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FFECT OF SUMMER PRUNING AND MAGNESIUM SPRAY ON THE MICROCLIMATE AND BERRY QUALITY OF FLAME SEEDLESS GRAPEVINES AND CARBOHYDRATE EXPORT

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ABSTRACT

This investigation was carried out for two successive seasons (2017 & 2018) in a private vineyard located at El-Nubaria region, El-Behira governorate, Egypt to study the effect of summer pruning practices and magnesium ($MgSO_4$) spray on the microclimate, vegetative growth, yield and bunch quality of Flame Seedless grapevines. The vines were seven years old, grown in a sandy soil, spaced at 2 X 3 meters apart, irrigated by the drip irrigation system, cane-pruned and trellised by the Spanish Parron system. The vines were pruned during the first week of January in both seasons of the study so as to maintain a load of 90 buds/vine (9 canes X 10 buds/vine).

Nine treatments were carried out as follows: control (untreated vines), pinching the main shoots, defoliation, foliar spraying with 1% $MgSO_4$ once, foliar spraying with 1% $MgSO_4$ twice, pinching + foliar spraying with 1% $MgSO_4$ once, pinching + foliar spraying with 1% $MgSO_4$ twice, defoliation + foliar spraying with 1% $MgSO_4$ once as well as defoliation + foliar spraying with 1% $MgSO_4$ twice. Pinching the main shoots treatment was applied just after fruit set stage, while defoliation treatment was carried out at veraison stage. Foliar spraying with 1% $MgSO_4$ was applied either once just after fruit set stage or twice after fruit set stage and two weeks later.

The results showed that all summer pruning and magnesium spray treatments either alone or in combination among them had the best results in comparison with control in both seasons. Pinching the main shoots + foliar spraying with 1% MgSO4 twice recorded the best canopy microclimate, which reflected in achieving the highest yield and its components, improving the physical and chemical properties of berries, ensuring the best vegetative growth traits and increasing leaf content of total chlorophyll, nitrogen, phosphorus and potassium and cane content of total carbohydrates for Flame Seedless grapevines.

INTRODUCTION

Summer pruning is considered as a complementary process for the preceding winter pruning and a preparatory practice for the subsequent one. It gains its importance from the fact that it is used as a useful means for maintaining vine balance between vegetative growth and productivity **(Crescimanno *et al.*, 2011).** Neglecting or carrying out summer pruning incorrectly has been accompanied with undesirable influence on the yield and fruit quality of the current year besides the following one. Many workers reviewed the effect of summer pruning on growth and fruiting of various grape cultivars. They emphasized the necessity of summer pruning for enhancing growth and production of grapes **(Abd El-Wahab *et al.*, 1997; Ibrahim *et al.*, 2001 and Abd El-Wadoud, 2015).**

Shoot pinching has a definite place as a principal element of summer pruning practices, it is mainly done to regulate the growth, and provide better ventilation and light interception into the vine canopy; since this technique has been found to increase carbohydrate content of the shoots which was reflected on bud fertility, yield and its components and fruit quality of various grape cultivars **(Abd El-Wahab *et al.*, 1997; Ibrahim *et al.*, 2001 and Omar 2004).**

Defoliation or leaf removal is of utmost importance that bunches should be exposed to sunlight during ripening for obtaining the best colouration of berries **(Dokoozlian *et al.*, 1995).** Some reports mentioned that partial defoliation of plants enhanced the efflux of assimilates from the remaining leaves **(Koblet *et al.*, 1996).** The removal of basal leaves around the bunch is widely adopted to improve the microclimate in the canopy, promotes good ripening of the grapes and reduces the incidence of fungal infection **(Di Lorenzo *et al.*, 2011).**

Magnesium (Mg) is an essential macro-element for plant growth. Mg is a constituent of the chlorophyll molecule and thus is indispensable for photosynthesis by plants as an activator of numerous enzymes and it is also a structural component of ribosome **(Mengel and Kirkby 2001).** In addition, it plays a vital role in all the biochemical and physiological processes of plants by different pathways such as metabolism of carbohydrates, energy transfer and synthesis of proteins, fats and nucleic acids **(Cakmak and Yazici, 2010).**

The aim of this study was to improve vegetative growth, yield and bunch quality through the application of some summer pruning practices and magnesium spray on Flame Seedless grapevines.

