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Effect of Cluster Tipping on Yield, Cluster Composition and Quality of Ruby Seedless Grapevines

Asmaa S. M. Omar[1]* and M. S. Aboryia[2]

[1]Pomology Department, Faculty of Agriculture,Mansoura University, Egypt, Egypt www.mans.edu.
[2]Pomology Department, Faculty of Agriculture, Damietta University, Egypt, Egypt www.du.edu.eg, modyaboryia@du.edu.eg

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ABSTRACT

This study was carried out during the seasons of 2019 and 2020 on Ruby Seedless grapevine cultivar (*Vitis venifera* L.) to study the effect of cluster tipping on yield, clusters and berries quality. Tipping was conducted by removing the terminal part of the cluster; when the berry diameter reached to 3–4 mm, at 16, 18 or 20 cm. In this respect, the data showed clearly that cluster tipping should be done to modify the clusters characteristics into suitable shape and compactness. The obtained results indicated that cluster tipping at 16 or 18 cm were more effective for improving cluster composition, berry diameter and berry quality. Inspite of these treatments didn't show any significant effect on yield/vine and per feddan, but they were more effective in increasing berry diameter and improving berry quality, since they increased SSC/acid ratio, total sugar, anthocyanin and total phenols contents compared to the untreated ones. Therefore, these treatments can be recommended to improve the clusters and berries quality of Ruby seedless grape under Egyptian Delta region conditions.

Keywords: Cluster tipping, Compactness, Ruby seedless, Cluster composition, Anthocyanin, Phenolic substances.

INTRODUCTION

Grape (*Vitis vinifera* L.) is one of the major commercial fruit crops with high export potential under Egyptian conditions. Since, its area is about 78,853 hectares with the total production of 1,759,472 tonnes (FAO, 2018). Ruby Seedless grapevine is considered to be one of the most popular seedless cultivar in Egypt with very vigorous growth and high fruitful. Hence, it has a great market acceptance due to its excellent nutritional properties and exportable demands (Mostafa *et al*., 2017). This cultivar faces a major production problem that its clusters are very tall, semi-compactness and have attractive less shape (Tello and Ibanez, 2014) according to the visual descriptor proposed by the International Organization of Vine and Wine (OIV, 2009). More integrated aspects approaches are needed for the sustainable production of this cultivar.

Low coloration and small berry size have been produced during the last several years, which is reflected in the grape quality. So, the grape growers gave a great attention to all cultural practices to improve the yield and berry quality (Belal *et al*., 2016).

The appearance of table grapes must primarily attract consumers and it is a response to the spread of any cultivar. Attractive factors for table grapes are berry and cluster size, shape and compactness of their clusters and berry color (Özer *et al.,* 2012). Good quality of table grapes represents a combination of medium-sized clusters of uniformly large and perfect berries with their characteristic color and pleasing flavor (Winkler *et al.,* 1974).

Several cultural practices can be used to achieve quality e.g.; canopy management, crop regulation and plant growth regulators to improve berry size and cluster conformation. Cluster and berry thinning are management practices to adjust over-crop and represent an approach in improving quality.

Thinning has a certain status as a technique without special skills for improving grapevine quality and yield regulation. Hand thinning by removing flowers or berries of clusters after fruit set, was carried out to increase berry weight and size, which improve quality. With removing of some clusters, the concerned leaf area per yield unit will be higher; hereby the grape quality will be improved. The regulation of the yield can lead to further advantages, where the ratio between vegetative and generative performance of the vines will be improved, the condition of the plants will be better, the diseases can be reduced and the growth of the shoots can be promoted. Berry thinning has been used to obtain largest berries, highest berry weight and fastest ripening. Thus, cluster thinning has a direct effect on the relationship between nutrient supply and vine requirements, which means that with fewer grape clusters on a vine, the photosynthetic assimilation is improved, leading to an increase in the quality of grapes (Reynolds *et al*., 1994). Hand thinning plays an important role with some grape cultivars since it controls the crop and improves the quality of its berry (Dhillon *et al*., 1992 and Palliotti & Cartechini, 1998).

