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EFFECT OF GIRDLING ON YIELD, FRUIT QUALITY AND STORAGE LIFE OF FLAME SEEDLESS AND RUBY SEEDLESS GRAPE CULTIVARS.

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ABSTRACT

Effect of girdling and its time on yield, fruit quality and storage life of Flame and Ruby seedless cultivars grown in a clay loam soil in Dakahlia Governorate was studied during two seasons (1997 and 1998). Girdling was performed at different times; before flowering, after fruit-set, 2 weeks after fruit set and at véraison.

This study revealed that girdling Flame seedless before flowering increased fruit set percentage, cluster compactness factor, yield, cluster weight, berry weight & size and total anthocyanin in berries skin. While, there was no effect on berries juice, T.S.S. and acidity contents. Girdling of Ruby seedless, before flowering, increased fruit-set percentage, cluster compactness factor, yield, cluster weight, berry weight and size, T.S.S., T.S.S./acidity and total anthocyanin in berries skin, and decreased acidity in juice berries. While, there was no effect on cluster length and berries juice volume.

Moreover, girdling both Flame and Ruby seedless at véraison increased T.S.S., T.S.S./acidity and total anthocyanin in berries skin, while decreased acidity in berries juice. There was no effect on fruit-set percentage, yield per vine, cluster weight, cluster length, cluster compactness factor, berry weight and size.

This study also revealed that girdling both Flame and Ruby seedless cultivars after fruit set or 2 weeks later improved the yield and quality. Yield increased with about 69.7 and 63.6% for Flame and 36.0 and 29.4% for Ruby seedless cultivars over the control as a mean of the two seasons, respectively. Also girdling increased cluster weight, berry weight and size, T.S.S., T.S.S./acidity and total anthocyanin in berries skin, while decreased acidity in berries juice. Berries characters were better than other treatments used drring room storage at 25-30°C and 45% R.H., this treatment decreased cluster weight loss, shattering percentage, decay percentage and total loss after 9 days. The reduction of total loss reached about 16.7 and 17.8% in Flame seedless and about 12.8 and 11.7% in Ruby seedless less compared to the control as a mean of the two seasons, respectively.

INTRODUCTION

The increase in yield, fruit quality and storage life in grapes is one of the most important objective in Egypt. The use of mechanical treatments such as girdling is an important method to increase production and improve quality of the yield and during storage life. Girdling has been used commercially to increase accumulation of carbohydrates in the parts above the wounds including flower or fruit clusters and to influence their development (Singh and Weaver, 1976, Nour *et al*., 1984 and Orth, 1990).

Therefore, this work was carried out to study the effect of the time of girdling on yield, fruit quality and the behaviour of fruits stored at room temperature under Dakahlia Governorate conditions.

MATERIALS AND METHODS

This study was carried out during 1997 and 1998 seasons on Flame and Ruby seedless cultivars growing in a private vineyard at Dakahlia Governorate. Eleven year old vines of each cultivars were growing in a clay loam soil, planted at 2.5 x 3 meters and trained according cardon system. The orchard was in a good condition and the vines recieved the normal agricultural practrices as in the commercial grape vineyards under Dakahlia conditions. The selected vines were almost similar in vigor and arranged in a randomized block design, with three replications per treatment, three vines each. The applied treatments was done on four dates as the following:-

1- Control (without girdling).
2. Girdling before flowering.
3./ Girdling after fruit-set.
4. Girdling 2 weeks after fruit-set.
5. Girdling at véraison.

Girdling was done by ringing vine arms using girdling scissors to remove a complete 4 mm ring. Wonds resulting from girdiling were immediately covered with bandag containing zinc oxide to avoid any fungus attack. During both growing seasons of study, three flower cluster per vine from each treatment were bagged in polyethylene to determine the fruit-set percentage using the following equation.

$$\text{Fruit set \%} = \frac{\text{Average berries number / cluster}}{\text{Average flowers number / cluster}} \times 100$$

At harvest time, yield, cluster weight, and cluster length were determined. Cluster compactness factor was calculated by dividing the number of berries per clustetr by its length according to Weaver *et al*. (1962).

