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Combining Ability And Heterosis For Half Diallel Crosses In Cowpea (Vigna Unguiculata L.)

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Abstract

The eight cowpea genotypes were used (AL_hokool, Black eyes, Italia, Gls/14, Ramshorn, JA10, JA20 and Max), which were cultivated in the spring of (2020) in order to perform the Diallel Meting Design (AA) according to the second method. (random model) proposed by Griffing (1956a). Then, The compared experiment was conducted by planting the seeds of parents and hybrids (8 parents + 28 individual hybrids) in the autumn season (2020) using a randomized complete block design (CRBD) in three randomly distributed replicates to estimate genetic parameters, the combining abilities and Heterosis for leaf area traits (cm^2. Plant $^{-1}$). The number of pods. Plant-1 and the number of seeds. Pod^{-1}, weight of 100 seeds (g), biological yield (g) and yield of individual plant (g). The results of the analysis of variance indicated that there were significant differences at the probability level (1%) for all traits. The results showed that there were significant differences for all the traits of the general combining abilities to specific combining abilities, the ratio of the components of the general combining abilities to specific combining abilities was greater than one for the number of pods . Plant-1traits and weighed 100 seeds (g), biological yield (g) and yield of individual plants, while the parents (4), (7) and (8) recorded significant effects in the desired direction for these traits. The hybrids x Gls/14) JA20, (x Black eyes JA20), (Ramshorn x Black eyes), (Max x Gls/14) and (Max x JA20) (Ramshorn x AL - hokool) showed the highest desirable heterosis in All traits are based on the deviation of the first generation from the average and best parents. While the results of the analysis showed significant of zero for the values of the additive and dominance variance and for all traits, while the dominance variance was greater than the additive variance for all traits except for the 100-seed weight (g) and biological yield (g). It was noticed through the values of genetic parameters that the mean of the degree of dominance was greater than one for all traits except for the trait of 100-seed weight (g), while the percentage of heritability in the narrow sense was high for the two traits of 100-seed weight (g) and biological yield (g), and it was medium in the trait The number of pods. Plant^{-1} and the yield of the individual plant (g).While it was decreased in traits of leaf area (cm^2. Plant^{-1}) and number of seeds. Pod^{-1} . The expected genetic improvement percentage was as a high percentage in the traits of 100-seed weight (g) and biological yield, and it was average for the traits of leaf area (cm^2.plant^{-1}) and the number of pods. Plant^{-1} The yield of the individual plant (g), while it was low for the number of seeds. Pod^{-1}.

Keywords: Heterosis, Half Diallel Crosses, cowpea, Vigna unguiculata L.

Introduction

Cowpea Vigna unguiculata (L.) is one of the most important crops of the Fabaceae family as it is an important source of proteins. It is also characterized by its drought tolerance and improving soil properties through its ability to Nitrogen atmospheric fixation . Cowpea is grown in two seasons, spring and autumn. The cultivation of cowpea crop in Iraq suffers from the deterioration of the old cultivars that were cultivated for a long time. Therefore, farmers turned to imported cultivars that are expensive, which calls for the advancement of a better reality by developing local varieties with high productivity and desirable quality (Al-Asafi et al., 2014). Cowpea is a highly self-pollinating and fertile crop, and selection to improve the crop depends mainly on the presence of genetic variations. Therefore, hybridization followed by selection is one of the common methods of genetic improvement it. Therefore, when developing genotypes that have high productivity, it is a primary aim in any breeding program. Half-diallel meting design, One of the important mating systems, gives as much information as possible about the studied traits and the dominant genetic influence on the trait and the main markers in the analysis of this system are the general and specific combining abilities in addition to the components of genetic variance. Previous studies indicated that when Half- diallel cross was used in cowpea, it was reached (Mohammed, 2016). In a study of full- diallel cross on cowpea yield for three parents (Ramshorn, Rahawya, and California black eye), it was found that the mean squares of the general and specific combining abilities were significant for the trait of the number of pods. plant-1, Owusu et al. (2020) found in a recent study for them on the cowpea crop that the mean squares of the general combining abilities was significant for the trait weight of 100 seeds, which is evidence of the control of additive genes in the inheritance of these two traits. The parents (Padi-Tuta, Songotra and lT86D-610) showed an general combining abilities of seed yield, While the hybrids (Sanzi-Nya x Songotra), (lT86D-610 X SARCL-57-2), (SARCL-57-2 X Songotra) and (Songotra x Padi) showed highly significant specific combining abilities for the number of pods.Plant^{-1} and number of seeds. pod^{-1}, which is an indication of the influence of the dominance gene action on the genetics of these traits, Wankhade et al (2018) obtained in hybridization LineXTester on cowpeas that there were excelled hybrid basis on average and better parents for number of seed. Pod^{-1}, weight of 100 seeds, number of pods. plant^{-1},Dias et al. (2016) confirmed when studying cowpea crop that the additive gene action is controlling the traits of the number of pod. Plant^{-1} and number of seeds. pod^{-1}, while the dominance gene action was dominant in the 100 seed weight. Nkhoma et al. (2020) mentioned in their study on cowpea crop that the percentage of heritability in the narrow sense was medium for the 100-seed weight trait and low for the number of seeds. Pod^{-1} and it was absent in trait of number of pods. Plant^{-1}, and the expected genetic improvement was low for both number of seed. Pod^{-1}, 100-seed weight, and the number of pods was not genetically improved. Based on the foregoing, the current study aims to estimate the general and specific combining abilities and their effects and to estimate the genetic variance and its components, phenotypic and environmental variance, the percentage of heritability in the narrow sense, the average of the degree of dominance, the expected genetic improvement, and the strength of the hybrid for the traits studied.

Materials and methods

The experiment was conducted in Kirkuk province / Riyadh district during the autumn season (2020) using eight cowpea genotypes, namely (AL-hokool, Black eyes, Italia, GLS/14, Ramshorn, JA10, JA20 and Max). In the spring season of the year (2020), the seeds of the parents for the eight genotypes were cultivated and entered into Half-diallel meting design and in the autumn season of the same year. The comparison experiment was conducted by cultivated the seeds of parents and adult hybrids (8 parents + 28 individual hybrids) according to the randomized complete block design (R.C.B.D) with three replicates. As the cultivation was done on furrow, the length of the furrow was (4 m) and the distance between one plant and another was (0.30 m), and the distance between one furrow was (1 m). The compound fertilizer (N.P.K) of Russian origin was added in one batch at the beginning of cultivation by (320 kg.ha^{-1}) and then urea fertilizer (N 46%) was added by (200 kg.ha^{-1})

at the beginning of flowering, Crop service operations were conducted by weeding, Thinning ... etc. from crop service operations, and measurements were taken for the traits: leaf area (cm^2) and the number of pods. Plant^{-1} and the number of seeds. Pod^{-1}, weight of 100 seeds (g), biological yield (g), and yield of the individual plant (g).

