Harvest index (%) |
|--------------------|----------------------------------|-----------------------------|-----------------------------|---------------------------------------|----------------------------------------|----------------------------------------|--------------------------|------------------------|------------------------|-----------------------|---------------------|----------------------|---------------------|
| 1                  | **2.74**                         | -0.61                       | -0.06                       | **0.07**                              | -0.03                                 | 0.03                                   | -0.06                    | 0.02                   | -0.29                  | 0.45                 | 7.10                 | 0.33                 |
| 2                  | -1.10                            | 0.27                        | -1.25                       | **0.11**                              | **5.77**                               | 0.16                                   | **0.19**                 | 0.16                   | **0.03**               | 0.33                 | **41.85**            | 0.90                 |
| 3                  | **3.85**                         | -1.00                       | -0.03                       | **2.47**                              | **0.20**                               | **0.15**                               | **0.03**                 | **0.09**               | 0.12                   | **0.14**             | 0.84                 | **49.89**            | 0.74                 |
| 4                  | **0.40**                         | 0.12                        | 0.07                        | **3.18**                              | **0.15**                               | **0.15**                               | **0.09**                 | 0.09                   | -0.08                  | **0.09**             | **18.02**            | **0.97**             |
| 5                  | -0.94                            | 0.32                        | -0.28                       | **5.90**                              | -0.12                                 | **0.24**                               | -0.09                    | **0.09**               | -0.08                  | **0.36**             | **2.02**             | **3.02**             |
| 6                  | **2.14**                         | 0.55                        | 0.11                        | -1.56                                 | **0.22**                               | -0.13                                 | **0.24**                 | -0.03                  | -0.60                  | **3.27**             | **0.62**             |                     |
| 7                  | **2.14**                         | 0.55                        | 0.11                        | -1.56                                 | **0.22**                               | -0.13                                 | **0.24**                 | -0.03                  | -0.60                  | **3.27**             | **0.62**             |                     |
| 8                  | **1.19**                         | **1.55**                    | -0.51                       | **7.11**                              | -0.03                                 | -0.32                                 | 0.04                     | 0.08                   | 0.35                   | -14.06               | -0.18                |                     |

Standard error: S.E.(g)
find that there is an effect of the general combining ability, which was positive and significant in the desired direction of the parents (4) and (5) at the probability level (1%) and the parent (6) at the probability level of the probability level (5%). While the parents (3), (7) and (8) gave negative and significant values in the unwanted direction, as for the rest of the parent for this trait, they did not reach the level of significance. Where, parent (2) gave the value of a positive significant effect on the general ability to unite at a probability level of (5%). While parent (3) and (5) gave a negative and significant value at the level of probability (5%), and from the same table, we note parent (7) in the trait of the biological yield, it had a positive and significant effect at the level of probability (5%) and had a negative and an unwanted negative effect with the same The level of statistical significance for the parent (3), as for the rest of the parent, it did not reach a significant level, and in the trait of the percentage of leaves, the parent (5) gave a negative and significant value in an unwanted direction at the probability level (1%), but the rest of the parent did not reach the significant limits for this trait, and we note that each of the parent (2), (4) and (7) In the trait of the seed yield, it had a positive and significant effect and in the desired direction at a probability level (1%) for the general ability to combine, While the parent (3) showed a negative and significant influence with the same level of probability, while parents (5) and (6) showed a negative significant and undesirable effect at a probability level (5%), and in the trait of the harvest index, the parent (4) was distinguished by a positive, desired and negative value, and in the direction Unwanted for parent (5) had a probability level (5%). As for the rest of the parents, they were positive and negative, but they were not statistically significant.

