EFFECT 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 (MgSO₄) 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% MgSO₄ once, foliar spraying with 1% MgSO₄ twice, pinching + foliar spraying with 1% MgSO₄ once, pinching + foliar spraying with 1% MgSO₄ twice, defoliation + foliar spraying with 1% MgSO₄ once as well as defoliation + foliar spraying with 1% MgSO₄ 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% MgSO₄ 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

<table>
<thead>
<tr>
<th>Physical</th>
<th>Sand (%)</th>
<th>91.3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Silt (%)</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td>Clay (%)</td>
<td>4.1</td>
</tr>
<tr>
<td>Texture</td>
<td>Sandy</td>
<td></td>
</tr>
<tr>
<td>Chemical</td>
<td>Organic matter (%)</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>pH (1:2.5 Extract)</td>
<td>8.8</td>
</tr>
<tr>
<td></td>
<td>EC (Mmhos/cm)</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>Ca Co <em>3</em> (%</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>N (meq/L)</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>P (meq/L)</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>K (meq/L)</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>Ca (meq/L)</td>
<td>1.15</td>
</tr>
<tr>
<td></td>
<td>Mg (meq/L)</td>
<td>0.53</td>
</tr>
<tr>
<td></td>
<td>Fe (meq/L)</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>Zn (meq/L)</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td>Mn (meq/L)</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Cu (meq/L)</td>
<td>0.04</td>
</tr>
</tbody>
</table>

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 (°C).
   
   c. Relative humidity (%)
   
   Light intensity (Lux) was measured using "Light probe meter", while air temperature (°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 (cm³) 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 (cm²) 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 (°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.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Caracteristics</th>
<th>Light intensity (Lux)</th>
<th>Air temperature (°C)</th>
<th>Relative humidity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (untreated vines)</td>
<td></td>
<td>27.03</td>
<td>28.29</td>
<td>33.76</td>
</tr>
<tr>
<td>Pinching the main shoots</td>
<td></td>
<td>27.71</td>
<td>28.99</td>
<td>31.45</td>
</tr>
<tr>
<td>Defoliation</td>
<td></td>
<td>27.39</td>
<td>28.63</td>
<td>31.86</td>
</tr>
<tr>
<td>Foliar spraying with 1% MgSO₄ once</td>
<td></td>
<td>27.15</td>
<td>28.43</td>
<td>32.07</td>
</tr>
<tr>
<td>Foliar spraying with 1% MgSO₄ twice</td>
<td></td>
<td>27.26</td>
<td>28.54</td>
<td>31.98</td>
</tr>
<tr>
<td>Pinching + foliar spraying with 1% MgSO₄ once</td>
<td></td>
<td>27.79</td>
<td>29.04</td>
<td>31.34</td>
</tr>
<tr>
<td>Pinching + foliar spraying with 1% MgSO₄ twice</td>
<td></td>
<td>27.92</td>
<td>29.15</td>
<td>31.19</td>
</tr>
<tr>
<td>Defoliation + foliar spraying with 1% MgSO₄ once</td>
<td></td>
<td>27.48</td>
<td>28.70</td>
<td>31.72</td>
</tr>
<tr>
<td>Defoliation + foliar spraying with 1% MgSO₄ twice</td>
<td></td>
<td>27.59</td>
<td>28.85</td>
<td>31.61</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Yield/vine (kg)</th>
<th>No. of bunches</th>
<th>Average bunch weight (g)</th>
<th>Average bunch length (cm)</th>
<th>Average bunch width (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (untreated vines)</td>
<td>13.69</td>
<td>15.14</td>
<td>32.3</td>
<td>42.37</td>
<td>453.4</td>
</tr>
<tr>
<td>Pinching the main shoots</td>
<td>15.82</td>
<td>18.18</td>
<td>32.7</td>
<td>48.37</td>
<td>528.4</td>
</tr>
<tr>
<td>Defoliation</td>
<td>14.14</td>
<td>15.60</td>
<td>32.8</td>
<td>33.5</td>
<td>431.1</td>
</tr>
<tr>
<td>Foliar spraying with 1% MgSO4 once</td>
<td>14.26</td>
<td>15.92</td>
<td>32.6</td>
<td>33.7</td>
<td>437.4</td>
</tr>
<tr>
<td>Foliar spraying with 1% MgSO4 twice</td>
<td>14.74</td>
<td>16.90</td>
<td>32.3</td>
<td>34.0</td>
<td>456.2</td>
</tr>
<tr>
<td>Pinching + foliar spraying with 1% MgSO4 once</td>
<td>15.76</td>
<td>18.22</td>
<td>32.6</td>
<td>34.5</td>
<td>483.3</td>
</tr>
<tr>
<td>Pinching + foliar spraying with 1% MgSO4 twice</td>
<td>16.01</td>
<td>18.45</td>
<td>32.9</td>
<td>34.7</td>
<td>487.4</td>
</tr>
<tr>
<td>Defoliation + foliar spraying with 1% MgSO4 once</td>
<td>14.59</td>
<td>16.59</td>
<td>32.4</td>
<td>33.8</td>
<td>450.3</td>
</tr>
<tr>
<td>Defoliation + foliar spraying with 1% MgSO4 twice</td>
<td>14.87</td>
<td>17.35</td>
<td>31.9</td>
<td>34.1</td>
<td>466.1</td>
</tr>
</tbody>
</table>

