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Evaluation of Foliar Spray with Some Amino Acids in Comparison to Some Antioxidants on Vegetative Growth and Cluster Quality of Red Globe Grape Cultivar

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Abstract

In the present study, we investigated the effect of foliar spray application of the amino acids compound “Pepton” at (1000 ppm), along with some vitamins (ascorbic acid at 500 ppm, vitamin E at 50 ppm, β–Sitosterol at 20 ppm), alone or combined with each other, on increasing the vegetative and reproductive growth and decreasing sun burned berries of *Vitis vinifera* cv. ‘Red Globe’ grown under the Egyptian climate. The experiment which comprised eight treatments was conducted in the two successive seasons 2019–2020 with a preliminary season of 2018 in a private vineyard located at kilometer 55 Cairo–Alexandria desert road. Results showed that on days of maximum temperature of 35°C to 40°C, the vines treated with amino acids were about 8°C cooler, compared with the control in both seasons. This result was due to their positive effect on the increment of the leaves surface area which acts as a barrier, leading to effectively reduce some undesirable phenomena and improve the grape quality. In addition, results revealed that using the combined treatment of amino acids and ascorbic acid gave the highest significant increase in total soluble solids and improve yield quality, cluster weight, chlorophyll and anthocyanin content and decrease the percentage of sun burned berries in both seasons of investigation.

Keywords: Red Globe grapevine, Amino acids, Ascorbic acid, Sunburn, Berry temperature.

Introduction

Under the hot climate conditions during summer periods, grapevine cv. Red Globe is characterized by having a considerably low vine vigor due to high temperature and high light intensity. These undesirable conditions led to increasing the possibility of berry exposure to sunburn as well as bad coloration of clusters causing a great loss. Therefore, as reported by **Lipton (1977),** sunlight intensity was the main reason for sunburn in several crops. It was found that the only explanation for the occurrence of these sunburns phenomena, is that the greater the intensity of the solar radiation, the greater the heat and light falling on the leaves and clusters, and accordingly, the temperature of the berries increases than the temperature of the surrounding air to approximately 10-15° C. **(Parchomchuk and Meheriuk, 1996)**. The high possibility of clusters being exposed to the phenomenon of sunburn and bad coloring calls for the need for external intervention to suppress them in areas exposed to high temperature in the berries, which necessitates the use of some compounds that increase the canopy vegetative growth and help reduce the incident of solar radiation, especially for Ultraviolet rays that reach up to the surfaces of clusters and leaves and lower the temperature inside them **(Glenn *et al.,* 2001).**

Role of Amino acids in plant cells (Pepton)

One of the most essential organic compounds and biostimulants for the plants is amino acids which contain a nutritional value of amino (-NH2) and carboxyl (-COOH) functional groups, along with a side chain (R group) specific to each amino acid. **(Nelson and Cox, 2004).**

Pepton 85/16 ® is found in micro granular form with high solubility in water and easy to mix and apply. It is obtained by the enzymatic hydrolysis of natural origin. Specialized processing results in a unique formulation based on Levorotatory-type amino acids, short-chain peptides, and polypeptides. The type of enzymatic hydrolysis used allows amino acids and peptides to be fully available to the plant. In addition, Pepton products are an excellent source of organic nitrogen and organic iron, fully assimilable to the plant. Pepton is a biostimulant product produced using a proprietary enzymatic hydrolysis of animal protein (APC Europe S.L., Spain). However, it was revealed in a study by **Emanuil, *et al.* (2020)** that pepton is a one of the favorable plant growth regulators.

In general, amino acids are biological stimulants, which have positive effects on plant growth and productivity **(Kowalcyk and Zielony, 2008).** They act as parts of co-enzymes of specific plant hormones and improve plant growth by improving photosynthesis **(Amin *et al.,* 2011).** The amino acids were selected for their positive effect on vegetative growth and chlorophyll formation. It also has a chelating effect on some micronutrients such as iron, zinc, manganese and copper by facilitating uptake and transport by the plant **(Ghasemi *et al.,* 2013).**

***Role of vitamins* (Ascorbic acid, Vitamin E, β–Sitosterol)**

Vitamins can be considered as compounds of hormonal precursors or biological regulators that are used in trace amounts and have a positive effect on plant growth and development. In general, it was found that these substances have a significant effect on the energy metabolism pathway **(Rady, *et al.,* 2015 and Orabi and Abdelhamid, 2016)**