Table (4) shows the estimation of the effects of the special combining ability for a single hybrid for the traits under study. As plant breeders aim to devise more early genotypes for flowers to obtain fertilization and complete pollination under suitable environmental conditions, it is noticed from the results of the effects of the special ability to combine for the trait of the duration to 50% flowering, and we find the hybrid (5 × 7) that was excelled by giving it the highest negative and significant effect and in the desired direction at a probability level (1%) that reached (-11.55). This means that the above hybrid showed earlier. For flowering for the duration to 50% flowering, followed by the hybrid (1 × 4) with a probability level (5%), As for the hybrids (1 × 7) and (2 × 6), they gave a significant effect in the direction of the unwanted effect of the flowering time at the probability level (1%) and the hybrids (1 × 3) at the probability level (5%). It is noticed that the rest of the hybrids did not reach the level of significance. From the foregoing, we find that the hybrid (5 × 7) had a special combining ability and was distinguished by the Heterosis, morally and in the desired direction according to the two concepts and that the hybrid (1 × 4) was the parent (1) have the negative general combining ability towards early flowering and showed a significant effect of the special ability to mix and at the same time showed the significance Heterosis of the hybrid, it can be recommended for these hybrids in Heterosis breeding and for the plant height trait, the combining ability showed a positive and significant effect, with a probability level of (5%) for hybrids (1 × 4), (3 × 5) and (6 × 8), while the hybrids (4 × 8) and (6 × 7) were negative significance at the probability level (5%), while the rest of the hybrids did not reach the significance limits. From (Table 3), we note that the strength of the hybrid was positive and significant compared to the mean of the two parents for the two hybrids (1 × 4) and (3 × 5), and it was negative, positive and insignificant compared to the best parents, and high significance compared to the average of the two parents for the hybrid (3 × 5). These fathers had positive and negative effects on the general combining ability, except for the parents (3) who was significant at the level of (5%) and in the desired direction. The presence of additional effects of the genes that control plant height, The hybrid (6 × 8) showed negative and significant hybrid strength for the best parents, and the parent (8) had a general significance combining ability in the same direction, and this is an indication that this hybrid can be used in the breeding programs for the strength of the hybrid according to the direction of the plant breeder. As for the other hybrids that showed negative or positive
hybrid strength and the special combining ability was not significant, although it corresponds in the same direction, it is possible to produce excelled genotypes from it through the later isolated generations, provided that one of their parents has a general combining ability in the same direction. and for the trait of the duration to maturity, the hybrid (2 × 5) showed a special, positive, and significant combining ability is desirable, while the hybrid (7 × 1) and (3 × 8) showed a negative significant effect and in an unwanted direction at a probability level of (5%). While the rest of the hybrids did not show any significant statistical evidence of the effect of the special ability to the union, and when the strength of the hybrid was observed in the two concepts, it was negative non-significant for the hybrid (2 × 5) and with a general combining ability, one of the parents is significant and in the same direction, it can be used in breeding programs to form distinct genotypes for the lack of or increasing the duration to maturity. While the two hybrids (1 × 7) and (3 × 8) showed negative and non-significant hybrid strength over the best parents in the unwanted direction (Table 3). The effect of the general combining ability for parent(1) and (8) is negative and immaterial, and parent(7) is positive and non-significant, while parent(3) showed a positive and significant effect of the general ability to union that the hybrids that showed positive or negative hybrid strength, in two concepts according to the direction of the breeder and special ability was non-significant, and it corresponds in the same direction, that it is possible to produce excelled genotypes from it through the later segregating generations, especially when their parents have a general combining ability and in the same direction as for the parent (3) who showed a positive and significant effect on the general combining ability, where it can be used to Introduced into future hybridizations. As for the trait of the number of vegetative branches, the hybrids (1 × 3), (2 × 7) and (3 × 7) showed a significant and desired effect at the level of probability (5%), and it was characterized by positive and significant Heterosis and in the desired direction according to the two concepts, and the parents included in the two hybrids had an effect of the general combining ability was non-significant, meaning that was the result of the non-additional gene action and this is an indication for recommending these hybrids for breeding with: Heterosis breeding, As for those hybrids that were characterized by a Heterosis according to the two concepts and their special ability was positive, but not significant, which confirms the presence of additive effects of genetics and thus superion segregates can be determined genetically. For the number of capsules per plant, four hybrids showed positive and significant values at the level of probability (1%) for the effect of the special combining ability (2 × 3), (3 × 7), (5 × 6) and (5 × 8), except for the two hybrids (1 × 2). And (1 × 3) and (4 × 5) are positive and significant at the level of probability of (5%), while hybrids (1 × 7), (2 × 4), (3 × 4) and (5 × 7) have a lasting effect. Negative and significant at the probability