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Effect of Tryptophan, Proline and Tyrosine on Vegetative Growth, Yield and Fruit Quality of Red Roumy grapevines

M. A. El-Kenawy
Viticulture Department, Horticulture Research Institute, Agricultural Research Centre, Cairo, Egypt.

THIS study was achieved out during two successive seasons (2018 & 2019) on 12 year-old Red Roumy grapevines. The chosen vines were grown in a clay soil under surface irrigation system in a private vineyard at El-deer hamlet, Aga, Dakahlia region, Egypt. Three amino acids namely tryptophan, proline and tyrosine were used as foliar application at rate 100 and 200 ppm on the vines for three times, at vegetative growth start, at full bloom stage and at verison stage. Results appeared that using tryptophan, proline and tyrosine were effective in improving shoot length, leaf area, total chlorophyll and total amino acids in the leaves in addition percentages of N, P, K and Mg in the leaves as well as enhanced yield per vine, cluster weight, berry weight, berry set, SSC content, total sugars, total anthocyanin and total phenols, also enhanced pruning wood weight, ripening wood, internode length and thickness while reduced titratable acidity in berries as compared with control in two seasons. Application of tryptophan at 200 ppm and tyrosine at 200 ppm gave the significant highest of vegetative growth parameters, yield and its components. While, proline at 200 ppm increased SSC% and SSC acid ratio, total anthocyanin, total phenols and total sugars while these reduced titratable acidity. The best net profit of Red Roumy grapevines was obtained with tryptophan at 200 ppm.

Keywords: Grapevines, Red Roumy, Tryptophan, Proline, Tyrosine, Growth and Fruit Quality**.**

Introduction

Grapevine (*Vitis vinifera,* L) is one of the economically great fruit yield worldwide (Alston and Sambucci, 2019). Grapes are one of the most productive fruit in the world, with almost 77.8 million tons output each year. While approximately 57% of grapes are used to produce wine, 36% are consumed as fresh table grapes and 7% as dried grapes. Grapes are widely distributed around the world, with an estimated surface area of 7.4 million hectares in 2018.Wine, juice, grape seed extract, dried grapes, and grape seed oil are all goods made from grapes. Since 2000, global table grape production and consumption have nearly doubled from 15.7 million tons to 27.3 million tons. (OIV, 2019).

Red Roumy grapevines cultivar is a late-season red table grape. The fruit ripens in first-September, can be held on the vine through first November. The berry's taste is sweet and neutral but with its seeds. It has great acceptance in the market because of its cheap price. Also, grape growers accept the cultivation of Red Roumy cultivar in response to the abundance of production. The biggest problem faced grape growers of Red Roumy grapevines cultivar is the reduction of berry set that produce the loose clusters. Therefore, clusters become inappropriate and unattractive from the consumer's point of view (Eman Abou-Zaid and Shaaba 2019).

Amino acids are the structure building blocks in the synthesis of proteins (Opike and Rolfe,2005). Important amino acids due to stimulate cell growth. They perform as stores which help to preserver appropriate pH value within the plant cell, since they contain both acid and basic groups, they eject the ammonia from the cell. This job is connected with amide formulation, so they protect the vine from ammonia toxicity. Amino acids task in the synthesis of other organic compounds, such as protein, amines ,pyrimidines,, purines, alkaloids, vitamins and enzymes (Abo Sedra et al., 2010).

Corresponding author: M. A. El-Kenawy, E-mail: emosaad76@yahoo.com.com, Tel. 01005641624
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Tryptophan is an aromatic amino acid created by the shikimate pathway, which is activated by chorismate. (Tzin and Galili ,2010) .Maeda and Dudareva (2012) reported that Tryptophan acid plays role in stimulating the plants growth and affect on auxin synthesis. Nahed et al (2009) and Abd-Elkader et al (2020) found that vegetative growth and yield increased by spraying of tryptophan acid. The foliar application of tryptophan led to raise in the total chlorophyll and carotenoids content in plants. Tryptophan prevents the early flower and berry fall and it is important in the operation of production of enzyme that catalyses' synthesis response of auxin, so it improves berry set (Saburi et al. 2014). Also, Woodward and Bartel (2005) notified that alternate pathway of IAA synthesis enter plants, all flight from tryptophan. Thus, supplying the plants by tryptophan, lead in the end to build and produce indole acetic acid (IAA).

