Efficiency of Foliar Spray with Ascorbic Acid and Nutrient Solution on Growth and Physiochemical Traits of Grape Fruits.Cv.Halwani.

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Abstract

The experiment was carried out in one of the orchards in Al-Diwaniyah Agricultural Secondary School for the 2024 season two factors were studied and according to their role in plant nutrition. The aim of the research was to study the effect of foliar spraying with vitamin C at concentrations (0, 250, 500 mg L-1) Nutrient solution under the trade name Despero at concentrations (0, 1, 2, 3 g L-1) on some vegetative and fruit characteristics of the grape cv. Halwani. Spraying with the two study factors led to the superiority of the spraying treatments with vitamin C and Despero nutrient solution, alone or in combination, in the percentage of dry matter, leaf area, relative chlorophyll, fruit weight, fruit length, fruit diameter, fruit volume, and percentage of total dissolved solids. The 500 mg L-1 treatment gave the highest value of 26.82%, 139.22 cm2, 43.57 Spad, 4.22 g, 2.22 cm, 1.91 cm, 3.92 cm3, and 16.60%, respectively. All studied traits also increased with increasing concentration of spraying with Despero compound up to 3 g L-1 in the 3 g L-1 treatment, which achieved the highest rate of 25.00%, 131.93 cm2, 41.78 Spad, 3.80 g, 2.15 cm, 1.86 cm, 3.57 cm3, 14.89% respectively. The two-way interaction showed a significant effect in the treatment of ascorbic acid at a concentration of 3 g L-1 and Despero nutrient solution at a concentration of 500 mg L-1, as it reached 27.86%, 154.16 cm2, 47.77 Spad, 4.43 g, 2.54 cm, 1.91 cm, 3.98 cm3, 18.14% .

Keywords: grapes, efficiency, vitamin C, Despero

Introduction

Grapes (Vitis vinifera L.) belong to the Vitaceae family, which includes 14 genera, the most important of which is Vitis, which is widely cultivated worldwide. This family includes more than 1,000 species. Grapes are native to western Asia, along the Caspian and Black Sea coasts. Commercial production from vineyards typically lasts between 30 and 50 years [1],[2]. The latest statistics from the Food and Agriculture Organization of the United Nations [3], showed that global grape production was estimated at 73,524,196.23 tons. Grapes are one of the oldest and most widespread crops in semi-arid, irrigated regions worldwide, which are frequently subject to drought. In such a context, understanding stress responses in grapevines can play a key role in the growth, performance, and sustainability of viticulture [4 .[

Studies have confirmed that the absorption and assimilation of nutrients is usually faster and more efficient through the leaves than through the roots, especially if they are not

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available in the soil, in addition to the slow transfer through the root system [5] . Vitamin C, the organic compound with the chemical symbol C6H8O6, is one of the vitamins found in higher plants and which they need in small quantities to maintain their normal growth. It is a water-soluble vitamin and protects chloroplasts from oxidation because it is one of the antioxidants. Its active form is called ascorbic acid, one of the most important antioxidants [6], [7], [8]. One of the important processes in the development of modern agriculture is foliar nutrition. Research indicates the possibility of supplying plants with various nutrients, including (NPK), by spraying plants with nutrients that are absorbed by the leaves, as the leaves are the active site in the process of photosynthesis and most other vital processes. Foliar spraying of various nutrients has proven effective in increasing fruit set. Fruit retention, production characteristics, and quality are also important in reducing fruit drop in fruit crops [9]. Despero is a high potassium fertilizer with a ratio of 10-10-40 +TE, to enhance plant growth in the vegetative and fruiting stages. This fertilizer has a balanced composition of nitrogen, phosphorus, and potassium in a ratio of 1:1:3, in addition to a group of essential microelements. Given that grape trees in Iraq suffer from neglect, which has led to low production in quantity and quality due to the lack of maintenance operations, including appropriate fertilization methods, and high temperatures during the growing season that exceed the permissible limit and their impact on the yield, the study aimed to determine the effect of foliar spraying of vitamin C and Despero compound on some vegetative and fruiting characteristics of the Halwani grape variety