level (1%) and the hybrid (2 x 5) at the probability level (5%). From the foregoing, we notice that the strength of the hybrid was positive and positive for the hybrid (5 × 8) for the average parents and positive and non-significant for the best parents. Both of their parents had an influence on the general combining ability, which confirms the possibility of benefitting from it by raising Heterosis and that the dominance variation is important for this hybrid to inherit this The characteristic, as we note that the hybrid (5 × 6) has outperformed by giving it a positive and significant Heterosis and in the two concepts, the effect of the general combining ability of the parents was negative, one of which is significant, and This is an indication to recommend these hybrids for breeding with Heterosis, Regarding the two hybrids (2 × 3) and (3 × 7), each of them have a positive and significant Heterosis for the average parents and negative and non-significant for the best parents, and that all the parents included in the two hybrids have significant effects of the general ability to unite in both directions, This reflects the presence of additional variability, so it can identify superion segregates and recommend the direction of forming genotypes in which the genes controlling the trait are compatible and that leads to an increase in the number of capsules in the plant. As for the two hybrids (1 × 2), the Heterosis was positive and had a non-significant, and in both concepts, both parents had a significant effect of the general combining ability, which
indicates the effect of the additional gene action of the trait where we note that the hybrids (1 × 7) and (2 × 4) and (3 × 4) and (5 × 7) have the Heterosis of a negative and significant hybrid and in both concepts, and one of its parents had positive significant effects for its general ability, such as the parents (1) and (2). And these hybrids can be identified as supernormal segregates from it in the segregates generations in which the genes with additional influence controlling the trait coincide and the Pedigree selection is adopted to select these genotypes. The trait of the number of seeds in the capsule distinguishes the hybrid (1 × 2) and (5 × 8) with a special positive combining ability that is positive and significantly desired, while the hybrid (1 × 7) was shown by giving it a negative and significant value at the level of probability (5%) and in the unwanted direction while the rest of the hybrids It was not statistically significant. It is evident that the two hybrids (1 × 2) and (5 × 8) were of positive and significant Heterosis in both concepts and had a special positive and significant combining ability. Therefore, they could be used in breeding programs for Heterosis to increase the number of seeds per capsule. While the hybrid (1 × 2) showed a negative and non-significant effect on the general ability to unite, meaning that results from the additional gene action controlling the genetics of this trait, which can be improved by selection. The effect of the special combining ability was positive non-significance at the probability level of (1%) in the desired direction of the hybrids (1 × 2) and (2 × 7) and (4 × 7) on the seed yield of the plant, while the hybrids (1 × 4) and 2 × 3, (5 × 8) and (6 × 8) was significant and desired at the level of probability (5%), and also the hybrids (2 × 4), (5 × 2) and (5 × 7) also showed an effect. significance and undesirable with the same probability according to the test. It is worth noting that the hybrid (1 × 2), (2 × 7) and (4 × 7) has a positive and significance Heterosis in both concepts and that all the parents constituting these hybrids have positive effects of the general combining ability, but did not reach the significance limits, this results when the action is the extra genetic who controls the inheritance of the trait, As for the hybrids that showed moral hybrid strength, the effect of their special combining ability was non-significant, and in the same direction, in which one of their parents had a positive general combining ability, it could be exploited by Selection. As for the weight of 1000 seeds, we note that the effects of the special ability on the union were significant and in the desired direction at a probability level (1%) for the hybrids (1 × 5), (3 × 5) and (3 × 6), significant and desirable at the level of (5%). For hybrid (1 × 2), As for the hybrids (1 × 3), (4 × 8), (5 × 6) and (5 × 7), they showed a significant effect and in the undesirable direction, while the hybrids did not reach the significant limits of the studied trait. The Heterosis was excelled in both concepts, and the effects of the general combining ability of parents were significant, which necessitated the recommendation of breeding with Heterosis in such a hybrid. As for the two hybrids (1 × 5) and (3 × 6), who showed the Heterosis of a significant hybrid and the parent (5) and (6) had an effect of the general combining ability is positive and desirable. The additional control effect on the trait and the adoption of the Pedigree selection method for selecting these genotypes. As for the average leaf weight trait, the hybrids (1 × 8), (2 × 7), (4 × 5) and (6 × 8) By giving them positive and significant values at the level of probability (5%), The hybrid (5 × 7) showed a negative and significant effect of the special combining ability. As for the rest of the hybrids, it did not reach the limits of significant. As for the above, it is noticed that the hybrids (1 × 8), (2 × 7) and (4 × 5) had positive and significant Heterosis, and in two concepts, This confirms that the dominance variance is important in controlling genetics of this trait and it is also possible to take advantage of hybrids by breeding the Heterosis. While the hybrids that showed excelled Heterosis and the effects of their special ability were significant, and the parents included in the hybrids were significant, such as parents (2) and (7), this means that there are both additional and non-additive effects of the genes that control the average weight of leaves. And for the biological yield trait, the two hybrids (3 × 7) and (6 × 8) were distinguished, which gave a significant and desired effect of the special ability to combine at a probability level (1%) while the hybrids (1 × 7), (2 × 8) and (3 × 4) were given a significant and desirable effect. A desired positive and significant value at a probability level of
