



## IMPROVING CHEMICAL CONTENT OF DATE PALM CV. KHASTAWI UNDER DIFFERENT LEVELS OF SPRAYING WITH MICRO-ELEMENTS, GIBBERELLIC ACID AND SALICYLIC ACID

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### Abstract

The purpose of the study was to determine how the date palm cultivar Khastawi responded to experimental treatments by applying microelements via spraying at quantities of 1 g L<sup>-1</sup> and 0 g L<sup>-1</sup>, and applying a quantity of GA3 and salicylic acid at 100 mg L<sup>-1</sup>, 200 mg L<sup>-1</sup>, and 0 mg L<sup>-1</sup>. The outcomes demonstrated that applying microelement spray (1 g L<sup>-1</sup>) had a substantial impact on the attributes under study, amounting to (0.88 mg g<sup>-1</sup>, 11.51%, 0.31%, 1.70%, 167.61 mg kg<sup>-1</sup>, 59.34 mg kg<sup>-1</sup>, 60.72 mg kg<sup>-1</sup>) for the traits (total chlorophyll, carbohydrates, phosphorus, potassium, iron, zinc, manganese), respectively. On the other hand, gibberellin spraying had no significant effect on any of the response measurements. However, applying a salicylic acid (SA) spray significantly affected the characteristics under investigation (carbohydrates, phosphorus, iron, zinc, manganese). The concentration of 200 mg L<sup>-1</sup> revealed the highest values for these characteristics (11.67%, 0.55%, 162.23 mg g<sup>-1</sup>, 66.93 mg kg<sup>-1</sup>, 63.73 mg kg<sup>-1</sup>). The substantial influence was revealed by the two-way interactions between the research components according to the

type of trait and the interaction factors. Conversely, the three-way interaction among the research components became significant for every attribute under investigation except elements Mn and N.

**Keywords:** Elements, Gibberellic and salicylic acid, Acid, Chemical content, Date palms.

## تحسين المحتوى الكيميائي لنخيل التمر صنف خستاوي تحت مستويات مختلفة من الرش بالعناصر الصغرى وحامض الجبرلين وحامض السالسليك

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### الخلاصة

اجريت دراسة على اشجار نخيل التمر صنف خستاوي للبحث في تأثير الرش كل من توليفة العناصر الصغرى بالتركيزين 0 و 1 غم لتر<sup>-1</sup>، وحامض الجبريليك والسالسليك بالتراكيز 200، 100 و 0 ملغم لتر<sup>-1</sup>. وقد أظهرت النتائج ما يلي:

أظهرت معاملة الرش بتوليفة العناصر الصغرى (1غم لتر<sup>-1</sup>) تأثيراً معنوياً في الصفات المدروسة وبلغت (0.88 ملغم غم<sup>-1</sup>، 11.51%، 0.31%، 1.70%، 167.61 ملغم كغم<sup>-1</sup>، 59.34 ملغم كغم<sup>-1</sup> و 60.72 ملغم كغم<sup>-1</sup>) وذلك للصفات (الكلوروفيل الكلي، الكربوهيدرات، الفسفور، البوتاسيوم، الحديد، الزنك والمنغنيز) على التتابع. ومن جهة اخرى لم يحقق الرش بالجبرلين أي تأثير معنوي في أي من الصفات المقاسة. فيما أظهر الرش بحامض السالسليك تأثيراً معنوياً في الصفات (الفسفور، الكربوهيدرات، الحديد، الزنك والمنغنيز) لا سيما عند التركيز 200 ملغم لتر<sup>-1</sup> والذي حقق أفضل القيم وبلغت 0.55%، 11.67%، 162.23 ملغم غم<sup>-1</sup>، 66.93 ملغم كغم<sup>-1</sup> و 63.73 ملغم كغم<sup>-1</sup> على التتابع. بلغ التداخل الثنائي بين عاملي الدراسة مستوى المعنوية وذلك تبعاً لنوع الصفة ومعاملة التداخل، فيما بلغ التداخل الثلاثي بين عوامل الدراسة مستوى المعنوية في كافة الصفات المدروسة باستثناء عنصري النتروجين والمنغنيز.

