Horticulture Research Journal, 3 (1), 102 : 111 - March 2025, ISSN 2974/4474

Response of Spraying Calcium Silicate, Nano- Calcium, and Seaweed Extract on The Productivity and Nutritional Status of Autumn Royal Seedless Grapevines Grown in Minia

Ahmed Y. El-Saman* and Mahmoud M. Refaai **

*Viticulture Dept. Hort. Res. Instit ARC. Giza, Egypt.

**Central Lab. of Organic agriculture ARC, Giza, Egypt

ABSTRACT

During 2021 and 2022 seasons, we tested the effects of spraying calcium silicate (0.05-0.2%), Nano-calcium (Kalmagbor compound; 0.025-0.1%), and seaweed extract 0.05-0.2%) on the productivity and nutritional status of Autumn Royal seedless grapevines grown in Minia governorate. Our findings indicate that the application of calcium silicate, nano-calcium, and seaweed extracts significantly enhanced various aspects of grapevine growth and development compared to the control treatment. These improvements included increased vegetative growth, improved vine nutritional status, higher yield and cluster weight, and favorable changes in berry physical and chemical properties. Furthermore, the observed positive effects were generally proportional to the increasing concentrations of these treatments. The most pronounced benefits were observed when applying calcium silicate, nano-calcium, and seaweed extracts in ascending order of application. However, the results showed no significant differences between the medium and higher concentrations of these compounds.The treatment that included three sprays of seaweed extract at 0.2% was responsible for obtaining the highest yield and best berry quality of Autumn Royal seedless grapevines.

Keywords: Autumn Royal Seedless grapevines- Calcium silicate- Nano-calcium- Kalmabor- Seaweed extracts.

INTRODUCTION

Grape occupies the third position in Egyptian fruit crop production, after citrus and mangoes. Thus, given the requirement for vast acreage to ensure high fruit production, grapevines grown in high temperature conditions face some problems concerning is berry shot, coloring and berry quality. Accordingly, grape growers in such regions use horticultural practices for enhancing grapes quality. Application various compounds are the most widely used in grapevines cv. some nutrients and the natural extracts are part from the bio-stimulants. Calcium (Ca^{2+}) is crucial to the composition of plant cell walls, significantly contributing to fruit firmness. While postharvest treatments with calcium salts initially enhance resistance to mechanical damage, studies have shown that the shelf life of these treated fruits may be shorter than untreated ones (Burns and Pressey, 1987). More effective calcium management occurs during fruit development. The beneficial impact of calcium application depends on various factors: Application method, Calcium salt type, and Timing of application. Studies on the application method provide support for the effectiveness of foliar over root application. Among the available calcium salts, the nitrate generally provides better results than calcium chloride. Supplying calcium during specific periods in fruit development is crucial (Crisosts, et al., 2000 and Wooldridge et al., 1998).

The challenges associated with calcium uptake by fruits stem from the unique regulation of calcium absorption compared to other nutrients. Calcium primarily moves passively through the plant via the transpiration stream from the soil (Ferguson, 1984, Marshner, 1995 and Mata et al., 2001).

Silicon is a beneficial plant nutrient that significantly enhances insect pest resistance, leading to increased yields. Studies have shown that silicon application is particularly effective in reducing pest populations and pest-induced damage in susceptible varieties compared to resistant ones. Silicon reinforces plant defenses through two primary mechanisms: acting as a physical barrier and as an enhancer of physiological resistance. In other words, silicon deposition strengthens plant tissues, creating a physical barrier against insect pests and stimulates the production of phenolic compounds that activate plant defense responses (Kanto, 2002 and Epstein and Bloom, 2003).

In recent years, nanotechnology has emerged as a promising approach for developing sustainable fertilization strategies. Nanomaterials, with their unique properties such as high surface area-to-volume ratio and small size, exhibit enhanced reactivity compared to bulk materials. These properties influence factors like crystallinity, morphology, and zeta potential, improving the colloidal stability and bioavailability of nutrients for plant roots (Zulfiqar et al., 2016, Bindraban et al., 2020 and Kotencik et al., 2021).

The unique chemical, physical, and biological properties of nanomaterials, such as their high surface area-to-volume ratio and small size, enable them to significantly enhance the effectiveness of fertilizers. This combination leads to products that increase nutrient uptake by plants (Prasad and Jha, 2009). Nano-fertilizers, including those incorporating nanoparticles or using nanomaterials for controlled nutrient release, have shown significant potential in enhancing nutrient uptake and improving crop yields in various plants, including fruit trees (Liu and Lal, 2015 and Zulfiqar et al., 2019).