Proline can be featured among each amino acids because its distinguished structure with its α-amino group as a secondary amine and possesses featured cyclic building which causes exceptional conformational strength to the protein structure (MacArthur and Thornton, 1991). Exogenous proline has lately been shown to alleviate H_2O_2-mediated oxidative stress in buds vegetative of grapevine (Ozden et al., 2008). Also, Proline does as the molecular chaperons it can protect the protein softly and improvement the activities of various enzymes. Many researches have mentioned proline as an antioxidant suggesting its role as ROS scavenger and singlet. The fragmentation of proline metabolism implies that proline is transferred between the cytosol, mitochondria and chloroplasts. The active uptake of proline in mitochondria has been observed, implying the presence of specialised amino acid transporters. (Kiyosue et al., 1996, Viehweger , 2014) The level of proline in particular increases during the ripening process (Pandy et al 1974).

Tyrosine is hydroxy phenyl amino acid that is applied to construction neurotransmitters and hormones (Petersen and Simmonds 2003). Hass, (1975) mentioned that biosynthesis of cinamic acids (which are the begging ngredients for the synthesis of phenols) is generated from tyrosine. Nahed et al. (2010) reported that the spray of tryptophan and tyrosine significantly promoted trunk length, shoot diameter, N%, P% and K% than the untreated plants. El-Sherbeny and Da silva (2013) found that using tyrosine improve to be successful agents in enhancing vegetative growth and production quality of beet plants, Beet root producers can effectively use these tyrosine to improve crop for edible purposes and to improvement pigments for extraction for use in colouration and medicinal industries. El-Sese et al. (2020) showed that tyrosine at 500 ppm recorded the highest yield of Red Roumy grapevine.

The aim of this study is to improve vegetative growth, production and fruit quality of Red Roumy grapevine cultivar by using tryptophan, proline and tyrosine.

Materials and Methods

This investigation was carried out during two successive seasons (2018 and 2019) in a private vineyard at El-deer village, Aga city, Dakahlia Governorate, Egypt on twelve year's old Red Roumy grapevines cultivar. The chosen vines were uniform vigor and healthy, spaced at 2 x 2 meters and trained according to spur pruned using quadrilateral cardoon trellis with supporting by

TABLE 1. Mechanical and chemical analysis of the experimental soil at the depth of (0-90 cm).

Mechanical	**Clay (%)**	47.15
	Silt (%)	26.69
	Sand (%)	26.16
	Texture	Clay
Chemical	**O.M. (%)**	2.2
	pH	7.6
	E.C.(1:5 extract) (Mmhos/cm)	0.60
	Ca Co_3 (%)	1.83
	N (ppm)	28
	P (ppm)	10
	K (ppm)	249

three vertical wire systems. Pruning was carried out in the 3rd week of February in the first and second seasons by leaving 4 spurs with 4 eyes on each cardoon plus 4 replacements spurs with 2 buds. The total load was 72 eyes. A completely randomized blocked design consists of seven treatments, each treatment, including 3 replicates, each one has 3 vines. The experimental soil was clay, its physiochemical characteristics of the soil samples at (0-90 cm) depth were determined according to Page et al. (1982).

Three materials such as Tryptophan ($C_{11}H_{12}N_2O$), Proline ($C_5H_9NO_2$) and Tyrosine ($C_9H_{11}NO_3$) were used as foliar application with concentration of 100 and 200 ppm at rates of 1and 2 grammes / 10 litters (feddan needs 40 and 80 grammes amino acid/ 400 litters water) on the vines for three times, at vegetative growth start (when shoots length reached about 30 - 40 cm), at full bloom stage and at verison stage.

Treatments applied as follow:

- Control
- Spraying with Tryptophan at 100 ppm.
- Spraying with Tryptophan at 200 ppm.
- Spraying with Proline at 100 ppm.
- Spraying with Proline at 200 ppm.
- Spraying with Tyrosine at 100 ppm.
- Spraying with Tyrosine at 200 ppm.

The following characteristics were determined:

Vegetative growth parameters

Vegetative growth parameters were taken from non-bearing shoots after 7days berry set to determine the following measurements:

Average shoots length (cm)

Average of shoot length was calculated by measuring the rate length of 4 shoots / vine (shoot from each side)

Average leaf area (cm2)

Representative sample four of mature leaves per each treated vines (6th or 7th leaves) from the top of the same previous shoots that were taken from the various vine sides and used for leaf area measurements according to the following equation Montero et al. (2000):

Leaf area (cm^2/leaf) = 0.587 (L x W)

Where, L = Length of leaf blade, W = Width of leaf blade

Total Chlorophyll content in the leaves

Sixth and seventh leaves from the tip of the growing shoots were used for the determination of total chlorophyll content in the leaves at two weeks after fruit set according to the methods described by Mackinny (1941). Total chlorophyll was calculated as mg/g fresh weight.