Ascorbic acid (AsA)

AsA is an effective antioxidant that is involved in the protection of photochemical processes **(Burton and Ingold, 1984).** Likewise, a similar approach was found regarding the use of ascorbic acid, where it was observed that it had a significant effect on the photosynthetic pigment properties as it gradually increased with augmenting the doses of ascorbic acid. The use of ascorbic acid at doses of 200 and 400 mg/L resulted in a significant increase in the total photosynthetic pigments as ascorbic acid binds to the chloroplasts and thus the effect of oxidative stress on photosynthesis is alleviated. In addition, ascorbic acid attenuates the altered cell division and serves as a primary substrate in the cyclic pathway of hydrogen peroxide enzymatic detoxification **(Beltaji, 2008).** Furthermore, **Gaafar *et al.,* (2020)** reported that foliar spraying of ascorbic acid gave a significant increase in the leaf surface area compared to the unsprayed treatment.

Vitamin E

Tocopherols and tocotrienols are known under the generic name vitamin E, and the chemical name tocochromanols **(Kamal-Eldin, 1996).** Besides its antioxidant function, vitamin E has been asserted to play an essential role in a range of different physiological phenomena affecting plant growth and development as well as senescence and interacting with signaling chains that transmit biotic and abiotic stress signals. **(Munné–Bosch, 2002).** Additionally, vitamin E is a fat-soluble antioxidant protecting cell membrane from reactive oxygen species **(Office of Dietary Supplements, US National Institute of Health, August 2019).**

β-Sitosterol ($C_{29}H_{50}O$)

β–Sitosterol is a white, waxy powder with a characteristic odor. Phytosterols are hydrophobic and soluble in alcohols and it is one of several phytosterols (plant sterols) with chemical structures similar to that of cholesterol. Phytosterols are also precursors of some plant growth hormones, particularly brassinosteroids. The crucial importance of brassinosteroids upon cell and plant growth, and development **(Schaller, 2003).** β-Sitosterol is the most prevalent component in berries, as it was found in great abundance in skin and flesh tissues during pre-véraison and véraison as well as, respectively. In contrast, Stigmasterol and Campesterol were present in lower amounts in all phenological stages **(Ruggiero *et al.,* 2013).**

The purpose of this work is to find an optimal method to increase the vegetative growth to provide a convenient shading area for the clusters, without adversely affecting yield components or fruit composition for sustainable grape production. Consequently, applying certain management practices, including spraying the vine canopy with amino acids and antioxidants can contribute to achieving a sustainable yield. Therefore, recognizing their effects is critical in developing successful practices to enhance all growth parameters of 'Red Globe' grape cultivar.

Materials and methods

A private vineyard located at kilometer 55 Cairo–Alexandria desert road, where this area is characterized by a hot climate and high solar radiation, was chosen for this investigation. This study was carried out during the two successive seasons 2019 and 2020 on 13 years-old Red Globe grapevines spaced 2 x 3 m and grown in a sandy soil. Vines were trained by the Spanish parron training system and pruned during the last week of January leaving 12 canes x 8 buds for each cane with a total vine load of 96 buds. Vines were irrigated through drip irrigation system.

One hundred and twenty uniform vines were chosen for this study (8 treatments x 3 replicates x 5 vines/replicate) and received common horticultural practices and the selected vines received three sprays in the following phonological stages: the first was three weeks after bud burst (at shoot length 50 cm), the second was after berry set and the third two weeks later for both seasons.

Pepton contains high amounts of L-α amino acids (84.83%), free amino acids (16.52%), and organic nitrogen content (12%) with low mineral-nitrogen composition (1.4%), medium potassium (4.45%), and high iron (4061 ppm) content (**Marfà *et al.,* 2009**).

It is noteworthy that vitamin C was dissolved in water, while vitamin A & E was dissolved in few drops of Ethyl alcohol before application. B-Sito was prepared at a concentration of 20 ppm the solution dissolved in a small amount of 100% ethanol and adjusted to the required concentration.

This experiment included the following treatments:

1. **Control**

2. **Amino acids compound (Pepton 1000 ppm)**
3. **Ascorbic acid (500 ppm)**
4. **Vitamin E (50 ppm)**
5. **β–Sitosterol (20 ppm)**
6. **Amino acids compound + Ascorbic acid**
7. **Amino acids compound + Vitamin E**
8. **Amino acids compound + β–Sitosterol**

A randomized complete block design was used in this experiment.

