

(Original Article)



Effect of Foliar Application of Some Natural Compounds on Growth and Fruiting of Ruby Seedless Grapevines

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Abstract

This study was conducted to study the effects of various natural plant extracts, including 5% moringa, 2% fulvic acid, 2% chitosan, 5% turmeric extract, 5% aloe vera, and 2% seaweed extract, on several growth aspects, yield, and some physical and chemical characteristics of ruby seedless grapes at Assiut University. The study was conducted throughout two seasons, 2018 and 2019, grown in the experimental orchard of the Faculty of Agriculture. In this regard, turmeric extract, seaweed extract, and aloe vera were the best treatments, with several growth parameters being higher. For yield, the best treatments in this regard were chitosan, seaweed extract and fulvic acid. The results so far suggest that three applications of either 2% chitosan, 5% aloe vera, or 2% seaweed extract would be desirable.

Keywords: *Berry Quality, Plant extracts, Yield, Ruby seedless grapevines.*

Introduction

Grapevines are the first major fruit crop in the world. Grapes are now grown on all major continents of the world as fresh fruit and processed products. Grapes and their products are a valuable source of dietary fiber, sugar, potassium, and several vitamins, in addition to a wide array of phenolic compounds that are well known for their beneficial health components (Passingham, 2004). Grapes are considered the third position after citrus and mango crops because of its high net return. In Egypt, its cultivated area is estimated at 186,404 feddans (1 feddan = 4200m²) and fruiting area of 178,485 feddans produced 1,790,734 tons of fruits in 2022 (M.A.L.R. 2022). Egypt ranks 32nd in the world (FAO 2018). The province of Assiut, where this study was conducted, is a latecomer in the cultivation and production of grapes, with an area under vine reaching 2,163 feddans producing approximately 27,634 tons of fruit. The use of natural plant extracts as safe agents for human health and the environment is a new alternative that may help improve growth and fruiting. Plant extracts are characterized by their content of organosulfur compounds, volatile components, fatty proteins, tannins, vitamins, nutrients, and antioxidants (Peter, 1999).

Thus, these plant extracts are considered as a source of antioxidants and nutrients that provide plants with everything they need. Their antioxidant properties seem to prevent reactive oxygen species (Botelho *et al.*, 2007, Bhanu *et al.*, 2013).

Antioxidants play an important role in plant defense against oxidative stress, as well as in the biosynthesis of most organic products and in the activation of cell division processes. Antioxidants have an auxin effect, which has a synergistic effect on the growth and productivity of most fruit trees. Their practical use for fruit trees under field conditions is an advantage. They also protect cells from senescence, stimulate cell division, promote biosynthesis of organic products and prevent fungal lesions.

The use of antioxidants instead of auxins and chemicals also produces organic fruits and reduces environmental pollution (Raskin, 1992 and Elade, 1992). Seaweed extracts contain high amounts of nutrients, amino acids, some vitamins, hormones and antioxidants that increase tree resistance to most abiotic and biotic stresses (Irizar-Graza *et al.*, 2003; Planes-Leyva *et al.*; 2003 Spinelli *et al.*, 2009).

The aim of this study was to investigate the effects of moringa, Fulvic acid, chitosan, turmeric extract, aloe vera, and seaweed extracts on growth, yield and fruit quality of ruby seedless grape cultivars grown under climatic conditions of Upper Egypt.

Materials and Methods

The study was conducted on 26-year-old ruby seedless vines during two seasons in 2018 and 2019. Ruby seedless vines were grown in an experimental garden at the Faculty of Agriculture, Assiut University, Egypt. Vine spacing was 2.5 x 2.0 meters, with 850 vines in each plot. The soil is clay, well drained and has physical and chemical properties listed in Table (1) according to Wilde *et al.*, 1985.

Table 1. Physio-chemical properties of soils in the experimental gardens.