MATERIALS AND METHODS

This investigation was carried out for two successive seasons (2017 & 2018) in a private vineyard located at El-Nubaria region, El-Behira governorate, Egypt to study the effect of summer pruning practices and magnesium ($MgSO_4$) spray on the microclimate, vegetative growth, yield and bunch quality of Flame Seedless grapevines. The vines were seven years old, grown in a sandy soil (Table, 1), spaced at 2 X 3 meters apart, irrigated by the drip irrigation system, cane-pruned and trellised by the Spanish Parron system. The vines were pruned during the first week of January in both seasons of the study so as to maintain a load of 90 buds/vine (9 canes X 10 buds/vine).

Table (1): Physical and chemical analysis of the vineyard soil

Physical	**Sand (%)**	**91.3**
	Silt (%)	**4.6**
	Clay (%)	**4.1**
	Texture	**Sandy**
Chemical	**Organic matter (%)**	**1.3**
	PH (1:2.5 Extract)	**8.8**
	EC (Mmhos/cm)	**0.33**
	Ca Co_3 (%)	**0.47**
	N (meq/L)	**7.3**
	P (meq/L)	**1.4**
	K (meq/L)	**0.21**
	Ca (meq/L)	**1.15**
	Mg (meq/L)	**0.53**
	Fe (meq/L)	**0.17**
	Zn (meq/L)	**0.23**
	Mn (meq/L)	**0.15**
	Cu (meq/L)	**0.04**

One hundred and eight uniform vines were chosen on the basis their growth depending on weight of prunings and trunk diameter of the vine as indirect estimates for vine vigour. Each four vines acted as a replicate and each three replicates were treated by one of the following treatments.

Nine treatments were applied as follows:

1. Control (untreated vines)
2. Pinching the main shoots (by cutting off 2-3 cm. of the shoot tip)
3. Defoliation (by removal of leaves beneath the bunches)
4. Foliar spraying with 1% $MgSO_4$ once
5. Foliar spraying with 1% $MgSO_4$ twice
6. Pinching + foliar spraying with 1% $MgSO_4$ once
7. Pinching + foliar spraying with 1% $MgSO_4$ twice
8. Defoliation + foliar spraying with 1% $MgSO_4$ once
9. Defoliation + foliar spraying with 1% $MgSO_4$ twice

Pinching the main shoots treatment was applied just after fruit set stage, while defoliation treatment was carried out at veraison stage. Foliar spraying with 1% $MgSO_4$ was applied either once just after fruit set stage or twice after fruit set stage and two weeks later.

The following parameters were measured to evaluate the tested treatments:-

1. **Microclimatic data**

Data of microclimatic factors were recorded after one week of veraison stage for each treatment and compared with those of the untreated treatments to identify the effect of each compound in ameliorating the bunch microclimate as follow:

a. Light intensity (Lux).
b. Air temperature (^{o}C).
c. Relative humidity (%)

Light intensity (Lux) was measured using "Light probe meter", while air temperature (^{o}C) and relative humidity(%) were measured using "Big Digit Hygro-Thermometer".

All the above-mentioned measurements were used by the microprocessor of the apparatus to calculate the average of canopy microclimate next to bunch in order to find the relationship between the microclimate and the effect of different treatments that were used in this investigation.

2. Yield and physical characteristics of bunch

Representative random samples of nine bunches/vine were harvested at maturity when TSS reached about 16-17% according to **Tourky *et al.*, (1995).**

Yield/vine (kg) was determined as number of bunches/vine X average bunch weight (g). Average bunch weight (g) and average bunch dimensions (length and width) (cm) were determined.

3. Physical properties of berries

Average berry weight (g), average berry size (cm^3) and average berry dimensions (length and diameter) (cm) were determined.

4. Chemical properties of berries

Total soluble solids (TSS %) in berry juice by hand refractometer and total titratable acidity expressed as tartaric acid (%) were determined according to **(A.O.A.C. 1985).** Hence, TSS /acid ratio was calculated. Total anthocyanin of the berry skin (mg/100g fresh weight) was determined according to **Husia *et al*., (1965).**

5. Morphological characteristics of vegetative growth

During the third week of June, the following morphological studies were conducted on four fruitful shoots/the considered vines:

a- Average leaf area (cm^2) was taken from the apical 5th and 6th leaves on the main shoot/vine and measured by using a CI-203- Laser Area-meter made by CID, Inc., Vancouver, USA.

b- Coefficient of wood ripening was calculated by dividing length of the ripened part of the shoot by the total length of the shoot according to **Bouard (1966).**

c- Weight of prunings (Kg) was estimated at dormancy period (winter pruning).