Statistical Analysis

Statistical analysis of the studied traits was conducted using the randomized complete block design (R.C.B.D) with three replicates, and the arithmetic means of the genotypes were tested using the least significant difference (L.S.D) at significant (5%).The genetic analysis was conducted according to the second method (random model) suggested by Grigging (1956a). The variance components of the general and specific combining abilities were calculated according to the following equations.

The effect of the general combining abilities for each parent

$$\hat{gi} = \frac{1}{r(n+2)}\left[Zi.. - (Z.../n)\right]$$

The effect of the specific combining abilities for each hybrid

$$\hat{Sij} = (Yij./r) - \frac{Zi.. + Z.j.}{r(n+2)} + \frac{Z..}{r(n+1)(n+2)}$$

The effects of the following two equations were tested:

$$S.E(\hat{gi}) = \sqrt{\frac{(n-1)\sigma^2 e}{n(n+2)}}$$

$$S.E(\widehat{sij}) = \sqrt{\frac{n(n-1)\sigma^2 e}{(n+1)(n+2)}}$$

The Heterosis was estimated on the basis of the deviation of the first generation of Half- diallel cross from the average of the two parents as a percentage, using the following equation (Falconer, 1989)

Heterosis = the average of the first generation - the average of the parents

As $\bar{F}1$ = the average of the first generation, $\bar{P}i$ = the average of the first parent, $\bar{P}j$ = the average of the second parent

Heterosis (H) = $\bar{F}1$ - $(\bar{P}_i+\bar{P}_j)$ / 2 X 100

The Heterosis on the average of the two parent was estimated as a percentage

Heterosis (H) = F - $(\bar{P}_i+\bar{P}_j / 2)$ / $(\bar{P}_i+\bar{P}_j / 2)$ X 100

The Heterosis was tested by calculating the value of (t) for each hybrid, as follows:

$$t = \frac{H}{\sqrt{V(H)}}$$

$\sigma^2 e$ = mse environmental variance

$V(H) = (3/2)\ \sigma^2 e/r$

The Heterosis was estimated on the basis of the deviation of the first generation of Half- diallel cross from the best parents as a percentage, citing (Al-Sahoki et al., 1983) according to the following equation:

Heterobeltiosis (H) = $\bar{F}1$ - B $\bar{P}$ X 100

So $\bar{F}1$ = the average of the first-generation hybrid, B $\bar{P}$ = the average of the best parents

The Heterosis on the best parents was estimated as a percentage

Heterobeltiosis (H) = $\bar{F}1$ - B $\bar{P}$ / B $\bar{P}$ X 100

The Heterosis was tested by calculating the value of (t) for each hybrid as follows:

$$t = \frac{H}{\sqrt{V(H)}}$$

$V(H) = 2\sigma^2 e / r$

5- :2-1-additive genetic variance σ^2 A, dominance variance σ^2 D, environmental variance σ^2 E, genetic variance σ^2 G and phenotypic variance σ^2 P were estimated. Then estimate the average degree of dominance, inheritance and expected genetic improvement through the following equations:

$$\bar{a} = \sqrt{\frac{2\sigma^2 D}{\sigma^2 A}}$$

The terms are adopted. If $\bar{a}$ equals zero, it means no dominance, if $\bar{a}$ is greater than one, it means super-dominance, and if $\bar{a}$ equals one, it means perfect dominance, and if $\bar{a}$ is less than one, it means partial dominance.

The percentage of male infertility was estimated in the narrow sense as estimation by Singht and Chaudhary, (2007) as in the following equation:

$$h^2 n.s = \frac{\sigma^2 A}{\sigma^2 P} \times 100$$

The limits of the values of inheritance in the narrow sense adopted by the virgins (1987) were adopted as follows

Less than 20% low, 20%-20% medium, more than 50% high

Then estimate the expected genetic improvement according to the equation:

$$G.S = K * h^2 n.s * \sigma P$$

As for the expected genetic improvement as a percentage (G.S%), it is estimated from the mean of the trait, as in the method (Kempthorme, 1969).

$$G.S\% = \frac{G.S}{X} * 100$$

The limits adopted by (Agarwal and Ahmed, 1982) are as follows

Less than 10% low, 10-30% medium, more than 30% high.

Results and discussion

Genotypes Evaluation

The results of the analysis of variance in Table (1) show for six traits, where it is noted that the mean squares of the genotypes, the parents, the hybrid, and the parents against the hybrid, was significant at the probability level (1%) for all the studied traits, namely (leaf area ($cm^2.plant^{-1}$) and the number of pods. plant $^{-1}$ and number of seeds pod and weight of 100 seeds (g),The biological yield (g) and the individual plant yield (g), which indicates the genetically different genotypes among themselves. The reason is due to the different genes that they possess and that control the inheritance of these studied traits. As well as the difference of the resulting hybrids, and this result is a good indicator for continuing the analysis and estimation of the components of genetic variance and the action of the genes controlling these traits. These differences are considered an important step from a genetic point of view, and therefore the possibility of benefiting from selection for excelled genotypes, and this agrees with many researchers who found significant differences between genotypes, including Al-Hamdani and Al-Nuaimi (2013), Nwofia et al. (2014), and Al-Jubouri (2014), and Gerrano et al. (2019).