Soil property	Value	Soil property	Value
- Sand %	15.43	-Total N%	0.16
-Silty%	33.22	-DTPA extractable P(ppm)	21.61
- Clay %	51.35	-NH4 OAC extractable K ppm	401.33
-Texture	clay	-DTPA extractable Fe ppm	13.19
-CaCO3%	3.66	-DTPA extractable Mn ppm	15.16
-Organic matter%	1.32	-DTPA extractable Zn ppm	2.35
-PH (1:1 suspension)	8.1	-DTPA extractable Cu ppm	2.11
-EC (ds/m-1)	2.69		

The selected vines (28 vines) were of uniform vigor, healthy, in good physical condition, free from insect damage and disease, and are dedicated to this study. The selected vines were pruned during the last week of December in both seasons.

The experiment consisted of seven treatments, each with four vines, including the standard treatment (control).

The trees were prepared according to the head training system and pruned in the second week of January. Pruning was carried out leaving 60 buds on the vine (16 fruiting branches with 3 buds on each and 6 replacement branches with 2 buds). The selected vines followed the normal agricultural practices used in the vineyard except for the treatments tested. These practices included applications of ammonium (farm yard manure) (F.Y.M.) ammonium sulfate (20.6% N), calcium superphosphate (15.5%

P₂O₅). Ammonium sulfate (48.0% K₂O) and F.Y.M. (0.25% N) were added once during the first week of January, phosphorus-calcium fertilizer was added once with farmyard compost. Potassium and nitrogen fertilizers were added once each during the growing season.

The study includes the following seven treatments from several natural compounds.

T1-control

T2-Spraying Moringa extract at 5%

T3-Spraying Fulvic acid at 2%

T4-Spraying chitosan at 2%

T5-Turmeric extract at 5%

T6-Aloe Vera at 5%

T7- Seaweed extract at 2%

Natural compounds (plant extracts) were applied three times at the beginning of growth (last week of March), immediately after fruiting (first week of May), and one month later (first week of June). Triton B was added as a wetting agent at 0.1% to all plant extract solutions and applied until run off.

The following parameters were measured over two trial periods.

1- Vegetative growth parameters:

At the last week of July during both seasons, the leaf length (cm), leaf width (cm) and shoot length (cm) were recorded.

2-Yield components:

The yield of each vine was recorded in weight (kg). Total yield weight (kg/vine) and bunch weight (g).

3- Berry physical properties:

-Berry length (cm)

-Berry diameter (cm)

-100 berry weight (g)

4- Berry chemical characteristics:

-TSS%

-Percentage of total acidity. (A.O.A.C. 2000)

-The ratio of TSS to acid.

-Percentage of reducing sugars in the juice according to the method (Lane and Eynon, 1965).

-Volumetric method as described in A.O.A.C. (2000).

The experiment followed a randomized complete block design (RCBD) and each treatment included four replications. A combined analysis of the two seasons of the trial was performed. Tests for differences between the two seasons were also performed.

Differences between the mean values of each treatment were compared using Duncan's multiple interval criterion at 5% probability (Steel and Torrie, 1984).

Results

1- Some parameters of vegetative growth

The data presented in Table (2) shows the effects of various natural plant extracts on several growth characteristics of ruby seedless grapes.

Leaf size (width and length, cm)

The results Table (2) revealed that Aloe Vera and control exceeded all the treatment concerning leaf width (cm). The difference between Aloe Vera and control was not significant. Although moringa and chitosan extracts gave lower values than control, the differences were not significant. On the other hand, the 2nd season of study significantly surpassed the 1st one, leaf length (cm) as affected by various plant extracts treatments was found in table (2).