**كلمات مفتاحية:** نخيل التمر، العناصر الصغرى، حامض الجبرلين، حامض السالسليك، المحتوى الكيميائي.

## Introduction

Zinc involvement in protein synthesis and the maintenance of cell membrane and elongation functions (14). Additionally, zinc helps to produce auxin, which lengthens cells, Furthermore, zinc plays a major function in the metabolism of carbohydrates and proteins, additionally, it is also thought to be the primary factor in the generation of pollen (7). Furthermore, Zn help to formation of Tryptophan amino acid, which are essential to the creation of IAA, which promotes cell division and activity and construction of membrane development. Iron is necessary for the synthesis of many enzymes that aid in the regeneration of numerous biological functions. Additionally, it is connected to protein synthesis, metabolism, photosynthesis, and chlorophyll synthesis. Additionally, iron is thought to be a cofactor for a variety of enzymes that aid in catalyzing special chemical reactions and improve the efficiency of metabolic conversion. An essential function of manganese is to control the development of cells the process of photosynthesis and chlorophyll synthesis, Additionally, it helps activate essential enzymes involved in a number of cellular processes and enhances the efficiency of photosynthesis by entering the chloroplast synthesis process, Additionally, it takes involved in reduction and oxidation reactions, particularly those involving iron compounds. Because superoxide dismutase is composed of manganese, it is one of the plant anti-oxidants that helps plant tissues from injury by taking out free radicals.

In several nations, growth regulators have been employed in applied agricultural activities, particularly when sprayed GA3 on the fruits of trees, helps lower the number of fruit abortions, postponing their maturation, growing in both size and weight of fruits, finally, boosting the yield's quantity (9 and 26). Numerous studies also demonstrated the beneficial effects of salicylic acid (SA) in boosting fruit tree yields and enhancing tree traits (12 and 20). For the reasons mentioned above, this experiment was carried out to study the effect of spraying microelements and growth regulators on chemical composition of the palm trees of the cv. Khastawi.

## Materials and Methods

The study was carried out at a private palm grove in the Heet-AlFurat during 2022 growth season, on palm of the Khastawi cv., thirty years old. 54 of homogeneous date palm were chosen. For the orchard, all maintenance procedures were completed.

**Table 1: soil's physical and chemical characteristics.**

Phospour Av. m g kg-1	Total Nitrogen %	C a CO3 g Kg-1	Bulk density g cm-3	O M %	E C ds m-1	p H
1.12	0.27	124.85	1.53	1.34	3.67	7.82
C l- M q L-1	H CO3= M q L-1	C O3= M q L- A v 1	N a+ M q L-1	M g++ M q L-1	C a++ Mq L-1	K M g kg-1
46.49	4.58	Nil	0.53	54.31	56.48	117.35
		Texture	Clay g K g-1	Silt g K g-1	Sand g K g-1	S O4= M q L-1
		<b>Sandy loam</b>	<b>132.5</b>	<b>245.1</b>	<b>622.4</b>	<b>30.82</b>

Analysis conducted at the central Lab, Coll. of Agric., Univ. of Anbar.

Treatments Employed in the Study:

- (Fe, Mn and Zn) with (0 and 1 g L<sup>-1</sup>).

–GA3 at (0, 100 and 200 mg L<sup>-1</sup>).

–Salicylic acid (SA) at (0, 100 and 200 mg L<sup>-1</sup>)

Sprays of SA and (Fe, Mn, and Zn) were applied thirty days prior to pollination and thirty to sixty days following pollination. In contrast, GA3 was sprayed on (three days following pollination and 25/5 after two months after pollination).

Three-factor factorial experiment was completed in accordance with the (R.C.B.D.). Statistics were used to analyse the data, and the (L.S.D.) test was used at 5% probability level (11), and the statistical program Genstat completed the analysis.

Total chlorophyll (mg g<sup>-1</sup> fresh weight) according to the (6), carbohydrates (%), nitrogen (%), phosphorus (%), potassium (%), iron (mg kg<sup>-1</sup>), zinc (mg kg<sup>-1</sup>) according to the (12), and manganese (mg kg<sup>-1</sup>) according to the (12).

## Results and Discussion

Total chlorophyll (mg g<sup>-1</sup> fresh weight): Table 2 shown that spraying with (Fe, Mn, and Zn) under (M1) treatment produced the best rate, 0.88 mg g<sup>-1</sup>, and was noticeably superior, while the treatment (M0) gave the lowest rate of the total chlorophyll attained 0.81mg g<sup>-1</sup>. Conversely, GA3 and SA had no appreciable impact on this characteristic. The binary interactions between GA3 with (Fe, Mn, and Zn), GA3 with SA shown a noteworthy impact, particularly with (M1G2) and (G0SA2), which produced the greatest value of 0.92 and 0.91 mg g<sup>-1</sup>, respectively. On the other hand, SA and (Fe, Mn, and Zn) do not significantly interact. Treatment (M1G2SA2) shown the best of total chlorophyll of 0.96 mg g<sup>-1</sup>, While (M0G0SA0), which provided the lowest rating of 0.73 mg g<sup>-1</sup>.

