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Effects of Cluster Tipping on Yield and Quality of Uslu and Cardinal Table Grape Cultivars

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Abstract

This research was conducted in Çanakkale, Turkey aimed to study the effects of cluster tipping applications on the yield and quality of Uslu (*V. vinifera* L.) and Cardinal (*V. vinifera* L.) grape cultivars. When the berries were 5–7 mm, the clusters were tipped at 1/3rd, 1/6th and 1/12th of the cluster length. In Uslu, cluster length (cm), cluster width (cm), cluster compactness (1–9), number of berries/cluster (n), berry weight (g) and titratable acidity (TA) (%) parameters were affected by the applications. In Cardinal, cluster length (cm), cluster compactness (1–9), number of berries/cluster (n), berry weight (g), total soluble solid (TSS) (%), titratable acidity (TA) (%) and maturity index parameters were affected by the applications. Yield was not affected by cluster tipping in Uslu and Cardinal grape cultivars. It was concluded that the cluster tipping applied to the Uslu in a proportion of one–third and to the Cardinal in a proportion of one–sixth of the cluster length would be positively sufficient in terms of increasing the grape quality.
Key Words: *Vitis vinifera* L., Cluster tipping, Yield, Quality, Çanakkale.

Özet

Salkım Ucu Kesme Uygulamalarının Uslu ve Cardinal Üzüm Çeşitlerinin Verim ve Kalitesi Üzerine Etkileri

Bu araştırma, Uslu ve Cardinal üzüm çeşitlerinin verim ve kalitesi üzerine salkım ucu alma uygulamalarının etkilerinin saptanması amacıyla, Çanakkale/Türkiye'de yürütülmüştür. Tane çapları 5–7 mm olduğunda, mevcut salkımların uçları 1/3, 1/6 ve 1/12 oranında kesilmiştir. Uslu üzüm çeşidinde, salkım uzunluğu (cm), salkım eni (cm), salkım sıklığı (1–9), tane sayısı/salkım (adet), tane ağırlığı (g) ve titre edilebilir asitlik (%) parametreleri uygulamalardan etkilenmiştir. Cardinal üzüm çeşidinde, salkım uzunluğu (cm), salkım sıklığı (1–9), tane sayısı/salkım (adet), tane ağırlığı (g), suda çözünebilir kuru madde (SÇKM) (%), titre edilebilir asitlik (%) ve olgunluk indisi parametreleri uygulamalardan etkilenmiştir. Uslu ve Cardinal üzüm çeşitlerinde salkım ucu alma uygulamalarının üzüm verimine önemli bir etkisi olmamıştır. Salkım ucu alma uygulamalarının, Uslu üzüm çeşidinde salkım uzunluğunun 1/3'ü, Cardinal üzüm çeşidinde ise 1/6'sı oranında gerçekleştirilmesinin, üzüm kalitesini arttırıcı yönde pozitif ve yeterli bir etki sağladığı belirlenmiştir.
Anahtar Kelimeler: *Vitis vinifera* L., Salkım ucu kesme, Ürün, Kalite, Çanakkale.

Introduction

Winkler et al. (1974) stated that good quality in table grapes represents a combination of medium sized clusters of uniformly large, perfect berries with the characteristic colour, pleasing flavour, and the texture of the variety. In addition to soil management, training and pruning, fertilization and irrigation that have an influence on the quality of grapes, several other cultural practices can also be used to achieve quality e.g.; crop regulation, canopy management, and plant growth regulators to improve berry size and color.

Pruning, shoot thinning, and crop thinning imposed on vine, inflorescences, clusters or berries provide a tool for adjusting crop load levels. Cirami et al. (1992) stated that thinning provides best choice for selectivity and quality improvement on berries. Inflorescence thinning is carried out before flowering and results in more nutrients for the remaining clusters; therefore more attractive bunches. In cluster thinning, entire clusters are removed after the berries have set. It is the easiest and best way of reducing crop on overloaded vines in order to that the remainder of the crop may develop and ripen properly (Winkler et al., 1974). Berry thinning consists of removal of parts of clusters after the setting of berry. It prevents compactness and has different size effects depending on the timing it has been done (Cirami et al., 1992). Cluster or berry thinning procedures have also influence on the severity of fungal diseases in the fruiting zone and/or in a cluster (Palliotti and Cartechini, 2000), and on berry composition (Guidoni et al., 2002; Cus et al., 2004).