Total free amino acids in the leaves

A sample of dry leaves (500 mg) was extracted with 50 ml of 80% ethanol and filtered to remove insoluble materials and then 1.0 ml of ethanol extract was added. Then, 0.5 ml of 0.07 mol l-1 phosphate buffer solutions (pH 8.04) and 0.5 ml of 2% ninhydrin solution containing 0.8 mg ml-1 of $SnCl_2–2H_2O$ was added. After 15 minutes on a boiling water bath, the combinations were promptly cooled with cold water before being reduced to 25 ml with distillated water. The absorbance values of these blue-purple products were evaluated against a reagent blank at 550 nm after being let to stand motionless for 10 minutes (Jayarman, 1981 and Chen et al., 2009).

N, P, K and Mg contents in the leaves

After 7 days berry set, samples of 20 leaf petioles per each replicate were taken from leaves opposite to cluster were used for the determination of N, P, K and Mg% contents in the leaves according to the methods described by Cottenie et al. (1982).

Yield and its components

At harvest time (mid-September) when SSC % of fruits reached about 16-17 % in control six clusters /vine were weighted and the average cluster weight was multiplied by number of clusters/vine to calculation average yield/vine. Also, average cluster weight (g) and average of 100 berry weight (g) were measured.

Berry set percentage

Berry set percentage was estimated by packing five flower clusters on each vine in perforated paper bags before bloom which are expelled after berry set. The percentage of berry set was calculated as follows:

$$\text{Berries set \%} = \frac{\text{Number of berries per cluster}}{\text{Number of total blossoms per cluster}} \times 100$$

Chemical properties of berries:

A representating sample of 6 clusters/ vine was taken at harvest time for the following measurements:

- Soluble solids content in berry juice (SSC %): It was estimated by manual refractometer (0068390, Atago, Co. Japan).
- Titratable acidity (as tartaric acid %) percentage was determined with according to A.O.A.C. (1980).

- SSC/acid ratio was calculated by dividing the percentage of SSC on titratable acidity, total sugars (%) were determined according to Sadasivam and Manickam (1996).
- Total anthocyanin of berries skin (mg/100g fresh weight) was calculated according to Husia et al. (1965).
- Total phenols: Two grammes of berry skin (randomly picked from 20 berries/replicate) were extracted with 20 mL methanol (80%) and filtered through filter paper No. 1 by shaking at 150 rpm for 12 hours.The methanol extract filtrate will be used to determine total phenols. 50 µL of the methanol extract was mixed with 100 µL Folin-Ciocalteu reagent, 850 µL of methanol and allowed to stand for 5 min at ambient temperature. A 500 µL of 20% sodium carbonate was added and allowed to react for 30 min. Absorbance was measured at 750 nm. Total phenols was quantified from a calibration curve obtained by measuring the absorbance of known concentrations of gallic acid and the results expressed as g g-1 FW gallic acid equivalent. total phenols concentration was measured according to (zieslin and ben zaken 1993).

Parameters at dormant seasons:

- Internode thickness was measured from the third base internode and expressed in cm. by using a caliper.
- The internode length was measured from the third base internode and expressed in cm. by using a meter.
- Wood ripening : twelve shoots of the current seasons growth were tagged for each replicated to follow up the rate of wood ripening which calculated by dividing shoot length ripened part by the total shoot length the methods described by (Rizk and Rizk ,1994)
- Pruning wood weight: the weight of pruning wood was determined at winter pruning time during the seasons of study and the data were recorded as g/vine.

Costs and net profit /feddan

Yield/ feddan ton (average two seasons) = Yield (kg fruit/vine) x Number of vines/1000.

Total costs / feddan (L.E.) = Treatments (amino acids) costs/ feddan (L.E.) + Costs of cultural practices/ feddan (L.E.).

Total production/ feddan (L.E.) = Yield/ feddan ton X price of one ton.

Net profit / feddan (L.E.) = Total production/ feddan (L.E.) - Total costs / feddan (L.E.).

Statistical analysis

The statistical analysis of the present data was carried out according to the methods_described by Snedecor and Chocran (1980). Averages were compared using the new L.S.D. at 5%.

Results and Discussion

Shoot length, leaf area, total chlorophyll and total amino acids in the leaves

Data presented in Table 2 indicate that spraying Red Roumy grapevines at three times with amino acid (tryptophan, proline and tyrosine) significantly enhanced shoot length, leaf area, total chlorophyll and total amino acids in the leaves as compared with control. Spraying of tryptophan at 200 ppm gave the significant highest values in this respect as compared with other treatments which recorded 145.0 and 148.0cm for shoot length, 132.0 and 138.0 cm^2 for leaf area, 2.75 and 3.04 mg/100g for total chlorophyll, and 1.50 and 1.69 mg/100g for total amino acids in the leaves in 2018 and 2019 seasons, respectively. Also, data showed non-significant differences between tryptophan at 200 ppm (T3) and tyrosine at 200 ppm (T7) on shoot length and leaf area in both seasons of study.

