Effect of planting dates and DSPER size spraying on maize growth

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Abstract

Aiming to study the effect of planting dates and spraying with the compound DSPER Size on the growth of (*Zea mays* L.), a factorial experiment was conducted using a randomized complete block design (RCBD) with split-plot design and three replications. The experiment was carried out in one of the agricultural fields designated for the Field Crops Department, College of Agriculture, University of Kerbala, at the Ibn Al-Bitar Vocational School in the Al-Husseiniya region during the summer season of 2024. The experiment included two factors Main plots planting dates (July 10, July 20, July 30, and August 9) and Subplots concentrations of the DSPER Size compound (0, 1.0, 2.0, 3.0, and 4.0) g l^{-1} .The results showed that the third planting date (July 30) outperformed in some of the studied traits, recording the highest mean plant height (223.71 cm) and stem diameter (29.781 mm). Meanwhile, the fourth planting date excelled in leaf area, with a mean of (6853.6 cm^2), and chlorophyll content, of (60.581 SPAD). The treatment with the compound concentration of 3 g L^{-1} significantly outperformed in giving the highest means for all traits plant height (213.25 cm), stem diameter (29.810 mm), number of leaves (13.240 leaf $plant^{-1}$), leaf area (6697.4 cm^2), and chlorophyll content (61.230 SPAD).The results of the study also showed the superiority of the interaction treatment between the third planting date (July 30) and the concentration of 3 g L^{-1}, which resulted in the highest plant height of (225.23 cm) and the number of leaves reaching (14.630 leaf $plant^{-1}$).

Keywords Zea mays, Planting dates, DSPER Size,Spraying.

Introduction

Maize is prominent among the world's major cereal crops, ranking third in economic importance after wheat and rice. In 2019, the global area cultivated with maize reached 197.2 million hectares, yielding 1,148.5 million tons [1]. In Iraq, maize is particularly significant due to its in various uses nutrition and animal feed [2]. The significant gap between Iraq's productivity rate and global production is largely due to the inefficient use of growth inputs, particularly the timing of planting. Proper timing is essential for maximizing the productivity of maize. Early planting can expose the plants to challenges caused by low temperatures during their early growth stages. On the other hand, planting too late can subject the plants to extreme heat during the critical flowering stage. High temperatures during flowering have several negative effects. They weaken the processes of pollination and fertilization, which reduces the number of grains formed. Additionally, high heat shortens the grain-filling period, adversely impacting the size and weight of the grains. Consequently, these factors significantly affect the final yield, leading to a noticeable decrease in the overall productivity of maize. Therefore, determining the optimal planting time is crucial for achieving a successful crop, The ideal painting time aligns temperature conditions with the plant's needs at every growth stage, from germination to harvest [3].

In recent years, there has been a growing need to adopt modern technologies to improve agricultural production. One such technology gaining traction is the use of biostimulants. These biostimulants positively influence various physiological processes in plants, such as respiration, carbon assimilation, and the synthesis of nucleic acids. They also enhance nutrients absorption, which increases chlorophyll concentration within the plant. Additionally, biostimulants play a crucial role in improving the plant's resilience against different types of environmental stresses [4]. One effective biostimulant is the compound "Disperse Size," which promotes growth and increases yield by enhancing pollination and fertilization rates in the ovaries.It also helps mitigate, the negative effects of high temperatures during the flowering period, ultimately boosting crop yield in the autumn growing season. facilitates the transfer of stored nutrients from the plant to the ear, improving the quality, size, and taste of the corn ear. Given the of low yield and unsuccessful pollination during the autumn growing season, this study was designed to identify the best planting time for maize during the autumn season,this study aims to identify the optimal planting time for maize and to determine the ideal concentration of the "Disperse Size" compound that will enhance the growth characteristics of maize.

Materials and Methods

A field experiment was conducted in an agricultural fields belonging to the Ibn Al-Bitar Vocational School in the Al-Husseiniya region of Karbala Governorate, situated in sandy loam soil, during the 2024 agricultural season. For studying the effect of planting dates and spraying with the compound "Disperse Size" on the growth of maize plants. The experiment followed a randomized complete block design (RCBD) with a split-plot design, consisting of 60 experimental units. The experiment included the study of two factors Main plots planting dates (July 10, July 20, July 30, and August 9) , Subplots concentrations of the "Disperse Size" compound (0, 1.0, 2.0, 3.0, 4.0 g L^{-1}). Soil preparation operations were carried out, including plo ughing (with a moldboard plow), harrowing, leveling, and dividing the field into multiple experimental units, each with an area of 9 m^2. The seeds were sown on three planting dates, on ridges with a spacing of 50 cm between ridges and 25 cm between holes. The experimental field was fertilized with the essential elements nitrogen, phosphorus, and potassium (NPK) at recommended fertilizer rates. Nitrogen was added in the form of urea (46%