From each treatment, three samples each containing 100 berries were used for physical and chemical determinations. Berry weight, berry size, juice volume, T.S.S., acidity, T.S.S. / acidity and total anthocyanin in berries skin were also determined according to Hsia *et al*. (1965).

For storage studies (at harvest), clusters from each vine were picked and immidiately taken to the laboratory. Nine samples of each practice (each sample was about 3 kgs) were held at room temperature (about 25-30°C) and relative humidity (about 40-45%). Each sample was put in a carton perforated box and examined at 3 days interval. Sample in three boxes (3 replicates) were taken in each sampling period and subjected to the flowoing determinations; cluster weight loss percentage, shattering, decay and total loss (by adding cluster weight loss percentage, shatter and decayed fruits), T.S.S., total acidity and T.S.S. / acid ratio were also determined.

The obtained data were statistically analyzed as a complete randomized block designs according to Snedecor and Cochran (1980). Treatment means were compared using L.S.D. method at 5% level.

RESULTS AND DISCUSSION

Fruit-set:

Data presented in Table (1) indicated that girdling both Flame and Ruby seedless cultivars before flowering significantly increased fruit-set percentage than the control. The increment due to this treatment reached about 10.6% over the control in Flame seedless and 7.5% in Ruby seedless as a mean of the two seasons under the study. Our data go in line with Dabas *et al*. (1980) and Jindal *et al*. (1982).

On the other hand, girdling after fruit-set, 2 weeks or girdling at véraison did not significantly affected fruit-set percentage in both cultivars in the two seasons of study.

Yield and cluster weight:

Its obvious from Table (1) that girdling both Flame and Ruby seedless cultivars before flowering or after fruit-set or girdling 2 weeks after fruit-set significantly increased yield and cluster weight than the control. The increment of cluster weight due to girdling application before flowering could be attributed to increase in fruit-set (Nour *et al*., 1984). While, the increment of cluster weight due to girdling after fruit-set or girdling 2 weeks after fruit set could be due to accumulation of carbohydrates above the girdling which increased berry weight and size. The increment in yield reached 35.4, 69.7 and 63.6% in Flame seedless and 23.2, 36.0 and 29.4% in Ruby seedless. Similar results were found by Dabas *et al*. (1980), Abdel-Kawi *et al*. (1984), Amen (1987), Jindel and Sharma (1990) and Carreno *et al*. (1998). Whereas, girdling both Flame and Ruby seedless cultivars at véraison had no significant effect on yield of the vines. Similar findings were obtained by Lavin (1983) and Carreno (1998).

Cluster length and compactness factor:

It is clear from Table (2) that all girdling treatments of both Flame and Rubby seedless cultivars did not significantly affect cluster length in the two seasons of study.

Concerning the effect of girdling on cluster compactness factor, the same table indicated that girdling of both Flame and Ruby seedless cultivars before flowering increased cluster compactness factor in the two seasons under the study. The increment may be due to increase fruit-set percentage and increase in size of berries.

Berry weight and size:

Data presented in Table (3) indicated that girdling application of both Flame and Ruby seedless cultivars before flowering, after fruit-set or 2 weeks after fruit-set increased berry weight and size. Harrel and Williams (1987) mentioned that the increase in berry size was associated with an alteration in the partitioning of recent photosynthate within the leaf. This data also revealed that girdling after fruit-set or 2 weeks after fruit-set gave a higher berry weight than the control. The increment in berry weight attributed to these treatments reached 28.9 and 28.8%, respectively in Flame seedless and 25.0 and 23.7% in Ruby seedless over the control as a mean of the two

seasons under study. These results are in agreement with those reported with Marchiori and Zanni (1974), Abdel-Fatah (1977); Jindal and Sharma (1990) and Rizk (1993).

On the other hand, girdling application at véraison did not significantly affect berry weight and size. These results are in agreement with those reported by Rizk (1993) and Carreno (1998).

Table 2: Effect of girdling on cluster length and cluster compactness factor on Flame and Ruby seedless grapes during 1997 and 1998 seasons.

