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# Evaluation of the performance of introduced maize genotypes at late sowing dates and high plant population suitable for the fall season in the Iraqi environment

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**Abstract**

A field experiment was conducted at Research Station A of the College of Agricultural Engineering Sciences - University of Baghdad in Al-Jadriya area for the fall season (2023). A randomized complete block design (RCBD) was used with a split-split plot arrangement with four replicates and three factors. The main plot included the two sowing dates (1st and 10th of August) and the sub plot included the plant densities (70 and 90 thousand plants ha$^{-1}$). Six genotypes of maize, two Iraqi and four Egyptian (Baghdad 3, Al-Maha, TW-78, TW-345, IY-355 and IY-207), represented the sub-sub plot. The results showed that the studied traits were significantly affected by delaying the sowing dates from August 1 to 10, with the exception of number of ear rows and number of grains per row, which did not reach the significant limit. Increasing the plant density from 70,000 to 90,000 plants ha$^{-1}$ had a significant effect on the studied traits, with the exception of ear diameter, number of ear rows, and number of grains per row. The traits differed significantly among the genotypes, except for ear length and diameter, which did not reach the significance level. The interaction of planting dates with plant density did not show a significant effect for the studied traits. The genotypes responded significantly to delayed sowing dates for the studied traits, except for ear length, number of ear rows, and number of grains per row. The genotypes did not show a significant response to increasing plant density for the studied traits. The three-way interaction (sowing dates × plant densities × genotypes) showed a significant effect for the studied traits, except for the number of ear rows.

**Keywords**: Maize, Sowing Dates, Plant Population ,Genotypes .

## 1. Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops in most countries of the world. It belongs to the Poaceae family and the Maydeae tribe, which includes eight genera, five of which are eastern and not of great importance. The other three genera are American, the most important of which is the genus Zea, represented by one species, mays. Maize is an annual herbaceous plant with monoecious. The cultivation of this crop is characterized by unique features that differ from other cereal crops such as rice, wheat, barley, and oats, as it bears the male organs at the top of the plant and the female organs in the axil of one of the leaves, near the middle of the plant [1]. Maize is a significant crop due to its nutritional and industrial value, as it contains a high percentage of oils, proteins, and carbohydrates. Furthermore, it is used in animal feed as green fodder or concentrated feed [2]. There is a significant gap between Iraq's productivity and global production. This may be due to the failure to utilize growth inputs in a manner that reflects on Maize productivity, such as the ideal sowing date and plant density. Changes in climatic conditions that coincide with different sowing dates may affect biological activities. Furthermore, climatic factors may affect the yield, both quantitatively and qualitatively. Early or late sowing may expose plants to unfavorable factors that affect their yield, such as temperature and light intensity [3]. The results of [4] showed that there were significant differences between different sowing dates in ear length, diameter, and weight. The 1st August sowing date had the highest rate of these traits, reaching 21.40 cm, 47.42 mm, and 285.4 g, respectively, while the 1st July sowing date recorded the lowest rate of ear length, diameter, and weight (16.83 cm, 30.68 mm, and 123.2 g, respectively). Plant density is one of the factors affecting the growth and yield of Maize, due to the different ability of plants to compete at different densities. Optimal growth and increase require an appropriate plant density that enables it to more efficiently utilize available elements, water, and light interception, in addition to other growth factors affecting crop growth [5]. The results of [6] indicated that the number of ear rows was significantly affected by different plant densities, as plants at low plant density (50,000 plants $ha^{-1}$) had the highest mean for the trait, reaching 16.23 ear $rows^{-1}$, while high density (90,000 plants $ha^{-1}$) had the lowest mean for the number of ear rows, reaching 15.37 ear $rows^{-1}$. Obtaining new genetic combinations with good traits that outperform the prevailing commercial and local genetic combinations in terms of yield, quality, or other desirable traits is one of the most important goals of plant breeding and improvement methods [7]. The unit area yield was significantly affected by the different genotypes, as the Pioneer genotype recorded the highest rate grain number of 9.616 t $ha^{-1}$, while Buhuth 106 genotype gave the lowest rate for the trait of 4.803 t $ha^{-1}$ [8]. This study aimed to determine the optimal sowing date for the introduced genotypes, as well as to determine the best plant density and to identify the genotype most suitable for the Iraqi environment in terms of growth and productivity.

