

## EFFECT OF SPRAYING WITH VITAMIN B9 AND E, AND THE AMINO ACID ARGININE OF SOME GROWTH CHARACTERS FOR TWO VARIETIES OF MAIZE

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### ABSTRACT

This study was aimed to investigate effect of some growth traits for two varieties of maize (*Zea mays* L.) to spraying vitamin B9 (folic acid), vitamin E (tocopherol), and arginine acid. A field experiment was conducted at the Agricultural Research Station, College of Agricultural Engineering Sciences - University of Baghdad, during the fall seasons of 2021 and 2022. Randomized complete block design (RCBD) within split plot arrangement with three replicates was used. The experiment included two factors, the first factor within the main plots represented two varieties of maize (Baghdad 3 and Sarah), while the second factor in the sub-plot represented spraying with vitamin E and B9 at concentrations of 1 and 2 g L<sup>-1</sup> and arginine acid at concentrations of 100 and 200 mg L<sup>-1</sup>, in addition to the control treatment (without spraying). The results showed that Sarah variety out performed in most studied traits for both seasons (75% silking, number of days from sowing to physiological maturity, dry weight, plant growth rate, physiological maturity, and leaves chlorophyll content). The growth characteristics were affected by spraying vitamin E, as the concentration exceeded 2 g L<sup>-1</sup> in most traits, as the highest means were gave for 75% of silking (61.33 and 63.67 day), dry weight (387 and 425.3 g plant<sup>-1</sup>), and plant growth rate at physiological maturity (3.66 and 3.95 g plant<sup>-1</sup> day<sup>-1</sup>) Leaf chlorophyll content (42.98 and 42.84 mg g<sup>-1</sup> fresh weight) for both seasons.

Keywords: silking, leaves chlorophyll content, plant growth rate, physiological maturity, folate

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تأثير الرش بفيتامين B9 و E والحامض الاميني الارجنين في بعض صفات النمو لصنفين من الذرة الصفراء

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المستخلص

أجريت تجربة حقلية في محطة التجارب الزراعية، كلية علوم الهندسة الزراعية - جامعة بغداد خلال الموسمين الخريفيين 2021 و 2022 لدراسة استجابة بعض صفات النمو لصنفين من الذرة الصفراء للرش بفيتامين B9 (حامض الفوليك) وفيتامين E (التوكوفيرول) وحامض الارجنين. طبقت التجربة على وفق تصميم القطاعات الكاملة المعشاة RCBD وبترتيب الالواح المنشقة وبثلاثة مكررات. تضمنت التجربة عاملين، العامل الأول (الرئيس) شمل صنفين من الذرة الصفراء (بغداد 3 وسارة)، اما العامل الثاني (الثانوي) شمل رش فيتامين E و B9 وبتراكيزين 1 و 2 غم لتر<sup>-1</sup> وحامض الارجنين بتركيزين 100 و 200 ملغم لتر<sup>-1</sup> فضلا عن المقارنة (بدون رش)، تم رش الفيتامينين والحامض الاميني في ثلاث مراحل في مرحلة 6 اوراق كاملة ومرحلة 8 اوراق كاملة و 10 اوراق كاملة. اظهرت النتائج تفوق الصنف سارة في اغلب الصفات المدروسة (75% تزهيراتنوي وعدد الايام من الزراعة الى النضج الفسلجي و الوزن الجاف و معدل نمو النبات عند النضج الفسلجي ومحتوى الاوراق من الكلورفيل)، وتأثرت صفات النمو برش فيتامين E، اذ تفوق التركيز 2 غم لتر<sup>-1</sup> في اغلب الصفات، اذ سجل اعلى المتوسطات لصفة 75% تزهيراتنوي (61.33 و 63.67 يوم) و الوزن الجاف (387 و 425.33 غم نبات<sup>-1</sup>) و معدل نمو النبات عند النضج الفسلجي (3.66 و 3.95 غم نبات<sup>-1</sup> يوم<sup>-1</sup>) ومحتوى الاوراق من الكلورفيل (42.98 و 42.84 ملغم غم<sup>-1</sup> وزن طري) للموسمين.