**Table 2: Effect of (Fe, Mn, and Zn), Effect of (Fe, Mn, and Zn), salicylic (SA) and gibberellin (GA3) on total chlorophyll (mg g<sup>-1</sup> fresh weight) of leaflets cv. Khastawy.**

Gibberellic acid (G)	Salicylic (SA)	(Fe, Mn, and Zn) (M)		SA×G			
		M0	M1				
G0	S0	0.73	0.82	0.78			
	S1	0.79	0.92	0.85			
	S2	0.92	0.90	0.91			
G1	S0	0.78	0.88	0.83			
	S1	0.84	0.78	0.81			
	S2	0.86	0.83	0.84			
G2	S0	0.81	0.93	0.87			
	S1	0.83	0.87	0.85			
	S2	0.75	0.96	0.85			
Mean G							
G×M	G0	0.82	0.88	0.85			
	G1	0.83	0.83	0.83			
	G2	0.80	0.92	0.86			
Mean S							
S×M	S0	0.78	0.88	0.83			
	S1	0.82	0.86	0.84			
	S2	0.84	0.90	0.87			
Mean M		0.81	0.88				
LSD5%	M	G	SA	G×M	S×M	SA×G	SA×G×M
	0.03	n.s	n.s	0.06	n.s	0.07	0.10

Carbohydrates (%): According to the data, there has been a noticeable rise in carbohydrates when spraying (Fe, Mn, and Zn) and with salicylic, as the treatments

(M1 and SA2) surpassed by providing the highest ratings of 11.51 and 10.86%, respectively, while carbohydrates reduced to the minimum at the treatments (M0 and SA0) and summarised as 9.43 and 9.95% (Table 3). Conversely, GA3 spray treatments showed no discernible impact on the attribute under study.

The binary interaction show the notable variations when the spraying between GA3 with (Fe, Mn, and Zn) and GA3 with salicylic, particularly at the treatment (M1G2), which yielded the highest percentages of 11.92%. However, spraying with (Fe, Mn, and Zn) and salicylic revealed no effect impact on the attribute under study. While, the triple interaction, had a noteworthy impact by providing (M1G2SA2) the greatest percentage of 12.76%, Whereas, the control treatment (M0G0SA0) decreased to 8.16%.

**Table 3: Effect of (Fe, Mn, and Zn), salicylic (SA) and gibberellin (GA3) on carbohydrates (%) of leaflets cv. Khastawy.**

Gibberellic acid (G)	Salicylic (SA)	(Fe, Mn, and Zn) (M)		SA×G			
		M0	M1				
G0	S0	8.16	9.65	8.91			
	S1	10.04	12.28	11.16			
	S2	11.68	10.61	11.14			
G1	S0	8.57	11.70	10.14			
	S1	8.82	12.18	10.50			
	S2	10.21	11.42	10.82			
G2	S0	9.36	12.27	10.82			
	S1	9.53	10.73	10.13			
	S2	8.45	12.76	10.61			
Mean G							
G×M	G0	9.96	10.85	10.40			
	G1	9.20	11.77	10.49			
	G2	9.11	11.92	10.52			
Mean S							
S×M	S0	8.70	11.21	9.95			
	S1	9.46	11.73	10.60			
	S2	10.12	11.59	10.86			
Mean M		9.43	11.51				
LSD5%	M	G	SA	G×M	S×M	SA×G	SA×G×M
	0.58	n.s	0.72	1.02	n.s	1.25	1.76

Nitrogen (%): The results in (Table 4) showed that spraying with (Fe, Mn, and Zn), GA3 and SA treatments revealed no impact on nitrogen content in leaflets.