1- Microclimatic measurements

Data for two of the microclimate factors were measured within the canopy for each treatment and recorded during the growing season as follows:

a. Canopy temperature º C
b. Sunlight intensity (1000 Lux)

They were measured at three levels of lower, middle and upper branches using an apparatus called "Scheduler Plant Stress Monitor", Standard Oil Engineered Materials Co., Ohio, USA. All the above-mentioned measurements were measured by using the microprocessor of the apparatus to calculate the average canopy microclimate.

2- Yield

a- Yield per vine (kg).
b- Average number of clusters per vine and Average cluster weight (kg).
c- Average berry size (cm^3).
d- Percentage of sun burned berries/cluster (%).

3- Chemical characteristics of berries

Samples of fifteen clusters for each treatment were taken randomly as follow: 5 clusters represent each of the three replicates. Clusters were collected at full color and their total soluble solids (TSS)% ranged from about 16 to 19 %**, (Badr and Ramming, 1994)**.

Laboratory determinations were evaluated as follow:

a. Determination of TSS %) and titratable acidity referring to **AOAC, (2000)** method and TSS / acid ratio.
b. Spectrophotometric determination of berry skin content of total Anthocyaninin (mg/100g FW) referring to **Yilidz and Dikmen (1990)**.

4- Physical and chemical characteristics of the vegetative growth

a. Leaf pigments content (chlorophyll mg/ml) was measured in the mature leaves of the sixth and seventh positions from the apex by using the nondestructive Minolta chlorophyll meter model SPAD 502 (SPAD) is an acronym for soil plant analysis development **(Wood *et al*., 1992).**
b. Leaf area (cm^2): Samples of leaves were randomly collected from each treatment for leaf area determination at harvest (using leaf area meter, Model CI 203, U.S.A.).
c. Shoot length (cm): it was determined by measuring the fruiting shoots.
d. The weight of pruning (Kg): it is manually determined using a spring balance.

5- Statistical analysis:

Means representing the effect of the tested treatments were compared by the new L.S.D. method at 0.05 according to **Snedecor and Cochran (1980)**.

Results and discussion

1- Microclimatic measurements

a. Canopy temperature ºC

The measured air temperature inside the canopy is significantly different among treatments as shown in Figure (1). However, the highest temperature was recorded in the control about 40ºC whereas the lowest temperature (32 ºC) was obtained from vines treated with the combined application of amino acids compound + ascorbic acid. These results were due to their positive effect in increasing the leaf area, which in turn reduces the effect of berries sunburn. **Millar (1972)** stated that foliar shading alone was able to reduce canopy temperatures in "Muscat the Alexandria" grape cultivar by more than 10°C. Additionally, high temperatures and sunlight intensities caused the berry ripening to slow down, as well as contributing to sunburn and berry shrinkage, especially on the canopy western side facing the sun (**Greer and Weedon, (2013).**

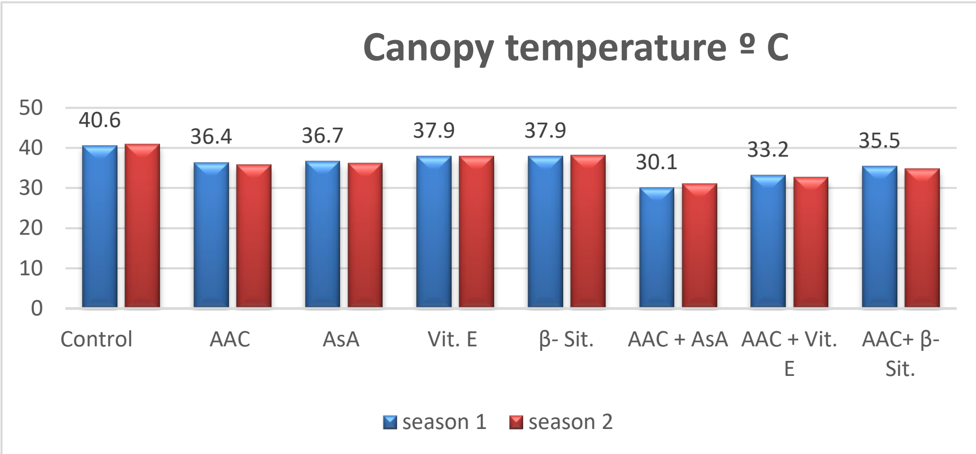

Figure (1) The effect of different treatments on the canopy temperature of "Red Globe" grapevines during the two growing seasons 2019 and 2020.

b. Sunlight intensity (1000 Lux)

Data of light intensity inside the vine canopy is displayed in Figure (2) showing its effect on different treatments. Control vines recorded significantly the highest light intensity. The best results were obtained from the combined treatment of amino acids and ascorbic acid, due to their positive effect on increasing the leaf area (Table 3) balancing the light intensity and the canopy surface area.

