The Future of Horticulture

Article

Increasing Yield of "Banaty" Grapevine by Foliar Application with Potassium Silicate and Seaweed Extract at Different Concentration

Ali, H. A.[1,*]; Uwakiem M. Kh.[2] and Moatamed, O. M.[1]

[1]Hort. Dept. Fac. of Agric. Minia Univ. Egypt

[2]Viticulture Department, Horticulture Research Institute, Agricultural Research Centre, Cairo, Egypt.

[*]**Corresponding author:** ali.sayed1@mu.edu.eg

Future Science Association

Available online free at www.futurejournals.org

Print ISSN: 2692-5826

Online ISSN: 2692-5834

DOI: 10.37229/fsa.fjh.2024.05.20

Received: 20 March 2024
Accepted: 30 April 2024
Published: 20 May 2024

Abstract: The current study was carried out in a private vineyard located west of Abu Qirqas Center, Minia Governorate, Egypt during the two consecutive seasons in 2021 and 2022 with on 30 vines from Banaty Seedless grapevines (10-years old), to investigate the impact of the foliar application with K-silicate and/or seaweed extract on production, and quality of Banaty grapevines, the trial was arranged in Randomized complete block design included 10 treatments individual or combined of the potassium silicate and seaweed extract as foliar application with three replicates as following; control (sprayed with tap water), (0.05, 0.1 % 0.2% for each of K-silicate or seaweed extract and the same concentrations for each application combined together. The results indicated that all yield, cluster and berry quality were increased with increasing studied concentration, except the average of shot berry% and total acidity were decreased. The highest mean values scored with foliar application at -silicate (0.2%) + seaweed extract (0.2%) without significant difference with the lower concentration, which recorded the lowest values of shot berry% and total acidity. So, it could be suggested to use lower concentration 0.1% for each of the applications under the same conditions.

Key words: Banaty grapevines, Potassium silicate, Seaweed extract, Yield, Quality

1. Introduction

Grapes (*Vitis vinifera* L.) rank high among the world's most coveted, delicious, and advantageous fruit crops (**Mohsen, 2021**). Grapes are the third most popular fruit in the world, with an annual production of 75.1 million metric tons (**FAO, 2020**). Among Egypt's fruit crops, it ranks fourth in terms of consumption rates and production area, after only olive (245142), mango (304118), and citrus (456082 fed). The grape acreage in Egypt has increased significantly over the last decade, reaching 1,904,486 fed. (80036 hectares) with a productive area of 1,74,715 fed. (73409 hectares), and yielding 1,60,000 metric tons (9.13 tons/feddan), according to **Kabsha *et al.* (2023)**. Behira governorate has over 40% of Egypt's total planted land for grapes and produces 18% of the country's total yield; the grape-growing region stretches from Alexandria in the north to Aswan in the south (**USDA, 2020**). The main features that enable table grapes to be grown all across Egypt include climate, soil type, and production technology. **Dhekny (2016**) states that phenolic chemicals, vitamins, and fiber are abundant in fresh grapes and grape products. Fresh fruit and raisins made from the White Banaty grape variety are very prized in Egypt.

Climate change has made viticulture more fragile than it has ever been. The climatic and geographical limitations on grapevine growing areas indicate high quality and optimal output (**Magalhães, 2008**). Because of the increased pests and illnesses brought on by milder winters, climate change will have a bigger impact on grapevine phenology, yield, and berry quality (**Jones, 2013 and Fraga *et al*., 2017**). A lot of work has gone into figuring out which horticultural practices are best for raising the production and berry quality of high-quality, popular, and long-lasting grapes intended for table use (**El-Mehrat *et al*., 2018)**. Therefore, any horticultural applications that could be used to improve these attributes—such as nutritional elements and biostimulants-would be essential.

Therefore, it can be beneficial to utilize and evaluate different fertilization procedures in order to supply the components required for vine growth and productivity while maintaining a healthy soil structure and a clean environment (**Doaa *et al*., 2019**). One of the main problems that farmers face is the outrageous cost of fertilizers. Not only has the over use of chemical fertilizers increased the salinity of the soil and contaminated subsurface water supplies, but it has also increased the price of mineral potassium fertilizer in Egypt. Because of this, researchers have focused on creating mineral fertilizer alternatives that are only somewhat harmful to the environment, people, and animals (**Belal *et al*., 2017; Abd El Rahman and AlSharnouby, 2021**). Foliar spraying is just an extra precaution to make sure plants get the right amount of nutrients, claim **Inglese *et al*. (2002**). For crops with broad leaf surfaces, foliar fertilization can enhance the efficiency and uptake of nutrients supplied to the soil, but it cannot replace soil fertilization (**Kannan, 2010).**

