Effect of varieties and liquid organic fertilizer on maize and estimation of some genetic parameters

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Abstract

A field arrangement was conducted during the spring season of 2024 at the Field Crops Department of the College of Agriculture, Al-Qasim Green University, located in the southern part of Babil Governorate at latitude 32.40°N and longitude 44.39°E. The study aimed to examine effect of varieties and liquid organic fertilizer on maize and estimation of some genetic parameters. The arrangement was implemented as a factorial arrangement using a randomized complete block design (RCBD) with three replications. The first factor consisted of five maize varieties (Maha, Fajr1, Baghdad3, Nahrain, and Furat), and the second factor was the foliar application of four concentrations of the organic liquid fertilizer: First focus = 50 mg L^-1, second focus = 100 mg L^-1, third focus = 200 mg L^-1, and comparison factor (control, distilled water). The results showed that the variety Fajr1 outperformed the others, achieving the highest average values for most yield traits and components, including the number of ears per plant, number of grains per row, number of rows per ear, grain yield, and biological yield, with values of 1.70 ears plant^-1, 40.20 grains row^-1, 16.24 rows ear^-1, 10.48 tons ha^-1, and 21.35 tons ha^-1, respectively. Additionally, the foliar application of the organic liquid fertilizer at a concentration of 200 mg L^-1 showed superior results, with the highest averages for traits such as the number of ears per plant, number of grains per row, number of rows per ear, 500-grain weight, grain yield, and biological yield, with values of 1.69 ears plant^-1, 40.20 grains row^-1, 15.47 rows ear^-1, 121.97 g, 12.15 tons ha^-1, and 20.90 tons ha^-1, respectively. Regarding the interaction between the two factors, the combination of 200 mg L^-1 × Maha variety achieved the highest averages in the studied traits. Furthermore, genetic analysis revealed that both genotypic and phenotypic variances were higher than environmental variances when sprayed with 200 mg L^-1 of organic fertilizer. The results also indicated that the phenotypic and genotypic coefficients of variation ranged from low to moderate for most studied traits, and broad-sense heritability values varied between moderate and high, with high heritability observed for most traits.

Keywords: Maize varieties, liquid organic fertilizer, phenotypic and genetic variation, heritability.

Introduction

The yellow maize crop (Zea mays L.) is one of the most prominent cereal crops belonging to the Poaceae family. It ranks third globally, after wheat and rice, in terms of cultivated area and production. In Iraq, the cultivated area reached 359.5 thousand hectare in 2023, with an average production of 538.25 thousand tons [1]. This crop is considered strategically important both in Iraq and globally, as it is used in human and animal nutrition. Maize grains are utilized in the production of oils, starch, and animal feed [2.[

However, maize cultivation in Iraq faces numerous challenges that limit its

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productivity, such as environmental changes and the inadequate supply of nutrients to plants at the appropriate stages of their growth. Therefore, experts must explore ways to increase maize production and improve its quality. One of the most important methods is foliar feeding with organic fertilizers, which plays a significant role in enhancing growth and productivity [3]. These fertilizers contain essential nutrients like nitrogen, which is heavily consumed by maize due to its high growth efficiency, accumulation of dry matter, and its C4 metabolism [4.[

Additionally, organic fertilizers contain organic carbon, which boosts soil fertility by preserving its physical, chemical, and biological properties [5]. They are also rich in essential micronutrients necessary for various stages of plant growth, such as zinc, which is crucial for metabolic processes and positively impacts both vegetative and reproductive growth stages [6]. Moreover, organic fertilizers contain amino acids that play an important role in improving the qualitative and productive traits of the crop, especially when sprayed during periods of stress, such as flowering. This results in healthier pollen grains capable of pollination, leading to increased fertilization and consequently higher yield both quantitatively and qualitatively. These amino acids also stimulate plant hormones and growth regulators [7.[

Despite significant advances in the use of these fertilizers, which are essential for sustained agricultural production and achieving high yields and quality, it is crucial to adopt varieties with strong production capacities and adaptability to the diverse environmental conditions in Iraq. This can be achieved by studying genetic variations, including the estimation of environmental, genetic, and phenotypic variances, as well as broad-sense heritability, which refers to the degree of heritability of quantitative traits from parent to offspring. Maize exhibits significant genetic variability linked to environmental variations, making it an important genetic indicator for plant breeders [8,9]. The main goal of the present research was to study the effects of Spraying Organic Fertilizer on maize (Zea mays L.) cultivars, i.e., Euphrates, Nahrain , Mehaa, dawn 1, and Baghdad- 3, with different heritability degree.