Treatments	Cluster length (cm)				Cluster compactness factor			
	Flame seedless		Ruby seedless		Flame seedless		Rubyseedless	
	1997	1998	1997	1998	1997	1998	1997	1998
1	27.7	28.3	31.3	32.0	6.2	6.1	6.9	6.6
2	28.3	28.7	32.0	32.7	7.5	7.5	7.8	7.5
3	29.3	29.7	31.6	32.3	6.1	5.9	6.8	6.9
4	29.3	29.7	31.7	32.0	6.0	5.8	6.8	6.9
5	28.0	28.3	31.0	32.0	6.1	6.0	6.8	6.6
L.S.D. at 5%	NS	NS	NS	NS	0.6	0.45	0.6	0.19

1. Control. 2. Girdling before flowering. 3. Girdling after fruit-set
4. Girdling 2 weeks after fruit-set. 5. Girdling at véraison.

Juice volume:

Regarding the effect on berries juice volume, data in Table (3) show clearly that girdling application of both Flame and Ruby seedless cultivars after fruit-set or 2 weeks after fruit-set significantly increased juice volume than the control. The increment due to these treatments recorded 1.8 and 2.4% in Flame seedless and 1.9 in Ruby seedless and 1.9% over the control as a mean of the two seasons under the study, respectively. This data go in line with those obtained by Rizk (1993).

On the other hand, girdling before flowering or at véraison had no significant effect in this respect.

Total soluble sloids, acidity and T.S.S./acid ratio:

Data presented in Table (4) indicated that all girdling application treatments used significantly increased T.S.S. percentage than the control. The highest T.S.S. percentage resulted from girdling application at véraison in both Flame and Ruby seedless cultivars in the two seasons under the study. Our data are in line with those found by Jindal and Sharma (1990), Rizk (1993), Gadallah (1994) and Carreno *et al*. (1998).

On the other hand, the same table show that all treatments used gave a significant decrease in total acidity in the berries juice of both Flame seedless and Ruby seedless cultivars. Nour *et al*. (1994) studied the effect of girdling and its time on berry quality of both Thompson seedless and Black Monukka grape cultivars, and found that girdling at full-bloom or after fruit

set reduced total acidity percentage. These findings are in harmony with those reported by Carreno *et al*. (1998).

Concerning the effect of girdling applications on T.S.S. / acid ratio, data in Table (4) indicated that the values took a similar trend as that noticed in case of T.S.S.

Total anthocyanin:

With regard to the effect of girdling on total anthocyanin in berries skin of both Flame and Ruby seedless grape cultivars, Table (4) indicated that all girdling treatments used significantly increased total anthocyanin in berries skin than the untreated vines on the two seasons under the study. Furthermore, girdling application at véraison stage gave more pronounced effect than all the other treatments used.

Effect of girdling applications on berry characters during staorage at room temperature:

Berry weight and size:

Data presented in Table (5) indicated that berries weight and size for both cultivars gradually decreased with advanced storage period from 3 to 9 days during the two seasons of study. Girdling application after fruit-set or girdling at 2 weeks after fruit-set gave the lowest reduction in this respect.

Juice volume:

Data presented in Table (6) show that juice volume gradually decreased with advanced storage period (25-30°C) and about 45% relative humidity. The data also took nearly the same trend that found with berry weight and size.

The total soluble solids, acidity and T.S.S. / acidity:

Data in Tables (6 and 7) show clearly that total soluble solids gradually increased towards the end of storage period. All girdling treatments application of both Flame and Ruby seedless grape cultivars gave the highest total soluble solids during room storage than the control in the two seasons under study.

Data also revealed that the acid values gradually decreased through the storage period. The least acidity values were obtained from girdling treatments at véraison.

Concerning the effect of girdling application on T.S.S. / acid ratio of both Flame and Ruby seedless cultivars during storage period, data presented in Table (7) show clearly that T.S.S. / acid ratio was increased during storage period. Girdling at véraison gave the highest value in this respect. Moreover, girdling after fruit-set or 2 weeks after fruit-set were equal in this respect. But, girdling before flowering gave somewhat increase in T.S.S. / acid ratio than the control of the two cultivars in the two seasons of study.

