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Comparative analysis of growth and seed quality of maize (*Zea mays* L.) hybrids under different planting pattern and plant space.

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ABSTRACT

This study was carried out during the 2023 season at the Agricultural Research Station of the College of Agriculture - University of Kirkuk, to determine the best hybrid, plant space, and plant pattern to study the effect of growth and quality traits on the maize crop. Experimental design using Randomized Complete Block Design (RCBD) according to the split-plot design, with three replications. Used four Plant space (15,20,25, and 30) cm and their symbol is (D1, D2, D3, and D4), Planting pattern (Single row 50cm and double row 30x50cm) and their symbol is (P1 and P2), and hybrids (DKC6050 and DKC6777) and their symbol are (G1 and G2) respectively. Significant differences were observed among hybrids, plant spacing, and plant patterns for each studied trait. Hybrid G2 exhibited performance for plant height (210.41 cm) and ear height (100.83 cm), ear length (20.92cm) and leaf area (6117.78 cm2) compared to G1 (188.48 cm, 92.04, 19.17 cm and5599.59cm2), respectively. plant spacing, particularly D2 and D3 significantly impacted plant height, ear length and leaf area (100.42 cm,100.19 cm),(20.19 , 20.67 cm) and (6109.00 and 6086.88cm2) respectively, while planting pattern P2 significantly effected on plant height, ear height and ear length by recording (203.13 cm,98.54 cm and 20.79 cm) while did not effect on 50 % of silking periods, leaf area, protein and oil% .The interactions between hybrids, plant spacing, and planting patterns significantly influenced trait. For instance, the interaction G2xD2 resulted in the highest ear height (106.67 cm), while the interaction G1xD1 led to the lowest number of days to reach 50% tasseling (53.67 days). These findings provide valuable insights into the factors affecting agronomic traits and can inform future breeding strategies and cultivation practices to enhance crop productivity and quality.

***Keywords*:** Maize, Hybrids, Plant spaces, Plant Patterns, Growth and Quality.

INTRODUCTION

Demand for maize is continually increasing due to food, feed, and industrial needs. Wheat, rice and maize are the essential cereal crops in the world nonetheless maize is the most popular due to its high yielding, easy of handling, readily digested and costs less than other cereals [1]. Due to its multiple uses, it has occupied an essential position among crops [2]. It is rich in protein, oil, vitamins, and minerals, so there is an urgent need for a vertical increase in production. It is characterized by a high ability to increase production and abundant growth, and it can interact and respond to the available environmental conditions [3]. Because the crop productivity rate in Iraq is still below the global production, as the cultivated area in Iraq for the year 2022 reached about 82,842 thousand hectares, with a production rate of 5,987 tons' ha-1, which is a very low amount, 45% of the global production of 10,880 tons' ha-1, according to statistics from the organization. Food and Agriculture [4].
Reasonable plant spacing and planting patterns are the key factors for high-yield and efficient crop cultivation [5, 6]. Qualitative traits are also affected by plant space and plant patterns, and competition, especially as a result of shading in the early and active stages of growth [7]. Enhanced agronomic practices often lead to improved productivity of maize production [8]. Different researchers have conducted many studies to determine optimum plant density and row spacing in the last decades. However, investigations on twin row planting alignments are still new and need further evaluation. Although the yield advantages of twin row maize have been inconsistent across various environments. Studies reported that yield increases with the twin row system, because hybrid, plant density, year and location affect the yield response to single or twin row formation [9]. The objective of this study was to compare single and twin-row planting patterns and row space to determine the optimum plant density for two maize hybrids.

Materials and Methods:

Experimental trials and treatments:

A field experiment was carried out in the fall season of 2023 at the Agricultural Research Station of the College of Agriculture- University of Kirkuk, to compare single and twin-row planting patterns and row space to determine the optimum plant density for two maize hybrids. The experimental land was prepared and plowed with disc plow. DAP fertilizer (P_2O_5 46% + N 18%) was added to each plot as a source of phosphorus in one batch before planting in an amount of 200 kg ha^{-1}, and urea fertilizer (N 46%), as a source of nitrogen in two batches, the first at planting, the second before the flowering stage [10].