## 2. Methodology

A field experiment was conducted at Research Station A of the College of Agricultural Engineering Sciences, University of Baghdad, in Al-Jadriya area, for the fall season of 2023. The Egyptian genotypes (TW-78, TW-345, IY-355, IY-207) were obtained from the Egyptian Ministry of Agriculture - Agricultural Research Center - Crops Research Institute - Maize Research Department, while the two local genotypes (Baghdad 3 and Al-Maha) were obtained from the Ministry of Agriculture - Office of Agricultural Research. The study included three plots: the first includes two sowing dates on August 1st and 10th, the second includes two plant densities (70 and 90 thousand plants $ha^{-1}$), and the third plot includes six Maize genotypes, four of which are Egyptian (codes TW-78, TW-345, IY-355, IY-207) and two local (Baghdad 3 and Al-Maha). The experiment was designed using a randomized complete block design (RCBD) with a split-split plot arrangement with four replicates. The main plots included sowing dates, the sub plot included plant densities, and the sub-sub plots included genotypes. The agricultural land was prepared by plowing, harrowing, and leveling. The soil was fertilized with triple superphosphate fertilizer at a rate of 200 kg $P_2O_5$ $ha^{-1}$ in one batch before planting [9]. The land was divided into 96 plots, each representing an experimental unit. The area of each plot was 2 x 3 $m^2$. Each plot included four rows of Maize, with the distance between rows being 75 cm and the distance between plants being 14.8 cm for a plant density of 90,000 plants $ha^{-1}$ and 19.04 cm for a plant density of 70,000 plants $ha^{-1}$. Seeds were sown at a rate of 2-3 seeds per hole and plants were thinned to one plant. Nitrogen fertilizer was added at the recommended rate of 350 kg N $ha^{-1}$ in the form of urea 46% nitrogen in three doses, the first dose two weeks after planting, the second at the elongation stage and the third at the flowering stage [9]. Weeding was carried out several times during the growing season, and irrigation was carried out whenever necessary. Match herbicide with the active ingredient Lufenuron 50 g/L was sprayed at a rate of 150-200 ml/100 liters of water to prevent corn stem borer infestation, and this was done once. Random soil samples were taken at a depth of 30 cm before planting and analyzed.

### 1.2. Studied traits

1.2.1. Ear Length (cm): Ear length was measured from its base to its top using a measuring tape for five ears taken from five random plants in each experimental unit [10].

1.2.2. Ear Row Number (Ear Row$^{-1}$): The number of rows was calculated for five ears taken from five random plants in each experimental unit.

1.2.3. Row Grain Number (Grain Row$^{-1}$): The number of grains per row was calculated for five ears taken from five random plants in each experimental unit.

1.2.4. Ear Diameter (cm): Ear diameter was measured using a verniea for five ears taken from five random plants in each experimental unit.

1.2.5. Ear weight (g): Five ears from five plants were randomly taken from each experimental unit and weighed using a sensitive balance. The weight was then adjusted based on 15.5% moisture.

1.2.6. Unit area yield (ton ha$^{-1}$): The unit area yield was calculated using the equation developed by [10], which is as follows:

Unit area yield = individual plant yield × number of plants per hectare.

This was then converted to ton ha$^{-1}$, and the weight was adjusted based on 15.5% moisture.

Statistical analysis of all studied traits was conducted using the GenStat program according to the RCBD design in a split-split plot arrangement. Means were compared according to the least significant difference (LSD) at a probability level of 0.05 [11].

## 3. Results and discussion

### 3.1. Ear Length (cm)

The results of Table (1) showed no significant differences between the study factors and their interactions, with the exception of sowing dates, plant density, and the three-way interaction of the study factors (sowing dates × plant density × genotypes). Table (1) showed that the first date 1st of August outperformed the second date (August 10), with an increase of 11.86%, by giving 19.34 cm. The reason for the superiority of the first date is due to the suitability of climatic conditions, including temperature, relative humidity, and photoperiod, for ear growth and development. The results of the same table showed that increasing plant density led to a reduction in ear length, as the low density (70,000 plants ha$^{-1}$) achieved the highest rate for ear length, reaching 18.87 cm, compared to the high density (90,000 plants ha$^{-1}$), which recorded the lowest rate, reaching 17.76 cm. The reason for the reduced ear length at high plant density is attributed to increased shading and competition between plants for light and carbon metabolism products, especially at the beginning of ear formation, which pushes the plant to form shorter ear lengths. The results of Table (1) did not show significant differences between genotypes, the interaction of sowing dates with plant density, the interaction of sowing dates with genotypes, and the binary interaction of plant density with genotypes in the ear length trait. The response of the genotypes differed according to the plant density and sowing dates, as the genotype Al-Maha under the first plant density and the first date gave the highest rate ear length of 22.52 cm, and it differed significantly from all other genotypes, densities and dates, with an increase of 37.99% over the genotype TW-345 in the second density and the second date, which recorded the lowest rate for the trait, reaching 16.32 cm (Table 1).

