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Effect of Spraying Some Amino Acids, Algae Extract, and Turmeric Extract on Shot Berries, Yield and Berries Quality of Prime Seedless Grapevines

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Abstract

This study was conducted through the 2020 and 2021 seasons on prime seedless grapevines grown under Minia Governorate conditions to investigate the effects of five different nutrients: Amino acids (methionine, tryptophane, cystine, cysteine, and lysine) at 0.05 or 0.1%, algae extract at 0.1 or 0.2%, turmeric extract at 0.1 or 0.2%, boric acid at 0.05%, and gibberellic acid (GA3) at 20 ppm on vine vegetative growth characteristics, nutritional status, shot berries, yield, and quality of berries. All the nutrient treated vines showed enhanced growth aspects, nutritional status, yield, and berry quality compared with the untreated controls. The promotion of vegetative growth, vine nutritional status, and some chemical characteristics of berries were related to the application of some amino acids, algae extract, Turmeric extract, boric acid, and (GA3) in descending order. As for the yield, cluster aspects, berry weight, and dimensions, as well as reducing shot berries of clusters were related to the application of some amino acids, algae extract, Turmeric extract, GA3, and boric acid in descending order. Conclusively: Treatment of prime seedless grapevines three times at growth start, just after three growth starts later with some amino acids at 0.1% is the best treatment yield and gave high fruit quality.

Keywords: Prime seedless; amino acids; Algae extract

Introduction

Prime seedless is the earliest white seedless table grape cv successfully grown under Minia conditions. This grape variety has good eating quality, which increases its marketing opportunities in the local and foreign markets. However, small and shot berries remain an essential disadvantage of grapevine cv. (Weaver, 1976).

Recently, antioxidants such as amino acids showed promising results in improving the growth, yield, and berries quality in different grapevine cv. Besides their essential role as structural building units necessary for cellular growth, amino acids have antioxidant indispensable effects in plant defense against oxidative stress as imposed by unfavorable conditions. Previous research showed that applying amino acids as sprays enhanced protein biosynthesis and protected plant cells from aging and cell death. Scavenging free radicals or preventing their formation will protect the lipids, especially the plasma and other organelle membranes, maintaining their health and permeability and thus controlling the incidence of disorders (Orth et al., 1993).

Amino acids stimulate the biosynthesis of natural hormones such as ethylene, indole acetic acid (IAA), gibberellic acid (GA_3), and other Cytokinins. Besides, they are essential components in synthesizing and maintaining organic foods, enzymes, and nucleic acids. Together, these actions are expected to enhance vine health, productivity, and berry quality (Elade, 1992).

Algae extract biodegradability and organic nature makes it an essential nutritional source in sustainable agriculture (Cassan et al., 1992). The algae extract content of amino acids, vitamins, growth hormones (Cytokinins, IAA, and IBA), and trace elements, including Zinc (Zn), iron (Fe), manganese (Mn), copper (Cu), cobalt (Co), molybdenum (Mo), and nickel (Ni) benefit the growth and development of the grapevine (Metting et al., 1990; Abdel-Mawgoud et al., 2010). Indeed, foliar application of algae extract was reported to enhance the growth, fruit quality, and yield of fruit crops, including grapes (Adam, 1999, AbdEl-Ghany et al., 2001).

Previous reports showed that using plant extracts, especially turmeric, promoted the growth, yield, and quality of different fruit crops, which was explained by the abundance of antioxidant phenolic compounds, other organic compounds, and plant pigments (Osawa, 1994; Pons, 2003 and Hanafy et al., 2012).

Foliar application of boron, in the form of boric acid, proved to be an effective delivery method in plants, which increased its bioavailability in reproductive and vegetative tissues. However, because of the possible toxicity to plant cells and the narrow difference between beneficial and toxic levels, plants should be carefully treated with boron supplements (Peacock and Christenson, 2005).

The different functions of boron for fruit trees (According to Adriano & Adriano, 1986; Nijjar, 1985 and Mengel et al., 2001) are listed as follows:

Activating the formation of meristems.

Encouraging root development.

Preventing the abortion of embryos.

Translocation and absorption of sugars since sugars may be moved in the form of borate complexes.

