Response of Corn (*Zea mays* L.) to Different Planting Dates and Their Impact on Yield and Quality Traits

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Abstract

A field experiment was conducted during the 2025 summer growing season at the Field Crops Department Research Station, College of Agriculture, Tikrit University, located in Salah Al-Din province , at coordinates 43.679° East longitude and 34.616° North latitude. The experiment was Applied using randomized complete block (RCBD) arranged in split-plot three replications to determine the effect of planting dates on physiological and morphological traits. The main plots included planting dates, while the sub-plots included the six genetic combinations (Saginto, ZP, DKC6777, Portiba, Layla, and DKC5911). The following results were obtained: The third planting date (August 1st) was excelled in vegetative and physiological growth traits, yield, and its components. It recorded the highest plant height, highest chlorophyll content, largest cob diameter, highest number of grains . row-1, highest total grain yield, highest biological yield, highest oil percentage, and the longest number of days to physiological maturity, reaching (171.25 cm), (41.35 SPAD), (48.87 mm), (37.32 grains . row^{-1}), (9.49 ton.ha^{-1}), (14.92 ton.ha^{-1}) (5.38%), and (104.50 days), respectively. Meanwhile, the first planting date (June 20th) was characterized by high heat accumulation values, recording (1769.23 K) until male flowering (57.44 days) and (1950.92 K) until female flowering. (59.17 days) and (2691.05 calories) until physiological maturity (104.50 days). In contrast, the second planting date (July 10) was distinguished by its superiority in protein content (9.05%) and ash content (1.14%). Regarding the genotypes, Saginto genotype showed the highest plant height, the highest number of leaves, the highest number of ear rows, the highest number of cob per plant, and the highest yield per plant, which was reflected in achieving the highest biological yield, harvest index, and oil percentage, recording (181.04 cm), (15.66 leaves . plant^{-1}), (14.82 rows . plant^{-1}), (1.24), (144.15 g), (13.79 tons ha^{-1}), (62.64%), and (5.71%) respectively. Meanwhile, genotype DKC5911 recorded the highest heat requirement. For male and female flowering and physiological maturity, the temperatures were 1808.96°C, 2004.53°C, and 2562.28°C, respectively. Genotype DKC6777 showed the earliest male and female flowering, recording the shortest number of days to reach 50% of the flowering stage (53.44 days and 55.33 days), while genotype Portiba was distinguished by its early physiological maturity, with the shortest duration (101.67 days). Genotype Layla was distinguished by its high chlorophyll content and high percentage of starch (39.54% SPAD and 30.28%, respectively.

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The third date (1 August) and the genotype (Saganto) were distinguished by their excelled in most of the studied traits. This was clearly reflected in the results of the interaction between the genotype and the planting date, as the genotype (Saganto) and the third date (1 August) recorded the highest values in the traits of the yield and its components, including the number of rows of cob, the number of grains .cob-1, the number of grains per cob, and the weight of 500 grains (17.27 rows . cob^{-1}), (782.40 grains . cob-1), and (145.00 g) respectively. At the first date (June 20), genotype (DKC6777) excelled in early flowering, recording the lowest number of days for male and female flowering (50.00 days) and (52.00 days) respectively. At the third date (August 1), genotype (Porteba) was distinguished by early physiological maturity (97.33 days). At the second date (July 10), genotype (DKC6777) was distinguished by the highest protein percentage (10.34%). At the second date (July 10), genotype (Porteba) was distinguished by the highest ash percentage (1.21%). At the third date (August 1), genotype (Saganto) recorded the highest oil percentage (6.13%), while genotype (Layla) recorded the highest starch percentage (32.91%). The third date (1 August) and the genotype (Saganto) were distinguished by their superiority in most of the studied traits. This was clearly reflected in the results of the interaction between the genotype and the planting date, as the genotype (Saganto) and the third date (1 August) recorded the highest values in the traits of the yield and its components, including the number of rows of the ear, the number of grains .cob-1, the number of grains .cob-1, and the weight of 500 grains (17.27 rows . cob-1), (782.40 grains . cob-1), and (145.00 g) respectively. At the first planting date (June 20), genotype DKC6777 exhibited the earliest flowering, recording the shortest number of days for male and female flowering (50.00 days and 52.00 days, respectively). At the third planting date (August 1), genotype Porteba showed the earliest physiological maturity (97.33 days). At the second planting date (July 10), genotype DKC6777 exhibited the highest protein content (10.34%), while genotype Porteba showed the highest ash content (1.21%). At the third planting date (August 1), genotype Saginto recorded the highest oil content (6.13%), and genotype Layla recorded the highest starch content. (32.91%(

