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EFFECT OF NITROGEN FERTILIZATION ON YIELD AND ITS COMPONENTS OF SOME MAIZE GENOTYPES

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ABSTRACT

The study aimed to demonstrate the effect of nitrogen fertilization on the yield of maize and its genotypes (Al Maha, Sumer, Al Fajr, Baghdad, 5018, Zia1×Zia4, Zia2×Zia4) under two levels of nitrogen fertilization (92 and 276 kg N/ ha), the experiment was applied using the randomized complete block design (RCBD) with split plot arrangement with three replications, and the main plots included two levels of nitrogen fertilization, As for the sub-plots, they included seven genotypes, The results showed the superiority of genotype 5018 by giving it the highest total kernels yield amounting to 8.541 tons/ h as a result of its superiority in the characteristics of the yield components which are the number of ears (1.350 ear / plant), the number of kernels per ear (721.950 kernel/ ear) and the weight of 100 kernel (29.340 g), as for the levels of nitrogen fertilization, the results showed that the levels of fertilizers were not significant in all traits except for the characteristic of the biological yield.

Keywords: Nitrogen fertilization, maize, biological yield.

تأثير التسميد النيتروجيني على الحاصل ومكوناته لتراكيب وراثية من الذرة الصفراء

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الخلاصة:

هدفت الدراسة لبيان تأثير التسميد النيتروجيني على حاصل الذرة الصفراء وتراكيبه الوراثية (المها، سومر، الفجر، بغداد، 5018، Zia1×Zia4، Zia2×Zia4) تحت مستويين من التسميد النيتروجيني (92 و 276 كغم N/ هـ)، وطبقت التجربة باستعمال ترتيب الالواح المنشقة Split plot Design وبثلاثة مكررات وفق تصميم القطاعات الكاملة المعشاة RCBD، وتضمنت الالواح الرئيسة مستويين من التسميد النيتروجيني أما الالواح الثانوية فتضمنت معاملات التراكيب الوراثية، وأظهرت النتائج تفوق التركيب الوراثي 5018 بإعطائه اعلى حاصل حبوب كلي بلغ 8.541 طن/ هـ نتيجة تفوقه في صفات مكونات الحاصل وهي عدد العرانيص (1.350 عرنوص/ نبات) وعدد الحبوب في العرنوص (721.950 حبة/عرنوص) ووزن 100 حبة (29.340 غم)، اما بالنسبة لمستويات التسميد النيتروجيني فأظهرت النتائج عدم معنوية مستويات الاسمدة في جميع الصفات باستثناء صفة الحاصل البايولوجي.

الكلمات مفتاحية: السماد النيتروجيني، الذرة الصفراء، الحاصل البايولوجي.

[*] **Part of MSc. Thesis of the first author**

INTRODUCTION

Maize crop (*Zea mays* L.) is one of the important economic cereal crops and comes third in terms of productivity and cultivated area after wheat and rice crops **(Khalaf & Hassan, 2022)**. In addition to its uses in many fields, such as food for humans, the production of vegetable oils, and its use as green fodder or silage for animals, because it contains a large vegetative part compared to other crops. It is one of the C4 plants that grow in environments exposed to high solar radiation due to its needs in the process of photosynthesis, which is accompanied by increased rates of evaporation-transpiration, as it causes a significant loss in the yield of maize, and the low productivity in Iraq is attributed to reasons including the adoption of the cultivation of synthetic and open-pollinated cultivars and the lack of local genetic resources in breeding and improvement programs **(Saeed, 2009)**, and not following modern agricultural and field practices, including the use of appropriate quantities of nitrogen fertilizers to increase the yield of maize, as about 40% of the increase in maize yield is due to the addition of nitrogen fertilizers **(Bender *et al*., 2013)**. Chemical fertilizers in general, and nitrogen fertilizers in particular, are an important factor for the level of productivity per unit area, and their importance lies in soil conditions that lack organic matter and some basic elements. Maize crop is a nitrogen-demanding crop, as it absorbs nitrogen fertilizers and other nutrients during its growing season. Nitrogen fertilization is necessary for crop growth, high yield, yield components, and kernel quality. Nitrogen plays a role in many important compounds for plant growth, especially chlorophyll and many enzymes **(Al-Dawoudi *et al.*, 2015)**. Also, nitrogen deficiency in general impedes growth, leads to yellowing of the leaves, reduces the chlorophyll content in the plant, and accelerates the aging of the leaves **(Moraditochaee *et al.*, 2012)**. **Al-Nasrawi (2015)** indicated that there were significant differences between the genotypes in the number of rows in the ear. Strain 4 outperformed the rest of the strains by giving it the highest average of 16.370 rows/ ear, compared to strain 5, which gave the lowest average of 14.775 rows/ ear, the researcher also noticed that there were significant differences in the levels of nitrogen fertilization in the number of rows/ ear when increasing the level of fertilization from 160 to-320 kg N/ ha had a significant effect on the trait mean. **Hamood (2019)** confirmed that there was no significant effect between nitrogen fertilization levels (120, 220, and 320) in the average weight of 300 kernel. The study aimed to find out the effect of two levels of nitrogen fertilization on seven genotypes of maize, as well as to study the interactions between levels of nitrogen fertilization and genotypes on yield and its components.

