Foliar applications of ascorbic and citric acids with soil application of humic acid to improve growth, yield, and fruit quality of grape

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ABSTRACT:

The purpose of this study is to see how foliar applications of ascorbic acid and citric acid, as well as soil applications of humic acid, affect Superior seedless grapevine growth, yield and fruit quality in both seasons of 2021 and 2022. This research was carried out at a private orchard in Al-Khatahtbah - Sadat, Menoufia Governorate, Egypt. The vineyard was planted at distance of 2 x 3 meters apart under drip irrigation and trellised using the Spanish Parron technique, which resulted in 12 spurs with ten eyes each. The treatments were as follows: control (untreated vines), foliar ascorbic acid and citric acid at concentrations 1200 and 1300 PPm for each and soil humic acid addition at concentrations 1.5 and 2 kg/fed. and varied combinations of them. All treatments significantly improved characteristics of vegetative growth such as shoot length, leaf development, leaf area, number of leaves/shoot, fresh weight and dry weight, total chlorophyll content, as well as cluster characteristics, berry physical parameters, berry biochemical characteristics and yield. The results cleared that increasing rates of ascorbic acid, citric acid and humic acid followed gradually by an increase in all studied parameters.

KeyWords: Grapevines; Superior seedless; Ascorbic acid; Citric acid; Humic acid; Vegetative growth; Yield. Quality.

INTRODUCTION:

Grapevine (*Vitis vinifera* L.) is one of the most important fruit crops in the world and it is Egypt's second crop after citrus. Vineyards have grown in popularity, particularly on newly reclaimed soil and numerous cultivars of table grapes are cultivated, including Superior Seedless, one of Egypt's most popular table grape cultivars. Previously, agricultural production was solely concerned with increasing the number of fruits and vegetables produced for the retail market. In recent years, consumers have been more interested in establishing important dietary sources, especially antioxidants. Much focus is now being given to farming practices that will increase the nutritional value of fruits and vegetables (Wang, 2006).

Grapevines are among the most economically important fruit crops worldwide, with a wide range of applications in the food and beverage industry, including wine production, table grapes and raisins (FAO, 2020). However, grapevines are highly sensitive to environmental stressors such as temperature fluctuations, drought and salinity, which can negatively impact growth, yield and fruit quality (Keller, 2010). As climate change continues to exacerbate these stresses, there is a growing need for innovative strategies to enhance grapevine resilience and maintain productivity.

Foliar ascorbic acid and citric acid treatments have been shown to boost vegetative growth, production and fruit quality in a variety of crops, including grapevines. Both ascorbic acid and citric acid have been found to boost grapevine photosynthesis, nutrient absorption and antioxidant capacity, resulting in increased growth, production and quality of fruit (Hassan *et al.,* 2016; El-Mageed *et al.,* 2017). Ascorbic acid, often known as vitamin C, is a powerful antioxidant that is essential for plant growth and development as well as oxidative stress defense (Smirnoff, 2018). Citric acid, on the other hand, is a crucial component of the tricarboxylic acid (TCA) cycle and is involved in plant energy generation, nutrient transport and stress tolerance (Sánchez *et al.,* 2018). In addition, foliar applications of ascorbic acid and citric acid, soil applications of humic acid have also been shown to improve grapevine development, yield and fruit quality. Also, humic acid has been shown to enhance nutrient availability, root development and water retention in the soil, leading to improved plant growth and stress tolerance (Canellas *et al.,* 2015). Humic acid is a complex biological compound derived from the decay of plants and plays a vital role in soil fertility and plant nutrition (Nardi *et al.,* 2002). Furthermore, humic acid has been proven to boost the synthesis of plant growth regulators like auxins and gibberellins, which can help grapevine growth and development even more