Table 2. Effect of natural plant extracts on leaf size (leaf width and length and shoot length of Ruby seedless grapevines during 2018 and 2019 seasons

Treatments	Leaf width (cm)			Leaf length (cm)			Shoot length (cm.)		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
T1- Control	11.20	11.43	11.32 ^{AB}	11.95	12.03	11.99 ^C	55.38	53.60	54.49 ^C
T2- Moringa 5%	10.25	11.63	10.94 ^{BC}	13.50	14.25	13.88 ^B	62.63	66.25	64.44 ^B
T3- Fulvic acid 2%	10.00	9.75	9.88 ^D	12.13	12.63	12.38 ^C	55.75	52.13	53.94 ^C
T4- Chitosan 2%	10.88	10.75	10.82 ^{BC}	14.00	13.63	13.82 ^B	60.00	64.75	62.38 ^B
T5- Turmeric extract 5%	10.33	11.00	10.67 ^C	13.83	14.13	13.98 ^B	75.25	76.38	75.82 ^A
T6- Aloe Vera 5%	11.63	12.00	11.82 ^A	15.63	16.38	16.01 ^A	68.13	75.00	71.57 ^A
T7- Seaweed 2%	10.33	10.88	10.61 ^C	13.93	14.25	14.09 ^B	70.15	74.25	72.20 ^A
Mean	10.66 ^b	11.06 ^a	10.86	13.57 ^b	13.90 ^a	13.73	63.90 ^a	66.05 ^a	64.98

Means with the same letters are not significantly different based on LSD of 5%.

All the treatments, with the exception of fulvic acid, significantly exceeded control. Aloe vera significantly exceeded all the treatments in this respect and it recorded 16.01 cm. Seaweed extract, moringa, turmeric extract, and chitosan recorded 14.09, 13.88, 13.98, and 13.82 respectively with no significant differences between them. The 2nd season of study also significantly got over the 1st one.

Shoot length (cm)

Data found in Table (2) represented the effect of various natural plant extract on shoot length of Ruby seedless grapevines during 2018 and 2019 seasons. Plant extract treatments significantly surpassed the control except for Fulvic acid which was the only treatment that has no significant effect. Turmeric extract, Seaweed extract, and Aloe vera recorded the highest values of shoot length. They significantly exceeded the remaining treatments. Shoot length associated with these treatments was

75.82, 72.20, and 71.57 cm, respectively. The difference between the two seasons of study was not significant in this respect.

2-Yield components

Yield per vine (kg)

The data presented in Table (3) show that the application of all natural plant extracts significantly outperformed the control. Chitosan and seaweed extracts were the best in this respect. They recorded 14.73 kg and 14.50 kg/vine, respectively, with no significant difference between them.

Fulvic acid and Aloe Vera also produced higher yield per vine (13.62 and 13.07 kg.) respectively with no significant differences between them.

The increment percentages associated with the previous prevalent treatment were 45.55, 43.28, 34.58, and 29.15% over the control, respectively. The presented data also revealed that the 2nd season of study was significantly higher than the 1st one.

Table 3. Effect of natural plant extracts on total yield per vine (kg), cluster weight (g) and cluster length and width (cm) of Ruby seedless grapevines during 2018 and 2019 seasons

Treatments	Total yield /vine (kg)			Cluster weight (g)			Cluster length (cm)			Cluster width (cm)		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
T ₁ - Control	8.96	11.28	10.12 ^E	367.39	373.60	370.50 ^E	21.85	22.65	22.25 ^E	20.18	22.78	21.48 ^C
T ₂ - Moringa 5%	10.72	11.99	11.36 ^D	439.16	400.02	419.59 ^D	26.25	25.50	25.88 ^{BC}	23.25	22.25	22.75 ^B
T ₃ - Fulvic acid 2%	12.08	15.15	13.62 ^B	483.35	505.52	494.44 ^A	22.18	27.13	24.66 ^{CD}	22.68	23.38	23.03 ^B
T ₄ - Chitosan 2%	12.85	16.61	14.73 ^A	476.08	487.30	481.69 ^{A^B}	26.75	28.50	27.63 ^A	26.25	24.00	25.13 ^A
T ₅ - Turmeric extract 5%	13.49	11.91	12.70 ^C	469.00	384.51	426.76 ^D	24.50	22.38	23.44 ^{DE}	22.33	17.13	19.73 ^D
T ₆ - Aloe Vera 5%	14.06	12.07	13.07 ^{BC}	468.94	402.25	435.60 ^{CD}	28.13	28.75	28.44 ^A	24.13	20.50	22.32 ^{BC}
T ₇ - Seaweed 2%	13.75	15.24	14.50 ^A	479.17	435.33	457.25 ^C	27.50	25.00	26.25 ^B	20.25	17.50	18.88 ^D
Mean	12.27 ^b	13.46 ^a	12.87	454.73 ^a	426.93 ^b	440.83	25.31 ^a	25.70 ^a	25.51	22.72 ^b	21.08 ^b	21.90