N) at a rate of 280 kg ha^{-1} in two equal doses. Phosphorus was added in the form of a compound fertilizer (18% N, 48% P) at a rate of 75 kg P_2O_5 ha^{-1} in a single dose before planting. The following traits were measured

1. Plant height (cm) The distance from the soil surface to the node bearing the male inflorescence [5].
2. Stem diameter (cm) Measured using a Vernier caliper at the 100% flowering stage, to the nearest millimeter, just below the second node of the stem, after removing the leaf sheath [6].
3. Number of leaves (leaf $plant^{-1}$) The total number of leaves was counted from the first green leaf at the soil surface to the top leaves of the plants, and the mean was calculated [7].
4. Leaf area (cm^2) Calculated by multiplying the square of the leaf length under the main ear by 0.75 for ten plants from the protected rows [8].
5. Total chlorophyll content (Sped) Chlorophyll content was estimated using a Sped-Meter Chlorophyll device, with readings taken from four leaves per plant, and the mean was calculated [9].

Results and Discussion

Plant Height (cm)

The results of Table (1) indicate a significant difference in plant height. The third planting date yielded the tallest plants, reaching a mean height of (223.71) cm, while the first planting date had the lowest mean height of (189.92) cm. This increased height in plant from the third planting date, compared to the first and second dates,can be attributed to the longer duration between planting and male flowering. since maize is a growth crop, it is height stabilization occurs at the time of male flowering. Lower temperatures and higher relative humidity during this period also promote continued vegetative growth, further enhancing plant height. These findings align with the results observed in reference [10].

The results of the same table also demonstrated that compound concentrations significantly affected plant height. The concentration of 3 g L^{-1} showed the highest mean plant height of (213.25) cm, while the concentration of (0 g L^{-1}) produced the lowest plant height, with an mean of (208.80) cm. This effect might be due to the contents of the compound, as the amino acids it contains help build the proteins necessary for plant growth and development, enhancing metabolic processes [11]. Additionally, it contains boron, which plays a crucial role in cell division and elongation, contributing to increased plant height.

Moreover, the results of Table (1) revealed a significant interaction between the two factors in terms of plant height. The highest response was recorded for the interaction between the third planting date and the concentration of 3 g L^{-1}, with an mean of (225.23) cm, while the interaction between the first planting date and the concentration of 0 g L^{-1} showed the lowest mean of (186.32) cm, representing a 20.88% increase.

Table (1) Effect of planting dates, DSPER Size compound concentrations, and their interaction on maize plant height (cm) .

Planting Dates	DSPER Size Compound Concentrations (g L^{-1})					Mean
	0	1	2	3	4	
7/10	186.32	190.46	191.49	191.93	189.41	189.92
7/ 20	209.90	213.74	214.47	215.14	212.36	213.12
7/ 30	221.99	223.76	224.79	225.23	222.78	223.71
8/9	216.99	218.67	219.95	220.69	217.03	218.67
Mean	208.80	211.66	212.68	213.25	210.40	
Values L.S.D (0.05)	Planting Dates		DSPER Size		Interaction	
	0.295		0.820		1.483	

Stem Diameter (mm)

The results of Table (2) show a significant effect of the planting dates on stem diameter. The third planting date produced the highest mean stem diameter of (29.781) mm, while the first planting date gave the lowest mean of (26.671) mm. This superiority of the third planting date in stem diameter could be due to the favorable climatic conditions it provided, such as optimal temperature, longer photoperiod, and higher relative humidity. These factors enhance root system growth and activity, improving water and nutrient uptake from the soil and transporting them to other parts of the plant. Consequently, the plant canopy intercepts more light, leading to more efficient photosynthesis. This results in increased dry matter production, which is then allocated to the plant structure and stored in the stem. This leads to increased stem thickness, aligning with findings by [12].