Recently, public health and environmental safety organizations encourage the use of natural ways as an alternative to different chemicals for enhancing safe production of fruit crops. In the newly scientific literature, we can read about several new methods of "green harvest". Among them, the most familiar is the cluster tipping by cutting the terminal part of the clusters, where it has low-

*** Corresponding author.**
E-mail address: asmaa2007@mans.edu.eg
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cost, portable and non-destructive technique (Artem et al., 2015). This treatment results in looser and lighter clusters, but with larger berries. The results of the cluster tipping are similarly to cluster thinning for presenting higher sugar content, more phenolic components, and anthocyanins contents (Fazekas *et al*., 2012, Özer *et al*., 2012, Dardeniz 2014 and Belal *et al*., 2016).

The main objective of the present study is to evaluate the effect of cluster tipping at 16, 18 and 20 cm on yield and cluster composition. Also, study the effect of these treatments on berry quality and choose the optimum tipping tall for the cluster of 'Ruby Seedless' grapes under Egyptian Delta region conditions.

MATERIALS AND METHODS

This investigation was conducted during the seasons of 2019 and 2020 on 4 -years-old 'Ruby Seedless' grapevines grown in a private vineyard at El-deer village, Aga, Dakahlia Governorate, Egypt. Thirty-Six vines were selected to be uniform in their vigor, healthy and received the standard agriculture practices, which are being used in the vineyard. Vines are grown in clay soil, the distance between rows was 2 and 3 m within rows, under flood irrigation system. The vines were trained using cordon system on double T supporting, and pruned by leaving 4 arms with 4 fruiting spurs, 2 eyes on each, so that the total bud load was 32 buds per vine. All experimental vines were adjusted to 30 cluster/vine and the control clusters' length was about 27-28 cm. The experiment was arranged in a complete randomized block design with three replicates per treatment, three vines for each one. Cluster tipping was carried out by removing the terminal part of the cluster when the berry diameter reached about (3–4 mm) by using special shears.

To aid in understanding the main illustrated parts of a grape bunch are in Fig.1 (Dokoozlian, 2000).

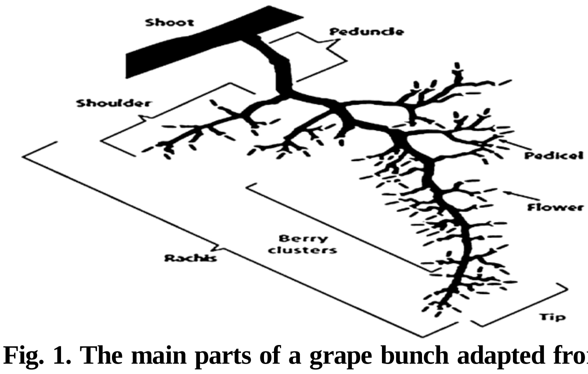

Fig. 1. The main parts of a grape bunch adapted from Dokoozlian, (2000).

The applied treatments were carried out by tipping the clusters as the following:

1- Cluster tipping at 16 cm.
2- Cluster tipping at 18 cm.
3- Cluster tipping at 20cm.
4- Control (leaving cluster without tipping)

At harvest time, when SSC/acid ratio reached about 16-17% and color development is about 75-80% of clusters in the untreated vines according to Radwan and Masood (2017), eighteen clusters from each replicate were taken and transported to the laboratory of Pomology Department, Mansoura University to determine the following parameters:

Yield and yield attributes:

- Yield per vine (kg) and yield/feddan (Ton) were estimated.
- Average cluster weight (g).
- Average number of berries per cluster as well as, cluster compactness coefficient according to El-Baz *et al*. (2002).
- SS/vine was estimated according to Shaulis & Steel (1969) and El-Baz *et al.* (2002), as follows:

SS/vine (kg) = SSC% × yield/vine × 0.01.

