



Estimation of genetic parameters of Egyptian and local maize cultivars under high plant density and late planting in Iraq

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Abstract

The aim of this study was estimating some genetic parameters of introduced genotypes of maize at high plant densities and late planting dates for the fall season of 2023. Four Egyptian Genotypes were used and compared with two local Genotypes (and tested at two planting dates (1st and 10th August) and two plant densities (70 and 90 thousand plants h⁻¹). A randomized complete block design (RCBD) with a split-split plot arrangement with four replications was used. The traits of tassling and silking, plant height, ear height, stem diameter, number of leaves, leaf area and its index, ear length, and individual plant yield were studied. The results of the genetic analysis showed that the standard error values were low in all the studied traits and in the two dates and densities. The results also indicated that the values of the coefficient of variation were less than 20% for all the studied traits at the two dates and the two plant densities. The genetic variation values were higher than the environmental variation in most of the traits studied, with the exception of the traits of ear height, leaf area, and ear length at the date of 1th August and the density of 70 thousand plants h⁻¹, and plant height, stem diameter, number of leaves, and leaf area index at the date of 1st August and the density of 90 thousand plants h⁻¹. The diameter of the stem, the leaf area, and its evidence at the date of 10th August, and the density of 70,000 plants ha⁻¹, the number of leaves, the leaf area, its evidence, and the ear length at the date of 10th August, and the density of 90,000 plants ha⁻¹. The environmental variance values were greater than the genetic variance, and the ratio of the genetic variance to the environmental variance for these traits is less than 1. The values of the phenotypic coefficient of variation were higher than the genetic variation values for all the traits studied at the two planting dates and the two plant densities. The results showed that the highest percentage of heritability in the broad sense in the first date was 86.1% under the density of 70 thousand plants ha⁻¹ for silking trait and in the second date also it was under the density of 70 thousand plants ha⁻¹ as it reached 97.3% for the same trait.

Keywords: Genetic parameters, heritability, maize, planting dates.

Introduction

The plant breeder's knowledge of the nature of inheritance of the trait, its association with other traits, and the number of genes that govern it is essential for the success of the breeding program. The nature of the genetic appearance of the plant is affected by two factors: the genetic nature and the surrounding growth factors, and their interaction produces the traits of the plant. The plant breeder must realize that there are variations resulting directly from the action of the genotype and other variations that change with changes in the environment. Because they are quantitative traits, they are affected by environmental factors, so they cannot be relied upon in genetic variations to produce a Genotyp or breed. Genetic variation can be expressed as the difference between genetic compositions grown under similar environmental conditions, and it is the first basis on which the breeder works. The main goal of studying genetic variation is to determine genetic proportions, the most important of which is to estimate genetic variation and the percentage of heritability in the broad sense. As for environmental variations, they represent the difference between plants with similar genotypes grown in different environments [1].

Heritability represents the ratio of transmission of a quantitative trait from parents to offspring. Heritability is of two types: heritability in the narrow sense, which is the ratio of additive variation to the phenotypic variation of the trait, and heritability in the broad sense, which represents the ratio of genetic variation to the phenotypic variation of the trait. This type of inheritance includes all types of genetic variation. Which includes the hybrid vigor , epistasis , and the additive , so what is inherited from it when relying on it is limited compared to heritability in the narrow sense, and this is what makes the breeder rely on the action of the additive gene in the trait and extracting its variation to base his program on it [2].

The results of [3] showed that with increasing plant density, the value of the standard error decreased (4.27%) and the coefficient of variation (3.96%), while the percentage of the phenotypic coefficient of variation and the coefficient of genetic variation converged, while the heritability rate at high density reached 97% for some traits (ear height Its length and number of grains. A study of five inbred lines and their single hybrids showed that the percentage of genetic variation was high compared to the environmental variation, which was low, and the values of the standard error and coefficient of variation were low, while the percentage of heritability in the broad sense was high for some traits, as the percentage for plant height reached 93.4% and the number of leaves was 76.5%. The leaf area is 95.9%, the number of ears is 70.0%, the ear length is 82.3%, the number of rows ear-1 is 61.5%, the number of row grains is 79.5%, and the plant yield is 98.9% [4]. [5] indicated, through their study of five inbred lines of maize and their single and double hybrids, that the percentage of heritability in the broad sense reached 26.3% and 76.7% for tassling and silking, sequentially, 24.1% and 43.9% for plant height and ear height, respectively, and 24.1% for number of leaves, and 47.5. % for ear length, 22.2% for number of grains in the row, 36.5% for grain weight, 68.9% for dry matter weight, and 84.2% for total grain yield. [6] showed in their study several methods for calculating broad-sense heritability on four hybrids of maize. The broad-sense heritability percentage was close for some traits (number of