It is noticed that the Heterosis was positive and significant and desired in the hybrids \((1 \times 7), (2 \times 8), (3 \times 4), (3 \times 7)\) and \((6 \times 8)\) according to the two concepts, but the effects of the general combining ability of parents did not reach significant limits, with the exception of parent(7), who showed a significant value for the general combining ability, and this means an indication for recommending these hybrids for breeding by Heterosis. As for the hybrids that were characterized by the Heterosis for this trait and their special ability was positive, but it was not of the same statistical significance, which confirms the presence of additional effects of gene, and through it, the superom segreates can be determined genetically, especially in hybrids in which one or both of their parents had a positive general combining ability. As for the trait of the percentage of leaves, the hybrid \((3 \times 6)\) and \((3 \times 8)\) was distinguished by giving it a positive significant value at the level of probability \((5\%)\) and in the desired direction, and it showed positive and significant Heterosis compared to the average of the parents and a positive value, but it did not reach the level of significance compared to the best parents of the hybrid \((3 \times 6)\) and a significant positive compared to the average of the parents, and negative and significant for the best parents of the hybrid \((3 \times 8)\). We note that the parents \((3), (6)\) and \((8)\) have effects of the general non-significant combining ability, and this means that there is an effect of the additional gene action for genes and its control of this trait by including these parents in making Hybridization to improve the trait and the possibility of selection in their superom segreates for those combinations that correspond. There are superom segreates of the trait, While the hybrid \((1 \times 7), (2 \times 8)\) and \((3 \times 7)\) showed a negative and significant effect of the special ability to combining at a probability level \((5\%)\) as well as a negative significant Heterosis according to the two concepts. It did not reach the limits, which confirms the recommendation to breed the Heterosis and that the dominance variation is important in controlling the genetics of this trait. As for the seed yield traits, the effects of the special combining ability were significant and desirable at a probability level of \((1\%)\) for \((1 \times 2), (1 \times 4), (2 \times 3), (2 \times 7), (2 \times 8)\) and \((3 \times 4), (4 \times 5), (4 \times 7), (5 \times 8), (6 \times 8)\) and a desired significant positive at \((5\%)\) probability level for the \((3 \times 7)\) hybrid, while each showed from the hybrid \((2 \times 4)\) and \((2 \times 5)\) and \((5 \times 7)\) a significant undesirable effect at a probability level of \((5\%)\). From the above, we note that the hybrids \((1 \times 2), (2 \times 3)\) and \((2 \times 7), (3 \times 7)\) and \((4 \times 7)\), It showed a significant effect of the special combining ability. The Heterosis was positive and significant compared to the average of the two parents at the level of probability \((5\%)\). As for the hybrid \((2 \times 7)\), which gave a significant effect to the general and private combining ability, this means that there are both additional and non-additive effects of the genes that control the yield of seeds. Regarding the harvest index, the hybrids \((1 \times 2), (1 \times 4), (2 \times 7), (3 \times 6), (4 \times 7)\) and \((5 \times 8)\) showed positive and significant values at the probability level of \((1\%)\) and significant positive and in the desired direction at a probability level \((5\%)\) for the hybrid \((2 \times 3)\). In light of the above, hybrids \((1 \times 2), (1 \times 4), (2 \times 3), (2 \times 7), (3 \times 6), (4 \times 7)\) and \((5 \times 8)\) showed a positive Heterosis. Significant is desirable according to the two concepts, and the effects of the general ability to combine were positive from the above, and to achieve the aim, it is possible to recommend these hybrids for breeding because of the Heterosis in this trait, As for the hybrids that showed significant Heterosis and in both concepts, but the effects of their special combining ability are not significant, and the parents \((1), (2), (7)\) and \((4)\) one of their parents have a general combining ability, it is possible to select for these genotypes in which the genes that lead are compatible to increase the proportion of the trait through the additional effect of genes controlling the trait and the diagnosis of superom segreates in subsequent generations. From above, we conclude the excelled of hybrids for more than one trait, where it is noticed the excelled of \((1 \times 2)\) for six traits, followed by \((1 \times 4)\) and \((2 \times 7)\) and \((3 \times 7)\) and \((5 \times 8)\) for five traits and hybrids \((2 \times 3)\) and \((3 \times 6)\) for four traits, two hybrids \((4 \times 5)\) and \((4 \times 7)\) for three traits, and hybrids \((1 \times 3)\) and \((2 \times 8)\) and \((3 \times 4)\) and \((3 \times 5)\) for two trait, and hybrids \((1 \times 5)\) and \((1 \times 7)\) and \((1 \times 8)\) and \((2 \times 5)\) and \((3 \times 8)\) and \((5 \times 6)\) and \((5 \times 7)\) for one trait, The effects of the high special combining ability of these hybrids are due to the high
value of their performance and excelled, which indicates that these hybrids were the best combinations to increase the yield of seeds and its components. These traits are based on her high averages. on this subject, other researchers obtained special effects on combine, significantly and desirable, for a number of hybrids and for a number of traits, including: [4]and[10·11·13·14·15·16].
