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EVALUATING THE PERFORMANCE OF SOME EGYPTIAN VARIETIES OF MAIZE AT HIGH PLANT DENSITIES AND LATE DATES IN THE FALL SEASON IN IRAQI ENVIRONMENT (YIELD AND ITS COMPONENTS)

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ABSTRACT

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) with the aim of evaluating the performance of some Egyptian varieties and comparing them with two local varieties of maize at high plant densities and late planting dates. A randomized complete block design (RCBD) was used in a split-spilt plots arrangement with four replications and three factors. The first factor included planting dates (1st and 10th August), the second factor included plant densities (70 and 90 thousand plants ha^{-1}), and the third factor included varieties (Baghdad 3, Al -Maha, TW-78, TW-345, IY-355 and IY-207). The results showed that the plants planted on the first date of 1stAugust excelled by giving the highest rate of number of ears plant (1.13 ear plant^{-1}) and Individual plant yield (180.72 gm plant^{-1}), while the traits of number of grains ear and weight of 100 grains were not significantly affected. The traits the number of grains ear^{-1} and Individual plant yield were significantly affected by increasing plant density, as the density exceeded 70,000 plant ha^{-1} with their highest mean reaching (613.3 grains ear^{-1} and 178.04 gm plant^{-1}) respectively, while the traits of number of ears plant and the weight of 100 grains were not significantly affected. The varieties differed significantly in the mentioned traits, with the exception of the number of ears. The Iraqi variety Baghdad 3 had the highest mean of grains number per ear (642.0 grains ear^{-1}), and the Egyptian variety TW-78 gave the highest mean weight of 100 grains and individual plant yield, which reached 31.64 gm and 178.05 gm plant^{-1} sequentially. The binary interaction (planting dates ×plant density) did not appear significant in the mentioned traits, while the results showed the response of the varieties to delaying the planting dates from 1st to 10th August for the mentioned traits with the exception of the number of grains per ear and the weight of 100 grains. The interaction of varieties and plant densities did not show significance for the mentioned traits, while the three-way interaction (planting dates × plant densities × varieties) showed significance for the weight of 100 grains and individual plant yield.

Key words: Densities, Maize, Sowing dates, Varieties.

[*]**This article is taken from the first researcher's master's thesis.**

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تقييم اداء بعض الاصناف المصرية ومقارنتها مع صنفين محليين من الذرة الصفراء عند كثافات نباتية عالية ومواعيد زراعة متأخرة تلائم البيئة العراقية (الحاصل ومكوناته)

