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(Original Article)

Effect of Spraying Seaweed Extract Applications on Vegetative Development Traits and Leaves Chemical Content of Thompson Seedless Grapevines

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Abstract

The present study was conducted on 20-years old Thompson seedless grapevines (*Vitis vinifera* L.), throughout two successive seasons of 2022 and 2023 seasons. The purpose of this study was to examine the effects of seaweed extract foliar sprays on the growing and yield of Thompson seedless grapevines in a private vineyard situated west of El-Wasta Center, Assiut Governorate, Egypt. The experiment included 4 treatments individual seaweed extract as foliar application in Randomized complete block design (RCBD) with three replicates as following: Control (sprayed with tap water), Seaweed extract (0.1%), Seaweed extract (0.2%) and Seaweed extract (0.4%).

The following characteristics were measured: vegetative aspects, i.e. h. Main shoot length, number of shoots leaves/plant, leaf area, lumber weight and cane thickness, chemical properties of Thompson seedless grapevine leaves (chlorophyll a, b, total chlorophyll, total carotenoid, leaves N, P, K, Zn, Fe and Mn) and yield.

The treatments showed that the highest concentrations of 0.2% and 0.4% seaweed extract increased vegetative growth parameters with no significant difference between them.

The highest values of the mentioned aspects were recorded for seaweed extract treatments (0.4%), followed by (0.2%) for eaclgah of them, with no significant differences between them during each two seasons. The lowest average vegetative traits served as controls.

The effect on yield of 'Thompson seedless' grapevine assessed by kg/vine and at different concentrations of foliar-applied seaweed extract compared to the control treatment.

Keywords: *Foliar application, vegetative aspects, Grapevine, Seaweed extract, Thompson seedless.*

Introduction

Botanically, the grape belongs to the genus Vitis in the family Vitaceae, which includes more than sixty genera. Most of them are used for ornamental purposes and only a few produces edible fruits. Berries from these grape strains. have higher nutritional value and could be consumed fresh as table grapes or dried for use as raisins,

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while the juice can be used in fresh pasteurized form or fermented to produce varieties of wine (Stove, 1971). Grapes are considered one of the most important fruits for local consumption and export.

They are popular in many temperate and tropical countries around the world and have been cultivated for 5000 to 7000 years (Passingham, 2004).

Climate, soil type and production technology are the main characteristics that allow the cultivation of table grapes throughout Egypt. According to Dhekny (2016), fresh grapes and grape products are full of healthy phenolic compounds, vitamins and fiber. In Egypt, the White Thompson seedless grape variety is highly prized for both fresh fruit and raisins. More grape varieties are grown worldwide than any other fruit crop, and grape production accounts for almost half of all fruit produced worldwide. Grapes are the world's most popular fruit plant and Egypt's second most important crop after citrus fruits. The number of vineyards is constantly increasing, especially in recently drained areas.

Several thousand grape varieties have been obtained from this species. Vitis vinifera is also a parent of many hybrid grapes in Eastern America, as breeders in this region wanted to incorporate some of the quality of Vitis vinifera into their grapes (Winkler *et al*., 1974 and Weaver, 1967).

According to the Ministry of Agriculture Statistics 2022 (Table 1), the total area dedicated for grapes attained 186404 feddans including 178485 feddans as fruitful vines producing about 1790734 tons with an average of 10.033 tons/feddans.

Foliar spray is simply an extra precaution to ensure plants receive an adequate amount of nutrients. Although foliar fertilization does not replace soil fertilization for crops with broad leaf surfaces, it can improve the efficiency and absorption of nutrients supplied to the soil (Kannan, 2010).

An essential type of biostimulants are the naturally occurring molecules, namely marine bioactive substances, obtained from seaweed (Shukla *et al*., 2019; Rouphael and Colla, 2020). The ability of these compounds to boost metabolism, increase antioxidant levels, and improve nutrient availability has positive effects on plant health, growth, and yield (Zhang *et al*., 2008). Seaweed (*Ascophyllum nodosum* L.) contains a variety of compounds such as cytokinins, auxins and other plant growth regulators (Khan *et al*., 2012). In addition, it contains many organic substances, sterols, vitamins, amino acids and complex polysaccharides.