Preventing the excessive accumulation of polyphenols.

Gibberellic acid (GA3) is known to increase the elongation of clusters of rachis and the yield of seedless grapes by increasing berry weight and dimensions. Using gibberellic acid just after berry setting or when averages of berries diameter ranged from 8 to 10mm of Crimson seedless cv. increased berry weight and dimensions compared to the check treatment (Dokoozlian, 2001).

This study was designed to investigate the effect of amino acids, algae extract, Turmeric extract, boric acid, and GA_3 on the growth, the state of vine nutrition,

productivity, and the physicochemical properties of the berries of prime seedless grapevines.

Materials and Methods

This study was conducted during the 2020 and 2021 seasons on fifty–four, uniform in vigour, 10-years-old prime seedless grapevines. The chosen vines are grown in a private vineyard located at Al-Maghraby company in west Abo Qurqas distinct, Minia Governorate, Egypt. The texture of the soil is sandy (Table 1). Soil analysis was carried out as previously outlined (Cottenie et al., 1982).

The selected vines are planted 3.0 x 2.0 meters apart. Spur pruning system using Gable supporting method was followed. In the last week of Dec., during the 2020 and 2021 seasons. Pruning was carried out, leaving 84 eyes based on leaving (18 fruiting spurs, each with four eyes plus six replacement spurs x two eyes).

The vines were irrigated via a deep irrigation system (EC= 950 ppm).

Table (1): Mechanical, physical, and chemical analysis of tested orchard soil

Constituent	Values	constituent	Values
Sand%	81.3	O.M.%	0.16
Silt%	11.2	CaCO3%	3.11
Clay%	7.5	Total N%	0.006
Texture grade	Sandy	Available P(ppm)	0.91
PH (1:2.5 extract)	7.97	Available K (ppm)	31.00
E.C. (1:2.5 extract(ppm)	1020		

The selected vines (54) received all the regular Horticultural practices that are commonly applied in the vineyard.

This study contained the following nine treatments:

T1–Control (untreated vines)
T2-Spraying Amino acids at 0.05%
T3–Spraying Amino acids at 0.1%
T4–Spraying Algae extract at 0.1%
T5–Spraying Algae extract at 0.2%
T6-spraying Turmeric extract at 0.1%
T7-Spraying Turmeric extract at 0.2%
T8–Spraying Boric acid at 0.05%
T9-Spraying gibberellic acid (GA3) at 20 ppm.

Each treatment was replicated three times, two vines each. The four compounds, namely amino acids (methionine-tryptophane–cystine–cysteine, and lysine), algae extract, turmeric extract, and boric acid (17%B), were sprayed three times; the first spray at growth start (last week of Feb.), Just after berry setting (first week of April) and at three weeks later (last week of April) and a single spray of gibberellic acid (GA3) at 20 ppm when averages diameter of the berries reached about 8-10 mm

Triton B as a wetting agent, was added to all solutions. A randomized complete block design (RCBD) was adopted. This experiment included nine treatments, and each treatment was replicated three times, two vines each.

*During both seasons, the following measurements were conducted:

1–Vegetative growth aspects, namely (main shoot length (cm); leaf area (cm^2) (Ahmed and Morsy, 1999); wood ripening coefficient (Bouard, 1966); Pruning wood weight (kg) per vine, and cane thickness (mm).

2–Chlorophyll A and chlorophyll B (as mg/g.F.W.) after extraction by Acetone (Hiscox and Isralstam, 1979).

3–Percentage of N, P, and K in the petioles of leaves located opposite to the basal clusters on a dry weight basis (Cottenie et al., 1982 and Balo et al., 1988).

4-Yield expressed in weight (Kg) and the number of cluster/vine as well as cluster weight (g). and cluster dimensions (length and width in (cm).

5–The percentage of shot berries was counted for each cluster and then divided by the total number of berries/clusters, and the product was multiplied by 100 to calculate the percentage of shot berries.

6–Physical and chemical characteristics of the berries, namely berry weight (g) and dimensions (longitudinal and equatorial in

(cm.), TSS% (by a hand refractometer), Reducing sugars% and total acidity % (as g. tartaric acid / 100 ml juice) (A.O.A.C., 2000).