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الخلاصة

نفذت تجربة حقلية في محطة ابحاث A التابعة لكلية علوم الهندسة الزراعية - جامعة بغداد - قسم المحاصيل الحقلية في منطقة الجادرية للموسم الخريفي (2023) بهدف تقييم اداء بعض الاصناف المصرية ومقارنتها مع صنفين محليين من الذرة الصفراء عند كثافات نباتية عالية ومواعيد زراعة متأخرة (مكونات الحاصل). استخدم تصميم القطاعات الكاملة المعشاة (RCBD) بترتيب الالواح المنشقة منشقة بأربعة مكررات وثلاثة عوامل، إذ تضمن العامل الاول مواعيد الزراعة (الاول والعاشر من آب) والعامل الثاني تضمن الكثافات النباتية (70 و 90 الف نبات هـ$^{-1}$) والعامل الثالث تضمن الاصناف (بغداد-3 و المها و TW-78 و TW-345 و IY-355 و IY-207). اظهرت النتائج ان النباتات المزروعة في الموعد الاول من آب تفوقت بأعطائها اعلى معدل لعدد عرانيص النبات (1.13 عرنوص نبات$^{-1}$) وحاصل النبات الفردي (180.72 غم نبات$^{-1}$) بينما لم تتأثر صفتي عدد حبوب العرنوص ووزن 100 حبة معنوياً. تأثرت صفتي عدد حبوب العرنوص وحاصل النبات الفردي معنوياً بزيادة الكثافة النباتية إذ تفوقت الكثافة 70000 نبات هـ$^{-1}$ بأعلى معدل لهما بلغ 613.3 حبة عرنوص$^{-1}$ و 178.04 غم نبات$^{-1}$ بالتتابع في حين لم تتأثر معنوياً صفتي عدد عرانيص النبات ووزن 100 حبة. اختلفت الاصناف معنوياً في الصفات المذكورة بأستثناء عدد العرانيص، إذ تفوق الصنف العراقي بغداد 3 بأعلى متوسط لعدد حبوب العرنوص (642.0 حبة عرنوص$^{-1}$) واعطى الصنف المصري TW-78 اعلى معدل لوزن 100 حبة وحاصل النبات الفردي اللذين بلغا 31.64 غم و 178.05 غم نبات$^{-1}$ بالتتابع. لم يظهر التداخل الثنائي (مواعيد الزراعة × الكثافة النباتية) معنوية في الصفات المذكورة، بينما اظهرت النتائج استجابة الاصناف بتأخير مواعيد الزراعة من 1 الى 10 آب للصفات المذكورة باستثناء عدد حبوب العرنوص ووزن 100 حبة. لم يظهر تداخل الاصناف والكثافات النباتية معنوية للصفات المذكورة، في حين اظهر التداخل الثلاثي (المواعيد الزراعية × الكثافات النباتية × الاصناف) معنوية لوزن 100 حبة وحاصل النبات الفردي.

الكلمات المفتاحية: كثافات نباتية، ذرة صفراء، مواعيد زراعة، اصناف.

INTRODUCTION

Maize (*Zea mays L.*) is from the Poaceae family and is considered one of the most important crops of this family. It occupies second place globally after wheat in terms of cultivated area and first place in terms of production. It is a triple-purpose crop, as it is considered food for humans and fodder for animals as a result. Because of its content of carbohydrate and protein compounds, in addition to its use in the production of edible oils, plant breeders have paid attention to this crop because it is bisexual and monoecious at the same time, in addition to its cross-pollination, Despite the importance of maize, its productivity in Iraq is still less than the required level, which is due to many reasons, including that the farmer is accustomed to growing open-pollinated varieties and varieties. The reason for the interest of geneticists and plant breeding in studying this crop is due to its importance at the local and global levels. By introducing new genetic compositions and deriving new and better ones through selection in order to adopt them as superior genetic compositions to the local ones, which is done through studying the components of phenotypic variation for economically

important quantitative traits **(Allaw, 2022; Aziz & Mohammed 2012)** indicated that there were significant differences in the number of ears with different planting dates, as the date of 1st July gave the highest rate of 1.31 ears plant^{-1} compared to the date of 30th July, which recorded the lowest rate (1.20) ears plant^{-1}. **Kazem & Hassan (2020)** indicated that there were significant differences in number of grains ear different planting dates in Baghdad, as the date 1st August had the highest average (606.70) grains ear^{-1} compared to the date 1st July, which recorded the lowest mean of 393.00 grains ear $^{-1}$, While the date 15th July exceeded the highest mean of 589.40 grains ear $^{-1}$, compared to the first date of July, which gave the lowest mean (475.60) grains ear $^{-1}$. **Amanah (2021)** indicated that there is no significant effect of plant densities on number of ears plant through his study of two plant densities (70 and 90) thousand plants ha^{-1} on the maize crop. There is a significant effect of the different genotypes on the weight of 100 grains, as the DKC6590 genotype excelled with the highest rate of the trait, amounting to 34.04 gm, compared to the ALMaha genotype, which gave the lowest rate of 28.20 gm **(Khalaf & Hassan, 2022)**. This study aims to study the yield and main yield components of four different Egyptian varieties of maize, compare them with two local varieties, test them under high plant densities and late planting dates for the fall season, Obtaining the best variety that suits the environmental stresses represented by plant densities and planting dates, and determining the best planting date that suits the fall season and the best plant density.