The same table shows that the compound concentrations had a significant effect on stem diameter. The concentration of (3 g L^{-1})produced the highest mean stem diameter of (29.810) mm, while the concentration of (0 g L^{-1})resulted in the lowest stem diameter with a mean of (26.510) mm. This effect may be attributed to the diverse components of the DSPER Size compound, which includes amino acids and essential nutrients like phosphorus and boron. These nutrients promote plant growth by enhancing the activity of metabolic enzymes. This positively impacts cell growth, development, and division in meristematic regions and facilitates the formation of plant cell walls, improving the translocation of photosynthetic products [13].

Moreover, the results of Table (2) indicate a significant interaction between the two factors in terms of stem diameter. The highest response was recorded for the interaction between the third planting date and the concentration of (3 g L^{-1}), with a mean of

(31.500) mm, while the interaction between the first planting date and the concentration of (0 g L^{-1})showed the lowest mean of (25.090) mm, representing a 21.64% increase.

Table (2) Effect of planting dates, DSPER Size compound concentrations, and their interaction on the stem diameter of maize plants (mm).

Planting Dates	DSPER Size Compound Concentrations (g L^{-1})					Mean
	0	1	2	3	4	
7/10	25.090	25.817	26.650	28.390	27.410	26.671
7/20	25.890	26.617	27.450	29.190	28.210	27.471
7/30	28.200	28.927	29.760	31.500	30.520	29.781
8/9	26.860	27.587	28.420	30.160	29.180	28.441
Mean	26.510	27.237	28.070	29.810	28.830	
Values L.S.D (0.05)	Planting Dates		DSPER Size		Interaction	
	0.3979		0.3978		0.7957	

Number of Leaves (leaf plant^{-1})

The results of Table (3)indicated a significant effect of the planting dates on the number of leaves in maize plants. The second planting date produced the highest mean number of leaves, reaching (13.983) leaf plant^{-1}, while the first planting date resulted in the lowest mean, with (11.080) leaf plant^{-1}, representing a percentage increase of %. This superiority in the second planting date for the number of leaves could be attributed to its favorable physiological timing, as the growth stages of the plant coincided with optimal environmental conditions. This allows the plant to make the most use of the available resources, leading to better vegetative growth and an increase in leaf number. Moreover, this date provided optimal sunlight utilization, thereby enhancing the photosynthesis process, which leads to greater carbohydrate production and, consequently, more leaf growth [14].

The same table also showed that compound concentrations had a significant effect on the number of leaves. The concentration of (3 g L^{-1})achieved the highest mean number of leaves, with (13.240) leaf plant^{-1}, while the concentration of (0 g L^{-1})produced the lowest mean number of leaves, with (12.151) leaf plant^{-1}.

Additionally, the results of Table (3)revealed a significant interaction between the two factors in the number of leaves. The highest response was observed in the interaction between the second planting date and the concentration of (3 g L^{-1}), with a mean of (14.630) leaf plant^{-1}, while the interaction between the first planting date and the concentration of (0 g L^{-1})showed the lowest mean of (10.543) leaf plant^{-1}, with a percentage increase of 38.76%.

Table (3) Effect of planting dates, DSPER Size compound concentrations, and their interaction on the number of leaves in maize plants (leaf plant^{-1}).

Planting Dates	DSPER Size Compound Concentrations (g L^{-1})					Mean
	0	1	2	3	4	
7/10	10.543	10.857	11.503	11.710	10.787	11.080
7/ 20	13.463	13.693	14.423	14.630	13.707	13.983
7/ 30	12.493	12.723	13.453	13.660	12.737	13.013
8/9	12.103	12.587	13.083	12.960	12.007	12.548
Mean	12.151	12.465	13.116	13.240	12.309	
Values L.S.D (0.05)	Planting Dates		DSPER Size		Interaction	
	0.2769		0.3034		0.5861	

Leaf Area (cm²)

The results of Table (4) indicated a significant effect of the planting dates on leaf area. The fourth planting date produced the largest leaf area, with a mean of (6853.6) cm², while the second planting date showed the lowest mean, with (6381.6) cm², which was not significantly different from the first planting date, which had a mean of (6594.6) cm². This superiority in leaf area for the fourth planting date could be attributed to the increase in the number of leaves and stem diameter due to the favorable conditions provided. This, in turn, increased leaf size and positively affected the overall leaf area, which is consistent with the findings of [15].

The same table also showed that compound concentrations significantly affected the leaf area. The concentration of (3 g L^{-1})achieved the highest mean leaf area, with (6697.4) cm², while the concentration of (4 g L^{-1})produced the lowest leaf area, with a mean of (6642.4) cm². This effect might be attributed to the positive response to the increased compound concentrations, which resulted in enhanced vegetative growth under suitable temperatures, as well as an increase in the number of leaves (Table 3).