Seaweed extracts, being biodegradable and organic, represent a valuable source of nutrients for sustainable agriculture (Cassan et al., 1992). They contain a diverse range of beneficial compounds, including trace nutrients such as Zinc (Zn), Iron (Fe), Manganese (Mn), Copper (Cu), Cobalt (Co), and Molybdenum (Mo); Amino acids; Vitamins; Plant growth hormones such as Cytokinins, Indole-3-acetic acid (IAA), Indole-3-butyric acid (IBA). These constituents contribute significantly to plant growth and development (Metting et al., 1990 and Abdel- Mawgoud et al., 2010).

Research has shown that seaweed extracts can induce numerous positive effects in treated plants, such as improved crop yield, enhanced stress tolerance, increased nutrient uptake, and enhanced resistance to frost and pests. Furthermore, thanks to its rich nutrient and growth factor content, it improved postharvest shelf life, increased seed germination, and reduced incidence of fungal and insect attacks (Metting et al., 1990).

Foliar spraying of seaweed extracts has been reported to positively influence growth, yield, and fruit quality in various fruit crops, including grapes (Morric and Branson, 2002, Parrado et al., 2007 and Kok et al., 2010).

This study aimed to investigate the effects of different concentrations of calcium silicate, nano-calcium (Kalmagbor compound), and seaweed extracts—applied by foliar sprays—on the growth and fruiting of Autumn Royal seedless grapevines.

MATERIALS AND METHODS

This study involved 60 Autumn Royal seedless grapevines (all were 11-y-old) during 2021 and 2022 seasons. These vines were grown in a private vineyard (Dakahlia Agriculture Development) situated at West Abu Qurqas district, El-Minia Governorate, Egypt.

Analysis of the soil revealed a well-drained sandy texture, and a water table ≥ 2.0 m deep. **Table (1)** shows the characteristics of the soil. Vines are spaced 2.0 m apart in rows, while the distance between two subsequent rows is 3.0 m to yield a total 700 vines per feddan.

Pruning was performed during the last week of December in both seasons leaving 84 eyes per vine (12 fruiting spurs × 6 eyes on each spur + 6 replacement spurs × 2 eyes). The selected 60 vines were healthy, with no visual signs of nutrient deficiency, and uniform vigor. A drip irrigation system based on well water was adopted for irrigation and regular fertilization.

Table (1). Mechanical, physical and chemical analysis of the tested orchard soil (Wilde et al., 1985).

Constituent	Values	Constituent	Values
Clay %	8.8	$CaCO_3$ %	2.58
Silt %	13.0	Total N%	0.011
Sand %	78.2	Av. P (olsen ppm)	1.15
Texture	Sandy	Av. K (ammonium acetate ppm)	33.3
pH (1:2.5 extract)	7.88		
EC. (1:2.5 extract) mmhos/ 1cm	1.60		
O.M. %	0.14		

All vines received the usually adopted practices in the vineyard expect those dealing with foliar application of calcium silicate, nano-calcium and seaweed extracts.

The study design comprised the following 10 regimens of foliar sprays of calcium silicate, nano-calcium and seaweed extracts, besides the control (vehicle).

T_1- Control (water sprayed vines)

T_2- Calcium silicate at 0.05%.

T_3- Calcium silicate at 0.1%.

T_1- Calcium silicate at 0.2%.

T_5- Nano-calcium (Kalmagbor compound) at 0.025%.

T_6- Nano-calcium (Kalmagbor compound) at 0.05%.

T_7- Nano-calcium (Kalmagbor compound) at 0.1%.

T_8- Seaweed extract at 0.05%.

T_9- Seaweed extract at 0.1%.

T_{10}- Seaweed extract at 0.2%.

The three foliar treatments with calcium silicate (25% Si and 10% Ca^{++}), Nano-calcium (Kalmagbor compound: 15% Ca^{++}, 2% Mg^{++}, 1.5% Boron, 5% Amino acids, and 10% nitrogen), or seaweed extracts were repeated three times at the last week of March (growth start), last week of April (just after berry setting), and one month later (last week of May). All spray solutions contained Triton B (0.5 ml/L) as a surfactant to increase the miscibility of the chemicals with water. All sprays were performed till run off at a rate of 2 L/ vine.

Each treatment consisted of three replicates, two vine each, in a Randomized Complete Block Design (RCBD). The following parameters were recorded during the study seasons:

1- Vegetative growth: main shoot length (cm), average # of leaves/shoot, average leaf area (cm)^2 **(**Ahmed and Morsy , 1999) wood ripening coefficient **(**Bouard , 1966) pruning weight (kg/vine), and Cane thickness (cm**) .**

2- Leaf chemical properties: chlorophyll a, chlorophyll b, total chlorophylls, and total carotenoids (mg/g F.W.) according to Von–Wettstein (1957), and Ca^{++} % according to Balo et al. (1988).

3- The average yield/vine (kg), clusters/vine, and the weight (g), length(cm), and shoulder (cm) of cluster.

4- Berry coloration (%).