Since, this values presented to vine productivity.

Berry quality:

- Samples of 100 berries from each replicate were randomly collected to determine average: berry weight (g) and berry diameter (mm).
- Soluble solids content (SSC %), total acidity, SSC/acid ratio and total sugars % were measured according to AOAC (2005).
- Total anthocyanin in berry skin were also determined according to the method described by Mazumadar and Majumder (2003)
- Total phenols contents were measured according to the method described by Iland *et al*. (2004).

Statistical analysis

This experiment was arranged as a complete randomized block design with three replicates, three vines per each one. Data were subjected to analysis of variance (ANOVA) using Costat Statistical Software (1986). Means of all data were compared by LSD method at 5% according to Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

This investigation was undertaken to study the effect of cluster tipping on yield, cluster and berry characteristics of Ruby Seedless grapevines during the seasons of 2019 and 2020. The obtained results are presented as following:

1- Effect of cluster tipping on yield:

Data present in Table (1) showed that all cluster tipping treatments gave a somewhat increment of yield/vine than the control but the differences are insignificant. Furthermore, cluster tipping at 16 and 18 cm gave a higher yield/vine than tipping at 20 cm or the control, where the increment was about 9.9 and 7.9% over the control as a mean of two seasons, respectively.

With regard to the effect of cluster tipping on yield/fed, similar results were found to those obtained on yield/vine. Since, clusters tipping at 16, 18, and 20 cm gave a higher yield/fed than the control during both seasons of this study. It is obvious from the obtained data that the results took a similar trend during the two seasons of this study. Since the increase in yield is slight, the search for the good quality of the final product is of interest.

Our results are in agreement with those found by Cheema (1997), who mentioned that thinning of Perlette grape reduced the number of berries, but there was a compensation by increasing the mass of berries, consequently, the yield was not affected. Furthermore, Belal *et al.* (2016) and Radwan & Masood (2017) on Ruby Seedless grapevines, showed that either removing the terminal quarter of the cluster or thinning by cutting back about 15% from the terminal portion of clusters, respectively, gave insignificant increment in the yield/vine as compared to the control. Fallahi *et al.* (2018) also find that leaving 18 clusters per arm on the vine (36 groups per vine) with tipping a terminal third of each cluster (19 cm) at fruit set time gave a slight increase in yield/vine compared to the control. Likewise, Fawzi *et al.* (2019) found that the the treatment of (cluster thinning at 2-3 mm berry diameter by removing the terminal quarter of the cluster + spraying boric acid at 0.2% + girdling) significantly increased the yield/vine of Thompson Seedless grapevines with more than the control about 22.26% as a mean of two seasons.

Table 1. Effect of cluster tipping on yield/vine and yield/fed of Ruby Seedless grapevines.

Treatment	Yield/Vine (Kg)				Yield/Fed (Ton)			
	2019	2020	Mean	Than control%	2019	2020	Mean	Than control%
Cluster tipping at 16 cm	16.49	17.24	16.86	9.9	11.54	11.86	11.70	9.0
Cluster tipping at 18 cm	16.89	16.24	16.56	7.9	11.82	11.37	11.59	8.0
Cluster tipping at 20 cm	15.78	15.56	15.67	2.1	11.04	10.89	10.96	2.1
Control	15.25	15.44	15.34	_	10.67	10.80	10.73	_
LSD at 5%	NS	NS	_	_	NS	NS	_	_