Table 4. Estimating the effects of the combining ability for each hybrid for the studied traits.

| Hybridization (F1) | Duration to 50% flowering (day) | Plant height (cm. plant⁻¹) | Number of vegetative branches (branch. plant⁻¹) | Number of capsules (capsule. plant⁻¹) | The number of seeds (seed. Capsule⁻¹) | Seed yield (g. Plant⁻¹) | Weight 1000 seeds (g) | Average leaf weight (g) | Biological yield (g) | Leaf percentage (%) | Seed yield (kg. ha⁻¹) | Harvest index (%) |
|-------------------|--------------------------------|-----------------------------|-----------------------------------------------|------------------------------------------|---------------------------------------|------------------------|----------------------|----------------------|----------------------|-----------------|---------------------|-----------------|
| 1x2               | 2.95                           | -2.30                       | -1.72                                         | 0.24                                    | *0.88                                 | *0.38                   | *1.28                | 0.80                 | -0.02               | 0.59            | -0.91               | **520.88         |
| 1x3               | *3.65                          | 0.93                        | 2.51                                          | *0.41                                    | *0.36                                 | 0.18                    | -0.41                | *-1.52               | -0.03               | 1.90            | -3.26               | *101.54         |
| 1x4               | *-4.11                         | *4.89                       | 0.45                                          | 0.04                                    | *1.67                                 | 0.20                    | *0.69                | 0.36                 | 0.18                | -0.96           | 3.07                | **172.21         |
| 1x5               | 2.45                           | -0.02                       | -0.35                                         | 0.28                                    | -4.94                                 | -0.01                   | -0.11                | **1.09                | 0.19               | 0.62            | 0.17                | -28.29           |
| 1x6               | 1.99                           | -2.32                       | -0.09                                         | 0.12                                    | -2.85                                 | -0.21                   | -0.26                | -0.21                | -0.01               | -0.58           | 0.28                | -64.29           |
| 1x7               | **5.25                         | -0.41                       | *-3.52                                        | -0.31                                   | **12.78                                | 0.00                    | 0.19                 | 0.39                 | 0.06                | *3.31           | *-3.64              | 25.46            |
| 1x8               | 2.65                           | -0.14                       | 1.88                                          | -0.18                                   | *-0.50                                 | *-0.70                   | *-0.17               | -0.01                | *0.36               | -0.02           | 2.12                | -42.37           |
| 2x3               | 1.02                           | -2.16                       | 1.38                                          | 0.17                                    | **14.43                                | 0.41                    | *0.65                | -0.01                | 0.08                | 0.68            | -0.65               | **162.05         |
| 2x4               | 0.92                           | -3.70                       | 0.65                                          | -0.14                                   | **-18.16                               | -0.45                   | *-0.92               | -0.53                | -0.10               | -2.02           | 2.60                | **230.87         |
| 2x5               | **3.71                         | -3.00                       | *2.85                                          | -0.13                                   | **-6.54                               | -0.42                   | *-0.70               | -0.11                | -0.18               | -0.49           | -0.40               | **173.87         |
| 2x6               | **5.69                         | 2.16                        | 1.11                                          | 0.24                                    | -5.44                                 | -0.22                   | -0.42                | 0.12                 | 0.14                | -0.40           | 0.87                | **104.04         |
| 2x7               | -0.05                          | 1.41                        | -0.65                                         | *0.58                                   | 2.79                                  | -0.18                   | **1.16               | 0.26                 | *0.41               | 1.41            | -0.41               | **289.05         |
| 2x8               | 2.35                           | 1.27                        | -0.59                                         | 0.34                                    | 1.67                                  | 0.30                    | 0.47                 | 0.53                 | -0.03               | *2.78           | **-3.45              | 117.88           |
| 3x4               | -2.05                          | 1.99                        | -1.45                                         | 0.10                                    | **-16.51                               | -0.37                   | 0.49                 | 0.40                 | 0.20                | **2.83          | -2.82               | **123.38         |
| 3x5               | -0.81                          | *4.62                       | -0.92                                         | -0.05                                   | -4.89                                 | 0.09                    | 0.14                 | **2.29                | 0.09               | 1.20            | -1.47               | 36.21            |
| 3x6               | 1.72                           | 0.52                        | -1.65                                         | -0.02                                   | 3.11                                  | 0.17                    | 0.45                 | **1.48                | 0.24               | -1.82           | **4.59               | **112.71         |