MATERIALS AND METHODS

A field experiment was carried out in the spring season of 2022 in the fields of the College of Agricultural Engineering Sciences - University of Baghdad, in order to study the effect of nitrogen fertilization on the yield and its components of maize genotypes under two levels of nitrogen fertilization. As well as evaluating some of its genetic parameters under each level of nitrogen. The experiment was carried out according to the RCBD design.in a split plot arrangement, with three replications. The two levels of nitrogen fertilization (92 and 276 kg N/ha) allocated to the main plot, while the maize cultivars (Al Maha, Sumer, Al Fajr, Baghdad, 5018, Zia1×Zia4, Zia2×Zia4) allocated to the sub-plots**.**

The experimental land was plowed with two perpendicular plows using the moldboard plow, and the soil was smoothed with rotary plows (Rotavator), then leveled using land plane and divided into three replications. Thus, the total experimental units became (7 × 2 × 3 = 42 experimental units) with dimensions (3 × 3m). Each experimental unit included 5 rows, the distance between rows was 70 cm, and the distance between plants was 25 cm. Planting was done in rows manually. During planting, all experimental plots were fertilized at once with triple superphosphate fertilizer (46% P_2O_5) at an amount of 200 kg/ ha P_2O_5 **(Abed *et al.*, 2017).** Whereas, for nitrogen fertilizer, it was added in the form of urea (46% N) at two levels (92 and 276 kg N/ ha) in two batches, the first two weeks after germination and the second before flowering. Preventive control of corn stem borer (*Sesamia criteco*) was carried out at the stage of (4- 5) leaves using granular diazinon, concentration of 10%, at a rate of 4 kg/ ha**.** Thinning, hoeing, weeding and irrigation were carried out according to the need of the crop **(Ibrahim&Abed,2015).** Statistical analyzes were done the Genstat program. Least Significant Difference test (LSD) was used to compare means at probability level of 0.05.

Characters studied:

1. Ear length (cm): It was calculated from the average ear length of the five plants for each experimental unit.
2. The number of rows in the ear: It was calculated from the average number of rows in the ears of the five plants for each experimental unit.
3. The number of kernels/ row: It was calculated from the average number of kernels per row for the five ears for each experimental unit.
4. The number of kernels/ ear: calculated by multiplying the number of kernels in a row × the number of rows of ear.
5. Weighing 100 kernel (g): The kernels of five plants were threshed and mixed for each experimental unit, from which a random sample of kernels was taken, 100 kernel were counted and then weighed with a sensitive balance **(Elsahooki, 1990)**.
6. Biological Yield (straw + ear) (g/ plant): The plants were dried by exposing them to the sun's rays due to high temperatures, taking into account turning them over, and after the stability of the weight, it was weighed with a sensitive scale.
7. The total kernels yield (ton/ha): the kernels yield was calculated by harvesting five plants from the middle line of each cultivar in each experimental unit. When the plants reached the stage of full maturity, the kernels of the ears were manually threshed and weighed using a sensitive balance, then the weight was adjusted to 14% humidity and divide the weight of the sample by the number of plants to obtain the yield of one plant per experimental unit, then the yield of experimental unit was converted to yield of the unit area in hectares **(Okab & Abed, 2022).**