الكلمات المفتاحية: التزهير الانتوي، محتوى الأوراق من الكلوروفيل، معدل نمو النبات، النضج الفسلجي، فوليات

## INTRODUCTION

Maize (*Zea mays* L.) is one of the most important strategic and economic crops in the world, ranking third in importance after wheat and rice. The rate of production of this crop in Iraq is still low and below the required level compared to global production (10, 11), as it did not exceed 4,054 tons per hectare, despite the increases in its cultivated area to 1,013,50 thousand hectares during 2020 (15). Maize is grown in Iraq during two seasons: the fall season, which is more suitable climate conditions for maize (9, 12), and the spring season, which is grown in a few hectares (8, 4). Plants of this crop, which were cultivated beginning the fall season, are exposed to high temperatures during vegetative stage, which leads to an increase in Reactive Oxygen Species (ROS) levels. These ROS are naturally produced by plants during biological processes, and increase as plant exposure to stresses, such as high temperatures. Studies were indicated that the use of vitamins, including B9 (folic acid) and vitamin E (tocopherol), protects the plant from the risk of oxidation (3, 5, 6). Vitamin B9 plays an important role in amino acid metabolism, nucleic acid formation, and holding of free radicals that are produced in the plant when exposed to stress, in addition to its other roles, such as cell division and elongation (16). Vitamin E plays an important role in protecting the green plastid membranes from photo damage, thus providing optimal conditions for the carbon assimilation process, (14). Amino acids also play an important role in plant productivity, tolerance contrasting conditions such as salinity, drought, and high temperature, including arginine as it contributes to reducing it through its different physiological effectiveness by changing the osmotic potential of the plant tissue. It also reduced significantly injuries resulting from vital stresses. It contributes to stimulating physiological processes as well as its role in cells division and the production of some natural growth hormones, (13). Crop management greatly affects the increases in production. One of the means of management is the use of good varieties with a high ability to exploit the available growth resources. Knowing the performance and response of

each variety to growth factors and modern field practices is one of the important things to increase production. This study was conducted to investigate effect of spraying with vitamin B9, E and amino acid arginine of some growth characters for two varieties of maize.

## MATERIALS AND METHODS

A field experiment was carried out at the field of the College of Agricultural Engineering Sciences, University of Baghdad, Al-Jadriyah during fall seasons of 2021 and 2022. to study the response of some growth traits for two maize varieties to spraying with vitamins and amino acids. The research field prepared as recommended then was divided into three replicates, each consisting of 42 experimental units (3x2m). Each experimental unit included 5 rows, with 2m long, and 75cm between the rows, and 25cm within the rows, to obtain a plant density of 53,333 plants ha<sup>-1</sup>. The experiment was applied according to the Randomized Complete Block Design (RCBD) within split plot arrangement with three replicates. The experiment included two varieties of maize Baghdad 3 and Sarah in the main plot, and spraying vitamin E and B9 at concentrations 1 and 2 g L<sup>-1</sup>, labeled as E1, E2, and spraying of arginine at concentrations of 100 and 200 mg L<sup>-1</sup> labeled as A1 and A2, respectively, in addition to the control without spraying in sub-plot. The vitamins and amino acids were sprayed in three stages 6 fully expanded leaves (emergence of the apical meristem above the soil surface) and 8 fully expanded leaves (rapid plant growth and leaf formation), and 10 fully expanded leaves (the beginning of tasseling and rapid growth of reproductive organs) (75% of the plants in the experimental unit), (19). As a preventive measure, corn stem borer was controlled by placing a small amount of granular diazinon insecticide (10% active ingredient) in the heart of the plant at a rate of 6 kg ha<sup>-1</sup> at the stage of 6 and 8 leaves. The sowing date was 6/8/2021 for the first season and 2/8/2022 at the second season. Urea (N%46) was added at a rate of 400 kg ha<sup>-1</sup> in two doses, the first after twenty days after emergence, and the second after one month of first dose, (28). Crop service operations were carried out whenever needed.

**Studied traits**

1. Number of days from planting to 75% silking (day).
2. The number of days from silking to physiological maturity (day).
3. The number of days from planting until physiological maturity (day).
4. Dry weight ( $\text{g plant}^{-1}$ ).
5. Plant growth rate at physiological maturity ( $\text{g plant}^{-1} \text{ day}^{-1}$ ).