days to tassling, leaf area, number of leaves, number of ears and their weight), while one method differed for the two traits of plant height. The total grain yield. [7] noted that the value of the coefficient of genetic variation was low for plant height and stem diameters, and the value of the phenotypic coefficient of variation was medium for ear length, while the value of the coefficients of genetic and phenotypic variation was medium for the number of ears plant⁻¹ and plant yield. [8] explained that the value of the genetic variance was higher than the environmental variance for some traits (crop growth rate, ears weight, individual plant yield, and total grain yield).

Most of the phenotypic variance was genetic, while the researchers indicated that the values of the standard error and coefficient of variation for the aforementioned traits were Low and within the required limits. [9] confirmed, through their study of fourteen maize hybrids, that the percentage of heritability in the broad sense was high in some traits, reaching 96% for tassling, 95% for silking, 88% for plant height, 86% for ear height, and 94% for yield. Grains and 83% by weight of 100 grains. The current study was conducted to estimate some genetic parameters, broad heritability, and the coefficient of genetic and phenotypic variation to determine the best criterion for selection in plant density and the appropriate planting date for Egyptian and Iraqi Genotypes of maize.

Materials and Methods

The place where the experiment was carried out and the sources of the species used in the study

A field experiment was carried out at Research Station A of the College of Agricultural Engineering Sciences - University of Baghdad - Department of Field Crops in the Jadriya region for the fall season (2023) to study some genetic parameters of Egyptian Genotypes of yellow corn with late planting dates and high plant densities.

Table (1): Names and symbols of maize Genotypes used in the study and their source.

Number of Genotypes	Genotypes symbols	Source
1	Baghdad 3	Ministry of Agriculture - Department of Agricultural Research, Iraq
2	Al-Maha	
3	TW-78	Al-Azhar University, college of Agriculture, Egypt
4	TW-345	
5	IY-355	
6	IY-207	

Study factors, design and arrangement of the experiment

The study included three factors: the first included two planting dates on the first and tenth of August, and the second included two plant densities (70 and 90) thousand plants per hectare. The third factor includes six Genotypes of maize, four of which are Egyptian (TW-78, TW-345, IY-355, IY-207) and two are local (Baghdad-3 and Al-Maha). The experiment was designed in a randomized complete block design (RCBD) in a split-split arrangement with four replicates, where the main plots included planting

dates, the sub plot included plant densities, and the sub – sub plots included the genotypes.

Land preparation and soil and crop service operations

The agricultural land was prepared by performing all agricultural operations on it, including plowing, smoothing, and leveling. The soil was fertilized with triple super-phosphate fertilizer at a rate of 200 kg P₂O₅ ha⁻¹ in one batch before planting [10]. The land was divided into 96 panels, each panel of which It represents an experimental unit. The area of one plate is 2 x 3 m². Each plate includes planting four lines of maize. The distance between one line and another is 75 cm, and the distance between one plant and another is 14.8 cm for a plant density of 90 thousand plants h⁻¹ and 19.04 cm for a plant density of 70 thousand plants h⁻¹ Seeds were planted at a rate of 2-3 seeds per hole, and the plants were thinned to one plant. Nitrogen fertilizer was added with a recommendation of 350 kg N ha⁻¹ in the form of urea 46% nitrogen and in three batches, the first batch two weeks after planting, the second at the elongation stage, and the third at the flowering stage [10]. The weeding process was conducted several times during the agricultural season. Irrigation was carried out whenever needed. Spraying with Match pesticide, the active ingredient of which is Lufenuron 50 g/L, was carried out at a rate of 150-200 ml/100 liters of water to prevent infection with the corn stem borer, and the pesticide was used once. The aforementioned was obtained from the Agricultural Protection Department/Ministry of Agriculture.

