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# Effect of Berry Thinning, Foliar Fertilization and Humic acid Application on Grape Yield and Quality of "Flame Seedless"

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## ABSTRACT

This study was carried out during the two successive seasons 2015 and 2016 on 13 years old Flame Seedless grapevines to study the effect of berry thinning as cutting tip of 1/3 cluster singly or combined with either nutrient solution or humic acid spraying on yield and fruit quality. The results showed that berry thinning insignificantly effect on yield/vine and cluster weight compared to untreated ones. Whereas, berry thinning plus nutrient solution or humic acid significantly increased the yield and cluster weight. All treatments significantly improved the berry quality in terms of increasing the berry weight, TSS, TSS/acid ratio and anthocyanin content and decreasing total acidity. The best recorded result was due to berry thinning plus humic acid application.

***Key words:*** Fertilization, Humic acid, Thinning, Yield, Berry quality.

## Introduction

Grapevines (*Vitis vinifera* L.) occupy more land in the world than any other single fruit and account for almost half of the total world production of all fruits. Grapes include more than 60 species and rank the top fruit crop all over the world and the second crop after citrus in Egypt. Vineyard, have continuously increased especially in the new reclaimed lands. Since the total area of grape in Egypt reached about 164310 feddans producing about 1434666 tons according to the statistics of the Ministry of Agriculture (2013). Fertilization and fruit thinning, as a cultural practice, are of the important tools to increase the yield and improve the fruit quality.

Flame seedless as a promising grapevine cultivar that grown successfully under Egypt environmental condition and has progressively developed in the last few years. Flame Seedless is one of the most popular cultivars of table grapes in Egypt.

Cluster thinning is a technique often implemented in field conditions, as it is claimed to improve grape quality through an increase in total soluble solids Gil-Munoz *et al*. (2009), Valdes *et al*. (2009) and in an enhanced anthocyanin and phenolics accumulation in red cultivars (Guidoni *et al*., 2002; Pena-Neira *et al*., 2007 and Santesteban *et al*., 2011). Cluster thinning resulted in increases of cluster weight, cluster size, berry size, berry color and index of maturity value. It decreased the yield and acidity values (Dardeniz and Kiamali, 2002 and Abdel-Razek *et al*, 2010).

Humic acid is the active constituents of organic humus, which can play a very important role in soil conditioning and plant growth and they have different effects on plants (Ferrara and Brunetti, 2010).

Plant growth stimulating effect of humic substances is associated with increased macro-nutrient intake (De Kock, 1955). Humic substances affect the ion exchange of plant nutrients that are useful in microbial activity by increasing conversions directly as well as result of the stimulating plant growth hormones Vaughan and Mc-Donald (1976). Humic acid plays an important role directly and indirectly in nutrition of the plants Lobartini *et al*. (1997). Humic acid application in the full bloom period increased significantly berry weight, titratable acidity and maturity index values of Italy grape cultivar (Ferrara and Brunetti, 2010 and Akin, 2011).

Potassium (K) is a mobile element in the plant and is an activator of enzymes that are essential for photosynthesis and respiration as well as enzymes that produce starch and proteins. It activities at least 60

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different enzymes involved in plant growth and improves fruit quality and supports the plant resistance to pathogens (Dhillon *et al*., 1999 and Tamim *et al*., 2000). Potassium application increases vine growth, yield and fruit quality (Conradia and Saayman, 1989). Potassium absorption has two peaks, the first at fruit setting stage and the second during berry maturation (Ban *et al*., 2003; Yu *et al*. 1994, Hiratsuka *et al*., 2001). Its effect is related to the source from which it has been taken (Ali *et al*., 2006; Lester *et al*., 2005). This is due to better absorption and or the effect of other substances composing the source (Zhenming *et al*., 2008; Marschner, 1995; Brady and Weil, 1999 and Bussakorn *et al*., 2003).

In plant nutrition, what makes boron different from other elements is that plants need boron more than other microelements. Boron has crucial and apparent functions pertaining cell wall synthesis, carbohydrate metabolism, RNA metabolism, respiration and positively affects fruit growth (Parr and Laughnan, 1983; Faust, 1989 and Marschner, 1995). The boron deficiency decreased the amounts of ascorbic acid and a non-protein compound it also remarkably decreased the activity of glutathione reductase (Cakmak and Romheld, 1997).

Phosphorus (P) is an essential nutrient required by plants for normal growth and development. The availability of P to plants for uptake and utilization is impaired in alkaline and calcareous soil due to the formation of poorly soluble calcium phosphate minerals (Bryan and Ellsworth, 2005). Adsorption and precipitation processes in soils result in only part of applied P fertilize remaining available to plants. The apparent recovery of applied fertilizer is usually low in the first cropping year following application and residual P plays a major role in agricultural soils by supplying P to plants (Matar *et al*., 1992).

Therefore the objective of this study was to evaluate the effect of berry thinning as well as nutrient solution and humic acid spraying on fruiting of Flame Seedless grapevines.