The experiment was implemented using a randomized complete block design (RCBD) according to the split split- plot design system, with three replications. plant space included (15,20,25, and 30) cm between plants and their symbol is (D1, D2, D3, and D4), respectively. The second factor represents the planting pattern (Single row 50cm between the rows and double row 30x50cm) and their symbol are (P1 and P2) respectively, while the third factor was two hybrids (DKC6050 and DKC6777) and their symbol are (G1 and G2). The experimental land was divided into (48) experimental units, each unit with an area of (2 x 2 m^2). The treatments were distributed randomly among the experimental units for each block, each replicate included 16 experimental units.

The seeds were planted on July 7, 2023, and 2 seeds were placed in each hole to a depth of 5 cm. Plants were harvested on November 15, 2023. Growth traits were studied (number of days to reach 50% tasseling (day), number of days to reach 50% silking (day), Leaf area (cm^2), Plant height (cm), Ear height (cm), Ear length (cm), Protein ratio (%), and Oil ratio (%)).

Data analysis:

The computer program SAS 9.0 was used to perform statistical analysis, and the means between hybrids, plant space, and planting pattern and their interactions were compared using the Least Significant Difference (LSD) at a significance level of 5% [11].

Results and Discussion:

Number of days to reach 50% tasseling (day):

It is clear from Table (1) regarding the number of days to reach 50% tasseling trait, that the hybrid G1 was significantly superior and gave the lowest mean number of days, amounting to (54.83) days, compared to the hybrid G2, which gave the highest mean, amounting to (56.00) days. Plant Space D1 was significant and gave the lowest mean number of days (54.08) days compared to other Plant Spaces. While there was no significant difference between plant patterns P1 and P2, which gave (55.58 and 55.25) days, respectively.

The interaction G1xD1 was significantly superior and gave the lowest mean number of days (53.67) days compared to the other interactions. The interactions G1xP1, G1xP2, and G2xP did not differ significantly from each other and reached (54.67, 55.00, and 55.50) days, respectively, while they differed significantly from the interactions G2xP1, which gave the highest mean of (56.50) days. While the interaction D1xP2 was significantly superior to the rest of the other interactions and gave the lowest mean number of days, amounting to (53.50) days.

Regarding the triple interactions, the interaction G1xD1xP2, G2xD1xP1, and G2xD2xP2 was significantly superior to the rest of the other interactions and gave the lowest mean number of days, reaching (52.00, 54.00, and 53.67) days, respectively. The results are consistent with [12, 13, 14, 15].

Table (1) Effect of planting patterns (P), plant spaces (D), hybrids (G) and their interactions on number of days to reach 50% tasseling (day).

G	P	D				GxP
		D1	D2	D3	D4	
G1	P1	55.33	54.67	54.67	54.00	54.67
	P2	52.00	55.00	56.33	56.67	55.00
G2	P1	54.00	57.00	58.33	56.67	56.50
	P2	55.00	53.67	54.00	59.33	55.50
Mean (D)		54.08	55.08	55.83	56.67	Mean (P)
DxP	P1	54.67	55.83	56.50	55.33	55.58
	P2	53.50	54.33	55.17	58.00	55.25
						Mean (G)
GxD	G1	53.67	54.83	55.50	55.33	54.83
	G2	54.50	55.33	56.17	58.00	56.00
L.S.D G= 0.71	L.S.D D= 0.99	L.S.D P= n.s		L.S.D GxD= 1.41		L.S.D GxP= 0.99
L.S.D DxP= 1.41	L.S.D GxDxP= 2.00					

Number of days to reach 50% silking (day):

Table (2) Effect of planting patterns (P), plant spaces (D), hybrids (G) and their interactions on number of days to reach 50% silking (day).