Likewise, the shading conditions increased the area of the final leaf mainly by increased leaf expansion rate and duration of leaf expansion **(Repková *et al.,* 2009).** Referring to the work of **Abeysinghe *et al.* (2019)** it was found that the berries dry matter accumulation was the lowest in the treatments exposed to high light intensities compared to the shaded vines.

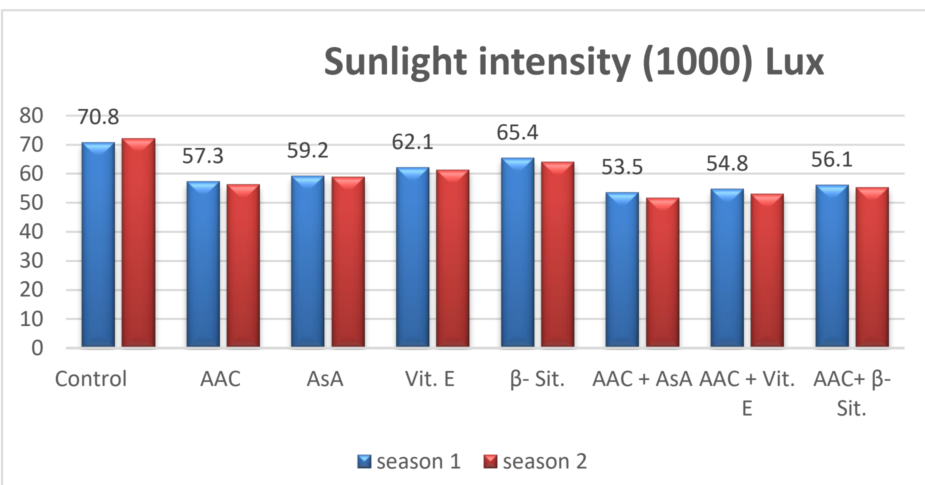

Figure (2) The effect of different treatments on sunlight intensity of "Red Globe" grapevines during the two growing seasons 2019 and 2020.

2- Yield

a. Yield per vine (kg).

Regarding the data displayed in Table (1), it is clear that there is a significant effect among treatments due to spraying amino acids (Pepton) and some antioxidants, alone or in combination with each other on the average yield per vine. Results revealed that the combined treatment of amino acids and ascorbic acid was the most superlative in the yield increment. Undesirable environmental conditions especially high temperature stress during growth and development is the main cause of significant yield losses **(Angadi *et al.*, 2000)**. Thus, any decrease associated the leaf area usually associated with lowering the photosynthesis process and consequently the reduction of yield as leaf area is the main factor determining light penetration inside the canopy. **(Schurr *et al.* 2006 and Váňová *et al.* 2006).** Noteworthiness, **Kowalczyk and Zielony (2008)** declared that amino acids as a biostimulant has positive effects on yield in addition to their significant mitigation of unfavorable phenomena such as sunburn caused by certain abiotic stress.

b. Average number of clusters per vine and cluster weight (kg)

The average number of clusters per vine and cluster weight (kg) demonstrated in Table (1) showed significant differences among treatments. The bearing rate of clusters and their number showed the utmost value in those treated by amino acids and ascorbic acid. Likewise, amino acids have positive effects on plant growth in term of numbers and weight of clusters per vine and as well as the overall yield **(Kowalcyk and Zielony, 2008).** It was deduced that the use of antioxidants, to enhance the productivity of grapevines, led to improving cluster numbers and weight and referred as metabolic enhanced **(Georgidou *et al.,* 2016 and Abdelmoniem *et al.,* 2019).** Furthermore, the application of antioxidants leads to improve mineral uptake and natural growth regulators production by plants **(El-Kady, 2011 and Georgidou *et al*., 2016).**

Table (1) Effect of different treatments on yield, average no. of clusters/vine, cluster weight and berry size of "Red Globe" grapevines during the two growing seasons 2019 and 2020.