5- Physico-chemical properties of the berries including its weight (g), longitudinal and equatorial dimensions (cm), TSS (%), total acidity (%) determined as g tartaric acid/100 mL Juice) according to the A.O.A.C. (2002) methods, and total reducing sugars (%) according to Lane and Eynon (1965).

The statistical analysis of the data was done by comparing the means of the results of the 10 treatments using New L.S.D at 5% (Mead et al., 1993).

RESULTS

1- Some vegetative growth aspects:

Data presented in **Table (2)** demonstrate that spraying calcium silicate (0.05-0.2%), Nano-Calcium (Kalmagbor compound) (0.025-0.1%), and seaweed extracts (0.05-0.2%) significantly increased several key growth parameters in Autumn Royal seedless grapevines compared to the untreated control. These parameters included: main shoot length, number of leaves/shoot, leaf area, wood ripening coefficient, pruning wood weight, and cane thickness.

Furthermore, the positive impact on these growth parameters was generally concentration-dependent for each treatment in both seasons. The most pronounced beneficial effects were observed when applying Calcium silicate, followed by Nano-Calcium (Kalmagbor compound), and then seaweed extracts. However, changing the concentration of any of the studied preparations from medium to high levels failed to demonstrate any improvements on such growth parameters.

he highest values for main shoot length (115.0 cm and 117.0 cm in 2021 and 2022, respectively), number of leaves per shoot (22.0 and 22.5 leaves), leaf area (111.5 cm² and 112.0 cm²), wood ripening coefficient (0.89 and 0.91), and cane thickness (1.20 cm and 1.22 cm) were observed in vines treated with three applications of 0.2% seaweed extract during both seasons. In contrast, untreated vines exhibited the lowest values for these parameters. These consistent results were observed across both growing seasons.

2- Leaf chemical composition:

Data obtained in **Table (3)** revealed that applying any of the three treatments (Calcium silicate, Nano-Calcium [Kalmagbor compound], and seaweed extracts) three times to the leaves of Autumn Royal seedless grapevines significantly increased their content of chlorophyll a, chlorophyll b, total chlorophyll, total carotenoids, and leaf calcium percentage compared to the untreated vines.

The magnitude of these increases followed the order: Seaweed extracts > Nano-Calcium > Calcium silicate. Furthermore, increasing the concentration of each treatment generally resulted in a gradual enhancement of these leaf chemical parameters.

Vines treated with 0.2% seaweed extract exhibited the highest values for these parameters, while the untreated control vines consistently recorded the lowest values across both seasons (2021 and 2022)

3- Yield and cluster aspects:

Data in **Table (4)** demonstrate that treating Autumn Royal seedless grapevines with Calcium Silicate (0.05-0.2%), Nano-Calcium (Kalmagbor compound) (0.025-0.1%), and seaweed extracts (0.05-0.2%) significantly enhanced yield, number of clusters/vine, cluster weight, and dimensions compared to the untreated control.

Statistical analysis indicated that the order of effectiveness in promoting yield and cluster characteristics was Seaweed extracts > Nano-Calcium > Calcium Silicate.

Moreover, the highest yield was achieved with 0.2% seaweed extract, reaching 11.88 kg/vine in 2021 and 15.68 kg/vine in 2022. In contrast, untreated vines produced 9.12 kg/vine and 9.36 kg/vine in 2021 and 2022, respectively. This translates to a yield increase of 30.3% and 67.5% with the seaweed extract treatment compared to the control.

While the treatments significantly influenced yield, no significant effect on the number of clusters per vine was observed in the first season of the study.

4- Percentage of berry coloration:

Table (5) clearly indicates that the percentage of berry coloration was significantly influenced by the application of Calcium silicate, Nano-Calcium (Kalmagbor compound), and seaweed extracts compared to the untreated control. The order of effectiveness in promoting berry coloration was: Seaweed extracts > Nano-Calcium > Calcium silicate.

The improvement of such berry attribute was concentration-dependent for each treatment. The highest berry coloration percentages (93.5% and 95.0% in 2021 and 2022, respectively) were observed in vines treated with 0.2% seaweed extract. In contrast, the untreated control vines exhibited lower berry coloration percentages, reaching only 71.0% and 72.5% in 2021 and 2022, respectively. This trend was consistent across both seasons.

5- Some physical and chemical characteristics of the berries

Data from **Tables (5 and 6)** reveal that spraying the leaves with Calcium Silicate (0.05-0.2%), Nano-Calcium (Kalmagbor compound) (0.025-0.1%), and seaweed extracts (0.05-0.2%) significantly enhanced several key physical and chemical attributes of grapes compared to the untreated control. These improvements included increased berry weight and dimensions (longitudinal and equatorial), higher Total Soluble Solids (TSS), TSS/acid ratio, and reducing sugars content. Besides, these treatments reduced the total acidity of the berries.

The order of effectiveness in improving berry quality was: Seaweed extracts > Nano-Calcium > Calcium Silicate.

