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A Comparison of the Effects of Magnesium and Potassium Citrate Different Concentration on Productivity of Flame Seedless Grapevines

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Abstract: Magnesium (Mg) and potassium (K) are the most crucial elemental constituents of chlorophyll molecules that regulate photosynthesis processes and affect grape production and quality. The production response of 'Flame Seedless' grapes was assessed under varying amounts of magnesium (0.05, 0.1, and 0.2%) and potassium citrate (250, 500, and 1000 ppm) via foliar application during 2023 and 2024 in Minia Governorate conditions. In a complete randomized block design with three replicates, findings indicated that during both seasons, foliar application of potassium citrate was more effective than magnesium, particularly at 1000 ppm, followed by 500 ppm, with no significant variation observed between the two concentrations. The foliar spraying with the highest combined concentration yielded the greatest mean values for yield, cluster parameters, and berry physicochemical features; the two subsequent highest concentrations exhibited no significant variance. These findings indicated that the application of foliar 0.1% Mg+ 500 ppm potassium citrate was the most economically treatment for best yield and fruit quality.

Key words: Magnesium, potassium citrate, yield, fruit quality and Flame seedless.

1. Introduction

The grape cultivation area totaled 85240 hectares, yielding 1435000 tons (**FAO, 2023**). In Egypt, grapes are among the most important and beneficial fruit crops, ranking second to citrus in production volume. The enhancement of grape output resulted from the introduction of novel varieties and the refinement of cultural practices. The Flame seedless grape is an emerging variety in Egypt that has progressively evolved in recent years. A substantial expanse of Flame seedless grapevine is being cultivated in the recently recovered territory along the desert roads in North and Middle Egypt. The Flame Seedless cultivar is acknowledged as a significant commercial and early variety in the Egyptian market. Therefore, it holds significant importance for both local and foreign markets that export to European countries.

Among the objectives of researchers is to enhance fruit output to meet local consumption demands and facilitate exports to international markets. The enhancement could be realized through the importation of cultural methods, including fertilization and the safeguarded cultivation of biotic and abiotic stressors (**Novello and de Palma, 2008**). The growth and productivity of grapevines depend on fertilization, which is a crucial and limiting component. An adequate supply of macro elements is essential for all plants to execute their normal physiological and biochemical functions (**Aly *et al.*, 2020**).

Potassium is a crucial macronutrient, particularly for fruit trees, significantly influencing plant growth and development. Numerous prior research has examined the impact of potassium on the productivity and quality of fruit crops (**Baghdady *et al.*, 2020; Kuzin *et al.*, 2020**). Foliar delivery of potassium is an efficient and rapid method to meet the nutritional requirements of trees during key periods, independent of soil-cation interactions. Nonetheless, a significant competition arises between fresh vegetative growth and fruits as sink organs, adversely affecting potassium uptake and root growth particularly because the levels of potassium in soil are inferior to its other forms: exchangeable and fixed (**Lester *et al.*, 2010**). Potassium, while absent from the structure of any organic substance (**Clarkson and Cooke, 2012**), is the sole element existing in an ionic state within sap plant cells (**Lester *et al.*, 2010**). It plays significant physiological roles in photosynthesis by regulating stomatal closing and opening, osmoregulation, preservation of the turgor pressure within cells, translocation of sugars through the cell division, phloem to fruits, fruit coloration, and the accumulation of soluble solids, potassium bioactive, and fruits pigments. Furthermore, it promotes the activation of enzymes, especially those that become inactive under low temperatures and abiotic stress (**Taha *et al.*, 2014**). Potassium is frequently utilized to enhance quality and yield in diverse crops. The extension of shelf life is similarly associated with adequate potassium feeding (**Thippeshappa *et al.*, 2014**). Furthermore, it is believed that 50 to 90 % of the potassium in applied fertilizers is dissipated into the environment and not assimilated by plants, leading to substantial financial losses (**Solanki *et al.*, 2015**). Foliar application serves merely as a supplementary method to ensure that plants obtain sufficient nutrients, as stated by **Inglese *et al.* (2002**). In crops with extensive leaf surfaces, foliar fertilization cannot substitute for soil fertilization; however, it may enhance the efficiency and absorption of nutrients provided to the soil (**Kannan, 2010**).