**6. Leaf chlorophyll content ( $\text{mg. g}^{-1}$  fresh weight leaf):** - The total chlorophyll was estimated by Goodwin (22) method, by taking 1 g of fresh yellow corn leaves and they were cut into small pieces and ground in a ceramic mortar with the addition of 20 ml acetone (80%) to extract the dye and left it for a whole day in the refrigerator, then completed the volume to 50 ml of distilled water, then placed in the centrifuge for 5 minutes at a speed of 1000 revolutions per minute, after that the liquid was taken and the reading was taken in the spectrophotometer at wavelengths (633, 645 nm) and it was done Estimate chlorophyll by the following equation:

$$\text{Total chlorophyll (mg.g}^{-1} \text{ fresh weight)} = (\text{D663} \times 8.02 - \text{D645} \times 20.2) \times \text{W} \times 1000 / \text{V}$$

Note that:

D = Optical Density

D663 = optical density for wavelength 663 nm.

D 645 = optical density for wavelength 645 nm.

V = final volume of extract (50 mL)

**Table 1. Effect of varieties and vitamin B9, E, amino acid arginine, and their interaction in mean the number of days to 75% silking (day) for the fall seasons of 2021 and 2022**

Growing season	Varieties	Vitamin B9, E and the amino acid arginine ( $\text{g L}^{-1}$ , $\text{mg L}^{-1}$ )						Means	
		C0	A <sub>100</sub>	A <sub>200</sub>	B <sub>1</sub>	B <sub>2</sub>	E <sub>1</sub>		E <sub>2</sub>
Fall 2021	Sarah	62.33	62.67	62.33	61.67	63.67	61.67	60.33	62.10
	Baghdad 3	64.33	63.67	64.33	62.67	64.67	62.33	62.33	63.48
	Means	63.33	63.17	63.33	62.17	64.17	62.00	61.33	
L.S.D <sub>0.05</sub>	Varieties =	0.73		Spray treatment=		0.96		Interaction=N.S	
Growing season	Varieties	Vitamin B9, E and the amino acid arginine ( $\text{g L}^{-1}$ , $\text{mg L}^{-1}$ )						Means	
		C0	A <sub>100</sub>	A <sub>200</sub>	B <sub>1</sub>	B <sub>2</sub>	E <sub>1</sub>		E <sub>2</sub>
Fall 2022	Sarah	64.00	65.33	64.00	63.33	66.33	66.00	63.00	64.57
	Baghdad 3	66.33	65.00	66.00	64.67	67.33	68.00	64.33	65.95
	Means	65.17	65.17	65.00	64.00	66.83	67.00	63.67	
L.S.D <sub>0.05</sub>	Varieties =	1.34		Spray treatments =		0.98		Interaction =N.S	

**Number of days from silking to physiological maturity (day):** Table 2 indicates that there is no significant effects of

W = weight of the tissue paper (1g)

**RESULTS AND DISCUSSION**

**Number of days from planting to 75% silking:** Table 1 indicates significant effects of varieties and spraying with vitamins and the amino acid arginine on the number of days from sowing to 75% silking, while the interaction did not significant effect on this trait and for the two seasons, respectively. and 64.57 day, while the Baghdad3 variety needed a longer period to reach this stage, reaching 63.48 and 65.95 day for the two seasons, respectively. Perhaps the reason for this is due to the differences between these two varieties in the period of their reaching 75% anthesis (non-visible data) (the appearance of female inflorescences between 3-7 days after the emergence of male inflorescences) and the reason could be due to the difference in the genotypes of yellow corn in the period of its reaching 75% silking, and this is consistent with what was indicated by Dhannoon et al (17), Okab and Abed (27), Abdulla et al (2), and data shows in the same Table indicates that the spraying treatment with vitamin E at a concentration of  $2 \text{ g L}^{-1}$  produced the shortest time to reach this stage with mean 61.33 and 63.67 days for the both seasons, respectively, while the longest time was gave when spraying treatment B2 with a concentration of  $2 \text{ g L}^{-1}$  in the first season and E1 with  $1 \text{ g L}^{-1}$  in the second season gave 64.17 and 67.00 day for the both seasons, respectively.