A gradual enhancement in berry quality was observed with increasing the concentration of each treatment, with a more pronounced effect at higher concentrations. The most significant improvements in berry quality were achieved with 0.2% seaweed extract where the berry weight reached 6.4 g and 6.5 g, and TSS content reached 20.1% and 20.6% in 2021 and 2022, respectively. In contrast, the untreated vines exhibited unfavorable effects on berry quality such as lower berry weight (5.1 g and 5.3 g) and TSS content (17.5% and 17.7%) in the respective seasons. These trends were consistent across both seasons.

DISCUSSION

Under hot region climatic conditions tike west El-Minia region grapevines suffering from some problems. The vines under such very hot weather face some stresses.

These stresses reflect on the yield depression, uneven cluster coloration and poor berries quality cluster compactness of some grapevines cultivars like Autumn Royall seedless grapevines also leads to exacerbate the pervious problems. Therefore many efforts have been made to improve grapes yield and fruiting using antioxidants like seaweed extracts, and some nutrients.

Seaweed extracts are natural fertilizers containing various nutrients, plant hormones, amino acids and some vitamins. Seaweed extracts are used in grapevines for enhancing vine growth and fruiting of grapevines cultivars. Many investigators found that, seaweed extracts stimulated the growth aspects and increased the yield with better berries quality (according by Norrie and Keathely, 2005, Kok et al., 2020, Carvalho, et al., 2019 Salvi, et al., 2019, Taskos et al., 2019 and Pessenti et al., 2022)

Nanotechnology has revolutionized fertilizer delivery by enabling the utilization of nanoscale materials as controlled-release vectors. This has paved the way for the development of 'smart fertilizers' – innovative systems designed to enhance nutrient use efficiency (Al-Amin-Sadek and Jayasuriya, 2007).

One prominent approach involves encapsulating fertilizers within nanoparticles. This can be achieved through various methods (Rai et al., 2012).

1. **Polymer-coated fertilizers**: Encasing fertilizer particles within a thin, often

biodegradable, polymer film. This controlled-release mechanism allows for the gradual release of nutrients as the polymer degrades.

2. **Porous nanomaterial encapsulation**: Trapping fertilizers within the pores of porous **nanomaterials** such as zeolites or mesoporous silica. The size and distribution of these pores regulate the rate of nutrient diffusion and release.
3. **Nanoparticle or nano-emulsion delivery**: Transforming fertilizers into nanoparticles or incorporating them into nano-sized emulsions. This significantly increases the surface area of the fertilizer, facilitating improved interaction with plant surfaces and potentially enhancing nutrient uptake.

Furthermore, cutting-edge nano-fertilizers integrate advanced nano-devices. These devices can monitor plant signals and dynamically adjust nutrient release in real-time. This synchronized delivery ensures that nutrients are made available to the plant precisely when and where they are needed. This targeted approach minimizes nutrient loss through leaching into the soil, volatilization into the atmosphere, and immobilization by soil microorganisms. By directly delivering nutrients to plant cells and reducing their interaction with the surrounding environment, nano-fertilizers optimize nutrient utilization **(Derosa *et al*., 2010).**

Calcium, a vital macronutrient, plays a multifaceted role in plant growth and development. It acts as a crucial intracellular messenger, mediating responses to hormonal signals, stress stimuli, and various developmental processes. As a fundamental component and regulator of cell walls and membranes, calcium is essential for maintaining cellular structure and function (Hepler and Winship, 2010). Moreover, calcium strengthens plant defenses against bacterial and viral diseases (Hepter, 2005).

Due to its limited mobility within the plant, calcium requires a continuous supply to support robust vegetative growth (Del-Amor and Marcelis, 2003). This fact necessitates innovative delivery strategies, and nano-fertilization technologies offer promising solutions to ensure adequate calcium availability for optimal plant performance.

Table (2). Effect of calcium silicate, nano- calcium and seaweed extract on some vegetative growth aspects. of Autumn Royal seedless grapevines during 2021 and 2022 seasons.