Keywords: Genetic composition, planting dates, yield traits, quality traits.

Introduction

maize *(Zea mays* L.) is an important cereal crop widely cultivated in various countries around the world. It ranks third in strategic and nutritional importance after wheat (*Triticum aestivum* L.) and rice (Oryza sativa L.). It is distinguished by its diverse applications, serving as a food source for humans, animal feed for both large and small animals, and in the production of oils and numerous other industries [1].

Planting date is a direct factor influencing corn grain yield and its composition. This is linked to the prevailing temperatures during different

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growth stages, particularly the period from germination to the emergence of the male inflorescence. High temperatures during this stage shorten the flowering period and affect pollen viability. Early autumn planting may coincide with high temperatures during the flowering stage, negatively impacting fertilization efficiency and increasing the number of unfertilized ovaries, thus reducing grain yield. Therefore, determining the appropriate planting date in light of climatic changes is a key factor in improving yellow corn productivity, as variations in planting dates significantly affect the temperature levels associated with different growth stages, from germination to the end of the season. Accordingly, planting the crop at the right time is an effective way to increase yield components and achieve the highest possible productivity [2]. Accumulated temperatures contribute to enhanced plant growth and increased grain filling, and the daily growth temperature is a fundamental concept for determining the optimal time and location for planting [3]. This temperature influences chlorophyll formation and the performance of vital processes such as stomata opening and closing. Furthermore, day length plays a crucial role in regulating plant growth. Short days accelerate flowering, while long days prolong the vegetative stage and delay flowering and maturity, making the growth period directly related to photoperiod. Numerous studies have highlighted the important role of crop cultivars in improving productivity, as cultivars are among the primary factors directly influencing growth traits, yield, and quality, in addition to their varying ability to adapt to prevailing environmental conditions. Based on the foregoing, evaluating yellow corn cultivars is a crucial step in determining their productivity and adaptability to local environmental conditions, particularly in light of climate change and varying agricultural resources. Understanding the nature of genetic variation among these cultivars provides a sound scientific basis for selecting superior genotypes and incorporating them into future genetic improvement programs [4]. Accordingly, this study aims to achieve the following: Determining the effect of planting dates on growth stages, productivity indicators, and protein content; evaluating the impact of genetic variation on growth and yield traits, and identifying the most productive genotypes; and investigating the interaction between the study factors on yield and quality traits in yellow corn.

Materials and Methods

A field experiment was conducted during the 2025 summer growing season at the Field Crops Research Station, College of Agriculture, Tikrit University, located in Salah al-Din Governorate at coordinates 43.679° East longitude and 34.616° North latitude. The experiment aimed to determine the effect of different planting dates on yield and quality traits. Ten random soil samples were taken from the field before planting at a depth of 30 cm for laboratory analysis to determine their chemical and physical properties. The laboratory analyses were conducted at the Tikrit University, College of Agriculture, Soil Science Department. The results are shown in Table (1) below.

Table (1) Physical and Chemical Properties of the Experimental Field Soil

Values	Unit	traits	No.
7.75		PH	1
352.	$Ds.m^{-1}$	Electrical Conductivity	2
552	$g.kg^{-1}$	Sand	3
260	$g.kg^{-1}$	s	4
188	$g.kg^{-1}$	Clay	5
Sandy Clay Loam	$g.kg^{-1}$	Texture	6
7.13	$g.kg^{-1}$	Organic Matter	7
14.70	mg.kg-1	Available Nitrogen	8
4.01	mg.kg-1	Available Phosphorus	9
130	mg.kg-1	Available Potassium	10

Factors of the Experiment:

Factor 1: Planting Dates

Three planting dates were used in this experiment (June 20, July 10, and August 1).