Table (1): Means ear length (cm) of Egyptian and Iraqi Maize genotypes for two plant densities and two sowing dates for the fall season 2023.

| Sowing dates | Plant density (1000 plant hectare$^{-1}$ | Genotypes | | | | | | Sowing dates× plant density |
|---|---|---|---|---|---|---|---|---|
| | | Baghdad 3 | Al-Maha | TW-78 | TW-345 | IY-355 | IY-207 | |
| 1st August | 70 | 19.77 | 22.52 | 19.05 | 19.82 | 19.50 | 19.35 | 20.00 |
| | 90 | 19.40 | 17.70 | 18.62 | 17.60 | 19.37 | 19.32 | 18.67 |
| 10th August | 70 | 18.50 | 16.70 | 17.40 | 17.77 | 18.67 | 17.35 | 17.73 |
| | 90 | 17.35 | 17.02 | 16.50 | 16.32 | 16.87 | 16.97 | 16.84 |
| L.S.D (0.05) | | Sowing dates × plant density × Genotypes = 2.02 | | | | | | n.s |

| Sowing dates | Genotypes | | | | | | Sowing dates means |
|---|---|---|---|---|---|---|---|
| | Baghdad 3 | Al-Maha | TW-78 | TW-345 | IY-355 | IY-207 | |
| 1st August | 19.59 | 20.11 | 18.84 | 18.71 | 19.44 | 19.34 | 19.34 |
| 10th August | 17.92 | 16.86 | 16.95 | 17.05 | 17.77 | 17.16 | 17.29 |
| L.S.D (0.05) | n.s | | | | | | 1.20 |

| Plant density (1000 plant hectare$^{-1}$ | Genotypes | | | | | | Plant density means |
|---|---|---|---|---|---|---|---|
| | Baghdad 3 | Al-Maha | TW-78 | TW-345 | IY-355 | IY-207 | |
| 70 | 19.14 | 19.61 | 18.22 | 18.80 | 19.09 | 18.35 | 18.87 |
| 90 | 18.37 | 17.36 | 17.56 | 16.96 | 18.12 | 18.15 | 17.76 |
| L.S.D (0.05) | n.s | | | | | | 0.55 |
| Genotypes means | 18.76 | 18.49 | 17.89 | 17.88 | 18.61 | 18.25 | |
| L.S.D (0.05) | n.s | | | | | | |

### 3.2. Ear Diameter (cm)

Table (2) shows no significant differences between the study factors and their interactions, with the exception of sowing dates and their interactions with genotypes, and the triple interaction of study factors (sowing dates, plant densities, and genotypes). We note from Table (2) that delaying the sowing date from August 1 to 10 resulted in a decrease in the rate ear diameter from 4.85 to 4.52 cm, respectively, for both dates. The superiority of the first date is attributed to the favorable climatic conditions for ear growth and development. Table (2) indicates that increasing plant density did not significantly affect ear diameter. The same table also showed no significant differences between genotypes for this trait. The interaction of sowing dates with plant densities did not reach the level of significance, while the genotypes responded to the sowing dates, and the response was in the direction of decreasing from the date of August 1 to the date of August 10, as the genetic composition IY-207 outperformed the date of August 1 with the highest rate ear diameter of 4.97 cm, and the genotypes TW-345, TW-78, Baghdad 3 and Al-Maha did not differ from it at the same date (August 1), as their rates reached 4.87, 4.90, 4.80 and 4.85 cm, respectively, and differed significantly from the rest, while the genetic composition Al-Maha at the date of August 10 gave the lowest rate for the trait, which reached 4.45 cm (Table 2). The results of Table (2) show that the genotypes were not affected by increasing the plant density from 70 to 90 thousand plants ha$^{-1}$, while the same table showed a significant three-way interaction in the ear diameter trait, as the genetic composition IY-207 under the second density at the first date achieved the highest rate for the trait, reaching 4.99 cm, and the genotypes Baghdad 3, TW-345 and TW-78 were similar to it at the same density and sowing date, and all the genotypes were similar to it under the first density and the same date (the first of August), while it differed from the rest and the genetic composition Al-Maha under the first density at the second date recorded the lowest rate for the trait, reaching 4.41 cm.