varieties on the characteristic of the number of days from silking to physiological maturity in the both seasons, while this characteristic was

affected by the concentrations of vitamins and amino acid sprays, as well as the interaction between the two factors and the both seasons, the concentration gave 2 g L<sup>-1</sup> of vitamin B9 for the shortest period. It took 38.50 and 31.50 days to reach this stage in the first season and the concentration of 100 mg L<sup>-1</sup> of the amino acid arginine in the second season, respectively. with mean 41.83 and 42.33 days for the both seasons, respectively. Perhaps this is due to the positive effect of folic acid and its important role in the biochemical and

physiological processes taking place in the plant (21). From the data of the same table, shows that the behavior of the Sarah variety when spraying the amino acid, vitamin E and B9 was asymptotic to the behavior of the Baghdad 3 variety, as spraying the amino acids A2, B2, and E2 at concentrations of 200 mg and 2 g of these materials reduced the number of days to reach this stage compared to the concentrations of 100 mg and 1 g, and compared to the control treatment and for the both seasons, respectively.

**Table 2. Effect of varieties and vitamin B9, E, amino acid arginine, and their interaction in mean the number of days from silking to physiological maturity (day) for the fall seasons of 2021 and 2022**

Growing season	Varieties	Vitamin B9, E and the amino acid arginine (g L <sup>-1</sup> , mg L <sup>-1</sup> )							Means
		C0	A <sub>100</sub>	A <sub>200</sub>	B <sub>1</sub>	B <sub>2</sub>	E <sub>1</sub>	E <sub>2</sub>	
Fall 2021	Sarah	42.33	40.67	39.00	40.00	38.33	41.00	40.67	40.29
	Baghdad	41.00	43.00	39.00	40.33	38.67	41.67	38.00	40.24
	Means	41.67	41.83	39.00	40.17	38.50	41.33	39.33	41.67
L.S.D <sub>0.05</sub>	Varieties = N.S	Spray treatments= 1.23			Interaction=1.62				
Growing season	Varieties	Vitamin B9, E and the amino acid arginine (g L <sup>-1</sup> , mg L <sup>-1</sup> )							Means
		C0	A <sub>100</sub>	A <sub>200</sub>	B <sub>1</sub>	B <sub>2</sub>	E <sub>1</sub>	E <sub>2</sub>	
Fall 2022	Sarah	41.67	41.67	31.33	41.33	32.00	41.33	33.33	37.52
	Baghdad	36.33	43.00	31.67	41.33	33.33	41.00	35.33	37.43
	Means	39.00	42.33	31.50	41.33	32.67	41.17	34.33	
L.S.D <sub>0.05</sub>	Varieties= N.S	Spray treatments =2.16			Interaction= 2.88				

**Number of days from planting until physiological maturity:** Results in Table 3 show a significant effects of varieties and spraying with vitamins and amino acids in this trait for both seasons, and the effect of interaction between the two factors in this trait in the second season only. The Table shows that Sarah variety needed fewer days to reach physiological maturity, with means of 105.95 and 106.76 days for the both seasons, while the Baghdad 3 variety needed 3 more days to reach physiological maturity, amounting to 107.10 and 108.38 days, with a differences of 1.15 and 1.62 days from Sarah variety for the both seasons respectively, and this could be due to that Sarah variety took fewer days to reach 75% anthesis and silking, while the Baghdad variety took 3 longer days to reach the two stages (non-visible data for anthesis (Table 1), which led to early maturation of plants of Sarah variety physiologically. The same Table shows a significant effects of

spray concentrations with vitamins and amino acid, as the treatment of spraying vitamin E with a concentration of 2g L<sup>-1</sup> had shortest time to reach this characteristic in the first season, while treatment (A2) 200 g L<sup>-1</sup> of the amino acid arginine gave in the first season The second is the lowest number of days, which amounted to 105.50 and 106.83 days, respectively, while the longest period to reach this stage had in the comparison treatment, with means of 108.17 and 108.50 days for both seasons, respectively. Perhaps the reason for that vitamin E at 2 g L<sup>-1</sup> did not differed significantly from the treatment. Spraying with vitamin B9 at 2 g L<sup>-1</sup> which excelled in reducing the number of days to silking, that is, the concentration of 2 g of vitamin E had fewer days to reach silking compared to other treatments, and did not different significantly from some treatments such as (A2) as well as the role of the amino acid in most processes Physiological and biochemical factors in plant

growth and development (23). The interaction did not significant between the two factors. From the data of the same Table shows that despite the similarity of the behavior of the trait in the both varieties under the influence of spraying with vitamins and amino acids in terms of reducing the number of days to physiological maturity by increasing the

concentrations of spraying these substances, the amount of difference in the number of days for this trait between the both varieties gave 1.67, 2.1, 2.2, and 2.32 days when spraying amino acid, vitamin B9, and vitamin E at concentrations of 100, 200 mg, and 1 and 2 g, respectively.