The increase in shoot length, leaf area, total chlorophyll and total amino acids in the leaves as a result of the different some amino acid treatments (tryptophan, proline and tyrosine) may be amino acids, as organic nitrogenous compounds, are the structure building blocks in the synthesis of proteins, which are created by a process in which ribosomes catalyse amino acid polymerization. (Opike and Rolfe,2005). Maeda and Dudareva (2012) found that tryptophan acid plays role in stimulating the vine growth and effect on auxin synthesis. Used to tryptophan in soil has proved very fruitful results for enhancing vegetative growth parameters of many vegetables (Abbas et al. 2013).

These results are in agreement with those obtained by Nahed and Laila (2007) who found that foliar application with tyrosine and tryptophan increased total free amino acids and chlorophyll on Salvia farinacea. Meanwhile Nahed et al (2010) reported that using of tyrosine at 200 ppm gave the best results in vegetative growth parameters .The highest values in vegetative growth parameters were obtained when plants were treated with tyrosine followed by tryptophan (Al-khawaga, 2014, Faissal et al., 2014, Al- Wasfy, 2014, Faissal et al., 2014 and 2015 Abd-Elkader et al., 2020).

N, P, K and Mg (%) contents in leaf petiole

The concerned data in Table 3 indicate that spraying Red Roumy grapevines with tryptophan, proline and tyrosine gave the highest values of N, P, K and Mg contents in leaf petioles compared to control. Also, the data showed that the treatment of tryptophan at 200 ppm (T3) gave the significant highest increase in N, P, K and Mg contents in leaf petioles. The N values were (2.31and 2.50 %), the P values were (0.71 and 0.75), the K values were (1.84 and 1.94%) and the Mg values were (0.77 and 0.86%) during two seasons, respectively. While, the lowest values in this respect were recorded by control (T1) which recorded (1.06 and 1.10 %), (0.26 and 0.31 %), (1.24 and 1.37 %) and (0.33 and 0.43%) in N, P, K and Mg contents in leaf petioles, respectively in both seasons of study. The results also showed that the differences between the values of tryptophan at 200 ppm (T3) and tyrosine at 200 ppm (T7) was insignificant for N, P and K % in leaf petioles during both seasons of study. Also, none significantly differences between tryptophan at 100 ppm (T2) and tyrosine at 100 ppm (T6) on Mg% in leaf petioles were clear.

These results may be due to the important of tryptophan and tyrosine as plant hormone that regulate various processes of plant growth and development, which plays in the regulation of cell division. Woodward and Bartel (2005). Zewail (2014) found that the effect of spraying amino acids in increasing various physiological processes, such as nutrient uptake by roots and metabolism in treated plants, could explain this and tryptophan produces plant hormone indole 3-acetic acid or IAA.

These results with those obtained by Belal et al (2016) they reported that foliar application of amino acid enhancing the total nitrogen, total phosphorus, total potassium and total Mg in leaf petioles on Flame Seedless grapevine. Hanan Ibrahem (2016) found that foliar application of tryptophan gave an increase of macronutrients (N, P and K) in shoots as compared with untreated Spathiphllum plants. These are rising as a result of changes in the quantities of amino acids and certain proteins, which acted to promote cell division and elongation.

Yield and, its components

Data presented in Table 4 show that spraying Red Roumy grapevines three times with tryptophan, proline and tyrosine significantly increased yield per vine and cluster weight as compared with control during both seasons. The application of tryptophan at 200 ppm (T3) and tyrosine at 200 ppm (T7) gave the highest values in yield per vine and cluster weight in 2018 and 2019 seasons, respectively with non-significant differences among of them. However, the control treatment (T1) recorded the lowest values of yield per vine and cluster weight in these respect during both seasons. As regards 100 berry weight data

TABLE 2. Effect of foliar application of tryptophan, proline and tyrosine on shoot length, leaf area, total chlorophyll and total amino acids in leaves of Red Roumy grapevines during 2018 and 2019 seasons.