Weight loss percentage:

Table (8) revealed that weight loss percentage was increased during room storage. Girdling at different times application significantly decreased weight loss percentage at the end of storage period than the control in both cultivars in the two seasons of study. Girdling after fruit-set or girdling at 2 weeks after fruit-set gave the best result in this respect. The reduction attributed to these treatments was 21.8 and 21.8% in flame seedless and 6.9 and 7.1% less than the control as a mean of the two seasons of study.

Shattering percentage:

Table (8) show that shattering percentage was increased during storage period. Girdling application before flowering, after fruit-set or girdling at 2 weeks after fruit set significantly decreased shattering percentage in both Flame and Ruby seedless cultivars. The reduction in shattering percentage was 19.0, 25.9 and 32.8% in Flame seedless and 5.5, 19.4 and 19.4% in Ruby seedless than the control as a mean of the two seasons of study. While, girdling at véraison did not significantly affected shattering percentage in this respect in both Flame seedless and Ruby seedless cultivars than the control in the two seasons of study.

Decay percentage:

Table (9) revealed that decay percentage increased as the storage period advanced. Girdling applications significantly decreased decay of both Flame and Ruby seedless cultivars. Girdling application after fruit-set or at 2 weeks after fruit-set significantly decreased the decay percentage. The decay percentage reduction was 9.3 and 10.1% in Flame seedles and 11.6 and 13.0% in Ruby seedless grape cultivars less than the control as a mean of the two seasons. While, girdling before flowering or at véraison gave some reduce in decay percentage than the control in the two seasons of study.

Total loss percentage:

Its obvious from Table (9) that total loss including loss of cluster weifgt, loss due to berry shattering and loss due to decay significantly increased at the end of storage periods. Mohamed (1994) found that maximum storage life was 8 days at room temperature for Flame and Ruby seedless cultivars. Tourky *et al*. (1995) mentioned that the most marketable condition for longer period and maximum storage life was 9 days at room temperature of Flame seedless, Ruby seedless and Perlette cultivars. The results in Table (9) indicated that girdling application significantly decreased total loss percent at the end of storage in the two cultivars than the control. The reduction was 11.5, 16.7, 17.8 and 10.3% of Flame seedless and 3.3, 12.8, 11.7 and 1.6% in Ruby seedless than the control as a mean of the two seasons of study.

In general, the data obtained from this study revealed that girdling application of both Flame seedless and Ruby seedless cultivars after fruit set or at 2 weeks after fruit-set were the most effective to improve the yield and fruit quality, also decreased total loss percentage during room storage than the other treatments used and the control.

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تأثير التحليق على المحصول وجودة الثمار والتخزين فى صنفى العنب الفليم والروبى سيدلس

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أجرى هذا البحث خلال موسمى ١٩٩٧ و ١٩٩٨ لدراسة تأثير مواعيد التحليق المختلفة على المصول وجودة الثمار وتخزين العنب الفليم والروبى سيدليس٠ وقد أجرى التحليق فى أربع مواعيد مختلفه٠

- قبل التزهير
- بعد العقد
- بعد أسبوعين من العقد٠
- فى مرحلة تحول اللون٠

وقد أوضحت الدراسة أن التحليق قبل التزهير أدى إلى زيادة معنويه فى نسبة العقد عن باقى المعاملات والكنترول وزاد معامل تزاحم العنقود وزيادة وزن العنقود ووزن وحجم الحبات٠ ولم تتأثر المواد الصلبة الكليه الذائبه فى صنف الفليم سيدلس بينما زادت فى صنف الروبى سيدليس ولذلك زادت صبغة الأنثوسيانين والتلوين فى القشرة للحبات ونسبة المواد الصلبة الكليه الذائبه / الحموضه وقلت نسبة الحموضه فى عصير الحبات لكلا الصنفين٠ ونقصت أيضا نسبة الفرط والفقد فى الوزن ونسبة الفقد الكلى فى نهاية فترة التخزين عن الكنترول٠