**Table 3. Effect of varieties and vitamin B9, E, amino acid arginine, and their interaction in mean the number of days from planting until physiological maturity (day) for the fall seasons of 2021 and 2022.**

Growing season	Varieties	Vitamin B9, E and the amino acid arginine (g L <sup>-1</sup> , mg L <sup>-1</sup> )							Means
		C0	A <sub>100</sub>	A <sub>200</sub>	B <sub>1</sub>	B <sub>2</sub>	E <sub>1</sub>	E <sub>2</sub>	
Fall 2021	Sarah	107.67	106.00	105.67	106.67	105.33	105.33	105.00	105.95
	Baghdad	108.67	107.00	106.33	106.67	107.00	108.00	106.00	107.10
	Means	108.17	106.50	106.00	106.67	106.17	106.67	105.50	
L.S.D <sub>0.05</sub>	Varieties =	0.35		Spray treatments=			1.30		Interaction=N.S
Growing season	Varieties	Vitamin B9, E and the amino acid arginine (g L <sup>-1</sup> , mg L <sup>-1</sup> )							Means
		C0	A <sub>100</sub>	A <sub>200</sub>	B <sub>1</sub>	B <sub>2</sub>	E <sub>1</sub>	E <sub>2</sub>	
Fall 2022	Sarah	108.33	106.66	106.33	106.66	106.33	106.66	106.33	106.76
	Baghdad	108.66	108.33	107.33	108.66	108.33	108.66	108.66	108.38
	Means	108.50	107.50	106.83	107.66	107.33	107.66	107.50	
L.S.D <sub>0.05</sub>	Varieties =	1.02		Spray treatments =			0.60		Interaction= 0.95

**Dry weight (g plant<sup>-1</sup>):** Data in Table 4 shows a significant effect of varieties and spraying with vitamins and the amino acid arginine, and the interaction between the two factors in the dry weight of the plant for the both seasons. Sarah variety produced highest means of this trait amounted to 368.67 and 401.43 g plant<sup>-1</sup> for the both seasons, respectively. and the reason for this could be due to that Sarah variety had the highest plant height, leaf area, and the most number of leaves (non-visible data), which was reflected to increases in the dry weight of the plant, The same Table indicates that this characteristic was significantly affected by spraying with vitamins and amino acid, as the treatment E2 had the highest concentration of 2 g L<sup>-1</sup> with mean 387 and 425.33 g plant<sup>-1</sup> for the both seasons, respectively. while the control treatment gave the lowest means of 316.50 and 339.83 g plant<sup>-1</sup> for the both seasons, and the concentrations of B1 and B2 did not differed between them and did not differed from vitamin E with a concentration of 1 g L<sup>-1</sup> in the first season, while these treatments

differed with respect to among them in the second season, and the reason could be due to the role of vitamin E in increasing the plant height, number of leaves and leaf area (non-visible data), which led to an increases in the dry weight of the plant. These results agreement with the results of Zeboon and Baqir (29), they indicated that the dry weight of plants increased by the effect of spraying with vitamin E. As for the interaction between the two factors, it was significant in this trait. The same Table, although shows that both varieties had similar behavior when spraying with vitamins and the amino acid arginine compared to the comparison treatment, and when the concentration of the amino acid arginine was increased from 100 to 200 mg L<sup>-1</sup> and vitamin E from 1 to 2 g L<sup>-1</sup> for both seasons, however, they differed in the increases in this trait, as Sarah variety had the highest dry weight under the influence of spraying all these materials in the first season. As for the second season, this trait decreased in Sarah variety when spraying vitamin B9 increased from 1 to 2 g L<sup>-1</sup>.