Table (1) Analysis of variance (parents, hybrid)for the studied traits

Sources of Variation	df	Leaf area ($cm^2.plant^{-1}$)	Number of $pods.plant^{-1}$	Number of $seeds.pod^{-1}$	Weight of 100 seeds (g)	Biological yield (g)	Individual Plant Yield (g)
replicates	2	1725.68	58.78	5.12	33.95	2704.23	24.75
genotype	35	**2999.33	**285.43	**6.42	**16.95	**85670.62	**317.70
parents	7	**24050.58	**67.12	**1.01	**34.08	**56352.46	**121.35
hybrid	27	**20695.06	**250.06	**5.59	**11.78	**74617.67	**285.73
parents against hybrid	1	**322855.90	**2768.60	**66.72	**36.51	**589327.40	**2555.33
Experimental Error	70	94.54	0.33	0.07	0.23	457.28	0.40

Combining ability

The general and specific combining abilities were studied according to the second method (Fixed Model) proposed by Griffing 1956), the significantly of the general combining abilities for the mentioned traits indicates the importance of the of additive gene action, While the significance of the specific combining abilities for the aforementioned traits infers the importance of the action of the non-additive genes, and the significance of the mean of the squares of the two general and specific combining abilities the importance of both the extra and non-additive gene action in the inheritance of these traits , It is noted from the results of Table (2) that the components of the variance of the general and specific combining abilities were significant in all traits, This confirms the importance of additive and non-additive gene action in the inheritance of these traits and this is in line with Patel et al. (2009), Muhammad (2016), Wankhade et al. (2017) and Owusu et al. (2018). It is noted from the variations of the general and specific combining abilities that the percentage of the variance components related to the general combining abilities to the percentage of the components of the variance of the specific combining abilities was greater than one for the traits: The number of pods.plant^{-1} ,the weight of 100 seeds (g), the biological yield (g) and the individual plant yield (g) This indicates the importance of the additive genes action, while the percentage was less than one for the two traits of leaf area (cm^2.plant^{-1}) the number of seeds.pod^{-1}. This indicates the importance of the non-additive genes action .

Table (2) The components of the variance of Griffing analysis of the general and specific combining abilities of the traits studied

variances	Leaf area (cm^2.plant^{-1})	Number of pods.plant^{-1}	Number of seeds.pod^{-1}	Weight of 100 seeds (g)	Biological yield (g)	Individual Plant Yield (g)
$\sigma^2_{G.C.A}$	**9393.49	**140.65	**1.88	**21.81	**86028.38	**131.18
$\sigma^2_{S.C.A}$	**10151.35	**83.77	**2.20	**1.61	**14189	**99.58
σ^2_E	31.51	0.11	0.02	0.08	152.43	0.13
$\sigma^2_{G.C.A}$ / $\sigma^2_{S.C.A}$	0.93	1.68	0.85	13.55	6.06	**9393.49 / **10151.35

Effects of the general combining abilities of parents:

The significantly of the general combining abilities of each parent indicates the importance of additional genetic variance in the genetic of these studied traits and that this parents, inherits his genes that control the trait to his offspring , Therefore, the effects of the general combining abilities of the parents were estimated in order to evaluate the parents as shown in Table (3) for the trait of leaf area (cm^2.plant^{-1}). The effect was significant and in the direction of the desired positive for parents (4), (7) and (8), reaching (37.09), (38.09) and (29.55), respectively. Significantly, toward the undesired negative for parents (1), (2), (3), (5) and (6), as it reached (-10.09), (-5.71), (-30.90), (36.17) and (-21.85).) respectively. for the traits of the number of pods. Plant^{-1} recorded a significant effect in the desired positive direction for the parents (4), (7) and (8), reaching (5.10), (0.73) and (5.60), respectively and the negative significance of the undesirable trend for parent(2), (3) and (4) reached (-2.50), (-3.40) and (-4.70), respectively, and it was not significant for parents (1), reaching (0.07), and a non-significant negative for the parents (6), as it reached (-0.9).In the traits of the number of seeds.pod^{-1}, the effect was significant in the desired direction of the parents (1), (6), (7) and (8), as it reached (0.45), (0.07), (0.73) and (0.05), respectively, while The effect was not significant in the direction of decrease for parents (2), (3), (4) and (5), as it reached (-0.23), (-0.22), (-0.18) and (-0.66), respectively. For the trait of weight of 100 seeds (g), it recorded a significant effect in the desired positive direction for the parents (2), (4), (5), (7) and (8), as it reached (0.54), (1.37) and (1.05) (0.22) and (1.12), respectively, while the effect was significantly negative in the undesirable direction of parents (1), (3) and (7), as it reached (-0.74), (-3.16) and (-0.40).It is noted in the trait of biological yield (g) that the effect was significant and in the direction of the desired increase for parents (2), (3) and (4), as it reached (120.50), (69.50) and (125.27) respectively, and significant in the direction of the unwanted decrease for parents (1), (5), (6), (7) and (8), as it reached (-93.10), (-16.05), (-34.10), (-98.77) and (-71.45), respectively. In the traits of the number of seeds, horn-1, the effect was significant in the desired direction of the parents (1), (6), (7) and (8), as it reached (0.45), (0.07), (0.73) and (0.05), respectively, while The effect was not significant in the direction of decrease for parents (2), (3), (4) and (5), as it reached (-0.23), (-0.22), (-0.18) and (-0.66), respectively. For the trait of weight of 100 seeds (g), it recorded a significant effect in the desired positive direction for the parents (2), (4), (5), (7) and (8), as it reached (0.54), (1.37) and (1.05) (0.22) and (1.12), respectively, while the effect was significantly negative in the undesirable direction of fathers (1), (3) and (7), as it reached (-0.74), (-3.16) and (-0.40).It is noted in the trait of biological yield (g) that the effect was significant and in the direction of the desired increase for parents (2), (3) and (4), as it reached (120.50), (69.50) and (125.27) respectively, and significant in the direction of the unwanted decrease for parents (1), (5), (6), (7) and (8), as it reached (-93.10), (-16.05), (-34.10), (-98.77) and (-71.45), respectively. It is evident in the trait of individual plant yield (g) that the effect was significant and in the desired direction for parents (2), (4), (7) and (8), as it reached (0.37), (4.97), (4.41) and (1.95), while The effect was significantly negative in the undesirable direction for fathers (1), (3), (5) and (6), reaching (-4.37), (-4.41), (-2.13) and (-0.79), respectively. In light of the above results, we note that the parents (4) had a significant effect of the general combining abilities and the desired direction and increase for the trait of leaf area ($cm^2.plant^{-1}$), weight of 100 seeds (g), biological yield (g) and yield of individual plant (g).Where, parent(7) had a significant effect on the general combining abilities for the trait of the number of seeds. pod^{-1}.Thus, it is possible to take advantage of these parents and Introduction them into future crosses because these parents have additional genes to improve these traits. Other researchers have obtained a desirable general combining abilities for some of the parents used, including Romanus et al., (2008) for the trait of leaf area ($cm^2.plant^{-1}$) and (Al-Shukurji). , 2011b) for the trait of the biological yield (gram) and Muhammad (2016) for the trait of the number of pods. $plant^{-1}$, Owusu et al. (2018) for the trait number of seeds. Pod^{-1},