Magnesium has an essential function in various physiological processes of plants. Currently, numerous developed nations are altering their agricultural policies to diminish or prohibit chemical substances (**Adnan and Anjum, 2021**). Fertilizers can be applied to crops using foliar spray or soil methods; however, foliar applying is straightforward, cost-effective, and environmentally benign (**Toor *et al.*, 2020; Adnan *et al.*, 2020a; Bilal *et al.*, 2020**). Foliar-applied magnesium is essential for the physiological and biochemical processes in plants (**Adnan *et al.*, 2020b**), such as initiating compounds for protein synthesis, starch metabolism, and energy transfer. Additionally, magnesium functions as a catalyst in reduction and oxidation reactions through plant tissues and improves drought resistance in plants (**Adnan *et al.*, 2021**). Magnesium is an essential for the activation of enzymes involved in nucleic acid synthesis photosynthesis, and respiration, (**Kleczkowski and Igamberdiev, 2021**). The chloroplast complex, responsible for light absorption, contains magnesium as the core atom of the chlorophyll molecule, which is crucial for the photosynthesis of carbon dioxide in plants (**Cakmak and Kirkby, 2008**).

In order to improve the yield, and fruit quality features of the Flame seedless table grape cultivar while it was grown in Minia Governorate conditions, the purpose of this study was to establish the ideal proportions of potassium and magnesium fertilizers that should be applied during the foliar application process.

2. Materials and Methods

2.1. Experimental site

A private vineyard, located in Tandah village, Mallawi, Minya Governoratewas selected as the study site.

Through soil analysis of grapevines in the test site, it was found that the soil of test site was clayey, with organic matter of 1.97%, pH value of 7.33 (1:2.5 extract), EC ppm (1:2.5 extract) of 292 and the nutrient of soil was indicated in Table (A) according to **Wilde *et al.* (1985)**

Table (A). Analysis of the tested soil

Soil characters		2023/2024
Particle size distribution (%)	**Sand**	2.18
	Silt	37.88
	Clay	59.94
	Texture class	Clay
$CaCO_3$ %		2.36
Soil nutrients	**Total N (%)**	0.26
	Available P (ppm)	5.14
	Available K (ppm)	490.5
	Zn (ppm)	2.74
	Fe (ppm)	2.98
	Mn (ppm)	3.59
	Cu (ppm)	0.08

2.2. Treatments description

The study was performed on 30 Flame seedless grapevines, each 10 years old, planted 2×3 m apart and chosen for their uniform vigor. Pruning was conducted in winter during both seasons utilizing the Gable support method for the cane pruning system. Pruning was performed, yielding the retention of 72 eyes (6 fruiting canes, each containing 10 buds plus 6 renewal spurs x 2 eyes) per vine. The vines were subjected to conventional horticultural practices, encompassing fertilization, a surface irrigation system derived from the Nile River, cultivation, and pest and disease management.

The experimental was layout to study the impact of magnesium and potassium citrate on growth, leaves chemical content, yield and its components as well as berries quality of Flame Seedless grapevines across 2023 and 2024 years. The 30 vines were placed in a Complete randomized block design containing three duplicates individual and /or combined as follows:

1. Control (tap water).
2. Magnesium (0.05%)
3. Magnesium (0.1%)
4. Magnesium (0.2%)
5. Potassium citrate (250 ppm)
6. Potassium citrate (500 ppm)
7. Potassium citrate (1000 ppm)
8. Magnesium (0.05%)+Potassium citrate (250 ppm)
9. Magnesium (0.1%)+Potassium citrate (500 ppm)
10. Magnesium (0.2%)+Potassium citrate (1000 ppm)

All applications were executed manually utilizing a sprayer, ensuring that the vines were sprayed until the run off. All the applications were performed thrice at beginning of veraison (vegetative growth), then after fruit set and one month later. Potassium citrate (Duster contain 36% potassium citrate) application was used, while magnesium (Gloco magnesium contain 7% magnesium sulphate).

2.3. Data collection

The subsequent criteria were assessed to evaluate the administered treatments.

2.3.1. Yield and physical attributes of clusters

Nine clusters per vine were taken as representative random samples. The following parameters were determined: Clusters number/vine, weight (g), yield (kg)/vine by multiply the previous parameters, luster dimensions (length and shoulder in (cm)) and berry setting (%) was computed as the following: packed 5 flower clusters per vine in perforated paper bags before bloom, which are discharged during berry set which computed as follows:

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

2.3.2. Physical characteristics of berries

To get the shot berry proportion, the percentage of berries in each cluster was divided by the total number of berries across all clusters and then multiplied by 100. Berry weight (g) and berry dimensions (longitudinal and equatorial).

2.3.3. Chemical characteristics of berries

The following parameters according to (**A.O.A.C, 2000**):

- TSS% in berry juice measured with a handheld refractometer.
- Titrating 5 ml of berry juice against 0.1 N NaOH with phenolphthalein determined the titratable acidity percentage.
- TSS/acidity ratio of berry juice was calculated.
- Reducing sugar%.
- The total anthocyanin content of the berry skin was quantified as mg/100g of fresh weight (**Hsia *et al.* 1965**).