6. Chemical characteristics of vegetative growth

During the fourth week of June, samples of leaves were taken from the apical 5th and the 6th leaves on the main shoot/vine, the following aspects were determined.

a- Leaf total chlorophyll content: it was determined by using nondestructive Minolta chlorophyll meter SPAD 502 **(Wood *et al.*, 1992).**

b- Leaf content of mineral elements: Nitrogen (%) was determined using the modified micro-Kjeldahl method according to **Pregl, (1945).** Phosphorus (%) was determined calorimetrically estimated according to **Snell and Snell (1967).** Potassium (%) was determined photometrically estimated according to **Jackson, (1967).**

c- Cane content of total carbohydrates (%): samples of canes were taken during the first week of January and determined according to **Smith *et al.*, (1956).**

- **Experimental design and statistical Analysis**

The randomized complete block design was adopted for this experiment. The statistical analysis of the present data was carried out according to **Snedecor and Cochran (1980).** Averages were compared using the new L.S.D. values at 5% level **(Steel and Torrie, 1980).**

RESULTS AND DISCUSSION

1. Microclimatic data

Data presented in (Table, 2) revealed that all microclimatic data *i.e.* light intensity, air temperature and relative humidity were significantly affected by all summer pruning either solely or in combined with magnesium spray as compared to untreated vines (control) in both seasons.

a. Light intensity (Lux).

Highest significant values of light intensity were occurred by pinching the main shoots followed by defoliation, while both control and magnesium spray treatments resulted in the least values in both seasons.

b. Air temperature (^{o}C).

Pinching the main shoots significantly resulted in the least values of air temperature followed by defoliation, whereas both control and magnesium spray treatments resulted in the highest values in both seasons.

c. Relative humidity (%)

Least significant values of relative humidity were obtained by pinching the main shoots followed by defoliation, while both control and magnesium spray treatments resulted in the highest values in both seasons.

The positive effect of summer pruning treatments on canopy microclimatic could be attributed to that summer pruning helps in ameliorating fruit quality by more exposure to sunlight and generally exhibiting higher concentrations of sugars and lower acidity in grape juice compared to those ripened in dense canopy shade **(Kliewer *et al.*, 1988).** Moreover**, Omar (2005)** reported that leaf removal allows the light to penetrate the canopy of the vine resulting in an increase in the photosynthetic activity of the leaves inside the canopy and permits air circulation raising temperature inside the canopy, consequently, ripening is promoted through the positive influence on grape composition *i.e.* increasing TSS and decreasing acidity. In addition to, summer pruning increases solar radiation received by the leaves in the interior canopy, which by its turn increases photosynthetic activity of the leaves and consequently carbohydrate accumulation **(Kliewer, 1981).** Shoot tipping improves the movement of photosynthetic towards the main shoot via removing the part of shoot tip, which consumes photosynthetic **(Abd El-Ghany *et al.*, 2005).**

Table (2): Effect of summer pruning and magnesium spray on the microclimate of Flame Seedless grapevines in 2017 and 2018 seasons.

Caracteristics / Treatments	Light intensity (Lux)		Air temperature (^oC)		Relative humidity (%)	
	2017	2018	2017	2018	2017	2018
Control (untreated vines)	27.03	28.29	32.22	33.76	24.76	25.94
Pinching the main shoots	27.71	28.99	31.45	33.07	24.17	25.41
Defoliation	27.39	28.63	31.86	33.43	24.48	25.69
Foliar spraying with 1% $MgSO_4$ once	27.15	28.43	32.07	33.62	24.64	25.83
Foliar spraying with 1% $MgSO_4$ twice	27.26	28.54	31.98	33.54	24.57	25.77
Pinching + foliar spraying with 1% $MgSO_4$ once	27.79	29.04	31.34	32.95	24.08	25.32
Pinching + foliar spraying with 1% $MgSO_4$ twice	27.92	29.15	31.19	32.78	23.97	25.19
Defoliation + foliar spraying with 1% $MgSO_4$ once	27.48	28.70	31.72	33.26	24.37	25.56
Defoliation + foliar spraying with 1% $MgSO_4$ twice	27.59	28.85	31.61	33.17	24.29	25.49
new L.S.D. at (0.05) =	0.63	0.69	0.71	0.74	0.52	0.55

2. Yield and bunch physical characteristics

As shown in (Table 3), it is obvious that all summer pruning and magnesium spray treatments were significantly affected the yield/vine and its components as compared with untreated vines (control) in both seasons. Highest significant yield was attained by pinching the main shoots + foliar spraying with 1% MgSO4 twice treatment in both seasons. The beneficial effect of summer pruning and magnesium spray treatments on the yield could be ascribed mainly to the increase in bunch weight in the first season and the increase of number of bunches /vine beside the increase in bunch weight in the second season.