**Table 4: Effect of (Fe, Mn, and Zn), Effect of (Fe, Mn, and Zn), salicylic (SA) and gibberellin (GA3) on nitrogen (%) of leaflets cv. Khastawy.**

Gibberellic acid (G)	Salicylic (SA)	(Fe, Mn, and Zn) (M)		SA×G			
		M0	M1				
G0	S0	2.24	2.50	2.37			
	S1	2.36	2.68	2.52			
	S2	2.60	2.54	2.57			
G1	S0	2.31	2.71	2.51			
	S1	2.49	2.46	2.48			
	S2	2.54	2.62	2.58			
G2	S0	2.45	2.55	2.50			
	S1	2.37	2.57	2.47			
	S2	2.42	2.63	2.52			
Mean G							
G×M	G0	2.40	2.57	2.49			
	G1	2.45	2.60	2.52			
	G2	2.41	2.58	2.50			
Mean S							
S×M	S0	2.33	2.59	2.46			
	S1	2.41	2.57	2.49			
	S2	2.52	2.60	2.56			
Mean M		2.42	2.58				
LSD 5%	M	G	SA	G×M	S×M	SA×G	SA×G×M
	N.S	n.s	n.s	n.s	n.s	n.s	n.s

Phosphorus (%): The data at (Table 5) demonstrated that (Fe, Mn, and Zn) and SA resulted in the dominance of treatments (M1 and SA2) with the maximum phosphorus percentage 0.31 and 0.31%, respectively, in contrast to the concentrations (M0 and SA0), that showed the lowest percentages of 0.27 and 0.26%, respectively. Conversely, GA3 spray treatments showed no effect on this trait.

The binary interaction showed that (Fe, Mn, and Zn) with SA, at the treatment (M1SA2), awarded the greatest rating of 0.35%. While the interaction between GA3 with SA and (Fe, Mn, and Zn) with SA revealed no discernible impact on the attribute under study. Conversely, the triple interaction demonstrated a noteworthy impact especially with treatment (M1G2SA2) that gave greatest proportion of 0.40%, whereas, the percentage at the treatment (M0G0SA0) was dropped to its lowest level of 0.21%.

**Table 5: Effect of (Fe, Mn, and Zn), Effect of (Fe, Mn, and Zn), salicylic (SA) and gibberellin (GA3) on Phosphorus (%) of leaflets cv. Khastawy.**

Gibberellic acid (G)	Salicylic (SA)	(Fe, Mn, and Zn) (M)		SA×G
		M0	M1	
G0	S0	0.21	0.30	0.26
	S1	0.32	0.27	0.30
	S2	0.25	0.31	0.28
G1	S0	0.24	0.24	0.24
	S1	0.29	0.33	0.31
	S2	0.25	0.35	0.30
G2	S0	0.29	0.28	0.28
	S1	0.26	0.32	0.29
	S2	0.28	0.40	0.34
Mean G				
G×M	G0	0.26	0.29	0.28
	G1	0.26	0.31	0.28
	G2	0.28	0.33	0.30
Mean S				
S×M	S0	0.25	0.28	0.26
	S1	0.29	0.31	0.30
	S2	0.26	0.35	0.31
Mean M		0.27	0.31	
LSD5%	M	0.02		
	G	n.s		
	SA	0.02		
	G×M	n.s		
	S×M	0.03		
	SA×G	n.s		
	SA×G×M	0.06		

Potassium (%): The data at the (Table 6) demonstrate the superiority with (Fe, Mn, and Zn) (M1) by assigning the maximum percentage of potassium, which gave 1.70% while (M0) gave the minimum percentage of 1.56%. Conversely, GA3, SA, binary and triple interaction spray treatments demonstrated no effect on this characteristic.

**Table 6: Effect of (Fe, Mn, and Zn), Effect of (Fe, Mn, and Zn), salicylic (SA) and gibberellin (GA3) on Potassium (%) of leaflets cv. Khastawy.**

Gibberellic acid (G)	Salicylic (SA)	(Fe, Mn, and Zn) (M)		SA×G
		M0	M1	
G0	S0	1.43	1.67	1.55
	S1	1.58	1.64	1.61
	S2	1.51	1.70	1.61
G1	S0	1.57	1.76	1.66
	S1	1.49	1.65	1.57
	S2	1.68	1.71	1.70
G2	S0	1.63	1.62	1.62
	S1	1.60	1.82	1.71
	S2	1.55	1.74	1.64
Mean G				
G×M	G0	1.51	1.67	1.59
	G1	1.58	1.71	1.64
	G2	1.59	1.73	1.66
Mean S				
S×M	S0	1.54	1.68	1.61
	S1	1.56	1.70	1.63
	S2	1.58	1.72	1.65
Mean M		1.56	1.70	
LSD5%	M	0.13		
	G	n.s		
	SA	n.s		
	G×M	n.s		
	S×M	n.s		
	SA×G	n.s		
	SA×G×M	n.s		

Iron (mg kg<sup>-1</sup>): The data at the (Table 7) show spraying with (Fe, Mn, and Zn) a notable rise the iron content of leaflets especially at the both treatments (M1 and SA2)

that gave the greatest values of 167.61 and 159.54 mg kg<sup>-1</sup>, respectively. However, the treatments (M0 and SA0) which gave the lowest value that summed up to 138.40 and 148.01 mg kg<sup>-1</sup>, respectively. while GA3 demonstrated no effect at this trait.