Table (3) estimations of the effect of the general combining abilities for each parent for the studied traits.

parents	Leaf area ($cm^2.plant^{-1}$)	Number of $pods.plant^{-1}$	Number of $seeds.pod^{-1}$	Weight of 100 seeds (g)	Biological yield (g)	Individual Plant Yield (g)
1	-10.09	0.07	0.45	-0.74	-93.10	-4.37
2	-5.71	-2.50	-0.23	0.54	120.50	0.37
3	-30.90	-3.40	-0.22	-3.16	69.50	-4.41
4	37.09	5.10	-0.18	1.37	125.27	4.97
5	-36.17	-4.70	-0.66	1.05	-16.05	-2.13
6	-21.85	-0.9	0.07	-0.40	-34.10	-0.79
7	38.09	0.73	0.73	0.22	-98.77	4.41
8	29.55	5.60	0.05	1.12	-71.45	1.95

S.E $\hat{gi}$	**1.66**	**0.10**	**0.05**	**0.08**	**3.65**	**0.11**

The specific combining abilities for Half- diallel cross

Table (4) shows the estimates of the effect of the specific combining abilities for each individual hybrid and for the studied traits, It is noted that the effect of specific combining abilities for leaf area trait ($cm^2.plant^{-1}$) was positively significant in the direction of the desired increase in hybrids (1×2), (1×5), (1×7), (1×8) and (2) ×3), (2x4), (2x6), (2x8), (3x4), (3x5), (3x6), (3x7) and (3x8)), (4x6), (4x7), (5x6), (6x8), (7x8),It ranged from (185.55) in hybrid (4 × 6) to (11.63) in hybrid (4 × 7), negative and significant in the direction of decrease in hybrids (1 × 3), (1 × 4), (1 × 6) and (2 x5), (2 x 7), (4 x 5), (4 x 8), (5 x 7), (5 x 8) and (6 x 7) and ranged from (-107.62) in the hybrid (6 x). 7) to (-7.99) in the hybrid (4×5).For the number of pods. $Plant^{-1}$, the effects of the specific combining abilities are positive in the desired direction of the cross (1×2), (1×3), (1×5), (1×6), (1×8) and (2×3).), (2x4), (2x6), (2x7), (2x8), (3x4), (3x7), 4x5, (4x6), (4x7), (4x8), (5x6), (5x8), (6x8), (7x8)It ranged from (14.08) in the hybrid (3×7) to (1.44) in the two hybrids (6×8) and (7×8), and it was negatively significant in the undesirable direction of the hybrid (1×4) and (1×7) and (2×5, (3×5), (3×6), (3×8), (5×7) and (6×7) and ranged from (-12.06) in the hybrid (1×4) to (- 2.46) in the hybrid (3×8). The effects of the specific combining abilities for the number of $seeds.pod^{-1}$ were significant and positive in the desired direction of the hybrid (1×2), (1×3), (1×5), (1×8), (2×4) and (2×). 5), (2x6), (2x7), (2x8), (3x4), (3x7), (4x7), 4x8, (5x6) and (5×7), (6×8), and (7×8), and it ranged from (2.06) in the hybrid (1×3) to (0.16) in the hybrid (2×5).Its significant negative was undesirable for hybrids (1×4), (1×6), (2×3), (3×5), (3×8), (4×5), (4×6) and (5). x8).It ranged from -1.50 in the hybrid (1×6) to (-0.61) in the hybrid (4×5), and it was not significant for the hybrid (1×7), (3×6) and (6×7).The traits of the weight of 100 seeds (g) showed that the effects of the specific combining abilities were positive in the desired direction of the cross (1×4), (1×5), (1×8), (2×5), (3×4) and (3) 6x), (3x7), (3x8), (6x7), (6x8), (7x8),It ranged from (2.29) in the hybrid (1×4) to (0.25) in the hybrid (3×8), and it was negatively significant in the undesirable direction of the hybrid(1×3), (1×6), (1×7) and (2x4), (3x5), (4x8), (5x7) and (5x8), It ranged from (-1.95) in the hybrid (1×6) to (-0.34) in the hybrid (5×7), and it was not significant for hybrids (2×3), (2×6), (2×7) and (4 × 5 and (5 × 6), and it was not significant for hybrids (1 × 2), (2 × 8), (4 × 6) and (4 × 7).It is noted in the trait of biological yield (gm) that the effects are significant and positive in the direction of increase for hybrids (1×5), (1×7), (1×8), (2×4), (2×6) and (2×7) And (2x8), (3x4), (3x5), (3x6), (3x8), (4x5), (4x6), (5x7) and (6 x 8) and (7 x 8) and ranged from (223.07) in hybrid (3 x 5) to (14.51) in hybrid (3 x 6),It was negatively significant in the undesirable direction of hybrids (1×3), (1×4), (1×6), (2×3), (3×7), (4×7), (5×6), and (5 × 8) and ranged from (67.11) in the hybrid (5 × 6) to (-29.77) in the hybrid (1 × 3), and it was not significant for the hybrid (1 × 2), and it was negative for the hybrid (2 × 5).), (4 x 8) and (6 x 7). For the trait of individual plant yield (g), the effects were significant and positive in the desired direction for the hybrids(1×2), (1×4), (1×5), (1×6), (2×3), (2×5) and (2x6), (2x7), (2x8), (3x7), (4x6), (4x7), (4x8), (5x6) and (6) x 7, (6 x 8) and (7 x 8) and ranged from (16.40) in the hybrid (3 x 7) to (2.05) in the hybrid (2 x 3)It was negatively significant in the undesirable direction of the hybrids (1×3), (1×7), (1×8), (2×4), (3×4), (3×6), (3×8), (4×5), (5×7) and (5×8) and ranged from (-10.25) in the hybrid (2×4) to (-2.18) in the hybrid (1×7), and it was not significant in the hybrid (3×5).It is noticed from the mentioned results that the hybrid (4×6) has a significant effect of specific combining abilities in the trait of leaf area (cm-2). As for the number of pod. $Plant^{-1}$ and the yield of the individual plant (g), the hybrid (3×7) had a special significant effect.