Therefore, seaweed extract is crucial for plant metabolism, productivity and improving plant growth, fruiting and harvest. In recent years, it has emerged as a crucial strategy for sustainable agriculture, especially in semi-arid and arid areas where soils lack organic nutrients (Cataldo *et al*., 2022). Seaweed extract has been found to have an impact on the growth, yield and fruit quality of a number of grape varieties, including Ruby Seedless (Stino *et al*., 2017), Flame Seedless (Salvi *et al*., 2019) and Sangiovese (Masoud *et al*., 2023).

To increase yields in Thompson seedless vineyards, this study examined the effects of seaweed extract at different concentrations on vegetative development traits and yield in Thompson seedless grapevines grown under the conditions of Assiut Governorate. It also provided information for the development of an environmentally friendly fertilization program.

Table 1. Area, Yield and Production of Grapevines in Egypt, 2022

Governorates	Total			
	Production	Yield	Fruitful Area	Total Area
Behera	98169	10.614	9249	10868
Gharbia	105011	9.395	11177	11217
Dakahlia	73658	13.329	5526	6533
Sharkia	37145	9.897	3753	6858
Ismailia	14985	6.874	2180	2252
Lower Egypt	349246	10.113	34534	40555
Giza	31714	8.969	3536	3581
Beni Suef	44750	8.795	5088	5296
Menia	204136	9.845	20734	21087
Middle Egypt	287775	9.557	30113	30727
Assuit	27634	12.776	2163	2255
Luxor	3887	6.489	599	1001
Upper Egypt	40926	10.529	3887	4638
Inside the valley	677947	9.892	68534	75920
Outside the valley	1112787	10.121	109951	110484
Total	1790734	10.033	178485	186404

Area: Fedden, Yield: Ton / Fed., Production (Ton.) Source: Agriculture Directorates of Governorates. Publisher: Economic Affairs Sector.

Materials and Methods

1. Trial Grapevines and their cultivation circumstances

The present study was conducted on 20-years old Thompson seedless grapevines (*Vitis vinifera* L.), throughout two successive seasons of 2022 and 2023 seasons.

The purpose of this study was to investigate the effects of foliar sprays with seaweed extract on the growth and yield of Thompson seedless grapevines in a private vineyard west of the El Wasta zone in Assiut Governorate, Egypt. Twelve vines\4 treatments were almost identical in terms of vigor. Grapevines grew on clay soil and were cultivated at a distance of 3 m between rows and 2 m between vines (700 vines/fed) under a surface irrigation system with Nile water (water table depth > 1.5 m). In both seasons, winter pruning was done with typical heads in the second week of January, with each vine having 60 eyes.

Preliminary testing of the tested soil's physical and chemical characteristics according to Wilde *et al*., (1985) were indicated in Table (2).

Table 2. Chemical and physical analysis of vineyard soil

Soil characters		2021/2022
Particle size distribution (%)	Sand	2.21
	Silt	36.97
	Clay	60.82
	Texture class	Clay
EC ppm (1:2.5 extract)		300
pH (1:2.5 extract)		7.50
Organic matter %		2.19
$CaCO_3$ %		2.25
Soil nutrients	Total N (%)	0.11
	Available P (ppm)	5.29
	Available K (ppm)	495.9
	Zn (ppm)	2.93
	Fe (ppm)	3.32
	Mn (ppm)	4.11
	Cu (ppm)	0.93

2. Treatments and experimental design

The experiment included four individual or combined treatments of the seaweed extract as a foliar application in a Randomized Complete Block Design (RCBD) with three replicates as follows:

1-Control (sprayed with tap water).

2-Spraying seaweed extract (0.1%).

3-Spraying seaweed extract (0.2%).

4-Spraying seaweed extract (0.4%).

In the treatments, shoots of seedlings were sprayed with seaweed extract three times, the first time at the beginning of growth, the second time after berry setting, and the third time at an interval of one month.

The seaweed extract analysis presented in Table (3) is based on (James, 1994).