Factor 2: Genotypes: Six genotypes were used in this experiment: (Layla, DKC5911, DKC6777, ZP, Sagento, and Portiba).

Preparation of the Experimental Field: The field experiment was conducted according to a randomized complete block design (RCBD). The experimental field was plowed twice perpendicularly using a moldboard plow, and the soil was smoothed using available tillers. Triple superphosphate fertilizer (46% P2O5) was added at a rate of 21 kg P2O5 in one application and mixed into the soil during sowing. Sowing was done in rows, 2 m long, with 6 rows spaced 50 cm apart and 20 cm between plants. Three seeds were placed in each hole at a depth of 3 cm. Thinning was carried out after 15 days. Planting was done by leaving one plant per pit, removing weeds manually, and watering as needed. The corn stalk borer was controlled by applying the pellet-based insecticide diazinon (10% active ingredient) to the plants at 30 days old.

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Studied Traits: Yield Traits and Components

1- Grain Yield per hectare ($t.ha^{-1}$): Calculated using equation [5] which = Weight of kernels per ear × Number of cob × Plant density

2- Biological Yield ($ton.ha^{-1}$): Calculated using the following equation: Biological Yield = Total dry weight of plant × Plant density [5]

3- Harvest Index: Calculated by dividing the grain yield ($ton.ha^{-1}$) by the biological yield ($ton.ha^{-1}$)

4- Weight of 500 kernels (g): Weighed 500 kernels on a sensitive scale after adjusting the moisture content to 15.5% [5]

5 - Number of grain row $^{-1}$ (grain row $^{-1}$): The number of grains . row-1 was calculated by dividing the number of grains .cob-1 of corn by the number of rows per ear of corn.

Qualitative Traits:

1. Protein Percentage (%)

The protein percentage was estimated using the [6] method and the Inframatic device supplied by Perten.

2. Ash Percentage (%): The ash content of the seeds was estimated using the standard method (0.1–0.8) [6].

Oil content (%): The oil content in the grains was estimated using a Soxhelet intermittent extraction device, as described in [7].

4- Starch content (%): The starch content in the corn kernels was estimated using a spectrophotometer at a wavelength of 490 nm, as described in [7].

Statistical Analysis

The data were statistically analyzed using a randomized complete block design (RCBD) with a split-plot distribution, as described in [8]. Significant differences between the means were then compared using Duncan's multiple range test at a significance level of 0.05. The SAS and Excel software programs were used to perform the statistical analysis.

Results and Discussion:

1- Total Grain Yield (ton ha^{-1})

The results in Table (2) show that planting dates had a significant effect on the studied trait. The third planting date recorded the highest average yield of the trait at 9.49 ton. ha^{-1}, while the first planting date gave the lowest average yield of 4.32 tons ha^{-1}, which was not significantly different from the second planting date at 5.71 tons ha^{-1}. These results indicate that planting timing plays an important role in determining the trait level, reflecting the different responses of plants to different planting dates. The differences in productivity of the genotypes are attributed to their varying responses to

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the climatic conditions associated with different planting dates, and the accompanying differences in actual and cumulative temperatures. These changes may negatively affect dry matter accumulation due to a decrease in photosynthetic efficiency, which is reflected in the number and degree of fullness of the economically viable parts formed, thus leading to variations in the economic yield levels of the crop. This is attributed to the fact that the plant requires more energy to complete photosynthesis under heat stress conditions, despite the high heat compensation point of corn, being a C4 plant, where the amount of CO_2 released during respiration equals the amount of CO_2 fixed in photosynthesis. This is related to the fact that the PEP carboxylase enzyme is less sensitive to high temperatures than the Rubisco enzyme, giving C4 plants relative efficiency in hot conditions. However, genetic makeups differ in their ability to maintain the integrity of cytoplasmic membranes by modifying fatty acid composition and increasing the proportion of saturated fatty acids, which require higher temperatures to maintain their stability.

