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EVALUATION OF THE PERFORMANCE OF THREE GENOTYPES OF MAIZE (*ZEA MAYS* L.) CULTIVATED AT DIFFERENT PLANTING DISTANCES IN YIELD AND ITS COMPONENTS

Dhuha Hashoosh Aflook AL-Asadi
Muhamed A. K. AL-Abody*
Department of Field Crops, College of Agriculture, University of Basrah, Iraq*
mohammad.kalaf@uobasrah.edu.iq

ABSTRACT

Studies are being carried out at Karmat Ali, University of Basrah's Agricultural Research Station, College of Agriculture. In silty loam soil during the spring agricultural season 2022, to evaluation of the performance of three genotypes of maize (Al-Maha, IPA-5018, Bhooth-106) cultivated at different planting distances in yield and its components , of different planting distances between seeds (15, 20, 25, 30) cm, which gave plant densities of (95238, 71428, 57142, 47619) plants ha^{-1}, on the yield and its components of three genotypes of maize (*Zea mays* L.). The experiment was applied, according to factorial experiments using randomized complete block design (R.C.B.D) with three replications. Traits were studied: cobs number per plant, grains number per cob, 300 grains weight, grain yield, biological yield, and harvest index. The results showed that the genotypes differed significantly in most of the characteristics of the study, as the genotype IPA-5018 excelled in most of the characteristics of the study, recording the highest average number of cob per plant, 300 grains weight, grain yield, biological yield, harvest index with averages of 1.33 cobs $plant^{-1}$, 70.05 g, 4.20 t ha^{-1}, 16.41 t ha^{-1}, 25.51% the genotype Al-Maha was superior to recording the highest number of grains per cob, reaching 464.0 grains cob^{-1}, with an increase in grain yield of 20.68%. The agricultural distance between the rows was 15 cm, giving the highest averages for 300 grains weight, grain yield, biological yield, and harvest index was 72.99 g., 4.47 t ha^{-1}, 16.83 t ha^{-1}, and 26.56%, while the 30 cm distance was superior by giving the highest average grains number in cob at 462.6 grains cob^{-1}, with an increase in grain yield amounting to 38.81%. The interaction between genotype IPA-5018 at a distance of 15 cm showed a significant superiority for 300-grain weight, grain yield, biological yield, and harvest index by giving the highest averages of 78.26 g., 4.98 t ha^{-1}, 17.69 t ha^{-1}, and 28.22%, respectively. Al-Maha genotype, at a distance of 30 cm, recorded a significant superiority in grains number per cob, amounting to 513.2 grains cob^{-1}, with an increase in grain yield of 62.21%.

INTRODUCTION

Yellow corn, *Zea mays* L., is regarded as one of the leading grain crops. with all of its vegetable and fruit sections, yellow corn serves various purposes as food and fodder for animals, highlighting its significance. Its leaves serve as a foundational component in the paper industry. The best kinds of oils and starch are taken from its grains. It is classified as concentrated fodder because it contains several vitamins, including B1, B2

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and F, 81% carbs, 10.6% protein, 4.6% oil, and 2% ash (Al-Nasrawi, 2015). With an average yield of 4,632 tons per hectare, Iraq's farmland will cover 90.522 thousand hectares in 2020 (Agricultural Statistics Directorate, 2020).

The selection of genotypes and the evaluation of their performance significantly increased crop yields of many crops, including the yellow corn crop. Their responses differ depending on the genetic ability of each genotype in the transfer of manufactured foodstuffs from source to downstream. As a result, one trend is the selection of highly productive genotypes, while the other is after serving the soil and crop to achieve the best possible production. The process of continuous provision of genotypes is accompanied by the adoption of the method of distributing plants in the field, which is one of the important applications for exploiting the various environmental factors (light, water, soil, fertilization, etc.) and benefiting from them to increase the quantity and quality of the crop per unit area. The variation of planting distances between plants leads to different plant densities that work. It reduces the seeding rate per unit area without any negative effect on the final yield, and the plant density is one of the important factors in controlling the ratio and efficiency of intercepting effective rays in the photosynthesis process, which in turn affects growth and crop productivity (Jaddoa *et al.,* 1998; Rafiq *et al.,* 2010).

Because there have been no previous studies on the study of genotypes of yellow maize crops cultivated at different agricultural distances between crops under the conditions of Basrah Governorate, this study was carried out to determine the best genotype of the study area that gives the highest yield, and to determine the optimal agricultural distance of crop.