Materials and Methods

A field arrangement was conducted in the arrangemental field of the Department of Field Crops, Faculty of Agriculture, Al-Qasim Green University, located in southern Babil Governorate, Iraq, at latitude 32.40°N and longitude 44.39°E during the spring growing season of 2024. After determining the required area for the arrangement, soil samples were taken from a depth of 0-30 cm from different locations before planting. These samples were thoroughly mixed for homogenization, air-dried, finely ground, and passed through a 2-mm sieve. A sample was then sent to the Muradiyah Research Station laboratory, affiliated with the Babil Agricultural Directorate, for chemical and physical analysis of the soil before planting. The results are shown in Table 1. The field was plowed twice perpendicularly using a moldboard plow. Diammonium phosphate (DAP) fertilizer was applied at a rate of 400 kg ha^{-1} during plowing, which contains 21% nitrogen and 48% phosphorus, broadcasted between the two plowing passes to ensure thorough mixing with the soil [10]. Afterward, the soil was smoothed, and the field was divided into three blocks with 2-meter spacing between blocks for irrigation ditches and pathways. Each block was subdivided into 20 arrangemental

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units with 1-meter spacing between the units to prevent spray drift during the application of the liquid organic fertilizer (Cifamin BK). This fertilizer was commercially sourced from the Italian company Cifo. Each arrangemental unit consisted of four planting rows, spaced 70 cm apart, with 30 cm between plants within rows, resulting in a plant density of 47,619 plants ha^{-1}, with an average of 56 plants per arrangemental unit. Sowing took place on February 17, 2024, with 2-3 seeds placed per hole after testing the germination percentages of the arrangemental varieties: Maha, Fajr 1, Baghdad 3, Al-Nahrain, and Al-Furat, which showed germination rates of 91%, 95%, 89%, 77%, and 92%, respectively. Once seedling emergence was complete, replanting was done for failed spots, and thinning was performed to one plant per hole 14 days after sowing, when plant height reached 15-20 cm. [11]. The field was irrigated immediately after planting with equal amounts of flood irrigation to ensure good germination. Irrigation was repeated in the early morning according to plant needs. Weed control was done manually with two weeding operations and one hoeing during the arrangement, as needed. Diazinon granules (10% active ingredient) were applied to control the corn stalk borer Sesamia cretica L. by placing 6 kg ha^{-1} of granules into the plant whorls, with two applications: the first 20 days after planting and the second 15 days after the first application [12]. Harvesting was done after grain filling and when signs of maturity appeared, with the leaves of most plants drying, based on the maturity stage of each variety. A factorial arrangement was carried out in a randomized complete block design with three replications. The first factor was the varieties, while the second factor was the foliar spray of liquid organic fertilizer (Cifamin BK). The foliar spray was applied three times: the first at the tasseling stage, the second at the silking stage, and the third seven days later. The spraying was done early in the morning using a 20-liter backpack sprayer, and a 6-meter-long nylon barrier was used to separate adjacent arrangemental units. The first factor included five varieties: Maha (V1), Fajr 1 (V2), Baghdad 3 (V3), Al-Nahrain (V4), and Al-Furat (V5). The second factor involved four concentrations of the liquid organic fertilizer Cifamin BK: the first concentration was distilled water only (C0), the second was 50 mg L^{-1} (C1), the third was 100 mg L^{-1} (C2), and the fourth was 200 mg L^{-1} (C3.(