Furthermore, phospholipase A, the enzyme responsible for converting unsaturated fatty acids to saturated ones, may be activated, affecting membrane fluidity and its response to heat stress. This finding is consistent with what was indicated in [8].

Significant differences were observed between the genotypes, as the (Saginto) genotype achieved the highest average for the trait, reaching (8.84) tons ha-1, compared to the (5911) genotype, which recorded the lowest average, reaching (3.77) t ha^{-1}. This indicates that the plant genotype clearly affects the level of the trait, which confirms the importance of selecting the appropriate genotypes to achieve the best possible performance for the trait under study.

Regarding the interaction between planting dates and genotypes, the results were also significant. Saginto genotype performed best at the third planting date, achieving the highest average yield of 12.80 ton.ha^{-1}, while the 5911 genotype at the first planting date recorded the lowest average yield of 2.77 tons ha^{-1}. These results indicate that the interaction between genotype and planting date plays a pivotal role in determining plant performance, confirming that selecting the appropriate planting date in conjunction with the optimal genotype can significantly contribute to improving desirable traits and increasing production efficiency.

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Table (2): Effect of genotypes, planting dates, and their interaction on total grain yield (ton.ha^{-1})

Average cultivars	Planting dates			cultivars
	third date	second date	First date	
8.84 a	12.80 a	7.56 c	6.15 c	Sagento
6.92 b	10.17 b	6.67 c	3.91 e	ZP
6.56 b	10.48 b	5.77 d	3.43 e	6777
6.87 b	9.27 b	6.12 c	5.24 d	Portiba
6.10 b	9.08 b	4.77 d	4.45 d	Layla
3.77 c	5.14 d	3.40 e	2.77 e	5911
	9.49 a	5.71 b	4.32 b	Average date

*Numbers with the same letters do not differ significantly from each other according to Duncan's multiple range test at a 5% probability level.

2- Biological Yield (ton.ha^{-1})

The results in Table (3) show clear and significant differences between the different planting dates in the biological yield trait, indicating the significant effect of planting date on this trait. The third planting date, August 1st, showed a significant advantage over the other dates, recording the highest average biological yield of (14.92) tons ha^{-1}. This average did not differ significantly from the average recorded for the second planting date, June 10th, which was (12.60) ton.ha^{-1}. In contrast, the first planting date, June 20th, yielded the lowest average for this trait, at 10.95 tons ha^{-1}. This is attributed to favorable environmental conditions, particularly moderate temperatures and adequate moisture during the growth stages. These factors contribute to enhanced photosynthesis, leading to increased plant biomass. This was reflected in superior growth traits such as plant height and leaf area, as well as yield components including the number of rows per cob, the number of grains . row-1, 500-grain weight, and total yield. These results are consistent with those reported by [9] and [10].

The results also showed that the studied genotypes differed significantly in biological yield, reflecting genetic variation in the efficiency and productivity of these genotypes. The Saganto genotype achieved the highest average biological yield of 13.79 ton.ha^{-1}, surpassing all other genotypes. Conversely, genotype 5911 recorded the lowest average for this trait at 11.25 ton.ha^{-1}, indicating lower productivity compared to the other studied genotypes. The differences in biological yield among the genotypes are attributed to genetic variation, as well as differences in the 500-grain weight trait, which positively impacted their biological productivity. These results align with the findings [11] indicating significant differences between cultivars in this trait.

Regarding the interaction between planting dates and genotypes, the results showed significant differences in biological yield, suggesting that the response of genotypes varies depending on planting dates. The Saganto genotype achieved the highest biological yield (16.67 ton.ha^{-1}) when planted at the third planting date, reflecting the high compatibility between this genotype and this planting date in achieving optimal production performance. Conversely, the 5911 genotype recorded the lowest biological yield (9.70 ton.ha^{-1}) at the first planting date, demonstrating its weak response to this date compared to the other treatments.