Biodynamics relies heavily on silicon, which is well-known in the viticulture sector for its ability to alter enzyme levels, thereby inducing stress resistance and altering grape quality traits (**Losada *et al.*, 2020**). A wide variety of secondary metabolites significantly impact the color, aroma, bitterness, and astringency of grapes. For the sake of the biological stability of grape juice, the concentration of hydrogen ions in the solution, represented as pH, is an important factor in evaluating grape quality. Furthermore, it influences the ionic shape of certain compounds, including anthocyanins (**Savoi *et al.*, 2020)**. One source of silicon and potassium that are very soluble is potassium silicate. In addition to serving as a silica supplement in agricultural production systems, it also provides trace levels of potassium. Adequate potassium feeding also improves fruit size, color, soluble solids, shelf life, ascorbic acid concentrations, tree yields, and shipping quality in many horticultural crops (**Kanai *et al.*, 2007**). Furthermore, it has been demonstrated that applying potassium silicate during the pre-harvest stage is an efficient way to manage diseases in a variety of fruit crops (**Singh *et al.*, 2020**).

Naturally occurring chemicals, specifically marine bioactive compounds derived from seaweeds, are an important class of biostimulants (**Shukla *et al*., 2019; Rouphael and Colla, 2020**). According to **Zhang *et al.* (2008**), these chemicals have a good effect on plant health, growth, and production by increasing antioxidant content, boosting metabolism, and improving nutrient availability. Among the many chemicals found in seaweed (*Ascophyllum nodosum* L.) are cytokinins and auxins, which are plant growth regulators (**Khan *et al*., 2012**). And it's packed with organic stuff, vitamins, amino acids, sterols, and complicated polysaccharides. As a result, improving plant metabolism, production, and development, fruiting, and harvest is dependent on seaweed extract. Sustainable agriculture has increasingly relied on this method in recent years, particularly in arid and semi-arid regions where organic nutrient-deficient soils are prevalent (**Cataldo *et al*., 2022**). Seaweed extract affected the growth, yield, and quality of fruit in Ruby Seedless, Flame Seedless, and Sangiovese grape types (**Stino *et al.,* 2017; Salvi *et al*.; 2019 and Masoud *et al.,* 2023**).

In order to enhance yields in Banaty vineyards, this study investigated the impacts of potassium silicate and/or seaweed extract at different concentration on berry setting, yield, and berry quality in superior Banaty grapevines cultivated under Minia governorate conditions. It also provided information for developing an environmentally friendly fertilization program.

2. Material and Methods

The current study was carried out in a private vineyard located west of Abu Qirqas Center, Minia Governorate, Egypt. The study was set out to investigate the impact of K-silicate and/or seaweed extract on production, and quality of Banaty grapevines, during the two consecutive seasons in 2021 and 2022 with on 30 vines from Banaty Seedless grapevines (10-years old) nearly identical in terms of growth vigor.

Grapevines was cultivated at 3 m between rows and 2 m apart between vines (700 vines/fed) under surface irrigation system using Nile water (water table depth > 1.5m). In both seasons, winter trimming was done using typical head pruning method during the second week of January, with each vine having 60 eyes. Additionally, the Egyptian Ministry of Agriculture's recommended insect management, fertigation, and standard agricultural procedures were applied to the experimental vines.

The soil used for cultivation was physically and chemically analyzed according to (**Wilde *et al.*, 1985)** before each season; the soil texture was clay and the chemical properties were 300ppm for EC (1:2.5 extract), 8.09 & 7.50 for pH, 2.25% for $CaCO_3$ and 2.19% for OM, while available nutrients (ppm) were 5.29, 495.9, 2.93, 3.32, 4.11 and 0.93 for P, K, Zn, Fe, Mn and Cu, respectively, while total nitrogen scored 0.11% during both seasons.

The experiment was arranged in Randomized complete block design (RCBD) included 10 treatments individual or combined of the potassium silicate and seaweed extract as foliar application with three replicates as following; control (sprayed with tap water), (0.05, 0.1 % 0.2% for each of K-silicate or seaweed extract and the same concentrations for each application combined together.

The treatments were sprayed shoots of seedlings with both of K-silicate and seaweed extract three times, the first at the beginning of growth, the second after berry setting, while the third one-month interval.