2- Effect of cluster tipping on number of berries/cluster and cluster weight

From Table (2), it is clear that cluster tipping at 16, 18, and 20 cm significantly reduced the number of berries per cluster than the control, and it was more pronounced in the cluster tipping at 16 and 18 cm. Since, these treatments reduced the number of berries/cluster by about 34 - 32% less than the control as a mean of two seasons of the study. Similar results were found by Dardeniz (2014), who showed that number of berries/cluster of Uslu and Cardinal cvs decreased sequentially with an increasing of tipping from 1/12 of cluster length to 1/6 and 1/3 compared with control. Similar results were obtained from Radwan and Masood (2017), they found that number of berries/cluster of Ruby Seedless decreased with increasing the rate of cluster cutting back from 15% to 30% compared with control. Also, Fawzi *et al.* (2019) showed that number of berries/cluster of Thompson Seedless grape decreased with increasing the rate of cluster thinning, whereas removing the terminal half of the cluster gave the least significant number of berries/cluster than the removing of quarter half of the cluster or the remainder treatments.

Regarding to the effect on cluster weight, data in the same table reveal that no significant effect on average cluster weight had obtained due to cluster tipping compared to the control. Thus, cluster tipping at 16 cm gave a somewhat increment in cluster weight than those tipping at 18 or 20 cm as a mean of two seasons of this study. Since, this treatment increased the average of cluster's weight by about 9.9% than the control.

Table 2. Effect of cluster tipping on number of berries/cluster and cluster weight of Ruby Seedless grapevines.

Treatment	No. of berries/cluster				Cluster weight (g)			
	2019	2020	Mean	Than control%	2019	2020	Mean	Than control%
Cluster tipping at16 cm	121.6	121.4	121.5	-34.1	550.0	574.9	562.4	9.9
Cluster tipping at 18 cm	126.4	123.4	124.9	-32.3	563.1	541.7	552.4	7.9
Cluster tipping at 20 cm	149.0	145.7	147.3	-20.1	526.2	518.9	522.5	2.1
Control	182.0	187.0	184.5	_	508.5	514.8	511.6	_
LSD at 5%	13.7	18.2	_	_	NS	NS	_	_

From the above-mentioned results it is clear that in spite of cluster tipping reduced the number of berries/cluster, but gave a somewhat increment of average cluster weight/vine. In this respect, Profio *et al.* (2011) found that mean cluster and berries weight of Merlot, Cabernet Franc, and Cabernet. Sauvignon cvs, tended to increase with clusters thinning. Also, Özer *et al.* (2012) showed that 1/3 removal of the terminal part of the cluster resulted in a somewhat increment on cluster weight of RecelUzumu table grapes. Similarly, Belal *et al.* (2016) on Ruby Seedless grapevines found that removing the terminal quarter of the cluster gave a slight increase in cluster weight as compared with the control. Fallahi *et al.* (2018) showed that clusters in non-thinned vines were longer but lighter weight than those in the other treatments because they left without shortened. Yet, treatment of only 10 clusters per arm (20 clusters per vine) remained on the vine with one-third cut from the tip of each cluster gave the highest significant cluster weight with cluster length at 18 cm compared with control. Rutan *et al.* (2018) also showed a strong correlation between bunch weight and the extent of cluster thinning, where the treated vines always producing bunches with an average weight more than the control on Pinot noir grapevines.

3- Effect on compactness coefficients

Table (3) presents that the compactness coefficient of a cluster was insignificantly affected by cluster tipping. Since, this parameter is depending on the number of berries per cluster and cluster length. So, cluster tipping at 16 and 18 cm produced a lower number of berries per cluster than the control. Yet, the present data showed that the same treatments gave a slight decrease in compactness coefficients compared to the control. This process consists of the removal of living parts and concentrates the activities of the vine into the remaining parts, preventing bunch compactness (Pastore *et al.*, 2011). Similar results were also obtained by Özer *et al.* (2012), Dardeniz (2014), Belal *et al.* (2016), and Radwan and Masood (2017). Also, Roberto *et al.* (2017) mentioned that although the control treatment showed the highest average yield per vine and productivity, it was important to mention that the berry thinning is an essential operation to enhance the attributes related to appearance, such as compactness and weight of berries because these factors determine the market price. Also, Fawzi *et al.* (2019) investigated that cluster thinning by removing a terminal portion of the clusters resulted in reduction of berry numbers/cluster and then reduction in cluster compactness coefficient.