Table 3: Effect of genotypes, planting dates, and their interaction on biological yield (ton ha^{-1})

Average cultivars	**Planting dates**			**cultivars**
	third date	**second date**	**First date**	
13.79 a	**16.67 a**	**13.23 c**	**11.46 d**	**Sagento**
12.78 b	**15.03 b**	**12.54 c**	**10.76 d**	**ZP**
12.93 b	**14.67 b**	**12.99 c**	**11.15 d**	**6777**
12.92 b	**14.68 b**	**12.85 c**	**11.22 d**	**Portiba**
13.27 b	**15.21 b**	**13.20 c**	**11.40 d**	**Layla**
11.25 c	**13.24 c**	**10.80 d**	**9.70 e**	**5911**
	14.92 a	**12.60 a**	**10.95 b**	**Average date**

*Numbers with the same letters do not differ significantly from each other according to Duncan's multiple range test at a 5% probability level.

3- Harvest Index

Based on the data in Table (4), the statistical analysis showed no significant differences in harvest index between different planting dates. However, the results showed significant differences in harvest index between genotypes. Genotype (Saganto) achieved the highest mean for this trait at (62.64%), while genotype DKC (5911) recorded the lowest mean for harvest index at (33.14%). This indicates a lower relative ability to allocate dry matter to the crop compared to other genotypes, confirming clear genetic variation in the expression of this trait. This result is consistent with the findings of [12]. Regarding the effect of the dual interaction between planting dates and genotypes, the results revealed a significant impact of this interaction on the harvest index trait, indicating that the response of genotypes to this trait varies according to the planting date. The Saganto genotype, when planted at the third planting date, showed a clear and significant advantage, recording the highest average for the trait at 76.82%. This reflects the optimal compatibility between this genotype and the third planting date in improving the harvest index. In contrast, the 5911 genotype, when planted at the first planting date, gave the lowest average for the trait at 28.25%, demonstrating its poor performance under these conditions compared to the other treatments.

Table (4): Effect of Genotypes, Planting Dates, and Their Interaction on the Harvest Index Trait

average Genotypes	**Planting dates**			**Genotypes**
	third date	**second date**	**First date**	
62.64 a	**76.82 a**	**57.41 b**	**53.70 b**	**Sagento**
52.32 b	**67.75 a**	**52.89 b**	**36.31 c**	**ZP**
48.82 b	**71.49 a**	**44.25 c**	**30.73 d**	**DKC6777**
52.42 b	**63.36 b**	**47.19 c**	**46.73 c**	**Portiba**
45.22 c	**59.85 b**	**36.26 c**	**39.55 c**	**Layla**
33.14 d	**39.42 c**	**31.49 d**	**28.51 d**	**DKC5911**
	63.11 a	**44.91 a**	**39.25 a**	**Average date**

*Numbers with the same letters do not differ significantly from each other according to Duncan's multiple range test at a 5% probability level.

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4- 500-grain weight (g):

The results in Table (5) show no significant differences between the different planting dates for the 500-grain weight trait. However, the results also show significant differences between the studied genotypes for the 500-grain weight trait. The (Saginto) genotype recorded the highest average weight (133.67 g), while the (DKC5911) genotype gave the lowest average weight (106.22 g). The difference between the genotypes in this trait is attributed to their varying ability to accumulate dry matter, in addition to their genetic traits, which are less affected by environmental factors. This result is consistent with (13) and (14), which indicated significant differences between the cultivars in this trait. Regarding the interaction between planting date and genotypes, the results showed that this interaction was statistically significant, indicating that the response of genotypes to the 500-grain weight trait varied depending on the planting date. The genotype (Saginto) achieved the highest value for the trait (145.00 g) at the third planting date (August 1), while conversely, the genotype (DKC5911) recorded the lowest value for the trait (90.00 g) at the first planting date (June 20).

Table (5): Effect of genotypes, planting dates, and their interaction on the 500-grain weight trait (g).

average Genotypes	**Planting dates**			**Genotypes**
	third date	**second date**	**First date**	
133.67 a	**145.00 a**	**132.33 a**	**123.67 b**	**Sagento**
125.56 b	**135.67 a**	**132.00 a**	**109.00 b**	**ZP**
122.44 b	**133.00 a**	**131.00 a**	**103.33 c**	**DKC6777**
112.00 c	**119.67 b**	**111.33 b**	**105.00 c**	**Portiba**
113.33 c	**117.33 b**	**118.33 b**	**104.33 c**	**Layla**
106.22 c	**120.67 b**	**108.00 c**	**90.00 d**	**DKC5911**
	128.56 a	**122.17 a**	**105.89 a**	**Average date**

*Numbers with the same letters do not differ significantly from each other according to Duncan's multiple range test at a 5% probability level.