Statistical analysis was manually done, and the treatment means were compared using new L.S.D. at 5% according to the method described by (Mead et al., 1993)

Results

1-Vegetative growth characteristics

Variations of the nutrient applications in the current study significantly changed the growth characteristics of vines, such as shoot length, leaf area, wood ripening coefficient, cane thickness and pruning wood weight (Table 2). Spraying the four nutrients namely amino acids at 0.05, 0.1%; algae extract at 0.1, 0.2% Turmeric extract at 0.1, 0.2%, and boric acid at 0.05% significantly increased these vegetative growth characteristics in prime seedless grapevines compared with the untreated vines and the single spray treatment with GA_3 at 20 ppm.

In order of effectiveness in enhancing the five growth vegetative aspects, the application of amino acids showed the best results, followed, in descending order, by algae extract, Turmeric extract, boric acid, and GA_3. The vines sprayed three times with amino acids at 0.1% during 2020, and 2021 registered the highest values of main shoot length (124.0, 125.0 cm), leaf area (114.2, 115.0 cm^2), wood ripening coefficient (0.96, 0.97), pruning wood weight (2.10, 2.15 kg.), and cane thickness (1.33, 1.35 cm.) in both seasons, respectively. In comparison with other nutrient treatments, using GA_3 once at 20 ppm produced minor changes. On the other hand, the untreated control vines produced the minimum values. These results were three during both seasons.

2–Leaf chemical composition

It is evident from the obtained data in Table (3) that treating prime seedless grapevines three times with any one of the five nutrients (amino acids at 0.05, 0.1%, algae extract at 0.1, 0.2%, turmeric extract at 0.1, 0.2%, boric acid at 0.5% and GA_3 at 20 ppm) was significantly stimulated chlorophyll A, chlorophyll B, N, P and K relative to the check treatment significant difference on each leaf chemical composition were observed among all nutrients. Increasing two concentrations of each nutrient had no significant effect on each leaf chemical constituent. The chemical components' highest values were observed on the vines that received GA_3 at 20 ppm, boric acid at 0.05%, turmeric extract at 0.1, 0.2%, algae extract at 0.1, 0.2%, and amino acids at 0.05, 0.1% in ascending order.

The vines that received amino acids at 0.1% displayed the highest values of chlorophyll a (4.7, 4.8 mg/g F.W), chlorophyll b (2.3, 2.4 mg/g F.W), total leaf nitrogen (N) (1.94, 1.98%), Phosphorus (P) (0.35, 0.36%), and potassium (K) (1.28, 1.29%) in both seasons, respectively. As with the vegetative growth characteristics, the untreated control vines showed the lowest leaf chemical composition values. These results were reproduced in both seasons.

3-Yield and cluster aspects

Treating prime seedless vines with any of the five nutrients, namely: Amino acids at 0.05, 0.1%, algae extract at 0.1, 0.2%, turmeric extract at 0.1, 0.2%, GA_3 at 20 ppm, and boric acid at 0.05% significantly improved the yield, number of clusters/vines, and weight and dimensions of the cluster compared with the untreated vines (Table 4). Significant differences in each parameter were observed among all nutrients.

In this respect, the best nutrients are amino acids, algae extract, turmeric extract, GA_3, and boric acid in descending order. The maximum number of clusters/ vine (30.0, 37.0 cluster), yield / vine (13.05, 16.28 kg); cluster weight (435.5, 440.0g), cluster length (27.8, 28.0 cm) and cluster width (16.8, 17.0 cm) were observed after spraying the vines three times with 0.1% Amino acids during the

2020 and 2021 seasons, respectively. The untreated vines produced the lowest values of number of clusters/vine (29.0, 30.0 clusters), yield/vine (11.2, 11.55 kg), cluster weight (380.0, 385.0 g), cluster length (21.5, 22.0 cm) and cluster width (11.5, 12.0 cm) in the first and second seasons, respectively. Compared with the untreated vines, amino acids at 0.1% increased the yield by 18.1 and 40.9% during the 2020 and 2021 seasons, respectively. Interestingly, none of the five investigated nutrient treatments changed the number of clusters per vine in the first season.

