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# INFLUENCE OF CANOPY MANAGEMENT PRACTICES ON YIELD AND BERRY QUALITY OF RUBY SEEDLESS GRAPEVINES UNDER DAKAHLIA GOVERNORATE CONDITIONS.

Rizk, M.H
Hort. Res. Inst. Agric. Res. Cent., Cairo

## ABSTRACT

This study was carried out during 2002 and 2003 seasons on Ruby Seedless grapevines to examine the effect of removing the basal leaves at bloom or after fruit set each alone or combined with shoot thinning and topping or both on yield, cluster characteristics as well as berry physical and chemical characteristics. All canopy management practices which contained leaf removal after fruit set with or without shoot thinning and topping increased packable and total yield per vine, cluster weight, compactness coefficient and juice volume, whereas the percentage of cull yield was decreased than the control. On the other hand, early removal of the basal leaves alone or combined with shoot thinning reduced total yield, cluster weight, berry weight and juice volume than the control. Canopy management practices of leaf removal after fruit set plus shoot thinning and topping gave a higher yield, cluster weight, berry weight and juice volume than the other treatments and the control. Cluster and berry length were not significantly affected by the above canopy management treatments. All canopy management applications increased T.S.S., T.S.S./acid ratio, anthocyanin and total reserved carbohydrates in the new canes and decreased the total acidity than the control.

## INTRODUCTION

Among the horticultural practices carried out in high vigor vine yards such as Ruby Seedless, canopy management is the most important practices through which grape production and berry quality can be improved.

Canopy management is the practice which results in the modification of position or amount of leaves, shoot and fruit in space to achieve a desired arrangement (Smart and Robinson, 1991). Canopy management has several viticulture advantages such as maximizing sunlight interception, which means minimizing shading and maintaining a balance between shoot growth and fruit productivity.

Grapevine leaves are net imports of carbohydrates until they reach 50%-80% of their final size (Koblet, 1969). The photosynthetic rate increases until leaves attain full size and decreases steadily thereafter (Kriedemann *et al.*, 1970). The most efficient leaves in the canopy are those that recently expanded. The age of the vine canopy can be manipulated with selective leave removal and shoot topping at appropriate growth stages (Carmo Vasconcelos & Castagnoli,2001 ).

Leaf removal, shoot thinning and topping are canopy management practices which can reduce excessive canopy density (Smart, 1985; Bledose *et al.* 1988;Hegazi&AbdeKawi,1992; Percival *et al.* 1994a and Reynolds *et al.* 1994a) increase yield (Smith *et al.* 1988; Percival *et al.* 1994b and Hunter *et* *al.* 1995), reduce the incidence of disease (Gubler *et al.* 1987; English *et al.* 1989 and Stapleton *et al.* 1995) and improve fruit composition (Crippen and Morrison, 1986 and Zoeklein *et al.* 1992).

Little information is available on the use of canopy management practices under Dakahlia governorate conditions. Therefore, the purpose of this study was to determine how different canopy management practices affect yield, fruit composition and carbohydrate reserves in the permanent vine structure.

Ultimately, the goal was to provide growers with tools for optimizing table grape production using these practice.

## MATERIALS AND METHODS

This experiment was carried out at EL-Mansoura Research Station, Horticultural Research Institute, during the seasons of 2002 and 2003 on Ruby Seedless grapevines. The vineyard was established in 1996 with vine spacing of 2m. within rows and 3.0 m in between rows. The vines are grown in clay-loam soil and trained to quadrate cardon and fruiting spurs were retained of two bud per spur under double T trellis system. All vines received the common cultural practices (except those under evaluation). The experiment block system with three replications per treatment of three vines each.

**Canopy management practices :-**

1 – No canopy manipulation (control)
2 – Early leaf removal (at bloom) (L. $R_I$)
3 – Leaf removal after fruit set (L. $R_{II}$)
4 – Early leaf removal + shoot thinning. (L. $R_I$ + Sh. Th.)
5 – Leaf removal after fruit set + shoot thinning (L. $R_{II}$ + Sh.Th.)
6 – Early leaf removal + Topping (L. $R_I$ + T.)
7 – Leaf removal after fruit set + Topping (L.$R_{II}$ + T.)
8 – Early leaf removal + shoot thinning + Topping (L. $R_I$ + Sh. Th. + T.)
9 – Leaf removal after fruit set +Shoot thinning +Topping (L. $R_{II}$ +Sh. Th. + T.).