## Material and Methods

*Plant materials, experimental site and treatments:*

The present study was performed during 2015 and 2016 seasons on 13 years old Flame Seedless cv. (*Vitis vinifera* L.), on sandy soil grapevine grown at Assiut Agriculture Research Station ARC, Assiut Governorate. All the selected vines are planted at 1.75x2.75 m apart and were of almost similar vigour, supported by (double T system). The double cordon system was used where bud load was 72 bud/vine (36 fruiting spurs x 2 bud).

All vines received the stander agricultural practices that are used in the vineyard including soil fertilization, irrigation and pest control, except for the tested different treatments through the two studied seasons.

The experiment was designed as randomized complete design (RCD) and the following four treatments was applied with three replicates for each treatment (1 replicate = 2 vine). Four treatments as follow:

1- 1/3 cluster thinning (CTh).
2- 1/3 cluster thinning (CTh) + nutrient solution (NS), (50 ml/100 L, phosphor 30% + potassium 20% + boron 1%).
3- 1/3 cluster thinning (CTh) + humic acid (HA), 0.1%.
4- Control (water only).

The 1/3 cluster thinning (berry thinning) was applied by cutting the tips of the cluster at the point of one third of the cluster length after fruit set. The chemicals were applied directly to the clusters with a handheld sprayer unit runoff. The solutions were sprayed at the fruit set and the implementation at the 30 days interval was continued until harvest. In both seasons, clusters from each vine were harvested after most (60%) of the fruits were considered to have exceeded the minimum market requirements of 16-17% total soluble solids according to Tourky *et al*. (1995) and full red berry color.

The following parameters were determined to evaluate the effect of different treatments on yield and berry quality.

1- Yield: at harvest date, the yield per vine was recorded in terms of weight (in kg/vine).
2- Cluster and berry characteristic:

At harvest, two clusters were taken randomly from the yield of each vine and the following characteristics were determined.

- Cluster weight (g),
- Average of 100 berries weight (g) and berry weight calculated by dividing it with 100.
- Berry length (cm), width (cm) and berry size ($cm^3$).

- Berry firmness, was recorded by using a texture analyzer instrument (Fruit Hardness Tester, No. 510-1) as a small cylinder by 3 mm penetrates into a distance of 3 mm inside the berry with a speed of 0.2 mm second, then the resistance of berry to this penetration force was recorded and taken as an expression of berry firmness ($g/cm^2$).
- Total soluble solids (TSS) in the juice by using the hand refractometer.
- Acidity in the juice as tartaric acid was determined by titration with 0.1 N NaOH using phenolphthalein as an indicator.
- Total anthocyanin of the berry skin (mg/100 g fresh weight) according to Husia *et al*. (1965).

All obtained data was tabulated and statistically analyzed according to Snedecor and Cochran (1990) using the L.S.D. test for distinguishing the significance differences between various treatment means.

## Results and Discussion

### 1- Yield and cluster weight:

Data presented in Table (1) showed the effect of berry thinning, nutrient solution and humic acid spraying on yield and cluster weight of Flame Seedless grapevines during 2015 and 2016 seasons. It is obvious from the data that the results took similar trend during the two studies seasons. Data indicated that cutting tip of 1/3 cluster ($T_1$) insignificantly effect the yield and cluster weight compared to control. Whereas, $T_1$ combined either nutrient solution ($T_2$) or humic acid ($T_3$) significantly increased the yield/vine and cluster weight compared to control ($T_4$). The maximum values of yield and cluster weight were taken due to cut tip of 1/3 cluster plus humic acid application ($T_3$). No significant differences due to cluster thinning plus nutrient solution ($T_2$) or humic acid ($T_3$).

**Table 1:** Effect of berry thinning, nutrient solution and humic acid spraying on yield, cluster weight and berry weight of Flame Seedless grapes during 2015 and 2016 seasons.

| Treatments | Yield (kg) | | Cluster weight (g) | | Berry weight | |
|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| 1/3 CTh | 6.31 | 6.65 | 298.60 | 296.32 | 2.42 | 2.36 |
| 1/3 CTh + NS 1.0% | 7.53 | 7.70 | 336.78 | 338.30 | 2.68 | 2.61 |
| 1/3 CTh + HA 0.1% | 7.75 | 7.88 | 341.15 | 345.73 | 2.76 | 2.68 |
| Control | 6.36 | 6.80 | 301.46 | 312.90 | 1.88 | 1.82 |
| L.S.D. 5% | 0.66 | 0.81 | 20.11 | 23.30 | 0.18 | 0.13 |

The record yield/vine was (6.31, 7.53, 7.75 & 6.36 kg) and (6.65, 7.70, 7.88 & 6.80 kg) due $T_1$, $T_2$, $T_3$ and $T_4$ during the two studied seasons, respectively. The corresponding cluster weight were (298.60, 336.78, 341.15 & 301.46 g) and (296.32, 338.30, 345.73 & 312.90 g), respectively. The increment percentage of cluster weight due to $T_2$ and $T_3$ over $T_1$ attained (18.40 & 21.19) and (13.23 & 15.88%), respectively.