4-Percentage of shot berries

Subjecting prime seedless grapevines to a three-time spray treatment with any of five nutrients, namely amino acids at 0.05, 0.1%, algae extract at 0.1, 0.2%, turmeric extract at 0.1, 0.2%, GA_3 at 20 ppm and boric acid at 0.05% significantly reduced the percentage of shot berries in the clusters compared to control (Table 4).

The best nutrients in the reduction shot berries were boric acid, GA_3, turmeric extract, algae extract and amino acids in ascending order. The minimum values, hence, the best results, of shot berries (4.3, 4.0%) were obtained when the vines received the 0.1% Amino acids regimen, while the highest shot berries, 9.5 and 9.2%, in both seasons, respectively, were produced by the untreated vines. These results were similar in both seasons.

5–Physical and chemical characteristics of the berries

The data in Table 5 show that amino acids at 0.05 or 0.1%, algae extract at 0.1 or 0.2%, Turmeric extract at 0.1 or 0.2%, boric acid at 0.05%, and GA_3 at 20 ppm significantly promoted the quality of the berries in comparison with untreated vines. These treatments increased both the berry weight and dimensions (longitudinal and equatorial), TSS%, reducing sugars %, while decreasing percentage of total acidity. The increase was significantly associated with using GA_3 at 20 ppm, boric acid at 0.05%, Turmeric extract, algae extract, and amino acids in ascending order.

Treating prime seedless grapevines thrice with 0.1% Amino acids gave the best physical and chemical characteristics of the berries. On the contrary, the nutrients applications in the control vines had unfavorable effects on the quality of berries. Similar results were attained during both seasons.

Discussion

Some amino acids and algae extract have potential antioxidant properties that strengthen plant cellular defense against reactive oxygen species-related pathological changes that prevail under unfavorable conditions. The roles of amino acids are well-established in enhancing protein biosynthesis, protection against senescence, scavenging free radicals, and abrogating oxidative changes of lipids and plasma membrane components, which altogether help the plant in fighting pathological conditions (**Orth *et al.*, 1993**). This study showed that treating the vines with amino acid sprays enhanced the vegetative growth characteristics and yield and improved the quality of berries.

Amino acids and algae extracts stimulate the natural production of hormones and growth-promoting elements such as IAA, GA_3, Cytokinins, and ethylene. These growth factors are essential for maintaining plant cell division and biosynthesis of organic macromolecules, enzymes, DNA, and RNA. Thus, treating the vines and other fruit trees with amino acids and algae extract induces overall health- and yield-promoting effects. The results obtained in the current study are supported by the previous findings by **Amin, 2007; El-Samman, 2010; Ahmed et al., 2010; Ibrahiem–Asmaa, 2011; Madian and Refaai, 2011; Gad El-Kareem and Abd El-Rahman, 2013, Abada and Ahmed–Basma, 2015; Khalaf, 2017 and Amin–Sarah, 2020.**

Using plant extracts, especially turmeric extract, had a beneficial effect on the growth and fruiting of different fruit crops, which is attributed to its high content of plant pigment, antioxidant phenolic compounds, and other organic compounds (**Osawa, 1994; Bruneton, 2001; Pons, 2003 and Hanafy et al., 2012).** Applying turmeric extract in this study produced positive effects on the vine's health, yield, and product quality, which agrees with previous reports (**Rizkalla, 2016; Ahmed et al., 2016; Ebraheim, 2017; Ibraheim, 2021; and El-Senosey, 2022).**

The beneficial effects of boric acid on stimulating growth, chlorophylls nutrients, yield, and quality of berries in grapevines cv prime seedless might be attributed to its impact on according to **Nijjar, 1985, Fraguas and Silvo, 1998).** The current results are in line with the findings of **Abd El-Gaber-Nermean, 2009; Abd El–Wahab, 2010; El–Kady–Hanaa, 2011; Ibrahiem-Asmaa and Radwan, 2019 and Mohamed and Qaoud, 2019.**

The beneficial effects of GA_3 on the berry quality parameters (weight and dimensions) observed here in this study gain support from previous studies (**William and Ayars 2005, Dimovska et al., 2014; Abada et al., 2015 and Ahmed et al., 2016).** GA_3 promotes cell division, cell growth and enlargement, uptake of water, and biosynthetic processes (**Nickell, 1985)**.