Shoot thinning was accomplished before bloom when shoots were approximately 15 cm. in length by removing secondary shoots, tertairy shoots and any shoots arrising directly from the cardon. Leaf removal consisted of the removal of all primary leaves and lateral shoots beginning at the base of shoots and continuing till the node opposite the top cluster .

Vines were defoliated one or six weeks after flowering on the north side of vines to avoid direct sunlight exposure of the fruit during the hottest part of the day. Topping was carried out by cutting shoots that grow beyond the trellis space about 60 – 90 cm above the top wire.

At harvest time, the clusters separated into either a packable or cull category on the basis of numbers of shot berries, cluster size, berry size and uniformity of set. Cluster weight and number of berries per cluster were determined. Compactness co-efficient was calculated by dividing number of berries per cluster by cluster length (Winkler *et al.* 1974).

From each treatment, three samples each containing 100 berries were randomly taken to measure the average berry weight, length, juice volume, percentage of total soluble solids, titrable acidity and TSS/acid ratio. Total anthocyanin content was estimated by separation the berry skin and the pigment was extracted by the method of (Hsia *et al.*1965). Then the optical density of the extract was determined at 530 Mu. The total carbohydrates content in new canes was determined as g/100 g dry weight in the following December according to the method of (Dubois *et al.* 1956).

The obtained data were statistically analyzed according to (Snedecor & Cochran, 1980).

## RESULTS AND DISCUSSION

**(1) Yield :**

Data presented in Table (1) show that leaf removal after fruit set with or without shoot thinning or topping increased the yield per vine than the control. The highest yield was recorded when basal leaves were removed after fruit set with shoot thinning and topping. The total yield per vine due to this treatment reached about 15.44 and 15.93 kg per vine during the two seasons of study respectively. Whereas, early removal of basal leaves alone or combined with shoot thinning, topping or shoot thinning plus topping reduced the total yield per vine than the untreated ones. The differences between these treatments or the control were not significant.

**Table (1): Effect of canopy management applications on yield of Ruby Seedless grapes.**

| Treatments | Yield per vine (kg) | | | | | |
|---|---|---|---|---|---|---|
| | Packable (kg) | | Cull (kg) | | Total yield (kg) | |
| | 2002 | 2003 | 2002 | 2003 | 2002 | 2003 |
| Control | 13.45 | 13.82 | 1.27 | 1.31 | 14.72 | 15.13 |
| L. $R_I$ | 13.36 | 13.62 | 0.97 | 0.96 | 14.33 | 14.58 |
| L. $R_{II}$ | 13.79 | 14.18 | 1.12 | 1.04 | 14.91 | 15.22 |
| L. $R_I$ + Sh. Th. | 13.49 | 13.75 | 0.96 | 0.98 | 14.45 | 14.73 |
| L. $R_{II}$ + Sh. Th. | 14.08 | 14.45 | 1.08 | 1.09 | 15.16 | 15.54 |
| L. $R_I$ + T. | 13.59 | 13.96 | 0.95 | 0.89 | 14.54 | 14.85 |
| L. $R_{II}$ + T. | 14.36 | 14.84 | 0.96 | 0.95 | 15.32 | 15.79 |
| L. $R_I$ + Sh. Th + T. | 13.70 | 14.17 | 0.89 | 0.94 | 14.59 | 15.11 |
| L. $R_{II}$ + Sh. Th. + T. | 14.51 | 14.99 | 0.93 | 0.94 | 15.44 | 15.93 |
| L S.D at 5 % | 0.24 | 0.35 | 0.13 | 0.10 | 0.54 | 0.63 |

- L.$R_I$ : Early leaf removal at bloom
- L.$R_{II}$ : Leaf removal after fruit set
- Sh. Th. : Shoot thinning
- T. : Topping

With regard to the effect of canopy management practices on cull yields, data from the same table showed that all treatments significantly reduced cull yields than the control. Thus Canopy management of leaf removal after fruit set, shoot thinning and topping gave lower percentage of cull yield than the other canopy managements used or the control during the two seasons of the study. Since, the cull yield percentage due to this treatment gained about 6.0% and 5.9% during the two seasons respectively.