RESULTS AND DISCUSSION

Ear length (cm)

The length of the ear in the plant is affected by the environmental conditions at the beginning of its emergence, as well as being affected by the genetic structure that characterize the genotype. It is one of the characteristics on which the number of kernels in the row depends, which is a major component of the number grain per ear **(Elsahookie & Daoud, 2021)**. The results indicate that there are highly significant differences between the genotypes in the ear length. Synthetic variety 5018 gave the highest mean of 20.567 cm, while the single cross, Zia2×Zia4, achieved the lowest mean of 16.90 cm (Table, 1), the reason for the difference may be attributed to the existence of genetically controlled differences between genotypes in this trait, this is consistent with what was found by **Al-Luhaibi (2022); Amanah (2021),** they noticed that the genotypes differ among themselves in the characteristic of ear length. The results also indicate that there are no significant differences between the levels of nitrogen fertilization in ear length. The results also indicate that there are highly significant interaction between studied factors. The genotype 5018 was distinguished with the highest rate for ear length (21.567 cm) under the first level of nitrogen fertilization of 92 kg N/ ha, compared to the second level of fertilization 276 kg N/ ha, in which the genotype Baghdad and 5018 outperformed with same rate for the ear length of 19.567 cm.

Table(1): Average ear length (cm) for genotypes of maize under two levels of nitrogen fertilization for the spring season 2022.

Genotypes	Nitrogen levels(kg N/ ha)		Mean Genotypes
	92	276	
Al Maha	18.800	19.067	18.934
Sumer	18.900	18.567	18.734
Al Fajr	19.867	17.750	18.809
Baghdad	19.300	19.567	19.434
5018	21.567	19.567	20.567
Zia1×Zia4	19.933	19.100	19.517
Zia2×Zia4	16.400	17.400	16.900
LSD 0.05	0.814		0.503
Mean nitrogen levels	19.252	18.717	
LSD 0.05	N. S		

Number of rows per ear

The results indicate that there are significant differences between the genotypes in the number of ear rows, where cultivar Baghdad gave the highest rate of 17.967, and the rate of increase was 10% over the Zia4×Zia2, which gave the lowest average of 16.367. This is consistent with what was found by **Al-Mafarji (2022); Al-Alusi (1999).** (Table, 2) also shows that there are no significant differences between the levels of nitrogen fertilization. The results indicate highly significant interaction between genotypes and levels of nitrogen fertilization, as the Baghdad cultivar excelled with the highest mean of 18.20 under the first fertilization level of 92 kg N/ ha, while its response decreased when the fertilization level increased to 276 kg N/ ha, giving a value of 17.733.

Table(2): Number of rows per ear for genotypes of maize under two levels of nitrogen fertilization for the spring season 2022.

Genotypes	Nitrogen levels kg N/ ha		Mean Genotypes
	92	276	
Al Maha	17.733	17.267	17.500
Sumer	17.200	16.467	16.834
Al Fajr	17.467	17.700	17.584
Baghdad	18.200	17.733	17.967
5018	17.067	17.333	17.200
Zia1×Zia4	16.400	17.067	16.734
Zia2×Zia4	15.633	17.100	16.367
LSD 0.05	0.865		0.377
Mean nitrogen levels	17.100	17.238	
LSD 0.05	N. S		

Number of kernels per row

The results show that there is a high significant difference between the genotypes in the number of kernels per ear (Table, 3), the superiority of 5018 cultivar in this trait due to its superiority in the ear length (Table, 1). The number of kernels per row reached 42.000 kernel, row-1, and was the highest average, while the Zia1×Zia4 gave the lowest mean of 35.785 kernels/row, Perhaps the reason for this differences between genotypes is that each genotype has a certain ability to produce kernel. This result agrees with **Al-Luhaibi (2022)**; **Amanah (2021)**; **Hadi & Hassan(2021).** The results also show that there is no significant difference between the levels of nitrogen fertilization in the number of kernels per row. The results indicate that there is a highly significant interaction between genotypes and levels of nitrogen fertilization. The 5018 cultivar excelled by giving the highest average of 40,730 kernels/ row under the level of 276 kg N/ ha, while the Sumer cultivar gave the lowest average of 38.230 kernel /row.