Whereas the hybrid (1×3) had a special significant effect on the number of seeds per pod-1, while for the 100-seed weight (g) trait, the effect of the hybrid (1×4) was significant and desirable, the effect of the hybrid was (3×5) morally desirable in the trait of the biological yield (g),Thus, these hybrids can be used for the transfer of genes and selection for them in the isolated generations for the desired traits due to their excellent genes. Hybrids with significant effects and in the desired direction were obtained for the specific combining abilities of some hybrids and for some traits for many researchers, including Chandharl et al. (2013), Al Hamdani (2014), Owusu et al. (2018) and Owusu et al. (2020).

Table (4) estimations of the effect of the specific combining abilities for each parent for the studied traits.

Hybrid	Leaf area ($cm^2.plant^{-1}$)	Number of $pods.plant^{-1}$	Number of $seeds.pod^{-1}$	Weight of 100 seeds (g)	Biological yield (g)	Individual Plant Yield (g)
2x1	0.41	8.88	0.71	-0.02	10.14	5.47
3x1	-85.65	7.08	2.06	-0.50	-29.77	-4.34
4x1	-21.61	-12.06	-1.36	2.29	-30.03	11.70
5x1	62.94	7.41	1.22	0.33	16.29	13.38
6x1	-29.45	8.64	-1.50	-1.95	-40.99	6.35
7x1	129.03	-8.36	0.01	-0.80	112.82	-2.18
8x1	95.26	6.44	1.96	2.25	18.67	-9.52
3x2	20.76	2.31	-1.05	0.17	-56.80	2.05
4x2	70.95	2.18	1.50	-0.48	135.23	-10.25
5x2	-102.54	-7.36	0.16	0.38	-5.21	4.44
6x2	90.39	4.88	0.24	0.22	131.34	5.69
7x2	-14.30	7.54	0.70	0.16	35.33	3.85
8x2	41.45	4.01	1.45	-0.17	69.99	7.79
4x3	55.66	3.04	0.48	1.95	124.84	-5.08
5x3	156.32	-4.82	-0.78	-0.81	223.07	0.02
6x3	94.28	-6.92	0.10	1.75	14.51	-7.75
7x3	96.31	14.08	1.44	1.20	-39.10	16.40
8x3	22.53	-2.46	-1.63	0.25	167.34	-4.19
5x4	-7.99	7.04	-0.61	0.09	71.58	-6.36
Hybrid	Leaf area ($cm^2.plant^{-1}$)	Number of $pods.plant^{-1}$	Number of $seeds.pod^{-1}$	Weight of 100 seeds (g)	Biological yield (g)	Individual Plant Yield (g)
6x4	185.55	9.94	-0.76	-0.12	196.18	6.70
7x4	11.63	10.94	1.70	-0.02	-47.80	12.30
8x4	-44.80	11.74	1.52	-0.86	-0.60	12.60
6x5	64.83	6.74	1.31	0.21	-67.11	6.72
7x5	-55.18	-4.92	1.17	-0.34	80.58	-9.69
8x5	-72.21	4.21	-1.34	-0.43	-34.39	-5.33
7x6	-107.62	-7.36	0.11	1.57	-7.28	5.48
8x6	30.09	1.44	1.42	1.01	35.04	9.90

8x7	**65.05**	**1.44**	**0.65**	**1.37**	**21.70**	**6.64**
S E (Sij)	**5.09**	**0.30**	**0.14**	**0.25**	**11.20**	**0.33**

Heterosis

The Heterosis based on the deviation of the first generation from the average of the parents as a percentage:

Table (5) shows the estimation of the Heterosis of the first-generation hybrids for the studied traits on the basis of the deviation of the first generation from the average of the parents, It is noticed that the traits of leaf area (cm2.plant-1) most of the hybrids showed significant positive hybrid strength in the desired direction at the probability level (1%) and the hybrid heterosis as a percentage ranging from (91.46) in the hybrid (3×6) to (10.68) in The hybrid (4×8), while the two hybrids (2×5) and (5×8) showed significant negative hybrid Heterosis and in the direction and in the undesired direction, reaching (-11.37) and (-5.68) respectively While the hybrid (6×7) showed non-significant positive hybrid Heterosis, and the hybrid (5×7) showed non-significant negative hybrid strength. As for the number of pods. Plant^{-1} had significant positive hybrid vigor in the desired direction at (1%) probability level for hybrids (1×2), (1×3), (1×5), (1×6), (1×8) and (2 x3), (2 x 4), (2 x 6), (2 x 7), (2 x 8), (3 x 4), (3 x 7), (3 x 8), (4 x 5)), (4×6), (4×7), (4×8), (5×6), (5×8), (6×8) and (7×8). 50.63) in the hybrid (4×8) to (14.86) in the hybrid (3×8),Whereas the hybrids (1×4), (2×5), (3×5), (3×6), (5×7) and (6×7) showed non-significant positive heterosis, while the hybrid and (1×7) non-significant negative Heterosis, This is in agreement with Muhammad (2016) and Verma et al. (2020).For the trait of the number of seeds. pod-1 showed the hybrids (1×2), (1×3), (1×5), (1×7), (1×8), (2×4) and (2×5). (2×6), (2×7), (2×8), (3×4), (3×6), (3×7), (4×7), (4×8) and (5×6), (4×8), (5×7), (6×7), (6×8) and (7×8) significant positive heterosis in the desired direction at the (1%) probability level and ranged from (46.20) in the hybrid (4×7) to (18.19) in the hybrid (3×4),Whereas the hybrids (1×4), (2×3), (4×5) and (4×6) showed non-significant positive heterosis, and the hybrids (1×6), (3×5) and (3) 8×) and (5×8) non-significant negative hybrid heterosis and this is in agreement with Wankhade et al. (2018).For the trait of the weight of 100 seeds (g) showed hybrids (1×3), (1×4), (1×8), (2×3), (2×6), (2×7) and (3×4) and (3x6), (3x7), (3x8), (4x6), (4x7), (6x7), (6x8), (7x8) heterosis Significantly positive in the desired direction at the probability level (1%) and heterosis of the hybrid as a percentage ranging from (23.64) in the hybrid (3×6) to (5.03) in the hybrid (2×6), while the hybrid (2×8) and 4×8) and (5×6) significant positive heterosis in the desired direction at the (5%) probability level amounted to (3.64), (3.44) and (3.76), respectively, The hybrid (1×6) showed significant negative heterosis in the undesirable direction at the (5%) probability level of (-4.98), while the hybrid (1×2), (1×5), (1×7) and (2×4), (2×5), (3×5), (4×5), (5×7) and (5×8) positive non-significant heterosis, This agrees with Mukati et al. (2016) and Verma et al. (2020).For the biological yield, all the hybrids showed significant positive heterosis in the desired direction at the (1%) probability level. The percentage heterosis ranged from (40.22) in the hybrid (3×5) to (4.34) in the hybrid (1×6) in the autumn season and this agree with Al-Hamdani (2014).for individual plant yield (gm), The hybrids showed (1×2), (1×4), (1×5), (1×6), (1×7), (2×3), (2×5), (2×6), and (1×7). (2x7), (2x8), (3x7), (4x6), (4x7), (4x8), (5x6), (6x7) and (6) 8×8 and (7×8) significant positive hybrid strength in the desired direction at the probability level (1%) and the hybrid strength as a percentage ranged from (60.06) in the hybrid (1×6) to (13.96) in the hybrid (2×3), Whereas the hybrids (1×3), (1×8) and (3×5) showed non-significant positive heterosis, Whereas the hybrids (2×4), (3×4), (3×6), (3×8), (4×5), (5×7) and (5×8) showed non-significant negative heterosis .