Conclusions

Treating prime seedless grapevines under Minia region conditions three times at growth start, just after berry set, and three weeks later with a 0.1% spray of some amino acids (methionine, tryptophane, cystine, cysteine, and lysine) produced the best yield and berry quality.

Conflicts of Interest/ Competing interest

All authors declare that they have no conflicts of interest.

Data availability statement

All data sets collected and analyzed during the current study are available from the corresponding author on reasonable request.

Table (2): Effect of applications of Amino acids, Algae extract, turmeric extract, boric acid and (GA_3) on some vegetative growth characteristics of prime seedless grapevines during 2020 and 2021 seasons.

Characters / Treatments	Main shoot length (cm)		Leaf area $(cm)^{2.}$		Wood ripening coefficient.		Pruning wood weight (kg. vine).		Cane thickness (cm)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T_1 Control (untreated vines)	105.5	106.0	98.5	99.0	0.71	0.72	1.58	1.60	1.11	1.12
T_2 Amino acids at 0.05%	119.5	120.5	112.0	112.5	0.91	0.92	1.99	1.99	1.27	1.28
T_3 Amino acids at 0.1 %	124.0	125.0	114.0	115.0	0.96	0.97	2.10	2.15	1.33	1.35
T_4 Algae extract at 0.1 %	117.0	117.5	110.0	111.0	0.81	0.83	1.78	1.79	1.22	1.24
T_5 Algae extract at 0.2 %	119.0	119.5	112.5	113.0	0.85	0.87	1.81	1.82	1.27	1.28
T_6 Turmeric extract at 0.1 %	110.0	111.0	104.5	105.0	0.78	0.79	1.69	1.70	1.18	1.19
T_7 Turmeric extract at 0.2 %	114.0	115.0	106.8	107.5	0.81	0.82	1.71	1.73	1.22	1.23
T_8 Boric acid at 0.05 %	109.0	109.5	103.0	103.5	0.75	0.76	1.66	1.68	1.16	1.18
T_9 (GA_3) at 20 ppm	106.0	107.0	99.0	99.5	0.72	0.73	1.60	1.61	1.12	1.12
New L.S.D. at 5%	1.1	1.3	1.3	1.4	0.05	0.06	0.07	0.08	0.02	0.03

Table (3): Effect of applications of Amino acids, Algae extract, turmeric extract, boric acid and (GA_3) on the leaf content of pigments and different nutrient elements of prime seedless grapevines during 2020 and 2021 seasons.

Characters / Treatments	Chlorophyll a (mg/ g F.W.)		Chlorophyll b (mg/ g F.W.)		Leaf N %		Leaf P %		Leaf K %	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T_1 Control (untreated vines)	3.2	3.3	1.1	1.1	1.61	1.62	0.16	0.17	1.10	1.11
T_2 Amino acids at 0.05%	4.4	4.5	2.1	2.2	1.85	1.91	0.32	0.33	1.26	1.27
T_3 Amino acids at 0.1 %	4.7	4.8	2.3	2.4	1.94	1.98	0.35	0.36	1.28	1.29
T_4 Algae extract at 0.1 %	4.1	4.2	1.7	1.8	1.76	1.78	0.27	0.29	1.21	1.22
T_5 Algae extract at 0.2 %	4.3	4.4	1.9	2.1	1.81	1.83	0.31	0.32	1.23	1.24
T_6 Turmeric extract at 0.1 %	3.8	3.9	1.4	1.6	1.68	1.70	0.22	0.23	1.16	1.18
T_7 Turmeric extract at 0.2 %	4.0	4.1	1.6	1.7	1.71	1.73	0.26	0.27	1.19	1.20
T_8 Boric acid at 0.05 %	3.6	3.7	1.3	1.4	1.67	1.68	0.21	0.22	1.15	1.16
T_9 (GA_3) at 20 ppm	3.3	3.3	1.1	1.2	1.62	1.63	0.17	0.18	1.11	1.11
New L.S.D. at 5%	0.6	0.7	0.2	0.3	0.04	0.06	0.02	0.03	0.04	0.05

Table (4): Effect of applications of Amino acids, Algae extract, turmeric extract, boric acid and (GA_3) on yield expressed in weight (kg.) and number of clusters per vine as well as weight and dimensions of cluster (length and width) and shot berries % of prime seedless grapevines during 2020 and 2021 seasons.