(Zandonadi *et al.*, 2010). Humic acid treatments are a continuous therapy for systems of agriculture that can be integrated into new environmentally friendly agricultural practices in the future. Biostimulants may benefit plant growth by boosting physiological processes and nutrient absorption. Humic acid, which constitutes the majority of humic compounds, is an especially active nutritional component in soil and compost (Chen *et al.*, 2004). The use of ascorbic acid, citric acid and humic acid in combination has been demonstrated to have synergistic benefits on grapevine development, yield and fruit quality, especially under severe environmental circumstances (Hassan *et al.*, 2016 and El-Mageed *et al.*, 2017). Hassan *et al.* (2016) found that foliar applications of ascorbic and citric acids, combined with soil applications of humic acid, significantly improved development, production and fruit quality of grapevines under salt stress. Similarly, El-Mageed *et al.* (2017) indicated that combination of ascorbic acid, citric acid and humic acid improved grapevine growing, yield and fruit quality during drought stress. The combined application of foliar ascorbic and citric acids with soil application of humic acid has emerged as a promising strategy for increasing grapevine growth, production and fruit quality in the face of climate change. This approach has been shown to enhance plant resilience, promote sustainable agricultural practices and contribute to global food security. Further research is needed to optimize the application rates and timing of ascorbic acid, citric acid and humic acid, as well as to explore their potential benefits in other crops and in various environments. This study aimed to investigate the effect of foliar applications of ascorbic acid and citric acid, as well as soil applications of humic acid, on Superior seedless grapevine growth, productivity and fruit quality. MATERIALS AND METHODS:

Superior seedless grapevines (*Vitis vinifera* L.) that were 5 years old and grown on sandy loam soil in a private vineyard in Al-Khatahtbah - Sadat, Menoufia Governorate, Egypt, were used in this study in two seasons (2021 and 2022). The grapevine was planted at distance of 2 × 3 meters apart under drip system irrigation and trellised using the Spanish Parron technique, leaving 12 spurs with 10 eyes for each. In both seasons, winter pruning systems went out towards the end of December. The experiment was carried out on 135 vines (3 replicates with three vines/ treatment × 15 treatment) for all the treatments that grew similarly to the crops and went through identical agricultural practices. A design with randomized complete block design was employed to evaluate the results. The chemical compositions of the soil and water were evaluated according to American Public Health Association APHA (2017) guidelines .as shown in tables (1 and 2).

The study included fifteen treatments:

(C). Control (the grapevines were untreated).

(H1). Humic acid addition of 1.5 (kg/fed).

(H2). Humic acid addition of 2 (kg/fed).

(As1). Foliar application of ascorbic acid (1200 ppm).

(As2). Foliar application of ascorbic acid (1300 ppm).

(As1H1). Foliar application of ascorbic acid (1200 ppm) with Humic acid addition of 1.5 (kg/fed).

(As1H2). Foliar application of ascorbic acid (1200 ppm) with Humic acid addition of 2 (kg/fed).

(As2H1). Foliar application of ascorbic acid (1300 ppm) with Humic acid addition of 1.5 (kg/fed). (As2H2). Foliar application of ascorbic acid (1300 ppm) with Humic acid addition of 2 (kg/fed).

(Ci1). Foliar application of citric acid (1200 ppm).

(Ci2). Foliar application of citric acid (1300 ppm).

(Ci1H1). Foliar application of citric acid (1200 ppm) with Humic acid addition of 1.5 (kg/fed).

(Ci1H2). Foliar application of citric acid (1200 ppm) with Humic acid addition of 2 (kg/fed).

(Ci2H1). Foliar application of citric acid (1300 ppm) with Humic acid addition of 1.5 (kg/fed).

(Ci2H2). Foliar application of citric acid (1300 ppm) with Humic acid addition of 2 (kg/fed).

All treatments were administered three times: once at bud burst, twice at fruit set and once one-month following the fruit set. All spraying solutions contained 0.05% Triton B (as a wetting agent). The water was sprayed until it ran off (2 L/vine).

Measurements:

Vegetative growth:

Shoot length (cm): After the bud burst, 10 shoots per vine were chosen at random and characterized to identify their maximum growth length (cm) at the middle of May.

Number of leaves/ shoot: On March 1st, 10 shoots per vine (among the spring flush) with pretty consistent diameters and lengths were labeled. The number of leaves/shoots was counted after each season.

Leaf area (cm^2): The average leaf area of twenty mature leaves abscised from the top of the developing stalk (6th or 7th leaf) at full bloom was measured, **Liu *et al.* (2015).** A portable leaf area metre (YMJ-A, Zhejiang Top Cloud Agri Technology Co., Ltd., China) was used to measure leaf area.

Fresh and dry leaf weight (g): The leaf sample was oven dried at 70^o C until it attained a uniform weight.

Total chlorophyll (SPAD): Total chlorophyll in leaves measured with a chlorophyll metre (SPAD-502, Soil-plant analysis Department (SPAD) department, Minolta camera Co., Osaka, Japan) at the top of the growing stalk (6th or 7th leaf) at full bloom (SPAD unit).

Yield characteristics:

Cluster physical parameters: A sufficient sample of five clusters per replication was obtained during harvest to measure cluster weight (g), cluster width (cm) and cluster length (cm).