Characters / Various Treatments	Main shoot length (cm)		Number of leaves per shoot		Leaf area $(cm)^2$		Wood ripening coefficient		Pruning wood weight (kg.)		Cane thickness (cm)	
	2021	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**
T_1- Control	91.5	92.0	15.0	17.0	98.5	99.0	0.68	0.70	1.54	1.58	0.88	0.90
T_2- Calcium silicate at 0.05%	96.0	98.0	17.5	18.0	101.5	102.0	0.71	0.72	1.61	1.63	0.98	1.00
T_3- Calcium silicate at 0.1%	99.0	100.5	18.0	18.5	103.0	103.5	0.73	0.74	1.66	1.67	1.05	1.07
T_4-Calcium silicate at 0.2%	103.5	105.0	19.0	19.5	104.5	105.0	0.75	0.76	1.68	1.70	1.09	1.10
T_5- Nano- Calcium at 0.025%	100.0	101.5	18.5	19.0	103.5	104.0	0.74	0.75	1.67	1.68	1.08	1.09
T_6- Nano- Calcium at 0.05%	106.5	107.5	19.5	20.0	106.0	106.5	0.77	0.79	1.71	1.73	1.11	1.13
T_7- Nano- Calcium at 0.1%	111.0	112.0	20.5	21.0	108.0	108.5	0.80	0.82	1.74	1.76	1.14	1.16
T_8- Seaweed extract at 0.05%	107.0	108.5	20.0	20.5	107.0	108.0	0.79	0.81	1.72	1.75	1.12	1.14
T_9- Seaweed extract at 0.1%	112.0	113.0	21.0	21.5	109.5	110.0	0.84	0.86	1.80	1.82	1.16	1.18
T_{10}- Seaweed extract at 0.2%	115.0	117.0	22.0	22.5	111.5	112.0	0.89	0.91	1.84	1.88	1.20	1.22
New L.S.D. at 5%	1.1	1.3	0.8	0.9	1.0	1.1	0.06	0.07	0.08	0.09	0.03	0.04

Table (3). Effect of calcium silicate, nano-calcium and seaweed extract on some leaf pigments and percentage of Ca in the leaves of Autumn Royal seedless grapevines during 2021 and 2022 seasons.

Characters Various treatments	Chlorophyll a (mg. g F.W.)		Chlorophyll b (mg. g F.W.)		Total Chlorophylls (mg. g F.W.)		Total carotenoids (mg. g F.W.)		Leaf Ca (%)	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
T_1- Control	3.4	3.6	1.5	1.6	4.9	5.2	1.1	1.1	2.80	2.85
T_2- Calcium silicate at 0.05%	3.7	3.8	1.7	1.8	5.4	5.6	1.3	1.4	3.05	3.11
T_3- Calcium silicate at 0.1%	3.9	4.0	1.9	2.0	5.8	6.0	1.5	1.6	3.14	3.16
T_4-Calcium silicate at 0.2%	4.1	4.2	2.1	2.2	6.2	6.4	1.7	1.8	3.22	3.26
T_5- Nano- Calcium at 0.025%	4.0	4.1	2.0	2.1	6.0	6.2	1.6	1.7	3.19	3.21
T_6- Nano- Calcium at 0.05%	4.4	4.5	2.3	2.4	6.7	6.9	1.8	1.9	3.30	3.33
T_7- Nano- Calcium at 0.1%	4.6	4.7	2.5	2.6	7.1	7.3	1.9	2.0	3.36	3.40
T_8- Seaweed extract at 0.05%	4.5	4.6	2.4	2.5	6.9	7.1	1.9	1.9	3.19	3.22
T_9- Seaweed extract at 0.1%	4.8	4.9	2.6	2.7	7.4	7.6	2.0	2.1	3.35	3.38
T_{10}- Seaweed extract at 0.2%	4.9	5.1	2.7	2.8	7.6	7.9	2.1	2.2	3.38	3.42
New L.S.D. at 5%	0.5	0.6	0.2	0.3	0.6	0.7	0.2	0.2	0.11	0.12

Table (4). Effect of calcium silicate, nano-calcium and seaweed extract on number of cluster per vine, yield and some cluster aspect of Autumn Royal seedless grapevines during 2021 and 2022 seasons.

Characters Various Treatments	No. of cluster per vine		Yield/ vine (g.)		Cluster weight (g.)		Cluster length (cm.)		Cluster shoulder (cm.)	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
T_1- Control	24.0	24.0	9.12	9.36	380.0	390.0	22.5	23.0	12.0	13.0
T_2- Calcium silicate at 0.05%	23.0	25.0	9.43	10.38	410.0	415.0	24.0	24.5	14.5	15.0
T_3- Calcium silicate at 0.1%	24.0	26.0	10.20	11.18	425.0	430.0	25.0	26.0	15.5	16.0
T_4-Calcium silicate at 0.2%	23.0	27.5	10.20	12.24	440.0	445.0	26.5	27.0	17.0	17.5
T_5- Nano- Calcium at 0.025%	23.0	27.0	9.90	11.88	430.0	440.0	26.0	27.0	16.0	16.5
T_6- Nano- Calcium at 0.05%	24.0	29.5	10.80	13.57	450.0	460.0	27.0	28.0	17.5	18.0
T_7- Nano- Calcium at 0.1%	24.0	30.0	11.04	13.95	460.0	465.0	28.0	28.5	18.0	18.5
T_8- Seaweed extract at 0.05%	25.0	30.0	11.38	13.80	455.0	460.0	27.5	28.0	17.5	18.0
T_9- Seaweed extract at 0.1%	25.0	31.0	11.75	14.88	470.0	480.0	29.0	30.0	19.0	19.5
T_{10}- Seaweed extract at 0.2%	25.0	32.0	11.88	15.68	475.0	490.0	30.0	31.0	19.5	20.0
New L.S.D. at 5%	NS	1.1	0.71	0.92	10.5	11.0	1.6	1.8	1.1	1.2

Table (5). Effect of calcium silicate, nano-calcium and seaweed extract on the percentage of berries coloration and some physical characteristics of berries. of Autumn Royal seedless grapevines during 2021 and 2022 seasons.