Treatments	Yield/vine (Kg)		Average no. of clusters/vine		Cluster weight (g)		Berry size (cm^3)		Sunburned berries %	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Control	16.8	16.3	23.5	22.9	714.2	714.0	10.2	10.0	30.7	32.1
Amino acids (Pepton 1 g/L)	20.6	20.4	27.8	27.6	753.0	749.8	11.9	11.6	08.7	08.3
Ascorbic acid (4g/L)	19.2	19.6	26.4	26.1	747.9	751.0	11.4	11.2	10.2	10.7
Vitamin E 40 ppm	18.5	18.7	24.7	25.5	741.5	738.5	11.0	10.8	15.4	15.6
β–Sitosterol $C_{29}H_{50}O$	18.0	18.2	24.2	24.9	727.6	726.3	10.8	10.5	21.5	20.6
Amino acids + Ascorbic acid	22.5	23.0	29.3	28.9	768.1	770.4	13.2	12.9	03.5	02.8
Amino acids + Vitamin E	21.5	21.3	28.5	28.3	755.3	758.4	12.4	12.6	05.8	05.5
Amino acids + β–Sitosterol	21.4	20.9	28.3	27.8	750.2	755.9	12.1	12.2	06.6	07.1
New L.S.D. at 0.05 %	**0.1**	**0.2**	**0.2**	**0.1**	**3.2**	**3.5**	**0.2**	**0.1**	**0.3**	**0.2**

c. Average berry size (cm^3).

Foliar spray of different treatment (Table 1) led to an increase in the berry size. The best results were obtained from spraying the vines by amino acids and ascorbic acid. This increase is ascribed to increasing the total leaf area due to the important role of the antioxidants which led to the increase of photosynthesis all over the vine and ultimately its overall health**.** However, the important role of antioxidants in enhancing mineral elements uptick and stimulating some important biological functions in plant cells was able to explain its favorable effect on berry physical and chemical properties. Furthermore, Vitamin E, is a natural and organic antioxidant compound that has an auxin action, which provide cell division and synergistic effect on improving berries quality of grapevines **(Abo El-Komsan *et al.*, 2003 and Abdelaal *et al.*, 2013).**

In addition, increasing the canopy foliage provides a suitable shading area for the clusters, which in turn enhanced the berry size, as high temperatures, can slow the growth of berries **(Greer and Weston, 2010).**

d. Percentage of sun burned berries/cluster

Regarding the effect of conducted treatments on the percentage of sun burned berries/cluster, total number of berries and number of infected berries / per cluster were counted at harvest and the severity of sunburn % was calculated as shown in Table (1). Results indicate that there were significant differences among treatments in both seasons. It is obvious that the best results were obtained from spraying the vines by amino acids and ascorbic acid which gave the lowest percentage of sunburned berries. This observation was confirmed in the present study, as the obtained data demonstrated that in particular, the severity of damage of non-shaded clusters amounted to 30 % of berries whereas in treated clusters ranged between 3–21 % of the berries were sunburned. This difference between the treated and untreated vines is ascribed to the high temperatures and light intensity which have another major effect on the quality of berries, particularly on the most exposed parts of the vines. Some 30% of berries in these clusters showed severe visible symptoms of shrinkage to raisin-like berries as well as sunburn **(Greer *et al.,* 2006).** Furthermore, **Greer and Weedon (2010)** observed that the heat spell had major effects on ripening; reducing its rate and delaying harvest ripeness and causing a high incidence of berry sunburn. In addition, the reduction of sunburned berries is ascribed to increasing the leaf area accompanied by the spraying of amino acids **(Teixeira *et al.,* 2017)** as well as the important role of antioxidants leading to the increase of photosynthesis all over the vine and ultimately its overall health**.**

3- Chemical characteristics of berries

a. TSS %), titratable acidity and TSS / acid ratio.