Table (5) the heterosis based on the average of the parents as a percentage of the studied traits

Hybrid	Leaf area ($cm^2.plant^{-1}$)	Number of $pods.plant^{-1}$	Number of $seeds.pod^{-1}$	Weight of 100 seeds (g)	Biological yield (g)	Individual Plant Yield (g)
2x1	**40.80	**42.86	**30.03	2.34	**10.10	**40.97
3x1	**17.75	**31.88	**37.28	**6.27	**8.89	0.40
4x1	**22.26	1.35	0.34	**17.65	**9.60	**53.59
5x1	**31.88	**30.66	**27.59	2.96	**11.23	**49.51
6x1	**30.72	**37.10	-3.16	*-4.98	**4.34	**60.06
7x1	**46.79	-1.01	**26.20	2.10	**19.42	**29.33
8x1	**41.15	**34.42	**45.45	**18.57	**12.01	0.44
3x2	**44.54	*25.98	3.17	**7.70	**11.19	**13.96
4x2	**39.98	**35.04	**40.18	1.44	**28.36	-0.17
5x2	**-11.37	0.79	**18.45	1.40	**13.84	**22.53
6x2	**59.41	**34.10	**20.28	**5.03	**26.57	**48.97
7x2	**12.72	**35.74	**40.08	**5.15	**15.37	**38.64
8x2	**25.77	**34.27	**45.67	*3.64	**21.92	**38.03
4x3	**56.26	**30.28	**18.19	**22.56	**31.23	-0.84
5x3	**74.24	0.76	-1.50	0.32	**40.22	0.21
6x3	**91.46	1.11	**21.33	**23.64	**18.66	-0.51
7x3	**54.13	**42.86	**39.60	**19.84	**10.83	**54.01
8x3	**37.64	**14.86	-3.07	**13.31	**36.35	-0.98
5x4	**14.87	**36.88	3.72	3.05	**24.84	-0.33
6x4	**85.27	**46.39	3.71	**6.53	**36.87	**48.31
7x4	**21.14	**43.97	**46.90	**7.42	**10.61	**54.59
8x4	**10.68	**50.63	**40.54	*3.44	**18.61	**46.13
Hybrid	Leaf area ($cm^2.plant^{-1}$)	Number of $pods.plant^{-1}$	Number of $seeds.pod^{-1}$	Weight of 100 seeds (g)	Biological yield (g)	Individual Plant Yield (g)
6x5	**43.46	**29.57	**24.87	*3.76	**7.61	**39.78
7x5	-2.61	1.05	**36.73	1.48	**21.77	-1.55
8x5	**-5.68	**26.53	-0.63	1.32	**12.16	-0.12
7x6	-1.34	0.67	**23.75	**16.70	**11.26	**56.53
8x6	**35.95	**24.75	**35.11	**13.39	**19.75	**56.49
8x7	**25.21	**21.63	**39.41	**15.44	**15.82	**42.57
SE(H)	6.88	0.41	0.17	0.35	15.12	0.44

The heterosis based on the deviation of the first generation from the best parents as a percentage:

Table (6) shows the estimation of heterosis of the first-generation hybrids for the studied traits on the basis of the deviation of the first generation from the best parents, Noting the trait of leaf area ($cm^2.plant^{-1}$) the hybrids showed (1×2), (1×4), (1×5), (1×6), (1×7), (1×8) and (2x3), (2x4), (2x6), (2x8), (3x4), (3x5), (3x6), (3x7) and (3) 8×8, (4×5), (4×6), (4×7), (4×8), (5×6), (6×8), and (7×8) positive significant heterosis and direction The increase at the probability level (1%) and heterosis as a percentage ranged from (80.85) in the hybrid (3×6) to (6.07) in the hybrid (3×8), and the hybrids reached (2×5) and (5×7) And (5 × 8) and (6 × 7) significant negative heterosis towards a decrease at the (1%) probability level and reached (-11.65), (-12.64), (-13.67) and (-19.84), respectively, While the two hybrids (1×3) and (2×7) showed non-significant positive heterosis and this is consistent with Ibrahim (2014).For the traits number of pods. $Plant^{-1}$ Hybrids (1×2), (1×3), (1×5), (1×6), (1×8), (2×3) and (2×4) (2×6), (2×7), (2×8), (3×4), (3×7), (3×8), (4×5), (4×6) and (4×7, (4×8), (5×6), (5×8), (6×8) and (7×8) positive, significant heterosis in the desired direction at the probability level (1%) and the heterosis ranged As a percentage from (45.11) in the hybrid (4×8) to (3.65) in the hybrid (3×8), the hybrids (1×7), (5×7) and (6×7) showed significant undesirable heterosis. At the (1%) probability level of (-4.53), (-7.10) and (-4.53), respectively, the hybrid (2×5) showed significant undesirable negative heterosis at the (5%) probability level of (-2.31).), did not reach the statistical significance limit in the hybrid (3 × 5), while the two hybrids (1 × 4) and (3 × 6) showed non-significant negative hybrid strength and this is in line with Wankhade et al. (2018) and Verma et al. (2020).For the trait the number of seeds. pod^{-1} showed hybrids (1×2), (1×3), (1×5), (1×7), (1×8), (2×4), (2×5) and (2×). 6), (2x7), (2x8), (3x4), 3x6, (3x7), 4x7, (4x8), (5x6) and (5×7), (6×7) and (7×8) positive and significant heterosis at the (1%) probability level. The heterosis as a percentage ranged from (45.33) in the hybrid (4×7) to (9.67). In the hybrid (2×6), while the two hybrids (1×4) and (3×5) showed undesirable negative significant heterosis at the (5%) probability level of (-4.92) and (-5.64), respectively, Whereas the hybrid and (3×8) showed significant undesirable negative hybrid power at the (1%) probability level of (-7.31), while the hybrids (1×6), (2×3) and (4×6) showed And (5 × 8) non-significant negative heterosis, and (4 × 5) hybrid showed non-significant positive hybrid strength. This agrees with Mukati et al. (2016) and Verma et al. (2020).For the characteristic of weight of 100 seeds (g), the hybrids (1×4), (1×8), (6×7), (6×8) and (7×8) showed significant positive and desirable heterosis at the probability level (1%).) and ranged from (13.47) in the hybrid (6×7) to (5.86) in the hybrid (6×8),