Characters Various Treatments	Berries coloration (%)		Berry weight (g.)		Berry length (cm.)		Berry diameter (cm)	
	2021	2022	2021	2022	2021	2022	2021	2022
T_1- Control	71.0	72.5	5.1	5.3	2.3	2.4	1.6	1.7
T_2- Calcium silicate at 0.05%	77.0	78.0	5.4	5.5	2.5	2.6	1.8	1.9
T_3- Calcium silicate at 0.1%	81.0	81.5	5.6	5.7	2.6	2.7	1.9	2.0
T_4-Calcium silicate at 0.2%	84.0	85.0	5.7	5.8	2.7	2.8	2.0	2.1
T_5- Nano- Calcium at 0.025%	82.5	83.5	5.6	5.7	2.5	2.6	1.9	2.0
T_6- Nano- Calcium at 0.05%	86.0	86.5	5.9	6.0	2.7	2.8	2.2	2.3
T_7- Nano- Calcium at 0.1%	88.5	89.0	6.1	6.2	2.8	2.9	2.3	2.4
T_8- Seaweed extract at 0.05%	88.0	89.0	6.0	6.1	2.7	2.8	2.2	2.3
T_9- Seaweed extract at 0.1%	91.5	93.0	6.2	6.3	2.9	3.0	2.4	2.5
T_{10}- Seaweed extract at 0.2%	93.5	95.0	6.4	6.5	3.0	3.1	2.5	2.6
New L.S.D. at 5%	1.4	1.6	0.7	0.8	0.4	0.5	0.2	0.3

Table (6) Effect of calcium silicate, nano-calcium and seaweed extract on some chemical characteristics of the berries. of Autumn Royal seedless grapevines during 2021 and 2022 seasons.

Characters **Various Treatments**	**TSS (%)**		**Total acidity (%)**		**TSS/acid ratio**		**Reducing sugars (%)**	
	2021	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**
T_1- Control	17.5	17.7	0.660	0.650	26.5	27.2	15.5	15.7
T_2- Calcium silicate at 0.05%	17.8	18.0	0.640	0.630	27.8	28.6	15.9	16.0
T_3- Calcium silicate at 0.1%	18.1	18.3	0.610	0.600	29.6	30.5	16.1	16.2
T_4-Calcium silicate at 0.2%	18.3	18.5	0.590	0.580	31.0	31.9	16.4	16.5
T_5- Nano- Calcium at 0.025%	18.2	18.4	0.600	0.590	30.3	31.2	16.3	16.4
T_6- Nano- Calcium at 0.05%	18.6	18.8	0.575	0.570	32.3	32.9	16.7	16.8
T_7- Nano- Calcium at 0.1%	19.0	19.2	0.560	0.550	33.9	34.9	17.0	17.1
T_8- Seaweed extract at 0.05%	18.9	19.1	0.570	0.560	33.1	34.1	16.9	17.0
T_9- Seaweed extract at 0.1%	19.6	19.9	0.540	0.530	36.3	37.5	17.7	17.8
T_{10}- Seaweed extract at 0.2%	20.1	20.6	0.510	0.500	39.4	41.2	18.2	18.3
New L.S.D. at 5%	0.4	0.5	0.012	0.014	1.3	1.4	0.3	0.4

REFERENCES

Abdel- Mawgoud, A.M., Tantawy, A.S., Hafez, M.M. and Habibn, H.A. (2010). Seaweed extract improves growth, yield and quality of different watermelon hybrids, Research Journal of Agriculture and Biological Sciences, 6(2): 161-168.

Ahmed, F.F. and Morsy, M.H. (1999). A new method for measuring leaf area in different fruit species . Minia , J. of Agric. Res. & Develop., 19: 97-105.

Al- Amin- Sadek, M.D. and Jayasuriya, H.P. (2007). nanotechnology prospects in agricultural context An overview. In Processing of the International Agricultural Engineering Conference, 3-6, Dec. Banghok, p. 548.

Association of Official Agricultural Chemists (2000). Official Methods of Analysis (A.O.A.C), 12th Ed., Benjamin Franklin Station, Washington D.Q, U.S.A, pp. 490-510.

Balo, E., Prilesszky, G., Happ, I., Kaholami, M. and Vega, L. (1988). Soil improvement and the use of leaf analysis for forecasting nutrient requirements of grapes. Potash Review (Subject 9, 2nd suite. No. 61: 1-5).