5- Number of grains row^{-1} (grains row^{-1}):

The results in Table (6) show significant differences in the number of grains . row-1 based on planting date.

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The third planting date (August 1) showed the highest value for the trait (37.32 grain row^{-1}), while the first planting date (June 20) recorded the lowest average (25.45 grains . row^{-1}). The second planting date (July 10) did not differ significantly from the first, which recorded an average of (26.89 grain row^{-1}). This is attributed to the suitability of temperature, relative humidity, and soil water tension during the flowering period, which contributed to successful fertilization, increased fertility, and positively impacted the number of grains . row-1 (15). These results were consistent with those of researchers (16) and (17).

The results also showed that the differences between the genotypes were significant. The (Saganto) genotype recorded the highest average for the trait (36.12 grain row^{-1}), compared to the (DKC5911) genotype, which gave the lowest average (20.17 grain row^{-1}). This may be attributed to the genetic difference between the genotypes for this trait, as the (Saganto) genotype excelled in most growth traits, such as plant height and chlorophyll content. This led to increased photosynthetic efficiency, which was reflected in a higher number of grains per plant. These results are consistent with those of researchers (18) and (19), who indicated significant differences between the genotypes for this trait. Regarding the interaction between planting date and genotypes, it was statistically significant. The genotype (Saginto) exhibited the highest value for the trait (45.30 grains . row-1) at the third planting date (August 1), demonstrating its suitability and responsiveness to the surrounding environmental conditions. Conversely, the genotype (DKC5911) recorded the lowest value for the trait (15.74 grain row^{-1}) at the first planting date (June 20), indicating that the response of genotypes to the studied trait is influenced by variations in planting date.

Table (6): Effect of genotypes, planting dates, and their interaction on the trait of number of grain row^{-1}

Genotypes	**Planting dates**			**average Genotypes**
	First date	**second date**	**third date**	
Sagento	**32.71 c**	**30.34 c**	**45.30 a**	**36.12 a**
ZP	**24.13 d**	**29.94 c**	**37.49 b**	**30.52 b**
DKC6777	**22.97 d**	**25.36 d**	**40.77 a**	**29.70 b**
Portiba	**30. 77 c**	**33.01 c**	**37.35 b**	**33.71 a**
Layla	**26.37 d**	**22.52 d**	**38.36 b**	**29.08 b**

DKC5911	**15.74 e**	**20.14 e**	**24.63 d**	**20.17 c**
Average date	**25.45 b**	**26.89 b**	**37.32 a**	

*Numbers with the same letters do not differ significantly from each other according to Duncan's multiple range test at a 5% probability level.

Effect of Genotypes and Planting Dates on Qualitative Traits

1- Protein Percentage (%)

The results in Table (7) show that planting dates have a significant effect on protein percentage. The second planting date, July 10th, showed a significant advantage over the other dates, recording the highest average for the trait at (9.05%). This indicates the availability of suitable environmental conditions during this date, which contributed to improving the physiological and productive performance of the plants. In contrast, the first planting date, June 20th, recorded the lowest arithmetic mean for the trait at (7.48%), reflecting the lower efficiency of plants in expressing this trait when planted earlier compared to the second planting date. The higher percentage of protein in the grains may be attributed to the increased temperatures during the grain-filling period in the second planting date of the autumn season. This led to an acceleration of nitrogen transfer from different parts of the plant to the grains, which contributed to increasing their protein content. [20] These results were consistent with those indicated by [21] and [22].