Table (1) Soil components

The texture of the soil	**Soil fractions (g kg^{-1})**			The organic matter (g/kg soil(	**Available Elements (mg kg^{-1})**			**Electrical Conductivity (EC) (ds.m-1)**	**pH interaction degree**	sample
Loamy	sand	silt	mud		Potassium	Phosphorus	Nitrogen			
	255	**336**	**409**	**7.23**	**187.21**	**15.71**	**31.4**	**3.72**	**7.2**	**soil**

Studied Traits:

Traits of Yield and Its Components:

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Measurements of yield indicators and their components were conducted on a random sample at harvest, following the appearance of maturity signs on the plants, for each arrangemental unit. The measurements were carried out as follows:

.1Number of Ears (ears per plant)

The number of ears in the random sample was counted, and then the average was calculated.

.2Number of Rows per Ear:

The average number of rows was determined from ten randomly selected ears.

.3Number of Grains per Row:

The number of grains per row was counted for each ear in each arrangemental unit.

.4Weight of 500 Grains (grams(

After threshing the ears of the random sample, a random sample of grains was taken, and 500 grains were weighed using a sensitive scale after drying the seeds to a moisture content of 15.5%.

.5Grain Yield (tons per hectare(

Grain yield was calculated after threshing for an area of 0.4 m2 in each experimental unit [13. [

.6Biological Yield (tons per hectare(

This was calculated based on the total dry weight of ten complete plants (stem + leaves + ears) after drying the sample until it reached a constant weight, and the average was taken. [14[

.7Harvest Index:(%)

The harvest index was calculated using the following equation: [15 [

Harvest Index = (Total Grain Yield / Biological Yield) × 100.

Statistical Analysis:

.1 After collecting and tabulating the data, statistical analysis was conducted using the GenStat program. The treatments included all expected combinations of the factors in a factorial arrangement, following a Complete Randomized Block Design (RCBD) with three replications [16]. The means were compared using the Least Significant Differences Test (L.S.D) at a significance level of 0.05, utilizing the ready-to-use statistical analysis software V.12 GenStat.

The table (2) illustrates the chemical composition of the liquid organic fertilizer (Cifamin BK.(

Per	Type	per	type
% 0.1	Manganese (Mn)	% 40	Amino Acids
% 0.01	Boron (B)	% 20	Organic Carbon (C)
% 0.01	Zinc (Zn)	% 8	Organic Nitrogen (N)
"It contains nitrogen and some organic acids, 30%."			

Results and Discussion

.1 Number of Ears per Plant (Ears Plant^{-1}(

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The results in Table (3) indicated significant differences between the varieties and the concentrations of fertilizer spray, as well as the interaction between these factors for this trait. The variety "Fajr 1" achieved the highest average, reaching 1.70 ears per plant, while the variety "Furat" had the lowest average of 1.44 ears per plant. There were no significant differences between the varieties "Maha" and "Al-Nahrain" for this trait. This may be attributed to the contribution of vegetative and reproductive growth of the genetic composition of the variety in increasing ear formation [17], which supports the findings referenced by [18]. The results in the same table also indicated significant differences between the concentrations of the fertilizer used, where the concentration of 200 $mg.L^{-1}$ achieved the highest average of 1.69 ears per plant and did not significantly differ from the concentration of 100 $mg.L^{-1}$, which gave an average of 1.67 ears per plant. In contrast, the control treatment (0 $mg.L^{-1}$) resulted in the lowest average of 1.18 ears per plant for this trait. This can be attributed to nitrogen, which increases leaf area and chlorophyll concentration in the leaves, leading to improved photosynthetic efficiency and increased dry matter through enhanced cell division and expansion. This reflects an increase in the number of ears per plant, as the ear serves as a sink for the dry matter that the leaf provides [19]. The interaction between varieties and fertilizer spray concentrations showed that the combination (200 $mg.L^{-1}$ × Fajr 1) achieved the highest average of 2.10 ears per plant, while the combination (control × Al-Nahrain) recorded the lowest average of 1.00 ears per plant, which did not significantly differ from the combination (control × Furat) for the number of ears per plant.