Table 3. Effect of cluster tipping on compactness coefficients and SSC/vine of Ruby Seedless grapevines.

Treatments	Compactness coefficients			SS/Vine (Kg)		
	2019	2020	Mean	2019	2020	Mean
Cluster tipping at 16 cm	7.60	7.58	7.59	2.99	3.13	3.06
Cluster tipping at 18 cm	7.02	6.85	6.93	3.08	3.00	3.04
Cluster tipping at 20 cm	7.45	7.28	7.36	2.40	2.63	2.51
Control	7.27	7.47	7.37	2.52	2.58	2.55
LSD at 5%	NS	NS	_	0.46	0.31	_

4- Effect on vine productivity (SS/vine, kg)

Concerning to the effect on (SS/vine, kg), which showed vine productivity, data from Table (3) show that cluster tipping at 16 or 18 cm gave higher significant values of SS/vine than cluster tipping at 20 cm or left without tipping. Since, these treatments increased the values of SS/vine by about 20% and 19.2%, respectively, than the control. Also, the results show that the increment of SS/vine was almost parallel to those found on yield/vine. So, cluster tipping at 16 and 18 cm, which gave a higher yield, also produced a higher percentage of SS/vine of Ruby Seedless grapevine during both seasons under this study. Whereas cluster tipping at 20 cm or the control gave a lower SS/vine and its productivity.

5- Effect of cluster tipping on berry weight and diameter

It is obvious from Table (4) that all cluster tipping produced higher significant values of berry weight and diameter than the control. Moreover, cluster tipping at 16 or 18 cm gave a more significantly effect in this respect, since these treatments increased average berry weight and diameter than cluster tipping at 20 cm or the untreated vines. Since, these treatments increased average berry weight by about 66.8 - 59.2%, respectively than the control.

The data also reveal that a similar effect on average berry diameter was found to those obtained from average berry weight. Since, all cluster tipping increased average berry diameter than the control. Furthermore, cluster tipping at 16 cm produced the highest berry diameter than the other treatments used or the control under the two seasons of this study, since this treatment increased berry diameter by about 10.9% than the control.

Table 4. Effect of cluster tipping on berry weight and berry diameter of Ruby Seedless grapevines.

Treatments	Berry weight (g)			Berry diameter (mm)		
	2019	2020	Mean	2019	2020	Mean
Cluster tipping at 16 cm	4.52	4.73	4.62	17.26	17.23	17.24
Cluster tipping at 18 cm	4.45	4.38	4.41	16.53	16.20	16.36
Cluster tipping at 20 cm	3.53	3.56	3.54	16.00	16.06	16.03
Control	2.79	2.75	2.77	15.33	15.76	15.54
LSD at 5%	0.58	0.13		1.02	0.91	

From the above mentioned results, it's clear that despite cluster tipping of Ruby Seedless grape gave non pronounced effect on yield/vine and per feddan and average clusters weight than the control, but these treatments gave a higher effect for increasing both berry weight and diameter than the control. These increment may be due to the effect of cluster tipping on reducing the number of berries/cluster significantly than the control. Also, cluster tipping at 16 or 18 cm gave a more pronounced effect for increasing both berry weight and diameter but reducing the number of berries per cluster. In this respect, thinning treatments changed the leaf/fruit ratio, which supports fruit growth and reduced the competition among the remainder fruits for the available photo assimilates (Palmer *et al.,* 1997). Also, Agusti *et al.* (2000) presented that thinning treatments increase the available carbohydrates, which are responsible for increasing both fruit weight and size. In this respect, berry size compensation is concerning only when the berries are in phase I of development, during the first 3-4 weeks following the fruit set. During this stage cell division occurs in the berry, and removal of competing clusters may change the carbon partitioning to allow greater berry diameter (Skinkis, 2017).

