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The effect of gene action in single crosses of corn (*Zea mays* L.)

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Abstract
This study employed Griffing's fixed model (1956) [18, 19]. in a hybridization program involving six pure yellow maize varieties, resulting in the creation of fifteen hybrids at the Agricultural Technical College in Mosul during the 2023–2024 growing season. Utilizing a completely randomized block design, the research assessed various genetic traits upon plant maturity, including plant height, number of shoots, rows per shoot, and individual yield (grams). Statistical analysis revealed significant mean squares for most traits at the 1% probability level. Notably, variance components for plant height and number of shoots were higher than expected. Additional genetic variance was significant across all traits except for the number of stalks per plant. Environmental variation was consistently positive, with dominant variance exceeding additive variance for all traits except shoot count. This suggests that non-additive genetic factors significantly influence certain characteristics such as row number and yield. The average degree of dominance surpassed one percent for most traits; however, broad-based heritability values remained below 60%, indicating low heritability in a strict sense. These findings underscore the importance of hybridization and indirect selection in enhancing maize traits while highlighting the complex interplay between genetic and environmental factors in trait expression.

Keywords: Additive variance, gene action, general and specific combining ability, genetic variance, hetrosis

Introduction

After rice, wheat, and barley, corn is regarded as one of the most significant cereal crops. Its grains and derivatives are important for industry, medicine, nutrition, and fodder. When the grains are mature or semi-ripe, they are utilized in human nourishment. They are consumed fried in lard, broiled, or boiled. After being combined with wheat flour, flour is also used to make bread.

Because of their high carbohydrate and fat content and low fiber content, grains are a staple in animal diets and a great source of energy (Arab Agricultural Statistics Yearbook. 2000) [16]. Because starch is derived from grains, which are extracted from a variety of components such dextrins, corn sugar, gelatinized starch, and silage, they are also utilized in animal feed for by-products of grain processing, such as bran and kabsa.

In 2010, the United States produced over 316 million metric tons of corn (Available online) Because of higher yields per hectare and more acres planted, this quantity is anticipated to rise in the future. The supply of corn grains exceeded the demand by a significant margin between 1950 and 2006.
Farmers received assistance from government initiatives (Abdullah Al_Raheem and Anees, 2024) [1], which allowed them to grow large quantities of grain at affordable prices. Feeding a lot of animals and poultry was encouraged by low maize grain prices. Up until 2000, cattle and poultry consumed 60% of the corn produced (Griffing, 1956b) [18, 19]. The price of maize grains and their consumption by poultry and cattle have both changed as a result of the growth of the ethanol fuel sector. Of the corn grain grown in the United States in 2010, only 42.9% was fed to cattle and poultry, 41.8% was used to make ethanol fuel, and 11.2% was utilized for food (Abdullah Al_Raheem and Anees, 2024) [1]. Distillers' grains and corn gluten feed are two byproducts of fuel ethanol manufacture that are used in place of some maize grains, particularly in livestock production. Livestock make good use of both by-products. maize gluten feed replaces 110–140 percent of the nutritional content of maize grain, while the corn gluten feed includes 100–110 percent of the nutritional value of corn grain, depending on the production logistics of the plant.
Both by-products are great sources of protein, however the values are lower for dairy cows that are nursing. 35–45% of the corn grain required to make gasoline ethanol is substituted by byproducts. All cattle in the US are essentially "finished" on diets that comprise 80–85% concentrates. Concentrates are now a combination of maize and by-products, whereas before they were made mostly of corn kernels (Sprague and Tatum, 1942) [29]. There are three uses for the feed component of the corn plant in the US. Some are collected as silage made from whole corn plants. Silage is utilized as a feed and energy source. In finishing systems, as roughage, or combined with wet byproducts and fed to beef cattle or animals that are "backgrounding" (Singh and Chaudhary, 2007) [28]. Following harvest, maize "waste" can also be used for grazing (Gupta and Ahmed,1982) [20]. Following grain harvest, beef cows or back-feeder heifers are put in cornfields to choose the best feed ingredients and any leftover grain. Livestock are the first to choose the high-quality grain that remains in the residue. While the leaves are tasty but indigestible, the peel is tasty and simple to digest. Because the best components are chosen first, food quality gradually deteriorates. Approximately 15% of the residue is consumed overall, with the remaining 85% going toward soil organic matter and erosion management. issue. In this system, growing calves require protein and energy supplements, but beef cows require minimal other dietary supplements (Al-Younes *et al*, 1987) [14].