Materials and Methods

This experiment was carried out in one of the orchards affiliated with the General Directorate of Vocational Education / Vocational Department in Al-Diwaniyah Mixed Agricultural Secondary School / Al-Qadisiyah Governorate, which is located at a longitude of 44.89 and a latitude of 32.01 (Appendix 1), and its height above sea level reaches approximately twenty-five meters for the 2024 season. 27 grape trees of the Halwani variety were selected, homogeneous in terms of growth strength as much as possible and 13 years old, planted at distances of (175 x 2) meters and irrigated by the irrigation canal method to study the effect of spraying with vitamin C and the Despero compound on some vegetative and fruit characteristics of the Halwani grape variety. Vitamin C tablets purchased from a German pharmacy were used at concentrations of (0, 250, and 500 mg L-1)(C0,C1,C2), respectively. Despero powder, a Turkish-made fertilizer, was used at three concentrations (0, 1, 2, and 3 g L-1) (D0,D1,D2,D3), respectively, as recommended by the manufacturer, with the ratios of 40% potassium, 10% phosphorus, and 10% nitrogen. A factorial design was used in the randomized complete block design with three replicates, and each treatment had one vine per experimental unit (3 x 3 x 3). Vitamin C was sprayed early in the morning on 4/10/2024, while Despero was sprayed on 4/11/2024. The spraying was repeated three times, with an interval of 20 days for both substances. The control treatment was sprayed with water only. The results were analyzed according to the analysis of variance table and the means were compared using the least significant difference (LSD) test at a significance level of 5% [10]. The statistical program GenStat was used in the data analysis process .

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Studied characteristics

Percentage of dry matter in leaves(%)

This was calculated in mid-July by taking leaf samples of 10 fully developed leaves from each treatment. The third and fourth leaves were selected from the tip of the new branch on June 20. These were washed with distilled water, their wet weight was taken, and then placed in an electric oven at 65°C for 72 hours. After drying, they were weighed using a sensitive electronic balance [11 .[

Leaf area (cm2 leaf-1(

Leaf area was measured on June 20, 2024, during the growing season. 10 fully developed leaves were taken from each tree in each replicate, starting from the fifth to the eighth leaf below the growing tip [12]. The average leaf area was calculated using the Digimizer program. Dividing the total measurements by 10, we obtain the average leaf area according to [13 .[

Relative chlorophyll (spad leaf-1(

Ten leaves were taken from each experimental unit on June 5, and relative chlorophyll was measured using a SPAD device (Chlorophyll meter, SPAD-502, Konica) [14 .[

Fruit weight (g fruit-1(

Calculated by dividing the weight of 20 grapes selected from each cluster in each treatment by the number of grapes weighed [15 .[

Fruit length (cm fruit-1 (

was calculated using a Vernier scale.

Fruit diameter (cm fruit-1 (

was calculated using a Vernier scale.

Fruit volume (cm3 fruit-1(

The volume of 25 grapes from each experimental unit was measured based on the volume of displaced water using a 2-liter graduated cylinder.

Percentage of total soluble solids (TSS) of the fruit.(%)

The percentage of total soluble solids in the fruits was measured by taking a drop of fruit juice from each experimental unit using a Hand Refractometer on the device directly upon harvest and the reading was corrected to 20°C [16 .[

Result and Discussion

Percentage of dry matter in leaves(%)

The results of Table (1) indicate that spraying with vitamin C had a significant effect on increasing the percentage of dry matter in leaves. The vitamin C2 treatment yielded the highest dry matter percentage, reaching 26.82%, while the C0 treatment yielded the lowest dry matter percentage, reaching 19.78%. The Despero (D3) spray treatment yielded the highest percentage, reaching 25.00%, while the D0 treatment yielded the lowest dry matter percentage, reaching 22.42%. The two-way interaction demonstrated a significant effect on increasing dry matter. The highest percentage was achieved in the C2D3 treatment, reaching 27.86%, while the control C0D0 treatment yielded the lowest percentage for this trait, reaching 18.05% .