Table (3): Effect of summer pruning and magnesium spray on yield and bunch physical characteristics of Flame Seedless grapevines in 2017 and 2018 seasons.

Caracteristics / Treatments	Yield/vine (kg)		No. of bunches		Average bunch weight (g)		Average bunch length (cm)		Average bunch width (cm)	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Control (untreated vines)	13.69	15.14	32.3	33.4	423.7	453.4	23.84	23.88	13.65	13.68
Pinching the main shoots	15.82	18.18	32.7	34.4	483.7	528.4	24.23	24.19	14.07	14.15
Defoliation	14.14	15.60	32.8	33.5	431.1	465.6	23.93	23.95	13.72	13.77
Foliar spraying with 1% $MgSO_4$ once	14.26	15.92	32.6	33.7	437.4	472.3	23.99	23.97	13.79	13.83
Foliar spraying with 1% $MgSO_4$ twice	14.74	16.90	32.3	34.0	456.2	497.1	24.12	24.07	13.92	13.97
Pinching + foliar spraying with 1% $MgSO_4$ once	15.76	18.22	32.6	34.5	483.3	528.2	24.29	24.21	14.13	14.28
Pinching + foliar spraying with 1% $MgSO_4$ twice	16.01	18.45	32.9	34.7	487.4	531.7	24.34	24.27	14.19	14.33
Defoliation + foliar spraying with 1% $MgSO_4$ once	14.59	16.59	32.4	33.8	450.3	490.9	24.05	24.02	13.85	13.91
Defoliation + foliar spraying with 1% $MgSO_4$ twice	14.87	17.35	31.9	34.1	466.1	508.7	24.19	24.14	13.99	14.06
new L.S.D. at (0.05) =	0.24	0.21	N.S.	0.1	3.9	3.4	0.04	0.03	0.05	0.04

The positive effect of pinching on increasing number of bunches/vine and yield can be explained by the temporary cessation of the growth of main shoots and the redistribution of assimilates in winter buds during their formation and made available to the developing inflorescences **(Hunter and Visser 1988).** Therefore, number of bunches increase with the increase in coefficient of bud fertility and high accumulation content of the reserved materials especially carbohydrates in the shoots besides the temporary cessation of the growth of the main shoots which aids in the redistribution of assimilates **(Ahmed, 1985).**

As regards bunch dimensions, it is clear that all summer pruning and magnesium spray treatments significantly increased bunch length and width as compared with control. Pinching the main shoots + foliar spraying with 1% MgSO4 twice treatment had significantly the highest ones in both seasons.

These obtained results in this respect are in line with those of **Abd El-Wahab *et al.*, (1997); Ibrahim *et al.*, (2001) and Abd El-Wadoud, (2015)** they mentioned that pinching the main shoots resulted in the highest average weight of bunch and yield.

With to respect to magnesium spray, **Bybordi and Shabanov (2010) and Zlamalova *et al.*, (2015)** showed that foliar application of magnesium significantly had the highest yield as compared to the untreated control.

3. Physical properties of berries

Data presented in (Table, 4) revealed that all berry physical characteristics *i.e.* berry weight, size, length and diameter were significantly affected by all summer pruning and magnesium spray treatments as compared to untreated vines (control) in both seasons. Highest significant values of those parameters were occurred by pinching the main shoots + foliar spraying with 1% MgSO4 twice treatment. Both control and defoliation treatment resulted in the least values of these ones in both seasons.

Table (4): Effect of summer pruning and magnesium spray on physical properties of berries of Flame Seedless grapevines in 2017 and 2018 seasons.