Measurements		Shoot length (cm)		Leaf area (cm^2)		Total chlorophyll (mg/g F.W)		Total amino acids (g /100g D.W)	
Treatments		2018	2019	2018	2019	2018	2019	2018	2019
T1	Control	110	116	108	112	1.91	2.02	1.02	1.04
T2	Tryptophan 100 ppm	132	137	125	130	2.11	2.44	1.24	1.35
T3	Tryptophan 200 ppm	145	148	132	138	2.75	3.04	1.50	1.69
T4	Proline 100 ppm	121	122	116	117	2.06	2.27	1.17	1.24
T5	Proline 200 ppm	124	125	118	120	2.19	2.30	1.30	1.32
T6	Tyrosine 100 ppm	131	136	120	130	2.35	2.73	1.17	1.42
T7	Tyrosine 200 ppm	145	144	128	134	2.56	2.86	1.45	1.50
New L.S.D at 5%		8.0	4.4	4.25	4.51	0.14	0.24	0.14	0.09

TABLE 3. Effect of foliar application of tryptophan, proline and tyrosine on percentages of N, P, K and Mg contents in leaf petioles of Red Roumy grapevines during 2018 and 2019 seasons.

Measurements		N (%)		P (%)		K (%)		Mg (%)	
Treatments		2018	2019	2018	2019	2018	2019	2018	2019
T1	Control	1.06	1.10	0.26	0.31	1.24	1.37	0.33	0.43
T2	Tryptophan at 100 ppm	1.25	1.47	0.45	0.49	1.35	1.53	0.61	0.71
T3	Tryptophan at 200 ppm	2.31	2.50	0.71	0.75	1.84	1.94	0.77	0.86
T4	Proline at 100 ppm	1.52	1.72	0.49	0.55	1.33	1.44	0.40	0.49
T5	Proline at 200 ppm	1.93	2.05	0.55	0.58	1.37	1.51	0.48	0.57
T6	Tyrosine at 100 ppm	2.11	2.24	0.60	0.64	1.62	1.67	0.55	0.65
T7	Tyrosine at 200 ppm	2.20	2.40	0.65	0.73	1.79	1.82	0.69	0.78
New L.S.D at 5%		0.15	0.24	0.07	0.05	0.09	0.12	0.07	0.07

showed that spraying grapevines with tryptophan gave the greatest values on 100 berry weight compared with proline and tyrosine at the same levels during both seasons. Spraying of tryptophan at 200 ppm (T3) gave the higher values in 100 berry weights, while the control treatment (T1) gave the lowest values of 100 berry weights in both seasons. The increment in yield per vine could be attributed to enhancing effect on berry weight as result of enhancing the nutritional status of the vines (Table 3) and enhancing leaf area and total chlorophyll in leaves (Table 2) as result using tryptophan, proline and tyrosine.

Also, data in Table 4 showed that spraying Red Roumy grapevine at three times with amino acid (tryptophan, proline and tyrosine) significantly enhanced berry set % as compared with control. Foliar application of tryptophan at 200 ppm gave the significant highest values in this respect as compared with other amino acids which recorded 11.48 and 11.80% for berry set in 2018 and 2019 seasons, respectively. While, untreated (T1) gave the lowest values of berry set % in both seasons.

These results are in harmony with those reported by Nahed et al. (2010) they showed that yield/ plant of *Thuja orientalis* L. plant was significantly increased with spraying of different amino acids such as tyrosine, thiamine and tryptophan .Also, showed that the highest values of yield / plant were obtained in the herb of plants which were treated with tyrosine. Belal et al (2016) found that foliar applications of amino acids increased yield per vine, cluster weight and 100 berry weights as compared with untreated vines of Flame seedless grapevines El-Sese et al. (2020) showed that foliar application with tyrosine at 500 ppm recorded the highest yield of Red Roumy grapevines .The beneficial effects of amino acids on vegetative growth parameters, vines nutritional status, yield beside physical properties of the fruits are in harmony with those obtained by Melouk (2007), Fayed (2010), Madian & Refaai (2011), khan et al. (2012), El-Sayed (2013), Al-khawaga (2014), Al-Wasfy (2014), Faissal et al. (2015) and Abd-Elkader et al. (2020).

Chemical properties of the berries

Data in Table 5 clearly show that all treatments (tryptophan, proline and tyrosine) used significantly increased SSC% and SSC acid ratio while these reduced titratable acidity in juice berries as compared with untreated except tyrosine at 100 ppm gave a non-significantly differences in SSC % in two seasons. The treatment of proline at 200 ppm (T5) gave in both seasons not only the highest values in soluble solids content (18.2

TABLE 4. Effect of foliar application of tryptophan, proline and tyrosine on yield/vine, cluster weight, 100 berry weights and berry set % of Red Roumy grapevines during 2018 and 2019 seasons.