G	P	D1	D2	D3	D4	GxP
G1	P1	59.33	58.67	58.67	58.00	58.67
	P2	56.00	59.00	60.33	60.67	59.00
G2	P1	58.00	61.00	62.33	60.67	60.50
	P2	59.00	57.67	58.00	63.33	59.50
Mean (D)		58.08	59.08	59.83	60.67	Mean (P)
DxP	P1	58.67	59.83	60.50	59.33	59.58
	P2	57.50	58.33	59.17	62.00	59.25
						Mean (G)
GxD	G1	57.67	58.83	59.50	59.33	58.83
	G2	58.50	59.33	60.17	62.00	60.00

L.S.D G= 0.93 L.S.D D= 1.32 L.S.D P= n.s L.S.D GxD= 1.87 L.S.D GxP= 1.32

L.S.D DxP= 1.87 L.S.D GxDxP= 2.64

It is noted from Table (2) regarding the number of days to reach 50% silking trait, that the hybrid G1 was significantly superior and gave the lowest mean of (58.83) days compared to the hybrid G2, which gave the highest mean of (60.00) days. plant space D1 showed significant superiority and gave the lowest mean number of days (58.08) days compared to plant space D4, which gave the highest mean number of days (60.67) days. While no significant differences appeared between plant patterns P1 and P2, reaching (59.58 and 59.25) days, respectively.

The interaction G1xD1 was significantly superior and gave the lowest mean number of days, which amounted to (57.67) days, compared to the interaction G2xD4, which gave the highest mean number of days, which amounted to (62.00) days. While the interaction G1xP1 was significantly superior and gave the lowest mean number of days, which was (58.67) days, compared to the interaction G2xP1, which gave the highest mean, which was (60.50) days. The interaction D1xP2 was significantly superior and gave the lowest mean of (57.50) days compared to the interaction D4xP2, which gave the highest mean of (62.00) days.

As for the triple interactions, the interactions G2xD2xP2 and G1xD1xP2 excelled and gave the lowest mean of (57.67 and 56.00) days, respectively, compared to the interaction G2xD4xP2, which gave the highest mean of (63.33) days. The results are consistent with [12, 13, 14, 15].

Leaf area (cm^2 plant^{-1}):

It is clear from Table (6) of leaf area trait that the hybrid G2 showed a significant increase and gave the highest mean of (6117.78) cm^2 compared to the hybrid G1, which gave the lowest mean of (5599.56) cm^2. plant spaces D2 and D3 showed a significant increase of (6109.00 and 6086.88) cm2, respectively, compared to plant spaces D1 and D4, which gave the lowest mean of (5639.06 and 5598.75) cm2, respectively. While the plant patterns P1 and P2 did not differ significantly from each other and gave a mean of (5808.08 and 5909.25) cm^2, respectively.

The interaction G2xD2 showed a significant increase and gave the highest mean of (6777.3) cm^2, and thus it outperformed the rest of the other interactions. While the interactions G2xP1 and G2xP2 showed a significant increase and gave the highest mean of (6072.75 and 6162.81) cm^2, respectively, thus outperforming the rest of the other interactions. The interactions D2xP2 and D3xP2 were significantly superior and gave the highest mean of (6307.8 and 6454.5) cm2, respectively, compared to the other interactions.

As for the triple interactions, the interactions G2xD2xP2 was significantly superior to the rest of the other interactions and gave the highest mean of (7157.3) cm^2. The results are consistent with [16, 17].

Table (3) Effect of planting patterns (P), plant spaces (D), hybrids (G) and their interactions on leaf area (cm^2 plant^{-1}).