The increment in berry weight and diameter due to cluster thinning were considered to be in accordance with the findings of Abd EL-Razek *et al.* (2010), Özer *et al.* (2012), Dardeniz (2014), Belal *et al.* (2016).

The purpose of cluster thinning is to give individual berries enough space to fully develop and still have a not too compact cluster, in addition, reducing the berries number per cluster without changing the number of leaves, which reduce the competition between the berries on assimilate materials, lead to an increase in berry weight (Radwan and Masood, 2017). Also, Silvestre *et al.* (2017) showed that berry thinning resulted in berries with higher length and width, probably due to better distribution of berries along with the bunch and resulted in higher berry mass for both seasons.

6- Effect on SSC, total acidity and SSC/acid ratio:

It is clear from Table (5) that cluster tipping of Ruby Seedless grape at 16 and 18 cm produced berries with higher significant values of SSC in berry juice thane tipping cluster at 20 cm or the untreated ones. Also, it's clear from the mean of the two seasons that the differences between them on SSC in berry juice were unpronounced.

Through the previous data displayed, it is clear that cluster tipping gave a lower number of berries/cluster since, the berry numbers/cluster of untreated vine were almost higher than the other treatments. So, the untreated clusters gave lower values of SSC in berry juice as a mean of two seasons compared to the tipping treatments

With regard to the effect of cluster tipping on total acidity, data in the same table show a reverse trend to those obtained from soluble solid content in berry juice. So, cluster tipping at 16 or 18 cm gave lower values of total acidity in berry juice. Yet, cluster tipping at 20 cm or left without tipping gave higher values of total acidity than the other treatments used.

Regarding to the effect on SSC / acid ratio in berry juice, data from Table (5) reveal that similar trend to that obtained from SSC in berry juice during the two seasons under the study. This is may be due to that cluster tipping increased the percentage of SSC but reduced the values of total acidity in berry juice. Similar results were observed, and it was explained by the source/sink ratio, as a consequence of the removal of a portion of Sangiovese grapes bunch (Pastore *et al*., 2011). The reduction in bunch size by berry thinning techniques, also increased the SSC % content in 'BRS Nubia' table grapes (Silvestre *et al*., 2017). Also, Radwan and Masood (2017) and Fawzi *et al.* (2019) showed that cluster tipping gave an increase in SSC% and maturity index but reduced the total acidity. Also, Xi *et al.*

(2018) found that total acid of the thinned vine dropped as compared with unthinned vines. Furthermore, Ivanišević *et al*. (2020) and Xi *et al*. (2020) found that cluster thinning significantly increased SSC%. While, cluster thinning significantly decreased total acidity of varieties under study compared to untreated vines.

Table 5. Effect of cluster tipping on SSC, total acidity and SSC/acid ratio of Ruby Seedless grapevines.

Treatments	SSC (%)			Total acidity (%)			SSC/acid ratio		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
Cluster tipping at16 cm	18.16	18.16	18.16	0.41	0.41	0.41	43.62	43.67	43.64
Cluster tipping at18 cm	18.26	18.46	18.35	0.43	0.42	0.42	41.89	43.65	42.77
Cluster tipping at 20 cm	16.86	17.00	16.93	0.47	0.46	0.46	35.65	36.69	36.17
Control	16.60	16.73	16.66	0.48	0.50	0.49	34.36	33.47	33.91
LSD at 5%	0.63	0.98	_	0.03	0.03	_	2.97	2.96	_

7- Effect on total sugars, anthocyanin and total phenols contents

Data present in Table (6) show the effect of cluster tipping on total sugar in berry juice of Ruby Seedless grapes. In this respect, the data reveal that cluster tipping at 16 or 18 cm produced significantly higher values of total sugars in berry juice than cluster tipping at 20 cm or left without tipping. Since, the untreated clusters produced a lower percentage of total sugars than the other treatments used. Likewise, these data are almost similar to those found of SSC values in berry juice.