Researchers mostly studied the effect of cluster thinning and berry thinning either done manually or chemically on different table grape cultivars (Dokoozlian and Hirschfelt, 1995; Gao and Cahoon, 2000; Çoban, 2001; Dardeniz and Kısmalı, 2002; Ezzahouani and Williams, 2003; Ikeda et al., 2004; Ateş and Karabat, 2006) on different wine grape cultivars (Morando et al., 1991; Bavaresco et al., 1991; Ozaki and Ichii, 1992; Arfelli et al., 1996; Palliotti and Cartechini, 2000; Guidoni et al., 2002; Naor et al., 2002; Cus et al., 2004) or French–American hybrids (Morris et al., 2004). The results showed that grape cultivars act differently depending on the level and timing of the thinning applications.

This research was performed for two consecutive years to determine the effects of cluster tipping (removing parts of clusters after setting of berries) on the yield and quality of Uslu and Cardinal cultivars of table grape.

Material and Methods

Cardinal (*V. vinifera* L.), hybrid of Flame Tokay and Alphonse Lavallée, is a dark black–purple colored and large sized grape cultivar with firm skin and flesh, and having very sweet flavor. It ripens early and has been favorably grown in many parts of the world. Uslu (*V. vinifera* L.) cultivar of grape was introduced in 1998 as a hybrid of Hönüsü and Siyah Gemre in Turkey. It has large clusters with big, dark red and oval berries. It ripens 7–8 days earlier than Cardinal and is recommended for Mediterranean regions (Çelik, 2006).

The experiment was carried out in the vineyards located in Umurbey Fruit Production Station, Çanakkale, Turkey. The vines of above mentioned cultivars were 12 years old grafted onto 41B American grape rootstock. Vines were trained to unilateral cordon system and spur pruned. The spacing in between rows and within rows were 2.25 m and 1.80 m; respectively. The soil was loamy clay, slightly alkaline, medium calcareous with low phosphorus and organic matter having adequate potassium. Cultural practices were performed in accordance with standard commercial practices for Cardinal and Uslu varieties of table grape. The vines were grown under dry land conditions.

Vines were selected on the basis of uniform vigor and fruit development. Cluster tipping treatments were done when berries were in the size of 5–7 mm. After calculation of the average cluster length of each cultivar, all cluster tips were cut at 3 different levels i.e.; $1/12^{th}$, $1/6^{th}$ and $1/3^{rd}$ of cluster length. Control vines were left untouched. In harvesting time, cluster length (cm), cluster width (cm), and cluster compactness were measured according to OIV 204 (Anonymous, 1983). Weight (g), total soluble solids content (TSS, %), titratable acidity (TA, %), and maturation index (TSS/TA) of berries were also determined during this research work. The yield (kg/vine) was calculated as the total weight of clusters divided by the total number of vines. Mean cluster weight (g) was obtained from the division of total cluster weight to total cluster number.

The pruning weight of each cultivar has been taken after winter pruning in the month of February. Inflorescences and shoots were counted in the following season. Moreover, the values of flower clusters per shoot were also calculated.

The experiment was conducted by using Randomized Complete Block Design (RCBD). Same set of vines were treated for two consecutive years. Repeated measurement analysis of variance was used to compare the treatments and year effects (Keskin and Mendeş, 2001; Winner et al. 1991). Bonferroni multiple comparison test was used determining the differences among treatments. All of the data analyses were done with SPSS for Windows (ver. 12) statistical package program.

Results and Discussion

The characteristics of cluster were found under the influence of treatments during this research work. Cluster tipping levels were effective on the cultivars' cluster length depending on the year of application (Table 1, 2). Control vines produced the longest clusters. Cluster width of Cardinal was independent of the treatments although it was affected by the years. Cardinal was found with wider clusters in the second year while Uslu with smaller ones. Cluster compactness significantly increased by the tipping level, and clusters were tighter as the level increased. On the other hand, cluster weight of the cultivars of the treatments acted independently. It was noted that the year differences were more important on this character.

Table 1. Effects of cluster tipping on the main characteristics of Uslu grape cultivar