Concerning the effect of canopy management practices on packable yield. Data in Table (1) took an opposite trend to that found with cull yield.

These results are in agreement with those reported by Koblet (1969), Quinlan & Weaver, 1970 and Carmo Vasconcelos & Castagnoli, 2001. They found that shoot topping at bloom improved the yield per vine. They added that, actively growing shoot tips compete with the developing inflorescences for assimilates. During bloom, the leaves in the mid-and upper-shoot section export carbohydrates to the shoot tip. After hedging, the direction of translocation is reversed; instead of moving up to the shoot tip, assimilates are diverted downword and made available to the developing inflorescences.

Winkler *et al.* (1974) and Peacock (1989) reported that shoot thinning adjust inflorescence numbers and reduce shoot congestion in the fruiting zone. Bledsoe *et al.* (1988); Smith *et al.* (1988) and Hunter *et al.* (1995) found that leaf removal and shoot thinning increased the yield of Cabernet Sauvignon grapevines .

Whereas, Jensen *et al.* (1976) reported that the removal of basal leaves reduced the packable and total yield of Ribier and Cardinal table grape varieties. The poor yield when basal leaves were removed early are believed to be due to the poor supply of metabolities.

**(2) Cluster weight and length :-**

Data presented in Table (2) show clearly that topping and leaf removal with or without shoot thinning as well as leaf removal after fruit set alone or combined with shoot thinning significantly increased cluster weight than the control. Whereas, leaf removal before flowering with or without shoot thinning reduced the cluster weight than the other canopy management practices or the control. The increase cluster weight observed in topping and leaf removal can be attributed primary to the increase in number of berries per cluster and berry weight.

These results are in line with those reported by Coombe (1962); Koblet (1969)and Koblet & Perret (1979) who reported that lateral shoots – during early stages of development – depend on assimilates provided by the main shoot for growth, competing with other vegetative and reproductive sink. Elimination of all competing vegetative growing tips, either on the main or lateral shoots, increase the pool of available carbohydrates for floral development, which may result in improving fruit set.

Concerning the effect on cluster length the data showed no apparent effect in that respect during both seasons of the study.

**(3) Number of berries per cluster and compactness coefficient :**

With regard to the effect of canopy management practices on the number of berries per cluster data from Table (2) indicated that all treatments increased number of berries per cluster than the control. Moreover, topping and leaf removal with or without shoot thinning as well as leaf removal before flowering alone or plus shoot thinning significantly increased number of berries per cluster than the control during the two seasons of the study. The increase in number of berries per cluster observed in canopy management practices may be due to the increase of berry set percentage (EL Shahat *et al.* 2002). These results are in line with those obtained by Bledsoe *et al.* (1988) and Percival *et al.* (1994b).

Data of Table (2) showed that the compactness coefficient took nearly the same trend of that found with number of berries per cluster The increase in compactness coefficient might be imputed to the increasing of berry set as mentioned by (EL Shahat *et al.* 2002).

Table (2): **Effect of canopy management applications on berry weight, berry length and juice volume of Ruby Seedless grapes.**