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

Table (A). Analysis of the seaweed extract

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

Data collection:

During the two seasons under study, harvesting took place during the second week of July, which is the typical commercial harvest date

1- Berry setting (%) was computed as the following: Following the initial spraying, two bunches were placed in white cheese bags with holes in them. These bags were flowering, opening, shutting:

$$\text{Berry Setting\%} = \frac{\text{Berries number /cluster}}{\text{Total flower number /cluster}}$$

2- Cluster number/vine.
3- Cluster weight (g).
4- Cluster length (cm).
5- Cluster width (cm).
6- Yield/vine (kg).

Physical characteristic of the berry:

1- Shoot berry%
2- Average berry weight (g).
3- Average berry longitudinal (cm).
4- Average berry equatorial (cm).

Chemical characteristic of the berry according to (**A.O.A.C., 2000**):

1- Hand refractometer readings for total soluble solids% in juice
2- Total acidity as a tartaric acid/100 ml juice).
3- Ratio between TSS/acidity.
4- Total sugar%.
5- Juice %.

Statistical analysis

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

3. Results and Discussion

3.1. Yield and cluster characteristic

The impact of K-silicate or/and seaweed extract at different concentrations as foliar spraying on the yield of "Banaty" grapevines, as measured in berry setting percentage, shoot berries percentage, clusters number/vine, average cluster weight, yield/vine, average cluster length and width, when compared to the untreated vines are indicated in Tables (1 & 2).

Table 1 showed the impact of spraying various rats of K- silicate or/and seaweed extract on berry setting percentage, number of cluster/vine and yield/vine (kg). The results demonstrated that when compared to the control vines, all treatments considerably raised berry setting percentage, number of cluster/vine and yield/vine (kg) values. With increasing concentration of the single applying of K-silicate or seaweed extract the traits were increased, while the concentration of 0.1 and 0.2% of potassium silicate or seaweed extract had no notable variation at ($P \leq 0.05$), the highest values recorded with the vines sprayed with seaweed extract at 0.2% followed by K-silicate at 0.2% in the absence of any discernible distinction between them. As for the combination application of potassium silicate and seaweed at various concentration, the result indicated an increase in berry setting percentage, number of cluster/vine and yield/vine (kg), the most elevated average values scored with the foliar spray with K-silicate (0.2%)+seaweed extract (0.2%) followed by the lower concentration 0.1% for each of the applications without significant difference between them. The same pattern was happened in the 2nd season.

Table (1). Effect of spraying K-silicate and seaweed extract on berry setting, shoot berries, number of cluster/vine and yield/vine of Bantay grapevines during 2021 and 2022 seasons

Characteristics / Treatments	Berry setting %		Number of cluster/vine		Yield/vine (kg)	
	2021	2022	2021	2022	2021	2022
Control	7.5	7.8	25.0	26.3	8.4	8.9
Potassium silicate (0.05%)	8.0	8.4	25.1	27.5	8.8	9.8
Potassium silicate (0.1%)	8.5	8.9	25.3	28.8	9.1	10.5
Potassium silicate (0.2%)	8.8	9.3	25.4	29.8	9.4	11.1
Seaweed extract (0.05%)	8.6	9.0	25.6	28.8	9.3	10.6
Seaweed extract (0.1%)	9.0	9.5	25.6	29.9	9.7	11.3
Seaweed extract (0.2%)	9.2	9.8	25.7	30.8	9.9	11.9
Potassium silicate (0.05) + Seaweed extract	9.1	9.5	25.3	29.9	9.5	11.2
Potassium silicate (0.1%)+ Seaweed extract	9.6	10.1	25.4	31.1	9.9	11.9
Potassium silicate (0.2%)+ Seaweed extract	9.9	10.5	25.4	31.9	10.0	12.4
New LSD at 5%	**0.4**	**0.5**	**N.S**	**1.1**	**0.4**	**0.7**

Data in Table 2 clearly illustrated that, with increasing concentration form 0.05, 0.1 & 0.2% form potassium silicate or/and seaweed extract, the cluster weight, length and width were significantly increased. From the data it can be indicated that, the vines sprayed with 0.2% from potassium silicate or seaweed extract recorded the highest values followed by the lower concentration 0.1% for each one without significant difference during the 2021 and 2022 seasons. Additionally, the vines sprayed with K-silicate and seaweed extract at the highest level (0.2%) also, recorded the highest value of the traits followed by 0.1% for each application, which unremarkable in comparison to one another. The other treatments recorded middle values foe cluster weight.