G	P	D1	D2	D3	D4	GxP
G1	P1	5519.3	5423.3	5678.3	5553.0	5543.44
	P2	5595.3	5458.3	6440.5	5128.8	5655.69
G2	P1	5977.3	6397.3	5764.3	6152.3	6072.75
	P2	5464.5	7157.3	6468.5	5561.0	6162.81

Mean (D)		5639.06	6109.00	6086.88	5598.75	Mean (P)
DxP	P1	5748.3	5910.3	5721.3	5852.6	5808.08
	P2	5529.9	6307.8	6454.5	5344.9	5909.25
						Mean (G)
GxD	G1	5557.3	5440.8	6059.4	5340.9	5599.56
	G2	5720.9	6777.3	6116.4	5856.6	6117.78

L.S.D G= 123.86 L.S.D D= 175.17 L.S.D P= n.s L.S.D GxD= 247.72
L.S.D GxP= 175.17 L.S.D DxP= 247.72 L.S.D GxDxP= 350.33

They reported that the double row planting system did not have a significant effect on plant height, the number of leaves, and leaf area of plant.

Plant height (cm):

It is noted from Table (4) for the plant height trait that the hybrid G2 showed a significant increase amounting to (210.41) cm compared to the hybrid G1, which amounted to (188.48) cm, this is due to the genetic difference between hybrids and the extent to which they respond to and benefit from environmental conditions. The plant Spaces D2 and D3 showed a significant increase amounting to (202.42 and 202.19) cm, respectively. Also, the plant pattern P2 was significantly superior and showed an increase of (203.13) cm compared to the plant pattern P1, which reached (195.76) cm.

The di-interaction G2xD2 showed a significant superiority over the rest of the other interactions and amounted to (218.70) cm. The interaction G2xP2 showed a significant increase amounting to (214.60) cm, superior to the rest of the other interactions. The interaction D3xP2 also showed a significant superiority amounting to (210.10) cm compared to the other interactions.

The triple interactions G2xD2XP2 and G2xD3XP2 showed a significant increase over the rest of the other parameters and reached (223.83 and 220.50) cm, respectively. The results are consistent with [12, 18,19].

This distribution decreases ‘plant to plant’ competition for nutrient and light, available water, increases radiation interception and dry matter production and provide minimum competition and maximum yield at any given plant density. Increased plant density causes thinner plant stems and often to become taller.

Ear height (cm):

Table (5) shows of the ear height trait that the hybrid G2 was significantly superior and gave the highest mean of (100.83) cm compared to the hybrid G1, which reached (92.04) cm. This is due to the genetic difference between the hybrids and the extent of their response to environmental conditions and benefiting from them. Plant Space D2 showed a significant increase of (100.42) cm compared to plant Space D1, which gave the lowest mean of (93.33) cm. The plant pattern P2 showed a significant superiority and gave the highest mean of (98.54) cm compared to the plant pattern P1, which reached (94.33) cm.

The interaction G2xD2 reached (106.67) cm, and thus it is superior to the rest of the other interactions. The interaction G2xP2 showed a significant increase of (101.67) cm compared to the interaction G1xP1, which gave the lowest mean of (88.67) cm.

Table (4) Effect of planting patterns (P), plant spaces (D), hybrids (G) and their interactions on plant height (cm).

G	P	D				GxP
		D1	D2	D3	D4	
G1	P1	185.10	181.83	190.34	183.93	185.31
	P2	189.37	190.43	199.70	187.10	191.65
G2	P1	202.60	213.57	198.20	210.50	206.22
	P2	201.87	223.83	220.50	212.20	214.60
Mean (D)		194.73	202.42	202.19	198.73	Mean (P)
DxP	P1	193.85	197.70	194.28	197.22	195.76
	P2	195.62	207.13	210.10	199.65	203.13
						Mean (G)
GxD	G1	187.23	186.13	195.03	185.52	188.48
	G2	202.23	218.70	209.35	211.35	210. 41

L.S. D GxP= 2.09 L.S. D GxD= 2. 95 L.S. D P= 1. 48 L.S. D D= 2. 09 L.S.D G= 1. 48
L.S.D DxP= 2.95 L.S.D GxDxP= 4.17

Interactions D2xP2 and D3xP2 significantly outperformed the rest of the other interactions and reached (103.33 and 101.67) cm, respectively.