The all binary interaction attained a significant effect especially the treatments (M1SA2, M1G0 and G2SA2) that gave highest rates of 179.00, 170.26 and 167.46 mg kg<sup>-1</sup>, respectively. The triple interaction showed significantly distinguished by giving the treatment (M1G2SA2) the greatest proportion that summed up to 186.67 mg kg<sup>-1</sup>, even though lowest treatment level (M0G0SA0), summarised as 123.60 mg kg<sup>-1</sup>.

**Table 7: Effect of (Fe, Mn, and Zn), Effect of (Fe, Mn, and Zn), salicylic (SA) and gibberellin (GA3) on Iron (mg kg<sup>-1</sup>) of leaflets cv. Khastawy.**

Gibberellic acid (G)	Salicylic (SA)	(Fe, Mn, and Zn) (M)		AS×G		
		M0	M1			
G0	S0	123.60	171.46	147.53		
	S1	141.43	162.38	151.91		
	S2	138.85	176.94	157.89		
G1	S0	135.04	156.70	145.87		
	S1	140.54	176.63	158.59		
	S2	133.12	173.39	153.26		
G2	S0	138.78	162.47	150.62		
	S1	145.96	141.88	143.92		
	S2	148.24	186.67	167.46		
Mean G						
G×M	G0	134.63	170.26	152.44		
	G1	136.23	168.91	152.57		
	G2	144.33	163.67	154.00		
Mean S						
S×M	S0	132.47	163.54	148.01		
	S1	142.65	160.30	151.47		
	S2	140.07	179.00	159.54		
Mean M		138.40	167.61			
LSD5%	M					
	G	n.s				
		SA	G×M	S×M	SA×G	SA×G×M
		5.80	8.20	8.20	10.04	14.19

Zinc (mg kg<sup>-1</sup>): The data at the (Table 8) showed that Spraying with (Fe, Mn, and Zn) and SA had a considerable impact on the zinc in the leaflets. (M1 and SA2) was greatly improved to treatment (M0 and SA0) and provided the largest proportion. of 59.34 and 56.95 mg kg<sup>-1</sup>, in contrast to therapies (M0 and SA0), in which the value reached 43.20 and 46.11 mg kg<sup>-1</sup>, respectively. Conversely GA3 show no effect. The all binary interaction attained a significant result especially the treatments (M1G2, M1SA2 and G2SA2) that gave highest rates of 63.39, 69.11 and 58.17 mg kg<sup>-1</sup>, respectively. The triple interaction showed a significant impact, as the therapy (M1G1SA2) that giving the greatest value of zinc in the leaflets, that summed up to 73.56 mg kg<sup>-1</sup>, contrasted with the treatment (M0G0SA0), which produced the least amount of 31.57 mg kg<sup>-1</sup>.



**Table 8: Effect of (Fe, Mn, and Zn), Effect of (Fe, Mn, and Zn), salicylic (SA) and gibberellin (GA3) on Zinc (mg kg<sup>-1</sup>) of leaflets Cv. Khastawy.**

Gibberellic acid (G)	Salicylic (SA)	(Fe, Mn, and Zn) (M)		SA×G			
		M0	M1				
G0	S0	31.57	64.78	48.17			
	S1	38.32	57.42	47.87			
	S2	43.85	65.64	54.75			
G1	S0	54.11	40.07	47.09			
	S1	52.35	42.35	47.35			
	S2	42.28	73.56	57.92			
G2	S0	36.60	49.53	43.07			
	S1	41.56	72.52	57.04			
	S2	48.21	68.13	58.17			
Mean G							
G×M	G0	37.91	62.61	50.26			
	G1	49.58	52.00	50.79			
	G2	42.12	63.39	52.76			
Mean S							
S×M	S0	40.76	51.46	46.11			
	S1	44.08	57.43	50.75			
	S2	44.78	69.11	56.95			
Mean M		43.20	59.34				
LSD5%	M						
	G	SA	G×M	S×M	SA×G	SA×G×M	
	3.94	n.s	4.82	6.83	6.83	8.37	11.83