| Treatments | Cluster weight (gm) | | Cluster length (cm) | | No. of berries/ cluster | | Compactness Coefficient | |
|---|---|---|---|---|---|---|---|---|
| | 2002 | 2003 | 2002 | 2003 | 2002 | 2003 | 2002 | 2003 |
| Control | 617 | 629 | 32.4 | 32.2 | 233 | 234 | 7.19 | 7.27 |
| L. $R_I$ | 612 | 618 | 33.1 | 33.0 | 261 | 249 | 7.89 | 7.55 |
| L. $R_{II}$ | 638 | 639 | 32.6 | 32.8 | 235 | 244 | 7.21 | 7.44 |
| L. $R_I$ + Sh. Th. | 619 | 613 | 32.3 | 34.0 | 242 | 263 | 7.49 | 7.74 |
| L. $R_{II}$ + Sh. Th. | 640 | 645 | 33.0 | 33.8 | 238 | 248 | 7.21 | 7.34 |
| L. $R_I$ + T. | 642 | 639 | 32.8 | 33.2 | 244 | 250 | 7.44 | 7.53 |
| L. $R_{II}$ + T. | 655 | 667 | 33.2 | 33.7 | 246 | 254 | 7.41 | 7.54 |
| L. $R_I$ + Sh. Th. + T. | 653 | 660 | 32.7 | 33.6 | 243 | 253 | 7.43 | 7.53 |
| L. $R_{II}$ + Sh. Th. + T. | 664 | 673 | 32.5 | 33.1 | 242 | 250 | 7.45 | 7.55 |
| L.S.D at 5 % | 11.44 | 9.74 | N.S. | N.S. | 6.56 | 5.83 | 0.22 | 0.23 |

- L.$R_I$ : Early leaf removal at bloom - L.$R_{II}$ : Leaf removal after fruit set
- Sh. Th. : Shoot thinning - T. : Topping

**(4) Berry weight and length :-**

Data in table (3) indicate that shoot topping and leave removal with or without shoot thinning as well as leaf removal after fruit set alone, increased berry weight than the other treatments or the control during the two seasons of the study. Whereas, leaf removal before flowering with or without shoot thinning reduced berry weight than the control.

The increase in berry weight by canopy management practices was explained by (Winkler *et al.* 1974) who reported that these treatments lead to the increase in photosynthetic activity of leaves as a result of the pronounced increase in their area. As a consequences of that, immigration of assimilates from leaves towards berries is enhanced.

These results are in agreement with those obtained by Mann & Singh (1985); Reynolds *et al.* (1986); Alia *et al.* (2001) and EL Shahat *et al.* (2002).

On the other hand, Jennsen *et al.* (1976) reported that removing basal leaves of Cardinal and Ribier seeded table grape cultivars just before bloom reduced berry weight.

Concerning the effect on berry length the data in Table (3) indicated that all canopy managements practices used increased berry length but the differences between these treatments or the control were not significant.

**Table (3): Effect of canopy management applications on berry weight, berry length and juice volume of Ruby Seedless grapes.**

| Treatments | Berry weight (gm) | | Berry length (cm) | | Juice volume (ml) | |
|---|---|---|---|---|---|---|
| | 2002 | 2003 | 2002 | 2003 | 2002 | 2003 |
| Control | 2.49 | 2.51 | 1.68 | 1.71 | 73 | 74 |
| L. $R_I$ | 2.24 | 2.43 | 1.74 | 1.76 | 69 | 72 |
| L. $R_{II}$ | 2.58 | 2.58 | 1.72 | 1.84 | 79 | 79 |
| L. $R_I$ + Sh. Th. | 2.41 | 2.28 | 1.77 | 1.75 | 72 | 70 |
| L. $R_{II}$ + Sh. Th. | 2.53 | 2.55 | 1.79 | 1.74 | 77 | 78 |
| L. $R_I$ + T. | 2.54 | 2.52 | 1.75 | 1.79 | 78 | 77 |
| L. $R_{II}$ + T. | 2.62 | 2.60 | 1.81 | 1.73 | 80 | 80 |
| L. $R_I$ + Sh. Th. + T. | 2.65 | 2.52 | 1.79 | 1.81 | 81 | 77 |
| L. $R_{II}$ + Sh. Th. + T. | 2.70 | 2.65 | 1.82 | 1.85 | 83 | 81 |
| L.S.D at 5 % | 0.07 | 0.07 | N.S. | N.S. | 3.83 | 3.33 |

- L.$R_I$ : Early leaf removal at bloom - L.$R_{II}$ : Leaf removal after fruit set
- Sh. Th. : Shoot thinning - T. : Topping

**(5) Juice volume :-**

It is apparent from the data of Table (3) that all canopy management practices except early leaf removal alone or with shoot thinning significantly increased juice volume in comparison with the control. The highest values in this respect resulted from the combined application of leaf removal after fruit set, shoot thinning and topping Alia *et al.* (2001) and EL Shahat *et al.* (2002) found similar results with application of summer pruning on Red Roomy and Thompson Seedless grapevines.