**Table 4. Effect of varieties and vitamin B9, E, amino acid arginine, and their interaction in dry weight ( $\text{g plant}^{-1}$ ) for the fall seasons of 2021 and 2022**

Growing season	Varieties	Vitamin B9, E and the amino acid arginine ( $\text{g L}^{-1}$ , $\text{mg L}^{-1}$ )							Means
		C0	A <sub>100</sub>	A <sub>200</sub>	B <sub>1</sub>	B <sub>2</sub>	E <sub>1</sub>	E <sub>2</sub>	
Fall 2021	Sarah	328.33	362.33	384.33	364.67	372.67	369.67	398.67	368.67
	Baghdad	304.67	338.33	365.33	360.33	364.33	359.33	375.33	352.52
	Means	316.50	350.33	374.83	362.50	368.50	364.50	387.00	
L.S.D <sub>0.05</sub>	Varieties= 7.45	Spray treatments= 6.88			Interaction=9.68				
Growing season	Varieties	Vitamin B9, E and the amino acid arginine ( $\text{g L}^{-1}$ , $\text{mg L}^{-1}$ )							Means
		C0	A <sub>100</sub>	A <sub>200</sub>	B <sub>1</sub>	B <sub>2</sub>	E <sub>1</sub>	E <sub>2</sub>	
Fall 2022	Sarah	343.33	414.33	422.33	418.67	392.33	376.67	442.33	401.43
	Baghdad	336.33	384.33	403.67	373.33	381.67	368.33	408.33	379.43
	Means	339.83	399.33	413.00	396.00	387.00	372.50	425.33	
L.S.D <sub>0.05</sub>	Varieties= 2.81	Spray treatments =5.70			Interaction= 7.57				

**Plant growth rate at physiological maturity ( $\text{g plant}^{-1} \text{day}^{-1}$ ):** Results in the Table 5 indicate significant differences between the varieties and between the spray concentrations of vitamins and the amino acid arginine, as well as the interaction between the two factors in the characteristic of plant growth rate. As the Table shows that the maximum mean plant growth rate gave in Sarah variety was 3.48 and 3.76  $\text{g plant}^{-1} \text{day}^{-1}$  for the both seasons, respectively. The reason for the superiority of Sarah variety in this characteristic could be due to its superiority in dry weight compared to Baghdad3 variety (Table 4) and reached this stage (physiological maturity) in fewer days compared to Baghdad3 variety (Table 3), which led to an increase in its growth rate at

this stage. This is consistent with what was indicated by Abdel-Azim (1) and Al-Tamimi (7), they concluded that there were a significant differences between the varieties in the characteristic of the plant growth rate. The same Table indicates that this trait was significantly affected by spraying with vitamins and the amino acid arginine, as the spraying treatment E (2  $\text{g L}^{-1}$ ) gave the highest mean of 3.48 and 3.76  $\text{g plant}^{-1} \text{day}^{-1}$  for the both seasons, respectively. While the comparison treatment recorded the lowest. The mean for this trait was 2.92 and 3.13  $\text{g plant}^{-1} \text{day}^{-1}$  for the both seasons, and all spray treatments were superior to the comparison treatment, in addition to the differences between the treatments.

**Table 5. Effect of varieties and vitamin B9, E and amino acid arginine, and their interaction in plant growth rate at physiological maturity ( $\text{g plant}^{-1} \text{day}^{-1}$ ) for the fall seasons of 2021 and 2022**

Growing season	Varieties	Vitamin B9, E and the amino acid arginine ( $\text{g L}^{-1}$ , $\text{mg L}^{-1}$ )							Means
		C0	A <sub>100</sub>	A <sub>200</sub>	B <sub>1</sub>	B <sub>2</sub>	E <sub>1</sub>	E <sub>2</sub>	
Fall 2021	Sarah	3.04	3.41	3.63	3.41	3.53	3.50	3.79	3.48
	Baghdad	2.80	3.16	3.43	3.37	3.40	3.32	3.54	3.29
	Means	2.92	3.29	3.53	3.39	3.47	3.41	3.66	
L.S.D <sub>0.05</sub>	Varieties = 0.07	Spray treatments= 0.05			Interaction=0.08				
Growing season	Varieties	Vitamin B9, E and the amino acid arginine ( $\text{g L}^{-1}$ , $\text{mg L}^{-1}$ )							Means
		C0	A <sub>100</sub>	A <sub>200</sub>	B <sub>1</sub>	B <sub>2</sub>	E <sub>1</sub>	E <sub>2</sub>	
Fall 2022	Sarah	3.16	3.88	3.97	3.92	3.68	3.53	4.15	3.76
	Baghdad	3.09	3.54	3.76	3.44	3.52	3.38	3.75	3.50
	Means	3.13	3.71	3.86	3.68	3.60	3.46	3.95	
L.S.D <sub>0.05</sub>	Varieties = 0.04	Spray treatments =0.05			Interaction =0.07				