The results emphasized the importance of using nutrient elements and humic acid has an important role in nutrition of plants and stimulating plant growth hormones.

These results are agreement with those obtained by Akin (2003), Abdel-Fatah *et al*. (2008), Abdel-Razek *et al*. (2010), Akin (2011) and El-Sayed *et al*. (2015) who observed that treatment of humic acid improved growth parameters and K promotes photosynthesis and transport assimilates of the carbohydrates to the storage organs.

### 2- Berry characteristic:

Data in Tables (1 to 4) showed that berry thinning singly or combined with either nutrient solution or humic acid application significantly improved the berry quality compared to untreated ones (control) during the two studied seasons.

No significant differences were found due to spray nutrient solution or humic acid. The improving berry quality in terms of increasing the weight and size as well as the total soluble solid, total soluble solid/acidity and anthocyanin content and decreasing titratable acidity %. Berry thinning whatever alone or combined with humic acid used had insignificantly effected on berry firmness, whereas berry thinning plus nutrient solution significantly increased the firmness compared to untreated ones (control). The best result regarding the berry quality was recorded due to berry thinning as cut tip of 1/3 cluster plus humic acid spray ($T_3$).

**Table 2:** Effect of berry thinning, nutrient solution and humic acid spraying on berry length, berry width and berry size of Flame Seedless grapes during 2015 and 2016 seasons.

| Treatments | Berry length | | Berry width | | Berry size | |
|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| 1/3 CTh | 1.91 | 1.92 | 1.96 | 1.95 | 2.64 | 2.60 |
| 1/3 CTh + NS 1.0% | 2.06 | 2.03 | 2.09 | 2.08 | 2.93 | 2.88 |
| 1/3 CTh + HA 0.1% | 2.13 | 2.10 | 2.18 | 2.17 | 3.01 | 2.99 |
| Control | 1.48 | 1.51 | 1.52 | 1.57 | 2.05 | 2.02 |
| L.S.D. 5% | 0.13 | 0.10 | 0.11 | 0.10 | 0.18 | 0.16 |

**Table 3:** Effect of berry thinning, nutrient solution and humic acid spraying on total soluble solid, total acidity and TSS/acid ratio of Flame Seedless grapes during 2015 and 2016 seasons.

| Treatments | TSS% | | Acidity % | | TSS/acid ratio | |
|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| 1/3 CTh | 18.8 | 18.7 | 0.450 | 0.442 | 41.78 | 42.31 |
| 1/3 CTh + NS 1.0% | 20.2 | 19.9 | 0.493 | 0.483 | 40.97 | 41.20 |
| 1/3 CTh + HA 0.1% | 20.6 | 20.1 | 0.486 | 0.458 | 42.38 | 43.89 |
| Control | 17.4 | 17.3 | 0.530 | 0.507 | 32.98 | 34.70 |
| L.S.D. 5% | 1.36 | 1.18 | 0.031 | 0.023 | 3.16 | 3.74 |

**Table 4:** Effect of berry thinning, nutrient solution and humic acid spraying on firmness and anthocyanin contents of Flame Seedless grapes during 2015 and 2016 seasons.

| Treatments | Firmness (g/cm$^2$) | | Anthocyanin (mg/100g FW) | |
|---|---|---|---|---|
| | 2015 | 2016 | 2015 | 2016 |
| 1/3 CTh | 170.3 | 164.7 | 2.81 | 3.66 |
| 1/3 CTh + NS 1.0% | 189.0 | 180.3 | 2.86 | 3.73 |
| 1/3 CTh + HA 0.1% | 176.6 | 165.2 | 2.89 | 3.86 |
| Control | 163.6 | 153.3 | 2.64 | 3.31 |
| L.S.D. 5% | 15.14 | 15.29 | 0.15 | 0.28 |

The highest values of berry weight (2.76 & 2.68 g), total soluble solid (20.6 & 20.1%), anthocyanin content (2.89 & 3.86) and TSS/acid ratio (42.38 & 43.89), against least weight (1.88 & 1.82 g), TSS (17.4 & 17.3%), anthocyanin content (2.64 & 3.31) and TSS/acid ratio (32.98 & 34.70), on untreated cluster (control) during the two studied seasons, respectively. Such results are of a good evidence for the importance of using berry thinning singly or combined with either nutrient solution (1%) or humic acid (0.1%) to improve the vine nutrient status and produce the high yield with good fruit quality.

The abovementioned results were in accordance with those obtained by Palliotti and Cartechini (2000), Dardniz and Kismali (2002), Guidoni *et al.* (2002), Akin (2003), Abdel-Razek *et al.* (2010), Akin (2011), Mohsen, Abeer (2011), Gatti *et al.* (2011) and El-Sayed *et al.* (2015).

## Conclusion

Consequently, to increase production and improve the berry quality can be advised that cutting tip of 1/3 cluster after berry set and thrice sprays of humic acid 0.1% after fruit set and implementation at the 30 days interval

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