Table 3. Analysis of the seaweed extract

Characters	Value	Characters	Value
Moisture%	6.0	S%	3–9
O.M%	45–60	Mg%	0.5–0.9
Inorganic matter%	45–60	Cu (ppm)	1.0–6.0
Protein%	6–8	Fe (ppm)	50–200
Carbohydrates %	35–50	Mn (ppm)	5–12
Alginic acid%	10–20	Zn (ppm)	10–100
Mannitol%	4–7	B (ppm)	20–100
Total N%	1.0–1.5	Mo (ppm)	1–5
P%	0.02–0.09	Cytokinin %	0.02
K%	1.0–1.2	IAA %	0.03
Ca%	0.2–1.5	ABA %	0.01

3. Data collection

The effects of spraying seaweed extract at varying concentrations on yield and growth were assessed using the following metrics.

A-Vegetative development traits

1-Average main shoots length (cm).

2-Number of leaves/shoots.

3-Leaf area (cm^2): The following equation was used according to (Ahmed and Morsy, 1999) to measure twenty leaves from each vine that were in opposite to the basal clusters; Leaf area = 0.56 (0.79 x w2) + 20.01

Where, W = the maximum leaf width

4-Pruning wood weight/vine (kg).

5-Cane thickness (mm).

B-Leaves chemical content

1-The following pigments (chlorophyll a, b, total chlorophyll and total carotenoid mg/100 g FW) were quantified in leaves according to Von Wettstein (1957).

2-In accordance with Summer (1985) and Chapman and Pratt (1961), in the 1st week of July, the leaf petioles that correspond to the basal clusters were tested for the percentage of N, P, and K, as well as the level of Zn, Fe, and Mn (ppm).

C-Yield

During the two seasons under study, harvesting took place during the second week of July, which is the typical commercial harvest date Yield/vine (kg) was recorded.

Statistical analysis: Comparing between the treatments were set as mentioned by Mead *et al.,* (1993), using new LSD at 5%

Results

During the seasons of 2022 and 2023, the following data showed effect of individual application of seaweed extract at varying concentrations on the certain aspects of vegetative growth, chemical content of leaves and yield of Thompson seedless grapevines.

1. Certain aspects of vegetative growth

Effect of seaweed extract sprays on Thompson seedless grapevines vegetative aspects i.e., main shoot length, number of leaves/plants, leaf area, pruning wood weight and cane thickness during 2022 and 2023 seasons are presented in Table (4 and 5).

Table 4. Effect of spraying seaweed extract on main shoot length, number of leaves/plant and leaf area of Thompson seedless grapevines during 2022 and 2023 seasons.

Characteristics / Treatments	Average main shoots length (cm)			Number of leaves/shoot			Leaf area (cm^2)		
	2022	2023	Mean	2022	2023	Mean	2022	2023	Mean
Control	94.3	95.1	94.70	19.5	19.7	19.60	170.6	171.1	170.85
Seaweed extract (0.1%)	97.2	98	97.60	22	22.5	22.25	174.5	174.3	174.40
Seaweed extract (0.2%)	98.8	99.6	99.20	23.1	23.8	23.45	175.9	175.8	175.85
Seaweed extract (0.4%)	99.9	100.8	100.35	24.1	24.9	24.50	176.7	177.1	176.90
New LSD at 5%	**1.4**	**1.5**		**1.1**	**1.2**		**1.3**	**1.4**	

Table 5. Effect of spraying seaweed extract on pruning wood weight and cane thickness of Thompson seedless grapevines during 2022 and 2023 seasons.

Characteristics / Treatments	Pruning wood weight (kg)/vine			Cane thickness (mm)		
	2022	**2023**	**Mean**	**2022**	**2023**	**Mean**
Control	1.72	1.79	1.76	0.91	0.96	0.94
Seaweed extract (0.1%)	1.87	1.95	1.91	1	1.05	1.03
Seaweed extract (0.2%)	1.94	2.04	1.99	1.05	1.1	1.08
Seaweed extract (0.4%)	1.99	2.09	2.04	1.07	1.12	1.10
New LSD at 5%	**0.06**	**0.07**		**0.03**	**0.04**	

Average main shoot length (cm)

The effect of seaweed extract sprays on main shoot length is shown in Table 4. The results in question showed that main shoot length increased significantly by foliar application of all treatments (0.1, 0.2 and 0.4% seaweed extract) compared to the control (spray with tap water) in both seasons.