The results also showed significant differences between the genotypes in the protein content of the grains. Genotype (6777) achieved the highest value for the trait at (9.46%), significantly outperforming the other genotypes, while genotype (Portiba) recorded the lowest mean value for the trait at (7.73%). The differences between the genotypes can be attributed to their genetic nature, which is linked to the physiological and biological processes that affect the formation of photosynthetic products. The superiority of genotype (Saginto), which had the largest leaf area, led to a higher protein content in it. This result is consistent with what [23] found regarding significant differences between cultivars in this trait. Regarding the interaction between planting dates and genotypes, the results showed a significant effect of this interaction on the studied trait, cultivation. Genotype (6777) performed best when planted at the second planting date, recording the highest value for the trait at (10.34%). This reflects the high compatibility between this genotype and the second planting date in achieving optimal trait performance. Conversely, genotype (Saginto) recorded the lowest value for the trait at the first planting date, at (6.66%), indicating its weak response to this date compared to the other genotypes and planting dates.

Table (7): Effect of genotypes, planting dates, and their interaction on the protein percentage trait

cultivars	Planting dates			Average cultivars
	First date	second date	third date	
Sagento	6.66 b	9.02 a	8.16 b	7.95 b
ZP	7.00 b	8.59 a	7.75 b	7.78 b
DKC 6777	8.40 b	10.34 a	9.65 a	9.46 a
Portiba	6.86 b	8.41 b	7.91 b	7.73 b
Layla	8.07 b	8.88 a	8.71 a	8.55 a
DKC 5911	7.91 b	9.03 a	9.49 a	8.81 a
Average date	7.48 b	9.05 a	8.61 a	

Numbers with the same letters do not differ significantly from each other according to Duncan's multiple range test at a 5% probability level.

2- Ash Percentage (%)

The results in Table (8) show significant differences in ash percentage between different planting dates. The second planting date showed a significant advantage over the other dates, recording the highest average ash percentage of (1.14)%. This indicates that this date provided suitable environmental conditions that contributed to increased accumulation of mineral elements in plant tissues. In contrast, the first planting date recorded the lowest average ash percentage of (0.82)%, reflecting a reduced ability of plants planted at this date to absorb or accumulate mineral elements compared to the other dates. The results also showed significant differences in ash percentage between the studied genotypes, reflecting genetic variation in the efficiency of nutrient absorption and accumulation within the plant. Genotype (6777) achieved the highest average ash content at 1.09%, significantly outperforming the other genotypes. In contrast, genotype (Layla) exhibited the lowest average ash content at 0.80%, indicating a lower genetic predisposition to express this trait compared to the other genotypes. Regarding the interaction between planting dates and genotypes, the results showed a significant effect of this interaction on ash content, suggesting that the response of genotypes to this trait varies depending on the planting date. Genotype (Portiba) performed best when planted at the second planting date, recording the highest ash content at 1.21%. This reflects the optimal compatibility between this genotype and the second planting date in promoting mineral accumulation. In contrast, the Layla genotype recorded the lowest value for the trait at the first planting date (0.72%), indicating its weak response to this date compared to the other treatments.

Table (8): Effect of genotypes, planting dates, and their interaction on the ash percentage trait

cultivars	**Planting dates**			**Average cultivars**
	First date	**second date**	**third date**	
Sagento	**0.81 e**	**1.37 a**	**0.91 d**	**1.03 b**
ZP	**0.82 e**	**1.07 c**	**0.97 d**	**0.95 c**
DKC 6777	**0.91 d**	**1.19 b**	**1.17 b**	**1.09 a**
Portiba	**0.80 e**	**1.21 b**	**0.83 e**	**0.95 c**
Layla	**0.72 f**	**0.93 d**	**0.75 f**	**0.80 d**
DKC 5911	**0.85 e**	**1.07 c**	**0.93 d**	**0.95 c**
Average date	**0.82 c**	**1.14 a**	**0.93 b**	

*Numbers with the same letters do not differ significantly from each other according to Duncan's multiple range test at a 5% probability level.

Oil percentage (3%)

The results in Table (9) show that planting dates have a significant effect on the oil percentage trait in seeds. The third planting date, August 1st, significantly outperformed the other dates, recording the highest mean score of (5.38%). In contrast, the first planting date, June 20th, gave the lowest mean score of (4.13%). These results are consistent with the findings of [24] and [25].