MATERIALS AND METHODS

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 varieties of maize with late planting dates and high plant densities.

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

Number of cultivars	Cultivars 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

The study included three factors: the first included two sowing dates on the first and tenth of August, and the second included two plant densities (70 and 90 thousand plants ha^{-1}). The third factor includes six varieties of maize, four of which are Egyptian (TW-78, TW-345, IY-355, IY-207) and two are local (Baghdad-3 and Al-Maha).

Design and arrangement of the experiment

The experiment was designed in a randomized complete block design (RCBD) in a split-split arrangement with four replications, where the main plots included planting dates, the secondary plots included plant densities, and the sub-sub plots included the varieties.

Land preparation, soil and crop management

The agricultural land was prepared by carrying out all agricultural operations on it, including plowing, 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 **(Saleh & Salman, 2005)**. The land was divided into 96 plots, each plot of which it represents an experimental unit. The area of one plot is 2 × 3 m^2. Each plot includes planting four lines. 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 ha^{-1} and 19.04 cm for a plant density of 70 thousand plants ha^{-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 **(Saleh & Salman, 2005)**. The weeding process was conducted several times during the agricultural season. Irrigation was done whenever needed. Spraying was done with Match pesticide, the active ingredient of which is Lufenuron 50 g/L, at a rate of 150-200 ml/100 liters of water to prevent infection by the corn stem borer for one time. The pesticide the aforementioned was obtained from the Agricultural Protection Department/ Ministry of Agriculture.

Studied traits:

1- Number of ears plant (ear $Plant^{-1}$): number of ears plant was calculated for five plants randomly for each experimental unit.

2- Number of grains ear (grain ear^{-1}): number of grains in the ear was calculated from the following equation:
number of grains ear = number of rows ear × number of grains row
3- Weight of 100 grains (gm): 100 grains were counted from each sample and then weighed with a sensitive balance taken from five plants randomly for each experimental unit.
4- Individual plant yield (gm plant^{-1}): ears of each plant were separated and weighed with a sensitive balance, and the weight was adjusted on the basis of 15.5% humidity for five plants taken randomly from each experimental unit **(Elsahookie, 1990)**.
Statistical analysis was conducted for all studied traits using the GenStat program according to the RCBD design within the split-split plots arrangement, and the means were compared according to the least significant difference (LSD) with a probability level of 0.05 **(Elsahookie & Wuhaib, 1990)**.

RESULTS AND DISCUSSION

Number of ears per plant (ear Plant^{-1})

The results of Table 2 indicated that the first date of 1st August was superior in giving it the highest mean of ears plant reached 1.13 ear Plant^{-1}, compared to the date of the 10th August, which gave the lowest mean number of ears (1.00 ears plant^{-1}). This result was similar to the results of **Aziz & Mohammed (2012); Regab & Jassim (2016); Hashim (2021)**. Plant densities and varieties and their interactions (planting dates × plant densities and plant densities × varieties) and the triple interaction (planting dates × plant density × varieties) did not show significant different for number of ears plant (Table 2). While the same table indicated a difference in the varieties by delaying the planting dates in the direction of a decrease from the date of the1st August to10th August, as the Egyptian variety TW-78 excelled at the date of 1st August with the highest number of ears, amounting to 1.22 ears plant^{-1}, and it did not differ significantly from the Egyptian variety IY-355 at the same date, which gave mean 1.17 ears plant^{-1}, while it differed from all other varieties used, and the Iraqi Al-Maha and Egyptian varieties (TW-78, TW-345, IY-355, and IY-207) were similar at the date 10th August by giving them the lowest rate.

Table (2): Response of Ears number plant^{-1} for Egyptian and Iraqi varieties of maize for two plant densities and two sowing dates for the fall season 2023.