Table 6. Effect of cluster tipping on total sugars, anthocyanin and total phenols contents of Ruby Seedless grapevines

Treatments	Total sugars (%)			Anthocyanin (mg/100g)			Total phenols (mg/100g)		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
Cluster tipping at 16 cm	16.51	16.54	16.52	47.31	54.07	50.69	4.11	4.12	4.11
Cluster tipping at 18 cm	17.28	17.68	17.48	47.58	56.16	51.87	4.65	4.55	4.60
Cluster tipping at 20 cm	15.67	16.21	15.94	49.38	53.05	51.21	3.81	3.76	3.78
Control	14.52	14.82	14.67	44.39	49.89	47.14	3.58	3.59	3.58
LSD at 5%	0.83	0.48		4.09	5.64		0.20	0.23	

Concerning to the effect on anthocyanin content, data in the same table show that cluster tipping produced berries with higher values of anthocyanin content in berries skin than those left without tipping. So, cluster tipping at 18 cm produced the highest values of anthocyanin content in berry skin comparing with the other treatments or the control. From these data, it is clear that cluster tipping at 16, 18, or 20 cm produced higher values of total sugars and anthocyanin content than those left without tipping. That is may be because that sugars are the major source of anthocyanin synthesis. Also, reducing the number of berries per cluster without changing the number of leaves, which reduce the competition between the berries on essential materials. So, it can be concluded that the berry thinning treatments were able to carbohydrates accumulation, which activate the process of growth and development, hence increase the berry weight and hastened ripening. These effects surely reflected on advancing the berry ripening and improving its quality in terms of increasing sugars and anthocyanin contents as well as total soluble solids and decreasing total acidity.

Dokoozlian and Hirschfeldt (1995) investigated that soluble solids contents of Flame Seedless berry juice at harvest were greater for cluster thinned vines compared to unthinned vines and there was a relationship between this parameter and berry color, which was the compositional parameter most sensitive to cluster thinning, thus, thinned vines accumulated color more rapidly than unthinned vines. Also, Guidoni *et al*. (2002) proposed that sugar content could regulate flavonoid accumulation in grape berries and found that cluster thinning significantly increased the soluble solid content and total sugars of the berry mesocarp and the hypothesis can be made that berry sugar concentration may also influence berry anthocyanin composition. This technique also increases ethylene production in some fruits, indicating advanced maturity (Lopez *et al*., 2011).

Furthermore, Colombo *et al*. (2020) showed that regulation of the source/sink ratio via cluster thinning is a common practice to enhance the accumulation of secondary metabolites, especially flavonoid and anthocyanins.

Our results are in line with those found by Profio *et al*. (2011), who showed that there was an increase in SSC% and anthocyanin concentrations across all cultivars under study (Merlot, Cabernet Franc, and Cabernet-Sauvignon) in response to cluster thinning, suggesting a positive relationship between sugar concentration and anthocyanin synthesis. Also, Belal *et al*. (2016), Radwan and Masood (2017) and Fawzi *et al*. (2019) investigated that either cluster tipping generally or increasing rate of tipping, respectively, resulted in increasing total sugars or anthocyanin content.

Regarding to the effect of cluster tipping on total phenols, data from the same table show that all cluster tipping increased total phenols as compared with control. Meanwhile, cluster tipping at 16 or 18 cm gave a significantly higher increment than the control. Whereas, the lowest values resulted from cluster tipping at 20 cm and the control as a mean of both seasons. So, Pirie and Mullins (1977) presented the relationship between levels of anthocyanins, total phenols, and sugars in the skin of ripening grapes of Shiraz and Cabernet Sauvignon grapes, which studied in the fruit during the period from véraison to maturity. In grapes with a wide range of anthocyanin contents per unit area of skin, there was a good correlation between sugar content of the skin and levels of phenolic substances. The closest correlations, e.g. sugar vs. anthocyanin and sugar vs. total phenols, were found in the first five weeks after véraison. The role of sugars in the regulation of phenolic biosynthesis in ripening grapes is discussed. Also, Fazekas *et al*. (2012) indicated that cluster tipping gave the highest significant values in total phenols and anthocyanin of local grapes compared with other treatments and the control.

