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Research Article

Evaluation of the performance of three genotypes of maize (*Zea mays* L.) cultivated at different planting distances in growth characteristics

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Abstract: Studies are being carried out at Karmat Ali, University of Basrah's agricultural research station, college of agriculture. It is located at 47.80º West longitude and 30.57º North latitude, in silty loam soil during the spring agricultural season of 2022, to evaluate the performance of genotypes (Al-Maha, IPA-5018, and Bhoouth-106) of yellow corn crop *Zea mays* L. which was planted at different planting distances between seeds (15, 20, 25, 30) cm, it gave plant densities of (95238, 71428, 57142, 47619) plant ha-1, respectively, in growth characteristics. The experiment was applied, according to factorial experiments using randomized complete block design (R.C.B.D) with three replications. The characteristics studied: were the number of days from sowing to 50% male flowering, the number of days from sowing to 50% female flowering, plant height, leaf area index, and stem diameter. The results showed that the genotypes differed significantly in terms of growth characteristics, as the genotype was superior to IPA -5018, recording the highest number of days of sowing up to 50% male flowering, number of days of sowing up to 50% female flowering, plant height, leaf area index, with averages of 57.25 days and 62.33 days, 130.58 cm, 2.72 cm, Al-Maha genotype was superior, recording the highest stem diameter of 21.08 mm. The agricultural distance between the rows was 15 cm, giving the highest averages for the number of days from planting to 50% male and female flowering, plant height and leaf area index reached 57.89 days, 63.67 days, 135.59 cm, and 3.27, while the distance of 30 cm was superior by giving the highest average in stem diameter of 21.64 mm. The results of the interaction between the genotypes of IPA -5018 at a distance of 15 cm showed a significant superiority for the number of days from sowing up to 50% male flowering, the number of days from sowing up to 50% female flowering, plant height and leaf area index were 60.67 days, 66.33 days, 145.87 cm, and 3.56, the combination record. Al-Maha, at a distance of 30 cm, significant superiority in stem diameter amounted to 25.53.

Keywords: Evaluation, genotypes of maize, different planting distances , growth characteristics

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 B2, B1, 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 Improve the growth characteristics 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

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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).

MATERIALS AND METHODS

Studies are being carried out at Karmat Ali, University of Basrah's Agricultural Research Station, College of Agriculture. It is located at 47.80º West longitude and 30.57º North latitude in silty loam soil during the spring agricultural season of 2022 to evaluate the performance of genotypes of maize crops planted at different agricultural distances and their effect on growth characteristics.

Before planting, samples were taken to analyze the soil field's chemical and physical characteristics. The soil and water 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 (3 m x 4 m = 12 m^2) 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 as a source of nitrogen fertilizer (Mohsen, 2007). Moreover, it was added in three equal batches, the first 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 in one batch when planting 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: Growth characteristics were studied: the number of days from sowing to 50% male flowering, the number of days from sowing to 50% female flowering, plant height (cm), leaf area index, and stem diameter (mm).

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	
Phosphorus	4.86	mg kg^{-1} soil
Potassium	125	
Sand	369	
Silt	536	g kg^{-1} soil
Clay	95	
Texture	Silty loam	

RESULTS AND DISCUSSION

Number of days from sowing until 50% male flowering:

It was found from the results in Table (2) that the genotypes differed significantly in the period from planting to 50% male flowering, and the genotype Bhoouth-106 took the least period of 53.42 days for the plants of the genotype IPA-5018, which took 57.25 days. The difference of genotypes in the number of days from cultivation up to 50% male flowering is due to the difference in their genetic nature and, thus, to the difference in their response to light and temperature and the extent of their vulnerability to environmental conditions. These results are in solidarity with many researchers AL-Shumary (2018) and Idan(2021), who noticed that During their studies, there were significant differences between genotypes in the number of days from sowing up to 50% male flowering. It is also noted from Table (2) that the agricultural distances differed significantly in terms of the number of days from sowing until 50% male flowering, where the distance of 15 cm gave the highest mean. For the characteristic, it reached 57.89 days, while the distance of 30 cm recorded the lowest average, which reached 52.56 days.

The reason for the decrease in the number of days from sowing to 50% of male flowering at the agricultural distance of 30 cm between rows may be attributed to the availability of nutrients and light and the lack of competition for them, as well as the lack of misleading, which leads to an increase in the temperatures falling on the ground, and thus an increase in the aggregate temperature of the plant, which is driven by To carry out the vital and physiological processes to reach early male flowering, and these results were in agreement with (Al-Zubaidy *et al*., 2018) and (AL-Badri, 2019).