Manganese (mg kg<sup>-1</sup>): The data at the (Table 9) showed that Spraying with (Fe, Mn, and Zn) and SA produced the supremacy of treatments (M1 and SA2) with the maximum value of manganese in the leaflets 60.72 and 61.27 mg kg<sup>-1</sup>, respectively, in contrast to the concentrations (M0 and SA0), which indicated the minimum amount of 55.95 and 55.61 mg kg<sup>-1</sup>, respectively. While, GA3 demonstrated no effect at this trait. The binary interaction show the noteworthy variations at the interaction between GA3 with (Fe, Mn, and Zn) and GA3 with SA, particularly at the treatments of (M1G0 and G2S2), which yielded the maximum values of 61.90 and 66.15 mg kg<sup>-1</sup>, respectively. While the treatments (Fe, Mn, and Zn) with SA and triple interaction demonstrated no effect at this trait.

**Table 9: Effect of (Fe, Mn, and Zn), Effect of (Fe, Mn, and Zn), salicylic (SA) and gibberellin (GA3) on Manganese ( $\text{mg kg}^{-1}$ ) of Cv. Khastawy.**

Gibberellic acid (G)	Salicylic (SA)	(Fe, Mn, and Zn) (M)		SA×G			
		M0	M1				
G0	S0	47.23	62.18	54.70			
	S1	51.54	66.35	58.94			
	S2	54.77	57.18	55.98			
G1	S0	56.86	60.23	58.55			
	S1	56.21	54.45	55.33			
	S2	61.58	61.76	61.67			
G2	S0	53.60	53.59	53.59			
	S1	57.69	62.47	60.08			
	S2	64.04	68.26	66.15			
Mean G							
G×M	G0	51.18	61.90	56.54			
	G1	58.22	58.81	58.52			
	G2	58.44	61.44	59.94			
Mean S							
S×M	S0	52.56	58.67	55.61			
	S1	55.15	61.09	58.12			
	S2	60.13	62.40	61.27			
Mean M		55.95	60.72				
LSD5%	M						
	G	SA	G×M	S×M	SA×G	SA×G×M	
	3.16	n.s	3.87	5.47	n.s	6.70	n.s

Zinc involvement in protein synthesis and the maintenance of cell membrane and elongation functions. Additionally, zinc helps to produce auxin, which lengthens cells (16). Furthermore, zinc plays a major function in the metabolism of carbohydrates and proteins, additionally, it is also thought to be the primary factor in the generation of pollen (18 and 23). Furthermore, Zn help to formation of Tryptophan amino acid, which are essential to the creation of IAA, which promotes cell division and activity and construction of membrane development (15). Iron is necessary for the synthesis of many enzymes that aid in the regeneration of numerous biological functions (19). Additionally, it is connected to protein synthesis, metabolism, photosynthesis, and chlorophyll synthesis (25 and 32). Additionally, iron is thought to be a cofactor for a variety of enzymes that aid in catalyzing special chemical reactions and improve the efficiency of metabolic conversion (21 and 24). An essential function of manganese is to control the development of cells the process of photosynthesis and chlorophyll synthesis (28), Additionally, it helps activate essential enzymes involved in a number of cellular processes and enhances the efficiency of photosynthesis by entering the chloroplast synthesis process. Additionally, it takes involved in reduction and oxidation reactions, particularly those involving iron compounds. Because superoxide dismutase is composed of manganese, it is one of the plant anti-oxidants that helps plant tissues from injury by taking out free radicals (29). Salicylic acid has an action that increases dividing cells and development (13 and 33). It increases the activity of the enzymes that make photosynthesis more efficient. Additionally, it results in a shift in the hormones that plants produce, such as auxins and cytokinins, that have a favorable effect on plant development and growth (22).

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## Conclusions

Regarding the study's findings, it can be said that the date palm reacted to foliar nutrition by treatments of (Fe, Mn, and Zn) and salicylic. As a result, we advise treating with the research variables that enhance the chemical composition and growth of trees.

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No Supplementary Materials.

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Author A.F.Z. Al-Dulaimy; methodology, writing—original draft preparation, Author N.A. Jubair writing—review and editing. All authors have read and agreed to the published version of the manuscript.

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