The goal of the research is to increase domestic production and open international markets for domestic goods in order to achieve economic growth. Currently, the rate of local manufacturing has expanded dramatically throughout Iraq due to the government-provided infrastructure. Cotton is regarded as one of the industrial summer crops, and its production in Iraq has decreased. in a significant manner. One of the crops that is grown in two seasons (spring and fall) and in a group is yellow corn. Grains are frequently utilized as grains and green feed. They are also utilized in the production of vegetable oils and as sustenance for humans. (Abdullah Al_Raheem and Anees, 2024) [1].

Given the rise in poultry projects and the plan to build a starch factory—of which yellow corn is the primary source—Iraq must double its production and increase its cultivation of this crop in the near future. This is because these projects require corn as a basic material for industry and feed. The Ministry of Agriculture has expressed interest in promoting and growing this crop's cultivation. There are several uses for yellow corn.

Due to their inclusion in livestock fattening and poultry feed, the seeds are mostly utilized as animal feed. They are: High in vitamin E, particularly in yellow-seeded types. White is favored for a variety of industrial uses, including the textile industry, where starch is produced from seeds. Vegetable fat is made from the oil that is taken from the seeds. It is good for people with sclerosis and for their nutrition. Arteries (Griffing, 1956b) [18, 19]. Bread, particularly white-seeded breads, are made from corn flour, which can also be combined with spelled flour to make bread and samoon.

Stems and leaves are utilized as fuel and animal feed (Ahmed *et al*, 2008) [2]. Advantages of corn grains and their applications in a variety of industries, including animal feed, human diet (which is gluten-free and regarded as a staple in many nations), and cooking oil production Industrial goods (adhesives, plastics, and biodegradable sponges) Products made from corn trash, leaves, and stalks include production of chemicals, feed, and biofuels In the United States, ethyl alcohol (biofuel) and animal feed are made from around 70% of the corn harvest. However, the majority of maize produced in the EU is utilized as feed (Ahmed and Hamdo, 2003) [3]. Lastly, because it has been utilized as a model organism for genetics and molecular biology for more than a century, maize is a plant of significant interest to the scientific community. One of the most vital crops for people is maize. Nowadays, the majority of the corn crop is utilized to make animal feed, with the remaining portion being used to make flour and flakes.

Additionally, alcoholic beverages including beer, whisky, syrups, and the creation of biofuel are utilized as raw materials. There are thousands of varieties of maize available today, which is thought to be due to human domestication of the corn plant some 7,000 years ago (Al-Hamdani *et al*, 2006) [4].

The aim of study: This study aims to analyze the variance in general and specific combining abilities of corn (*Zea Mays L*), assess their percentage contributions, evaluate heterosis, and estimate genetic parameters. It also seeks to examine the variances of genotype and phenotype, the traits studied, and additional genetic variance, along with the effectiveness of the genes involved.

Materials and method

The second (fixed) method of (Griffing, 1956b) [18, 19]. was used to introduce six pure strains of yellow corn (1–6) {1. HS, 2.KM3.NA,4.SR,5.MO,6.AS} into a semi-reciprocal hybridization program in order to produce fifteen individual hybrids in the field of the Agricultural Technical College in Mosul. On July 15, 2023, the individual hybrids were grown alongside The Six Fathers. utilizing three replications of a randomized complete block design (RCBD), each of which contained six pure strains and fifteen unique hybrids. Each genotype has two meadows in the experimental unit. The meadow was 5 meters long, and there were 0.75 meters between each meadow. There were 0.25 meters separating the meadows. Each hole received two seeds, which were subsequently trimmed to produce a single plant (Kempthorne, 1956) [23]. A phosphorus source of 200 kg per hectare was the triple superphosphate fertilizer P2O5. The entire amount was applied when plowing, and 46% urea fertilizer was used. 400 kg of nitrogen per hectare is applied as a nitrogen source in two batches, one at planting and one a month later. In order to control the corn stalk borer (Sesamia criteca), the granular pesticide diazinon 10% was used locally twice a season, the first two weeks following the initial control and the the second two weeks after the first control. At the end of the season, when the plants matured, the stalks were harvested and separated to obtain their grains for the purpose of evaluating them and studying their genetic characteristics (Ahmed *et al*, 2008) [2]. Features, plant height, number of shoots, number of rows per shot, and individual plant yield (grams) were all noted. The statistical study was carried out using a completely randomized block design, and the general and specific ability to coalesce was assessed. The hybrid strength was computed using the difference between the first generation's average and the parents' average (Al-Taweel, 2009) [13]. The typical degree of dominance, the anticipated genetic improvement, and the percentage of wide and narrow heritability were all taken into consideration.