As for the triple interactions, the interaction G2xD2XP2 was superior and gave the highest mean of (110.00) cm compared to the interaction G1XD3XP1, which gave the lowest mean of (84.67) cm. The results are consistent with [12, 18,19]. They reported that differences in ear characteristics of maize hybrids such as ear height, ear length, ear weight were significant and differed from hybrid to hybrid. Also, those traits were highly affected by different environmental conditions as well.

Table (5) Effect of planting patterns (P), plant spaces (D), hybrids (G) and their interactions on ear height (cm).

G	P	D				GxP
		D1	D2	D3	D4	
G1	P1	88.33	91.67	84.67	90.00	88.67
	P2	95.00	96.67	98.33	91.67	95.42
G2	P1	96.67	103.33	95.00	105.00	100.00
	P2	93.33	110.00	105.00	98.33	101.67
Mean (D)		93.33	100.42	95.75	96.25	Mean (P)
DxP	P1	92.50	97.50	89.83	97.50	94.33
	P2	94.17	103.33	101.67	95.00	98.54
						Mean (G)
GxD	G1	91.67	94.17	91.50	90.83	92.04
	G2	95.00	106.67	100.00	101.67	100.83
L.S.D G= 0.99	L.S.D D= 1.41	L.S.D P= 0.99		L.S.D GxD= 1.98		L.S.D GxP= 1.40
L.S.D DxP= 1.98	L.S.D GxDxP= 2.80					

Length ear (cm):

It is clear from Table (6) of the length ear trait that the hybrids differed significantly among themselves, as the hybrid G2 outperformed (20.92) cm compared to the hybrid G1, which reached 19.71 cm. This is due to the genetic difference between the hybrids. The Plant Spaces of D2, D3, and D4

were superior and gave the highest means of (20.91, 20.67, and 20.17) cm, respectively, compared to the Plant Space of D1, which gave the lowest mean of (19.50) cm. As for the plant patterns, the plant pattern P2 gave the highest mean of (20.79) cm. Thus, it surpassed the plant pattern P1, which gave a mean of (19.83) cm.

The interactions G2xD2, G2xD3, and G2xD4 were significantly superior to the rest of the interactions and reached (22.33, 20.83, and 21.00) cm, respectively. The interactions G1xP2, G2xP1, and G2xP2 did not differ

significantly from each other and reached (20.50, 20.75, and 21.08) cm, respectively, while they outperformed the interaction D1xP1, which gave the lowest mean of (18.92) cm. The interactions D4xP1, D2xP2, and D3xP2 showed significant superiority over the rest of the other interactions and gave the highest mean of (20.33, 21.67, and 21.83) cm, respectively.

As for the triple interactions, the interactions G1xD3XP2, G2xD2xP1, G2xD4xP1, G2xD2xP2, and G2xD3xP2 gave the highest mean of (21.67, 21.67, 21.67, 23.00, and 22.00) cm, respectively, and thus they significantly outperformed the rest of the other interactions. The results are consistent with [20, 21, 22

Protein ratio (%):

Table (7) shows that the G1 and G2 hybrids did not differ significantly from each other and gave a mean of (16.01 and 15.96) %, respectively. While protein ratio was affected by the plant spaces, as the plant space D2 gave the highest mean for the trait, amounting to (16.37) %, compared to the other plant spaces, D1, D3, and D4, which gave a mean of (15.76, 16.01, and 15.82) %, respectively. Perhaps the increase in the percentage of protein is due to the lack of density. Vegetarianism, which reduces misinformation and competition between plants for growth factors, which increases the protein content in grains, and this is in agreement with Al-Badri (2019). The protein percentage was not affected by plant patterns P1 and P2 and gave a mean of (15.90 and 16.08) %, respectively.