Table (2): Means ear diameter (cm) of Egyptian and Iraqi Maize genotypes for two plant densities and two sowing dates for the fall season 2023.

| **Sowing dates** | **Plant density (1000 plant hectare$^{-1}$** | **Genotypes** | | | | | | **Sowing dates× plant density** |
|---|---|---|---|---|---|---|---|---|
| | | **Baghdad 3** | **Al-Maha** | **TW-78** | **TW-345** | **IY-355** | **IY-207** | |
| **1st August** | **70** | **4.80** | **4.95** | **4.97** | **4.78** | **4.77** | **4.96** | **4.87** |
| | **90** | **4.80** | **4.76** | **4.83** | **4.96** | **4.70** | **4.99** | **4.84** |
| **10th August** | **70** | **4.68** | **4.41** | **4.48** | **4.48** | **4.59** | **4.46** | **4.52** |
| | **90** | **4.43** | **4.50** | **4.49** | **4.43** | **4.67** | **4.61** | **4.52** |
| **L.S.D (0.05)** | | **Sowing dates × plant density × Genotypes = 0.22** | | | | | | **n.s** |

| **Sowing dates** | **Genotypes** | | | | | | **Sowing dates means** |
|---|---|---|---|---|---|---|---|
| | **Baghdad 3** | **Al-Maha** | **TW-78** | **TW-345** | **IY-355** | **IY-207** | |
| **1st August** | **4.80** | **4.85** | **4.90** | **4.87** | **4.73** | **4.97** | **4.85** |
| **10th August** | **4.55** | **4.45** | **4.48** | **4.46** | **4.63** | **4.53** | **4.52** |
| **L.S.D (0.05)** | **0.18** | | | | | | **0.18** |

| **Plant density (1000 plant hectare$^{-1}$** | **Genotypes** | | | | | | **Plant density means** |
|---|---|---|---|---|---|---|---|
| | **Baghdad 3** | **Al-Maha** | **TW-78** | **TW-345** | **IY-355** | **IY-207** | |
| **70** | **4.74** | **4.68** | **4.72** | **4.63** | **4.68** | **4.71** | **4.69** |
| **90** | **4.61** | **4.63** | **4.66** | **4.70** | **4.68** | **4.80** | **4.68** |
| **L.S.D (0.05)** | **n.s** | | | | | | **n.s** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Genotypes means** | **4.68** | **4.65** | **4.69** | **4.66** | **4.68** | **4.75** | |
| **L.S.D (0.05)** | **n.s** | | | | | | |

### 3.3. Number of ear rows (row ear $^{-1}$)

Table (3) indicates no significant differences between the study factors and their interactions, with the exception of genotypes. Table (3) shows that the number of ear rows was not affected by delayed sowing dates. The same table also shows that increased plant density did not affect the number of ear rows. We note from Table (3) that Al-Maha genotype outperformed its plants, giving them the highest rate number of ear rows, reaching 17.10 row ear $^{-1}$. The Baghdad 3 genotype did not differ from this, with a rate of 17.05 row ear $^{-1}$. However, it differed from all other genotypes used in the study, with the lowest being the IY-355 genotype, which reached 14.35 row ear $^{-1}$. The reason for the differences in the number of ear rows may be attributed to the genetic nature of each genotype, such as ear diameter and the number of ovary origins on the ear. All interactions of the study factors (sowing dates × plant densities), (sowing dates × genotypes), (plant densities × genotypes), and (sowing dates × plant densities × genotypes) did not reach the level of significance in the trait of number of ear rows (Table 3).