**Leaf chlorophyll content (mg. g<sup>-1</sup> fresh weight):** The data in Table 6 indicates that there was a significant effects of varieties and spraying with vitamins and the amino acid on the leaf chlorophyll content for the both seasons, and the effect of the interaction between the two factors was significant in the second season. As the Table shows that the leaves of Sarah variety gave the highest content of total chlorophyll, amounting to 40.85 and 42.04 mg. g<sup>-1</sup> fresh weight, for the both seasons, respectively. Perhaps the reason is due to the genetically different varieties in this trait, and these results are consistent with Obeid (26) and Kadhim and Hamza (24). This indicates significant differences between the varieties in the characteristic of chlorophyll content in the leaves, the same Table shows the spray treatment E2 (2 g L<sup>-1</sup>) produced the highest mean for this characteristic amounting to 42.98 mg g<sup>-1</sup> fresh weight for the first season, while the spray treatment A200 (200 mg L<sup>-1</sup>) produced highest mean for the second season was 43.30 mg g<sup>-1</sup> fresh weight, an increase percentage of 18.59% and 17.59% over the comparison treatment respectively, and the treatments A2 and E2 did not differed significantly between them in the second

season. while the comparison treatment gave the lowest mean for this characteristic, which amounted to 36.24 and 36.82 mg. g<sup>-1</sup> fresh weight, and all spraying treatments excelled over the comparison treatment for the two seasons in succession. Perhaps the reason for this is due to the role of vitamin E in protecting the chloroplast membranes from photo oxidation and thus provides optimal conditions for the process of assimilation (14) and the role of the amino acid arginine in cell division and the formation of chlorophyll (23) and this agrees with the findings of Marzauk and others (25) and Elewi and Zeboon (18) and El\_ Tohamy et al (18) they found that the data of the same Table, the response of the two varieties to spraying with vitamins and the amino acid arginine was similar in terms of increasing the chlorophyll content in the leaves by increasing the concentrations of spraying these substances compared to the comparison treatment. It achieved the highest average of 45.21 mg. g<sup>-1</sup> fresh weight, while the lowest chlorophyll content was recorded in Baghdad 3 variety when these materials were not sprayed (control), with mean of 35.18 mg. g<sup>-1</sup> fresh weight.

**Table 6. Effect of varieties and vitamin B9, E and amino acid arginine, and their interaction in The chlorophyll content of the leaves (mg. g<sup>-1</sup> fresh weight) for the fall seasons of 2021 and 2022**

Growing season	Varieties	Vitamin B9, E and the amino acid arginine (g L <sup>-1</sup> , mg L <sup>-1</sup> )							Means
		C0	A <sub>100</sub>	A <sub>200</sub>	B <sub>1</sub>	B <sub>2</sub>	E <sub>1</sub>	E <sub>2</sub>	
Fall	Sarah	37.57	39.24	42.40	40.14	41.46	41.01	44.11	40.85
2021	Baghdad	34.92	37.85	40.06	38.57	40.14	37.92	41.85	38.76
	Means	36.24	38.55	41.23	39.36	40.80	39.47	42.98	
L.S.D <sub>0.05</sub>	Varieties =	0.56		Spray treatments=			0.85		Interaction=N.S
Growing season	Varieties	Vitamin B9, E and the amino acid arginine (g L <sup>-1</sup> , mg L <sup>-1</sup> )							Means
		C0	A <sub>100</sub>	A <sub>200</sub>	B <sub>1</sub>	B <sub>2</sub>	E <sub>1</sub>	E <sub>2</sub>	
Fall	Sarah	38.47	41.15	45.21	40.89	42.87	42.17	43.55	42.04
2022	Baghdad	35.18	38.79	41.38	39.69	41.19	38.07	42.12	39.49
	Means	36.82	39.97	43.30	40.29	42.03	40.12	42.04	
L.S.D <sub>0.05</sub>	Varieties =	0.39		Spray treatments =			0.69		Interaction =1.27

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