Significant effects on plant growth and chlorophyll formation are driven by potassium silicate stimulation, which in turn increases average clusters weight and number (Table 1 & 2) enhances yield characteristics through photosynthetic production. Potassium silicate's positive effects as a foliar spray could be because it boosts photosynthesis, decreases transpiration, increases energy compounds, stabilizes cell membranes, promotes cell division and elongation, increases antioxidant levels, and increases leaf water potential and nutrient bioavailability through potassium and silicon role. The nutritional content is enhanced by potassium silicate, which leads to high amounts of gibberellic acid and indole acetic acid. These acids encourage cell division and elongation, which in turn causes a cluster to grow in both length and width. In addition to potentially increasing indole acetic and gibberellic acid synthesis, silica induces the release of excessive amounts of abscisic acid. The present results are consistent with by **Mostafa (2017**) who reported that the percentage of yield, berry setting, vine weight, number of clusters, and cluster dimensions (length & shoulder) were all improved over the control treatment when Superior grapevine was treated with K-Si at concentrations ranging from 0.05 to 0.4% once, twice, three, or four times. The same results were found by **Abdel Aal *et al.* (2017)** on Crimson seedless grapevines and **Eisa *et al.* (2023)** on Thompson Seedless grapes.

Results in bigger cluster and weights may be attributable to the effects of seaweed extract on cell division, endogenous levels of growth promoters, macro- and micronutrients, carbs, and hormones, especially cytokinins (**Khan *et al*., 2012**). Additionally, it might have increased the fruit's natural peak polyamine concentration. Our findings are consistent with those of prior field trials that shown an increase in yield and its component due to seaweed extract. **Abo-Zaid *et al*. (2019**) found that spraying seaweed four times was more effective than the control group. The recommendations were as follows: once in April at the start of growth after flowering, once in mid-April just after berry setting, once in mid-May a month later, and once in late May two weeks later. This would enhance cluster properties and boost 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 demonstrated by **Omar *et al.* (2020)** 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.

Table (2). Effect of spraying K-silicate and seaweed extract on cluster weight, cluster length and cluster width of Bantay grapevines during 2021 and 2022 seasons

Characteristics / Treatments	Cluster weight (g)		Cluster length (cm)		Cluster width (cm)	
	2021	2022	2021	2022	2021	2022
Control	335.0	340.0	20.5	20.8	10.0	10.4
Potassium silicate (0.05%)	350.0	356.0	23.2	23.7	10.5	10.8
Potassium silicate (0.1%)	361.0	366.0	23.5	24.1	10.9	11.3
Potassium silicate (0.2%)	370.0	372.0	23.7	24.3	11.2	11.5
Seaweed extract (0.05%)	365.0	367.0	23.7	24.1	11.0	11.2
Seaweed extract (0.1%)	377.0	378.0	24.1	24.6	11.5	11.6
Seaweed extract (0.2%)	384.0	385.0	24.2	24.9	11.7	11.9
Potassium silicate (0.05) + Seaweed extract (0.05%)	375.0	375.0	24.0	24.6	11.4	11.7
Potassium silicate (0.1%)+ Seaweed extract (0.1%)	388.0	383.0	24.4	25.0	11.9	12.1
Potassium silicate (0.2%)+ Seaweed extract (0.2%)	394.0	390.0	24.6	25.2	12.2	12.3
New LSD at 5%	**9.0**	**8.0**	**0.3**	**0.4**	**0.4**	**0.4**

3.2. Berry physical characteristic

Table 3 present the morphophysical parameters of the grapevine "Banaty," which include shoot berry, average berry weight, longitudinal and equatorial, and how these parameters are affected by foliar applying with K-silicate or/and seaweed extract at different concentrations in comparison to the untreated treatments during the seasons of 2021 and 2022. These parameters are important for successful marketing locally, regionally, or globally.

All treatments significantly ($P \leq 0.05$) reduced shoot berry % when compared to the control, and increased average berry weight, longitudinal and equatorial during two experimental seasons. However, when tested over the experimental of two seasons, foliar sprays of 0.1 and 0.2% potassium silicate and seaweed extract showed no discernible differences. Shoot berry % was higher for the control, and decreased in single or mixed applications. While, average berry weight, longitudinal and equatorial were increased. Combined application with reduce the shoot berry%, and increase average berry weight, longitudinal and equatorial. The lowest reduction of shoot berry and highest values of average berry weight, longitudinal and equatorial were recorded with 0.2 potassium silictate+0.2 seaweed extract with no significant difference with application of 0.1% potassium silicate+0.1% seaweed extract. Generally, applying of K- silicate and seaweed extract foliarly at higher concentration; brought about the lowest reduction in shoot berry% (5.6 and 4.6%), and highest average berry weight (1.88 and 1.91 cm), longitudinal (1.69 and 1.67 cm) and equatorial (1.60 and 1.70 cm), respectively, as compared with untreated treatment, consecutively during both 2021 and 2022 seasons.