Bindraban, P.S., Dimkpa, C.O. and Pandey, R. (2020). Exploring phosphorus fertilizers and fertilization strategies for improved human and environmental health. Bio., Fertil. Soils, 56: 299-317.

Bouard, J. (1966). Recherches physiologiques sur la vigne et en particulier sur laoutment des serments. Thesis Sci. Nat. Bardeux, France p. 34.

Burns, J.K. and Pressey, R. (1987). Ca^{++} in cell walls of ripening tomato and peach . J. Amer Soc. Hort. Sci., 112 :782-787 .

Carvalho, R.P., Pasqual, M., Silveira, H.R.O., Melo, P.C., Bispo, D.F.A., Laredo, R.R. and Lima, L.A.S. (2019). "Niagara Rosada" table grape cultivated with seaweed extracts, physiological , nutritional and yielding behavior. J. Apple. Phycology, 31(3): 2053-2064.

Cassan, L., Jeannin, I., Lamze, T. and Morot- Gaudry, J.F. (1992). The effect of the ascophyllum nodosumextract Goemer GA 14 on the growth of spijach. Botauca Maarina, 35: 437-439.

Crisosto , C.H. , Day , K.R. , Johnson , R.N. and Garner, D. (2000). Influence of in season folair calcium sprays on fruit quality and surface discoloration incidence of peach and nectarines. J. Amer Pomol Soc., 54 : 118-122

Del Amor, F.M. and Marcelis, L.F.M. (2003). Regulation of nutrient uptake water uptake and growth under calcium starvation and recovering J. Hort. Sci., Biotechnol., 78(3): 343-349.

Derosa, M.R., Monreal, C., Schnitzar, M., Walsh, R. and Sultan, Y. (2010). nanotechnology in fertilizer . Nat. Nanotechnol. J., 5: 91.

Epstein, E. and Bloom, A.J. (2003). Miniural nutrition of plant principles and perspectives 2nd Ed. John Wiley & Sons New York pp. 1-20.

Helper, P.K. (2005): Calcium a central regulator of plant growth and development. The plant Cell, 17(8): 2142-2155.

Hepler, P.K. and Winship, L.J. (2010). Calcium at the cell wallcyto plast interface. J. Integer plant Biol., 52 (2): 147-160.

Kanto, T. (2002). Research of silicate for improvement of plant defense against pathogens in Japan. Abstract of 2nd , silicon in Agric. Conf., pp. 22-26.

Kok, D., Bal, E., Celik, S., Ozer, C. and Karauz, A. (2010). The influences of different seaweed doses on Table quality characteristics of cv. Trakya Llkeren (*Vitis vinifera* L.) Bulgarian Journal of Agricultural Science, 16(4): 429-435.

Kolencik, M., Nemcek, L., Sebesta, M. Urik, M., Ernest, D., Kratesova, G . and Konickova, Z. (2021). Effect of TiO2 as plant growth stimulating nanomaterial on crop production in plant responses to nanomaterials, pp. 129- 144. ISBN.

Lane, J. H. and Eynon, L. (1965). Determination of reducing sugars by means of Fehling's solution with methylene blue as indicator. A.O.AC. Washington D.C.U.S.A., pp. 100-110.

Liu, R. and Lal, R. (2015). Potential of engineered nano particles as fertilizers for increasing agronomic productions. Sci. Total Environ, 514: 131-139.

Marschner , H. (1995). Mineral Nutrient of higher plants 2nd ed . A Ca Demic press , San Diego .

Mata , A.P. , Azner , Y. , Blanco , A. and Val , J. (2001). Evaluacion preliminer del calcimax on manzano para la prevencion del bitter pit. In Alcaraz – CF , carvajal M. Martinez V. (eds) Nutrition mineral en una Agricultura Meditricion sostenible . Vol I. CAAMA-CARM Murcia , pp. 435-441.

Mead, R., Currnow, R. N. and Harted, A. M. (1993). Statistical Methods in Agricultural. Biology. 2nd Ed. Chapman & Hall, London, pp.50 - 70.

Metting, B., Zimmerman, W.J., Crouch, I. and Van- Staden, J. (1990). Agronomic Uses of seaweed and microalgae . In: Akartsuka, I. (ed.) Introduction to Applied phyceology, pp. 589-628. SPB Academic publishing, the Hagu, SBP Academic publishing,

Norrie, J. and Branson, T. (2002). Marine plant extracts in pact on grape yield and quality. Acta Horticulturae, 594: 315-319.

Norrie, J. and Keathley (2005). benefits of *Ascophyllum nodosum* marine – plant extract applications to Thompson seedless grape. Production. X Inter Symposium on plant Bioregulators in fruit product, 727(6): 243-248.