Table.3. Effect of varieties and concentrations of liquid organic fertilizer on number of ears per plant.

The Effect of Spray Concentrations $mg.L^{-1}$	Cultivars					The Transactions	
	Euphrates	Nahrain	Baghdad - 3	dawn 1	Mehaa		
1.18	1.01	1.00	1.36	1.29	1.26	0	"Spray concentrations $mg \cdot L^{-1}$"
1.35	1.26	1.46	1.40	1.59	1.16	50	
1.67	1.75	1.66	1.70	1.86	1.79	100	
1.69	1.75	1.72	1.65	2.10	1.72	200	
	1.44	1.46	1.53	1.70	1.46	"Average Class Impact"	
"Interaction Effect"		"Spray Impact"		"Class Impact"		أ. ف. م. (0.05)	
0.17		0.07		0.08			

.2Grains number in Ear

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The results in Table (4) indicated significant differences among varieties and the concentrations of fertilizer application, as well as a significant interaction between the two factors concerning the number of grains per spike. The results showed that the variety Fajr 1 produced the highest average of 40.20 grains per spike, while the variety Maha recorded the lowest average of 35.95 grains in earfor this trait. This may be attributed to the genetic variation among the varieties regarding this trait, as each variety has a genetic capacity to produce a different number of grains per spike, varying from one variety to another [20,21.[
Additionally, the results from the same table indicated significant differences among the concentrations of fertilizer applied. The concentration of 200 mg.L^-1 achieved the highest average of 40.20 grains in earand did not differ significantly from the 100 mg.L^-1 concentration, which yielded an average of 40.00 grains per spike. In contrast, the control treatment at 0 mg.L^-1 recorded the lowest average of 34.36 grains in earfor this trait. This could be attributed to the role of organic fertilizer in increasing plant height and leaf area, leading to enhanced photosynthesis and the transfer of products to the spike, thereby increasing the number of grains in ear[22]. As for the interaction between the varieties and fertilizer concentrations, the combination (200 mg.L^-1 × Fajr 1) resulted in the highest average of 44.77 grains in ear, while the combination (control × Maha) resulted in the lowest average of 29.13 grains in earin the trait of the number of grains per spike
.

Table .4. Effect of varieties and concentrations of liquid organic fertilizer on grains number in ear.

"The Effect of Spray Concentrations mg.L⁻ ¹"	Cultivars					Transactions	
	Euphrates	Nahrain	Baghdad-3	Dawn1	Meha		
34.36	34.93	37.80	34.27	35.67	29.13	0	"Spray Concentrations mg.L⁻ ¹"
37.55	36.20	37.67	38.57	38.51	36.80	50	
40.00	37.90	40.23	41.27	41.84	39.57	100	
40.20	40.60	37.33	40.80	44.77	38.30	200	
	37.41	38.11	38.58	40.20	35.95	"Average Effect of the Class	
interaction Effect"		"Spray Effect"		Class Effect"		أ. ف. م. (0.05)	
2.07		0.92		1.03			

-3Rows number in Ear

The results of Table (5) showed significant differences among the varieties and the concentrations of fertilizer spray, as well as the interaction between the two factors regarding the number of rows in the ear. The variety "Fajr 1" achieved the highest average

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of 16.24 rows per plant, while the "Furat" variety recorded the lowest average of 14.00 rows per plant for this trait. The differences may be attributed to the genetic composition of the variety, the extent of its developed growth, and its good nutrition, which leads to increased leaf area, photosynthesis, and chlorophyll content, resulting in a higher number of rows in the ear [23], in accordance with [24]. The results of the same table also indicated significant differences among the concentrations of fertilizer spray used, with the concentration of 200 mg/L achieving the highest average of 15.47 rows per plant, while the control treatment (0 mg/L) had the lowest average of 14.43 rows per plant for this trait. This may be attributed to the organic fertilizers that provided the plant with most of the nutrients it needs throughout the growth period, which in turn increases the accumulation of dry matter, reduces the rate of ovary abortion, and enhances fertilization, leading to an increased number of rows per ear, consistent with [25]. As for the interaction between the varieties and the fertilizer concentrations, the combination (200 mg/L × Fajr 1) achieved the highest average of 16.97 rows per plant, while the combination (control × Furat) had the lowest average of 14.40 rows per plant, with no significant differences compared to the varieties "Nahrain" and "Baghdad 3" and "Maha" in the control combination for the number of rows in the ear.