The impact of K-silicate on berries physical quality are consistent with the reports of **Abdel Aal *et al.* (2017)** who found that applying K-silicate at 0.1% in foliar way led to an increase in berry weight, longitudinal and equatorial. **Eisa *et al.* (2023)** stated that 2000 ppm potassium silicate in foliar way improved berries number /cluster and both, berry length and width.

The results of **Omar *et al.* (2020), Mohamed *et al.* (2021), El-Senosy (2022)** on Flame Seedless, **Al-Sagheer *et al.* (2023)** on Thompson Seedless, and other studies support the high mean values of physical traits of berries caused by increasing seaweed extract. These studies all showed that vines treated with higher levels of seaweed led to an increase in berry physical parameters as (berry weight, length, diameter, and shape index).

Table (3). Effect of spraying K-silicate and seaweed extract on average berry weight (g), berry longitudinal and berry equatorial of Bantay grapevines during 2021 and 2022 seasons

Characteristics / Treatments	Shoot berries %		Average berry weight (g)		Average berry longitudinal		Average berry equatorial	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	9.3	9.5	1.40	1.43	1.45	1.50	1.30	1.35
Potassium silicate (0.05%)	8.2	8.4	1.51	1.53	1.52	1.55	1.41	1.44
Potassium silicate (0.1%)	7.5	7.7	1.61	1.64	1.57	1.59	1.47	1.50
Potassium silicate (0.2%)	7.0	7.2	1.68	1.72	1.60	1.61	1.50	1.55
Seaweed extract (0.05%)	7.4	7.6	1.60	1.62	1.56	1.58	1.46	1.51
Seaweed extract (0.1%)	6.8	6.8	1.69	1.74	1.62	1.62	1.52	1.57
Seaweed extract (0.2%)	6.4	6.2	1.75	1.81	1.64	1.63	1.56	1.61
Potassium silicate (0.05) + Seaweed extract (0.05%)	6.7	6.0	1.70	1.72	1.61	1.62	1.52	1.58
Potassium silicate (0.1%)+ Seaweed extract (0.1%)	6.0	5.2	1.81	1.83	1.66	1.65	1.57	1.65
Potassium silicate (0.2%)+ Seaweed extract (0.2%)	5.6	4.6	1.88	1.91	1.69	1.67	1.60	1.70
New LSD at 5%	**0.6**	**0.7**	**0.08**	**0.09**	**0.04**	**0.03**	**0.05**	**0.06**

3.3. Berry chemical quality characteristics

Table 4 show the average values of berries chemical quality characters (TSS%, total acidity, TSS/acid ratio, juice%, and total sugar) of grapevine cv. 'Banaty' as a result of foliar application of K-silicate and/or seaweed extract at different concentrations during the 2021 and 2022 growing seasons.

Grapevine berries' chemical quality rose relative to untreated plants when the rates of K-silicate or seaweed extract increased except total acidity was decreased. The most extreme averages of TSS%, total acidity, TSS/acid ratio, juice%, and total sugar recorded with 0.2% seaweed extract during 2022 and 2023 without significant difference with 0.2% potassium silicate. Combined foliar application significantly increase mentioned traits comparing to other treatments and the highest mean values of all quality and lowest mean value of total acidity recorded with 0.2% potassium silicate + 0.2% seaweed extract during 2022 and 2023 followed by the lower concentration for each application mixed together. The same pattern was happened through two seasons.

Fruit weight and length increases led to an improves fruit output and quality, may be caused by potassium, which regulates a number of enzyme activities in plants by changing the pace of photosynthesis and speeding up the movement of leaves through the phloem and into the storage tissue (**Doaa *et al*., 2019 and Kumaran *et al*., 2019**). According to previous studies (**Amiri and Fallahi,**

2007; Ashraf *et al.*, 2010; and Upadhyay *et al.*, 2019), fruit quality was enhanced by potassium spraying, which raised the chlorophyll concentration and encouraged an increase in photosynthetic products, juice content, fruit size, flavor and color were all improved. These outcomes are consistent with **Abdel Aal *et al.* (2017**) indicated that spray potassium silicate at 0.1% three times was improving berries TSS%, acidity, TSS/acid ratio, reducing sugar, total anthocyanin of Crimson seedless grapevines. Additionally, **Awad *et al.* (2023**) stated that applying a 5g/L dose of K-Si to grapevines improved the TSS/acidic ratio and reduced T.A. in the juiced berries.