Season one (spring 2023)

In the field of the Agricultural Technical College in Mosul, the seeds of the six pure strains were sown. For every strain, three tillers were used for planting. The tiller was 5 meters long, the hole was 0.25 meters, and the space between the tillers was 0.75 meters. Each hole received two seeds, which were subsequently trimmed to produce a single plant. All half-crosses between the strains were completed during the plant's flowering stage, yielding fifteen unique hybrids (Al-Hassan and Muhammad, 2008; Narrator, 1980) [5, 26]. The male and female inflorescences were bagged to manage pollination, and the pollen grains were then moved to the female inflorescences after roughly three days. In order to reproduce their seeds and preserve their vigor and purity, the parental lines underwent self-pollination at the same time. Each strain's self-pollinated shoots and hybrid shoots (individual hybrids) were picked separately at the end of the season, and their seeds were then planted for planting the following season (Gupta and Ahmed,1982) [20].

Season Two (autumn, 2024)

On July 15, 2024, the individual hybrids—numbering fifteen—were planted. For every genetic makeup, two seeds were sown in the aforementioned dimensions at a pace of two seeds per hole, until only one plant remained. Using a randomized block design, the six parents and the individual hybrids were planted at the conclusion of the season to conduct the comparison experiment. Three replicates of complete breeding (RCBD), each containing six pure strains and fifteen unique hybrids, When the plants reach maturity toward the end of the season to evaluate the camels and research their genetic traits, the stems of the parents and individual camels were taken and separated to get their grains (Amin, 2013) [15]. Data was noted on the attributes (Mehdi and Al-Ak, 2014) [24].

- Plant height (cm), measured from the base of the male inflorescence in the milky phase to the point where the stem emerges from the soil surface (Mohammed, 1990) [25]. number of columns' rows. The quantity of spiders Yij = µ + ti + bj + eij - Individual plant yield (g) calculated by dividing the five plants' yield by the total number of plants harvested following a 15.5% humidity adjustment (Saad, 1999) [27].

Statistical analysis

Statistical analysis was carried out using a randomized complete block design (RCBD) for all researched traits for the genotypes (both parents and crosses of first generation), and the averages of the genotypes were compared using the least significant difference (L.S.D.) test at the probability level of 5% and 1% (Narrator, 1980) [26], in accordance with the following mathematical mode Given that M is the trait's overall average and Yij is the genotype I observation value in sector j.

ti = genotype effect For genotype I and in sector j, i. bj = effect of sector j. eij = effect of the experimental error of the observation (Singh and Chaudhary. 2007) [28]. The hybrid power of heterosis Equation (Narrator, 1980) [26]. was used to determine the hybrid's vigor by calculating the difference between the first generation's average and the parents' average.

The following formula was used to determine the hybrid strength V(H) variation:
To test for significance, the t value was computed for every

hybrid. l: $t = \frac{(H)}{\sqrt{V(H)}}$

$\sigma^2A = 2\sigma^2_{gca}$ Addative variance

$2\sigma^2D = \sigma^2sca$

E.G.A = *G.A*/x *100

$$E.G.A = \frac{G.A}{\bar{x}} \times 100$$

$\sigma^2G = \sigma^2A + \sigma^2D$ Genetic variance

phenotypic variance$\sigma^2P = \sigma^2G + \sigma^2e$

the heritability and dominance degree average and the expected genetic improvement

h^2. n. s= **σ^2A / σ^2P narrow sense heritability**

the dominance degree avrage $\bar{a} = \sqrt{\frac{2\sigma^2_D}{\sigma^2_A}}$

the expected genetic improvement (ΔG

Results and discussion

Table 1: Analysis of variance estimated general and specific combining ability (Griffing 1956) [18, 19].