Table .5. Effect of varieties and concentrations of liquid organic fertilizer on rows number in Ear

"The Effect of Spray Concentrations $mg.L^{-1}$"	cultivars					Transactions	
	Euphrates	Nahrain	Baghdad-3	Dawn1	Meha		
14.43	14.40	14.80	14.80	14.93	14.83	0	"Spray Concentrations $mg.L^{-1}$"
15.16	16.06	15.06	16.03	16.49	15.16	50	
15.03	16.00	15.30	16.20	15.19	16.50	100	
15.47	15.24	16.47	16.34	16.97	16.34	200	
	14.00	14.96	15.91	16.24	14.96	"Average Effect of the Class	
interaction Effect"		"Spray Effect"		Class Effect"		أ. ف. م. (0.05)	
0.46		0.20		0.23			

500 .4grains weight (g(

The results in Table (6) showed no significant differences among the varieties, while there were significant differences in the concentrations of the fertilizer spray and the interaction effect on the trait of 500-grain weight. The same table indicated significant

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differences between the concentrations of the fertilizer spray used, with a concentration of 200 mg L⁻¹ achieving the highest average of 121.97 g, whereas the control treatment at 0 mg L⁻¹ resulted in a lower average of 98.71 g for this trait. This may be due to the fact that the amino acid proline enhances the chlorophyll content in the leaves, increases leaf area, and boosts dry matter, leading to an increase in grain weight, as grains are the final product of the photosynthesis process and are supplied with greater amounts of water and essential nutrients for this process [26].Regarding the interaction between varieties and fertilizer concentrations, the combination of (200 mg L⁻¹ × Fajr 1) achieved the highest average of 129.00 g, while the combination of (control × Furat) resulted in the lowest average of 94.68 g, which did not significantly differ from the combination of (control × Nahrain) for the trait of 500-grain weight.

Table .6. Effect of varieties and concentrations of liquid organic fertilizer on 500 grains weight.

"The Effect of Spray Concentrations $mg.L^{-1}$"	cultivars					Transactions	
	Euphrates	Nahrain	Baghdad-3	Dawn1	Meha		
98.71	94.68	95.02	102.00	99.67	102.17	0	"Spray Concentrations $mg.L^{-1}$"
106.71	109.68	106.68	106.66	102.00	108.50	50	
110.24	111.35	113.35	110.00	105.33	111.17	100	
121.97	121.68	122.02	118.66	129.00	118.50	200	
	109.35	109.27	109.33	109.00	110.08	"Average Effect of the Class	
interaction Effect"		"Spray Effect"		Class Effect"		أ. ف. م. (0.05)	
3.44		1.44		NS			

.5Grain Yield (ton ha-1(

The results in Table (7) indicated significant differences among the varieties, the concentrations of foliar fertilizer, and the interaction between these factors regarding grain yield (ton ha-1). The variety Fajr 1 achieved the highest average yield of 10.48 ton ha-1, while the variety Maha recorded the lowest average yield of 8.22 ton ha-1 for this trait. This variation may be attributed to the genetic characteristics of the variety, which play a crucial role in the efficiency of nutrient uptake from its sources in both the root and vegetative systems of the plant and its conversion into accumulated food reserves in the grains. The superiority of the Fajr 1 variety