Pararda, J. Gilete, M.L., Friaza, V., Garcia- Martinez, A., Gonzalez- Miret, M.L., Outista, J.D.B. and Heredia, F.J. (2007). Enzymatic vegetable extract with bioactive components: Influence of fertilizer on the colour and anthocyanins of Red grapes, Journal of the Science of Food and Agriculture, 87: 2310-2318.

Pessent, I.L., Ayub, R.A., Marcon, J.L., Clasen, F.C. , Rombaldi, C.V. and Botelho, R.V. (2022). Influence of abscisic acid, *Ascophyllum nodosum* and Aloe Vera on the phenolic composition and color of grape berry and wine of cabernet sauvignon, variety Ciencia Tec. Vitiv, 37(1): 1-12

Prasad, K. and JHa, A.K. (2009): Znonano particly synthesis and adsorption study , Nat, Sci. 1: 129-135.

Rai, V., Achargya, S. and Dey, N. (2012). Implications of nanobiosensors in agriculture, J. of Biomaterials and nanobiitechnology . 3: 315-324.

Salvi, L., Brunetti, C., Cataldo, E., Niccolai, A., Centrito, M., Ferrini, F.

and Mattii, G.B. (2019). Effect of *Ascophyllum nodosum* extract on *Vitis vinifera* consequences on plant physiology grape quality and secondary metabolism plant physio. & Biochem, 139: 21-32.

Taskas, D., Stamatiadis, S, Yvin, J.C. and Jamois, F. (2019). Effects of an *Ascophyllum nodosum* L. Le Jol. Extract on grapevine yield and berry composition of a Merlot vineyard Scientia, Horticulurae, 250: 27-32.

Von- Wettstein, D. V. C. (1957). Clatale und der Sumbmikro Skopisne Formwechsel de Plastids. Experimental Cell Research, 12 :427.

Wilde, S.A., Corey, R.B.; Layer, J.G. and Vdigt, G.K. (1985). Soils and plant Analysis for tree culture. Oxford and IBH publishing Co, New Delhi, India.

Wooldridge , J.P. Joubert, M. E. and Lourens, F. C. (1998). Effects of pre – harvest calcium nitrate and calcium chloride spray on Apple. Deciduous fruit ripening plant cell Environ, 7 : 477-489 .

Zulfiqar, F., Navarro, M., Ashraf. M., Akram, N.A. and Munne, Bosch, S. (2019). Nanofertilizer use for sustainable agriculture Advantages and limitations. Plant Sci., 289: 110270.

Zulfiqar, U., Subhani, T. and Husain, S.A. (2016). Synthesis and characterization of silica nano- particles from clay. J. Asian Ceram. Soc., 4:91-96.

الملخص العربى

تأثير رش سليكات الكالسيوم والنانو كالسيوم ومستخلص الاعشاب البحرية على الانتاجية والحالة الغذائية لكرمات العنب الأوتم رويال تحت ظروف منطقة المنيا

أحمد يوسف السمان * محمود محمد رفاعى**

*قسم بحوث العنب- معهد بحوث البساتين- مركز البحوث الزراعية- الجيزة- مصر

**المعمل المركزى للزراعة العضوية- مركز البحوث الزراعية- الجيزة- مصر

أجريت هذه الدراسة خلال موسمى 2021 و 2022 لاختبار تاثير الرش الورقى لسليكات الكالسيوم بتركيز ما بين 0.05 الى 0.2% ونانو الكالسيةم فى صورة المركب التجارى (كالماجبور) بتركيز ما بين 0.25 الى 0.1% ومستخلص الاعشاب البحرية بتركيز ما بين 0.05 الى 0.2% وذلك لتحسين صفات النمو الخضرى والانتاجية والحالة الغذائية لكرمات العنب الأوتم رويال تحت ظروف منطقة المنيا .تأثرت صفات النمو الخضرى والحالة الغذائية للكرمات وكمية المحصول ووزن العنقود وكذلك الصفات الطبيعية والكيميائية للحبات ايجابيا باستخدام اى من سليكات الكالسيوم او النانو كالسيوم او مستخلص الاعشاب البحرية وذلك بالمقارنة بالكونترول. وكان التحسن متوافقا مع زيادة التركيز المستخدم من هذه المواد وتم الحصول على أفضل النتائج عند استخدام سليكات الكالسيوم والنانو كالسيوم ومستخلص الاعشاب البحرية مرتبة ترتيبا تصاعدياً. ولم يكن لزيادة التركيز المستخدم من هذه المواد من التركيز الأوسط الى الأعلى اية تأثيرات واضحة على الصفات تحت الدراسة. كما أظهرت النتائج أن رش كرمات العنب الأوتم رويال ثلاثة مرات خلال موسم النمو بمستخلص الأعشاب البحرية بتركيز 0.2% أدى الى الحصول على أعلى محصول وتحسين جودة الحبات.