The results also showed significant differences between the studied genotypes in this trait. The Saganto genotype recorded the highest mean score of (5.71%), significantly outperforming the other genotypes, indicating its high genetic efficiency in oil formation and accumulation. Meanwhile, the genotype DKC (5911) gave the lowest mean score. The percentage of the trait reached (4.27%), indicating its weak response and genetic

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susceptibility compared to other genotypes under the same conditions.

Regarding the effect of the binary interaction between planting dates and genotypes, the results showed significant differences in the studied trait. The Saganto genotype, when planted at the third planting date, achieved the highest mean percentage of the trait at (6.13%). This superiority was significant compared to all other interaction parameters, reflecting the optimal compatibility between this genotype and the third planting date in achieving the highest oil production efficiency. In contrast, the 5911 genotype, when planted at the first planting date, recorded the lowest mean percentage of the trait at (3.63%), confirming that this genotype is less able to take advantage of the conditions of this planting date.

Table (9): Effect of genotypes, planting dates, and their interaction on the percentage of oil yield trait

cultivars	Planting dates			Average cultivars
	First date	second date	third date	
Sagento	4.97 d	6.03 a	6.13 a	5.71 a
ZP	3.71 h	4.82 e	5.22 c	4.58 d
DKC6777	3.86 g	4.78 e	5.08 d	4.57 d
Portiba	4.61 e	5.76 b	5.84 b	5.40 b
Layla	4.01 g	4.82 e	5.37 c	4.73 c
DKC5911	3.63 h	4.53 f	4.64 e	4.27 e
Average date	4.13 c	5.12 b	5.38 a	

*Numbers with the same letters do not differ significantly from each other according to Duncan's multiple range test at a 5% probability level.

Starch content (%)

The results in Table (10) show that planting dates have a significant effect on the studied trait. The third planting date recorded the highest mean for the trait at (30.46%), while the first planting date gave the lowest mean for the trait at (26.38%), which did not differ significantly from the second planting date, which recorded a mean of (27.84%). The results also showed significant differences between the genotypes. Genotype Layla exhibited the highest trait value at 30.28%, compared to genotype 5911, which recorded the lowest average trait value at 26.81%. This reflects the genetic differences between the studied

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genotypes. The variation in the growth rate between the genotypes can be attributed to their genetic predisposition to nutrient accumulation, a finding consistent with those of [19] and [12]. Regarding the interaction between planting dates and genotypes, significant differences were observed. Genotype Layla achieved the highest trait value at 32.91% at the third planting date, while genotype 5911 recorded the lowest trait value at 24.28% at the first planting date. This confirms that the effect of planting dates is highly dependent on the genotype used.

Table (10): Effect of genetic makeup, planting dates, and their interaction on the percentage of starch.

cultivars	Planting dates			Average cultivars
	First date	second date	third date	
Sagento	**25.79 c**	**26.86 b**	**28.90 b**	**27.18 b**
ZP	**26.64 b**	**27.61 b**	**30.82 a**	**28.36 b**
DKC6777	**26.45 b**	**27.75 b**	**29.39 b**	**27.86 b**
Portiba	**27.05 b**	**28.57 b**	**31.03 a**	**28.88 a**
Layla	**28.08 b**	**29.85 a**	**32.91 a**	**30.28 a**
DKC5911	**24.28 c**	**26.42 b**	**29.72 a**	**26.81 b**
Average date	**26.38 b**	**27.84 b**	**30.46 a**	

*Numbers with the same letters do not differ significantly from each other according to Duncan's multiple range test at a 5% probability level.

Conclusions:

The study results showed that the most suitable planting date for yellow corn in the autumn season is August 1st, as this date achieved a significant advantage in most field and qualitative traits. Planting on this date contributed to improved production efficiency and increased yield quality in terms of both quantity and quality. Genetic combinations played a significant role in all qualitative and quantitative plant traits and yield traits, particularly the Saganto and ZP genotypes. The interactions between the Saganto genotype and the third planting date recorded the highest biological yield and total grain yield.

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