Berry physical characteristics: At harvest, 150 berries were picked at random from the representative clusters' basal, middle and apical regions to examine the berries' physical and biochemical qualities. Berry weight (g), berry volume (cm^3) and berry firmness were assessed as physical attributes. Berry firmness (lp/inch^2) was measured using a pressure tester, a penetrometer (mod. FT 011).

Berry biochemical characteristics:

Total soluble solids percentage: T.S.S % was estimated in 10 mL of berry juice filtrate using a refract meter (A.O.A.C., 2000).

Total acidity: The total acidity of 10 mL of berry juice was determined. Titration techniques were used. The berry extract is mixed with 100 mL of distilled water. Titration with 0.1 N NaOH was used to determine the total acidity percentage. Tartaric acid (%), equating to g/100 ml of juice was used to measure total acidity (A.O.A.C. 2000).

Yield:

The yield of each vine was weighed separately and yield per vine was rectified. Yield per feddan was determined by combining yield per vine and the number of vines per feddan (in tonnes after harvesting).

Data analysis:

The F-value test was used to examine the data and the means were compared using the L.S.D. at a 5% probability level (Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION:

Vegetative growth:

Ascorbic acid, citric acid and humic acid treatments significantly increased vegetative parameters in Superior seedless grapevines compared to control in terms of shoot length, leaf area, number of leaves per shoot and leaf total chlorophyll content in the two studied seasons (2021 and 2022). Data in Table (3) shows that the largest significant value of shoot length was reached with vines received by foliar application of ascorbic acid (1300 ppm) with humic acid at 2 (kg/fed) in the first season and humic acid at 2 (kg/fed) in the second season. Much of the significant value of leaf area with canes is received by application of humic acid at 2 (kg/fed) in the first season and foliar application of citric acid (1200 ppm) in the second season. Foliar application of citric acid (1300 ppm) combined with humic acid at 2 (kg/fed) gave the greatest value in the number of leaves/shoots in the first season and foliar application of ascorbic acid (1300 ppm) with humic acid at 2 (kg/fed) in the second season. The highest value of leaf fresh weight is reached by foliar application of citric acid (1300 ppm) with humic acid at 2 (kg/fed) in the first season and foliar application of ascorbic acid (1300 ppm) with humic acid at1.5 (kg/fed) in the second season.

The best value of leaf dry weight was reported in vines that were treated with a foliar application of citric acid (1300 ppm) with humic acid at 2 (kg/fed) in both two seasons. The highest significant value of leaf total chlorophyll content was obtained with vines received foliar application of citric acid (1200 ppm) with humic acid at 2 (kg/fed) in the first season while foliar application of ascorbic acid (1200 ppm) with humic acid 2 (kg/fed) gave the best value in the second season. Control treatment produced the lowest value of all vegetative measurements in both two seasons.

These findings are consistent with those of several other researchers, including Ali *et al.* (2013) who evaluated the effect of humic acid on Thompson seedless grapevines and observed that humic acid at rates 6 and 9 liter/feddan considerably improved vegetative metrics compared to control treatment. Also, Shaheen *et al.* (2012) evaluated the influence of applying compost, biofertilizer and humic acid on various vegetative development metrics of Crimson seedless grapevine. They observed that humic acid at the rate 12 l /fed greatly improved shoot length and leaf area compared to the control. Furthermore, Mohamed (2018) sprayed Red globe grapevines with citric acid at a concentration of 1000 ppm. He stated that citric acid significantly enhanced average shoot length, number of leaves per shoot, leaf area and total surface of leaf area per vine compared to the control. Also, Mohamed (2020) observed that foliar spraying of "Barrany" grapevine with ascorbic acid (0, 2 and 6 mg L-1) produced a beneficial effect on leaf area, shoot length and chlorophyll content. The increase in vegetative parameters might be attributed to humic acid's beneficial effect, which includes a modification of soil physiological properties that leads to greater dissolvability of various chemicals and nutrient absorption. Furthermore, Humic acids influence plant growth by influencing gene expression in meristem formation and structure, cell cycle, microtubule organization and cytokinesis. humic acids have a crucial function in the division of cells and development processes according to Trevisan *et al*. (2010). In addition, Blokhina *et al.* (2003) reported that antioxidants such as ascorbic and citric acids have important roles like antioxidant defense, regulation of photosynthesis and growth, enhancing the rates of chloroplast structure, photochemical reduction and photosynthetic electron transfer, as well as photosynthesis. Moreover, Fayed (2010) indicated that the ascorbic and citric acids at concentration 1000 PPm have major roles in several physiological and physical processes, including as cell growth and division, result in increased biomass and a greater photosynthetic rate of Thompson seedless grapevine.