Sowing dates	Plant density (1000 plant hectare^{-1}	Varieties						Sowing dates× plant density
		Baghdad 3	Al-Maha	TW-78	TW-345	IY-355	IY-207	
1st August	70	1.15	1.15	1.15	1.05	1.15	1.10	1.12
	90	1.10	1.10	1.30	1.15	1.20	1.00	1.14
10th August	70	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	90	1.10	1.00	1.00	1.00	1.00	1.00	1.01
L.S.D (0.05)		Sowing dates × plant density × varieties = n.s						n.s
Sowing dates		Varieties						Sowing dates means
		Baghdad 3	Al-Maha	TW-78	TW-345	IY-355	IY-207	
1st August		1.12	1.12	1.22	1.10	1.17	1.05	1.13
10th August		1.05	1.00	1.00	1.00	1.00	1.00	1.00
L.S.D (0.05)		0.09						0.07
Plant density (1000 plant hectare^{-1}		Varieties						Plant density means
		Baghdad 3	Al-Maha	TW-78	TW-345	IY-355	IY-207	
70		1.12	1.12	1.22	1.10	1.17	1.05	1.13
90		1.05	1.00	1.00	1.00	1.00	1.00	1.00
L.S.D (0.05)		n.s						n.s
Varieties means		1.08	1.06	1.11	1.05	1.08	1.02	
L.S.D (0.05)		n.s						

Number of grains per ear (grain ear^{-1})

The results of Table 3 showed that there is no significant effect of planting dates and interactions (planting dates × plant densities), (plant densities × varieties), (planting dates × varieties) and (planting dates × plant density × varieties) on number of grains ear. While the trait varied with increasing plant density from 70 to 90 thousand plants ha^{-1}, The first density excelled with the highest mean (613.3 grain ear^{-1}) compared to the second density, which gave the lowest mean of 589.1 grain ear^{-1}. The reason may be attributed to the fact that increasing number of plants per unit area led to a reduction in source efficiency (number of leaves and leaf area) these traits were mentioned in the master's thesis, and thus It led to a decrease in the readiness of carbon assimilation products and led to the abortion of the ovaries, which was reflected in the capacity of the sink (length of ear, number of its rows, and number of grains in the row) these traits were mentioned in the master's thesis.

This result agrees with **Al-Mowsawi (2019); Amanah (2021).**

The results of Table 3 showed that there was a significant difference between the varieties, as the Iraqi variety Baghdad 3 excelled by giving it the highest mean number of grains ear, amounting to 642.0 grain ear^{-1}, and it did not differ significantly from the Iraqi variety Al-Maha, which recorded 628.6 grains ear^{-1}, and the Egyptian variety IY-207, which recorded 606.8 grains ears^{-1}. While it differed from all the other varieties used in the study, while the Egyptian variety TW-78 gave the lowest mean (559.3 grain ear $^{-1}$). The reason for the difference between the varieties in the number of grains ear may be attributed to the nature of the genetic base of the varieties, as each variety has a genetic base that controls number of grains ear, **Allaw (2022)** reached a similar result.

Table (3): Response of Grain number ear^{-1} for Egyptian and Iraqi varieties of maize for two plant densities and two sowing dates for the fall season 2023.

Sowing dates	**Plant density (1000 plant hectare^{-1}**	**Varieties**						**Sowing dates× plant density**
		Baghdad 3	Al-Maha	TW-78	TW-345	IY-355	IY-207	
1st August	70	613.8	692.4	580.3	653.2	532.3	651.9	620.6
	90	639.1	627.2	570.8	584.7	586.5	600.7	601.5
10th August	70	686.0	609.0	535.3	598.5	614.7	592.4	606.0
	90	629.0	586.0	550.8	557.1	555.5	582.4	576.8
L.S.D (0.05)		Sowing dates × plant density × varieties = n.s						n.s

Sowing dates	Varieties						Sowing dates means
	Baghdad 3	Al-Maha	TW-78	TW-345	IY-355	IY-207	
1st August	626.4	659.8	575.5	618.9	559.4	626.3	611.1
10th August	657.5	597.5	543.0	577.8	585.1	587.4	591.4
L.S.D (0.05)	n.s						n.s