The treatments showed that the highest concentration of 0.4% seaweed extract increased main shoot length with significant differences. The highest values of main shoot length (100.35 cm) were recorded for seaweed extract (0.4%) treatment, followed by (99.20 cm) for seaweed extract (0.2%) treatment, with none between both seasons recognizable differences were visible. The control had the shortest main shoot length of 94.70 cm in both seasons. During the two seasons, main shoot length (cm) values were in the middle range for the other treatments examined.

Number leaves/shoot

The data obtained in Table (4) clearly showed that seaweed extract in different concentrations (0.1, 0.2 and 0.4%) as a foliar application was significantly associated with the stimulation of the number of leaves/plants compared to the untreated vines. In all treatments, leaf number/plant increased significantly with an increase in concentration up to 0.4% for algae extract. The 0.4% concentration recorded the highest average leaf number values among all treatments, with no significant differences only in the first season between 0.2% and 0.4% seaweed extract as a foliar application. While all treatments increased the number of leaves compared to the control. During both experimental periods, there was no significant difference in the highest mean values reported for the 0.2% and 0.4% seaweed extract treatments, respectively. In terms of leaf count, the other treatments evaluated achieved average results across the two seasons. In the first season the average leaf number was 24.1 and in the second season it was 24.9, with an average of 24.5 leaves per plant.

Leaf area (cm^2)

Table (4) shows the effect of applying seaweed extract on leaf area. The results showed a significant increase in leaf area in all treatments examined compared to the control. Foliar application of (0.1, 0.2 and 0.4%) seaweed extract significantly increased leaf area. Increasing the concentration increased the leaf area with no significant difference between 0.2 and 0.4% for each seaweed extract during the two seasons. In the treatments, the algae extract significantly increased the leaf area compared to the control. The highest leaf area was associated with vine foliar application of 0.4%, followed by 0.2% seaweed extract in both seasons.

Pruning wood weight

The data presented in Table (5) concerns the effects of different concentrations of seaweed extract as a spray method on lumber weight in the 2022 and 2023 seasons. There was a significant impact on lumber weight through different treatments. With an increase in concentration from 0.1 to 0.4% for algae extract, the lumber weight was increased in both seasons. The highest application of 0.4% seaweed extract recorded the highest lumber weight, followed by 0.2% seaweed extract, with no significant difference recorded between them only in the first season. In both seasons, control vines achieved the lowest lumber weight and other treatments achieved intermediate values.

Cane thickness (mm)

The use of seaweed extract at different concentrations (0.1, 0.2, and 0.4%) compared to the control (sprinkling with tap water) significantly increased sugarcane thickness in both seasons, as shown in Table 5. Increasing concentration of seaweed extract reflected in increasing cane thickness comparing with the control.

The data showed that vines sprayed with (0.2 or 0.4%) seaweed extract increased cane thickness with no significant difference between these treatments in the 2022 and 2023 seasons, but the 0.4% seaweed extract treatment achieved the highest individual treatments for the cane thickness.

All researchers agreed that it is beneficial to use natural plant extracts to promote growth. Growth-promoting compounds may be readily available that could explain the enhanced growth, such as vitamin B complex (Cabrera *et al*., 2003) and natural hormones such as IAA, amino acids, cytokinin and GA3, which are present in seaweed extract (Blunden, 1991). In addition, the increased concentration of macro and micro elements of the seaweed extract may also be responsible for its ability to promote growth. A class of growth regulators known as polyamines, which are essential for promoting cell elongation and cell division, which in turn increases shoot length and leaf area, can, in addition to alginates, enzymes, polysaccharides and 1,3-1,6 via oligosaccharides called laminarin D-glucan is synthesized (Colavita *et al*., 2011). Studies found similar results performed on seedless Ruby vines by Ahmed (2022), Early Sweet vines by Mohamed *et al*. (2021), seedless Flame vines from El-Senosy (2022), and Thompson seedless vines from Al-Sagheer *et al*. (2023) were carried out and Prime seedless grapevines by Abada *et al*. (2023).