| 3x7               | -0.68                          | 1.10                        | -2.42                                         | *0.46                                   | **12.17                                | -0.01                   | 0.38                 | 0.57                 | 0.10                | **3.66          | -4.31               | **94.13           |
| 3x8               | -1.61                          | 0.60                        | *-4.02                                        | 0.11                                    | 0.99                                  | 0.15                    | -0.10               | -0.25                | 0.20                | -1.61           | **3.44               | -24.54           |
| 4x5               | 0.42                           | 2.08                        | 1.01                                          | -0.03                                   | *8.49                                  | 0.42                    | 0.48                 | -0.35                | *0.39               | -0.36           | 2.86                | **120.80         |
| 4x6               | -3.05                          | -3.82                       | -0.05                                         | 0.34                                    | 6.65                                  | 0.07                    | -0.02               | -0.38                | -0.03               | -1.30           | 1.29                | -4.80            |
| 4x7               | 2.89                           | 0.06                        | 1.85                                          | -0.29                                   | 4.51                                  | -0.12                   | **1.24               | 0.01                 | 0.00                | 2.02            | -1.28               | **111.21         |
| 4x8               | -1.38                          | *-4.81                      | -0.09                                         | 0.07                                    | 4.67                                  | 0.17                    | -0.56               | -1.01                | 0.01                | -0.30           | 0.12                | **140.79         |
| 5x6               | 1.52                           | -2.25                       | -1.52                                         | 0.15                                    | **15.77                                | 0.25                    | -0.14               | **-1.57               | 0.22               | -0.93           | 2.47                | -34.87           |
| 5x7               | **-11.55                       | -2.71                       | 0.05                                          | 0.03                                    | **12.49                                | 0.34                    | **0.76               | **-1.02               | **-0.34              | -1.28           | -1.09               | **190.12         |
| 5x8               | -1.81                          | -0.98                       | 0.45                                          | -0.15                                   | **11.82                                | 0.67                    | **0.66               | 0.11                 | -0.12               | -0.53           | 0.53                | **166.21         |
| 6x7               | 2.65                           | *-4.94                      | -1.02                                         | -0.17                                   | -3.57                                 | 0.43                    | **1.24               | 0.01                 | -0.05               | 0.44            | -0.52               | 11.38            |
| 6x8               | -1.95                          | *5.02                        | -0.95                                         | 0.18                                    | 3.98                                  | -0.43                   | **0.63               | -0.01                | **0.32               | **4.34          | -2.23               | **157.71         |
| 7x8               | -1.68                          | -1.57                       | 1.28                                          | 0.16                                    | -4.85                                 | -0.26                   | -0.24               | -0.17                | -0.16               | -0.45           | -0.95               | -60.04           |
| 8x8               | 2.09                           | 2.34                        | 1.71                                          | 0.22                                    | 3.65                                  | 0.34                    | 0.34                 | 0.43                 | 0.19                | 1.44            | 2.07                | 48.83            |

The fixed model of the studied traits (**) and (*) were significant at a probability level of 1% and 5%, respectively, and (n.s.) were not significant.
The results of the phenotypic variance components in Table (5) showed that the values of the difference treatments were different from the homogeneity or dispersion for all the variations as the environmental variation was low in traits, duration to 50% flowering, plant height, duration to maturity, number of capsules per plant, the 1000 seed weight, average leaf weight and biological yield. While the values were average for the number of vegetative branches. The number of seeds per capsule, seed yield per plant, leaf percentage, total seed yield and harvest index, while the values of additional variance were low for all the studied traits except for the number of capsules per plant, so The value of the variation coefficient is average, As for the values of the dominant and genetic variances, they were low in most of the traits, except for the trait of the number of capsules per plant, the seed yield per plant, the weight of 1000 seeds, and the harvest index, in which the values of the difference coefficients were medium and high for the total seed yield.As for the phenotypic variation, it was low for traits, duration to 50% flowering, plant height, duration to maturity, average leaf weight, average for traits, number of vegetative branches, number of capsules in plants, number of seeds per capsule, weight of 1000 seeds, biological yield, percentage of leaves, and harvest index, and the dispersion of the difference coefficient was high in the two traits of the seed yield of the plant and the total seed yield, From the above, we notice that the results of the values of the phenotypic and genetic variation treatments were different, and this is mainly due to the difference in the values of both phenotypic and genetic variances, and these values were between low, medium and high for all traits. We note from the estimates of phenotypic difference coefficients that these estimates were identical for most of the traits. This gives confidence to the plant breeders, depending to a large extent on the phenotype of selection for the excelled genotypes, where the expression of the gene is clear on the performance of the genotypes.