Plant density (1000 plant hectare^{-1}	Varieties						Plant density means
	Baghdad 3	Al-Maha	TW-78	TW-345	IY-355	IY-207	
70	649.9	650.7	557.8	625.8	573.5	622.1	613.3
90	634.0	606.6	560.8	570.9	571.0	591.5	589.1
L.S.D (0.05)	n.s						13.8
Varieties means	642.0	628.6	559.3	598.4	572.2	606.8	
L.S.D (0.05)	38.1						

Weight of 100 grains (gm)

Table 4 showed that there were no significant differences in the weight of 100 grains with delaying planting dates, increasing plant density, the interaction between them, the interaction of varieties and planting dates, and the interaction (varieties × plant density).

The difference in varieties had a significant differences on the weight of 100 grains, as the Egyptian variety TW-78 had the highest mean of 31.64 gm, different from all the Iraqi and Egyptian varieties used in the study, while the Iraqi variety Al-Maha recorded the lowest mean (26.01 gm) (Table 4), which may be due to The reason for the superiority of the Egyptian variety TW-78 is due to the genetic factors that characterize the variety and the extent to which it is affected by environmental factors, as this trait is determined by the genetic factor with a limited influence of other growth factors. This result agreed with **Al-Kaisy (2015)**; **Almousawi & Hassan (2021)**.

The results of Table 4 showed a significant triple - interaction for the weight of 100 grains. The Egyptian variety TW-78, with a density of 90 thousand plants ha^{-1}, at the date of 1st August, gave the highest mean (32.55 gm), and did not differ significantly from the same variety in the density of 70 thousand plants ha^{-1}. On the date 1st August, and in the first and second densities on the second date 10th August, and the Iraqi variety Baghdad 3 at the second density on the first date, and the Egyptian variety IY-207 at the first density on the first date, and the same variety at the second density on the second date, while it differed from the others of the varieties used, the least of which was the value of the Iraqi variety Al-Maha. The first density at the second appointment amounted to 24.55 gm.

Table (4): Response of weight of 100 grains (gm) for Egyptian and Iraqi varieties of maize for two plant densities and two sowing dates for the fall season 2023.

Sowing dates	Plant density (1000 plant hectare^{-1}	Varieties						Sowing dates× plant density
		Baghdad 3	Al-Maha	TW-78	TW-345	IY-355	IY-207	
1st August	70	27.20	27.10	32.20	26.45	29.10	30.80	28.81
	90	30.20	26.25	32.55	27.85	28.15	28.70	28.95
10th August	70	25.35	24.55	31.15	28.00	29.60	26.90	27.59
	90	25.95	26.15	30..65	25.45	28.90	30.55	27.94
L.S.D (0.05)		Sowing dates × plant density × varieties = 2.97						n.s

Sowing dates	Varieties						Sowing dates means
	Baghdad 3	Al-Maha	TW-78	TW-345	IY-355	IY-207	
1st August	28.70	26.68	32.38	27.15	28.63	29.75	28.88
10th August	25.65	25.35	30.90	26.73	29.55	28.73	27.77
L.S.D (0.05)	n.s						n.s

Plant density (1000 plant hectare^{-1}	Varieties						Plant density means
	Baghdad 3	Al-Maha	TW-78	TW-345	IY-355	IY-207	
70	26.28	25.83	31.68	27.23	29.35	28.85	28.20
90	28.08	26.20	31.60	26.65	28.53	29.63	28.45
L.S.D (0.05)	n.s						n.s
Varieties means	27.18	26.01	31.64	26.94	28.94	29.24	
L.S.D (0.05)	1.35						

Grian yield (gm)