Measurements		Yield/vine (Kg)		Cluster weight (g)		100 berry weight (g)		Berry set %	
Treatments		2018	2019	2018	2019	2018	2019	2018	2019
T1	Control	15.106	15.721	581	583	551	540	8.43	8.53
T2	Tryptophan at 100 ppm	16.007	16.839	616	624	590	593	10.28	10.43
T3	Tryptophan at 200 ppm	16.588	17.640	638	653	605	607	11.48	11.80
T4	Proline at 100 ppm	15.331	16.155	590	598	550	556	9.36	9.56
T5	Proline at 200 ppm	15.591	16.290	600	603	561	574	9.56	9.63
T6	Tyrosine at 100 ppm	16.016	17.082	616	633	580	577	9.36	9.50
T7	Tyrosine at 200 ppm	16.484	17.343	634	642	586	592	9.83	9.90
New L.S.D at 5%		0.23	0.32	9.0	12.0	12.0	19.0	0.376	0.296

TABLE 5. Effect of foliar application of tryptophan, proline and tyrosine on soluble solids content (SSC), titratable acidity and SSCAcid ratio of Red Roumy grapevines during 2018 and 2019 seasons

Measurements		SSC (%)		Titratable Acidity (%)		SSC Acid ratio	
Treatments		2018	2019	2018	2019	2018	2019
T1	Control	16.9	17.2	0.714	0.680	23.66	25.29
T2	Tryptophan at 100 ppm	17.6	17.8	0.646	0.613	27.24	29.03
T3	Tryptophan at 200 ppm	17.8	17.9	0.606	0.58	29.37	30.86
T4	Proline at 100 ppm	18.0	18.2	0.583	0.553	30.87	32.91
T5	Proline at 200 ppm	18.2	18.5	0.542	0.526	33.57	35.17
T6	Tyrosine at 100 ppm	17.0	17.3	0.701	0.663	24.25	26.09
T7	Tyrosine at 200 ppm	17.2	17.4	0.64	0.616	26.87	28.24
New L.S.D at 5%		0.4	0.3	0.033	0.027	1.75	1.34

and 18.5%), SSC acid ratio (33.57and 35.17 %) but also the lowest titratable acidity (0.542 and 0.526%) in 2018 and 2019 seasons, respectively, as compared with other treatments. While, control treatment (T1) gave the lowest values in SSC, SSC acid ratio and increased titratable acidity in berries in both seasons.

These results with those obtained by Pandy et al. (1974) found that proline level increased at of the ripening process. Accumulation of proline has been suggested to contribute to stress tolerance in several ways. Proline does as the molecular chaperons it is can protect the protein softly and improvement the activities of various enzymes. Many studies have mentioned proline level increased at of the ripening process. El-Sayed (2013) found that proline significantly increased SSC % and reduced total acidity than untreated .Belal et al. (2016) clearly showed that using amino acids significantly increased soluble solids content while these reduced total acidity in berries as compared to untreated.

Total anthocyanin, total phenols and total sugars

Regarding the effect of amino acids on total anthocyanin, total phenols and total sugars data presented in Table 6 show that total anthocyanin in berry skin, total phenols and total sugars were significantly increased as a result of foliar applications of tryptophan, proline and tyrosine in berries as compared with control. Spraying of proline at 200 ppm (T5) gave the highest values in total anthocyanin in berry skin, total phenols and total sugars in both seasons. Non-significant differences between foliar application tyrosine at 100 ppm (T6) and tyrosine at 200 ppm (T7) on total anthocyanin in berry skin, total phenols in the first season and total sugars in both seasons were clear.

These results are agreement by Pandy et al. (1974) showed that proline level increased at of the ripening process. Hass, (1975) reported that the biosyntheses of cinamic acids (which are the begging materials for the synthesis of phenols) are derived from tyrosine. Meanwhile, El-Sayed, (2013) found that application of Phenylalanine and proline increased total sugars %, total anthocyanin than control of Crimson Seedless" grape. EL-Sherbeny and Da silva (2013) they found that proline improve yield per plant for edible purposes and to increase pigments for extraction for use in coloring and medicinal industries. Belal et al (2016) clearly showed that

TABLE 6. Effect of foliar application of tryptophan, proline and tyrosine on total anthocyanin, total phenols and total sugars of Red Roumy grapes during 2018 and 2019 seasons

Measurements		Total anthocyanin (mg/100g F.W)		Total phenols (mg/100g D.W)		Total sugars (%)	
Treatments		2018	2019	2018	2019	2018	2019
T1	Control	21.0	21.2	192	225	12.7	13.0
T2	Tryptophan at 100 ppm	23.2	23.5	206	236	13.3	13.4
T3	Tryptophan at 200 ppm	23.5	23.7	214	281	13.4	13.5
T4	Proline at 100 ppm	27.4	29.4	316	341	13.4	13.7
T5	Proline at 200 ppm	28.5	32.6	344	354	13.6	13.9
T6	Tyrosine 100 ppm	25.8	27.6	261	289	12.8	13.1
T7	Tyrosine 200 ppm	26.4	25.6	268	299	12.9	13.0
New L.S.D at 5%		1.4	1.4	13.0	10.0	0.4	0.2

application of amino acids significantly increased total sugars, total anthocyanin in berry skin and total phenols of Flame Seedless Grapevines. These results regarding the beneficial effects of amino acid on chemical properties of the fruits are in harmony with those obtained by El-Sayed, (2013), Al-Khawaga (2014), Faissal et al. (2014) , Al-Wasfy, (2014) and Faissal et al. (2015).