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 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.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (untreated vines)</td>
<td>2.89</td>
<td>2.92</td>
<td>2.65</td>
<td>2.71</td>
<td>1.62</td>
<td>1.65</td>
<td>1.60</td>
<td>1.62</td>
</tr>
<tr>
<td></td>
<td>Pinching the main shoots</td>
<td>3.04</td>
<td>3.09</td>
<td>2.75</td>
<td>2.79</td>
<td>1.73</td>
<td>1.76</td>
<td>1.72</td>
<td>1.74</td>
</tr>
<tr>
<td></td>
<td>Defoliation</td>
<td>2.92</td>
<td>2.96</td>
<td>2.68</td>
<td>2.72</td>
<td>1.64</td>
<td>1.66</td>
<td>1.61</td>
<td>1.64</td>
</tr>
<tr>
<td></td>
<td>Foliar spraying with 1% MgSO4 once</td>
<td>2.94</td>
<td>2.97</td>
<td>2.69</td>
<td>2.73</td>
<td>1.65</td>
<td>1.68</td>
<td>1.63</td>
<td>1.67</td>
</tr>
<tr>
<td></td>
<td>Pinching + foliar spraying with 1% MgSO4 once</td>
<td>2.99</td>
<td>3.03</td>
<td>2.72</td>
<td>2.76</td>
<td>1.68</td>
<td>1.70</td>
<td>1.67</td>
<td>1.69</td>
</tr>
<tr>
<td></td>
<td>Pinching + foliar spraying with 1% MgSO4 twice</td>
<td>3.05</td>
<td>3.08</td>
<td>2.76</td>
<td>2.80</td>
<td>1.75</td>
<td>1.77</td>
<td>1.73</td>
<td>1.76</td>
</tr>
<tr>
<td></td>
<td>Defoliation + foliar spraying with 1% MgSO4 once</td>
<td>3.07</td>
<td>3.11</td>
<td>2.79</td>
<td>2.82</td>
<td>1.76</td>
<td>1.79</td>
<td>1.75</td>
<td>1.77</td>
</tr>
<tr>
<td></td>
<td>Defoliation + foliar spraying with 1% MgSO4 twice</td>
<td>2.97</td>
<td>3.02</td>
<td>2.71</td>
<td>2.75</td>
<td>1.66</td>
<td>1.69</td>
<td>1.64</td>
<td>1.67</td>
</tr>
<tr>
<td></td>
<td>New L.S.D. at (0.05)</td>
<td>0.02</td>
<td>0.01</td>
<td>0.02</td>
<td>0.01</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.01</td>
</tr>
</tbody>
</table>