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Table 1. Efficiency of Foliar Spray with Ascorbic Acid and Nutrient Solution on the percentage of dry matter of Grape Fruits.Cv.Halwani.(%)

vitamin C	Despero				Average C
	D_0	D_1	D_2	D_3	
C_0	18.05	19.59	20.06	21.43	19.78
C_1	22.84	24.64	25.31	25.70	24.62
C_2	26.35	26.19	26.85	27.86	26.82
Average D	22.42	23.47	24.07	25.00	
L.S.D	C*D= 0.98		D= 0.57		C= 0.50

Leaf area (cm2leaf-1(

The study treatments significantly affected leaf area. The results in Table (2) show that the C2 vitamin C spray treatment applied to grapevines significantly outperformed the other treatments, achieving the largest leaf area of 139.22 cm2. This is compared to the remaining levels, which differed significantly from the standard C0 treatment, which recorded the lowest leaf area of 109.29cm2. Furthermore, leaf area increased significantly with each increase in Despero spray levels. Level D3 achieved the highest area of 131.93cm2, with a significant difference from level D0, which then reached 117.60 cm2. Regarding the interaction between the two study factors, treatment C2D3 demonstrated significant superiority compared to the other treatments, achieving the highest leaf area of 154.16 cm2, while treatment C0D0 recorded the lowest leaf area of 103.24 cm2 .

Table 2. Efficiency of Foliar Spray with Ascorbic Acid and Nutrient Solution on leaf area of Grape Fruits.Cv.Halwani (cm2 leaf-1 .(

vitamin C	Despero (D)				Average C
	D_0	D_1	D_2	D_3	
C_0	103.24	109.02	110.88	114.04	109.29
C_1	119.03	122.22	125.73	127.58	123.64
C_2	130.52	131.85	140.33	154.16	139.22
Average D	117.60	121.03	125.65	131.93	
L.S.D	C*D=1.99		D= 2.30	C= 3.98	

Relative chlorophyll (spad leaf-1(

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Table (3) shows a significant superiority of vitamin C treatments over the control treatment (C0) in the relative chlorophyll content of grape leaves. Treatment C2 recorded the highest rate for the trait, reaching 43.57 spad, while the control treatment C0 recorded the lowest rate for the aforementioned trait, reaching 35.13 spad. It was also observed that spraying with compound D produced a significant difference in the relative chlorophyll content of grape leaves, with the highest chlorophyll content in treatment D3 reaching 41.78 spad, while the control treatment D0 produced the lowest rate for the trait, reaching 38.50 spad. The interaction between the study factors showed a significant effect in increasing the chlorophyll content of grape leaves. The interaction treatment C2D3 produced the highest rate, reaching 47.77 spad, while the control treatment C0D0 produced the lowest rate, reaching 32.87 spad .

Table 3. Efficiency of Foliar Spray with Ascorbic Acid and Nutrient Solution on the relative chlorophyll of Grape Fruits.Cv.Halwani (Spad Leaf-1 .(

vitamin C	Despero (D)				Average C
	D0	D_1	D_2	D_3	
C_0	32.87	34.43	35.80	37.40	35.13
C_1	38.17	38.73	39.47	40.17	39.13
C_2	40.90	42.33	43.27	47.77	43.57
Average D	37.31	38.50	39.51	41.78	
L.S.D	C*D=1.700		D=0.981	C= 0.850	

Fruit Weight (g fruit-1(

The results of Table (4) indicate that vitamin C had a significant effect on increasing fresh fruit weight. Vitamin C2 treatment yielded the highest average fruit weight of 4.22g, while C0 treatment yielded the lowest average fruit weight of 3.09g. Spraying with compound D yielded the highest average fruit weight of 3.80g, while D0 treatment yielded the lowest average fruit weight of 3.45g. The two-way interaction demonstrated a significant effect on increasing fruit weight. Treatment C2D3 yielded the highest average fruit weight of 4.43g, while C0D0 yielded the lowest average fruit fresh weight of 3.02g .