All these studies showed that vegetative growth parameters increased with increasing concentration of seaweed extract. The weight of lumber, leaf area and its nutritional status increased significantly by spraying yeast, algae and fish oil compared to unsprayed seedless ruby vines (Masoud and Abou-Zaid 2017).

2. Leaves chemical content

The results presented in Tables 3 to 5 represent the average values of the chemical properties of the leaves of Thomson seedless grapevines (chlorophyll a, b, total chlorophyll, total carotenoid, leaves N, P, K, Zn, Fe and Mn) as determined by Foliar spraying will be affected with different concentrations of algae extract during the 2022 and 2023 winter seasons.

Leaves chlorophyll content mg/g F.W

Table (6) shows the influence of seaweed extract on chlorophyll, A, B and total chlorophyll levels in the leaves of Thompson seedless grapevines at different concentrations.

The results clearly showed that treating Thompson seedless grapevines with seaweed extract at different concentrations significantly increased the chlorophyll content of the leaves compared to the untreated treatment. As the concentrations of the applications studied increased, gradual improvements in these parameters were noted. There was no noticeable improvement in chlorophyll content (a, b and total) when the seaweed extract content was increased from 0.2 to 0.4%. Instead of using algae extract, it was far better to apply 0.4% algae extract topically to increase chlorophyll concentration.

Table 6. Effect of spraying seaweed extract on chlorophyll a, b, total chlorophyll and total carotenoid of Thompson seedless grapevines during 2022 and 2023 seasons

Characteristics / Treatments	Chlorophyll a mg/100 g FW			Chlorophyll b mg/100 g FW			Total chlorophyll mg/100 g FW			Total carotenoid mg/100 g FW		
	2022	2023	Mean	2022	2023	Mean	2022	2023	Mean	2022	2023	Mean
Control	1.19	1.22	1.21	0.98	0.99	0.99	2.17	2.21	2.19	7.1	7.4	7.25
Seaweed extract (0.1%)	1.32	1.31	1.32	1.07	1.09	1.08	2.39	2.4	2.40	8.5	8.9	8.70
Seaweed extract (0.2%)	1.39	1.37	1.38	1.12	1.13	1.13	2.52	2.5	2.51	9.1	9.6	9.35
Seaweed extract (0.4%)	1.44	1.4	1.42	1.15	1.15	1.15	2.59	2.55	2.57	9.6	10.1	9.85
New LSD at 5%	**0.06**	**0.04**		**0.04**	**0.04**		**0.08**	**0.07**		**0.6**	**0.7**	

Grapevine treatments with 0.2% and 0.4% seaweed extract resulted in the highest mean chlorophyll content, while treatments with lower concentrations showed no noticeable differences. Applying a medium concentration of algae extract (0.2%) to the vines produced the most cost-effective results in terms of leaf chlorophyll content. Chlorophyll a (mg/100 g FW) reached 1.42 under the promised treatment, chlorophyll b (mg/100 g FW) reached 1.15 and total chlorophyll (mg/100 g FW) reached 2.57 in both seasons. During the two seasons, the leaves of the untreated vines reached 1.21 chlorophyll a (mg/100 g FW), 0.99 chlorophyll b (mg/100 g FW) and 2.19 total chlorophyll (mg/100 g FW).

Total carotenoid mg/100g FW

The results shown in the same Table 6 indicate that compared to the untreated treatment, the total carotenoid content of the leaves was significantly increased by seaweed extract. The connection between the increase and the increasing algae extract concentrations was obvious. Total carotenoids were highest in vines treated with 0.4% seaweed extract (9.85 mg/100g), followed by vines treated with 0.2% seaweed extract, values of 9.35 mg/100 g, but were not significantly different from the highest treatment.

The untreated vines had the lowest total carotenoid content (7.25 mg/100g). A similar pattern was observed in both seasons.