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in terms of the number of spikes and grains contributed to a greater grain yield[27], consistent with findings from[28]regarding the genetic impact of the variety on grain yield. The results from the same table also indicated significant differences among the concentrations of the foliar fertilizer used. The concentration of 200 mg L-1 achieved the highest average yield of 12.15 ton ha-1 and was not significantly different from the 100 mg L-1 concentration, which provided an average yield of 11.60 ton ha-1. In contrast, the control treatment (0 mg L-1) recorded the lowest average yield of 5.39 ton ha-1 for this trait. This may be due to the effect of proline application, which increased the yield components, thereby enhancing grain yield[29]. As for the interaction between the varieties and the concentrations of the foliar fertilizer, the combination (200 mg L-1 × Fajr 1) achieved the highest average yield of 13.81 ton ha-1, while the combination (control × Nahrain) recorded the lowest average yield of 3.87 ton ha-1, which was not significantly different from the combination (control × Maha) for the grain yield trait.

Table .7. Effect of varieties and concentrations of liquid organic fertilizer on grain yield

"The Effect of Spray Concentrations mg.L⁻ ¹" Dawn1	cultivars					Transactions	
	Euphrates	Nahrain	Baghdad-3	Dawn 1	Meha		
5.39	5.42	3.87	6.49	6.59	4.59	0	"Spray Concentrations mg.L⁻ ¹"
8.22	8.68	8.48	8.84	9.49	5.61	50	
11.60	12.25	11.27	11.29	12.06	11.17	100	
12.15	11.80	12.36	11.28	13.81	11.52	200	
	9.53	8.99	9.47	10.48	8.22	"Average Effect of the Class	
interaction Effect"		"Spray Effect"		Class Effect"		أ. ف. م. (0.05)	
1.44		0.64		0.72			

.6Biological Yield (Ton ha⁻ ¹(

The results in Table (8) show significant differences between the varieties, fertilizer spraying concentrations, and the two-way interaction regarding the biological yield trait. The variety Fajr 1 had the highest average yield of 21.35 tons ha⁻ ¹, while the variety Maha achieved the lowest average of 17.58 tons ha⁻ ¹ for this trait. This may be attributed to the selection of good varieties being the most important factor in creating a better opportunity to maximize vegetative growth. This occurs through an increase in leaf number and leaf area, allowing for greater light interception, which leads to more

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photosynthesis accumulation and dry matter production, ultimately reflecting an increase in biological yield [30.[

The same table results also indicated significant differences between fertilizer spraying concentrations. The concentration of 200 mg L^{-1} achieved the highest average of 20.90 tons ha^{-1}, while the control treatment (0 mg L^{-1}) recorded the lowest average of 15.63 tons ha^{-1} for this trait. This increase can be attributed to the abundance of absorbed elements and the profuse vegetative growth resulting from the organic fertilizer spray, in addition to improving the efficiency of physiological activities, enzyme effectiveness, and plant hormones, which enhance growth, ensure greater nutrient synthesis, and accumulate dry matter, reflecting an increase in biological yield [31]. As for the two-way interaction between varieties and fertilizer spray concentrations, the combination of (200 mg L^{-1} × Fajr 1) achieved the highest average of 26.65 tons ha^{-1}, while the combination of (control × Nahrain) recorded the lowest average of 12.31 tons ha^{-1} for the biological yield trait .

Table .8. Effect of varieties and concentrations of liquid organic fertilizer on biological yield .

"The Effect of Spray Concentrations mg.L^{-1}"	cultivars					Transactions	
	Euphrates	Nahrain	Baghdad-3	Dawn 1	Meha		
15.63	18.54	12.31	14.16	16.85	16.28	0	"Spray Concentrations mg.L^{-1}"
19.03	20.38	16.79	19.58	20.76	17.65	50	
20.25	20.73	21.65	19.82	21.16	17.92	100	
20.90	21.83	22.97	22.58	26.65	18.47	200	
	19.62	18.43	18.29	21.35	17.58	"Average Effect of the Class	
interaction Effect"		"Spray Effect"		Class Effect"		أ. ف. م. (0.05)	
0.21		0.09		0.10			