MATERIALS AND METHODS

At the Agricultural Research Station of the College of Agriculture, University of Basrah, Karma location, a field experiment was conducted at 47.80° West longitude and 30.57° North latitude in spring agricultural season 2022. To estimate some genetic parameters of the genotypes of the yellow corn crops planted at different agricultural distances. Samples were taken to analyze the soil field's chemical and physical characteristics before planting, and the samples were examined in the main laboratory at the College of Agriculture, University of Basra, with the outcomes displayed in Table 1. The experiment included two factors: the first factor included 3 approved genotypes that were obtained from the General Authority for Agricultural Research, Baghdad (Al-Maha, IPA-5018, Bhooth-106), and the second factor included four different agricultural distances between crops (15, 20, 25, 30) cm, which gave plant densities of 95238, 71428, 57142, and 47619) plants ha^{-1}, respectively.

The experiment was carried out utilizing the randomized complete block design (RCBD) with three replicates in accordance with the factorial experimentation methodology. Because the various treatments were planted randomly within each sector , the number of experimental units increased to (12) units for each replicate, for a total of 36 experimental units. The soil was prepared for cultivation by plowing it with two

orthogonal plows, moldboard plows, and disc harrows, then leveling it with a leveling machine, and finally dividing the land into three sectors according to the design used. Each plot contains 12 experimental units; thus, a total of 36 experimental units with dimensions (3mx4m=12m²) and six lines were included in each experimental unit of 3 m length, a distance of 70 cm between lines, and agricultural distances between rows of 15, 20, 25 and 30 cm. A distance of 1.5 m was left between experimental units and repeaters, and a distance of 2 m between the main treatments.

Yellow corn seeds were sown in the spring season on 26.03.2022; 2-3 seeds were placed in a hole, and then thinning into one plant was carried out three weeks after sowing. Then the experimental land was watered immediately after planting, while the other irrigations were given one irrigation every week according to the plant's needs. Urea fertilizer was 240 kg N ha^{-1} as a source of nitrogen fertilizer (Mohsen, 2007). Moreover, it was added in three equal batches, the first one coming after emergence, the second one after one month from planting, and the third one at the start of flowering. When planting, 200 kg $hectare^{-1}$ of triple superphosphate fertilizer (P_2O_5) was applied in one batch. and potassium fertilizer (K_2O) was added at an amount of 80 kg $hectare^{-1}$ (Al-Abedy, 2011) Irrigation and weeding operations were also carried out during the season according to the crop's needs, and the plants were harvested on 24.07.2022. The following characteristics were studied: cobs number per plant (cob $plant^{-1}$), grains number per cob, 300 grains weight (g), total grain yield (t ha^{-1}), the biological yield (t ha^{-1}), and the harvest index (%).

Table (1) the physical and chemical field's properties.

Characteristics	Values	Units
pH	7.38	
E.Ce.	8.65	Desimines m^{-1}
Organic matter	10.5	g kg-1
Nitrogen	53.0	mg kg $^{-1}$ soil
Phosphorus	4.86	
Potassium	125	
Sand	369	g kg $^{-1}$ soil
Silt	536	
Clay	95	
Texture	Silty loam	

Results and Discussion

Cobs number per plant (cobs $plant^{-1}$):

The results shown in Table (2) show that the genotype IPA-5018 had the highest average number of cobs per plant, amounting to 1.33 cobs $plant^{-1}$, while the genotype Bhooth-106 gave the lowest average number of cob, amounting to 1.22 cobs $plant^{-1}$. The reason for this discrepancy between the genotypes in the number of cobs in the plant is due to the difference in their genetic makeup and their ability to interact with environmental conditions in order to be able to show their maximum genetic potential. These results

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agree with some researchers (AL-Nassery *et al.*, 2016) and (Majeed *et al.*, 2017) and (Zidane, 2020), they indicated that there were significant differences between the genotypes in the number of cobs in the plant.

Table (2) Effect of genotypes, planting distances, and their interaction on cobs numberper plant (cob plant^{-1})

Genotypes	Planting distances (cm)				Average Genotypes
	15	20	25	30	
Al-Maha	1.27	1.27	1.27	1.27	1.27
IPA-5018	1.32	1.35	1.35	1.32	1.33
Bhooth-106	1.22	1.22	1.22	1.22	1.22
Average distances	1.27	1.28	1.28	1.27	
L.S.D $_{(0.05)}$	Genotypes	Planting distances		Interaction	
	0.01	N.S		N.S	

Grains number per cob (grains cob^{-1}):

Table (3) shows the significant superiority of Al-Maha genotype, which gave the highest average of 464.0 grains cob^{-1}. In comparison, the Bhooth-106 genotype recorded the lowest average of 398.4 grains cob^{-1}, and the reason for this may be due to the significant genetic variation between the genotypes of this trait and that each genotype can produce a certain number of grains in one cob. These results agree with AL-Shumary(2018) and Zidane (2020), who indicated significant differences between the genotypes of this trait. Table (3) also indicates that the agricultural distance of 30 cm is superior to the rest of the agricultural distances, as it recorded the highest average of 462.6 grains of cob^{-1}, while the distance of 15 cm recorded the lowest average of 400.4 grains of cob^{-1}.