**(6) Total soluble solids, acidity and TSS/acid ratio :-**

Data presented in Table (4) indicated that all canopy management applications significantly increased T.S.S percentage in comparison with the control during the two seasons of this study. However, the highest TSS percentage resulted from leaf removal after fruit set combined with shoot thinning and topping. Concerning the effect of canopy management applications on acidity percentage at harvest, the data generally, reveal that all treatments tended to reduce acidity in the berry juice. The differences between all treatments used and the control were significant.

In regard to the effect on the T.S.S/acid ratio the data disclosed a general trend of increasing this ratio with all canopy management applications compared with the control. These increments were significant during the two seasons. The highest TSS acid ratio resulted from the treatment of leaf removal after fruit set combined with shoot thinning and topping. The obtained results concerning T.SS and acidity percentage might be explained by promoting vine vigour. and aids in supplying the clusters with assimilate. These results are in coincidence with those obtained by Wolf *et al.*(1986); Kliewer and Bledosoe (1987); Candolfi–Vasconcelos & Koblet (1990) and Zoecklein (1992) reported that leaf removal increased soluble solids. The recommended time for leaf removal was two to three weeks post blooming.

Table (4): Effect of canopy management applications on T.S.S, acidity and T.S.S / acid ratio of Ruby Seedless grapes

| Treatments | T.S.S % | | Acidity % | | T.S.S / acid ratio | |
|---|---|---|---|---|---|---|
| | 2002 | 2003 | 2002 | 2003 | 2002 | 2003 |
| Control | 17.5 | 17.7 | 0.518 | 0.511 | 33.87 | 34 64 |
| L. $R_I$ | 18.0 | 18.1 | 0.579 | 0.575 | 31.09 | 31.48 |
| L. $R_{II}$ | 18.2 | 18.4 | 0.561 | 0.559 | 32.44 | 32.92 |
| L. $R_I$ + Sh. Th. | 18.1 | 18.3 | 0.569 | 0.565 | 31.81 | 32.39 |
| L. $R_{II}$ + Sh. Th. | 18.3 | 18.6 | 0.556 | 0.543 | 32.91 | 34.25 |
| L. $R_I$ + T. | 18.5 | 18.7 | 0.545 | 0.540 | 33.94 | 34.63 |
| L. $R_{II}$ + T. | 18.7 | 19.0 | 0.532 | 0.535 | 35.15 | 35.51 |
| L. $R_I$ + Sh. Th. + T. | 18.6 | 18.8 | 0.539 | 0.533 | 34.51 | 35.27 |
| L. $R_{II}$ + Sh. Th. + T. | 18.9 | 19.1 | 0.521 | 0.518 | 36.28 | 36.87 |
| L.S.D at 5 % | 0.44 | 0.43 | 0.01 | 0.01 | 1.20 | 1.25 |

- L.$R_I$ : Early leaf removal at bloom — - L.$R_{II}$ : Leaf removal after fruit set
- Sh. Th. : Shoot thinning — - T. : Topping

Table (5): Effect of canopy management applications on anthocyanins in berry skin and total carbohydrates in the canes of Ruby Seedless grapes.

| Treatments | Anthocyanin (O.D) | | Total carbohydrates | |
|---|---|---|---|---|
| | 2002 | 2003 | 2002 | 2003 |
| Control | 0.513 | 0.564 | 21.3 | 21.8 |
| L. $R_I$ | 0.593 | 0.612 | 22.1 | 22.5 |
| L. $R_{II}$ | 0.623 | 0.656 | 23.4 | 23.9 |
| L. $R_I$ + Sh. Th. | 0.610 | 0.632 | 22.5 | 22.9 |
| L. $R_{II}$ + Sh. Th. | 0.658 | 0.673 | 23.2 | 24.1 |
| L. $R_I$ + T. | 0.619 | 0.642 | 22.9 | 23.3 |
| L. $R_{II}$ + T. | 0.685 | 0.696 | 24.0 | 24.4 |
| L. $R_I$ + Sh. Th. + T. | 0.672 | 0.658 | 23.2 | 23.5 |
| L. $R_{II}$ + Sh. Th. + T. | 0.694 | 0.713 | 24.6 | 25.2 |
| L.S.D at 5 % | 0.02 | 0.03 | 0.49 | 0.54 |