Caracteristics / Treatments	Average berry weight (g)		Average berry size (cm^3)		Average berry length (cm)		Average berry diameter (cm)	
	2017	2018	2017	2018	2017	2018	2017	2018
Control (untreated vines)	2.89	2.92	2.65	2.71	1.62	1.65	1.60	1.62
Pinching the main shoots	3.04	3.09	2.75	2.79	1.73	1.76	1.72	1.74
Defoliation	2.92	2.96	2.68	2.72	1.64	1.66	1.61	1.64
Foliar spraying with 1% $MgSO_4$ once	2.94	2.97	2.69	2.73	1.65	1.68	1.63	1.67
Foliar spraying with 1% $MgSO_4$ twice	2.99	3.03	2.72	2.76	1.68	1.70	1.67	1.69
Pinching + foliar spraying with 1% $MgSO_4$ once	3.05	3.08	2.76	2.80	1.75	1.77	1.73	1.76
Pinching + foliar spraying with 1% $MgSO_4$ twice	3.07	3.11	2.79	2.82	1.76	1.79	1.75	1.77
Defoliation + foliar spraying with 1% $MgSO_4$ once	2.97	3.02	2.71	2.75	1.66	1.69	1.64	1.67
Defoliation + foliar spraying with 1% $MgSO_4$ twice	3.02	3.05	2.73	2.78	1.70	1.73	1.68	1.71
new L.S.D. at (0.05) =	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.01

The increase in berry weight and dimensions observed in summer pruning treatments can be interpreted in view of the fact that these treatments lead to the increase in photosynthetic activity of leaves. As a consequence of that, immigration of assimilates from leaves towards berries is enhanced **(Winkler, 1965).**

The obtained results referring to the positive effect of summer pruning treatments on the physical characteristics of berries are in agreement with those reported by **Abd El-Wahab *et al*., (1997); Ibrahim *et al*., (2001) and Abd El-Wadoud, (2015)** they showed that pinching the main shoots resulted in the highest average berry weight, berry size and berry dimensions.

With to respect to magnesium spray, **Rizk-Alla *et al*. (2006)** mentioned that foliar spray of Mg-EDTA at 0.3 % resulted in the highest values of berry weight and size as compared to the control.

4. Chemical properties of berries

As shown in (Table 5), it is obvious that all summer pruning and magnesium spray treatments significantly improved all berry chemical characteristics as compared with untreated vines (control). Pinching the main shoots + foliar spraying with 1% $MgSO_4$ twice treatment significantly resulted in the highest values of TSS, TSS/acid ratio in berry juice and anthocyanin in berry skin as well as the least percentage of acidity in both seasons.

The positive effect of summer pruning treatments on berry chemical properties *i.e.* TSS%, acidity% and TSS/acid ratio of the berry juice could be attributed to that removing shoot tips promotes lateral shoot growth at the nodes closer to the excised tip. Lateral shoots developed during the period of active shoot growth become net exporters of carbohydrates. They provide an additional photo-assimilating surface to support their own growth and export the surplus to the main shoot, contributing to fruit ripening. The most efficient leaves during ripening are located at the top of the canopy and those arising from lateral shoots **(Candolfi-Vasconcelos and Koblet, 1994).** Closely related to this topic is the work of **Ali *et al*., (2006)** who found that these findings can be interpreted as summer pruning might increase the intensity of photosynthesis in the leaves situated in the section of bunches. This, by its turn, enhanced the immigration of assimilates from leaves towards bunches during the process of ripening. With respect to defoliation, Shading has been identified as a major factor in reducing grapevine fruit quality **(Smart, 1985).** On the other hand, summer pruning helps in ameliorating fruit quality by more exposure to sunlight and generally exhibiting higher concentrations of sugars and lower acidity in grape juice compared to those ripened in dense canopy shade **(Kliewer *et al*., 1988).** Moreover, **(Omar, 2005)** reported that leaf removal allows the light to penetrate the canopy of the vine resulting in an increase in the photosynthetic activity of the leaves inside the canopy and permits air circulation raising temperature inside the canopy, consequently, ripening is promoted through the positive influence on grape composition i.e. increasing TSS and decreasing acidity.

Regarding magnesium spray, **Malakouti (2006)** mentioned that the foliar application of Mg solution was increased the translocation of synthesized materials of the photosynthesis from the leaf to the grape fruit. In addition, **Bybordi and Shabanov (2010)** found that with the increase in the amount of Mg application, the leaf chlorophyll content and hence photosynthesis level was increased, contributing to a significant increase in the percentages of total soluble solids.

These obtained results in this respect are in line with those of **Abd El-Wahab *et al*., (1997); Ibrahim *et al*., (2001) and Abd El-Wadoud, (2015)** they ensured that pinching the main shoots resulted in the highest values of TSS and TSS/acid ratio and anthocyanin in berry skin as well as the lowest acidity of berry juice.