Table 5 showed a significant difference in the yield of individual plants by delaying planting dates, as the date of 1st August was superior by giving the highest mean 180.72 gm plant^{-1} compared to the date 10th August, which gave the lowest mean (165.53 gm plant^{-1}). The reason for the superiority of the first date 1st August may be attributed to the appropriate environmental conditions during the flowering period, which reflected positively on the vitality of the pollen grains, which led to the success of the pollination process and thus led to an increase in the length of the ear, number of its rows, number of grains in the row (these traits

were mentioned in the master's thesis), number of grains ear, and weight of 100 grain, in addition to what led to an increase Plant yield. **Al-Mashhadani (2015)** found a similar result. The yield of an individual plant decreases with an increase in plant density from 70 to 90 thousand plants ha^{-1}, as the first density gave the highest mean 178.04 gm $plants^{-1}$ compared to the second density, which gave the lowest mean (168.22 gm $plants^{-1}$) (Table 5). The reason for the decrease in yield at high density may be due to the decrease in its main components number of ears, number of grains ear, and weight of grains (Table 2,3,4) and its secondary components, represented by number of rows ear and number of grains in the row (these traits were studied in the master's thesis), which was reflected in the plant's yield. **Majeed *et al.* (2017); Amanah & Hadi (2022)** reached similar results by obtaining significant differences according to plant density.

The results of the same table indicated that there was a significant difference between the varieties used in the individual plant yield, as the Egyptian variety TW-78 excelled with the highest mean of 178.05 gm $plant^{-1}$, and it did not differ significantly from the two Egyptian varieties IY-355 and IY-207, whose means were 175.72 and 176.47 gm $plant^{-1}$, respectively, and the Iraqi variety Baghdad 3, which averaged 175.16 gm $plant^{-1}$, while it differed significantly from the other varieties. The Iraqi variety Al-Maha had the lowest mean, reaching 166.51 gm $plant^{-1}$. This result agreed with **Wahed & Al-Azawi (2023)**.

Table 5. Response of Grian yield (gm) for Egyptian and Iraqi varieties of maize for two plant densities and two sowing dates for the fall season 2023.

Sowing dates	Plant density (1000 plant hectare-1	Varieties						Sowing dates× plant density
		Baghdad 3	Al-Maha	TW-78	TW-345	IY-355	IY-207	
1st August	70	181.95	195.70	191.55	171.40	174.75	200.70	186.01
	90	189.90	165.15	183.50	172.30	173.40	168.40	175.44
10th August	70	179.25	151.25	168.80	170.50	188.35	162.25	170.07
	90	149.55	153.95	168.35	153.15	166.40	174.55	160.99
L.S.D (0.05)		Sowing dates × plant density × varieties = 12.57						n.s

Sowing dates	Varieties						Sowing dates means
	Baghdad 3	Al-Maha	TW-78	TW-345	IY-355	IY-207	
1st August	185.92	180.42	187.52	171.85	174.07	184.55	180.72
10th August	164.40	152.60	168.57	161.82	177.37	168.40	165.53
L.S.D (0.05)	11.35						12.31
Plant density (1000 plant hectare-1	Varieties						Plant density means
	Baghdad 3	Al-Maha	TW-78	TW-345	IY-355	IY-207	
70	180.60	173.47	180.17	170.95	181.55	181.47	178.04
90	169.72	159.55	175.92	162.72	169.90	171.47	168.22
L.S.D (0.05)	n.s						4.65
Varieties means	175.16	166.51	178.05	166.84	175.72	176.47	
L.S.D (0.05)	4.40						

CONCLUSION

1- Delaying the planting date from 1st and 10th August led to a decrease in number of ears plant and thus a decrease in the plant yield, from this we conclude that the date of 1st August is better than 10th August.
2- Reducing the plant density from 90000 to 70000 plants ha^{-1} led to an increase in number of ear grains and thus an increase in plant yield.
3- The best introduced variety in terms of grain weight and plant yield is the Egyptian variety TW-78.
4- The two interactions (planting dates × plant densities) and (planting dates × varieties) did not affect the mentioned yield traits, while the interactions planting dates × varieties and planting dates × plant densities × varieties affected some of the mentioned yield traits.

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