Parameters at dormant seasons

Results in Table 7 indicated that all foliar applications of amino acids (tryptophan, proline and tyrosine) improved pruning wood weight, ripening wood, internode length and thickness compared with control in two seasons of the study except proline at 100 ppm (T4) gave non-significant differences in ripening wood in both seasons and internode length and thickness in the first season compared with control. The vines which sprayed with tryptophan at 200 ppm (T3) and tyrosine at 200 ppm (T7) gave the significant highest of pruning wood weight, ripening wood, internode length and thickness as compared with the other treatments in two seasons. On the other hand, control treatment (T2) gave the lowest values in pruning wood weight, ripening wood, internode length and thickness during the two seasons of the study. Pruning wood weight, ripening wood, internode length and thickness are considered important parameters that determine the vigor of vines and fruit quality in the next season. When pruning wood weight, ripening wood, internode length and thickness increase, the vines will be mature and reach full production in the following season. This sets the vine into a contuse vegetative growth cycle, and better production of wood, leaf and fruit. (Vasconcelos and Castagnoli, 2000).

The positive effect of amino acid on improving pruning wood weight, ripening wood, internode length and thickness could be attributed to its major role on stimulating cell division and elongation, carbohydrate assimilation, photosynthesis, nucleic acid and protein synthesis (El-Sese et al., 2020) and this reflected on improving vegetative growth, physiological status and subsequently, reflected on improving the previous properties**.**

These results are in agreement with those obtained by Abou Dahab and Abd El-Aziz (2006) they found that using of tryptophan significantly increased shoot diameter and length

TABLE 7. Effect of foliar application of tryptophan, proline and tyrosine on pruning wood weight, ripening wood, internode length and thickness in Red Roumy grapevines during 2018 and 2019 seasons

	Measurements	Pruning wood weight (k g)		Ripening wood (%)		Internode (length(cm		Internode (thickness (cm	
	Treatments	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**
T1	**Control**	1.51	1.57	74.1	77.1	5.8	5.8	0.99	1.03
T2	**Tryptophan 100 ppm**	1.61	1.83	80.3	83.0	6.2	6.2	1.16	1.18
T3	**Tryptophan 200 ppm**	1.92	2.05	87.9	90.5	6.5	6.6	1.26	1.28
T4	**Proline 100 ppm**	1.60	1.76	74.3	77.5	5.9	6.0	1.02	1.04
T5	**Proline 200 ppm**	1.84	2.02	76.4	78.5	6.0	6.2	1.03	1.12
T6	**Tyrosine 100 ppm**	1.86	2.20	79.2	82.4	6.3	6.3	1.13	1.16
T7	**Tyrosine 200 ppm**	1.90	2.54	79.8	85.6	6.4	6.5	1.26	1.27
	New L.S.D at 5%	0.06	0.17	4.4	4.5	0.3	0.3	0.13	0.09

on Philodendron erubescens plants .Hassan et al. (2010) showed that stem diameter of plum trees increased with foliar application of amino acids. Nahed et al. (2010) reported that brunch diameter of *Thuja orientalis* significantly increased with tyrosine and tryptophan. In addition, Rasmia et al (2014) showed that foliar applications with amino acids at 100, 200 and 300mg/l gave the best stem thickness of Date Palm as compared with control. Also, Wassel et al., (2015) found that all foliar application of amino acids (methionine, cysteine and tryptophan) + K-silicate increased all the vegetative growth parameters (shoot diameter and length) compared with the untreated of Pomegranate trees.

Costs and net profit /feddan

It is clear from the obtained data in (Table 8) that spraying Red Roumy grapevines with tryptophan, proline and tyrosine gave the best net profit/ feddan as compared with control. In addition, the treatment of foliar tryptophan at 200 ppm gave the highest values in net profit/ feddan as compared with other treatments which recorded 3927.5 (L. E.) over control as average two seasons.

Conclusion

From this study it can be concluded that foliar application of tryptophan at 200 ppm and tyrosine at 200 ppm gave the significant highest of vegetative growth parameters and yield its components while, proline at 200 ppm increased of SSC and SSC acid ratio, total sugars, total anthocyanin in berry skin, total phenols and total sugars while these reduced titratable acidity. The best net profit of Red Roumy grapevines was obtained with tryptophan at 200 ppm.