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Table 4. Efficiency of Foliar Spray with Ascorbic Acid and Nutrient Solution on fruit weight of Grape Fruits.Cv.Halwani (g fruit-1.(

vitamin C	Despero				Average C
	D_0	D_1	D_2	D_3	
C_0	3.02	3.06	3.09	3.18	3.09
C_1	3.34	3.49	3.63	3.78	3.56
C_2	4.00	4.17	4.27	4.43	4.22
Average D	3.45	3.57	3.66	3.80	
L.S.D	C*D= 0.058		D=0.034	C=0.029	

Fruit Length (cm fruit-1(

Table (5) shows increases in average fruit length. Vitamin A significantly increased the average length in treatment C2, which recorded the highest average of 2.22 cm, compared to the standard treatment C0, which recorded the lowest average fruit length of 1.87 cm. As for the D compound spray treatment, treatment D3 differed significantly from all other treatments, yielding the highest average fruit length of 2.15 cm, while the standard treatment recorded the lowest average of 1.97 cm. Regarding the interaction between the study factors, the C2D3 interaction treatment recorded the highest average fruit length of 2.54 cm, while the C0D0 interaction treatment recorded the lowest average of 1.85 cm .

Table 5. Efficiency of Foliar Spray with Ascorbic Acid and Nutrient Solution on fruit length of Grape Fruits.Cv.Halwani (cm fruit-1 .(

vitamin C	Despero				Average C
	D_0	D_1	D_2	D_3	
C_0	1.85	1.87	1.89	1.90	1.87
C_1	1.92	1.94	1.97	2.01	1.96
C_2	2.07	2.09	2.18	2.54	2.22
Average D	1.94	1.97	2.01	2.15	
L.S.D	C*D= 0.08		D= 0.05	C= 0.04	

Fruit Diameter (cm fruit-1(

The results of Table (6) show significant differences in fruit diameter when using vitamin C. Treatment C2 achieved the highest fruit diameter of 1.91 cm, significantly superior to all other treatments, while treatment C0 showed the lowest fruit diameter of 1.75 cm. Spraying with compound D resulted in a significant increase in this trait,

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with level D3 achieving the highest fruit diameter of 1.86 cm, significantly superior to treatment D0, which recorded the lowest fruit diameter of 1.81 cm. The interaction between the two study factors showed a significant effect on this trait, with treatment D2D3 achieving the highest fruit diameter of 1.91 cm, significantly superior to all other treatments, while treatment C0D0 recorded the lowest fruit diameter of 1.72 cm .

Table 6. Efficiency of Foliar Spray with Ascorbic Acid and Nutrient Solution on fruit diameter of Grape Fruits.Cv.Halwani (cm fruit-1(

vitamin C	Despero				Average C
	D_0	D_1	D_2	D_3	
C_0	1.72	1.74	1.76	1.76	1.75
C_1	1.78	1.80	1.81	1.87	1.81
C_2	1.88	1.90	1.91	1.95	1.91
Average D	1.79	1.81	1.83	1.86	
L.S.D	C*D=0.011		D=0.007	C= 0.006	

Fruit Size (cm3 fruit-1(

Table (7) shows significant differences in fruit size as a result of spraying with vitamin C. Treatment C2 recorded the highest fruit size, reaching 3.92 cm3, significantly superior to the other vitamin treatments, while treatment C0 showed the lowest size, reaching 3.12 cm3. Spraying with Despero resulted in a significant increase in this trait, with D3 achieving the highest dry weight, reaching 3.57 cm3, significantly superior to treatment D0, which recorded the lowest fruit size, reaching 3.37 cm3 .

The interaction between the two study factors, spraying with vitamin C and Despero, showed a significant effect on this trait. Treatment C2D3 achieved the highest fruit size, reaching 3.98 cm3, significantly superior to all other treatments, while treatment C0D0 recorded the lowest fruit size, reaching 2.98 cm3 .