Plant yield (gm)	Number of rows in the arnous	Number of spikes in aplant	Plant height (cm)	Degree of freedom D. F	S.O.V Sources of difference
1.55	0.924	0.008	126.08	2	Replication
**7270.86	**31.427	0.032	**1553	20	genetic structure
**3832.94	**79.119	0.0598	**3207.15	5	GCA
**84 16.83	**15.529	0.023	**1001.62	15	SCA
0.995	0.372	0.026	109.74	40	Error
0.05	0.649	1.133	1.43	-	6²GCAl 6²SCA

Table (1) shows the results of the analysis of variance of the general and specific federal estimates for the studied traits according to the second method of analysis and the fixed model, where the mean squares of the general and specific federal estimates were significant at the 1% probability level for all traits except for the number of shoots on the plant. The decrease in its value from one is due to the non-additive (sovereign) action of genes in inheriting traits. The results show the participation of additional and non-additive genetic influences in controlling the inheritance of the studied traits, except for the number of shoots in the plant, where the non-additive genetic influence was controlling the inheritance of this trait.

Table 2: hetrosis of hybrids based on the deviation of the first generation from the average of the parents

Plant yield (gm)	Number of rows in the arnous	Number of spikes in aplant	Plant height (cm)	Hybrids
**66.3	**3.93	0.033	**44.63	2*1
**52.6	0.2	0.1	**48.93	3*1
**64.1	**1.3	*0.133	**49.83	4*1
**148.7	**2.6	*0.2	**35.07	5*1
**45.1	0	*0.133	**33.4	6*1
**58.6	**4.8	0.1	9.37	2*3
**93.9	*0.66	0.067	*15.47	2*4
**102.9	**2.26	0.067	**25.03	2*5
**92.2	**5.13	0.067	-0.83	2*6

**68.7	**1.33	0.033	2.03	3*4
**143.9	**1.06	0.33	2.53	3*5
**25.8	**0.73	*0.167	1	3*6
**54.3	0.2	0.1	2.67	4*5
**85.3	**4.73	*0.133	*18.63	4*6
**112.9	**2.20	0.067	*13.6	5*6

Table No. (2) shows the strength of the hybrid based on the deviation of the average of the first generation from the average of the parents through a group of reciprocal crosses, as the chance of finding new genetic matches is high in terms of calculating the vigor of the hybrid for the genetic traits studied and for each hybrid on the basis of the deviation of the average of the first generation from the average of the parents. There is a significant difference in hybrid vigor between the studied traits studied for the same hybrid and from one hybrid to another for the same trait, and it is possible to benefit from the moral strength of the hybrid in the desired direction in a program to improve quantitative traits.

The hybrid (1*2) showed desirable, positive, and significant characteristics in the desired direction for plant height/cm, plant yield/g, and number of rows per stalk, while the characteristic for the number of stalks per plant was not significant. As for the hybrid (1*3), the characteristic was plant height/cm. Plant yield/gm Significant and desirable and in the desired direction, while the characteristics of the number of stalks on the plant and the number of rows on the stalk showed positive values and were not significant. As for the hybrid (1*4), the traits of plant height/cm and plant yield/g showed significant and desirable values, while the features of shoots numbers, the rows per shoot numbers, and the plant yielding per gram exhibited affirmative and considerable values at the 1% measure, concerning the attribute of shoots per plant numbers, the values demonstrated an affirmative and considerable trend at the probability level 5%, and in the desired direction. The hybrid (5*1) showed positive and significant hybrid vigor at a probability level of 1% and aligning with expectations for plant height, number of rows per stalk, and plant yield/g, while the trait for number of stalks per plant demonstrated a remarkable and affirmative trend at a likelihood level of 5%. Regarding the hybrid (6*1), the plant height and grain yield had affirmative and noteworthy worth at the 1% likelihood level that aligning with expectations. The number of shoots on the plant had in the affirmative and considerable value at the 5% expectation level. With regard to the rows number in the stalk, it does not have any value for the strength of the hybrid.

Respecting the hybrid (3*2), it had an affirmative and considerable measure at the 1% likelihood level for the number of rows per stalk and plant yield/g, while the trait for plant height and the stalks number for every plant had affirmative and unworthy values. Regarding hybrid (4*2), the plant yield had an affirmative and considerable worth at 1% level and was aligning with expectations. Also, the number of spiders was positive and unworthy.

In respect to the hybrid (5*2), plant height/cm, number of shoots, and plant yield/g exhibited affirmative and noteworthy values at the 1% likelihood level, while the number of shoots demonstrated positive and unworthy values.

For the hybrid (6*2), the number of rows and plant yield exhibited an affirmative and considerable value at the 1% likelihood level, however the number of shoots demonstrated an affirmative value without reaching the considerable level, nevertheless the plant height had a negative and unworthy value.