Data presented in Table (2) revealed that treated vines with amino acids and ascorbic acid gave the highest values for TSS %), TSS / acid ratio and reduced titratable acidity. Similarly, an increase in soluble solids and a decrease in acidity percentage were observed in earlier studies done by **Ahmed *et al.* (2002)** using ascorbic acid and **Khan *et al.* (2002)** using amino acids on grapevines. They reported that spraying with antioxidants such as ascorbic acid was very effective in improving fruit quality in terms of raising TSS and reducing total acidity. These results were attributed to their positive effect, which ameliorate the vegetative growth providing more shade as high temperatures impede sugar accumulation **(Greer and Weston, 2010).**

Also, the treatment of amino acids gave not only the highest values in soluble solids content but also the lowest total acidity as compared with other treatments **(Belal *et al.,* 2016).**

b. Total anthocyanin

As shown in Table (2), significantly the best results were obtained from vines treated with amino acids and ascorbic acid through providing a suitable shading area for the clusters. These results showed that air temperature within the vine canopy affected the accumulation of anthocyanin in Red Globe berry skin. Maximum anthocyanin content was gained by the vines with moderate air temperature in both seasons. Many previous studies showed that elevated temperature could decrease the total anthocyanin concentrations and change their composition in berry skin **(Spayd *et al.,* 2002).**

It was found that ascorbic acid (vitamin C) has proposed functions in photosynthesis as an enzyme cofactor including the synthesis of ethylene, gibberellins and anthocyanins **(Smirnoff and Wheeler, 2000)**. In addition, the positive effect of amino acids on the anthocyanin content of berry skin could be attributed to the amino acids play role in the biosynthesis and translocation of sugars and the building of anthocyanin pigment in the grape juice **(Ahmed and Abd El-Hameed, 2003).** Likewise, the application of amino acids was effective in improving total anthocyanin in berry skin as compared with control in both seasons as mentioned by **Belal *et al.,* (2016).**

Table (2) Effect of different treatments on TSS %, acidity %, TSS/acid ratio and anthocyanin of "Red Globe" grapevines during the two growing seasons 2019 and 2020.

Treatments	TSS %		Acidity %		TSS/acid Ratio		Anthocyanin mg/100g FW	
	2019	2020	2019	2020	2019	2020	2019	2020
Control	16.8	16.5	0.73	0.72	23.0	22.9	24.6	23.2
Amino acids (Pepton 1 g/L)	17.8	17.9	0.60	0.56	29.6	31.9	30.5	30.8
Ascorbic acid (4g/L)	17.6	17.5	0.61	0.61	28.8	28.7	30.2	30.2
Vitamin E 40 ppm	17.5	17.5	0.63	0.63	27.7	27.7	29.8	30.1
β–Sitosterol $C_{29}H_{50}O$	17.2	16.9	0.66	0.65	26.1	26.0	27.2	26.5
Amino acids + Ascorbic acid	18.9	18.8	0.50	0.49	37.8	38.4	35.4	35.0
Amino acids + Vitamin E	18.4	18.5	0.55	0.53	34.3	35.8	32.0	33.5
Amino acids + β–Sitosterol	18.1	18.3	0.58	0.55	31.2	33.2	30.8	31.2
New L.S.D. at 0.05 %	**0.1**	**0.1**	**0.01**	**0.01**	**0.2**	**0.2**	**0.2**	**0.2**

4- Chemical and physical characteristics of the vegetative growth

a. Leaf pigments content (chlorophyll)

The effect of different treatments on the leaf pigments contents is illustrated in Table (3). It was clearly shown that the compound application of amino acids and ascorbic acid recorded the highest values. Similarly, **Soad *et al.* (2010)** observed in strawflower a significant increase in the contents of chlorophyll a and b in comparison to those of untreated seedlings with increasing concentration of Pepton from 250 to 1000 ppm applied by foliar spraying. These results are attributed primarily to the effect of amino acids on leaf pigments content which plays an important role in the formation of chlorophyll **(Ghasemi *et al.,* 2013).** Likewise, the exogenous foliar application of pepton increased the chlorophyll content attributes of spinach plants **(Emanuil *et al.,* 2020).**

Furthermore, ascorbic acid (AsA) foliar application significantly increased chlorophyll a, chlorophyll b, carotenoids, and accordingly the total photosynthetic pigments, especially at a dose of 400 mg L^{-1} **(Gaafar *et al.,* 2020)**

b. Leaf area (cm^2)

Regarding the effect of foliar application of amino acids and vitamins, it was found that the combination between amino acids and ascorbic acid gave significantly the highest values in increasing the leaf area compared to the other treatments and control (Table 3). These results could be attributed to the beneficial effect of amino acids on new cell production by restoring the specific enzymes for protein synthesis **(Levitt, 1980).** The amino acid Glycine plays an important role in formation of vegetative growth. **(Ghasemi *et al.,* 2013).** Acid hydrolysate of peptone from vegetable sources is a rich source of nitrogenous material and contains a high concentration of free amino acids. The optimal concentration of available amino acids can play diverse roles in plant metabolism and growth under stress conditions **(Teixeira *et al.,***

2017). Moreover, the higher level of peptone spray at 1000 mg L^{-1} significantly ($p < 0.05$) increased the leaf area, as compared to the control **(Emanuil *et al.*, 2020).**

As well, AsA is a ubiquitous molecule that proves effective in improving and regulating cell division and growth **(Akram *et al.*, 2017).**

Table (3) Effect of different treatments on chlorophyll content (SPAD), leaf area cm^2, shoot length (cm) and weight of pruning (Kg) of "Red Globe" grapevines during the two growing seasons 2019 and 2020.