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Conflicts of interest

The author declares that there are no conflicts of interest related to the publication of this study.

TABLE 8. Effect of foliar application of tryptophan, proline and tyrosine on costs and net profit /feddan of Red Roumy grapevines as average two seasons (2018 and 2019)

	Treatments	Costs of *cultural practices / fed. (L.E.)	Treatments costs/fed. (L.E.)	Total costs / fed. (L.E.)	/Yield .fed Ton	Total production /fed. (L.E.)	Net profit / fed. (L.E.)	Net profit / fed. over control (L.E.)
T1	**Control**	9000	0	9000	15.413	38532.5	29532.5	0.0
T2	**Tryptophan 100 ppm**	9000	600	9600	16.423	41057.5	31457.5	1925.0
T3	**Tryptophan 200 ppm**	9000	1200	10200	17.464	43660.0	33460.0	3927.5
T4	**Proline 100 ppm**	9000	480	9480	15.843	39607.5	30127.5	595.0
T5	**Proline 200 ppm**	9000	960	9960	16.140	40350.0	30390.0	857.5
T6	**Tyrosine 100 ppm**	9000	240	9240	16.549	41372.5	32132.5	2600.0
T7	**Tyrosine 200 ppm**	9000	480	9480	16.913	42282.5	32802.5	3270.0

* Cultural practices such as (Fertilizers, Pesticides, fungicides, Irrigation and Labour)
- Tryptophan (g) 40 x 3doses = 120 g = 600 (L.E.) / feddan
- Tryptophan (g) 80 x 3doses = 240 g = 1200 (L.E.) / feddan
- Proline (g) 40 x 3doses = 120 g = 480 (L.E.) / feddan
- Proline (g) 80 x 3doses = 240 g = 960 (L.E.) / feddan
- Tyrosine (g) 40 x 3doses = 120 g = 240 (L.E.) / feddan
- Tyrosine (g) 80 x 3doses = 240 g = 480 (L.E.) / feddan
- One feddan = 1000 vines
- Price one ton from yield = 2500 (L .E.)

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تأثيرالرش بالتربتوفان والبرولين والتيروسين على النمو الخضرى والمحصول وجودة ثمار عنب الرومى الاحمر

مسعد عوض القناوى
قسم بحوث العنب - معهد بحوث البساتين - مركز البحوث الزراعيه - الجيزة - مصر.

أجريت هذه الدراسة خلال موسمى 2018 و 2019 فى مزرعة خاصة فى قرية الدير التابعة لمركز أجا محافظة الدقهلية على كرمات عنب رومى أحمر عمرها 12 سنة ومنزرعة فى تربة طينية وتروى بنظام الرى بالغمر

وذلك بهدف دراسة تأثير الرش ببعض الاحماض الامنية مثل التربتوفان والبرولين والتيروسين على النمو والمحصول وجودة الحبات على صنف الرومى الاحمر .

وقد أظهرت النتائج الاتى:

أن الرش الورقى بالاحماض الامنية مثل (التربتوفان والبرولين والتيروسين) كان فعالا في زيادة قيم النمو الخضرى مثل (طول الأفرع ، المساحة الورقية) وأيضا المحتوى الكلى للكلوروفيل والأحماض الأمينية الكلية فى الأوراق و النسبه المئويه لكل من النيتروجين ، الفوسفور ، البوتاسيوم ، الماغنسيوم وكذلك تحسين كمية المحصول ووزن العنقود ووزن الحبات ونسبه العقد وتحسين صفات الجودة فى الحبات مثل المواد الصلبة الذائبة والسكريات الكلية وصبغة الأنثوسيانين والفينولات الكلية وخفض نسبة الحموضة خلال موسمى الدراسة بالمقارنة بالكنترول.

وكانت المعاملة بالتربتوفان بتركيز 200 جزء فى المليون والمعاملة بالتيروسين بتركيز 200 جزء فى المليون أفضل المعاملات فى تحسين صفات النمو الخضرى وكذا المحصول ومكوناته بينما كانت المعاملة بالبرولين بتركيز 200جزء فى المليون هى الافضل فى تحسين صفات الجودة فى الحبات مثل المواد الصلبة الذائبة والسكريات الكلية وصبغة الأنثوسيانين والفينولات الكلية وخفض نسبة الحموضة.

ولتحسين ربح الفدان يوصى برش عنب الرومى الاحمر بالتربتوفان 200 جزء فى المليون ثلاث مرات عند بداية النمو الخضرى وعند نهاية التزهير وخلال مرحلة الفيريزون .