The increase in chlorophyll content resulting from higher concentrations of seaweed extract could be attributed to the decrease in chlorophyll degradation that resulted in higher chlorophyll levels and may have been caused in part by the betaines present in the seaweed extract (Whapham *et al*., 1993 and Blunden *et al*., 1997). Similarly, Salvi *et al*. (2019) plants given algae extract showed an increase in pigment levels through improved photosynthesis and stomatal conductance. In previous studies, spraying high concentration seaweed extract has been shown to provide the highest pigment levels. These results are consistent with those of Mohamed *et al*. (2021) agree on Early Sweet, El-Senosy (2022) on Flame seedless, Belal *et al*. (2023) on Early Sweet and Abada *et al*. (2023) on Prime Seedless.

Leaves content of nitrogen%

Table (7) shows the results of the treatments of the leaves of Thompson seedless vines for nitrogen content. In both the 2022 and 2023 seasons, leaf nitrogen content showed a significant ($P \leq 0.05$) increase in treatments compared to the untreated vine. However, there was no noticeable difference at ($P \leq 0.05$) between foliar application of seaweed extract at concentrations of 0.2 and 0.4% in both seasons. The nitrogen content was higher after the topical application of 0.4% seaweed extract than in the other treatments. The results showed that vines supplemented with different concentrations of seaweed extract had increased levels of nitrogen. The highest nitrogen content was achieved with a seaweed extract of 0.4%, followed by the lower concentrations thereof, which were not significantly different ($P \leq 0.05$). The results for the other treatments were average in both seasons.

Table 7. Effect of spraying seaweed extract on leaf N, P and K% of Thompson seedless grapevines during 2022 and 2023 seasons

Characteristics / Treatments	Leaf N%			Leaf P%			Leaf K%		
	2022	**2023**	**Mean**	**2022**	**2023**	**Mean**	**2022**	**2023**	**Mean**
Control	1.7	1.71	1.71	0.2	0.21	0.21	1.15	1.18	1.17
Seaweed extract (0.1%)	1.86	1.88	1.87	0.28	0.29	0.29	1.28	1.27	1.28
Seaweed extract (0.2%)	1.94	1.95	1.95	0.32	0.34	0.33	1.31	1.32	1.32
Seaweed extract (0.4%)	1.99	2.01	2.00	0.33	0.37	0.35	1.34	1.35	1.35
New LSD at 5%	**0.06**	**0.07**		**0.03**	**0.04**		**0.04**	**0.04**	

Leaves content of phosphorus %

The results presented in Table (7) showed the effect of foliar application of seaweed extract treatments on the phosphorus content in seedless leaves of Thompson seedless grapevine. The results showed that all applications significantly increased phosphorus content compared to the untreated vines (tap water spraying) in the 2022 and 2023 seasons ($P \leq 0.05$), while for algae there were no significant differences between foliar application of treatments of 0, 2 and 0.4% extract were found in both seasons. In addition, the leaf addition of 0.4% algae extract achieved the best results in increasing the phosphorus content compared to the 0.2% algae extract. As the concentration of the algae extract combinations increased, the phosphorus content also increased. Despite a content of 0.2%, algae extract achieved the highest average value of phosphorus content in the 2022 and 2023 seasons. The other treatments recorded intermediate values of the trait in both seasons.

Leaves content of potassium%

The results presented in Table (7) explained that the potassium content of the Thompson seedless grape vine leaves increased significantly ($P \leq 0.05$) when seaweed extract was applied to the leaves compared to the untreated vines sprayed with tap water. During both seasons, a gradual increase in potassium was observed with increasing amounts of seaweed extract. The concentrations of 0.2 and 0.4% for seaweed extract had no significant difference. Nevertheless, the foliar application with 0.4% seaweed extract achieved the highest average values of K% compared to the other treatments. The other treatments recorded medium values in the 2022 and 2023 seasons.

Leaves content of Zinc (ppm)

From the data in Table 8, grapevine sprayed with 0.1, 0.2, and 0.4% seaweed extract had a pronounced, definite effect on the mean values of zinc per ppm in leaves. Significantly increased zinc content was found in the foliar applications compared to the control, but there were no significant differences at 0.2 and 0.4% for seaweed extract in either season. The lowest mean values were reported for the untreated plants in both seasons.