Table 7. Efficiency of Foliar Spray with Ascorbic Acid and Nutrient Solution fruit size of Grape Fruits.Cv.Halwani (cm3 fruit-1.(

vitamin C	Despero				Average C
	D_0	D_1	D_2	D_3	
C_0	2.98	3.06	3.16	3.25	3.12
C_1	3.36	3.47	3.57	3.66	3.52
C_2	3.77	3.88	3.98	4.07	3.92
Average D	3.37	3.47	3.57	3.66	
L.S.D	C*D= 0.011		D=0.006	C= 0.005	

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Total soluble solids content of the fruit(%)

The results in Table (8) indicate that the vitamin C spray treatments significantly outperformed the control treatment (C0) in the percentage of total soluble solids in grape fruits. Treatment C2 yielded the highest rate of 16.60%, compared to the control treatment (C0), which yielded the lowest rate of 11.63%. It was also noted that spraying with compound D gave a significant difference in the percentage of total dissolved solids in the culms, reaching the highest percentage in treatment D3, which amounted to 14.89%, while the standard treatment D0 gave the lowest rate of the aforementioned characteristic, which amounted to 13.58%. The interaction between the study factors showed a significant effect on the percentage of total dissolved solids, as the two interaction treatments C2D3 between spraying with vitamin C and compound D gave the highest percentage, which amounted to 18.14%, while the standard treatment C0D0 gave the lowest rate, which amounted to 11.12% .

Table 8. Efficiency of Foliar Spray with Ascorbic Acid and Nutrient Solution of the percentage of total soluble solids Grape Fruits.Cv.Halwani.(%)

vitamin C	Despero				Average C
	D_0	D_1	D_2	D_3	
C_0	11.12	11.49	11.72	12.18	11.63
C_1	12.77	13.18	13.84	14.34	13.53
C_2	15.18	16.06	17.00	18.14	16.60
Average D	13.02	13.58	14.19	14.89	
L.S.D	C*D=0.38		0.22 D=	C= 0.19	

The reason for the increase in the percentage of dry matter, leaf area and relative chlorophyll content of grape leaves may be due to the use of vitamin C, which has the greatest impact on the significant increase in leaf area as a result of its work in increasing the chlorophyll content of the leaves, which leads to an increase in the carbon metabolism process and provides the energy needed for growth and construction processes, in addition to its positive role in cell division, expansion and specialization, and it is considered one of the substances that help regulate plant growth and development [17]. Or the reason may be attributed to the fact that vitamins, including vitamin C, have an essential role in the work of enzymes, including photosynthesis enzymes, and are a co-factor in increasing the activity of enzymatic activities that have an effective role in the formation of pigments [18]. The positive effect of ascorbic acid on different aspects of plant composition and its role in improving systemic resistance against

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harmful risk factors that may be present in the environment surrounding plant growth during the growing season or its effect on the activities of nutritional cycles in plants, it plays an important role in the electron transport system, it is a cofactor in many key enzymes in plants and all these are reasons that help in improving the quantity and quality of the crop [[19, [20 .[

The significant increase in vegetative and fruiting characteristics of grapevines as a result of foliar spraying is attributed to the research factors. The response of plants to foliar feeding varies depending on the type of crop, the nature of the fertilizer, the concentration of the active ingredient, and the number of sprays. Foliar fertilization is important for supplying fruit trees with mineral nutrients, especially under conditions of limited soil nutrient availability. The research showed that foliar feeding reduces the negative impact of heat stress, thus enhancing drought resistance during severe drought periods for grapevines. It also improves the water deficit index in the leaves and improves the quality of grapes. Also, the balance in the levels of nutrients in NPK mineral fertilizer is necessary during the annual growth cycle [21 .[

Conclusion

In this study, the results of the study represented by vitamin C at a concentration of 500 mg L-1 (C2) improved the vegetative growth and fruiting characteristics, and spraying the compound Despero at a concentration of 3 g L-1 (D3) on the leaves contributed to enhancing the vegetative and fruiting characteristics. The combined effect between spraying with vitamin C and the compound Despero in the C2D3 treatment showed the best results for all the studied characteristics and improving the vegetative and fruiting growth characteristics. Hence, we find that the study factors recorded the best results, whether individually or jointly, in the vegetative growth characteristics in the percentage of dry matter, leaf area, relative chlorophyll percentage, and fruit characteristics represented by the weight, length, and diameter of the fruit and the percentage of total soluble solids in the fruit .

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