2.4. Data Analysis

All data were analyzed using new L.S.D. technique at 5% according to **Mead *et al.* (1993).**

3. Result and Discussion

3.1. Yield (kg) per vine and cluster physical parameters

The effects of varying magnesium concentrations (0.05%, 0.1%, and 0.2%) and potassium citrate levels (250, 500, and 1000 ppm), both individually and in combination, on the yield and physical characteristics of Flame Seedless grapevine clusters—including cluster number per vine, weight, yield in kg per vine, berry setting %, cluster length, and shoulder—during the 2023 and 2024 growing seasons are presented in Table 1.

The data presented in Table (1) demonstrated that magnesium and/or potassium citrate at varying concentrations significantly enhanced the yield (kg) per vine and cluster physical parameters compared to untreated vines over the two growing seasons, except the cluster number in the 1st season had no significant impact. This increase was proportional to the rising concentrations, with no discernible variation found between the highest consecutive concentrations of all treatments. The use of Mg or K-citrate significantly enhanced the mentioned parameters in both seasons, relative to the control treatment. The effectiveness of potassium citrate treatments, across all concentrations, exceeded that of magnesium treatments alone during both growing seasons. The vines treated with a 1000 ppm K-citrate solution exhibited the highest values of cluster number per vine (27.0 & 31.0), weight (371.0 & 378.0 g), yield per vine (10.1 and 12.1 kg), berry setting % (17.7 & 18.5%), cluster length (19.4 & 20.7 cm), and shoulder (12.5 & 13.5 cm). The reduced concentration yielded a considerable trait; nonetheless, no discernible variation was observed between the two concentrations. The amalgamation of magnesium and potassium citrate produced a substantial enhancement in yield kg/vine and cluster parameters relative to the control and other treatments. The maximum traits occurred with the application of Mg (0.2%) plus potassium citrate (1000 ppm), succeeded by Mg (0.1%) with K-citrate (500 ppm). No substantial difference existed between the two treatments in either season.

Potassium citrate stimulation significantly affects vegetative growth and pigments, subsequently increasing the average weight and number of clusters, so enhancing yield characteristics through photosynthetic production. One possible explanation for potassium's usefulness as a foliar spray is that it decreases transpiration, stabilize cell membranes, enhance photosynthesis, augment energy compounds, promote cell division and elongation, elevate leaf water potential, increase antioxidant levels, and improve nutrient bioavailability through its functional role. Potassium enhances the nutritional content, resulting in elevated levels of GA3 and IAA. These acids promote cellular proliferation and elongation, resulting in an increase in both length and width of the cluster. Similar findings were reported by **Abdel Aal *et al.* (2017)** with Crimson Seedless grapevines and by **Eisa *et al*. (2023**) on Thompson Seedless grapes.

The beneficial impact of magnesium application on grapevine productivity can be ascribed to its function in improving plant metabolism, which is evident in both berry yield and quality. Foliar fertilizers like magnesium improve yield and its components because the mineral plays an important role in the production of organic molecules like carbohydrates and lipids, which are then delivered to the reproductive organs (**Marschner, 2011**). Regarding Mg spray, **Bybordi and Shabanov (2010)** and **Zlámalová *et al.* (2015)** found that foliar treatment of Mg resulted in significantly higher yields relative to the untreated control. The results obtained in this regard align with those of **Farag and Abd El-All (2019); Qaoud and Mohamed (2019); Eisa *et al.* (2023).**

Table (1). Berry setting%, cluster length and cluster shoulder of Flame seedless grapevines as affected by foliar applying with magnesium and K-citrate during 2023 and 2024 growing seasons