Means with the same letters are not significantly different based on LSD of 5%.

Cluster weight (g)

Table (3) showed that Fulvic acid, chitosan, and seaweed extracts gave the highest values of cluster weight. These treatments recorded 494.44, 481.69, and 457.25 g. with percentages of 33.45, 30.01, and 23.41% over the control, respectively. The 1st year of study was significantly higher than the 2nd one.

Cluster length and width (cm)

The given data Table (3) revealed that the natural plant extract treatments with exception of Turmeric extract significantly exceeded the control. The prevalent treatments on increasing the cluster length were Aloe Vera and chitosan. They recorded 28.44 and 27.63 cm. with no significant differences between them. Both treatments significantly surpassed the remaining treatments.

Table (3) shows that chitosan significantly exceeded all treatments. Such treatment recorded 25.13 cm cluster width. It was followed by Fulvic acid and

moringa extract which gave 23.03 and 22.75cm, respectively. The rest of treatments did not have significant effect on this trait.

3-Berry measurements

Berry length (cm.)

Data found in Table (4) showed the effects of different plant extracts spraying on berry length of Ruby seedless grapevines. The results demonstrated that Aloe Vera and seaweed extracts caused a significant increase of berry length (1.57 and 1.56 cm.) while the rest of treatments did not significantly differ from the control. The 1st year of study gave higher berry length compared with the 2nd seasons

Table 4. Effect of natural plant extracts on berry's size (length and diameter), (cm) and 100 berries weight (g) of Ruby seedless grapevines during 2018 and 2019 seasons

Treatments	Berry length (cm)			Berry diameter (cm)			100 berries weigh (g)		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
T ₁ - Control	1.50	1.44	1.47 ^B	1.25	1.29	1.27 ^C	221.25	202.00	211.63 ^D
T ₂ - Moringa 5%	1.61	1.30	1.46 ^B	1.35	1.26	1.31 ^{BC}	253.45	266.50	259.98 ^B
T ₃ - Fulvic acid 2%	1.61	1.42	1.52 ^{AB}	1.36	1.39	1.38 ^A	258.63	216.25	237.44 ^C
T ₄ - Chitosan 2%	1.60	1.39	1.50 ^{AB}	1.37	1.39	1.38 ^A	244.15	270.00	257.08 ^B
T ₅ - Turmeric extract 5%	1.52	1.50	1.51 ^{AB}	1.31	1.40	1.36 ^{AB}	255.25	233.25	244.25 ^{BC}
T ₆ - Aloe Vera 5%	1.62	1.51	1.57 ^A	1.35	1.32	1.34 ^{AB}	248.75	238.00	243.38 ^{BC}
T ₇ - Seaweed 2%	1.68	1.43	1.56 ^A	1.38	1.40	1.39 ^A	283.35	280.00	281.68 ^A
Mean	1.59 ^a	1.43 ^b	1.51	1.34	1.35	1.34	252.12 ^a	243.71 ^a	247.92

Means with the same letters are not significantly different based on LSD of 5%.

Berry width (cm.)