Table (3): Means Number of ear rows (row ear $^{-1}$) of Egyptian and Iraqi Maize genotypes for two plant densities and two sowing dates for the fall season 2023.

| Sowing dates | Plant density (1000 plant hectare$^{-1}$) | Genotypes | | | | | | Sowing dates× plant density |
|---|---|---|---|---|---|---|---|---|
| | | Baghdad 3 | Al-Maha | TW-78 | TW-345 | IY-355 | IY-207 | |
| 1st August | 70 | 17.30 | 17.60 | 15.50 | 15.65 | 14.50 | 16.30 | 16.14 |
| | 90 | 16.20 | 17.20 | 15.50 | 16.10 | 14.00 | 16.10 | 15.85 |
| 10th August | 70 | 17.40 | 17.10 | 14.30 | 16.00 | 14.50 | 15.60 | 15.82 |
| | 90 | 17.30 | 16.50 | 15.10 | 15.20 | 14.40 | 14.70 | 15.53 |
| L.S.D (0.05) | | Sowing dates × plant density × Genotypes = n.s | | | | | | n.s |

| Sowing dates | Genotypes | | | | | | Sowing dates means |
|---|---|---|---|---|---|---|---|
| | Baghdad 3 | Al-Maha | TW-78 | TW-345 | IY-355 | IY-207 | |
| 1st August | 16.75 | 17.40 | 15.50 | 15.88 | 14.25 | 16.20 | 16.00 |
| 10th August | 17.35 | 16.80 | 14.70 | 15.60 | 14.45 | 15.15 | 15.68 |
| L.S.D (0.05) | n.s | | | | | | n.s |

| Plant density (1000 plant hectare$^{-1}$) | Genotypes | | | | | | Plant density means |
|---|---|---|---|---|---|---|---|
| | Baghdad 3 | Al-Maha | TW-78 | TW-345 | IY-355 | IY-207 | |
| 70 | 17.35 | 17.35 | 14.90 | 15.83 | 14.50 | 15.95 | 15.98 |
| 90 | 16.75 | 16.85 | 15.30 | 15.65 | 14.20 | 15.40 | 15.69 |
| L.S.D (0.05) | n.s | | | | | | n.s |
| Genotypes means | 17.05 | 17.10 | 15.10 | 15.74 | 14.35 | 15.68 | |
| L.S.D (0.05) | 0.87 | | | | | | |

### 3.4. Number of grains per row (grain row$^{-1}$)

Table (4) shows no significant differences between the study factors and their interactions, with the exception of genotypes and the three-way interaction of the study factors (sowing dates, plant densities, and genotypes). Table 3 shows no difference in row grain number due to delayed sowing dates. The same table shows that increasing plant density had no effect on row grain number. Table 4 shows that the two genotypes IY-355 and IY-207 (Those who did not differ significantly between them) excel at the highest mean of the trait, with an increase of 8.66% and 5.43%, over Al-Maha genotype, which recorded the lowest mean for the trait, reaching 36.80 grain row$^{-1}$. The difference in row grain number between genotypes may be attributed to genetic variation within the genotypes, as well as variation in ear length (Table 1), as the ability of genotypes to produce a specific number of grains varies. The interaction of the two study factors (plant density and sowing dates) did not show significant differences in the number of grains per row, and the genotypes were not significantly affected by delaying sowing dates and increasing plant density (Table 3). While the same table indicated the response of genotypes to increasing plant density and delaying sowing dates, the genetic composition IY-355 under the first density (70 thousand plants ha$^{1}$) on the second date (August 10) gave the highest rate number of row grains, reaching 42.60 grain row$^{-1}$, and the genotypes Al-Maha, IY-207 and TW-345 were similar to it under the first density on the first date of August, with their values reaching 39.55, 40.15 and 42.15 grain row$^{-1}$, respectively, and the genotypes Baghdad 3 and IY-355 under the second density (90 thousand plants ha$^{-1}$) on the same date, with their rate reaching 39.65 and 41.75 grain row$^{-1}$, respectively, and the genotypes IY-207 and Baghdad 3 under the first density on the second date, with their rates reaching 38.00 and 39.70 grain row$^{-1}$, and the two compositions The IY-355 and IY-207 genotypes under the second density at the same date achieved 38.65 and 39.80 grain row$^{-1}$grains respectively for the two genotypes, while the Maha genotype under the first density at the second date recorded the lowest mean for the trait, reaching 35.45 grain row$^{-1}$.