Soil and climatic conditions analysis

Random soil samples were taken before planting at a depth of 30 cm and analyzed in the Central Laboratory for Soil, Water and Plant Analysis – Consulting Office of the College of Agricultural Engineering Sciences – University of Baghdad. Some chemical and physical properties of the experimental soil were measured for the 2023 season and the results are shown in table (1).

Table (2): Some chemical and physical properties of the experimental soil before planting.

The measured traits	Value	Unit of measurement
electrical conductivity EC 1:1	0.76	dS m-1
PH 1:1	7.20	-----
Available nitrogen	20.00	mg Kg ⁻¹ soil
Available Phosphorus	5.06	
Available potassium K	98.12	
Organic soil matter	18.6	mg Kg ⁻¹ soil
Carbonate minerals	321	
Dissolved calcium Ca ⁺²	2.5	Milliequivalent L ⁻¹
Soluble magnesium (Mg ⁺²)	1.6	
Dissolved sodium (Na ⁺)	1.8	
Soluble potassium (K ⁺)	1.02	



Soluble bicarbonate (HCO₃⁻)		1.1	
Dissolved chlorine (CL⁻)		3.4	
Soluble sulfates		3.0	
Soluble carbonates		Nil	-----
Texture classification		Loam	-----
Soil separators	Sand	432	Mg Kg ⁻¹ soil
	Clay	108	
	Loam	46	

Studied traits (genetic parameters and statistical criteria)

Genetic analysis was conducted using the Statistical Package Agricultural Research (SPAR 2.0) program to estimate some genetic parameters and statistical criteria for the studied traits (tassling, silking, plant height, ear height, stem diameter, number of leaves, leaf area, leaf area index, ear length, and individual plant yield) for the maize Genotypes at the first and tenth dates. From August, the two densities (70 and 90) thousand plants hectare⁻¹, where the coefficient of variation (CV%) was found to estimate the homogeneity between the traits, as well as the standard error (SE) for those traits, were also found. Genotypic, phenotypic and environmental variations and heritability in the broad sense were also found ($h^2_{b.s}$). according to the equations developed by [11], which are as follows:

Genetic, environmental and phenotypic variations:

$$\sigma^2g = \frac{MSV - MSe}{r}$$

$$\sigma^2e = MSe$$

$$\sigma^2P = \sigma^2g + \sigma^2e$$

Since:

- σ^2g = genotypic variation
- σ^2E = environmental variation
- σ^2P = phenotypic variation
- MSV = mean square of Genotypes
- MSe = mean square of error
- R= replications
- Heritability broad senses

$$h^2_{b.s} \% = (\delta^2 g / \delta^2 p) \times 100$$

Since:

- $h^2_{b.s}$ = heritability
- σ^2g = genotypic variation
- σ^2P = phenotypic variation

The ranges established by [12] were based on heritability in the broad sense and are as follows:

- When the broad heritability rate is less than 40%, it is low.

- When the heritability rate in the broad sense is (40 - 60) %, it is average.
- When the broad heritability rate is more than 60%, it is high

The coefficient of phenotypic variation and the coefficient of genetic variation for traits were also estimated according to the following equations:

$$PCV = (\sqrt{\sigma^2_p / \bar{x}}) \times 100$$

$$GCV = (\sqrt{\sigma^2_g / \bar{x}}) \times 100$$

Since:

PCV= Phenotypic coefficient of variation

GCV= genotypic coefficient of variation

σ^2_P = phenotypic variation

σ^2_g = genotypic variation

\bar{x} = trait means

Results and Discussion

Genetic parameters

The plant breeder's knowledge of the nature of inheritance of the trait, its association with other traits, and the number of genes that govern it is essential for the success of the breeding program. The nature of the genetic appearance of the plant is affected by two factors: the genetic nature and the surrounding growth factors, and their interaction produces the traits of the plant. The plant breeder must realize that there are variations that result directly from the action of (genotype) and other variations that change with changes in the environment because they are quantitative traits and are affected by environmental factors. Therefore, it cannot be relied upon in genetic variations to produce a Genotyp or inbred line [3]. Therefore, estimating genetic, environmental and phenotypic variations, coefficients of phenotypic and genetic variation, and the degree of heritability in the broad sense provides important information from which the most appropriate methods for improving crops can be inferred. Genetic analyzes were conducted to estimate these parameters for each planting date and plant density separately, and it is clear from the analysis of variance tables (3 and 4) that there are statistically significant differences.