لاتوجد فروق معنويه بين التحليق بعد العقد أو بعد أسبوعين من العقد وكانت أحسن المواعيد المناسبه للتحليق لكلا الصنفين حيث قلت نسبة العقد ومعامل تزاحم العنقود وزاد وزن العنقود بنيبة ٦٩,٧ و ٦٣,٧% بالنسبة للصنف فليم سيدلس و ٣٦,٠ ، ٢٩,٤% للصنف روبى سيدلس٠ وكذلك زاد وزن وحجم الحبات وأيضا المواد الصلبة الكليه الذائبة وكذلك نسبة المواد الصلبة الكليه الذائبه فى العصير وتركيز الصبغة فى القشرة زيادة معنويه وقد نقصت كل من نسبة الفرط ونسبة الفقد فى الوزن والأعفان فى نهاية فترة التخزين عن باقى المعاملات مما أدى إلى نقص الفاقد الكلى للمحصول بنسبة ١٦,٧ و ١٧,٨% للصنف فليم سيدليس و ٨.١٢ و ١١,٧% للصنف روبى سيدلس عن الكنترول كمتوسط للموسمين٠

أما التحليق فى مرحلة تحول اللون لم يؤثر معنويا على نسبة العقد ، معامل تزاحم العنقود ، وزن العنقود ، وزن وحجم الحبات ، كمية العصير ولكن زادت نسبة المواد الصلبة الكليه الذائبه فى عصير الحبات وكذلك نسبة المواد الصلبة الكليه الذائبه / الحموضه وكمية صبغة الأنثوسيانين فى قشرة الحبات وقلت أيضا نسبة الحموضة فى العصير ٠ أما بالنسبة لسلوك الثمار فى نهاية فترة التخزين فقد قلت نسبة الفقد الكلى للثمار فى نهاية فترة التخزين عن الكنترول٠

Table 1: Effect of girdling on fruit-set percentage, yield per vine and cluster weight of Flame seedless and Ruby seedless grapes.

Treat.	Fruit-set (%)				Yield per vine (kg)				Cluster weight (kg)			
	Flame seedless		Ruby seedless		Flame seedless		Ruby seedless		Flame seedless		Ruby seedless	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
1	16.0	16.0	16.2	16.0	9.5	10.2	19.8	22.4	376.7	341.0	576.0	561
2	18.0	17.4	19.5	19.0	14.3	12.5	23.8	28.2	570.0	414.7	680.0	705
3	16.3	16.0	16.3	16.0	16.2	17.3	27.0	30.4	646.7	577.0	770.0	760
4	16.1	16.1	16.3	16.0	16.3	16.1	27.5	27.2	650.0	538.6	786.7	680
5	16.1	16.0	16.2	15.9	9.8	10.4	20.0	23.2	390.0	347.0	570.0	580
L.S.D. at 5%	0.6	0.85	0.57	0.20	1.15	3.5	2.3	0.33	45.7	51.3	27.9	8.4

1. Control. 2. Girdling before flowering. 3. Girdling after fruit-set
4. Girdling 2 weeks after fruit-set. 5. Girdling at véraison.

Table 3. Effect of girdling on berry weight, berry size and juice volume of Flame seedless and Ruby seedless grapes.

Treat.	Berry weight / 100 berries (gm)				Berry size / 100 berries (ml)				Juice volume / 100 gm berries			
	Flame seedless		Ruby seedless		Flame seedless		Ruby seedless		Flame seedless		Ruby seedless	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
1	193.0	186.7	250.0	248.0	186.7	181.7	243.3	230.0	74.0	73.3	75.1	75.1
2	216.3	211.3	283.3	272.7	210.7	205.0	280.0	256.7	74.3	73.7	75.4	75.2
3	259.2	230.7	313.3	308.7	245.0	223.3	296.7	283.3	75.3	74.7	76.7	76.2
4	252.8	236.7	316.7	299.3	250.0	230.0	300.0	280.0	75.7	75.3	76.7	76.2
5	196.8	190.0	250.0	250.7	191.7	185.0	245.0	236.7	74.3	73.7	75.3	75.0
L.S.D. at 5%	12.8	16.9	31.2	17.4	13.7	16.1	19.5	13.4	1.3	1.1	0.87	0.70

1. Control. 2. Girdling before flowering. 3. Girdling after fruit-set
4. Girdling 2 weeks after fruit-set. 5. Girdling at véraison.