Table(3):Number of kernels per rows for genotypes of maize under two levels of nitrogen fertilization for the spring season 2022.

Genotypes	**Nitrogen levels kg N/ ha**		**Mean Genotypes**
	92	**276**	
Al Maha	36.330	38.870	37.600
Sumer	38.570	38.230	38.400
Al Fajr	42.270	36.370	39.320
Baghdad	42.470	39.000	40.735
5018	43.270	40.730	42.000
Zia1×Zia4	36.670	37.600	37.135
Zia2×Zia4	34.170	37.400	35.785
LSD 0.05	1.753		1.183
Mean nitrogen levels	39.107	38.314	
LSD 0.05	N. S		

Number of kernels per ear

The results show that there are highly significant differences between the genotypes in the number of kernels per ear (Table, 4), as the Baghdad cultivar achieved the highest mean of 733.050 grain/ ear, and it did not differ significantly from the 5018 cultivar , with 721.950 grain/ear، it may be because of their superiority in number of rows per ear and number of kernels per row (Tables 2 and 3), This leads to their superiority in the number of kernels per ear. Whereas the single cross 4 × 2 gave the lowest rate of the trait (586.900 grain /ear). This confirms what **Al-Mowsawi (2019)** concluded that the differences between the genotypes are evidence of the divergence of their genetic base. It is noted from the results in Table 4 that the character of the number of kernels per ear was not affected by the change in levels of nitrogen fertilization. The results also indicate that there is a highly significant interaction between the genotypes and their response to the difference in nitrogen fertilization levels, as 5018 cultivar gave the highest mean for the trait at the level of 276 kg N/ ha, which amounted to 705.600 kernels/ ear.

Table(4):Number of kernels per ear for genotypes of maize under two levels of nitrogen fertilization for the spring season 2022.

Genotypes	Nitrogen levels kg N/ ha		Mean Genotypes
	92	276	
Al Maha	644.500	671.400	657.950
Sumer	663.000	629.000	646.000
Al Fajr	738.500	640.500	689.500
Baghdad	773.600	692.500	733.050
5018	738.300	705.600	721.950
Zia1×Zia4	600.900	641.700	621.300
Zia2×Zia4	534.000	639.800	586.900
LSD 0.05	46.210		26.830
Mean nitrogen levels	670.400	660.071	
LSD 0.05	N. S		

Weight of 100 kernel (g)

The results show that there is no significant difference between nitrogen fertilization (Table, 5), the reason for this is due to the fact that the filling of the grain is the last thing that happens in the life of the plant, so if the plant organs have formed in their final size and there are sufficient quantities of produced materials, then there is no organ of the plant that competes with the deposition of dry matter in the grain, and therefore the weight of the grain does not differ much from one treatment to another **(ElSahooki, 2002)**. The results also indicate that there are highly significant differences between the genotypes in the weight of 100 kernel. The 5018 cultivar gave the highest average weight for 100 kernel (29.340 g), and did not differ much from the Baghdad cultivar, which gave 29.305 g. It may be attributed to the long period of physiological maturity of the two cultivars, while it varied with the average value of the single cross hybrid Zia2×Zia4, which gave 25.090 g. The grain weight is determined according to the activity of the genotype and the amount of metabolites **(Lucas & Otegui, 2001).** This result is consistent with what was reached **(Kazem, 2020**). The results also indicate the existence of a highly significant interaction between the study factors, as cultivar 5018 achieved the highest average weight of 32.790 g under the fertilizer level of 276 kg N/ ha, while the single cross hybrid Zia2×Zia4 exhibited a different behavior with the lowest average of the trait amounted to 21.490 g under the same fertilizer level.

Table(5):Weight of 100 kernel (g) for genotypes of maize under two levels of nitrogen fertilization for the spring season 2022.