Table (3): Mean variations of the studied traits for Genotypes of maize at the date 1st August and densities of 70 and 90 thousand plants h⁻¹.

1 st August							
70 thousand plants ha ⁻¹				90 thousand plants ha ⁻¹			
Sources of variation	Replication	Genotypes	Error	Sources of variation	Replication	Genotypes	Error
d.f	3	5	15	d.f	3	5	15
Tassling(daily)	0.500	27.366**	1.300	Tassling(daily)	3.555	19.200**	1.022



Silking(day)	0.055	11.766**	0.455	Silking(day)	1.444	10.666**	0.511
Plant height(cm)	53.13 9	232.179* *	31.47 4	Plant height(cm)	10.233	110.750* 5	31.66 5
Ear height(cm)	68.51 7	205.708* *	41.78 1	Ear height(cm)	52.166	426.574* *	32.47 8
Stem diameter(mm)	0.017	0.034 ^{n.s}	0.016	Stem diameter(mm)	0.017	0.100* 0.028	0.028
Leaves number	1.481	2.501**	0.387	Leaves number	0.120	2.258* 0.602	0.602
Leaf area(cm ²)	0.004	0.006*	0.002	Leaf area(cm ²)	0.001	0.011** 0.002	0.002
Leaf area Index	0.493	0.464 ^{n.s}	0.382	Leaf area Index	0.053	0.518** 0.115	0.115
Ear length(cm)	1.952	2.837* 0.806	0.806	Ear length(cm)	5.857	6.425 ^{n.s} 5.572	5.572
Yield plant(gm)	13.69 9	354.817* *	59.40 3	Yield plant(gm)	169.03 7	557.685* *	32.58 2

*0.05 significant **0.01 significant

Table (4): Mean variations of the studied traits for Genotypes of maize at the date 10th August and densities of 70 and 90 thousand plants h⁻¹.

10 th August							
70 thousand plants ha ⁻¹				90 thousand plants ha ⁻¹			
Sources of variation	Replication	Genotypes	Error	Sources of variation	Replication	Genotypes	Error
d.f	3	5	15	d.f	3	5	15
Tassling(day)	0.222	27.600**	1.422	Tassling(day)	0.055	21.100**	0.988
Silking(day)	0.444	26.266**	0.177	Silking(day)	2.055	13.766**	0.455
Plant height(cm)	70.388	715.802**	70.64 8	Plant height(cm)	51.939	611.043**	20.38 8
Ear height(cm)	43.535	690.505**	19.55 9	Ear height(cm)	16.731	592.644**	25.49 1
Stem diameter(mm)	0.052	0.023*	0.008	Stem diameter(mm)	0.002	0.134**	0.015
Leaves number	0.402	8.898**	0.659	Leaves number	0.680	1.748* 0.694	0.694
Leaf area(cm ²)	0.005	0.014*	0.005	Leaf area(cm ²)	0.007	0.023** 0.004	0.004
Leaf area Index	0.424	1.196*	0.482	Leaf area Index	0.410	1.084* 0.339	0.339

Ear length(cm)	1.876	0.555 ^{n.s}	0.422	Ear length(cm)	2.028	2.241 [*]	0.681
Yield plant(gm)	206.29 5	407.369 **	15.07 6	Yield plant(gm)	249.28 0	668.458 **	47.87 7

*0.05 significant **0.01 significant

Genetic parameters at the date of 1st August, and the plant density is 70 thousand plants ha⁻¹