The interaction had a significant effect, as the genotype IPA-5018 at the distance of 15 cm achieved the highest average number of days from sowing up to 50% of male flowering amounted to 60.67 days, while the genotypes Al-Maha and Bohuth-106 at the distance of 30 cm recorded the lowest number of days of 51.67 and 51.67 days, respectively, and these were similar. Results with Abdullah and Harchan (2014).

Table (2) Effect of genotypes, planting distances, and their interaction on the number of days from sowing until 50% male flowering

Genotypes	Planting distances (cm)				Average Genotypes
	15	20	25	30	
Al-Maha	57.33	55.67	54.00	51.67	54.67
IPA-5018	60.67	58.33	55.67	54.33	57.25
Bhooth-106	55.67	54.00	52.33	51.67	53.42
Average distances	57.89	56.00	54.00	52.56	
L.S.D $_{(0.05)}$	Genotypes	Planting distances		Interaction	
	0.56	0.64		1.11	

Number of days from sowing until 50% female flowering:

Table (3) indicates the significant effect of genotypes on the number of days from sowing to 50% female flowering, as it took plants of genotype Bhoouth-106 the least number of days to reach 50% female flowering, which amounted to 58.50 days, for plants of genotype IPA-5018, which took 62.33 days, and the reason may be because the genotypes differ in terms of the number of days required for female flowering, depending on the genotypes, their genetic characteristics, and their response to environmental conditions during the period of plant growth. These results are consistent with what some researchers found Abdualla *et al*., (2010) and AL-khadhi (2019) and Idan (2021), who noticed that there was a significant difference between the genotypes used in their studies of the duration required for the characteristic of the number of days for female flowering. Table (3) shows that the agricultural distances between the walls differed significantly, as the distance of 15 cm achieved the highest average of 63.67 days, compared to the agricultural distance of 30 cm, which achieved the lowest average of 57.22 days.

The reason for the superiority of the short agricultural distance may be due to the lack of misleading, the abundance of nutrients and light, and the lack of competition for them by the plant, which prompted the plant to accelerate the process of growth and emergence of the reproductive parts, and these results are consistent with what some researchers found Mohammed and Mohammedan (2012); Al-Zubaidy *et al*., (2018). The interaction between genotypes and

planting distances was significant. The genotype IPA-5018, at a distance of 15 cm, achieved the highest average number of days from sowing until 50% female flowering reached 66.33 days, while the cultivar Bhoouth-106 at a distance of 30 cm, recorded the lowest average number of days, reached 56.33 days. These results are consistent with Mohammad and Mohammedan (2012) and Abdullah and Harchan (2014).

Table (3) Effect of genotypes, planting distances, and their interaction on the number of days from sowing until 50% female flowering

Genotypes	Planting distances (cm)				Average Genotypes
	15	20	25	30	
Al-Maha	64.00	61.33	59.33	57.00	60.42
IPA-5018	66.33	64.33	60.33	58.33	62.33
Bhooth-106	60.67	58.67	58.33	56.33	58.50
Average distances	63.67	61.44	59.33	57.22	
L.S.D (0.05)	Genotypes	Planting distances		Interaction	
	0.52	0.60		1.05	

Plant height (cm):

It is clear from the results in Table (4) that the genotype IPA-5018 achieved the highest average plant height of 130.58 cm, while the genotype Bhoouth-106 gave the lowest average of 113.82 cm. The reason for the superiority of the genotype IPA-5018 may be due to its genetic nature, which was reflected through its response to the environmental conditions clearly and then increasing the rate of cell division and elongation, which had a positive effect on increasing the plant height, as well as the superiority of the genotype IPA-5018 in the length of the growth stage from cultivation until 50% of male flowering (Table 2) and these results agree With what was found by some researchers Al-Temimi (2021), Ali (2022), who found that there were significant differences in the plant height of the yellow corn crop. The results also indicated significant differences between the agricultural distances, as the distance of 15 cm achieved the highest plant height of 135.59 cm, While the distance of 30 cm recorded the lowest height of the plant, which reached 109.11 cm. The reason may be due to shading and competition for light, which pushes the internodes to elongate in search of light and thus increases plant height. These results are consistent with what was found (Carpici *et al*., 2010) and (Ramezani *et al*., 2011) and (Al-Zubaidy *et al*., 2018), who mentioned the existence of significant differences between the agricultural distances in the characteristic of plant height. ‘

It is also noted in the Table that there are significant differences between the genotypes and the planting distances between the crops in the characteristic of plant height. The genotype IPA-5018, at a distance of 15 cm, recorded the highest plant height of 145.87 cm, while the genotype Bhoouth-106 recorded, at a distance of 30 cm, the lowest plant height of 145.87 cm. 104.93 cm, and this indicates a difference in the response of the genotypes of the studied trait to the effect of increasing plant density, and these results agreed with Abdualla *et al*., (2010) and Abdullah and Harchan (2014).