Characteristics / Treatments	Cluster number/vine		Cluster weight (g)		Yield/vine (kg)		Berry setting %		Cluster length (cm)		Cluster shoulder (cm)	
	2023	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**
Control	26.0	26.0	339.0	344.0	8.8	8.9	12.1	12.4	17.1	17.5	11.1	11.5
Mg (0.05%)	26.0	28.0	350.0	355.0	9.1	9.9	13.9	14.3	18.3	18.8	11.6	12.2
Mg (0.1%)	26.0	30.0	358.0	364.0	9.3	10.9	15.4	15.7	19.0	19.5	12.1	12.7
Mg (0.2%)	26.0	31.0	363.0	370.0	9.4	11.5	16.6	17.0	19.6	20.0	12.3	13.0
K-citrate (250 ppm)	27.0	29.0	359.0	363.0	9.6	10.6	15.3	15.8	19.1	19.6	12.0	12.7
K-citrate (500 ppm)	27.0	31.0	367.0	372.0	9.9	11.5	16.6	17.3	19.9	20.2	12.4	13.2
K-citrate (1000 ppm)	27.0	32.0	371.0	378.0	10.1	12.1	17.7	18.5	19.4	20.7	12.5	13.5
Mg (0.05%) + K-citrate (250 ppm)	27.0	31.0	366.0	371.0	9.9	11.5	16.7	17.2	20.0	20.3	12.5	13.1
Mg (0.1%) + K-citrate (500 ppm)	27.0	33.0	373.0	380.0	10.1	12.5	17.0	18.6	20.8	20.9	12.8	13.6
Mg (0.2%) + K-citrate (1000 ppm)	27.0	34.0	378.0	385.0	10.2	13.1	18.2	19.9	21.3	21.14	13.0	13.9
New LSD at 0.05	**N.S**	**1.2**	**6.0**	**7.0**	**0.3**	**0.7**	**1.3**	**1.4**	**0.7**	**0.6**	**0.3**	**0.4**

3.2. Physical characteristics of berries

Results from a foliar spraying experiment in 2023 and 2024 showing the effects of magnesium at 0.05, 0.1, & 0.2%, and potassium citrate at 250, 500, & 1000 ppm, on the physical characteristics of berries of "Flame Seedless" grapevines compared to untreated vines in terms of shot berries, average berries weight, longitudinal and equatorial are presented in Table (2).

Table (2) showed that compared to the control treatment, applications of magnesium and/or potassium citrate three times to the vines decreased the shot berry percentage and increased average berries weight, longitudinal and equatorial. Furthermore, the statistical analysis indicated a significant difference across both seasons. The minimum percentage of shot berries and maximum of average berries weight, longitudinal and equatorial were reported with potassium citrate at 1000 ppm, followed by 500 ppm, with no noteworthy variation between the two as individual treatments. The identical tendency prevailed in both seasons. The data in the same Table demonstrated that the combination of magnesium and K-citrate resulted in decreased shot berry percentage for all treatment combinations compared to the untreated vines. The minimum recorded shot berry percentage was (5.8 & 5.5) and maximum scored for average berries weight was (3.75 & 3.86 g), longitudinal (1.89 & 1.92 cm) and equatorial (1.63 & 1.67 cm) for Mg (0.2%) + K-citrate (1000 ppm), followed by Mg (0.1%) + K-citrate (500 ppm), with no noteworthy variation observed between these treatments throughout the 2023 and 2024 seasons. Over two seasons, the control vines consistently attained the highest percentage of shot berries and lowest for average berries weight, longitudinal and equatorial, whilst the other treatment groups yielded intermediate values.

Applying magnesium increased the physical qualities of berries since it is a necessary element for chlorophyll molecule structure, which boosts chlorophyll production (**Papadakis *et al*., 2023**). Considering the magnesium spray, **Farag and Abd El-All (2019); Qaoud and Mohamed (2019); Eisa *et al*. (2023); El-Katawy *et al.* (2024)** they all mentioned that spraying with different forms of Mg led to an increase in physical berries quality at different varieties of grapevines

The influence of potassium on the physical quality of berries aligns with the findings of **Uwakiem (2015), Ahmed *et al.* (2018), Abdel Aal *et al*. (2017**), and **Eisa *et al.* (2023**), all of whom reported that foliar application of various potassium forms enhanced berry attributes such as diameter, firmness, weight, and volume of 100 berries as well as shot berry %, berries longitudinal and equatorial.

Table (2). Average shot berries, berry weight (g), berry longitudinal and berry equatorial of Flame seedless grapevines as affected by foliar applying with magnesium and K-citrate during 2023 and 2024 growing seasons

Characteristics / Treatments	Shot berries %		Berry weight (g)		Berry longitudinal (cm)		Berry equatorial (cm)	
	2023	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**
Control	9.0	9.2	3.45	3.51	1.69	1.75	1.48	1.53
Mg (0.05%)	8.1	8.3	3.55	3.62	1.74	1.80	1.54	1.58
Mg (0.1%)	7.4	7.5	3.62	3.70	1.77	1.85	1.59	1.62
Mg (0.2%)	7.0	7.1	3.68	3.77	1.79	1.88	1.60	1.64
K-citrate (250 ppm)	7.3	7.6	3.63	3.71	1.78	1.85	1.57	1.63
K-citrate (500 ppm)	6.7	7.0	3.70	3.80	1.81	1.90	1.61	1.66
K-citrate (1000 ppm)	6.4	6.5	3.75	3.86	1.82	1.92	1.63	1.67
Mg (0.05%) + K-citrate (250 ppm)	6.8	6.9	3.70	3.79	1.82	1.89	1.60	1.66
Mg (0.1%) + K-citrate (500 ppm)	6.2	6.1	3.78	3.87	1.85	1.95	1.64	1.71
Mg (0.2%) + K-citrate (1000 ppm)	5.8	5.5	3.84	3.94	1.87	1.98	1.66	1.73
New LSD at 0.05	**0.5**	**0.6**	**0.07**	**0.08**	**0.03**	**0.04**	**0.03**	**0.03**