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 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% MgSO4 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 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.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Characteristics</th>
<th>TSS (%)</th>
<th>Acidity (%)</th>
<th>TSS/acid ratio</th>
<th>Total anthocyanin (mg/100g F.W.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (untreated vines)</td>
<td>16.03</td>
<td>16.09</td>
<td>0.67</td>
<td>0.66</td>
<td>23.93 24.38 284.8 297.3</td>
</tr>
<tr>
<td>Pinching the main shoots</td>
<td>17.37</td>
<td>17.91</td>
<td>0.63</td>
<td>0.61</td>
<td>27.57 29.36 306.0 320.6</td>
</tr>
<tr>
<td>Defoliation</td>
<td>16.31</td>
<td>16.56</td>
<td>0.66</td>
<td>0.64</td>
<td>24.71 25.88 301.1 315.1</td>
</tr>
<tr>
<td>Foliar spraying with 1% MgSO₄ once</td>
<td>16.63</td>
<td>16.94</td>
<td>0.65</td>
<td>0.64</td>
<td>25.58 26.46 297.5 311.4</td>
</tr>
<tr>
<td>Foliar spraying with 1% MgSO₄ twice</td>
<td>17.03</td>
<td>17.27</td>
<td>0.64</td>
<td>0.62</td>
<td>26.61 27.85 296.8 310.7</td>
</tr>
<tr>
<td>Pinching + foliar spraying with 1% MgSO₄ once</td>
<td>17.68</td>
<td>17.94</td>
<td>0.62</td>
<td>0.60</td>
<td>28.51 29.90 293.6 307.4</td>
</tr>
<tr>
<td>Pinching + foliar spraying with 1% MgSO₄ twice</td>
<td>17.59</td>
<td>18.56</td>
<td>0.61</td>
<td>0.58</td>
<td>29.49 32.00 302.3 316.7</td>
</tr>
<tr>
<td>Defoliation + foliar spraying with 1% MgSO₄ once</td>
<td>16.65</td>
<td>17.12</td>
<td>0.65</td>
<td>0.63</td>
<td>25.62 27.17 299.1 313.2</td>
</tr>
<tr>
<td>Defoliation + foliar spraying with 1% MgSO₄ twice</td>
<td>17.34</td>
<td>17.59</td>
<td>0.63</td>
<td>0.62</td>
<td>27.52 28.60 302.2 316.2</td>
</tr>
</tbody>
</table>

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.**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Characteristics</th>
<th>2017 Average leaf area (cm²)</th>
<th>2018 Coefficient of wood ripening</th>
<th>2017 Weight of prunings (Kg)</th>
<th>2018 Weight of prunings (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (untreated vines)</td>
<td></td>
<td>181.6</td>
<td>189.3</td>
<td>0.68</td>
<td>0.73</td>
</tr>
<tr>
<td>Pinching the main shoots</td>
<td></td>
<td>192.1</td>
<td>204.3</td>
<td>0.81</td>
<td>0.83</td>
</tr>
<tr>
<td>Defoliation</td>
<td></td>
<td>184.2</td>
<td>192.7</td>
<td>0.72</td>
<td>0.76</td>
</tr>
<tr>
<td>Foliar spraying with 1% MgSO4 once</td>
<td></td>
<td>185.3</td>
<td>193.5</td>
<td>0.73</td>
<td>0.76</td>
</tr>
<tr>
<td>Foliar spraying with 1% MgSO4 twice</td>
<td></td>
<td>188.7</td>
<td>197.3</td>
<td>0.76</td>
<td>0.80</td>
</tr>
<tr>
<td>Pinching + foliar spraying with 1% MgSO4 once</td>
<td></td>
<td>194.4</td>
<td>205.4</td>
<td>0.82</td>
<td>0.85</td>
</tr>
<tr>
<td>Pinching + foliar spraying with 1% MgSO4 twice</td>
<td></td>
<td>197.9</td>
<td>208.5</td>
<td>0.84</td>
<td>0.86</td>
</tr>
<tr>
<td>Defoliation + foliar spraying with 1% MgSO4 once</td>
<td></td>
<td>187.1</td>
<td>195.6</td>
<td>0.75</td>
<td>0.78</td>
</tr>
<tr>
<td>Defoliation + foliar spraying with 1% MgSO4 twice</td>
<td></td>
<td>190.5</td>
<td>199.1</td>
<td>0.78</td>
<td>0.81</td>
</tr>
</tbody>
</table>