Treatments	Chlorophyll SPAD		Leaf area cm^2		Shoot length (cm)		Weight of pruning (Kg)	
	2019	2020	2019	2020	2019	2020	2019	2020
Control	24.7	25.1	116.3	116.9	107.6	108.2	2.9	2.9
Amino acids (Peptone 1 g/L)	35.8	35.6	136.1	137.5	131.0	128.7	4.0	4.1
Ascorbic acid (4g/L)	34.4	34.7	129.1	128.4	122.8	120.4	3.8	3.9
Vitamin E 40 ppm	31.5	32.2	125.8	124.7	117.5	118.0	3.5	3.5
β–Sitosterol $C_{29}H_{50}O$	29.0	29.3	125.5	124.2	113.4	113.6	3.5	3.4
Amino acids + Ascorbic acid	45.9	46.0	158.1	156.3	160.2	158.5	5.5	5.6
Amino acids + Vitamin E	41.5	40.8	149.2	147.6	148.7	148.2	4.9	4.9
Amino acids + β–Sitosterol	38.1	38.7	138.2	138.0	142.1	139.3	4.4	4.5
New L.S.D. at 0.05 %	**0.6**	**0.8**	**6.0**	**5.0**	**3.4**	**3.1**	**0.2**	**0.2**

c. Shoot length (cm)

The increase in shoot length that is obvious from the previous results shown in Table (3) in the sixth treatment (amino acids + ascorbic acid), could be ascribed to the effective components of amino acids in increasing the shoot length which led to more shade on the clusters and in turn reducing the harmful sunlight radiation to reach the clusters. This idea goes in parallel with that of **El-Naggar *et al.* (2013).**

In addition, the obtained results of ascorbic acid on vegetative growth are in agreement with those of **Khiamy (2003) and Wassel *et al.* (2007)** on different grapevine cultivars. They stated that ascorbic acid was very effective in enhancing growth parameters namely shoot length.

d. Weight of pruning (Kg).

Pruning weight is an important indicator used to appraise biomass production, carbon storage cycle, vigor and vine balance as stated by **Smart and Robinson (1991) and Keller (2015).** Concerning the effect of the different materials involved in this study, data obtained in Table (3) clearly show that the combined treatment of amino acids and ascorbic acid has a positive effect on the weight of pruning in both seasons. The weight of pruning lowest values were detected in the case of untreated vines. The canopy vigor and productivity can be balanced through pruning levels as pruning the vines for optimum cropping according to the vigor is the most reliable method to maintain a balance between growth and production. According to **Smart and Robinson (1991),** pruning weight is proportional to the leaf area carried on the shoots in the previous growing season. In addition, **Khiamy (2003) and Wassel *et al.* (2007)** pointed out that antioxidants such as ascorbic acid was very effective in enhancing the number of leaves/shoot and leaf area of different grapevine cultivars. The ratio of yield to pruning weight gives a good indication of the balance between fruit and vegetative growth.

Conclusion

Reflecting the importance of amino acids and antioxidants, we can deduce that under high temperature and high sunlight intensity, the canopy managements leading to reduce these factors were the most effective in improving the vegetative growth and cluster quality along with alleviating the undesirable effect of sunburn of Red Globe grape cultivar. With regard to the compounds that are naturally present in plant cells such as amino acids, foliar spraying of these acids has been found to be an easy technique and an alternative approach to mineral fertilizers. In addition to being a recommended solution under the hypothesis that they would play a role as abiotic stress alleviators. In this way our results showed that combined treatment of amino acids and ascorbic acid can change different plant traits especially the leaf area to convenient ones that suit the current microclimatic conditions and therefore protecting the clusters from the deleterious effects of sunburn.

Conflicts of Interest/ Competing interest

This manuscript has no conflicts of interest.

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