3.3. Chemical characteristics of berries

In 2023 and 2024, the impacts of varying doses of magnesium combined with potassium citrate on the chemical properties of the "Flame Seedless" grapevine variety were compared to those of untreated vines. The findings are displayed in Table 3. The criteria include TSS%, total acidity, TSS/TA ratio, total anthocyanin (mg/100g FW), and reducing sugar percentage.

Table 3 demonstrated that all spraying treatments considerably enhanced the TSS%, TSS/TA ratio, total anthocyanin (mg/100g FW), and reducing sugar percentage, while reduce total acidity compared to the control group, which received tap water sprays. The optimal results for TSS%, TSS/TA ratio, total anthocyanin (mg/100g FW), and reducing sugar % and lowest total acidity in the berries were achieved on the vines treated with 1000 ppm K-citrate. No substantial variations were observed at 500 and 1000 ppm K-citrate. The highest percentages of TSS%, TSS/TA ratio, total anthocyanin (mg/100g FW), and reducing sugars were (20.2-20.6%, 31.4-33.1, 26.7-27.1 mg/100g and 16.5-17.3%) and lowest total acidity (0.636-.623%), respectively in the two seasons, were observed in vines treated with 1000 ppm potassium citrate. Conversely, the lowest percentages recorded with vines that received water spraying.

The proportion of mentioned traits exhibited a statistically significant difference among the various combinations of magnesium and potassium citrate treatments applied as foliar sprays three times. A considerable enhancement in Flame seedless grapevines was observed, as the TSS%, TSS/TA ratio, total anthocyanin (mg/100g FW), and reducing sugar % increased and total acidity decreased with increasing concentrations of dual applications compared to individual use, with no notable variations between the two higher levels when contrasted with the control. The maximum percentage of TSS%, TSS/TA ratio, total anthocyanin (mg/100g FW), and reducing sugar % recorded with 0.2% Mg+1000 ppm of K-citrate, and the same treatment reduced the total acidity. Consequently, the percentage increase in TSS%, TSS/TA ratio, total anthocyanin (mg/100g FW), and reducing sugar and decrease in total acidity content in berries due to the specified treatment compared to the water-sprayed control was 11.96-12.37%, 30.59-35.41%, 9.6-9.13%, 12.00-13.46% and 14.29-17.24%, respectively, throughout two seasons.

Malakouti (2006) indicated that the spraying of magnesium solution enhanced the transfer of photosynthetically produced elements from the leaf to the grape fruit. Furthermore, **Bybordi and Shabanov (2010)** discovered that an increase in magnesium application resulted in elevated leaf chlorophyll content and, thus, enhanced photosynthesis levels, leading to a substantial rise in total soluble solids percentages. Furthermore, the significance of magnesium in cellular division and glucose metabolism (**Ilyas *et al.*, 2014**). In the same concern, **Mostafa *et al.* (2017)**; **Farag and Abd El-All (2019); Qaoud and Mohamed (2019); Eisa *et al.* (2023)** they all found a superior chemical parameters of different grapevines varieties were observed due to foliar spray by different magnesium at different concentrations.

The augmentation of fruit weight and length, enhancing fruit yield and quality, could be linked to potassium, which modulates various enzymatic activities in plants by altering the photosynthetic rate and elevating the translocation rate from leaves through the phloem to storage tissues (**Doaa *et al.*, 2019; Kumaran *et al.*, 2019**). Previous studies (**Amiri and Fallahi, 2007; Ashraf *et al.*, 2010; Upadhyay *et al.*, 2019**) indicated that potassium spraying enhanced fruit quality by increasing chlorophyll concentration, which subsequently improved photosynthetic products, fruit size, juice content, color, and flavor. These findings are consistent with **Abdel Aal *et al.* (2017)** resulted that the use of 0.1% potassium silicate spray three times enhanced the total soluble solids percentage, acidity, TSS/acidity ratio, reduced sugar content, and overall anthocyanin levels in Crimson seedless grapevines. Furthermore, **Awad *et al.* (2023)** observes that applying of potassium silicate at a dose of 5g/L on vines markedly enhanced the TSS/acid ratio while reducing the overall acidity of grape juice berries.