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 magnesiu 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.**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Treatments</th>
<th>2017 (SPAD)</th>
<th>2018 (SPAD)</th>
<th>2017 (%)</th>
<th>2018 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (untreated vines)</td>
<td>37.28</td>
<td>39.64</td>
<td>24.57</td>
<td>25.91</td>
<td></td>
</tr>
<tr>
<td>Pinching the main shoots</td>
<td>39.96</td>
<td>42.83</td>
<td>26.54</td>
<td>27.83</td>
<td></td>
</tr>
<tr>
<td>Defoliation</td>
<td>37.85</td>
<td>40.38</td>
<td>25.04</td>
<td>26.36</td>
<td></td>
</tr>
<tr>
<td>Foliar spraying with 1% MgSO4 once</td>
<td>38.02</td>
<td>40.54</td>
<td>25.13</td>
<td>26.48</td>
<td></td>
</tr>
<tr>
<td>Foliar spraying with 1% MgSO4 twice</td>
<td>38.81</td>
<td>41.35</td>
<td>25.63</td>
<td>27.04</td>
<td></td>
</tr>
<tr>
<td>Pinching + foliar spraying with 1% MgSO4 once</td>
<td>40.07</td>
<td>42.95</td>
<td>26.71</td>
<td>27.95</td>
<td></td>
</tr>
<tr>
<td>Pinching + foliar spraying with 1% MgSO4 twice</td>
<td>40.29</td>
<td>43.29</td>
<td>26.96</td>
<td>28.32</td>
<td></td>
</tr>
<tr>
<td>Defoliation + foliar spraying with 1% MgSO4 once</td>
<td>38.43</td>
<td>40.97</td>
<td>25.39</td>
<td>26.72</td>
<td></td>
</tr>
<tr>
<td>Defoliation + foliar spraying with 1% MgSO4 twice</td>
<td>39.37</td>
<td>41.63</td>
<td>25.85</td>
<td>27.29</td>
<td></td>
</tr>
<tr>
<td>new L.S.D. at (0.05) =</td>
<td>0.13</td>
<td>0.17</td>
<td>0.24</td>
<td>0.29</td>
<td></td>
</tr>
</tbody>
</table>

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 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.**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>2017 Nitrogen (%)</th>
<th>2018 Nitrogen (%)</th>
<th>2017 Phosphorus (%)</th>
<th>2018 Phosphorus (%)</th>
<th>2017 Potassium (%)</th>
<th>2018 Potassium (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (untreated vines)</td>
<td>1.58</td>
<td>1.63</td>
<td>0.13</td>
<td>0.16</td>
<td>1.29</td>
<td>1.32</td>
</tr>
<tr>
<td>Pinching the main shoots</td>
<td>2.21</td>
<td>2.23</td>
<td>0.41</td>
<td>0.44</td>
<td>1.63</td>
<td>1.66</td>
</tr>
<tr>
<td>Defoliation</td>
<td>1.61</td>
<td>1.65</td>
<td>0.17</td>
<td>0.21</td>
<td>1.32</td>
<td>1.36</td>
</tr>
<tr>
<td>Foliar spraying with 1% MgSO4 once</td>
<td>1.75</td>
<td>1.82</td>
<td>0.22</td>
<td>0.25</td>
<td>1.39</td>
<td>1.42</td>
</tr>
<tr>
<td>Foliar spraying with 1% MgSO4 twice</td>
<td>2.09</td>
<td>2.11</td>
<td>0.34</td>
<td>0.37</td>
<td>1.51</td>
<td>1.54</td>
</tr>
<tr>
<td>Pinching + foliar spraying with 1% MgSO4 once</td>
<td>2.23</td>
<td>2.28</td>
<td>0.45</td>
<td>0.49</td>
<td>1.67</td>
<td>1.69</td>
</tr>
<tr>
<td>Pinching + foliar spraying with 1% MgSO4 twice</td>
<td>2.27</td>
<td>2.31</td>
<td>0.48</td>
<td>0.51</td>
<td>1.72</td>
<td>1.75</td>
</tr>
<tr>
<td>Defoliation + foliar spraying with 1% MgSO4 once</td>
<td>1.94</td>
<td>1.95</td>
<td>0.26</td>
<td>0.28</td>
<td>1.47</td>
<td>1.49</td>
</tr>
<tr>
<td>Defoliation + foliar spraying with 1% MgSO4 twice</td>
<td>2.14</td>
<td>2.17</td>
<td>0.38</td>
<td>0.40</td>
<td>1.56</td>
<td>1.58</td>
</tr>
<tr>
<td>new L.S.D. at (0.05)</td>
<td>0.04</td>
<td>0.03</td>
<td>0.03</td>
<td>0.02</td>
<td>0.05</td>
<td>0.04</td>
</tr>
</tbody>
</table>
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.