The reason for this may be due to the competition between plants for growth factors and the lack of supply of photosynthetic materials, which led to the abortion of pollinated grains, causing a reduction in the number of grains in the cob. These results are consistent with (Abdulkarim *et al.*,2018). Cultivation between borders had a significant effect, so the genotype of Al-Maha at a distance of 30 cm achieved the highest average number of grains per cob, reaching 513.2, while the genotype Bhooth-106 recorded at a distance of 15 cm, the lowest average amounted to 377.0, and these results coincided with (Al-Qaissy, 2022).

Table (3) Effect of genotypes, planting distances, and their interaction on grainsnumber in cob (grains cob^{-1})

Genotypes	Planting distances (cm)				Average Genotypes
	15	20	25	30	
Al-Maha	428.3	441.7	472.5	513.2	464.0
IPA-5018	395.9	425.5	446.6	466.0	433.5
Bhooth-106	377.0	391.8	416.5	408.4	398.4
Average distances	400.4	419.7	445.2	462.6	
L.S.D$_{(0.05)}$	Genotypes	Planting distances		Interaction	
	16.00	18.48		32.00	

300 grains weight (g):

The results of Table (4) showed the significant superiority of the genotype IPA-5018 in this trait, as it recorded the highest weight of 300 grains, which amounted to 70.05 g., compared to the genotype Bhooth-106, which recorded the lowest weight of 300 grains, which amounted to 60.87 g. The reason may be due to the state of competition between grains within one cob due to the increase in the number of its grains, which led to a decrease in the sedimentary materials per grain, and then a decrease in their weight as a result of the increase in the number of grains. These results are consistent with many researchers (AL-Shumary,2018) and (AL-Omairi,2022). Table (4) shows that the agricultural distance between the jacks of 15 cm recorded the highest weight of 300 grains, which amounted to 72.99 g., while the distance of 30 cm recorded the lowest weight of 300 grains, which amounted to 59.65 g .

The reason for this may be attributed to the fact that the distance of 15 cm gave the highest index of leaf area, which effectively contributed to increasing the output of the photosynthesis process. (Zubaidy *et al.*, 2018; and AL-Badri, 2019), As for the effect of the interaction between genotypes and planting distances between crops, it was significant; genotype IPA-5018 was achieved at the planting distance of 15 cm, the highest weight of 300 grains reached 78.26 g., while the genotype was recorded as bhooth-106, at a distance of 30 cm, the lowest weight of 300 grains was 53.16 g. These findings are consistent with Abdullah and Harchan (2014).

Table (4) Effect of genotypes, planting distances, and their interaction on 300 grainsweight (g)

Genotypes	Planting distances (cm)				Average Genotypes
	15	20	25	30	
Al-Maha	72.92	68.77	63.56	60.60	66.46
IPA-5018	78.26	71.41	65.35	65.19	70.05
Bhooth-106	67.79	63.46	59.08	53.16	60.87
Average distances	72.99	67.88	62.66	59.65	
L.S.D $_{(0.05)}$	Genotypes	Planting distances		Interaction	
	0.80	0.92		1.60	

Total grain yield (t ha^{-1}):

Table (5) shows the significant superiority of the genotype IPA-5018, as it achieved the highest average grain yield of 4.20 t ha^{-1}, while the genotype Bhooth-106 recorded the lowest average grain yield of 3.48 t ha^{-1}, and the reason may be attributed to the difference in yield components for each genotype (number of grains per cob and grain weight) because it determines the amount of increase and decrease in the economic yield of maize crop. These results agree with (AL-Shumary,2018). It is also noted in Table (5) that the agricultural distance between the rows, 15 cm, achieved the highest grain yield of 4.47 t ha^{-1} and differed significantly from the other agricultural distances, as the distance of 30 cm recorded the lowest grain yield of 3.22 t ha^{-1}.

Perhaps the reason is due to the increase in the number of plants per unit area, which were able to compensate for the deficiency in the yield components. The superiority of

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this distance in the characteristic of leaf area index, which led to obtaining a higher efficiency in light interception, which was reflected positively in increasing the dry matter and thus increasing the yield of grains per unit area, and these results are consistent with (AL-Badri,2019) and (Al-Qaissy,2022). The effect of the interaction between genotypes and the agricultural distance was significant, as the genotype achieved IPA-5018 at the 15 cm agricultural distance. The highest grain yield amounted to 4.98 t ha^{-1}, while bhooth-106 recorded the genotype at the agricultural distance of 30 cm, and the lowest grain yield reached 3.07 t ha^{-1}, which is consistent with (Al-Qaissy,2022).