Table 8. Effect of spraying seaweed extract on leaf Zn, Fe and Mn ppm of Thompson seedless grapevines during 2022 and 2023 seasons

Characteristics / Treatments	Leaf Zn ppm			Leaf Fe ppm			Leaf Mn ppm			Yield/vine (kg)		
	2022	2023	Mean	2022	2023	Mean	2022	2023	Mean	2022	2023	Mean
Control	57.2	59.1	58.15	60.3	60.7	60.50	57.6	56.8	57.20	8.4	8.9	8.65
Seaweed extract (0.1%)	60.7	63.1	61.90	65.1	65.2	65.15	62.7	61.6	62.15	9.3	10.6	9.95
Seaweed extract (0.2%)	63.2	65.3	64.25	66.9	67.2	67.05	64.9	63.8	64.35	9.4	11.1	10.25
Seaweed extract (0.4%)	64.3	66.2	65.25	68.5	68.9	68.70	66.9	65.7	66.30	9.7	11.3	10.50
New LSD at 5%	**1.5**	**1.4**		**1.7**	**1.9**		**2.1**	**2.2**		**0.4**	**0.7**	

Leaves content of iron (ppm)

The data obtained in Table (8) clearly showed that seaweed extract at different concentrations (0.1, 0.2 and 0.4%) for each leaf type significantly stimulated iron content compared to the untreated vines (sprayed with tap water). which led leaves. As the proportion of seaweed extract increased up to 0.4%, foliar iron content was significantly increased in all different treatments, with the 0.4% concentration having the highest average values of foliar iron content for all treatments, with no significant differences between foliar applications of 0.2 and 0.4% for algae extract. While the combination between treatments increased leaf iron content compared to other treatments and control. In both seasons, the other experimental treatments resulted in intermediate leaf iron levels.

Leaves content of manganese (ppm)

From the data in Table 8, it was shown that the vines sprayed with seaweed extract at a concentration of 0.1, 0.2 and 0.4% had a significant effect on the manganese content in ppm in the leaves of Thompson seedless vines. At the same time, the manganese content increased from 0.1 to 0.4% as the concentration of foliar applications increased during the growth stages. At the different concentrations of the algae extract, a high manganese content was achieved in the best treatment from 0.4% in descending order to 0.2% and then 0.1% compared to the untreated plants, with no significant difference between both applications the concentration of 0.2 and 0.4. Both seasons showed the same pattern.

Plant hormones contained in seaweed extract can promote root development and improve nutrient absorption, thereby increasing the overall vigor and growth of the plant. Several studies have shown the special growth-stimulating properties of seaweed extract, which, in addition to influencing the structure of plant roots, can also alter the biological, chemical and physical properties of the soil (Taskos *et al*., 2019). Furthermore, the ability of seaweed extract to improve nutritional status can be explained by the fact that it contains both macro and micronutrients (Cabrera *et al*., 2003). Our results are consistent with those of Mohamed *et al*. (2021) match early sweet grapevine leaves; El-Senosy (2022) on flames, seedless vine leaves; Belal *et al*. (2023) on early sweet vine leaves; and Abada *et al.* (2023) on premium seedless grapevine leaves. They all found that an increase in seaweed extract concentration was associated with an increase in N, P and K% as well as Fe, Zn and Mn ppm in grapevine leaves.

Yield/vine (kg)

The effects of different applied treatments on the yield per vine (kg) of 'Thompson seedless' grapevines are shown in Table (8). The results showed that in the 2022 and 2023 seasons, compared to the untreated treatment, each treatment significantly increased the yield per vine ($P \leq 0.05$). However, no significant differences were found between foliar application of seaweed extract treatments at 0.2 and 0.4% during the two seasons. Foliar application of algae extract at 0.1, 0.2 and 0.4% also increased yield per vine. The result showed that the increase was (10.50 kg) for 0.4 algae extract followed by (10.25 kg) for 0.2% algae extract with no significant difference compared with control treatment (8.6 5 kg) in succession the 2022 and 2023 seasons.

Results in larger clusters and weights may be due to the effects of seaweed extract on cell division, endogenous levels of growth promoters, macro- and micronutrients, carbohydrates and hormones, particularly cytokinins (Khan *et al*., 2012). Additionally, it may have increased the fruit's natural maximum polyamine concentration. Our results are consistent with those of previous field trials that showed an increase in yield and its components with algae extract. Abo-Zaid *et al*. (2019) found that spraying algae four times was more effective than the control group.