It was found that the values of the dominant genetic variance were higher than the additional genetic variance in all traits except for plant height, duration to maturity, and number of seeds per plant, indicating the importance of the dominant genetic action in controlling these traits, This means that the variances related to the dominant genes were more effective than those related to the additional genes in heritability, so that these aforementioned traits can be improved by selection. The environmental variance values were less than the genetic variance values in the traits, duration to maturity, number of vegetative branches, biological yield and leaf percentage, and this result indicates the limited role of environmental factors in the performance of the traits (except for the aforementioned) and thus can be genetically improved. These results agrees with [3] and [10, 12, 15, 17, 18].

Table (5) shows the values of heritability in the broad and narrow sense, and the expected genetic improvement as a percentage and the average degree of dominance. As it is noticed that the values of heritability in a broad sense were high in traits, duration to 50% flowering, number of capsules per plant, yield of seeds per plant, weight of 1000 seeds, seed yield and harvest index, and ranged from (0.67 - 0.89)%.

The reason for the high values of the wide heritability in these traits is due to the high values of genetic variation and the low value of environmental variation in controlling the heritability of these traits, medium for the traits, plant height, duration to maturity, average leaf weight and biological yield, and the traits were low, the number of vegetative branches, the number of seeds per plant, and the percentage of leaves, These results agree with [7] and [12, 19, 20, 21, 22].

As for the narrow sense heritability, the average was low for the trait, the number of vegetative branches, the number of seeds per plant, the yield of seeds per plant, the biological yield, the percentage of leaves, the seed yield, and the harvest index. The reason for this is the decrease in the value of the additional variance and the increase in the sovereign variance. Since selection for these traits is not
Table 5. Estimating the components of phenotypic variation and some genetic parameters of the studied traits.

| Genetic Parameters | Duration to 50% flowering (day) | Plant height (cm. Plant\(^{-1}\)) | Duration to maturity (day) | Number of vegetative branches (branch. plant\(^{-1}\)) | Number of capsules (capsule. Plant\(^{-1}\)) | The number of seeds (seed. Capsule\(^{-1}\)) | Seed yield (g. Plant\(^{-1}\)) | Weight 1000 seeds (g) | Average leaf weight (g) | Biological yield (g) | Leaf percentage (%) | Seed yield (kg. ha\(^{-1}\)) | Harvest index (%) |
|--------------------|-------------------------------|----------------------------------|---------------------------|---------------------------------------------|---------------------------------------------|-----------------------------------------------|----------------------------|---------------------|---------------------|---------------------|---------------------|----------------------|----------------------|
| VE                 | 5.33                          | 6.63                             | 3.57                      | 0.06                                         | 16.22                                       | 1.46                                           | 0.15                                    | 0.23                              | 0.04                              | 2.51                             | 5.19                              | 2900.42                           | 3.97                              |
| C.V\%              | 2.00                          | 3.91                             | 1.20                      | 10.12                                        | 7.76                                        | 17.26                                          | 18.72                                   | 7.06                              | 5.40                              | 9.40                             | 10.08                             | 10.40                             | 16.26                             |
| VA                 | 6.96                          | 5.34                             | 1.62                      | 57.66                                        | 0.19                                        | 0.01                                           | 0.23                                    | 0.02                              | 0.07                              | 0.17                             | 2165.81                           | 0.36                              |
| C.V\%              | 2.29                          | 3.51                             | 0.81                      | 14.63                                        | 6.22                                        | 4.84                                           | 7.06                                    | 3.82                              | 1.56                              | 1.82                             | 9.00                              | 4.90                              |
| VD                 | 12.13                         | 2.00                             | 0.07                      | 0.03                                         | 72.99                                       | 0.33                                           | 0.54                                    | 0.02                              | 1.94                              | 2.40                             | 26779.44                          | 7.54                              |
| C.V\%              | 3.03                          | 2.14                             | 0.16                      | 7.15                                         | 16.46                                       | 27.75                                          | 10.82                                   | 3.82                              | 8.25                              | 6.85                             | 31.61                             | 22.41                             |
| VG                 | 19.10                         | 7.34                             | 1.69                      | 0.02                                         | 130.65                                      | 0.19                                           | 0.34                                    | 0.77                              | 0.04                              | 2.01                             | 2.57                              | 28945.25                          | 7.90                              |
| C.V\%              | 3.80                          | 4.11                             | 0.82                      | 5.84                                         | 22.03                                       | 28.16                                          | 12.92                                   | 5.40                              | 8.40                              | 7.09                             | 32.86                             | 22.94                             |