Table (5) Effect of genotypes, planting distances, and their interaction on total grainsyield (t ha^{-1})

Genotypes	Planting distances (cm)				Average Genotypes
	15	20	25	30	
Al-Maha	4.44	3.95	3.55	3.15	3.77
IPA-5018	4.98	4.42	3.96	3.44	4.20
Bhooth-106	4.00	3.57	3.29	3.07	3.48
Average distances	4.47	3.98	3.60	3.22	
$L.S.D_{(0.05)}$	Genotypes	Planting distances		Interaction	
	0.07	0.08		0.14	

Biological yield (t ha^{-1}):

Table (6) shows the significant superiority of the genotype IPA-5018 in the biological yield, as it achieved the highest average biological yield of 16.41 t ha^{-1}, while the genotype bhooth-106 recorded the lowest average biological yield of 14.92 t ha^{-1}. The reason for this is due to the increase in its components resulting from its superiority in some growth characteristics, which leads to giving it a better opportunity to increase the efficiency of the photosynthesis process, and thus led to an increase in the rates of production and accumulation of dry matter, which was reflected in improving the biological crop. These results are consistent with some researchers (Al-Temimi,2017; AL-Shumary,2018), who noticed significant differences between the genotypes in the characteristic of the biological crop. It is noted from Table (6) that the agricultural distance between the hollows of 15 cm achieved the highest average biological yield of 16.83 t ha^{-1}, while the agricultural distance between the hollows of 30 cm achieved the lowest average biological yield of 14.29 t ha^{-1}. The reason may be that this leads to an increase in the number of plants per unit area, which reduces the competition of bushes and weakens them, thus increasing the plant's height, which contributes to increasing the biological yield. The interaction between the genotypes and the agricultural distances had a significant effect, so the genotype IPA-5018 at the distance of 15 cm achieved the highest average biological yield of 17.69 t ha^{-1}, while the genotype Bhooth-106 at the distance of 30 cm had the lowest average biological yield of 13.70 t ha^{-1}, and these results are consistent with (Al-Qaisi,2019).

Table (6) Effect of genotypes, planting distances, and their interaction on biological yield (t ha^{-1})

Genotypes	Planting distances (cm)				Average Genotypes
	15	20	25	30	
Al-Maha	16.66	15.93	14.87	14.21	15.42
IPA-5018	17.69	16.81	16.17	14.97	16.41
Bhooth-106	16.15	15.39	14.43	13.70	14.92
Average distances	16.83	16.04	15.15	14.29	
L.S.D $_{(0.05)}$	Genotypes	Planting distances		Interaction	
	0.36	0.42		0.72	

Harvest Index (%):

The results of Table (7) indicate the significant superiority of the genotype IPA-5018, which recorded the highest average harvest index of 25.51%, compared to the genotype Bhooth-106, which gave the lowest average harvest index of 23.12%. From the source to the downstream, and the availability of the factors that led to an increase in the ability of the superior genotype, which was represented by the apparent improvement in some growth traits on the one hand, and the increase in the size of the outfalls (the number of grains in cob) on the other hand, the increase in grain yield, which led to an increase in the harvest index through the relationship direct correlation between it and grain yield, and these results agreed with AL-Shumary, (2018).

As it was clear from the results of Table (7), the agricultural distance exceeded 15 cm in harvest index, which achieved the highest average of 26.56%, while the distance of 30 cm recorded the lowest average of 22.56%. The reason may be due to the increase in the number of plants per unit area Optimization leads to competition between members of the same plant and with neighboring plants for materials and nutrients, and these results are consistent (Hamdan and Bactash, 2014). The interaction between the genotypes and the agricultural distances had a significant effect, so the genotype IPA-5018 at the distance of 15 cm achieved the highest mean harvest index of 28.22%, while the genotype Bhooth-106 at a distance of 30 cm achieved the lowest average harvest index of 21.64%, and these results were consistent with (Hamdan and Baktash, 2014).

Table (7) Effect of genotypes, planting distances, and their interaction on harvest index (%)

Genotypes	Planting distances (cm)				Average Genotypes
	15	20	25	30	
Al-Maha	26.69	24.80	23.91	23.06	24.62
IPA-5018	28.22	26.34	24.50	22.98	25.51
Bhooth-106	24.78	23.23	22.83	21.64	23.12
Average distances	26.56	24.79	23.75	22.56	
L.S.D $_{(0.05)}$	Genotypes	Planting distances		Interaction	
	0.61	0.70		1.22	

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