Table 4: Effect of girdling on T.S.S., acidity, T.S.S. / acid ratio and total anthocyanin of Flame seedless and Ruby seedless grapes.

Treat.	T.S.S. (%)				Acidity (%)				T.S.S. / acid ratio				Total anthocyanin			
	Flame seedless		Ruby seedless		Flame seedless		Ruby seedless		Flame seedless		Ruby seedless		Flame seedless		Ruby seedless	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
1	16.0	16.3	15.7	15.3	0.71	0.73	0.73	0.68	22.5	22.3	21.5	22.6	0.09	0.09	0.08	0.08
2	17.5	17.3	17.3	17.3	0.67	0.68	0.70	0.67	25.4	25.4	24.7	25.8	0.14	0.14	0.09	0.10
3	17.7	17.3	17.3	17.7	0.63	0.68	0.71	0.66	28.1	25.4	24.4	26.8	0.15	0.14	0.10	0.09
4	18.0	18.0	17.7	17.3	0.62	0.67	0.71	0.66	29.0	25.9	24.9	26.2	0.16	0.16	0.13	0.11
5	18.0	19.0	17.7	18.0	0.62	0.66	0.68	0.63	29.0	28.8	26.0	28.7	0.18	0.17	0.14	0.14
L.S.D. at 5%	1.4	1.0	1.03	1.0	0.04	0.04	0.02	0.03	2.8	1.2	1.17	1.4	0.02	0.02	0.01	0.02

1. **Control.**
2. **Girdling before flowering.**
3. **Girdling after fruit-set**
4. **Girdling 2 weeks after fruit-set.**
5. **Girdling at véraison.**

Table 5: Effect of girdling on berry weight, and berry size of Flame and Ruby seedless grapes during room storage at 1997 and 1998 seasons.

	1997 season											
	Berry weight (gm)						Berry size (ml)					
	Flame seedless			Ruby seedless			Flame seedless			Ruby seedless		
Treat.	3 days	6 days	9 days	3 days	6 days	9 days	3 days	6 days	9 days	3 days	6 days	9 days
1	191.0	186.0	185.0	243.0	238.0	233.0	189.7	186.0	184.0	236.0	233.0	229.7
2	213.3	210.0	208.3	275.0	270.0	264.0	211.7	209.0	207.3	269.0	266.0	263.0
3	256.3	252.0	265.3	305.0	301.0	293.0	254.3	250.7	248.3	290.0	287.0	283.0
4	251.7	249.0	247.0	307.7	299.0	294.7	250.3	248.7	246.3	296.0	298.0	290.0
5	194.3	190.0	188.3	245.3	236.0	233.7	193.0	190.7	187.3	238.0	236.0	238.7
L.S.D. at 5%	4.2	5.1	5.7	1.9	2.1	2.2	4.8	3.7	4.2	1.5	3.2	3.2
	1998 seasons											
1	183.7	178.3	176.7	247.0	243.2	221.7	182.7	176.7	174.0	227.7	223.3	216.7
2	208.3	205.7	203.3	271.0	265.0	248.3	205.0	204.7	201.7	254.0	246.7	241.7
3	228.3	225.0	222.3	307.7	302.7	283.3	227.7	223.3	220.0	281.7	277.3	275.0
4	233.3	231.7	228.3	298.3	292.3	278.3	231.0	231.0	226.7	256.7	271.7	265.0
5	188.3	185.0	182.7	250.0	244.3	228.3	187.3	183.3	181.7	235/0	232.3	223.3
L.S.D. at 5%	11.3	7.8	8.3	16.2	5.0	6.4	6.5	5.1	5.3	8.0	11.5	13.0

1. **Control.**
2. **Girdling before flowering.**
3. **Girdling after fruit-set**
4. **Girdling 2 weeks after fruit-set.**
5. **Girdling at véraison.**

Table 6: Effect of girdling on juice volume and T.S.S. of Flame and Ruby seedless grapes during room storage at 1997 and 1998 seasons.