Most of the natural plant extracts significantly increased fruit diameter compared to the control (Table 4). Except for moringa, the plant extract treatments were significantly superior to the control. The highest values were observed for seaweed, fulvic acid, and chitosan at 1.39 cm, 1.39 cm and 1.38 cm, respectively. No significant differences were found between the two seasons of the study.

100 berries weight (g)

Table (4) Data suggested that all the plant extracts significantly exceeded the control. Seaweed extract is the prevalent treatment and significantly got over all the treatments. Moringa and chitosan also recorded a higher weight of 100 berries compared to the control. The weight of 100 berries for the abovementioned treatment were 281.68, 259.98, and 257.08(g), respectively.

The percentage increase of such treatments were 33.10, 22.84, and 21.48 % over the control, respectively.

On the other hand, the difference between the two seasons of study was not significant.

4-Chemical constituents

Acidity percentage

Table (5) shows the effect of some natural plant extract treatments on acidity % of Ruby seedless grapes. Only moringa and Fulvic acid recorded lower acidity % compared with the control while the rest of treatments showed no significant differences than the control. The differences between the two seasons of study were insignificant.

Total soluble solids percentage (TSS %), TSS/acid ratio, and Reducing sugars%

Table (5) shows that only moringa extract significantly outperformed the control while other natural plant extracts had no significant effect on TSS%, TSS/acid ratio, and amount of reducing sugars.

Table 5. Effect of natural plant extracts on some chemical characteristics of berries of Ruby seedless grapevines during 2018 and 2019 seasons

Treatments	TSS%			Acidity%			TSS / acid ratio			Reducing Sugars %		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
T ₁ - Control	20.75	18.13	19.44 ^A	0.37	0.39	0.38 ^{AB}	57.98	46.11	52.05 ^{BC}	18.75	17.00	17.88 ^A
T ₂ - Moringa 5%	21.50	17.13	19.32 ^A	0.30	0.26	0.28 ^C	72.74	66.53	69.64 ^A	19.88	16.00	17.94 ^A
T ₃ - Fulvic acid 2%	16.25	17.25	16.75 ^B	0.29	0.30	0.30 ^C	56.35	58.53	57.44 ^B	15.25	15.75	15.50 ^C
T ₄ - Chitosan 2%	19.00	17.75	18.38 ^A	0.41	0.42	0.42 ^A	48.07	43.61	45.84 ^C	17.50	16.25	16.88 ^B
T ₅ - Turmeric extract 5%	19.00	19.50	19.25 ^A	0.34	0.36	0.35 ^B	56.11	53.89	55.00 ^B	17.50	18.00	17.75 ^A
T ₆ - Aloe Vera 5%	20.75	18.00	19.38 ^A	0.41	0.33	0.37 ^{AB}	51.97	55.83	53.90 ^{BC}	19.38	16.50	17.94 ^A
T ₇ - Seaweed 2%	16.75	17.43	17.09 ^B	0.39	0.31	0.35 ^B	43.45	57.04	50.25 ^{BC}	15.75	16.13	15.94 ^C
Mean	19.14 ^a	17.88 ^b	18.51	0.36 ^a	0.34 ^a	0.35	55.24 ^a	54.51 ^a	54.87	17.72	16.52 ^b	17.12

Means with the same letters are not significantly different based on LSD of 5%.

Discussion

At recent years, fruit growers have been attempting to use alternatives of synthetic chemicals and fertilizers for improving grape cultivars. Accordingly, various natural plant extracts are extensively used in vineyards. Investigators agreed upon the effectiveness of natural plant extracts for enhancing growth, yield and berry quality of grapes. For instance, Bassiony and Ibrahim (2016), Akl *et al.*, (2017), Khan *et al.*, (2020), and Alsahy and Aljabary (2020) confirmed that Moringa extract had a considerable impact on yield and quality of grape cultivars. Iqbal (2014) noted that Moringa leaves are rich in natural cytokinins, minerals, phytohormones and in organic salts which lead to an increase in the yield of plants when applied exogenously.