Yield characteristics:

Physical parameters of the cluster*:*

The results in Table (4) revealed significant differences between treatments in cluster parameters of Superior seedless grapevines. In both seasons, the treatment with humic acid 2 (kg/fed) provided the highest value in cluster weight, whereas the control produced the lowest value in the two experimental seasons of 2021 and 2022. Furthermore, foliar application of citric acid (1200 ppm), followed by foliar application of citric acid (1200 ppm) with humic acid at 1.5 (kg/fed) and foliar application of citric acid (1300 ppm) with humic acid at 2 (kg/fed) treatments, provided the best value in cluster length in the first season, with application of humic acid at 2 (kg/fed) treatment providing the best value in the second season. In all seasons, the humic acid treatment at 2 (kg/fed) had the most significant value in cluster width, but the control treatment had the highest value in length/width form.

Berry physical characteristics*:*

In the two studied seasons, foliar spraying of vineyards with ascorbic and citric acids combined with the application of humic acid significantly increased berry physical characteristics such as the average weight of 100 berries (g), average volume of 100 berries (cm^3) and berry firmness ($Ib/inch^2$) of Superior seedless grapevines as compared to the control. The results also showed that vines that received foliar applications of citric acid (1300 ppm) combined with humic acid at 2 (kg/fed) treatment presented the best value in the first season and the application of humic acid at 2 (kg/fed) treatment gave the highest value in the second season, while the application of humic acid at 2 (kg/fed) treatment provided the greatest value in the average volume of 100 berries in both seasons. In the same line, canes treated with foliar citric acid (1300 ppm) with the application of humic acid at 2 (kg/fed) had the greatest value in berry firmness during both seasons, whereas the control treatment had the lowest.

Berry biochemical characteristics*:*

Table 5 clearly showed that when compared to the control, foliar spraying vineyards with ascorbic acid and citric acid with the application of humic acid resulted in significantly increased total soluble solids and significantly decreased total acidity of Superior seedless grapevines in the two studied seasons. Furthermore, data demonstrated that vines receiving foliar applications of citric acid (1200 ppm) with humic acid at 1.5 kg/fed in the first season and humic acid at 2 kg/fed in the second season had the highest significant value of total soluble solids, whereas the value for the control therapy was the lowest. Similarly, in both seasons investigated, the control treatment produced the greatest total acidity value in Superior seedless grapevines when compared to other treatments.

The yield:

Data gathered throughout both experimental seasons, as shown in Table (6), clearly show that all treatments evaluated increased Superior seedless grapevine production value during both experimental seasons. However, the growth varied from treatment to treatment, with the highest statistically significant rise occurring in combination with the addition of humic acid at 2 kg/fed, whereas the control generated the lowest value in both seasons.

The obtained results of yield and yield characteristics agree with Popescu (2018) used three doses on two wine varietals, cv. Feteasca Regala and cv. Riesling Italian: 30, 40 and 50 mlL-1. They found that humic acid increased grapevine productivity and berry quality. In addition, humic acid pulverization boosted the production and berry quality of 'Alphonse Lavallée' grapevines, according to Sabir *et al.* (2021). Furthermore, Abdel-Salam (2016) investigated the physical and chemical parameters of Ruby seedless grapevine after foliar application with ascorbic and citric acids at concentrations of 2000 ppm. He found that ascorbic and citric acids were more successful than the control in terms of cluster weight, weight and juice volume of 100 berries and chemical qualities such as TSS and acidity. In the same line, Mohamed (2020) mentioned that foliar spraying "Barrany" grapevine with ascorbic acid at concentrations (0, 2 and 6 mg L^{-1}) significantly enhanced all measured quality attributes such as bunch number, bunch weight, bunch length, berry number, berry length and average weight of the berry. El-Badawy *et al.* (2017) studied the effect of foliar spraying Washington navel orange plants with ascorbic acid and citric acid at 1 g/L concentrations. In comparison to the control, ascorbic acid and citric acid enhanced average fruit weight, number of fruits per tree, fruit juice, T.S.S., TSS/acid ratio and yield per tree while lowering overall acidity and fruit drop. Also, Mosa *et al.* (2022) tested the effect of foliar spraying of ‘Le Conte’ pear with citric acid at concentrations of 500, 1000 and 1500 ppm and humic acid at 3, 4 and 5% on yield composition. They found that citric acid significantly enhanced yield and fruit quality such as fruit weight, size, length, diameter, firmness, fruit shape, percentages of TSS, acidity, total and TSS/acid ratio compared to control. Additionally, El Refaey *et al.* (2022) observed that spraying Picual olive trees with ascorbic acid (50 and 100 mg/L) increased tree growth, productivity and fruit quality. The increase in yield could be attributed to antioxidants' beneficial effect on protecting plant cells from senescence and disorders by preventing free radicals that cause oxidation during plant metabolism, as well as enhancing cell division, the biosynthesis of natural hormones such as IAA and activating enzymes and the biosynthesis of chlorophylls, all of which improve growth and vine nutritional status in favour of increasing yield and fruit quality (Raskin, 1992; Nijjar, 1992). Similarly, humic acid increases output by altering systems associated with cell respiration, the process of photosynthesis, protein synthesis, water absorption and food absorption (Pizzeghello *et al.* 2002). Humic acid, as plant biostimulants, can improve farm agro-environmental performance. These reactive natural compounds formed from nutrients found in soil and compost can increase nutrient efficiency, crop physiological performance, yield and crop quality indices in horticultural crops (Calvo *et al.* 2014).