Table (3). T.S.S%, total acidity, T.S.S/acidity, reducing sugar% and total anthocyanin (mg/100g FW) of Flame seedless grapevines as affected by foliar applying with magnesium and K-citrate during 2023 and 2024 growing seasons

Treatments \ Characteristics	TSS%		Total acidity%		TSS/acidity ratio		Total anthocyanin (mg/100g FW)		Reducing sugar%	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
Control	18.4	18.6	0.721	0.725	25.5	25.7	25.0	25.2	15.1	15.6
Mg (0.05%)	18.9	19.0	0.698	0.700	27.1	27.1	25.6	25.9	15.6	16.0
Mg (0.1%)	19.4	19.5	0.678	0.677	28.6	28.8	26.0	26.4	16.0	16.5
Mg (0.2%)	19.7	19.8	0.660	0.657	29.8	30.1	26.3	26.6	16.1	16.8
K-citrate (250 ppm)	19.3	19.6	0.677	0.665	28.5	29.5	26.1	26.3	15.9	16.5
K-citrate (500 ppm)	19.7	20.2	0.655	0.643	30.1	31.4	26.5	26.8	16.3	16.9
K-citrate (1000 ppm)	20.2	20.6	0.636	0.623	31.4	33.1	26.7	27.1	16.5	17.3
Mg (0.05%) + K-citrate (250 ppm)	19.8	20.0	0.656	0.640	31.2	31.3	26.5	26.7	16.4	16.9
Mg (0.1%) + K-citrate (500 ppm)	20.3	20.5	0.636	0.617	31.9	33.2	27.1	27.2	16.7	17.4
Mg (0.2%) + K-citrate (1000 ppm)	20.6	20.9	0.618	0.600	33.3	34.8	27.4	27.5	16.9	17.7
New LSD at 0.05	**0.4**	**0.5**	**0.020**	**0.021**	**1.5**	**1.8**	**0.4**	**0.4**	**0.3**	**0.4**

4. Conclusion

The fruit quality properties of Flame seedless grapevines can be significantly improved by the applied treatments. The results indicate that the use of any of the tested materials alone yielded superior outcomes compared to the control group. Optimal results were observed when both evaluated materials were applied together. The sequential application of 0.2% magnesium combined with 1000 ppm potassium citrate, followed by 0.1% magnesium with 500 ppm potassium citrate, yielded optimal results in enhancing leaf total chlorophyll content, thereby facilitating carbohydrate production via photosynthesis and promoting vegetative growth, which subsequently improved yield and fruit quality attributes. So, it could be concluded that treating Flame Seedless grapevines cultivated in the Minia region three times—at the onset of veraison, post-fruit set, and one month thereafter—with a mixture of 0.1% magnesium and 500 ppm potassium citrate yielded the most favorable economic outcomes concerning yield and berry quality.

References

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

Abdel Aal, A. M. K.; Abada and Hesham, M. A.M. & 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.

Adnan, M. & Anjum, M. Z. (2021). Back to past; organic agriculture. Acta Scientific Agriculture, 5(2), 01-02.

Adnan, M., Abbas, B., Asif, M., Hayyat, M. S., Raza, A., Khan, B. A., Hassan, H., Khan, M.A.B., Toor, M.D. & Khalid, M. (2020a). Role of micro nutrients bio-fortification in agriculture: A review. International Journal of Environmental Sciences & Natural Resources, 24(4), 209-213.

Adnan, M., Hayyat, M. S., Imran, M., Rehman, F. U., Saeed, M. S., Mehta, J. & Tampubolon, K. (2020b). Impact of foliar application of magnesium fertilizer on agronomic crops: A review. Ind. J. Pure Appl. Biosci, 8, 281-288.

Adnan, M., Tampubolon, K., ur Rehman, F., Saeed, M. S., Hayyat, M. S., Imran, M., Tahir, R. & Mehta, J. (2021). Influence of foliar application of magnesium on horticultural crops: A review. Agrinula: Jurnal Agroteknologi dan Perkebunan, 4(1), 13-21.

Ahmed, F., Abdelaal, A., El-Masry, S. E. & Metwally, M. (2018). Trials for improving the productivity and reducing shot berries in superior grapevines by using silicon and glutathione. Journal of Productivity and Development, 23(1), 23-38.

Aly, M., Harhash, M. M., El-Kharpotaly, A. A. & Younes, A. H. A. (2020). Yield and Quality of Table Grapes cv. Flame Seedless as affected by Bud Break and Pre-Harvest Treatments. Journal of the Advances in Agricultural Researches, 25(3), 312-323.