| VP                 | 24.42                         | 13.98                            | 3.64                      | 0.08                                         | 146.87                                      | 1.65                                           | 0.40                                    | 1.00                              | 0.08                              | 4.52                             | 7.76                              | 31845.67                          | 11.87                             |
| C.V\%              | 4.30                          | 5.67                             | 1.21                      | 11.68                                        | 23.35                                       | 33.81                                          | 14.72                                   | 7.64                              | 12.60                             | 12.32                             | 34.47                             | 28.12                             |
| H2. b.s            | 0.78                          | 0.53                             | 0.46                      | 0.25                                         | 0.89                                        | 0.11                                           | 0.69                                    | 0.77                              | 0.50                              | 0.44                             | 0.33                              | 0.90                              | 0.67                              |
| H2. n.s            | 0.29                          | 0.38                             | 0.44                      | 0.25                                         | 0.39                                        | 0.11                                           | 0.02                                    | 0.23                              | 0.25                              | 0.01                             | 0.02                             | 0.06                              | 0.04                              |
| Ā                   | 1.87                          | 0.87                             | 0.30                      | 2.53                                         | 8.13                                        | 2.15                                           | 1.41                                    | 7.73                              | 5.34                              | 4.97                             | 6.47                              |
| Gi                 | 2.48                          | 2.51                             | 1.47                      | 8.36                                         | 0.25                                        | 0.03                                           | 0.41                                    | 0.12                              | 0.05                              | 0.10                             | 18.84                             | 0.18                              |
| G%                 | 2.16                          | 3.81                             | 0.93                      | 14.92                                        | 3.57                                        | 1.45                                           | 6.03                                    | 3.36                              | 0.31                              | 0.45                             | 3.64                              | 1.48                              |

\(σ^2_g\) = Genotypic variance, \(σ^2_e\) = Phenotypic variance, \(σ^2_p\) = Environmental variance, GCV = Genotypic coefficient of variation, PCV = Phenotypic coefficient of variation, \(h^2 (bs)\) = Heritability in broad sense, \(h^2 (ns)\) = Heritability in narrow sense, Ā = the average of the degree of dominance, Gi = Expected genetic advance, G% = Relative expected genetic advance.
feasible in the early generations. Average traits of the duration to 50% flowering, plant height and duration to maturity, number of capsules per plant, weight of 1000 seeds and average leaf weight ranged from (0.23 - 0.44). These results agree with [4] and [7, 8, 23, 24]. From the results of the table, we find that the expected genetic improvement of the studied traits ranged between (0.03) for the seed yield trait of the plant and (8.93) for the seed yield trait, except for the trait of the number of vegetative branches that showed negative variation due to the presence of a sampling error, and therefore it is considered zero. When estimating the genetic improvement as a percentage of the general average for each trait, it becomes clear that it was low for all traits except for the number of capsules in the plant. It was moderate, reaching (14.92)%. The reason for this is due to the decrease in the value of the the narrow sense heritability percentage of it, and this means that improving these traits will be non-significant in the early segregates generations. These results agree with [6] and [7, 14, 24, 25, 26, 27, 28], to give them a high and medium heritability percentage. Regarding the average of the degree of dominance, it is noted from Table (5) that the trait: duration to 50% flowering, number of capsules per plant, yield of seeds per plant, weight of 1000 seeds, average leaf weight, biological yield, leaf percentage, seed yield and harvest index, were greater than the correct one, which indicates the existence of suppression segregates. With the importance of the dominant gene act and the possibility of exploiting the phenomenon of Heterosis and breeding by relying on it to improve these traits, As for the trait of plant height and duration to maturity, they were less than the correct one, which indicates the presence of molecular dominance, which indicates the importance of the additional and dominant genetic action. As for the number of vegetative branches and the number of seeds in the plant, it was equal to zero, which means a lack of dominance for these traits. [4] and [8, 23, 24, 29, 30], have been included.

4. Conclusion
We conclude from the foregoing that there were significant differences between the parents and their hybrids for most of the traits, evidence of a genetic variation between them, and therefore the genetic parameters had to be estimated to know the genetic systems controlling the traits under study and that the percentage of the components of the variance of the general and special combining ability was less than the correct one for some traits, and this is due to the non-additional genetic effects, while some occurred under the influence of the additional genes, and the effects of the general combining ability were in the desired direction for all parents and for some traits, and this indicates that these parents have genetic genes that can be used to improve these traits. The effects of the special ability to combine showed significant and desirable for the hybrids (1 × 2) (1 × 4), (2 × 7), (3 × 7) and (5 × 8) for most of the traits, so these hybrids can be followed up for their supersion segregates and select compatible strains. It has most of the traits. The values of heritability in the narrow sense were average for the traits of the duration to 50% flowering, plant height, duration to maturity, number of capsules per plant, weight of 1000 seeds and average leaf weight. Therefore, working on developing new genotypes from hybrids that are superior in the ability of special ability and the mean traits and multiplying the seeds of the genotypes that excel in their hybrids and preserving them after they are included in the breeding programs.

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