CONCLUSION:

This study shows that spraying of ascorbic and citric acids combined with soil application of humic acid might be applied to improve crops that confront several problems such as climate change. Furthermore, the utilization of these treatments is a potential natural resource that may be exploited as an alternative to minimizing chemical fertilizer application, lowering both environmental pollution and fertilizer costs. The collected results demonstrated that spraying of ascorbic and citric acids with soil application of humic acid had an improved influence on vegetative growth parameters, production and fruit quality. Despite the promising results obtained from the combined application of ascorbic, citric and humic acids, further research is needed to optimize the application rates and timing of these treatments, as well as to explore their potential benefits in other crops and under different environmental conditions. Moreover, the underlying mechanisms by which ascorbic acid, citric acid and humic acid exert their beneficial effects on plant development, yield and fruit value remain to be fully elucidated. A better understanding of these mechanisms will be crucial for the development of more targeted and effective strategies for enhancing plant resilience in the face of environmental change.

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Table 1: The experimental site's water chemical properties.

pH	EC dS/m	Ca^{++} (mg/L)	Mg^{++} (mg/L)	Cl^- (mg/L)	SO_4^{--} (mg/L)	HCO_3^- (mg/L)	$Caco_3$ (mg/L)
7.4	2.4	68	16.3	56.5	41	140	190

Table 2: The experimental site's soil chemical properties.

EC (dS/m)	pH (1:2.5)	Soluble cations (meq/L)				Soluble anions (meq/L)		
		K^+	Ca^{++}	Mg^{++}	Na^+	Cl^-	HCO_3^-	SO_4^-
2.6	7.9	0.33	8.15	4.57	13.29	12.11	4.06	10.17

Table 3: Effect of foliar applications of ascorbic and citric acids combined with soil application of humic acid on vegetative parameters (shoot length, leaf development (leaf area, number of leaves/ shoots, fresh weight and dry weight) and total chlorophyll content of Superior seedless cultivar during 2021 and 2022 seasons.