Fulvic acid is similar to humic acid, as both are produced by microbial degradation of plant matter in a soil with sufficient oxygen. Fulvic acid application has positive effects on growth yield and quality of various grape cultivars (El-Boray *et al.* (2015); El-Kenawy (2017); Ahmed *et al.* (2017); Mostafa *et al.* (2017), and Li *et al.* (2021)).

Chitosan also has been used by investigators to simulate growth and fruiting of grapes (El-Kenawy, 2017 and Refaai and Silem, 2021). Chitosan supplies the plant

with essential nutrients that promote growth and productivity (Malerba and Cerana, 2018). It is also used to resist biotic and abiotic stresses of plants (Reddy *et al.*, 2000).

The effectiveness of turmeric extract on grapes has been demonstrated by many workers, Abdel –Al- and Abd El-Rahman (2013), Akl *et al.* (2017); Abdel-al *et al.* (2017), Refaai and Silem (2021), and El- Senosy *et al.* (2021) who found that turmeric extract improved vine growth, yield, and berry quality of grapes.

Aloe Vera leaves contain bioactive compounds such as antioxidants. Application of Aloe Vera was used on fruit trees to improve quality of grape (Pessenti *et al.*, 2022) or to extend the shelf life of grapes under storage (Farahi (2015) and Alberto *et al.* (2015)).

Finally, seaweed extracts are natural fertilizers containing various nutrients, vitamins, amino acids, and plant hormones. Seaweed extracts are used in grapevines for enhancing vine growth and yield of grape cultivars. Many investigators found that seaweed stimulated the vegetative growth and increased yield with better berry quality (Norrie and Keathley (2005); Kok *et al.* (2010); Ahmed *et al.* (2013); Carvalho *et al.* (2019); Salvi *et al.* (2019); Taskos *et al.* (2019), and Pesenti *et al.* (2022).

The above studies are in agreement with the results of the present study. Under the conditions of the present study, natural plant extracts had positive effects on growth, yield components, bunch size, berry size and weight, and reduced acidity and increased TSS/acid ratio.

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تأثير الرش الورقي ببعض المركبات الطبيعية على النمو والإثمار في العنب الروبي سيدليس

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الملخص

أجريت هذه الدراسة بمزرعة أبحاث كلية الزراعة، جامعة أسيوط خلال موسمي 2018، 2019 لدراسة تأثير رش بعض المستخلصات النباتية الطبيعية المختلفة وهي مستخلص المورينجا بتركيز 5% وحمض الفولفيك بتركيز 2% والشيتوزان بتركيز 2% ومستخلص الكركم بتركيز 5% ومستخلص الصبار بتركيز 5% مستخلص الطحالب بتركيز 2% على بعض صفات النمو الخضري وكمية المحصول وبعض الصفات الطبيعية والكيميائية لحبات العنب الروبي سيدليس

تفوقت معاملات المستخلصات النباتية معنوياً على الكونترول وأعطى مستخلص الكركم والطحالب والصبار أعلى القيم لبعض صفات النمو الخضري أما بخصوص كمية المحصول فكانت أفضل المعاملات هي الشيتوزان ومستخلص الطحالب وحمض الفولفيك. وبالنسبة لبعض الصفات الطبيعية للحبات فكانت أفضل المستخلصات هي مستخلص الطحالب والمورينجا والشيتوزان وبخصوص الصفات الكيميائية للحبات فكان لمستخلص المورينجا وحمض الفولفيك ومستخلص الشيتوزان أفضل النتائج في هذا الصدد.

وبالتالي فأتضح من نتائج التجربة فاعلية الرش ثلاث مرات خلال الموسم بأحدي المستخلصات النباتية التالية وهي الشيتوزان بتركيز 2% والصبار بتركيز 5% ومستخلص الطحالب بتركيز 2%

الكلمات الدالة: العنب الروبي سيدليس، المحصول، المستخلصات النباتية، جودة الحبات