- L.$R_I$ : Early leaf removal at bloom — - L.$R_{II}$ : Leaf removal after fruit set
- Sh. Th. : Shoot thinning — - T. : Topping

**Anthocyanin :-**

Data in Table (5) indicated that all canopy management applications significantly increased total anthocyanins in berry skin than the control. Yet vines managed with leave removal after fruit set, shoot thinning and topping gave more pronounced effect than all the other practices used. Reports on the effect of sun exposure on anthocyanin content are inconsistent. Increasing sun exposure of berries increased the color of Cabernet Franc (Georgessi and Lee, 1985) and Cabernet Sauvignon (Carbonneau, 1984). Moreover, Candolfi-Vasconcelos & Koblet (1990) reported that canopies composed only of lateral leaves generate fruit with higher anthocyanin content as compared to non defoliated controls Lateral leaves, being youngest leaves in the canopy, may play a major role in metabolic processes occurring during fruit ripening.

**Carbohydrates in new canes :-**

It is apparent from the data presented in Table (5) that total carbohydrates in canes at the end of the growing season was affected significantly with different canopy management manipulations. Moreover leaf removal after fruit set plus shoot thinning and topping appeared to assimilate and store higher carbohydrates content than the other treatments or the control. These results go in the same direction with those of Wolf *et al.* (1986) and Bledsoe *et al.* (1988) and Carmo-Vasconcelose & Castagnoli (2001) reported that canopy management increased the level of carbohydrate reserves in trunk of Pinot Noir grapevines.

Moreover, Koblet (1987) demonstrated that basal leaves cease in fall their carbohydrate export whereas young leaves remain active. With further leaf development there is a continued increase in photosynthetic activity.

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## تأثير معاملات تشكيل المجموع الخضرى على المحصول وصفات الحبات للعنب روبى سيدلس تحت ظروف محافظة الدقهلية .

**محمود حسين رزق**

**معهد بحوث البساتين – مركز البحوث الزراعية – وزارة الزراعة .**

أجريت هذه الدراسة خلال عامى ٢٠٠٢ و ٢٠٠٣ على صنف العنب روبى سيدلس وذلك لدراسة تأثير التوريق المبكر أثناء بداية التزهير أو بعد العقد كلا بمفرده أو بالإضافة إلى خف الأفرخ او التطويش أو مع كليهما على المحصول والصفات الطبيعية والكيميائية للثمار .

وقد أدت كل معاملات التوريق بعد العقد سواء بمفردها أو بالإضافة إلى خف الأفرخ والتطويش إلى زيادة المحصول القابل للتسويق وإجمالى محصول الكرمة ووزن العناقيد ومعامل التزاحم وأيضا حجم العصير بينما قلت النسبة المئوية للثمار الغير قابلة للتسويق عن أشجار المقارنة. ومن جهة أخرى فقد أدى التوريق المبكر عند التزهير سواء بمفردة أو مع خف الأفرخ إلى تقليل المحصول ووزن العناقيد وحجم العصير أما معاملة تشكيل المجموع الخضرى والتى تتضمن التوريق بعد العقد بالإضافة إلى خف الأفرخ والتطويش فقد أدت إلى زيادة المحصول ووزن العناقيد ووزن الحبات وحجم العصير عن باقى المعاملات الأخرى أو أشجار المقارنة . أما طول العنقود وطول الحبة فلم يتأثر معنويا بأى من معاملات تشكيل المجموع الخضرى المستعملة فى التجربة . كما أدت جميع معاملات تشكيل المجموع الخضرى إلى زيادة فى نسبة المواد الصلبة الذائبة ونسبتها إلى الحموضة وزيادة محتوى قشرة الثمار من صبغة الأنثوسيانين وزيادة محتوى الكربوهيدرات المخزنة فى القصبات بينما قلت نسبة الحموضة فى عصير الحبات عند مقارنتها بالأشجار التى لم يتم إجراء تشكيل للمجموع الخضرى فيها .