The results of Table (5) indicated that all standard error values for the studied traits are low, and this decrease indicates the similarity of the trait data and its closeness to the arithmetic mean, while the values of the coefficient of variation for all the studied traits were less than 20%, which indicates homogeneity of the data. It is clear from the same table that the values of genetic variation are greater than the environmental variation in most of the studied traits. This indicates that the variation between the genotypes is mainly due to heredity with little influence of the environment and is therefore inherited. As for some traits such as ear height, leaf area, and ear length, the values were Its genetic variance is less than the environmental variance by 1.91%, 50%, and 37.17%. These traits also showed a decrease in the ratio of genetic variance to environmental variance, as it was less than 1. In such traits, selection is more difficult than for other traits and takes a longer period due to the difficulty of distinguishing the trait's phenotype. The PCV values were higher than the GCV values, which indicates that the emergence of differences was not the result of genotype only, but rather due to environmental influences. Table (5) also shows that the heritability percentage was high in the traits of tassling, silking and plant height, as it reached 83.3%, 86.1%, and 61.4%, respectively, while the degree of heritability was moderate in the plant height, number of leaves, and individual plant yield, as it ranged between 49.5% and 57.7%, while it gave The traits of leaf area and ear length had low broad heritability values, reaching 28.6% and 38.6%, respectively. This result is similar to the results of [13].

Table (5): Some genetic parameters for the studied traits of maize Genotypes at the date of 1st August and the density of 70 thousand plants h⁻¹.

Traits	SE	C.V %	$\delta^2 g$	$\delta^2 e$	$\delta^2 p$	$\frac{\delta^2 g}{\delta^2 e}$	PCV %	GC V %	$h^2_{b.s}$ %
Tassling(day)	0.80 6	2.29 9	6.516	1.300	7.816	5.01 2	5.63 8	5.14 8	83. 3
Silking(day)	0.47 7	1.21 7	2.827	0.455	3.283	6.20 6	3.26 9	3.03 4	86. 1
Plant height(cm)	3.96 6	2.32 2	50.17 6	31.47 4	81.650	1.59 4	3.74 0	2.93 2	61. 4
Ear height(cm)	4.57 0	4.36 8	40.98 1	41.78 1	82.763	0.98 0	6.14 8	4.32 6	49. 5
Stem diameter(mm)	0.09 1	6.11 8	0.004	0.016	0.021	0.26 6	6.87 6	3.13 9	20. 8

Leaves number	0.43 9	4.44 6	0.528	0.387	0.915	1.36 6	6.83 9	5.19 6	57. 7
Leaf area(cm²)	0.03 4	6.12 8	0.001	0.002	0.003	0.41 6	7.25 7	3.88 7	28. 6
Leaf area Index	0.43 7	8.65 1	0.020	0.382	0.402	0.05 3	8.87 9	2.00 2	5.1
Ear length(cm)	0.63 5	4.81 1	0.507	0.807	1.314	0.62 8	6.14 0	3.81 5	38. 6
Yield plant(gm)	5.44 9	4.39 3	73.85 3	59.40 3	133.25 7	1.24 3	6.57 9	4.89 8	55. 4

Genetic parameters at the date of 1stAugust, and the plant density is 90 thousand plants ha⁻¹

The results of Table (6) showed that the standard error values for the studied traits are low, and this decrease indicates the similarity of the trait data and its closeness to the arithmetic mean, while the values of the coefficient of variation for all the studied traits were less than 20%, which indicates homogeneity of the data. The genetic variance values were greater than the environmental variance in most of the studied traits. This indicates that the variance between the genotypes is mainly due to heredity, with little influence of the environment and is therefore inherited. As for some traits, such as plant height, stem diameter, number of leaves, and leaf area index, the variance values were the genetic variation is less than the environmental variation by 37.56%, 35.71%, 31.22% and 13.04%, respectively. This indicates that the contribution of the environment was greater in the phenotypic variation of these traits. These traits also showed a decrease in the ratio of genetic variation to environmental variation, as it was less than 1. In such traits, selection is more difficult than for other traits and takes a longer period due to the difficulty of distinguishing the pattern. The apparent trait, is it a genetic or environmental effect? The PCV values were higher than the GCV values, which indicates that the emergence of differences was not the result of genetic compositions only, but rather due to environmental influences, and they did not differ from the density of 70 thousand plants ha⁻¹. It was shown from Table (6) that the percentage of heritability in the broad sense was low for the traits of plant height, stem diameter, and ear length, as it reached 38.4%, 38.6%, and 3.6%, respectively, while the traits number of leaves and leaf area, and their evidence, gave average values (40.7%, 50.4%, and 46.5%), respectively. While the traits of tassling and silking, ear height, and individual plant yield recorded high heritability values of 81.6%, 83.2%, 75.2%, and 80.1%, respectively. [14] obtained similar results.