Parameters / Treatments	Shoot length(cm)		Leaf area (cm²)		Number of leaves/ shoots		Leaf fresh weight(g)		Leaf dry weight(g)		Total chlorophyll (SPAD)	
	Season											
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
C	119.43 e	122.63 e	124.57 c	125.54 c	19.88 i	19.00 h	3.11 g	3.16 j	0.90 f	0.93 f	33.99 c	40.49 e
H1	158.97 abc	155.77 ab	148.20 b	150.68 ab	24.95 bcd	23.20 fg	3.73 f	3.93 hi	1.07 e	1.11 e	37.97 a-d	43.02 cde
H2	163.02 abc	160.40 a	180.06 a	163.85 a	26.02 ab	25.17 abc	4.13 bc	4.32 cd	1.23 abc	1.28 abc	35.90 de	41.41 de
As1	140.52 d	143.33 d	134.66 bc	162.76 ab	22.33 h	23.37 efg	3.71 f	3.90 i	1.08 e	1.10 e	38.20 a-d	42.98 cde
As2	158.47 abc	147.47 cd	142.97 bc	165.34 a	24.72 cd	24.13 b – f	3.98 cde	4.19 d-g	1.17 b-e	1.24 bcd	39.54 ab	43.63 b-e
As1H1	161.92 abc	147.50 cd	148.32 b	149.62 ab	23.28 fgh	24.50 b – f	3.96 cde	4.15 d - h	1.11 de	1.14 de	37.33 a - d	47.65 ab
As1H2	160.72 abc	148.33 cd	134.28 bc	137.39 bc	25.78 abc	25.07 abcd	4.11 bcd	4.28 de	1.13 cde	1.17 cde	38.22 a - d	49.53 a
As2H1	161.00 abc	152.27 bc	148.70 b	163.58 a	23.43 e - h	25.27 abc	4.01 b - e	4.77 a	1.20 a-d	1.26 bcd	35.78 de	41.02 de
As2H2	176.17 a	156.37 ab	175.15 a	151.88 ab	25.65 abc	26.00 a	4.23 ab	4.50 bc	1.22 a - d	1.22 cde	38.73 a - d	44.32 b - e
Ci1	151.77 cd	151.80 bc	138.10 bc	165.93 a	22.55 gh	22.67 g	3.86 ef	4.04 f – i	1.11 de	1.16 de	37.03 bcd	47.37 ab
Ci2	151.25 cd	155.13 ab	141.96 bc	158.00 ab	23.93 def	23.67 d – g	3.89 def	4.06 e - i	1.15 b - e	1.18 cde	37.17 a - d	42.08 cde
Ci1H1	155.25 bcd	153.70 abc	140.31 bc	149.15 ab	23.73 d - g	23.87 c – g	3.85 ef	3.98 ghi	1.13 cde	1.21 cde	38.91 abc	44.97 bcd
Ci1H2	169.92 ab	157.20 ab	144.00 bc	155.49 ab	26.23 a	24.17 b – f	3.89 def	4.00 f – i	1.18 a - d	1.23 cd	40.02 a	43.55 b - e
Ci2H1	162.03 abc	155.70 ab	129.28 bc	152.73 ab	24.60 cde	24.80 a – e	4.05 b - e	4.22 def	1.24 ab	1.34 ab	36.06 cde	45.75 abc
Ci2H2	170.45 ab	158.27 ab	148.84 b	151.81 ab	26.60 a	25.47 ab	4.39 a	4.59 ab	1.27 a	1.37 a	37.64 a - d	42.22 cde

Means in each column followed by the same letter (s) are not significantly different at 0.05 % level.

Table 4: Effect of foliar applications of ascorbic and citric acids with soil application of humic acid on cluster parameters and berry physical characteristics of Superior seedless cultivar during 2021 and 2022 seasons.