Characters / Treatments	No. of clusters / vine.		Yield/ vine (kg)		Cluster weight (g)		Cluster length (cm)		Cluster width (cm)		Shot berries %.	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T_1 Control (untreated vines)	29.0	30.0	11.02	11.55	380.0	385.0	21.5	22.0	11.5	12.0	9.5	**9.2**
T_2 Amino acids at 0.05%	30.0	36.0	12.75	15.48	425.0	430.0	26.0	26.5	15.0	15.0	6.0	**5.8**
T_3 Amino acids at 0.1 %	30.0	37.0	13.05	16.28	435.0	440.0	27.8	28.0	16.8	17.0	4.3	**4.0**
T_4 Algae extract at 0.1 %	30.0	33.0	12.60	13.93	420.0	422.0	25.0	25.5	14.0	14.5	7.2	**7.0**
T_5 Algae extract at 0.2 %	30.0	34.0	12.66	14.45	422.0	425.0	26.2	26.5	14.8	15.0	6.8	**6.5**
T_6 Turmeric extract at 0.1 %	30.0	32.0	12.30	13.28	410.0	415.0	23.3	23.6	13.0	13.5	8.4	**8.0**
T_7 Turmeric extract at 0.2 %	30.0	33.0	12.45	13.70	415.0	420.0	24.2	24.8	13.8	14.0	7.8	**7.0**
T_8 Boric acid at 0.05 %	30.0	31.0	11.85	12.25	395.0	400.0	22.0	22.5	12.0	12.2	9.0	**8.8**
T_9 (GA_3) at 20 ppm	30.0	30.0	12.00	12.30	400.0	410.0	23.0	23.0	12.8	13.0	8.5	**8.0**
New L.S.D. at 5%	NS	1.8	0.8	1.22	11.2	11.6	0.8	0.9	0.6	0.7	0.8	0.9

Table (5): Effect of applications of Amino acids, Algae extract, turmeric extract, boric acid and (GA3) on some physical and chemical characteristics of the berries of prime seedless grapevines during 2020 and 2021 seasons.

Characters / Treatments	Berry weight (g.)		Berry longitudinal (cm.)		Berry equatorial; (cm.)		TSS%		Reducing sugars %		Total acidity %	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T1 Control (untreated vines)	3.70	3.75	2.10	2.10	1.70	1.72	2020	2021	2020	2021	0.695	0.695
T2 Amino acids at 0.05%	4.28	4.30	2.35	2.38	1.90	1.93	17.5	17.8	15.3	15.6	0.615	0.610
T3 Amino acids at 0.1 %	4.35	4.38	2.40	2.42	1.94	1.96	19.0	19.2	16.8	17.0	0.600	0.590
T4 Algae extract at 0.1 %	4.18	4.22	2.28	2.30	1.88	1.90	19.4	19.6	17.2	17.3	0.655	0.650
T5 Algae extract at 0.2 %	4.25	4.28	2.31	2.32	1.91	1.92	18.5	18.6	16.3	16.4	0.648	0.645
T6 Turmeric extract at 0.1 %	4.05	4.10	2.18	2.20	1.82	1.84	18.8	18.9	16.6	16.7	0.668	0.660
T7 Turmeric extract at 0.2 %	4.45	4.20	2.21	2.22	1.85	1.86	18.3	18.4	16.1	16.2	0.655	0.650
T8 Boric acid at 0.05 %	3.78	3.82	2.12	2.14	1.73	1.75	18.5	18.6	16.3	16.4	0.670	0.665
T9 (GA3) at 20 ppm	4.00	4.10	2.16	2.18	1.80	1.82	18.0	18.1	15.8	15.9	0.692	0.690
New L.S.D. at 5%	0.22	0.24	0.06	0.07	0.05	0.06	17.8	17.8	15.6	15.7	0.015	0.018

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