According to **Khan *et al.* (2012) & Petoumenou and Patris (2021**), some enzymes found in seaweed extract aid in the production of proteins, certain phytohormones, amino acids, and carbohydrates. This is associated with a rise in total sugar%, TSS% and a fall in TA% in grape juice. The data obtained also align with the findings of **Mohamed *et al.* (2021**) on early sweet, **El-Senosy (2022**) on flame seedless, and **Al-Sagheer *et al.* (2023**) on Thompson seedless. These studies found that as the concentration of seaweed extract increased, TSS%, TSS/acid, sugar percentage, and total acidity percentage all increased relative to the control.

Table (4). Effect of spraying K-silicate and seaweed extract on T.S.S%, total acidity, TSS/acid ratio, juice % and total sugar% of Bantay grapevines during 2021 and 2022 seasons

Characteristics / Treatments	TSS%		Total acidity%		TSS/acid ratio		Juice %		Total sugar%	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Control	18.1	18.6	0.470	0.455	38.5	40.88	75.1	75.8	16.1	16.5
Potassium silicate (0.05%)	18.7	19.3	0.418	0.404	44.74	47.77	77.5	77.7	16.7	17.1
Potassium silicate (0.1%)	19.2	19.7	0.387	0.374	49.61	52.67	78.0	78.1	17.2	17.5
Potassium silicate (0.2%)	19.5	19.9	0.361	0.352	54.02	56.53	78.3	78.2	17.5	17.7
Seaweed extract (0.05%)	19.3	19.8	0.388	0.375	49.74	52.80	77.9	78.0	17.1	17.6
Seaweed extract (0.1%)	19.7	20.1	0.360	0.349	54.72	57.59	78.3	78.4	17.6	18.1
Seaweed extract (0.2%)	19.9	20.2	0.335	0.327	59.40	61.77	78.5	78.6	17.8	18.4
Potassium silicate (0.05) + Seaweed extract (0.05%)	19.9	20.2	0.359	0.325	55.43	62.15	78.4	78.4	17.6	18.0
Potassium silicate (0.1%)+ Seaweed extract (0.1%)	20.4	20.7	0.331	0.300	61.63	69.00	78.9	78.7	18.0	18.5
Potassium silicate (0.2%)+ Seaweed extract (0.2%)	20.7	20.9	0.306	0.287	67.65	70.37	79.2	78.9	18.2	18.8
New LSD at 5%	**0.4**	**0.3**	**0.028**	**0.025**	**6.1**	**4.0**	**0.4**	**0.3**	**0.4**	**0.4**

4. Conclusion

Foliar treatment of 0.2% potassium silicate + 0.2% seaweed extract yielded the greatest mean values across the board, with no discernible variation at lower concentrations. From an economical perspective, treating the vines with a medium quantity of potassium silicate (0.1%) and seaweed extract (0.1%) yielded the greatest outcomes in terms of berry quality and increased quantitative production of "Banaty" grapevines. Therefore, according to the research, a mixed medium concentration of 0.1% is best used under the same conditions.

Reference

A.O.A.C. (2000). Association of Official Agricultural Chemists. Official Methods of Analysis 14th ed. Benjamin Franklin Station, Washington D.C.U.S.A., pp. 490-510.

Abd El-Rahman, A.S. and Al-Sharnouby S.F.S. (2021). Possibility of reducing the amount of mineral potassium fertilizers for flame seedless grapevines by using rock-feldspar. Journal of Horticultural Science & Ornamental Plants, 13 (3), 249- 258.

Abdel Aal, A. M. K.; Abada and Hesham, M. A.M. and Mohamed, A. E. (2017). Trials for solving the problem of poor berries colouration and improving yield of Crimson seedless grapevines. New York Science Journal, 10(12), 91-103.

Abo-Zaid, F.; Zagzog, O.; El-Nagar, N. and Qaoud, E. S. (2019). Effect of sea weed and amino acid on fruiting of some grapevine cultivars. Journal of Productivity and Development, 24(3), 677-703.

Al-Sagheer, N. R. A.; Abdelaal, A. H. M.; Silem, A. A. E. M. and Shoug, M. A. (2023). Response of Thompson seedless grapevines (h4 strain) grown on sandy soil to foliar application of some antioxidants and seaweed extract. Archives of Agriculture Sciences Journal, 6(2), 179-190.

Amiri, M. E. and Fallahi E.F. (2007). Influence of Mineral Nutrients on Growth, Yield, Berry Quality, and Petiole Mineral Nutrient Concentrations of Table Grape. J. Plant Nutr., 30: 463–470.