With to respect to magnesium spray, **Zlamalova *et al*., (2015)** showed that foliar application of magnesium significantly had the highest TSS in berry juice as compared to the untreated control.

Table (5): Effect of summer pruning and magnesium spray on chemical properties of berries of Flame Seedless grapevines in 2017 and 2018 seasons.

Caracteristics / Treatments	TSS (%)		Acidity (%)		TSS/acid ratio		Total anthocyanin (mg/100g F.W.)	
	2017	2018	2017	2018	2017	2018	2017	2018
Control (untreated vines)	16.03	16.09	0.67	0.66	23.93	24.38	284.8	297.3
Pinching the main shoots	17.37	17.91	0.63	0.61	27.57	29.36	306.0	320.6
Defoliation	16.31	16.56	0.66	0.64	24.71	25.88	301.1	315.1
Foliar spraying with 1% $MgSO_4$ once	16.63	16.94	0.65	0.64	25.58	26.46	297.5	311.4
Foliar spraying with 1% $MgSO_4$ twice	17.03	17.27	0.64	0.62	26.61	27.85	296.8	310.7
Pinching + foliar spraying with 1% $MgSO_4$ once	17.68	17.94	0.62	0.60	28.51	29.90	293.6	307.4
Pinching + foliar spraying with 1% $MgSO_4$ twice	17.99	18.56	0.61	0.58	29.49	32.00	302.3	316.7
Defoliation + foliar spraying with 1% $MgSO_4$ once	16.65	17.12	0.65	0.63	25.62	27.17	299.1	313.2
Defoliation + foliar spraying with 1% $MgSO_4$ twice	17.34	17.59	0.63	0.62	27.52	28.60	302.2	316.2
new L.S.D. at (0.05) =	0.27	0.34	0.01	0.02	0.05	0.07	8.3	9.2

5. Morphological characteristics of vegetative growth

Data presented in (Table, 6) revealed that all vegetative growth characteristics expressed as average leaf area, coefficient of wood ripening and weight of prunings significantly were affected by all summer pruning and magnesium spray treatments as compared to untreated vines (control) in both seasons. Highest significant values of those parameters were attained by pinching the main shoots + foliar spraying with 1% MgSO4 twice treatment both seasons.

The positive influence of the conducted treatments was previously supported by **Abd El-Wahab *et al*., (1997); Ibrahim *et al*., (2001) and Abd El-Wadoud, (2015)** they stated that pinching the main shoots resulted in the highest values of average leaf area, coefficient of wood ripening and weight of prunings. With respect to defoliation, late leaf removal (at veraison stage) increased the production of photosynthetically and physiologically efficient leaf area which increased root density **(Hunter and Le Roux, 1992)** resulting in an appreciable increase in nutrient absorption and translocation of more carbohydrates to vegetative growth **(Hunter and Visser, 1990).**

Concerning magnesium spray, **Rizk-Alla *et al*. (2006)** mentioned that foliar spray of Mg-EDTA at 0.3 % significantly increased the leaf area and the weight of pruning wood as compared to the control.

Table (6): Effect of summer pruning and magnesium spray on morphological characteristics of vegetative growth of Flame Seedless grapevines in 2017 and 2018 seasons.

Caracteristics / Treatments	Average leaf area (cm^2)		Coefficient of wood ripening		Weight of prunings (Kg)	
	2017	2018	2017	2018	2017	2018
Control (untreated vines)	181.6	189.3	0.68	0.73	1.88	1.91
Pinching the main shoots	192.1	204.3	0.81	0.83	2.12	2.15
Defoliation	184.2	192.7	0.72	0.76	1.93	1.95
Foliar spraying with 1% $MgSO_4$ once	185.3	193.5	0.73	0.76	1.97	1.98
Foliar spraying with 1% $MgSO_4$ twice	188.7	197.3	0.76	0.80	2.04	2.07
Pinching + foliar spraying with 1% $MgSO_4$ once	194.4	205.4	0.82	0.85	2.16	2.19
Pinching + foliar spraying with 1% $MgSO_4$ twice	197.9	208.5	0.84	0.86	2.21	2.23
Defoliation + foliar spraying with 1% $MgSO_4$ once	187.1	195.6	0.75	0.78	2.01	2.03
Defoliation + foliar spraying with 1% $MgSO_4$ twice	190.5	199.1	0.78	0.81	2.09	2.10
new L.S.D. at (0.05) =	3.2	2.7	0.01	0.02	0.04	0.03

6. Chemical characteristics of vegetative growth

***Leaf content of total chlorophyll and cane content of total carbohydrates**

As shown in (Table 7), it is obvious that all summer pruning and magnesium spray treatments significantly increased leaf content of total chlorophyll and cane content of total carbohydrates as compared with untreated vines (control). Pinching the main shoots + foliar spraying with 1% MgSO4 twice treatment resulted in significantly the highest values of leaf content of total chlorophyll and cane content of total carbohydrates in both seasons.