The di-interactions G1xD2 and G2xD2 outperformed the rest of the other interactions in terms of protein and gave the highest mean of (16.16 and 16.57) %, respectively. Interactions G1xP2, G2xP1, and G2xP2 showed significant superiority in protein ratio and gave the highest mean of (16.22, 15.98, and 15.94) %, respectively, compared to the interaction G1xP1, which gave the lowest mean of (15.80) %. The D2xP1, D2xP2, D3xP2, and D4xP2 interactions excelled and gave the highest mean of (16.31, 16.42, 16.11, and 16.00) %, respectively, compared to the interaction D4xP1, which gave the lowest mean of (15.64) %.

As for the triple interactions, the interaction G2xD2xP2 was superior and gave the highest mean of (16.74) % compared to the interaction G1xD4xP1 and gave the lowest mean of (15.52) %. The results are consistent with [7, 23, 24, 25].

Oil ratio (%).

Table (7) Effect of planting patterns (P), plant spaces (D), hybrids (G) and their interactions on protein ratio (%).

G	P	D1	D2	D3	D4	GxP
G1	P1	15.74	16.24	15.74	15.52	15.80
	P2	15.99	16.09	16.38	16.43	16.22
G2	P1	15.71	16.39	16.07	15.76	15.98
	P2	15.60	16.74	15.86	15.58	15.94
Mean (D)		15.76	16.37	16.01	15.82	Mean (P)
DxP	P1	15.63	16.32	15.90	15.64	15.90
	P2	15.79	16.42	16.12	16.00	16.08
						Mean (G)
GxD	G1	15.87	16.16	16.05	15.97	16.01
	G2	15.65	16.57	15.97	15.67	15.96

L.S.D G= n.s L.S.D D= 0.34 L.S.D P= n.s L.S.D GxD= 0.48 L.S.D GxP= 0.34 L.S.D DxP= 0.48 L.S.D GxDxP= 0.68

Table (8) notes that the G1 and G2 hybrids did not differ significantly from each other and gave a means of (3.49 and 3.50) %, respectively. The oil percentage was also not affected by the plant density D1, D2, D3, and D4, and gave mean for the trait amounting to (3.48, 3.55, 3.46, and 3.49) %, respectively. The oil percentage was not affected by plant types P1 and P2 and gave a mean of (3.46 and 3.53) %, respectively.

The di- interactions G1xD2 and G2xD3 excelled and gave the highest mean of (3.61 and 3.56) %, respectively, compared to the interaction G1xD3, which gave the lowest mean of (3.36) %. Interactions G1xP2, G2xP1, and G2xP2 showed significant superiority in oil ratio and gave the highest mean of (3.58, 3.52, and 3.48) %, respectively, compared to the interaction G1xP1, which gave the lowest mean of (3.39) %. The D1xP2 and D2xP2 interactions outperformed and gave the highest mean of (3.62 and 3.59) %, respectively, compared to the interaction D1xP1, which gave the lowest mean of (3.34) %.

As for the triple interactions, the interactions G1xD2xP2 and G2xD4xP1 excelled and gave the highest mean of (3.77) and 3.65%, respectively, compared to the interaction G2xD1xP1, which gave the lowest mean of (3.29) %. The results are consistent with [7, 23, 24, 25].

Table (8) Effect of planting patterns (P), plant spaces (D), hybrids (G) and their interactions on oil ratio (%).

G	P	D1	D2	D3	D4	GxP
G1	P1	3.39	3.44	3.37	3.38	3.39
	P2	3.62	3.77	3.37	3.38	3.58
G2	P1	3.29	3.57	3.58	3.65	3.52
	P2	3.61	3.40	3.54	3.34	3.47
Mean (D)		3.48	3.55	3.46	3.49	Mean (P)
DxP	P1	3.34	3.50	3.47	3.52	3.46
	P2	3.62	3.59	3.44	3.47	3.53
						Mean (G)
GxD	G1	3.51	3.61	3.36	3.49	3.49
	G2	3.45	3.49	3.56	3.50	3.50