Ashraf, M.Y., Gul A., Ashraf, M., Hussain, F. and Ebert, G. (2010). Improvement in yield and quality of Kinnow (Citrus deliciosa X Citrus nobilis) by potassium fertilization. Journal of Plant Nutrition, 33: 1625-1637.

Awad, A. S. A.; Abou Sayed-Ahmed, T. A. M., Nomier, S. A. E. G. and Mohsen, F. M. S. (2023). Effect of foliar spraying some nano fertilizers on physico–chemical attributes of Flame seedless grapes to minimize the conventional used fertilizers. IJCBS, 24(11), 188-197.

Belal, B.E.A.; El-Kenawy, M.A. and Thorana, S.A., Abo El-Wafa (2017). Partial replacement of mineral potassium fertilizer for Thompson Seedless grapevines by using different sources of organic and natural fertilizer. J. Plant Production, Mansoura Univ., 8 (4), 19-25.

Cataldo, E.; Fucile, M. and Mattii. G.B. (2022). Biostimulants in viticulture: A sustainable approach against biotic and abiotic stresses. Plants, 11, 162. https://doi.org/10.3390/plants11020162.

Dhekny, S. A. (2016). 'Encyclopedia of food and health.' Academic Press, Oxford, pp. 261-265.

Doaa, M. H.; Sefan, R. F. and El-Boray, M. S. (2019). Effect of potassium nano fertilizer on yield and berry qualities of 'Flame Seedless' grapevines. J. of Plant Production, Mansoura Univ., 10 (11), 929-934.

Eisa, R. A.; Merwad, M. A. and Mostafa, E. A. M. (2023). Influence of spraying magnesium, silicon and salicylic acid on improving growth, yield and fruit properties of grapevine. Egyptian Journal of Chemistry, 66(5), 405-412.

El-Mehrat, H. G.; H. H. Yoness and F. A. Abdelrhman (2018). Effect of potassium silicate spray with packaging on storability and control postharvest diseases of grapevine fruits. Menoufia J. Plant Prod., Vol. 3 June 189 – 207.

El-Senosy, O. M. A. R. (2022). Effect of chitosan and seaweed extracts on fruiting of flame seedless grapevines grown under sandy soil condition. International Journal of Modern Agriculture and Environment, 1(1), 24-32.

FAO (2020). Food and Agriculture Organization of the United Nations. Food and Agriculture Organization Corporate Statistical Database. https://www.fao.org/statistics/en/

Fraga, H.; de Cortázar Atauri, I. G.; Malheiro, A. C.; Moutinho-Pereira, J. and Santos, J. A. (2017). Viticulture in Portugal: A review of recent trends and climate change projections. Oeno One, 51(2), 61-69.

Inglese, P.; Gullo G. and Pace, L.S. (2002). Fruit growth and olive oil quality in relation to foliar nutrition and time of application. Acta Hortic., 586, 507-509.

James, B. (1994). Chapters from life. Ann. Rev. Physiol. Plant. Mol. Biolog. 4,1-23.

Jones, G. (2013). Uma Avaliação do Clima para a Região Demarcada do Douro: Uma análise das condições climáticas do passado, presente e futuro para a produção de vinho. ADVID-Associação Para o Desenvolvmento da Viticultura Duriense; ADVID-Associação para o Desenvolvmento da Viticultura Duriense: Vila Real, Portugal, 110.

Kabsha, E. A.; Fahmy, M. A.; Bagdady, G. A. and Hamdy, A. (2023). GA_3 Enhances the Chemical and Physical Properties, Yield, and Reducing Compactness of H4 Grapevines. Egyptian Journal of Chemistry, 66(8), 117-127.

Kanai, S.; Ohkura, K.; Adu-gyamfi, J. J.; Mohapatra, P. K.; Nguyen, N. T.; Saneoka, H. & Fujita, K. (2007). Depression of sink activity precedes the inhibition of biomass production in tomato plants subjected to potassium deficiency stress. Journal of Experimental Botany, 58, 2917–2928.

Kannan, S. (2010). Foliar Fertilization for Sustainable Crop Production. In: E. Lichtfouse (ed). Genetic Engineering, Biofertilization, Soil Quality and Organic Farming. Sustainable Agriculture Reviews 4. Springer Verlag, Springer, pp: 371-402.

Khan, A. S.; Ahmad, B.; Jaskani, M. J.; Ahmad, R. and Malik, A. U. (2012). Foliar application of mixture of amino acids and seaweed (*Ascophylum nodosum*) extract improve growth and physicochemical properties of grapes. Int. J. Agric. Biol., 14(3), 383-388.