Table (6): Some genetic parameters for the studied traits of maize Genotypes the date of 1st August and the density of 90 thousand plants h⁻¹.

Traits	SE	C.V %	$\delta^2 g$	$\delta^2 e$	$\delta^2 p$	$\delta^2 g / \delta^2 e$	PCV %	GC V %	$h^2_{b.s}$ %
Tassling(day)	0.714	2.084	4.544	1.022	5.566	4.446	4.864	4.395	81.6
Silking(day)	0.505	1.332	2.538	0.511	3.050	4.966	3.254	2.969	83.2
Plant height(cm)	3.979	2.227	19.771	31.66	51.436	0.624	2.839	1.760	38.4
Ear height(cm)	4.029	3.708	98.524	32.478	131.002	3.033	7.447	6.458	75.2
Stem diameter(mm)	0.119	7.402	0.018	0.028	0.046	0.642	9.454	5.880	38.6
Leaves number	0.548	5.558	0.414	0.602	1.016	0.687	7.219	4.606	40.7
Leaf area(cm ²)	0.033	5.806	0.002	0.002	0.004	1	8.251	5.861	50.4
Leaf area Index	0.240	6.002	0.100	0.115	0.216	0.869	8.212	5.605	46.5
Ear length(cm)	1.669	11.800	0.213	5.572	5.785	0.038	12.024	2.308	3.6
Yield plant(gm)	4.036	3.068	131.275	32.582	163.858	4.029	6.881	6.159	80.1

Genetic parameters on 10th August, and plant density is 70 thousand plants ha⁻¹

The results of Table (7) for some genetic parameters of the studied traits at the second date, 10th August, showed that the standard error (SE) values were low for all traits and within acceptable limits (less than 20), and that the low value of the standard error is evidence that the trait data are similar and close to the mean. Arithmetic. The same table indicates that the coefficient of variation values for all studied traits are less than 20%, which is within statistically acceptable limits, and this is evidence of the homogeneity of the studied traits. Table (7) also indicates that the genetic variance values for most of the studied traits are greater than the environmental variance values. This indicates that most of the variances between the Genotypes used are caused by genetics with little influence of the environment, with the exception of the traits of stem diameter and leaf area, the evidence of which is that the environmental variance values were greater than Genetic variation decreased by 50%, 66.66%, and 63.07%, respectively. Which indicates that the environment has a major influence in showing the variation of these traits. These traits also showed a decrease in the ratio of genetic variation to environmental variation as it was less than 1. Therefore, selection is difficult for such traits due to the lack of distinction between the trait variation, whether it resulted from

the environment or not. Genetics? The phenotypic coefficient of variation values were greater than the genetic variation coefficient values for all traits studied. Table (7) showed that the percentage of the heritability broad sense was high for the traits of tassling and silking, plant height, ear diameter, number of leaves, and individual plant yield. The percentage ranged between 69.5% for plant height and 97.3% for silking, which indicates the possibility of improving these traits through selection due to their high genetic variation. While the percentage of broad heritability was low for the traits of stem diameter, leaf area, and their index, reaching 33.1, 27.1, and 27.0%, respectively. this result is similar to the results of [15] .

Table (7): Some genetic parameters for the studied traits of maize Genotypes at the date of 10th August and the density of 70 thousand plants h⁻¹.