For both hybrids (4*3) and (5*3), the attributes of the number of rows per stalk and plant yield were affirmative and noteworthy at the 1% likelihood level, but unworthy and affirmative for both height and number of stalks for every plant.

As for the hybrid (6*3), the number of rows in shoots and plant yield were positive and significant at the 1% probability level, positive and significant at the 5% level for the number of shoots, and positive and insignificant for plant height.

As for the hybrid (5*4), the grain yield characteristic was positive and significant at 1%, while the rest of the characteristics were positive and not at the level of significance.

With respect to (6*4), the attributes of the number of stalk rows and plant product were affirmative and considerable at the 1% measure, however the plant height and number of stalks were affirmative and considerable at the 5% likelihood level.

Regarding the hybrid (6*5), the attributes of the rows number with shoots and plant product were affirmative and remarkable at the prospect level of 1%, while the attributes of height were affirmative and significant at 5%, and without reaching the level of significance for the number of shoots. These results agree with (Narrator, 1980 Saad, 1999; Youssef and Ramo, 2005; Singh and Chaudhary, 2007) [26, 27, 28, 33].

Table 3: Estimating the combining ability of each father for the studied attributes

Plant yield (gm)	Number of rows in the arnous	Number of spikes in aplant	Plant height (cm)	The parent
-6.54	-0.97	-0.036	-18.8	***1***
-1.52	2.59	-0.036	9.91	***2***
-9.07	-2.4	-0.0028	3.35	***3***
-0.57	0.36	0.002	13.15	***4***
24.88	1.39	0.097	2.56	***5***
-7.16	-0.97	-0.019	5.05	***6***
0.18	0.11	0.03	1.95	S.E(GI)

Table (3) demonstrates rates of the consequence of the general federal potential for each parent and every trait. It is noted that the parent (2) combines well with the desired trend for the attribute: plant height (9.91) and number of rows (2.59), meaning that this parent possesses desirable genes for these traits. The father expressed (4) Its union with the desired direction of the plant height characteristic (13.15), which gave positive moral values. As for the parent (5), it showed good union in the desired direction for plant height (2.56), plant yield (24.88), and number of plants. The rows (1.39) and the father (6) demonstrated expected positive values for the plant height characteristic (5.05). These results indicate that the general federal estimate shows the rate of performance of the fathers in the hybrid compositions.

Table 4: shows the effect of specific ability combining on the studied characteristics

Plant yield (gm)	Number of rows in the arnous	Number of spikes in aplant	Plant height (cm)	The parent
12.71	3.22	-0.017	18.45	1*2
7.09	0.09	0.017	26.48	1*3
9.69	-0.005	0.083	23.42	1*4
70.1	-1.76	0.117	9.87	1*5
-1.74	-2.13	0.100	8.36	1*6
8.9	-3.73	0.083	-14.7	2*3
34.74	-9.03	-0.050	6.17	2*4
19.24	-2.33	0.050	16.95	2*5
41	3.76	-0.03	-8.75	2*6
17.95	-10.7	0.050	-3.53	3*4
68.32	-0.13	0.017	-1.82	3*5
-17.85	0.63	-0.23	-3.19	3*6
25.32	0.42	-0.117	-17.47	4*5
32.71	2.92	-0.06	10.48	4*6
35.92	0.69	-0.03	6.66	5*6
1.94	0.19	0.32	20.44	S.E(S

Table (4) exhibits the outcome of the special unitary potential on the quantitative traits studied, as the hybrids (2*1), (3*1), (4*1), (5*1), (3*2), and (4*2) showed (5*2), (6*2), (4*3), (5*3), (5*4), (6*4), and (6*5) are expected positive and noteworthy values, for this characteristic, however the hybrids (6*1) and (6*3) demonstrated negative values that did not aligning with expectations for the plant yield. The hybrids (3*1), (4*1), (5*1), (6*1), (3*2), (2*5), (4*3), and (5*3) values were positive, considerable, and aligning with expectations, however the hybrids (2*1), (4*2), (6*2), (6*3), (5*4), (6*4), and (6*5) exhibited negative values. To describe the number of stalks in a plant, the hybrids (2*1), (3*1), (6*2), (6*3), (5*4), (6*4), and (5*6) also showed positive and desirable values for the number of rows characteristic, in the cob of corn, while the hybrids showed (4*1), (5*1), (6*1), (3*2), (4*2), (5*2), (4*3), and (53) Negative values And in the direction that is not desirable for this characteristic.