Table (4): Means Number of grains per row (grain row$^{-1}$) of Egyptian and Iraqi Maize genotypes for two plant densities and two sowing dates for the fall season 2023.

| Sowing dates | Plant density (1000 plant hectare-1 | Genotypes | | | | | | Sowing dates× plant density |
|---|---|---|---|---|---|---|---|---|
| | | Baghdad 3 | Al-Maha | TW-78 | TW-345 | IY-355 | IY-207 | |
| 1st August | 70 | 35.80 | 39.55 | 37.40 | 42.15 | 36.95 | 40.15 | 38.67 |
| | 90 | 39.65 | 36.55 | 36.90 | 36.35 | 41.75 | 37.25 | 38.08 |
| 10th August | 70 | 39.70 | 35.45 | 37.40 | 37.50 | 42.60 | 38.00 | 38.44 |
| | 90 | 36.25 | 35.65 | 36.80 | 36.60 | 38.65 | 39.80 | 37.29 |
| L.S.D (0.05) | | Sowing dates × plant density × Genotypes = 4.63 | | | | | | n.s |

| Sowing dates | Genotypes | | | | | | Sowing dates means |
|---|---|---|---|---|---|---|---|
| | Baghdad 3 | Al-Maha | TW-78 | TW-345 | IY-355 | IY-207 | |
| 1st August | 37.73 | 38.05 | 37.15 | 39.25 | 39.35 | 38.70 | 38.37 |
| 10th August | 37.98 | 35.55 | 37.10 | 37.05 | 40.63 | 38.90 | 37.87 |
| L.S.D (0.05) | n.s | | | | | | n.s |

| Plant density (1000 plant hectare-1 | Genotypes | | | | | | Plant density means |
|---|---|---|---|---|---|---|---|
| | Baghdad 3 | Al-Maha | TW-78 | TW-345 | IY-355 | IY-207 | |
| 70 | 37.75 | 37.50 | 37.40 | 39.83 | 39.78 | 39.08 | 38.55 |
| 90 | 37.95 | 36.10 | 36.85 | 36.48 | 40.20 | 38.53 | 37.68 |
| L.S.D (0.05) | n.s | | | | | | n.s |
| Genotypes means | 37.85 | 36.80 | 37.13 | 38.15 | 39.99 | 38.80 | |
| L.S.D (0.05) | 1.76 | | | | | | |

**3.5. Ear Weight (g)**

Table (5) shows significant differences between the study factors and their interactions, with the exception of the interaction between plant density and sowing dates and plant density and genetic composition. The results of Table (5) show that the st outperformed the first date by an increase of 8.39%, or 16.9 g, over the tenth date of August, which rated 201.4 g. The reason for the first date's superiority in ear weight may be due to its superior ear length (Table 1), ear diameter (Table 2), ear row number (Table 3), and row number of grains (Table 4). The results of Table (5) show that increasing the plant density from 70,000 to 90,000 plants ha$^{-1}$ led to a decrease in ear weight by 4.79%, or 10.3 g. Table (5) indicated the superiority of the genetic composition IY-355 with the highest ear weight of

216.6 g and did not differ significantly from the genotypes Baghdad 3, TW-78 and IY-207, which had rated of 210.0, 212.7 and 214.4 g, respectively, while it differed from the other genotypes, and the genetic composition Al-Maha was the genetic composition with the lowest rate ear weight, which reached 201.1 g and did not differ significantly from the genetic composition TW-345. The difference between the genotypes in the ear weight trait is attributed to the variation between them in the secondary components of the crop represented by the ear length, diameter, number of rows and number of grains per row (Tables 1, 2, 3 and 4, respectively), which was reflected in the differences between the genotypes under study. The two-way interaction (sowing dates × plant density) did not reach the level of significance, while the genotypes responded to delayed sowing dates and the response was downward from August 1 to 10, as the genotype IY-207 gave the highest rate ear weight at the first date, reaching 225.4 g, and did not differ significantly from the genotypes Al-Maha, Baghdad 3, IY-355, and TW-78 at the first date of August, whose rates reached 217.0, 217.8, 215.7, and 222.3 g, respectively, and the genotype IY-355 at the second date, which rated 217.5 g and differed significantly from the rest. The genotype Al-Maha recorded the lowest rate for the trait at the tenth date of August, reaching 185.2 g (Table 5). The same table indicated that ear weight was not affected by increasing plant density from 70 to 90 thousand plants $ha^{-1}$. It is clear from Table (5) that the genetic composition IY-207 was superior under a density of 70 thousand plants $ha^{-1}$ on the first date 1 of August with the highest rate ear weight of 231.7 g and did not differ significantly from the genotypes Baghdad 3 and Al-Maha (216.9 and 230.8 g, respectively), and the genotypes TW-345 and TW-78 (219.2 and 226.8 g, respectively) under the first density on the first date, as well as the genetic composition Baghdad 3 (218.7 g) and the genotypes IY-355, TW-78 and IY-207 (217.6, 217.9 and 219.0 g, respectively) under the second density on the first date, and the genetic composition Baghdad 3 (220.5 g) and the genetic composition IY-355 (229.8 g) under the first density on the second date, while it differed from the rest and the genetic composition Al-Maha under The first density on the second date was the lowest, reaching 181.3 g.