Traits	SE	C.V %	$\delta^2 g$	$\delta^2 e$	$\delta^2 p$	$\frac{\delta^2 g}{\delta^2 e}$	PCV %	GCV %	$h^2_{b.s}$ %
Tassling(day)	0.843	2.293	6.544	1.422	7.966	4.601	5.427	4.919	82.1
Silking(day)	0.298	0.748	6.522	0.177	6.700	36.847	4.594	4.533	97.3
Plant height(cm)	5.943	3.577	161.288	70.648	231.937	2.282	6.482	5.406	69.5
Ear height(cm)	3.127	3.261	167.736	19.559	187.295	8.575	10.093	9.551	89.5
Stem diameter(mm)	0.063	4.843	0.004	0.008	0.012	0.5	5.923	3.410	33.1
Leaves number	0.574	6.353	2.059	0.659	2.719	3.124	12.899	11.227	75.7
Leaf area(cm ²)	0.054	10.115	0.002	0.006	0.008	0.333	11.839	6.153	27.1
Leaf area Index	0.491	10.115	0.178	0.482	0.661	0.369	11.839	6.152	27.0
Ear length(cm)	0.459	3.857	0.033	0.422	0.455	0.078	4.007	1.084	7.3
Yield plant(gm)	2.745	2.411	98.073	15.076	113.149	6.505	6.607	6.151	86.6

Genetic parameters on 10th August, and plant density is 90 thousand plants ha⁻¹

The results of Table (8) indicated that the standard error values for all studied traits were low and within acceptable limits (less than 20), and this indicates the consistency of the trait data and its closeness to the arithmetic mean. The results of Table (8) also showed that the coefficient of variation values were low for all the traits studied and within statistically acceptable limits, and this indicates the homogeneity of the traits. The genetic variance values for most of the studied traits are greater than the environ-



mental variance values. This indicates that most of the variations between the Genotypes used are caused by genetics, with little influence from the environment. With the exception of the number of leaves, leaf area, leaf leaf area, and ear length, the values of the genetic variation were less than the environmental variation by 62.10%, 80%, 45.13V, and 42.73%, respectively, which indicates that the contribution of the environment was The phenotypic variation of these traits was greater, and these traits also showed a decrease in the ratio of genetic variation to environmental variation, which was less than 1. Therefore, selection for such traits is more difficult than for other traits and takes a longer period due to the difficulty of distinguishing the trait's phenotype. Is it a genetic or environmental effect? The results of Table (8) showed that the values of the phenotypic coefficient of variation are greater than the values of the genetic variation coefficient for all studied traits. The percentage of heritability in the broad sense was high in some traits, such as tassling, which amounted to 83.5%, silking, 87.9%, plant height, 87.8%, ear height, 84.7%, stem diameter, 65.5%, and individual plant yield, 76.4%. While the leaf area trait gave an average value for heritability in the broad sense. It reached 49.4%, while the heritability value was low in the traits of leaf number, leaf area index, and petiole length, as it was less than 40%. [16] reached similar results.

Table (8): Some genetic parameters for the studied traits of maize Genotypes at the date of 10th August and the density of 90 thousand plants h⁻¹.

Traits	SE	C.V %	$\delta^2 g$	$\delta^2 e$	$\delta^2 p$	$\frac{\delta^2 g}{\delta^2 e}$	PCV %	GC V %	$h^2_{b.s}$ %
Tassling(day)	0.703	1.959	5.027	0.988	6.016	5.088	4.833	4.418	83.5
Silking(day)	0.477	1.240	3.327	0.455	3.783	7.312	3.574	3.352	87.9
Plant height(cm)	3.192	1.856	147.663	20.388	168.052	7.242	5.328	4.995	87.8
Ear height(cm)	3.570	3.569	141.788	25.491	167.279	5562	9.143	8.418	84.7
Stem diameter(mm)	0.088	6.214	0.029	0.015	0.045	1.933	10.592	8.578	65.5
Leaves number	0.589	6.460	0.263	0.694	0.958	0.378	7.587	3.977	27.4
Leaf area(cm ²)	0.049	8.728	0.001	0.005	0.009	0.2	12.277	8.633	49.4
Leaf area Index	0.411	10.441	0.186	0.339	0.525	0.548	12.995	7.736	35.4
Ear length(cm)	0.583	4.654	0.390	0.681	1.071	0.572	5.836	3.522	36.4
Yield plant(gm)	4.892	4.068	155.145	47.877	203.022	3.240	8.378	7.324	76.4

The Genotypes had significant genetic differences in the two planting dates and plant densities for the studied traits. The attribute data are similar and homogeneous. The genetic variance was greater than the environmental variance for most traits, while the environmental variance was higher than the genetic variance for some of the studied traits. The percentage of heritability varied widely and was more than 60% for most of the traits studied at all planting dates and plant densities used.

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