The recommendations were as follows: once in April at the beginning of growth after flowering, once in mid-April shortly after the berries set, once in mid-May a month later and once at the end of May two weeks later.

This would improve grape characteristics and increase fruit production. Increasing the concentration of seaweed extract from 0.05 to 0.2% improved yield (cluster number, yield/vine, cluster weight, length and width) as reported by Omar *et al*. (2020) reported on Flame Seedless, Mohamed *et al*., (2021) on Early Sweet, El-Senosy (2022) on Flame Seedless and Al-Sagheer *et al*. (2023) on

Thompson seedless and other studies show the high average values of berry physical properties caused by the increase in chitosan.

These studies all showed that vines treated with higher amounts of algae resulted in an increase in physical berry parameters such as berry weight, length, diameter and shape index. For ruby red seedless vines, yeast spraying combined with algae and fish oil resulted in the highest cluster number, heaviest clusters, and highest yield per vine compared to the other spray treatments and the unsprayed treatments (Masoud and Abou-Zaid (2017).

Conclusion

Foliar treatment of 0.4 % seaweed extract yielded the greatest mean values across the board, with no discernible variation at lower concentrations. From an economic perspective, treating the vines with a medium quantity of (0.2%) seaweed extract yielded the greatest outcomes and increased quantitative production of "Thompson Seedless" grapevines. Therefore, according to the research, a medium concentration of 0.2 % is best used under the same conditions.

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تأثير رش مستخلص الأعشاب البحرية على صفات النمو الخضري ومحتوى الأوراق الكيميائي في كروم العنب طومسون سيدلس

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الملخص

أجريت هذه الدراسة على كروم العنب طومسون سيدلس عمرها 20 عامًا، على مدار موسمين متتاليين 2022، 2023. وكان الغرض من هذه الدراسة هو دراسة تأثير الرش الورقي لمستخلص الأعشاب البحرية على نمو وإنتاجية كروم العنب طومسون عديمة البذور في مزرعة عنب خاصة تقع غرب مركز الواسطى، محافظة أسيوط، مصر.

تضمنت هذه التجربة 4 معاملات فردية من مستخلص الأعشاب البحرية كرش ورقي بتصميم القطع كاملة العشوائية (RCBD) بثلاث مكررات على النحو التالي: معاملة الكنترول (رش بماء الصنبور)، مستخلص الأعشاب البحرية (0.1%)، مستخلص الأعشاب البحرية (0.2%) ومستخلص الأعشاب البحرية (0.4%).

لتقييم تأثير تركيزات مختلفة من الرش بمستخلص الأعشاب البحرية على النمو وكمية المحصول وتم قياس الخصائص التالية: الصفات الخضرية وشملت طول الفرع الرئيسي، عدد الأوراق / كرمة، مساحة الورقة، وزن خشب التقليم وسمك القصبات، الخصائص الكيميائية للأوراق في كروم العنب طومسون سيدلس (الكلوروفيل أ، ب، الكلوروفيل الكلي، الكاروتينات الكلية ومحتوى الأوراق من الحديد والزنك والمنجنيز والفوسفور والبوتاسيوم والنيتروجين ثم كمية المحصول للكروم محل الدراسة.

أظهرت المعاملات أن أعلى تركيزات من مستخلص الأعشاب البحرية (0.2%، 0.4%) زاد من معدلات النمو الخضري دون وجود فرق كبير بينهما وكان أقل متوسط للصفات الخضرية لمعاملة الكنترول.

مع زيادة تركيز مستخلص الأعشاب البحرية زاد المحصول، وسجلت أعلى القيم مع الكروم التي تم رشها بمستخلص الأعشاب البحرية بنسبة 0.4٪. وكان نفس الاتجاه صحيحًا في الموسم الثاني.

الكلمات المفتاحية: *الرش الورقي، الصفات الخضرية، العنب، طومسون عديم البذور، مستخلص الأعشاب البحرية.*