Genotypes	Nitrogen levels kg N/ ha		Mean Genotypes
	92	276	
Al Maha	24.600	29.490	27.045
Sumer	28.160	26.900	27.530
Al Fajr	32.170	23.640	27.905
Baghdad	30.100	28.510	29.305
5018	25.890	32.790	29.340
Zia1×Zia4	27.650	23.280	25.465
Zia2×Zia4	28.690	21.490	25.090
LSD 0.05	5.314		2.130
Mean nitrogen levels	28.180	26.586	
LSD 0.05	N. S		

Biological Yield (g/ plant)

The results show that there are significant differences between the genotypes (Table 6), and the reason for these differences in the biological yield may be attributed to the difference in its morphological characteristics**.** The single hybrid Zia1×Zia4 outperformed with the highest Biological Yield of 290.720 g/plant. This may be attributed to the long period of time it reached physiological maturity, while the single cross hybrid Zia2×Zia4 gave the lowest rate of 276.010 g /plant. This is close to the results of **Al-Lahibi (2022)** ; **Kazem (2020).** It is also clear from the results that the characteristic of the biological yield was affected significantly by the levels of nitrogen fertilization, as the biological yield at the level of 92 kg N /ha reached 271.101 g/ plant, while at the level of 276 kg N/ ha reached 296.883 g/ plant The rate of increase between the two levels was 9.5%. This is consistent with what was found by **Al-Alusi *et al*., (2016)** that there are differences in the Biological Yield when the levels of nitrogen fertilization change. The reason may be attributed to the conversion of the dry matter into straw and not seeds. The results also show the existence of a highly significant interaction between the two studied factors, as the 5018 cultivar gave the highest average of 308.870 g/plant under the second level of nitrogen fertilization 276 kg N/ ha.

Table(6):Biological yield (g/plant) for genotypes of maize under two levels of nitrogen fertilization for the spring season 2022.

Genotypes	Nitrogen levels kg N /ha		Mean Genotypes
	92	276	
Al Maha	268.720	305.470	287.095
Sumer	270.060	292.900	281.480
Al Fajr	276.270	284.550	280.410
Baghdad	271.600	295.920	283.760
5018	268.070	308.870	288.470
Zia1×Zia4	280.380	301.060	290.720
Zia2×Zia4	262.610	289.410	276.010
LSD 0.05	5.438		4.015
Mean nitrogen levels	271.101	296.883	
LSD 0.05	3.084		

Total kernels yield (ton/ hectare)

The results indicate the presence of highly significant differences between the genotypes (Table, 7), as 5018 cultivar achieved the highest yield of 8.541 ton/ ha and outperformed all studied genotypes, while the single cross Zia2×Zia4 gave the lowest grain yield of 6.449 ton/ ha and did not differ significantly from the single cross hybrid Zia1×Zia4, which gave 6.726 tons/ ha. The reason for the superiority of 5018 cultivar in the kernel yield trait is attributed to its superiority in the individual plant yield and the main yield components, and this is consistent with the results of **Al-Lahibi (2022)**; **Al-Mowsawi (2019**). The results also shows that there is no significant differences between the levels of nitrogen fertilization in the kernel yield per area unit (ton/ ha). the result indicates the existence of a highly significant interaction between the response of the genotypes to the levels of nitrogen fertilization, as 5018 cultivar achieved the highest value of 8.659 ton/ ha at the second fertilizer level 276 kg N /ha compared with lowest kernel yield of the single cross hybrid Zia2×Zia4 which gave 6.451 ton/ ha.

Table (7):Total kernels yield (ton/ hectare) for genotypes of maize under two levels of nitrogen fertilization for the spring season 2022.

Genotypes	Nitrogen levels kg N/ ha		Mean Genotypes
	92	276	
Al Maha	7.826	7.703	7.765
Sumer	7.220	7.041	7.131
Al Fajr	8.222	7.576	7.899
Baghdad	7.129	7.311	7.220
5018	8.423	8.659	8.541
Zia1×Zia4	6.746	6.706	6.726
Zia2×Zia4	6.446	6.451	6.449
LSD 0.05	0.221		0.166
Mean nitrogen levels	7.430	7.350	
LSD 0.05	N.S		

CONCLUSIONS

The response of genotypes to nitrogen fertilization levels was different due to their different genetic nature, the genotype of 5018 gave the highest total kernels yield ton/ha,the difference was not significant between nitrogen fertilization levels in yield and its components except for the biological yield trait.

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