As for plant height characteristics, the hybrids showed (2*1), (3*1), (4*1), (5*1), (6*1), (4*2), (5*2), and (6).4) and (6*5) showed positive values in the desired direction, while the hybrids showed (3*2), (6*2), (4*3), (5*3), (6*3), and (5*4). (Negative values and in the other direction Desirable for this trait. this result agrees with (Sprague and Tatum, 1942; Narrator, 1980 Yadav and Singh, 1987; Saad, 1999; Singh andChaudhary, 2007) [26, 27, 28, 29, 32].

Table 5: Estimation of genetic action and genetic parameters for the studied traits

Plant yield (gm)	Number of rows in the arnous	Number of spikes in aplant	Plant height (cm)	Genetic parameters
319.33 170.7	6.56 3.52	0.002 0.002	258.12 142.87	σ^2A
2805.28 962.3	5.05 1.77	-0.001 0.003	297.29 114.8	σ^2D
3124.61 730.7	11.61 3.16	0.001 0.00	555.41 157.91	σ^2G
3124.94 570.5	11.74 2.14	0.01 0.00	591.99 108.08	σ^2P
0.33 0.2	0.12 0.08	0.009 0.005	36.58 23.95	σ^2E
1.00	0.99	0.14	0.94	B. S
0.10	0.56	0.26	0.44	n. S
4.19	1.24	0.88	1.52	ā
8.10	17.88	3.62	914	%AG

The components of phenotypic variance for the studied traits were estimated as shown in Table No. (5), if most of the component values deviated from zero for all attributes except for the attribute of the number of stalks in the plant, where the additional genetic variance values were significant and deviated from zero in all attributes except for the attribute of the stalks number in the plant, while the variance values were sovereign Significant and deviant from zero for all attributes except for the shoots number on the plant. The environmental variance values exhibited affirmative measures for all traits. The dominant variance measures also outperformed the additive for all traits except for the number of shoots. This reinforces the role of non-additive genetic influences, which have shown to control some traits, such as the number of rows in the shoots and the yield of the individual plant, as in Table (1). The results agree with (Yadav and Singh, 1987; Hamdo, 2001 Al-Hamdani and Taha, 2006 Al-Taweel, 2009; AL-Laila and Aamidi, 2010; Tonk *et al* 2011; Ali, 2012; Ali and Shakor, 2012; AL-Laila, 2015) [4, 6, 7, 8, 9, 13, 21 30, 32].

The average degree of dominance was more than one for all traits except for the number of spiders, this indicates that the average square of the deviation of the special federal estimate is greater than the average square of the deviation of the general combining potential estimate for all characteristics except for the number of cobwebs. This indicates that the traits are affected by super dominance genes, and this enables researchers to use them in the hybridization program for this trait (Al-Naimi, 2006; AL-Laila and Aamidi, 2010; Ali, 2012; Ali and Shakor, 2012; AL-Laila, 2015; AL-Obaidy, 2016; Al-Obaidi, 2017) [6, 7, 8, 9, 10, 11, 12].

As shown in Table (5), the heritability values in the broad sense were less than 60% for all traits, as they are considered high heritability values, and this is considered important in reducing the determination of the heritability of traits and the extent of their selection in the improvement program.

Concerning the values of heredity in the narrow sense, they were low for all attributes. These values were based on the criteria mentioned by previous studies (Yadav, and Singh 1987; Youssef and Ramo, 2005) [32, 33].

The low values of heritability in the narrow sense for all traits are due to the fact that the values of additional variance were low for all traits except for plant height and plant yield, as well as for genetic and dominant variance, so they were high for plant height and plant yield and low for the rest of the traits. This is explained by the superiority of the dominant and superior influence of genes and the interaction between these effects. and environmental factors

The degree of heritability in the narrow sense is more important because it expresses the percentage of extra consequences of genes that can be transmitted from one generation to another. Therefore, the method of indirect selection and crossbreeding is one of the successful programs that can be followed to improve these traits. These results are in line with (Yadav and Singh, 1987; Hussain, 2005; Al-Hamdani andYoussef, 2006 Al-Naimi, 2006; Al-Taweel, 2009; Tonk *et al* 2011) [4, 10, 13, 22, 30, 32, 33].

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