Table (5): Means ear weight (g) of Egyptian and Iraqi Maize genotypes for two plant densities and two sowing dates for the fall season 2023.

| Sowing dates | Plant density (1000 plant hectare$^{-1}$ | Genotypes: Baghdad 3 | Al-Maha | TW-78 | TW-345 | IY-355 | IY-207 | Sowing dates× plant density |
|---|---|---|---|---|---|---|---|---|
| 1st August | 70 | 216.9 | 230.8 | 226.8 | 219.2 | 213.8 | 231.7 | 223.2 |
| | 90 | 218.7 | 203.1 | 217.9 | 204.2 | 217.6 | 219.0 | 213.4 |
| 10th August | 70 | 220.5 | 181.3 | 203.5 | 208.4 | 229.8 | 197.2 | 206.8 |
| | 90 | 183.9 | 189.1 | 202.7 | 185.3 | 205.3 | 209.5 | 196.0 |
| L.S.D (0.05) | | Sowing dates × plant density × Genotypes = 15.0 | | | | | | n.s |

| Sowing dates | Genotypes: Baghdad 3 | Al-Maha | TW-78 | TW-345 | IY-355 | IY-207 | Sowing dates means |
|---|---|---|---|---|---|---|---|
| 1st August | 217.8 | 217.0 | 222.3 | 211.7 | 215.7 | 225.4 | 218.3 |
| 10th August | 202.2 | 185.2 | 203.1 | 196.9 | 217.5 | 203.4 | 201.4 |
| L.S.D (0.05) | 10.7 | | | | | | 4.8 |

| Plant density (1000 plant hectare$^{-1}$ | Genotypes: Baghdad 3 | Al-Maha | TW-78 | TW-345 | IY-355 | IY-207 | Plant density means |
|---|---|---|---|---|---|---|---|
| 70 | 218.7 | 206.1 | 215.1 | 213.8 | 221.8 | 214.5 | 215.0 |
| 90 | 201.3 | 196.1 | 210.3 | 194.8 | 211.4 | 214.3 | 204.7 |
| L.S.D (0.05) | n.s | | | | | | 2.8 |
| Genotypes means | 210.0 | 201.1 | 212.7 | 204.3 | 216.6 | 214.4 | |
| L.S.D (0.05) | 8.0 | | | | | | |

### 3.6. Unit yield (ton ha$^{-1}$)

Table (6) for indicates significant differences between the study factors and their interactions, with the exception of the interaction between sowing dates and plant densities and the interaction between genotypes and plant densities. The results of Table (6) show that delaying the sowing date from August 1 to 10 negatively impacted the total yield, as the second date decreased by 8.40%, or 1.21 ton ha$^{-1}$, compared to the first date, which yielded the highest yield of 14.4 ton ha$^{-1}$. Increasing the plant density from 70,000 to 90,000 plants ha$^{-1}$ led to a 21.51% increase in the total yield, or 2.68 ton ha$^{-1}$ (Table 6). The reason for the superiority of the high plant density is due to the increased number of plants per unit area, which positively impacted the unit yield. The results of Table (6) show that there is a difference in the total yield according to the genotypes, as the genetic composition TW-78 was superior, giving the highest rate yield per unit area, which reached 14.22 ton ha$^{-1}$, and the genotypes Baghdad 3, IY-355 and IY-207 did not differ from it, as their rates reached 13.95, 14.00 and 14.06 ton $ha^{-1}$, respectively, compared to the genetic composition Al-Maha, which recorded the lowest rate yield per unit area, which reached 13.25 ton $ha^{-1}$. The interaction of plant densities with sowing dates was not significant, while the genotypes differed with the delay of sowing dates, as the genetic composition TW-78 achieved the highest rate yield per unit area at the first date, reaching 14.96 tons $ha^{-1}$, and the genotypes Al-Maha, Baghdad 3 and IY-207 were similar to it at the same date, as their rates reached 14.28, 14.91 and 14.60 ton $ha^{-1}$, respectively, different from the rest, and the genetic composition Al-Maha recorded the lowest rate at the second date, reaching 12.22 ton $ha^{-1}$ (Table 6). The results of the same table show that the Baghdad 3 genetic composition under the second density in the first date was superior with the highest rate yield per unit area of 17.09 ton $ha^{-1}$. The TW-78 genetic composition did not differ from it in the same density and date, as its rate reached 16.51 ton $ha^{-1}$ and differed from all other genotypes, densities and dates, while the Al-Maha genetic composition under the first density in the second date recorded the lowest rate of 10.58 ton $ha^{-1}$.