Kumaran, P.B.; Venkatesan, K.; Subbiah, A. and Chandrasekhar, C.N. (2019). Effect of pre-harvest foliar spray of potassium schoenite and chitosan oligosaccharide on yield and quality of grapes var. Muscat Hamburg. International Journal of Chemical Studies, 7(3):3998-4001.

Losada, M. M.; Hernández-Apaolaza, L.; Morata, A. and Revilla, E. (2022). Impact of the application of monosilicic acid to grapevine (Vitis vinifera L.) on the chemical composition of young red Mencia wines. Food Chemistry, 378, 132140.

Magalhães, N. (2008). Tratado de viticultura: a videira, a vinha eo terroir (Vol. 16). Lisboa: Chaves Ferreira. C., Ed.; Esfera Poética: Lisboa, Portugal, 2008; ISBN 978-972-8987-15-2.

Masoud, A. A.; Mohamed, A. K.; Abou Zaid, I. A.; El-Hakim, A. and Mohamed, H. (2023). Effect of foliar application with some natural and chemical compounds on yield of Ruby Seedless grape cultivar. Assiut Journal of Agricultural Sciences, 54(1), 198-212.

Mead, R.; Curnow, R. N. and Harted, A. M. (1993). Statistical methods in Agricultural and Experimental Biology.2nd Ed. Chapman & Hall, London pp. 10-44.

Mohamed, S. H. F.; Khiamy, Kh. O. M. and Qaoud, E. M. (2021). Response of Early Sweet Grapevines to Foliar Application of Algae Extract and some Micronutrients. Hortscience Journal of Suez Canal University, 10(1), 77-84.

Mohsen, F. S. (2021). Effect of Some Rootstocks on the Performance of Flame Seedless Grapevines. Egyptian Journal of Horticulture, 48, 1-8.

Mostafa, M. M. H. (2017). Effect of spraying potassium silicate on productivity of superior grapes. MSc. Thesis. Agric. Fac. Minia Univ. Egypt.

Omar, A. D.; Ahmed, M. A.; Al-Obeed, R. and Alebidi, A. (2020). Influence of foliar applications of yeast extract, seaweed extract and different potassium sources fertilization on yield and fruit quality of 'Flame Seedless' grape. Acta Scientiarum Polonorum. Hortorum Cultus, 19(5): 143–15.

Petoumenou, D.G. and Patris, V.E. (2021). Effects of several preharvest canopy applications on yield and quality of table grapes (*Vitis vinifera* L.) Cv. Crimson Seedless. Plants, 10, 906

Rouphael, Y. and Colla, G. (2020). Bio stimulants in agriculture. Front Plant Sci., 11, 40.

Savoi, S.; Herrera, J. C.; Carlin, S.; Lotti, C.; Bucchetti, B.; Peterlunger, E.; Castellarin, S.D. and Mattivi, F. (2020). From grape berries to wines: Drought impacts on key secondary metabolites. Oeno One, 54(3), 569-582.

Shukla, P.; Mantin, E.; Adil, M.; Bajpai, S.; Critchley, A. and Prithiviraj B. (2019). Ascophyllum nodosum based bio stimulants: sustainable applications in agriculture for the stimulation of plant growth, stress tolerance, and disease management. Front Plant Sci., 10, 655.

Stino, R. G.; Ali, M. A.; Abdel-Mohsen, M. A.; Maksoud, M. A. and Thabet, A. Y. I. (2017). Quality attributes of Flame seedless grapes as affected by some bio-stimulants. Int J Chem Tech Res, 10(2), 273-288.

Upadhyay, A.K.; Jagdev, S.; Kumar, S.A.; Jinal, L. and Oulkara, D.P. (2019). Effect of varying levels of potassium on berry quality of Cabernet Sauvignon grapes under tropical conditions. Indian Journal of Horticulture. 76, (4):634- 640.

USDA (2020). Overview of Egypt's Table Grape Sector. https://www.fas.usda.gov/data/egypt-overview-egypts-table-grape-sector.

Wilde, S. A.; Corey, R. B.; Lyre, I. G. and Voigt, G. K. (1985). Soil and Plant Analysis for Tree Culture. 3" d Oxford 8113M publishing Co. New Delhi, 96-106.

Zhang, L.; Zhang, J.; Christie, P. and Li, X. (2008). Pre-inoculation with arbuscular mycorrhizal fungi suppresses root knot nematode *(Meloidogyne incognita*) on cucumber (Cucumis sativus). Biology and Fertility of Soils, 45, 205-211.