Table (7): Effect of summer pruning and magnesium spray on leaf content of total chlorophyll and cane content of total carbohydrates of Flame Seedless grapevines in 2017 and 2018 seasons.

Caracteristics / Treatments	Total chlorophyll (SPAD)		Total carbohydrates (%)	
	2017	2018	2017	2018
Control (untreated vines)	37.28	39.64	24.57	25.91
Pinching the main shoots	39.96	42.83	26.54	27.83
Defoliation	37.85	40.38	25.04	26.36
Foliar spraying with 1% $MgSO_4$ once	38.02	40.54	25.13	26.48
Foliar spraying with 1% $MgSO_4$ twice	38.81	41.35	25.63	27.04
Pinching + foliar spraying with 1% $MgSO_4$ once	40.07	42.95	26.71	27.95
Pinching + foliar spraying with 1% $MgSO_4$ twice	40.29	43.29	26.96	28.32
Defoliation + foliar spraying with 1% $MgSO_4$ once	38.43	40.97	25.39	26.72
Defoliation + foliar spraying with 1% $MgSO_4$ twice	39.37	41.63	25.85	27.29
new L.S.D. at (0.05) =	0.13	0.17	0.24	0.29

The relative increase in total carbohydrate content of canes observed in summer pruning treatments may be attributed to the high rate of shoot growth and wood ripening, since there existed a highly positive correlation between carbohydrate accumulation in the canes and the degree of wood ripening, in addition to the increase in the intensity of photosynthesis in leaves as well as the great accumulation of organic and mineral nutrients in favor of the rest tissues of the vines **(Winkler, 1965).** In addition, summer pruning increases solar radiation received by the leaves in the interior canopy, which by its turn increases photosynthetic activity of the leaves and consequently carbohydrate accumulation **(Kliewer, 1981).** Shoot tipping improves the movement of photosynthetic towards the main shoot via removing the part of shoot tip, which consumes photosynthetic **(Abd El-Ghany *et al.*, 2005).**

Regarding magnesium spray, **Bybordi and Shabanov (2010)** found that with the increase in the amount of Mg application, the leaf chlorophyll content and hence photosynthesis level was increased, contributing to a significant increase in the percentages of dry matter.

These results are in accordance with those obtained by **Abd El-Wahab *et al.*, (1997) and Abd El-Wadoud, (2015)** they found that pinching the main shoots resulted in the highest values of leaf content of total chlorophyll and cane content of total carbohydrates.

With to respect to magnesium spray, **Rizk-Alla *et al*. (2006)** mentioned that foliar spray of Mg-EDTA at 0.3 % significantly increased the leaf content of total chlorophyll and cane content of total carbohydrates as compared to the control.

*** Leaf content of mineral elements**

Data presented in (Table, 8) revealed that leaf content of mineral elements expressed as nitrogen, phosphorus and potassium significantly were affected by all summer pruning and magnesium spray treatments as compared to untreated vines (control) in both seasons. Highest significant values of those parameters were attained by pinching the main shoots + foliar spraying with 1% MgSO4 twice treatment both seasons.

Table (8): Effect of summer pruning and magnesium spray on leaf content of mineral elements of Flame Seedless grapevines in 2017 and 2018 seasons.

Caracteristics / Treatments	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	2017	2018	2017	2018	2017	2018
Control (untreated vines)	1.58	1.63	0.13	0.16	1.29	1.32
Pinching the main shoots	2.21	2.23	0.41	0.44	1.63	1.66
Defoliation	1.61	1.65	0.17	0.21	1.32	1.36
Foliar spraying with 1% $MgSO_4$ once	1.75	1.82	0.22	0.25	1.39	1.42
Foliar spraying with 1% $MgSO_4$ twice	2.09	2.11	0.34	0.37	1.51	1.54
Pinching + foliar spraying with 1% $MgSO_4$ once	2.23	2.28	0.45	0.49	1.67	1.69
Pinching + foliar spraying with 1% $MgSO_4$ twice	2.27	2.31	0.48	0.51	1.72	1.75
Defoliation + foliar spraying with 1% $MgSO_4$ once	1.94	1.95	0.26	0.28	1.47	1.49
Defoliation + foliar spraying with 1% $MgSO_4$ twice	2.14	2.17	0.38	0.40	1.56	1.58
new L.S.D. at (0.05) =	0.04	0.03	0.03	0.02	0.05	0.04