Table (6): Means Unit yield (ton $ha^{-1}$) of Egyptian and Iraqi Maize genotypes for two plant densities and two sowing dates for the fall season 2023.

<table>
<tr><th rowspan="2">Sowing dates</th><th rowspan="2">Plant density (1000 plant hectare$^{-1}$</th><th colspan="6">Genotypes</th><th rowspan="2">Sowing dates× plant density</th></tr>
<tr><th>Baghdad 3</th><th>Al-Maha</th><th>TW-78</th><th>TW-345</th><th>IY-355</th><th>IY-207</th></tr>
<tr><td rowspan="2">1st August</td><td>70</td><td>12.73</td><td>13.69</td><td>13.40</td><td>11.99</td><td>12.23</td><td>14.04</td><td>13.02</td></tr>
<tr><td>90</td><td>17.09</td><td>14.86</td><td>16.51</td><td>15.50</td><td>15.60</td><td>15.15</td><td>15.79</td></tr>
<tr><td rowspan="2">10th August</td><td>70</td><td>12.54</td><td>10.58</td><td>11.81</td><td>11.93</td><td>13.18</td><td>11.35</td><td>11.90</td></tr>
<tr><td>90</td><td>13.46</td><td>13.85</td><td>15.15</td><td>13.78</td><td>14.97</td><td>15.71</td><td>14.48</td></tr>
<tr><td colspan="2">L.S.D (0.05)</td><td colspan="6">Sowing dates × plant density × Genotypes = 0.96</td><td>n.s</td></tr>
<tr><td rowspan="2">Sowing dates</td><td colspan="7">Genotypes</td><td rowspan="2">Sowing dates means</td></tr>
<tr><td>Baghdad 3</td><td>Al-Maha</td><td>TW-78</td><td colspan="2">TW-345</td><td>IY-355</td><td>IY-207</td></tr>
<tr><td>1st August</td><td>14.91</td><td>14.28</td><td>14.96</td><td colspan="2">13.75</td><td>13.91</td><td>14.60</td><td>14.40</td></tr>
<tr><td>10th August</td><td>13.00</td><td>12.22</td><td>13.48</td><td colspan="2">12.85</td><td>14.08</td><td>13.53</td><td>13.19</td></tr>
<tr><td>L.S.D (0.05)</td><td colspan="7">0.85</td><td>0.92</td></tr>
<tr><td rowspan="2">Plant density (1000 plant hectare$^{-1}$</td><td colspan="7">Genotypes</td><td rowspan="2">Plant density means</td></tr>
<tr><td>Baghdad 3</td><td>Al-Maha</td><td>TW-78</td><td colspan="2">TW-345</td><td>IY-355</td><td>IY-207</td></tr>
<tr><td>70</td><td>12.64</td><td>12.14</td><td>12.61</td><td colspan="2">11.96</td><td>12.70</td><td>12.70</td><td>12.46</td></tr>
<tr><td>90</td><td>15.27</td><td>14.36</td><td>15.83</td><td colspan="2">14.64</td><td>15.29</td><td>15.43</td><td>15.14</td></tr>
<tr><td>L.S.D (0.05)</td><td colspan="7">n.s</td><td rowspan="2">0.35</td></tr>
<tr><td>Genotypes means</td><td>13.95</td><td>13.25</td><td>14.22</td><td colspan="2">13.30</td><td>14.00</td><td>14.06</td></tr>
<tr><td>L.S.D (0.05)</td><td colspan="8">0.35</td></tr>
</table>

## Conclusions

The first of August is a better sowing date for Egyptian maize genotypes than the tenth of August. Egyptian maize genotypes respond to high plant densities, yielding the highest yield at a plant density of 90,000 plants $ha^{-1}$. The Iraqi environment was favorable for Egyptian maize genotypes.

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