	1997 season											
	Juice volume / 100 gm berries						T.S.S.					
	Flame seedless			Ruby seedless			Flame seedless			Ruby seedless		
Treat.	3 days	6 days	9 days	3 days	6 days	9 days	3 days	6 days	9 days	3 days	6 days	9 days
1	73.8	73.0	72.0	74.7	74.3	73.3	16.4	16.6	17.0	15.5	15.7	15.9
2	73.8	72.7	71.5	75.2	74.7	73.7	16.8	17.0	17.5	15.8	16.0	16.2
3	75.2	74.2	73.3	76.5	75.7	75.3	17.0	17.5	17.9	16.4	16.5	17.5
4	75.2	74.5	73.7	76.5	76.2	75.8	18.7	18.7	18.9	16.8	16.9	17.0
5	73.8	73.0	72.2	75.0	74.3	73.7	18.0	18.5	18.8	16.7	17.3	18.3
L.S.D. at 5%	0.7	0.4	1.2	0.8	1.1	1.1	1.4	1.5	1.6	0.1	0.6	1.1
	1998 seasons											
1	72.8	72.5	71.2	74.7	74.2	73.2	16.4	16.6	17.0	15.6	15.8	16.3
2	73.2	73.0	71.8	75.0	74.5	73.4	16.8	17.0	17.5	15.8	17.3	18.0
3	74.2	73.8	73.3	76.0	75.3	74.3	17.0	17.5	17.9	16.4	17.7	18.3
4	74.8	74.7	73.5	76.0	75.2	74.1	18.7	18.7	18.9	16.8	18.3	18.7
5	73.2	72.5	71.7	74.7	74.2	73.3	18.0	18.5	18.8	16.7	18.7	19.0
L.S.D. at 5%	0.5	0.8	1.1	0.5	0.7	0.6	1.1	0.8	0.8	0.6	0.7	1.3

1. **Control.**
2. **Girdling before flowering.**
3. **Girdling after fruit-set**
4. **Girdling 2 weeks after fruit-set.**
5. **Girdling at véraison.**

Table 7: Effect of girdling on acidity, and T.S.S./acid ratio of Flame and Ruby seedless grapes during room storage at 1997 and 1998 seasons.

	1997 season											
	Acidity						T.S.S./acid ratio					
	Flame seedless			Ruby seedless			Flame seedless			Ruby seedless		
Treat.	3 days	6 days	9 days	3 days	6 days	9 days	3 days	6 days	9 days	3 days	6 days	9 days
1	0.70	0.64	0.64	0.71	0.69	0.67	23.6	25.9	26.6	21.8	22.8	23.7
2	0.62	0.62	0.57	0.69	0.68	0.67	27.0	27.4	29.7	22.9	23.5	24.2
3	0.62	0.60	0.60	0.70	0.68	0.66	27.3	29.2	29.8	23.4	24.6	25.5
4	0.61	0.61	0.59	0.70	0.69	0.67	30.7	30.8	32.0	24.0	24.8	25.4
5	0.61	0.61	0.60	0.68	0.67	0.66	29.5	30.5	31.3	25.6	25.8	27.7
L.S.D. at 5%	0.01	0.02	0.02	NS	NS	NS	0.7	2.4	2.3	1.9	0.3	0.40
	1998 seasons											
1	0.72	0.70	0.60	0.67	0.66	0.65	22.2	23.6	24.3	23.1	23.8	25.3
2	0.67	0.62	0.60	0.66	0.66	0.64	24.6	27.7	28.8	25.1	26.4	28.1
3	0.66	0.64	0.59	0.65	0.65	0.62	26.2	27.8	30.5	26.1	27.8	29.1
4	0.65	0.62	0.60	0.64	0.64	0.61	26.9	29.0	30.0	27.8	27.6	30.1
5	0.63	0.62	0.59	0.62	0.64	0.60	28.7	31.0	33.4	29.3	30.9	32.4
L.S.D. at 5%	0.05	0.05	0.06	0.02	0.02	0.02	0.2	0.2	0.2	1.1	0.6	1.7

1. **Control.**
2. **Girdling before flowering.**
3. **Girdling after fruit-set**
4. **Girdling 2 weeks after fruit-set.**
5. **Girdling at véraison.**

Table 8: Effect of girdling on weight loss and shattering percentage of Flame and Ruby seedless grapes during room storage at 1997 and 1998 seasons.