.9 Harvest Index

The results from Table (9) revealed significant differences among the varieties, fertilizer spray concentrations, and the interaction of these factors on the harvest index trait. The Maha variety achieved the highest mean of 53.67, whereas the Nahrain variety had the lowest mean of 43.31, which was not significantly different from the Baghdad 3 and Euphrates varieties (with means of 45.55 and 45.3, respectively) for this trait. The variation in the harvest index could be attributed to the efficiency of the vegetative growth of each variety and its ability to convert total photosynthates into economic yield [32]. The same table also showed significant differences among fertilizer spray concentrations, where the 100 mg/L

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concentration achieved the highest mean of 57.94. This concentration was not significantly different from the 200 mg/L concentration, which recorded a mean of 55.11. In contrast, the control concentration (0 mg/L) recorded the lowest mean of 33.37 for this trait. This increase in the harvest index may indicate enhanced nutrient and metabolic transfer from the plant parts to the sink (grains), thereby improving grain yield and its components, resulting in a higher harvest index [33]. For the two-way interaction between varieties and fertilizer spray concentrations, the combination (100 mg/L × Maha) recorded the highest mean of 68.35, while the combination (0 mg/L × Baghdad 3) recorded the lowest mean of 27.33, which was not significantly different from the combinations (control × Euphrates) and (control × Maha) for the harvest index trait.

Table .9. Effect of varieties and concentrations of liquid organic fertilizer on harvest index

"The Effect of Spray Concentrations mg.L⁻ ¹"	cultivars					Transactions	
	Euphrates	Nahrain	Baghdad-3	Dawn 1	Meha		
33.37	29.07	38.09	27.33	39.10	33.29	0.0	"Spray Concentrations mg.L⁻ ¹"
42.42	40.53	33.41	43.30	45.71	49.17	50	
57.94	55.95	51.59	56.86	56.99	68.35	100	
55.11	55.65	50.15	54.73	51.18	62.01	200	
	45.3	43.31	45.55	48.24	53.67	"Average Effect of the Class	
interaction Effect"		"Spray Effect"		Class Effect"		أ. ف. م. (0.05)	
6.012		3.046		3.406			

Results and Discussion of Genetic Analysis

.1Genetic Characteristics of Yield Traits and Their Components Studied in the Fourth Environment

Table (10) shows that the highest value of genetic variance was for the harvest index (63.97), followed by the weight of 500 seeds (17.67), biological yield (8.53), number of grains per ear (7.82), grain yield (0.95), and number of ears per plant (0.53). The lowest value was for the number of ears per plant (0.01). The same table indicates that the highest value of phenotypic variance was also for the harvest index (85.66), followed by the weight of 500 seeds (19.02), biological yield (8.53), number of grains per ear (8.32), grain yield (1.67), and number of rows per ear (0.84), while the lowest value was for the number of ears per plant (0.01). The highest value of environmental variance was found for the harvest index (21.68), followed by the weight of 500 seeds (1.35), grain yield (0.72), number of grains per ear (0.50), number of rows per ear (0.31), and number of ears

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(0.001), while the lowest value was for biological yield (0.0001). The high genetic variance compared to phenotypic variance indicates that the varieties differ in their genetic composition, allowing for selection of superior genetic compositions for the aforementioned traits. It is noted that high genetic variance values occur at a concentration of 200 mg/L for yield traits and their components, suggesting that changes in genetic and phenotypic variance contribute to the optimal development of the studied traits[34.[

The same table also shows high heritability values for the following traits: biological yield, number of grains per ear, weight of 500 seeds, number of ears per plant, harvest index, and number of rows per ear (99.89, 93.98, 92.90, 76.59, 74.68, 63.18) respectively, while the average value for grain yield was (56.73). The traits mentioned above, which exhibited high heritability, can be improved in the environment where they excelled. Some researchers have also reported broad heritability values ranging from high to low for various traits[35.[