Additionally, the results of Table (4)revealed a significant interaction between the two factors in terms of leaf area. The highest response was observed for the interaction between the fourth planting date and the concentration of (3 g L^{-1}), with a mean of (6911.7) cm², while the interaction between the second planting date and the concentration of (0 g L^{-1})showed the lowest mean, with (6296.0) cm², representing a 9.77% increase.

Table (4) Effect of planting dates, DSPER Size compound concentrations, and their interaction on the leaf area of maize plants (cm²).

Planting Dates	DSPER Size Compound Concentrations (g L^{-1})					Mean
	0	1	2	3	4	
7/10	6509.0	6601.0	6612.7	6652.7	6597.7	6594.6
7/ 20	6296.0	6388.0	6399.7	6439.7	6384.7	6381.6
7/ 30	6642.0	6734.0	6745.7	6785.7	6730.7	6727.6

8/9	6768.0	6860.0	6871.7	6911.7	6856.7	6853.6
Mean	6553.8	6645.8	6657.4	6697.4	6642.4	
Values	**Planting Dates**		**DSPER Size**		**Interaction**	
L.S.D (0.05)	60.60		30.30		30.30	

Chlorophyll Content (SPAD)

The results of Table (5) show a significant difference between the planting dates in terms of the plant's chlorophyll content. The fourth planting date yielded the highest mean, with (60.581) SPAD, while the first planting date produced the lowest mean chlorophyll content, with (57.941) SPAD. This superiority in chlorophyll content for the fourth planting date could be attributed to the optimal timing for growth, as it aligned the plant's critical growth stages with ideal environmental conditions. This synchronization allowed the plant to allocate resources more efficiently for chlorophyll production. Additionally, this planting date coincided with periods of better nutrient availability in the soil, particularly nitrogen, which is essential for the structure of the chlorophyll molecule. Increased nitrogen uptake directly leads to higher chlorophyll synthesis [16].

The same table also shows that the compound concentrations had a significant effect on this trait. The concentration of (3 g L^{-1})resulted in the highest mean chlorophyll content, with (61.230) SPAD, while the concentration of (0 g L^{-1})produced the lowest mean, with (57.930) SPAD. This effect may be closely related to the availability of nitrogen provided by the amino acids in the compound, as nitrogen plays a crucial role in chlorophyll molecule formation. Additionally, nitrogen contributes to the synthesis of amino acids required for the development of chloroplasts. This integrated process ultimately increases chlorophyll concentration in the leaves [17]. These findings are consistent with those of [18], who observed a significant increase in carbon fixation pigments, particularly chlorophyll (a), due to the foliar application of amino acids. The increase in chlorophyll is attributed to the role of amino acids in activating the Krebs cycle, which stimulates the biosynthetic pathway for chlorophyll production.

Furthermore, Table (5)indicates a significant interaction between the two factors on chlorophyll content, with the highest response observed for the interaction between the fourth planting date and the concentration of (3 g L^{-1}), with a mean of (62.500) SPAD. In contrast, the interaction between the first planting date and the concentration of (0 g L^{-1})recorded the lowest mean, with (56.360) SPAD, representing a 10.89% increase.

Table (5) Effect of planting dates, DSPER Size compound concentrations, and their interaction on the chlorophyll content of maize plants (SPAD).

Planting Dates	**DSPER Size Compound Concentrations (g L^{-1})**					**Mean**
	0	**1**	**2**	**3**	**4**	
7/10	56.360	57.087	57.920	59.660	58.680	57.941
7/ 20	57.870	58.597	59.430	61.170	60.190	59.451

7/ 30	58.290	59.017	59.850	61.590	60.610	59.871
8/9	59.200	59.927	59.760	62.500	61.520	60.581
Mean	57.930	58.657	59.240	61.230	60.250	
Values L.S.D (0.05)	**Planting Dates** 0.1998		**DSPER Size** 0.4455		**Interaction** 0.8118	

Spraying with (3 g L^{-1}) of DSPER at a 30/7 planting date improved the growth characteristics of maize plants, increasing plant height and stem diameter. On the other hand, spraying with (3 g L^{-1}) of DSPER at a 9/8 planting date increased leaf area and chlorophyll content in leaves. These results emphasize the importance of determining the optimal planting time and using DSPER at appropriate concentrations to improve maize growth.

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