Table (4) Effect of genotypes, planting distances, and their interaction on plant height (cm)

Genotypes	Planting distances (cm)				Average Genotypes
	15	20	25	30	
Al-Maha	135.03	126.60	117.43	109.37	122.11
IPA-5018	145.87	138.17	125.27	113.03	130.58
Bhooth-106	125.87	116.93	107.57	104.93	113.82
Average distances	135.59	127.23	116.76	109.11	
L.S.D (0.05)	Genotypes	Planting distances		Interaction	
	0.87	1.01		1.75	

Leaf area index:

The results of Table (5) indicated that there are significant differences between the genotypes in the characteristic of leaf area index, as the genotype IPA-5018 achieved the highest average of 2.72, while the

genotype Bhoouth-106 recorded the lowest average of 2.45, and this may be due to the superiority of the genotype. IPA-5018 increased its leaf area, which was reflected in the increase of its leaf area index. These results agree with AL-Shumary (2018), as it is noted from the Table that the plants planted with a planting distance of 15 cm between plants were significantly superior and achieved the highest average in the leaf area index characteristic amounted to 3.27. , while the distance of 30 cm achieved the lowest average of 2.18, and this may be because the area occupied by the plant at the short distance is less compared to the leafy area of the plant, unlike plants grown at a higher distance, the area occupied by the plant is more significant, and therefore this is reflected in the area index. These results are consistent with Mohammad and Mohammedan (2012) and Al-Jumaili (2016).

It is also noted in the Table that there is a significant effect of the interaction between the genotypes and the agricultural distances between the crops; genotypes and the planting distances achieved significant differences, as the genotype IPA-5018 at the agricultural distance of 15 cm gave the highest leaf area index of 3.56, while genotype Bhoouth-106 at a distance of 30 cm, was recorded the lowest average was 2.13. The reason may be the increase in the number of plants per unit area. These results are consistent with Mohammad and Mohammadan (2012).

Table (5) Effect of genotypes, planting distances, and their interaction on leaf area index

Genotypes	Planting distances (cm)				Average Genotypes
	15	20	25	30	
Al-Maha	2.99	2.72	2.56	2.20	2.61
IPA-5018	3.56	2.80	2.30	2.23	2.72
Bhooth-106	2.26	2.22	2.19	2.13	2.45
Average distances	3.27	2.58	2.35	2.18	
L.S.D (0.05)	Genotypes 0.023	Planting distances 0.027		Interaction 0.047	

Stem diameter (mm):

The results of Table (6) indicate that the genotypes significantly affected this trait, as the Al-Maha genotype gave the highest average stem diameter of 21.08 mm. In contrast, the genotype Bhoouth-106 recorded the lowest average of 16.95 mm. The increase is due to the genetic difference between genotypes and its direct effect on increasing the stem diameter characteristic. These results are consistent with some researchers, Abdulla *et al*. (2010) and Zidane (2020). Also, Table (6) showed significant differences between agricultural distances in this trait, as the distance of 30 cm achieved the highest average of 21.64 mm, compared to the distance of 15 cm, which recorded the lowest average of 16.37 mm. Perhaps the reason for this is the result of misleading and competition between plants for nutrients and the low percentage of light reaching the lower parts of the plant, which leads to the stems elongating in search. These results are consistent with AL-Badri (2019) and AL-khadhi (2019), who mentioned significant differences between the planting distances in the stem diameter characteristic.

As for the interaction between genotypes and agricultural distances between groves in their effect on this trait, the results indicated that the genotype was superior to the Al-Maha planted with a distance of 30 cm between groves, as it recorded the highest average stem diameter of 25.53 mm, while the genotype gave Bhoouth-106 cultivated with a distance of 15 cm between the lowest average was 15.03 mm. These results are consistent with AL-khadhi (2019).

Table (6) Effect of genotypes, planting distances, and their interaction on stem diameter (mm)

Genotypes	Planting distances (cm)				Average Genotypes
	15	20	25	30	
Al-Maha	17.06	19.53	22.20	25.53	21.08
IPA-5018	17.03	18.90	19.60	19.84	18.84
Bhooth-106	15.03	16.13	17.06	19.56	16.95
Average distances	16.37	18.18	19.62	21.64	
L.S.D(0.05)	Genotypes 0.36	Planting distances 0.41		Interaction 0.72	

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