The same table indicated that the expected genetic improvement values were moderate for the harvest index (14.23), while they were low for the traits number of ears, number of grains per ear, number of rows per ear, weight of 500 seeds, grain yield, and biological yield (0.21, 5.58, 1.19, 8.34, 1.51, 6.01) respectively. These results suggest the potential for genetic improvement in these traits, similar to findings by other researchers who reported expected genetic improvement values ranging from high to low for various traits[36.[

Additionally, the expected genetic improvement values as a percentage were high for the traits biological yield and harvest index (31.50, 30.98) respectively, while they were moderate for the traits number of ears, number of grains per ear, and grain yield (14.35, 16.58, 14.69) respectively. Conversely, the expected genetic improvement values as a percentage were low for the traits number of rows per ear and weight of 500 seeds (8.91, 8.21) respectively. This highlights the significance of expected genetic improvement percentages in these traits, reflecting the importance of the genetic aspect in enhancement, which aligns with findings by other researchers[37.[

The same table illustrates that the coefficients of genetic variation were moderate for the traits biological yield and harvest index (15.30, 17.40) respectively, while they were low for the traits number of ears, number of grains per ear, number of rows, weight of 500 seeds, and grain yield (7.96, 8.30, 5.44, 4.13, 9.47) respectively. These results are consistent with previous studies[38.[

The table also pointed to moderate coefficients of phenotypic variation for the traits grain yield, biological yield, and harvest index (12.57, 15.31, 20.14) respectively, while they were low for the traits number of ears, number of grains per ear, number of rows, and weight of 500 seeds (9.09, 8.56, 6.85, 4.29) respectively. These findings correspond with those of other researchers.

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Table (10) Values of environmental, genetic, and phenotypic variances, broad-sense heritability, expected genetic improvement, genetic improvement as a percentage, and coefficients of genetic and phenotypic variation for the traits under study, influenced by the concentration of organic fertilizer spray (200 mg L^{-1}.(

coefficient of variation	coefficient of genetic variation	Expected genetic improvement%	Genetic improvement expected	Inheritance in the broad sense	phenotypic variation	genetic variation	environmental variability	Characteristics
9.09	**7.96**	**14.35**	**0.21**	**76.59**	**0.01**	**0.01**	**0.00**	**Number of earlets per plant**
8.56	**8.30**	**16.58**	**5.58**	**93.98**	**8.32**	**7.82**	**0.50**	**Number of grains per row**
6.85	**5.44**	**8.91**	**1.19**	**63.18**	**0.84**	**0.53**	**0.31**	**Number of rows. ear**
4.29	**4.13**	**8.21**	**8.34**	**92.90**	**19.02**	**17.67**	**1.35**	**Weight of 500 grains**
12.57	**9.47**	**14.69**	**1.51**	**56.73**	**1.67**	**0.95**	**0.72**	**Grain yield**
15.31	**15.30**	**31.50**	**6.01**	**99.89**	**8.53**	**8.53**	**0.00**	**Biological yield**
20.14	**17.40**	**30.98**	**14.23**	**74.68**	**85.66**	**63.97**	**21.68**	**Harvest index**

Conclusions:

.1 Significant differences were observed among the genetic structures for all studied traits, with the cultivar Fajr 1 achieving the highest averages in growth traits, yield, and its components for most attributes. Additionally, applying liquid organic fertilizer to the studied yellow corn varieties generally increased yield and its components, with a spraying concentration of 200 mg L⁻¹ outperforming in all studied traits. The results also indicated a significant effect of the interaction between the study factors, as the combination of the cultivar Fajr 1 with the

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spraying concentration of 200 mg L⁻¹ yielded the highest averages for most of the studied traits.

.2 The results of the genetic analysis indicated that both genetic and phenotypic variances were higher than environmental variances when spraying with a concentration of 200 mg L⁻¹ of organic fertilizer.

.3 The results of the genetic analysis showed that the coefficients of phenotypic and genetic variation ranged from low to moderate for most studied traits. Furthermore, the results indicated that the broad-sense heritability values varied between high and moderate, with most traits exhibiting high heritability, suggesting the potential for direct selection of these traits by plant breeders.

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