	1997 season											
	Weigh loss (%)						Shattering (%)					
	Flame seedless			Ruby seedless			Flame seedless			Ruby seedless		
Treat.	3 days	6 days	9 days	3 days	6 days	9 days	3 days	6 days	9 days	3 days	6 days	9 days
1	7.6	10.0	24.3	6.0	7.6	17.2	2.2	4.4	6.7	2.5	5.4	7.2
2	6.5	8.9	20.5	5.9	7.2	16.9	1.9	3.6	5.2	2.2	5.3	6.9
3	5.2	7.7	19.3	5.3	6.9	16.2	1.7	2.5	4.9	2.0	4.4	5.9
4	5.3	8.2	18.3	5.2	6.8	16.1	1.9	3.0	4.8	1.9	4.0	5.8
5	6.3	9.3	20.9	5.7	6.9	16.8	2.0	4.5	6.2	2.0	5.1	7.2
L.S.D. at 5%	0.6	0.6	1.0	0.2	0.18	0.3	0.2	0.3	0.4	0.37	0.38	0.30
	1998 seasons											
1	7.5	9.6	23.3	6.4	8.4	17.8	1.8	2.7	4.9	2.4	5.7	7.3
2	7.2	8.9	19.1	5.5	7.9	17.1	1.6	2.5	4.2	2.1	4.7	6.7
3	6.8	8.6	17.9	5.4	7.6	16.3	1.2	2.5	3.7	1.9	4.3	5.8
4	6.7	8.7	17.8	5.5	7.6	16.4	1.5	2.1	3.1	1.9	4.3	5.8
5	6.9	8.6	20.5	5.9	7.9	17.4	1.6	2.0	4.2	2.4	5.7	7.1
L.S.D. at 5%	NS	0.5	2.5	0.3	0.03	0.2	0.2	0.2	0.3	0.2	0.3	0.3

1. Control.
2. Girdling before flowering.
3. Girdling after fruit-set
4. Girdling 2 weeks after fruit-set.
5. Girdling at véraison.

Table 9: Effect of girdling on decay and total loss percentage of Flame and Ruby seedless grapes during room storage at 1997 and 1998 seasons.

	1997 season											
	Decay %						Total loss %					
	Flame seedless			Ruby seedless			Flame seedless			Ruby seedless		
Treat.	3 days	6 days	9 days	3 days	6 days	9 days	3 days	6 days	9 days	3 days	6 days	9 days
1	13.7	18.5	22.5	3.7	5.0	11.7	23.5	32.4	53.5	12.2	18.0	36.1
2	13.3	17.6	21.5	3.5	4.9	11.4	21.9	30.1	47.2	11.6	17.4	35.2
3	11.2	17.6	21.5	3.0	4.3	10.5	18.1	27.8	45.7	10.3	15.6	32.6
4	11.6	17.3	21.4	3.2	4.3	10.3	18.8	28.5	44.5	10.3	15.1	32.2
5	12.6	17.4	21.4	3.9	4.8	11.4	20.9	31.2	48.5	11.6	16.8	35.4
L.S.D. at 5%	0.8	0.6	0.5	0.3	0.27	0.3	1.1	0.9	2.1	1.0	1.3	2.0
	1998 seasons											
1	12.6	18.3	22.9	3.9	5.3	12.2	21.9	30.6	51.1	12.7	19.4	37.3
2	11.2	16.5	21.7	3.6	5.0	11.9	20.0	27.9	45.0	11.2	17.6	35.7
3	7.5	15.6	19.7	2.9	3.9	10.7	15.5	26.7	41.3	10.2	15.8	32.8
4	7.7	15.8	19.3	2.9	3.8	10.4	15.9	26.6	40.2	10.3	15.7	32.6
5	8.7	16.6	20.2	3.8	5.1	12.3	17.2	27.2	44.0	12.1	18.7	36.8
L.S.D. at 5%	0.4	0.8	0.8	0.2	0.3	0.1	1.3	1.6	2.1	0.8	1.1	1.1

1. **Control.**
2. **Girdling before flowering.**
3. **Girdling after fruit-set**
4. **Girdling 2 weeks after fruit-set.**
5. **Girdling at véraison.**