While the hybrid showed (1×2), (1×3), (1×5), (1×6), (2×3), (2×6), (3×4) and (3×5).), (3×7), (3×8), (5×6), (5×7) and (5×8) significant negative heterosis in the undesired direction at the (1%) probability level and ranged from (23.95-) in the hybrid (3×5) to (-2.82) in the hybrid (2×6),While the hybrid (2×8) showed a positive significant desirable hybrid power at a (5%) probability level that reached (2.64), while the hybrid (4×6) showed an undesirable negative significant hybrid strength at a (5%) probability level that reached (2.26-), while the hybrids (2×4), (3×6), (4×5), (4×7) and (4×8) showed non-significant positive heterosis. The hybrids (1×7), (2×5) and (2×7) showed non-significant negative hybrid vigor. This is in agreement with Mukati et al. (2016) and Verma et al. (2020).It is noted in the trait of the biological yield (gm) that heterosis was positive and significant and in the direction of the desired increase at the probability level (1%) for hybrids (1×5), (1×7), (1×8), (2×3) and (2x4), (2x6), (3x4), (3x5), (3x6), (3x8), (4x5), (4x6) and (5x) 6), (5 x 7), (5 x 8), (6 x 7), (6 x 8) and (7 x 8), and the strength of the hybrid as a percentage ranging from (32.69) in the hybrid (3 x 5) to (4.42 in hybrid (2×3),While the hybrid (2×8) showed a positive significant desirable heterosis at the (5%) probability level that amounted to (3.22), while the hybrid (4×7) showed undesirable negative significant heterosis at the (1%) probability level that reached - 4.18), and the hybrid (1×2) showed undesirable negative significant heterosis at the (5%) probability level of (-3.75), while the hybrids (1×3), (1×6) and (2×) showed 5) and (4×8) non-significant positive heterosis at the levels (1%) and (5%),While the hybrids (1×4), (2×7) and (3×7) showed non-significant negative heterosis, this is consistent with Al-Hamdani (2014).For the trait of individual plant yield (g), the hybrids showed (1×3), (1×8), (2×4), (3×4), (3×6), (3×8) and (4×5). And (5 × 7) significant negative heterosis in the undesired direction at the probability level (1%) and the hybrid strength as a percentage ranged from -14.78 in the hybrid (1 × 8) to (-3.40) in the hybrid (5 × 7), It did not reach the desired significance level in the two hybrids (3 × 5) and (5 × 8),While the rest of the hybrids showed significant positive heterosis at the probability level (1%) in the desired direction, and the heterosis as a percentage ranged from (57.58) in the hybrid (1×6) to (12.15) in the hybrid (2×3).

Table (6) the heterosis based on the best parents as a percentage of the studied traits

Hybrid	Leaf area ($cm^2.plant^{-1}$)	Number of $pods.plant^{-1}$	Number of $seeds.pod^{-1}$	Weight of 100 seeds (g)	Biological yield (g)	Individual Plant Yield (g)
2x1	**35.63	**31.94	**17.89	**-5.61	-3.75*	**23.89
3x1	0.55	**26.39	**33.18	**-12.15	0.84	**-12.98
4x1	**12.01	-1.32	-4.92*	**7.61	-2.18	**25.93
5x1	**26.65	**24.31	**18.79	**-7.86	**8.71	**27.77
6x1	**17.40	**34.72	-3.72	**-5.32	3.43	**57.58
7x1	**27.05	**-4.53	**20.82	-1.06	**15.44	**12.31
8x1	**24.54	**26.21	**35.17	**10.35	**7.88	**-14.78
3x2	**19.68	**21.21	-3.84	**-16.42	**4.42	**12.15
4x2	**32.83	**21.70	**33.71	0.52	**25.37	**-7.93
5x2	**-11.65	-2.31*	**15.14	1.90	1.54	**18.61
6x2	**38.50	**25.91	**9.67	**-2.82	**11.49	**32.75
7x2	0.82	**21.28	**32.31	-0.08	-2.02	**36.73
8x2	**14.78	**17.07	**41.87	2.64*	3.22*	**32.51
4x3	**24.14	**21.70	**15.45	**-5.06	**26.06	**-7.18
5x3	**43.90	0.00	-5.64*	**-23.95	**32.69	-1.46
6x3	**80.85	-1.42	**18.42	1.93	**10.79	**-12.59
7x3	**16.94	**32.25	**37.65	**-3.33	-0.51	**53.65
8x3	**6.07	**3.65	**-7.31	**-11.45	**21.99	**-3.45
5x4	**9.33	**26.97	1.76	0.57	**13.74	**-5.22
6x4	**53.98	**40.12	-1.14	-2.26*	**23.11	**23.13
Hybrid	Leaf area ($cm^2.plant^{-1}$)	Number of $pods.plant^{-1}$	Number of $seeds.pod^{-1}$	Weight of 100 seeds (g)	Biological yield (g)	Individual Plant Yield (g)
7x4	**13.79	**42.57	**45.33	1.20	**-4.18	**44.39
8x4	**6.20	**45.11	**37.62	1.52	2.43	**40.12
6x5	**24.30	**25.19	**16.93	**-6.87	**6.08	**21.06
7x5	**-12.64	**-7.10	**32.80	**-6.54	**15.13	**-3.40
8x5	**-13.67	**13.41	-0.39	**-2.89	**5.67	-0.99