Characteristics / Treatments	Cluster parameters								Berry physical characteristics							
	Cluster weight(g)		Cluster length (cm)		Cluster width(cm)		length/ width shape		Average weight of 100 berry(g)		Average volume of 100 berry (cm³)		Specific gravity (g/cm³)		Fruit Firmness (Ib/inch²)	
	Season															
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
C	647.00 d	643.00 c	21.33 c	21.17 d	10.67 c	10.33 f	2.00 a	2.05 a	593.33 b	580.33 h	592.00 c	571.83 g	1.00 a	1.01 a	2.33 e	2.19 g
H1	705.33 ab	706.67 a	24.33 ab	24.33 ab	13.67 abc	14.33 ab	1.79 abc	1.70 bc	629.33 a	631.00 ab	653.00 a	635.00 ab	0.96 bc	0.99 b	2.54 bcd	2.45 cde
H2	708.67 a	709.00 a	22.67 abc	25.50 a	16.33 a	14.67 a	1.40 bc	1.74 bc	633.33 a	635.00 a	663.00 a	641.00 a	0.96 c	0.99 b	2.57 bcd	2.50 cd
As1	690.67 c	695.50 b	23.33 abc	22.67 c	14.33 ab	12.33 e	1.66 abc	1.84 b	620.00 a	616.50 g	611.67 b	619.33 f	1.01 a	1.00 b	2.43 de	2.38 f
As2	695.00 bc	696.00 b	22.00 abc	23.33 bc	13.00 abc	13.17 cde	1.70 abc	1.77 bc	625.67 a	618.33 fg	615.67 b	621.00 ef	1.02 a	1.00 b	2.54 bcd	2.43 def
As1H1	695.33 bc	696.67 b	23.67 abc	23.50 bc	13.33 abc	12.67 de	1.79 abc	1.86 b	623.33 a	619.50 efg	614.67 b	624.33 c - f	1.01 a	0.99 b	2.67 abc	2.42 ef
As1H2	701.00 abc	697.33 b	23.67 abc	24.33 ab	14.67 ab	13.17 cde	1.62 abc	1.85 b	635.67 a	621.33 d - g	620.00 b	626.67 c - f	1.03 a	0.99 b	2.49 cde	2.44 def
As2H1	698.33 abc	697.00 b	22.67 abc	23.67 bc	13.67 abc	13.83 abc	1.68 abc	1.71 bc	634.33 a	624.00 cde	618.00 b	624.33 c - f	1.03 a	1.00 b	2.42 de	2.46 cde
As2H2	704.00 ab	698.67 b	20.33 abc	24.00 bc	15.67 ab	14.50 ab	1.32 c	1.66 c	638.00 a	626.17 bcd	619.00 b	627.33 cde	1.03 a	1.00 b	2.45 de	2.47 cde
Ci1	695.33 bc	693.00 b	25.00 a	23.00 bc	13.00 abc	13.17 cde	1.93 ab	1.75 bc	623.00 a	618.00 g	605.33 bc	621.17 c - f	1.03 a	0.99 b	2.40 de	2.43 def
Ci2	698.67 abc	694.00 b	20.67 bc	23.83 bc	14.33 ab	13.30 cd	1.48 abc	1.79 bc	633.67 a	621.67 d - g	610.67 b	622.83 def	1.04 a	1.00 b	2.66 abc	2.47 cde
Ci1H1	698.33 abc	693.33 b	25.00 a	23.67 bc	16.33 a	13.60 bcd	1.56 abc	1.74 bc	627.67 a	623.83 c - f	611.00 b	624.67 c - f	1.03 a	1.00 b	2.46 de	2.48 cde
Ci1H2	702.67 ab	694.50 b	24.00 abc	24.00 bc	14.67 ab	13.77 abc	1.64 abc	1.74 bc	634.00 a	624.67 cde	613.67 b	629.83 bcd	1.03 a	0.99 b	2.49 cde	2.51 bc
Ci2H1	702.00 abc	696.00 b	23.00 abc	23.83 bc	12.33 bc	14.00 abc	1.97 a	1.70 bc	639.00 a	629.00 bc	613.33 b	626.33 c - f	1.04 a	1.00 b	2.72 ab	2.57 ab
Ci2H2	704.00 ab	698.17 b	25.00 a	24.33 ab	14.67 ab	13.93 abc	1.73 abc	1.75 bc	644.67 a	628.67 bc	617.00 b	631.67 bc	1.05 a	1.00 b	2.76 a	2.63 a

Means in each column followed by the same letter (s) are not significantly different at 0.05% level.

Table 5: Effect of foliar applications of ascorbic and citric acids with soil application of humic acid on some chemical parameters of Superior seedless cultivar during 2021 and 2022. seasons.

Parameters Treatments	T.S.S (%)		Total acidity (%)		T.S.S/acid ratio	
	Season					
	2021	2022	2021	2022	2021	2022
C	12.94 c	13.32 c	0.95 a	0.93 a	13.65 d	14.33 f
H1	13.56 b	14.07 a	0.88 ab	0.88 bc	15.52 abc	15.98 cde
H2	13.62 b	14.23 a	0.85 ab	0.85 cde	16.05 ab	16.68 cde
As1	13.60 b	13.61b	0.90 ab	0.89 b	15.11 bc	15.30 e
As2	13.39 b	13.71 b	0.88 ab	0.87 bcd	15.33 bc	15.82 cde
As1H1	13.66 b	13.69 b	0.88 ab	0.86 b - e	15.63 abc	15.93 cde
As1H2	13.53 b	13.72 b	0.85 ab	0.85 cde	15.94 abc	16.08 bcd
As2H1	13.70 b	13.74 b	0.85 ab	0.85 cde	16.13 abc	16.17 a – d
As2H2	13.49 b	13.79 b	0.83 b	0.84 de	16.35 abc	16.36 abc
Ci1	13.33 bc	13.60 b	0.90 ab	0.88 bcd	14.88 cd	15.52 de
Ci2	13.56 b	13.78 b	0.88 ab	0.87 bcd	15.52 abc	15.88 cde
Ci1H1	14.34 a	13.76 b	0.88 ab	0.86 b - e	16.41 abc	16.05 bcd
Ci1H2	13.51 b	13.77 b	0.85 b	0.86 bcd	15.93 abc	15.95 cde
Ci2H1	14.33 a	13.76 b	0.85 b	0.85 cde	16.89 abc	16.26 abc
Ci2H2	13.65 b	13.80 b	0.83 b	0.82 e	16.55 abc	16.77 a

Means in each column followed by the same letter (s) are not significantly different at 0.05% level.