Amiri, M. E. & 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. & 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. & 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.

Baghdady, G. A., Abdrabboh, G. A. & Shahda, M. A. (2020). Effect of some preharvest treatments on yield and fruit quality of Crimson seedless grapvines. Environ. Sci, 15(3), 1-14.

Bilal, H. H., Tahir, R., Adnan, M., Ali, S. M., Islam, H., Umer, M. S., Mir, F.A., Ahmad, R.I. & Iftikhar, M. (2020). Does foliar application of macro and micronutrients have any impact on roses production? A review. Annals of Reviews and Research, 6(1), 555677.

Bybordi, A. & Shabanov, J. A. (2010). Effects of the foliar application of magnesium and zinc on the yield and quality of three grape cultivars grown in the calcareous soils of Iran. Notulae Scientia Biologicae, 2(2), 81-86.

Cakmak, I. & Kirkby, E. A. (2008). Role of magnesium in carbon partitioning and alleviating photooxidative damage. Physiologia plantarum, 133(4), 692-704.

Clarkson, D. T. & Cooke, D. T. (Eds.). (2012). Transport and receptor proteins of plant membranes: molecular structure and function. Springer Science & Business Media. Springer; Berlin/Heidelberg, Germany

Doaa, M. H., Sefan, R. F. & El-Boray, M. S. (2019). Effect of potassium nano fertilizer on yield and berry qualities of ‘Flame seedless’ grapevines. Journal of Plant Production, 10(11), 929-934.

Eisa, R. A., Merwad, M. A. & 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-Katawy, M. F. A., Abdel Ghany, N., Ibrahim, M. F. M., Ghobrial, G. F. & Nasser, A. E. H. (2024). Effect of Calcium, Magnesium Fertigation and Molybdenum Foliar Sprays on Yield and Fruit Quality of Flame Seedless Table Grape Cultivar. Arab Universities Journal of Agricultural Sciences, 32(1), 99-111.

FAO (2023). Crops and livestock products. Accessed 4/8/2023. https://www.fao.org/faostat/ar/#data/QCL

Farag, A. R. A. & Abd El-All, A. E. A. (2019). Effect of summer pruning and magnesium spray on the microclimate and berry quality of flame seedless grapevines and carbohydrate export. Egypt. J. of Appl. Sci., 34 (11), 272-289.

Hsia, C. L., Luh, B. S. & Chichester, C. O. (1965). Anthocyanin in freestone peaches. Journal of Food Science, 30(1), 5-12.

Ilyas, M., Ayub, G., Hussain, Z., Ahmad, M., Bibi, B. & Rashid, A. (2014). Response of tomato to different levels of calcium and magnesium concentration. World Applied Sciences Journal. 13, 1560-1564.

Inglese, P., Gullo, G. & Pace, L. S. (2000, September). Fruit growth and olive oil quality in relation to foliar nutrition and time of application. In IV International Symposium on Olive Growing 586 (pp. 507-509).

Kannan, S. (2010). Foliar fertilization for sustainable crop production. Genetic engineering, biofertilisation, soil quality and organic farming, 371-402.

Kleczkowski, L. A. & Igamberdiev, A. U. (2021). Magnesium signaling in plants. International Journal of Molecular Sciences, 22(3), 1159.

Kumaran, P.B., Venkatesan, K., Subbiah, A. & 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.

Kuzin, A. I., Kashirskaya, N. Y., Kochkina, A. M. & Kushner, A. V. (2020). Correction of potassium fertigation rate of apple tree (Malus domestica Borkh.) in central Russia during the growing season. Plants, 9(10), 1366.

Lester, G. E., Jifon, J. L. & Makus, D. J. (2010). Impact of potassium nutrition on postharvest fruit quality: Melon (Cucumis melo L) case study. Plant and soil, 335, 117-131.

Malakouti, M. J. (2006). Nutritional disorders in fruit trees on the calcareous soils of Iran. In Proceedings of the 18th World Congress of Soil Science: Frontiers of Soil science Technology and the Information Age. Philadelphia, Pennsylvania, USA.

Marschner, H. (Ed.). (2011). Marschner's mineral nutrition of higher plants. Academic press. London UK: Pp. 672.

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

Mohamed, A. A., Ahmed, A. H., Mansour, H. A. & Omar, M. N. (2024). Influence of Spraying Kaolin and Potassium Silicate on Quality, Storability and Fungal Diseases Control of "King Roby" Grapevine. Egyptian Journal of Horticulture, 51(2), 233-250.