7x6	****-19.84**	****-4.53**	****19.18**	****13.47**	****6.64**	****37.79**
8x6	****9.35**	****15.24**	****26.29**	****5.86**	****14.37**	****34.54**
8x7	****22.46**	****18.29**	****35.14**	****10.73**	****15.39**	****38.71**
SE(H)	**7.94**	**0.47**	**0.20**	**0.40**	**17.46**	**0.51**

Components of genetic, environmental and phenotypic variance

The results of the variance components in Table (7) show that the additive variance values differed significantly from zero for all studied traits, which are the total leaf area ($cm^2.plant^{-1}$), the number of pods.plant-1, the number of $seeds.pod^{-1}$, and the weight of 100 seeds (g). The biological yield (g) and the individual plant yield (g) in the autumn season and this is in line with Ashio et al. (2015).and the dominance variance values also differed significantly from zero for all the studied traits, and the dominance variance was greater than the additive variance for all studied traits except for the 100-seed weight and biological yield (g), and this is in line with Ameen et al. (2014) and Muhammad (2016), which indicates that Dominant variance was the largest proportion of the additive variance, and therefore these traits can be improved by hybridization , As for the 100-seed weight and biological yield traits, these two traits can be improved by iterative selection of the special ability to combine. While the results showed the values of environmental variance less than the genetic variance and all the studied traits, which indicates the importance of the genetic variance for the studied traits, and this value indicates the lack of the role of the environmental factor in the performance of these traits and thus can be genetically improved. Genetic variance formed a high percentage of phenotypic variance compared to environmental variance for the studied traits. All of the genetic, environmental and phenotypic variances differed significantly from zero and all traits and the Dominant variance values also differed significantly from zero for all the studied traits, and the Dominant variance was greater than the additive variance for all studied traits except for the 100-seed weight and biological yield (g), and this is in line with Ameen et al. (2014) and Muhammad (2016), which indicates that Dominant variance was the largest proportion of the additive variance, and therefore these traits can be improved by Hybridization ,As for the 100-seed weight and biological yield traits, these two traits can be improved by iterative selection of the special ability to combine. While the results showed the values of environmental variance less than the genetic variance and all the studied traits, which indicates the importance of the genetic variance for the studied traits, and this value indicates the lack of the role of the environmental factor in the performance of these traits and thus can be genetically improved. Genetic variance formed a high percentage of phenotypic variance compared to environmental variance for the studied traits. All of the genetic, environmental, and phenotypic variances differed significantly from zero and all traits.

Table (7) values of genetic parameters for the studied traits

Genetic Parameters	**Traits**					
	Leaf area ($cm^2.plant^{-1}$)	**Number of $pods.plant^{-1}$**	**Number of $seeds.pod^{-1}$**	**Weight of 100 seeds (g)**	**Biological yield (g)**	**Individual Plant Yield (g)**
σ^2A	**1872.39±280.06**	**28.11±4.19**	**0.37±0.06**	**4.35±0.65**	**17175.19±2564.87**	**26.21 ± 3.91**

σ^2D	**1011984 ± 884.17**	**83.66 ± 7.30**	**2.18 ± 0.19**	**1.53 ± 0.14**	**14036.57 ± 1235.80**	**99.45 ± 8.67**
σ^2G	**11992.23 ± 1468.65**	**111.77 ± 21.99**	**2.55 ± 0.29**	**5.88 ± 3.41**	**31211.76 ± 13450.30**	**125.66 ± 20.51**
σ^2E	**31.51 ± 5.25**	**0.11 ± 0.02**	**0.02 ± 0.003**	**0.08 ± 0.01**	**152.43 ± 25.40**	**0.13 ± 0.02**
σ^2p	**12023.74 ± 1659.43**	**111.88 ± 15.44**	**2.57 ± 0.35**	**5.96 ± 0.82**	**31364.19 ± 4328.67**	**125.79 ± 17.36**

Estimating the average degree of dominance, inheritance, and expected genetic improvement:

Table (8) shows the values of the percentages of genetic parameters, heritability, the degree of dominance, and the expected genetic improvement as a percentage. It is noted that the average degree of dominance ($\bar{a}$) was greater than one correct for all the studied traits except for the trait of the weight of 100 seeds (g), which was less than the correct one, which indicates the existence of super-dominance and this is another indication of the possibility of benefiting from the phenomenon of Heterosis to obtain hybrid This is in agreement with Iqbal et al. (2012), Muhammad (2016) and Olajide) and llori, 2017).As for the 100-seed weight trait, the dominance was partial, and thus selection can be used in breeding programs for this trait, and this is in line with Dieni et al. (2019).As for the values of heritability in the narrow sense, they were low in the number of seeds, pod^{-1}, leaf area ($cm^2.plant^{-1}$),The reason for the low heritability is due to lower values of additive variance compared to phenotypic variance and a higher value of dominance variance in line with Nkhoma et al. (2020) and Owusu et al. (2020). While it was medium in the number of pods. $Plant^{-1}$ and the trait of the individual plant yield (g) and this agrees with Owusu et al. (2020), while the value of heritability in the narrow sense was high in the trait of weight of 100 seeds (g) and biological yield (g).This is in agreement with Akansha et al. (2011) and Shanko et al. (2014).As for the expected genetic improvement as a percentage, it was high in terms of 100-seed weight (g) and biological yield (g), and this is in agreement with Nwosu et al. (2013) and Shanko et al. (2014). While it was average in leaf area ($cm^2.plant^{-1}$), number of $pods.plant^{-1}$, number of $seeds.pod^{-1}$ and yield of individual plant (g).

Table (8) Estimates of the degree of dominance, heritability in the narrow sense, and genetic improvement as a percentage of the traits studied

Genetic Parameters	**Traits**					
	Leaf area ($cm^2.plant^{-1}$)	**Number of $pods.plant^{-1}$**	**Number of $seeds.pod^{-1}$**	**Weight of 100 seeds**	**Biological yield (g)**	**Individual Plant Yield (g)**

				(g)		
$\bar{a}$	**3.29**	**2.44**	**3.43**	**0.84**	**1.28**	**2.75**
h^2.NS	**15.57**	**25.13**	**14.40**	**72.99**	**54.76**	**20.84**
G S	**3004.84**	**467.82**	**40.63**	**313.62**	**17068.41**	**411.37**
G.S%	**16.17**	**22.84**	**11.84**	**44.11**	**43.04**	**22.11**

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