Table 6: Effect of foliar applications of ascorbic and citric acids with soil application of humic acid on yield of Superior seedless cultivar during 2021 and 2022 seasons:

Treatments	Season 2021				Season 2022			
	Yield (kg/vin)	Increase % than the control	Yield feddan (ton)	Increase % than the control	Yield (kg/vin)	Increase % than the control	Yield feddan (ton)	Increase % than the control
C	16.18 d	-	11.32 d	-	16.08 c	-	11.25 c	-
H1	17.63 ab	8.22	12.34 ab	8.27	17.67 a	9.00	12.37 a	9.05
H2	17.72 a	8.69	12.40 a	8.70	17.73 a	9.30	12.41 a	9.35
As1	17.27 c	6.31	12.09 c	6.37	17.39 b	7.53	12.17 b	7.56
As2	17.38 bc	6.90	12.16 bc	6.91	17.40 b	7.59	12.18 b	7.64
As1H1	17.38 bc	6.90	12.17 bc	6.98	17.42 b	7.69	12.19 b	7.71
As1H2	17.53 abc	7.70	12.27 abc	7.74	17.43 b	7.75	12.20 b	7.79
As2H1	17.46 abc	7.33	12.22 abc	7.36	17.43 b	7.75	12.20 b	7.79
As2H2	17.60 ab	8.07	12.32 ab	8.12	17.47 b	7.96	12.23 b	8.01
Ci1	17.38 bc	6.90	12.17 bc	6.98	17.33 b	7.21	12.13 b	7.25
Ci2	17.47 abc	7.38	12.23 abc	7.44	17.35 b	7.32	12.15 b	7.41
Ci1H1	17.46 abc	7.33	12.22 abc	7.36	17.33 b	7.21	12.13 b	7.25
Ci1H2	17.57 ab	7.91	12.30 ab	7.97	17.36 b	7.37	12.15 b	7.41
Ci2H1	17.55 abc	7.81	12.29 abc	7.89	17.40 b	7.59	12.18 b	7.64
Ci2H2	17.60 ab	8.07	12.32 ab	8.12	17.45 b	7.85	12.22 b	7.94

Means in each column followed by the same letter (s) are not significantly different at 0.05% level.

الرش الورقي لحمض الأسكوربيك وحمض الستريك مع الإضافة الأرضية لحمض الهيوميك لتحسين نمو ومحصول وجودة ثمار العنب

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الملخص العربي:

تهدف هذه الدراسة إلى معرفة تأثير الرش الورقي لحمض الأسكوربيك وحمض الستريك مع إضافة حمض الهيوميك إلي التربة سواء بصورة مفردة أو بصورة متداخلة علي نمو ومحصول وجودة ثمار عنب السوبريور خلال الموسمين المتتاليين لعامي 2021 و 2022. تم تنفيذ هذه الدراسة في بستان خاص يقع في الخطاطبة – السادات – محافظة المنوفية على كرمات عنب منزرعة على مسافة 2 × 3 متر ومدعمة بنظام البارون الأسباني، مع ترك 12 قصبة وعدد 10 عين لكل قصبة. أجريت المعاملات على النحو التالي: الكنترول (الكروم غير المعالجة)، رش حمض الأسكوربيك وحمض الستريك بتركيز 1200 و1300 جزء في المليون لكلا منهما، إضافة حمض الهيوميك إلى التربة بتركيز 1.5 و2 كجم للفدان والمزج بين المعاملات بطرق مختلفة. أظهرت النتائج المتحصل عليها أن جميع المعاملات قد حسنت معنويا خصائص النمو الخضري مثل طول الطراح، مساحة الأوراق، عدد الأوراق على الطراحات والوزن الرطب والجاف للأوراق، الكلوروفيل الكلي، بالإضافة إلى خصائص العنقود، الخصائص الطبيعية للحبات، الخصائص الكيميائية للحبات والمحصول الكلي. كما أظهرت النتائج أن زيادة تركيز حمض الأسكوربيك، حمض الستريك وحمض الهيوميك أدت إلى لزيادة الصفات المدروسة.

الكلمات الاسترشادية: كرمات العنب, السوبريور سيدلس, حمض الاسكوربيك, حمض السيتريك, حمض الهيوميك.