L.S.D G= n.s L.S.D D= n.s L.S.D P= n.s L.S.D GxD= 0.23 L.S.D GxP= 0.17 L.S.D DxP= 0.23 L.S.D GxDxP= 0.33

Conclusion:

The study elucidated significant variations in multiple agronomic traits across different hybrids, plant spacing, and plant patterns. Hybrid G2 consistently outperformed G1 for plant height and ear height and ear length, underscoring the role of genetic diversity in trait manifestation. plant spacing, particularly D2 and D3, emerged as key determinants of plant height, ear length and leaf area. while planting pattern P2 demonstrated superiority over P1. the interaction of plant space and plant pattern (20cm x double row) was superior in traits (plant height, length ear, and leaf area), and the triple interaction between hybrid, plant space, and plant pattern (DKC6777x 20cm x double row) was superior in all traits studied except oil ratio. These findings offer valuable insights for breeders and growers to tailor cultivation practices and improve crop performance under varying growing conditions.

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تحليل مقارن لنمو وجودة بذور هجن الذرة الصفراء (*Zea mays* L.) تحت أنماط وكثافات نباتية مختلفة.

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الخلاصة

أجريت هذه الدراسة خلال الموسم 2023 في محطة البحوث الزراعية التابعة لكلية الزراعة – جامعة كركوك، بهدف تحديد أفضل الهجين والمساحة النباتية والنمط النباتي لدراسة تأثير صفات النمو والجودة في محصول الذرة الصفراء. باستخدام تصميم القطاعات العشوائية الكاملة (*RCBD*) وفق تصميم القطع المنشقة بثلاثة مكررات. تم استخدام اربعة كثافات نباتية (15،20،25، 30) سم ورمزها (*D1*، *D2*، *D3*، *D4*)، ونمطين نباتيين (صف واحد 50 سم وصف مزدوج *x50*30 سم) ورمزها (*P1* و *P2*). والهجين (*DKC6050* و*DKC6777*) ورمزها (*G1* و*G2*) على التوالي. وقد لوحظ وجود اختلافات معنوية بين الهجن والكثافات النباتية والأنماط النباتية لكل صفة مدروسة. أظهر الهجين *G2* أداءً لارتفاع النبات (210.41 سم) وارتفاع العرنوص (100.83 سم) وطول العرنوص (20.92 سم) ومساحة الورقة (6117.78 سم2) مقارنة بـ *G1* (188.48 سم، 92.04، 19.17 سم و5599.59 سم2)، على التوالي. أثرت الكثافات النباتية وخاصة *D2* و*D3* معنويا على ارتفاع النبات وطول العرنوص ومساحة الورقة (100.42 سم، 100.19 سم)، (20.19، 20.67 سم) و (6109.00 و6086.88 سم2) على التوالي، في حين أثر النمط النباتي *P2* معنويا على ارتفاع النبات وارتفاع العرنوص وطول العرنوص بتسجيل (203.13 سم، 98.54 سم، 20.79 سم) بينما لم يؤثر في 50% للوصول للتزهير الانثوي والمساحة الورقية والبروتين ونسبة الزيت. كما أثر التداخل بين الهجن والكثافات النباتية والانماط النباتية معنوياً في الصفة، إذ أدى التداخل *G2xD2* إلى أعلى ارتفاع للعرنوص (106.67 سم)، بينما أدى التداخل *G1xD1* إلى أقل عدد من الأيام ليصل إلى 50% تزهير ذكري (53.67 يومًا). توفر هذه النتائج رؤى قيمة حول العوامل التي تؤثر على السمات الزراعية ويمكن أن تفيد استراتيجيات التربية المستقبلية وممارسات الزراعة لتعزيز إنتاجية المحاصيل وجودتها.

الكلمات المفتاحية : الذرة الصفراء، الهجن، الكثافات النباتية، الأنماط النباتية، النمو والجودة.