These results are in agreement with those obtained by **Rizk-Alla *et al*. (2006)** they mentioned that foliar spray of Mg-EDTA at 0.3 % significantly had the highest values of leaf mineral content *i.e.* nitrogen, phosphorus and potassium as compared to the control.

From the obtained results, it can be concluded that pinching main shoots accompanied with foliar spraying with 1% MgSO4 twice attain the optimum results by enhancing yield, improving fruit quality attributes, ensuring the best vegetative growth aspects and increasing the leaf content of total chlorophyll and cane content of total carbohydrates for Flame Seedless grapevines.

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تأثير التقليم الصيفى والرش بالماغنسيوم على المناخ الدقيق وجودة حبات العنب الفليم سيدلس وتصدير الكربوهيدرات

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أجرى هذا البحث لمدة موسمين متتاليين (2017، 2018) بأحد المزارع الخاصة بمنطقة النوبارية التابعة لمحافظة البحيرة لدراسة تأثير إجراء بعض معاملات التقليم الصيفى والرش بالماغنسيوم على المناخ الدقيق والنمو الخضرى والمحصول وجودة العناقيد لكرمات العنب الفليم سيدلس، وكان عمر الكرمات سبع سنوات نامية فى تربة رملية، منزرعة على مسافة 2×3 متر، وتروى بنظام الرى بالتنقيط. تم تقليم الكرمات تقليما قصبيا تحت نظام تدعيم التكاعيب الأسبانية ، كما تم تقليم الكرمات فى الأسبوع الأول من شهر يناير خلال موسمى الدراسة مع ترك حمولة براعم 90 عين/كرمة (9 قصبات X 10 عين/كرمة).

وقد اشتملت الدراسة على تسع معاملات على النحو التالى: الكنترول (كرمات غير معاملة)، تطويش الأفرع الرئيسية ، التوريق، الرش الورقى بـ 1 ٪ كبريتات الماغنسيوم مرة واحدة، الرش الورقى بـ 1 ٪ كبريتات الماغنسيوم مرتين، تطويش الأفرع الرئيسية + الرش الورقى بـ 1 ٪ كبريتات الماغنسيوم مرة واحدة، تطويش الأفرع الرئيسية + الرش الورقى بـ 1 ٪ كبريتات الماغنسيوم مرتين، التوريق + الرش الورقى بـ 1 ٪ كبريتات الماغنسيوم مرة واحدة، التوريق + الرش الورقى بـ 1 ٪ كبريتات الماغنسيوم مرتين. تمَّ إجراء معاملة تطويش الأفرع الرئيسية بعد مرحلة العقد مباشرة، بينما أجريت معاملة التوريق عند مرحلة بداية طراوة أو ليونة الحبات، كما تم اجراء الرش الورقى بـ 1 ٪ كبريتات الماغنسيوم إما مرة واحدة بعد مرحلة العقد مباشرة أو مرتين حيث سجلت الرشة الأولى بعد مرحلة العقد مباشرة، بينما الرشة الثانية بعد أسبوعين من الرشة الأولى.

أشارت نتائج الدراسة إلى أن جميع معاملات التقليم الصيفى والرش الورقى للماغنيسيوم إما بصورة منفردة أو مشتركة فيما بينهم حققت أفضل النتائج مقارنة بالكرمات الغير معاملة فى كلا الموسمين، وقد سجلت معاملة تطويش الأفرع الرئيسية + الرش الورقى بـ 1 ٪ كبريتات الماغنسيوم مرتين أفضل مناخ دقيق للمسطح الخضرى مما انعكس ذلك فى تحقيق أعلى محصول بما فى ذلك مكوناته وتحسين الصفات الطبيعية والكيماوية للحبات مع الحصول على أفضل صفات خضرية وكذلك زيادة محتوى الأوراق من الكلوروفيل الكلى وعناصر النيتروجين، الفوسفور والبوتاسيوم ومحتوى القصبات من الكربوهيدرات الكلية لكرمات العنب الفليم سيدلس.