**REFERENCES**


تأثیر التقلیم الصیفى والرش بالماغنسیوم على المناخ الدقیق وجودة حبات العنب الفلیم سیدلس وتصدر الكرویهیرات

أشرف رضا على فرج1، أحمد إسماعیل أحمد عبدالعال2

1قسم بحوث العنب – معهد بحوث البساتین – مركز البحوث الزراعیة بالجیزة – مصر
2معهد بحوث الأرضیا والماء والبيئة – مركز البحوث الزراعیة بالجیزة – مصر

أجرى هذا البحث لمدة موسیميين متتالین (2017، 2018) بأحد المزارع الخاصة بمنطقة النوباریة التابعة لمحافظة البحیرة لدراسة تأثیر إجراء بعض معاملات التقلیم الصیفى والرش بالماغنسیوم على المناخ الدقیق والنمو الخضري والمحصول وجودة العناقيد لكرمات العنب الفلیم سیدلس، وكان عمر الكرمات سابع سنوات نامیة في تربة رملیة، مزرعة على مساحة 2×3 متر، وتغذیة بناص الري بالتنقیط. تم تقلیم الكرمات تقلیما قصبا تحت نظام تدўم التكاعب الأسبانية ، كما تم تقلیم الكرمات في الأسبوع الأول من شهر نیار خلال موسمي الدراسة. مع ترك حموله براعم 90 عین/كرمة (9 قصبات X عین/كرمة).

وقد اشتملت الدراسة على تسع معاملات على النحو التالی: الكنترول (كرمات غير معلّمیة)، تطویش الأفرع الرئيسية، التوریق، الرش الورقی بـ 1 % كبریتات الماغنسیوم مرة واحدة، الرش الورقی بـ 1 % كبریتات الماغنسیوم مرة واحدة، تطویش الأفرع الرئيسية + الرش الورقی بـ 1 % كبریتات الماغنسیوم مرة واحدة، تطویش الأفرع الرئيسية + التوریق + الرش الورقی بـ 1 % كبریتات الماغنسیوم مرة واحدة، التوریق + الرش الورقی بـ 1 % كبریتات الماغنسیوم مرة واحدة، التوریق + الرش الورقی بـ 1 % كبریتات الماغنسیوم مرة واحدة.

تم إجراء معاملة تطویش الأفرع الرئيسية بعد مرحلة العقد مباشرة، بينما أجريت معاملة التوریق عند مرحلة بداية طراوة أو لونية الحبات، كما تم إجراء الرش الورقی بـ 1 % كبریتات الماغنسیوم إما مرة واحدة بعد مرحلة العقد مباشرة أو مرة بسیعین من الريكة الأولى بعد مرحلة العقد مباشرة، بينما الرشة التالیة بعد أسبوعين من الريكة الأولى.
أشارت نتائج الدراسة إلى أن جميع معاملات التقليل الصيفي والرش الورقي للماغنسيوم إما بصورة منفردة أو مشتركة فيما بينهم حققت أفضل النتائج مقارنة بالكرامات الغير معاملة في كلا الموسمين، وقد سجلت معاملة تطويش الأفرع الرئيسية + الرش الورقي بـ 1 % كبريتات الماغنسيوم مرتين أفضل مناخ دقيق للمسطح الخضري مما انعكس ذلك في تحقيق أعلى محصول بما في ذلك مكوناته وتحسين الصفات الطبيعية والكيميائية للحبات مع الحصول على أفضل صفات خضرية وكذلك زيادة محتوى الأوراق من الكربوهيدرات الكلية وعناصر النتروجين، الفوسفور والبوتاسيوم وتحسن القصبات من الكربوهيدرات الكلية لكرامات العنب الليمور سيديس.