Mostafa, M. F. M., El-Boray, M. S., El-Baz, E. L. & Omar, A. S. (2017). Effect of fulvic acid and some nutrient elements on king ruby grapevines growth, yield and chemical properties of berries. Journal of Plant Production, 8(2), 321-328.

Novello, V. & de Palma, L. (2006, February). Growing grapes under cover. In International Symposium on Grape Production and Processing 785 (pp. 353-362).

Papadakis, I. E., Antonopoulou, C., Sotiropoulos, T., Chatzissavvidis, C. & Therios, I. (2023). Effect of Magnesium on Mineral Nutrition, Chlorophyll, Proline and Carbohydrate Concentrations of Sweet Orange (*Citrus sinensis* cv. Newhall) Plants. Applied Sciences, 13(14), 7995.

Qaoud, E. S. M. & Mohamed, M. A. (2019). Using boron, magnesium and some amino acids to improve yield and fruit quality of Roomy Red grapevines. Hortscience Journal of Suez Canal University, 8(1), 79-86.

Solanki, P., Bhargava, A., Chhipa, H., Jain, N. & Panwar, J. (2015). Nano-fertilizers and their smart delivery system. Nanotechnologies in food and agriculture, 81-101.

Taha, R. A., Hassan, H. S. A. & Shaaban, E. A. (2014). Effect of different potassium fertilizer forms on yield, fruit quality and leaf mineral content of Zebda mango trees. Middle-East Journal of Scientific Research, 21(1), 123-129.

Thippeshappa, G. N., Ravi, C. S. & Ramesha, Y. S. (2014). Influence of soil and foliar application of silicon on vegetative characters, fruit yield and nutrients content of sapota leaf. Research on Crops, 15(3), 626-630.

Toor, M. D., Adnan, M., Javed, M. S., Habibah, U., Arshad, A., Din, M. M. & Ahmad, R. (2020). Foliar application of Zn: Best way to mitigate drought stress in plants; A review. International Journal of Applied Research, 6(8), 16-20.

Upadhyay, A.K., Jagdev, S., Kumar, S.A., Jinal, L. & 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.

Uwakiem, M. K. (2015). Effect of spraying silicon, selenium and humic acid on fruiting of Early Sweet grapevines. In The 2nd Inter. Conf. on Hort. Crops. 15-18 March., Egypt. J. Hort. 42 (1), 333-343.

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

Zlámalová, T., Elbl, J., Baroň, M., Bělíková, H., Lampíř, L., Hlušek, J. & Lošák, T. (2015). Using foliar applications of magnesium and potassium to improve yields and some qualitative parameters of vine grapes (*Vitis vinifera* L.). Plant, Soil and Environment 61 (10), 451–7.

مقارنه تركيزات مختلفة من الماغنسيوم و سترات البوتاسيوم على إنتاجية العنب فليم سيدلس

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يعتبر كل من الماغنسيوم و البوتاسيوم من أهم العناصر حيث تدخل فى تكوين جزئ الكلوروفيل الذى ينظم عمليه التمثيل الضوئى و بالتالى يؤثر على إنتاجية و جودة العنب. تم تقييم إستجابة إنتاج عنب فليم سيدلس بتركيزات مختلفة من الرش الورقى لكل من الماغنسيوم (٠,٠٥، ٠,١ و ٠,٢%) و سترات البوتاسيوم (٢٥٠، ٥٠٠ و ١٠٠٠ جزء فى المليون) خلال عامى ٢٠٢٣ و ٢٠٢٤ تحت ظروف محافظة المنيا. من خلال تصميم كامل العشوائية فى ٣ مكررات أشارت النتائج المتحصل عليها خلال الموسمين أن الرش الورقى بسترات البوتاسيوم كان الأكثر فعاليه فى زيادة الإنتاجية و الجوده عن الرش بالماغنسيوم و خاصة عند إستخدام معدل ١٠٠٠ جزء فى المليون يليه ٥٠٠ جزء فى المليون مع عدم وجود فرق معنوي بينهما. و لكن عند الرش الورقى بأعلى تركيز مشترك بينهما سجل أفضل القيم للمحصول و صفات العناقيد و الصفات الفيزيائية و الكيميائية للحبات و لم يلاحظ أى إختلاف معنوي بين أعلى تركيزين مشترك متتالين. و بالتالى تشير النتائج إلى أن الرش الورقى بإستخدام ٠,١% ماغنسيوم + ٥٠٠ جزء فى المليون سترات بوتاسيوم كان أفضل معاملة إقتصاديا للحصول على أفضل محصول من الفليم سيدلس بأفضل جوده.

الكلمات المفتاحيه: ماغنسيوم، سترات بوتاسيوم، محصول، جوده ثمار فليم سيدلس