Also, crop thinning has been shown to provide more berry quality benefits than later thinning. Such benefits include increase secondary metabolite production: anthocyanins, phenolics, and aroma compounds. Later season crop thinning has been used largely to achieve greater precision in targeting final yield goals. Many growers will thin clusters at the lag phase to achieve the desired yield (Skinkis, 2017)

There were trends observed amongst phenolic compound groups that suggested a correlation between their concentrations and the yield as ton/ha subsequent to the varying cluster thinning treatments. The removal of crop, as seen in this study, appeared to allow more light exposure to the remaining fruit, although cluster light exposure was not itself measured. Significant differences and very close associations with the levels of crop thinning and the concentrations of the phenolics were observed. With more intense cluster thinning, the phenolic concentrations increased (Rutan *et al*., 2018)

The same results were obtained from Xi *et al*. (2020) who studied the effect of cluster thinning and girdling on aroma composition in 'Jumeigui' table grape.

CONCLUSION

From this study, it is clear that the effects of cluster tipping are manifested in cluster and berry morphology and composition. Also, reduced berry number loosened the clusters, but it did not affect the quantity of yield due to the increase in the weight and diameter of the berries as a result of performing the tipping process and consequently the increase in the weight of the treated clusters, especially cluster tipping at 16 and 18 cm. Results presented the importance of cluster tipping for Ruby Seedless grapes in order to obtain high profitability. Where, medium loose bunches with large berries have a higher market value.

On the light of previous results, cluster tipping at 16 and 18 cm can be recommended to grape growers as an effective practice to produce attractive, semi-compact cluster with large berries as well as improve the quality with preserving the quantity of Ruby Seedless grapevines under Delta conditions.

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تأثير تقصير العنقود على المحصول و تركيب و جودة عناقيد العنب الروبى سيدلس.

أسماء سعيد مصطفى عمر[1] ومحمد سعد أحمد أبورية[2]

[1]قسم الفاكهة - كلية الزراعة - جامعة المنصورة

[2]قسم الفاكهة - كلية الزراعة - جامعة دمياط

أجريت هذه الدراسة خلال موسمى 2019 ، 2020 لتقييم تأثير تقصير عناقيد العنب صنف الروبى سيدلس على المحصول و أثره على صفات العناقيد والحبات. حيث تم إزالة الجزء الطرفى من العنقود عند وصول قطر الحبات إلى 3:4 مم وذلك بتقصير العنقود إلى طول 16، 18 و 20 سم مقارنة بالعناقيد الغير معاملة. اوضحت النتائج المتحصل عليها ان تقصير العنقود اعطى افضل النتائج من خلال صفات العناقيد وكذا الحبات، إذ أظهرت الدراسة أن محصول الكرمة والفدان لم يتأثر تأثيرا واضحا نتيجة للمعاملات السابقة. فى حين أظهرت المعاملات زيادة ملحوظة فى وزن و حجم الحبات وكذا تحسين خواصها من خلال زيادة نسبة المواد الصلبة الذائبة/الحموضة وكذا السكريات الكلية و محتوى الثمار من الأنثوسيانين والمواد الفينولية مقارنة بتلك الغير معاملة. لذا يمكن التوصية بتقصير عناقيد العنب الروبى سيدلس بطول 16،18 سم حيث أعطت نتائج إيجابية من خلال زيادة حجم الحبات وتحسين التلوين وخواص الثمار للعنب الروبى سيدلس المنزرعة تحت ظروف الدلتا.