Applications	Cluster length (cm)			Cluster width (cm)			Cluster compactness (1–9)			Number of berries/cluster (n)		
	Year 1	Year 2	Mean	Year 1	Year 2	Mean	Year 1	Year 2	Mean	Year 1	Year 2	Mean
Control	24.11	19.29	21.70 A	11.14	8.29	9.72 C	3.56	3.47	3.52 B	77.52	30.43	53.98 A
1/12 tipping	22.23	20.32	21.28 A	11.25	9.85	10.55 BC	3.65	3.62	3.64 B	69.31	35.31	52.29 AB
1/6 tipping	21.53	16.88	19.21 BC	12.27	9.21	10.74 AB	3.76	3.83	3.80 AB	63.60	24.11	43.85 B
1/3 tipping	18.45	16.51	17.48 C	13.28	9.76	11.52 A	4.14	3.99	4.07 A	61.77	25.10	43.44 B
Mean	21.58 a	18.25 b		11.99 a	9.28 b		3.78	3.73		68.05	28.74	
Applications	**Main cluster weight (g)**			**Berry weight (g)**			**TSS(%)**			**Titratable acidity (%)**		
	Year 1	**Year 2**	**Mean**	**Year 1**	**Year 2**	**Mean**	**Year 1**	**Year 2**	**Mean**	**Year 1**	**Year 2**	**Mean**
Control	247.7	110.6	179.1	3.20	3.63	3.42 C	12.55	14.05	13.30	0.722	0.658	0.690 AB
1/12 tipping	241.0	139.6	190.3	3.49	3.92	3.70 BC	12.69	14.21	13.45	0.750	0.673	0.711 A
1/6 tipping	242.2	104.3	173.2	3.81	4.33	4.07 AB	12.90	14.75	13.83	0.688	0.618	0.653 AB
1/3 tipping	255.4	110.4	182.9	4.13	4.45	4.29 A	13.29	14.44	13.87	0.658	0.625	0.642 B
Mean	246.6 a	116.2 b		3.66 b	4.08 a		12.86	14.36		0.704	0.644	
Applications	**Maturity index (TSS/titratable acidity)**			**Yield (kg/vine)**			**Inflorescence/shoot (n)**			**Pruning weight (g)**		
	Year 1	**Year 2**	**Mean**	**Year 1**	**Year 2**	**Mean**	**Year 1**	**Year 2**	**Mean**	**Year 1**	**Year 2**	**Mean**
Control	17.38	21.39	19.39	3.086	0.712	1.899	0.67	1.26	0.96	584.2	775.4	679.8
1/12 tipping	16.96	21.16	19.06	3.085	1.007	2.046	0.81	1.34	1.08	672.2	922.6	797.4
1/6 tipping	18.77	24.06	21.42	3.096	0.629	1.862	0.69	1.56	1.13	602.2	818.8	710.5
1/3 tipping	20.19	23.11	21.65	2.630	0.715	1.673	0.78	1.46	1.12	650.6	866.9	758.8
Mean	18.33 b	22.43 a		2.974 a	0.766 b		0.74 b	1.41 a		627.3	845.9	

Table 2. Effects of cluster tipping on the main characteristics of Cardinal grape cultivar

Applications	Cluster length (cm)			Cluster width (cm)			Cluster compactness (1–9)			Number of berries/cluster (n)		
	Year 1	Year 2	Mean	Year 1	Year 2	Mean	Year 1	Year 2	Mean	Year 1	Year 2	Mean
Control	19.93	20.31	20.12 A	9.68	10.70	10.19	3.91	4.09	4.00 B	56.98	54.51	55.75 A
1/12 tipping	18.86	18.64	18.75 A	9.95	10.64	10.30	4.02	4.01	4.02 B	49.04	47.30	48.16 AB
1/6 tipping	16.65	16.71	16.68 B	10.05	11.11	10.58	4.37	4.27	4.32 AB	44.81	41.33	43.07 B
1/3 tipping	16.76	15.28	16.02 B	10.83	11.55	11.19	4.28	4.36	4.33 A	43.44	40.24	41.84 B
Mean	18.05 a	17.74 b		10.13 b	11.00 a		4.15	4.18		48.57	45.85	
Applications	**Main cluster weight (g)**			**Berry weight (g)**			**TSS(%)**			**Titratable acidity (%)**		
	Year 1	Year 2	Mean	Year 1	Year 2	Mean	Year 1	Year 2	Mean	Year 1	Year 2	Mean
Control	250.9	314.4	282.7	4.39	5.76	5.08 B	13.33	13.69	13.51 B	0.603	0.610	0.607 A
1/12 tipping	224.7	281.8	253.3	4.59	5.99	5.29 AB	13.69	13.61	13.65 AB	0.567	0.583	0.575 AB
1/6 tipping	213.5	254.5	234.0	4.76	6.16	5.46 AB	14.10	14.53	14.32 AB	0.583	0.510	0.547 AB
1/3 tipping	229.4	259.7	244.5	5.29	6.45	5.87 A	14.71	14.82	14.77 A	0.541	0.530	0.536 B
Mean	229.6 b	277.6 a		4.76 b	6.09 a		13.96	14.16		0.574	0.558	
Applications	**Maturity index (TSS/titratable acidity)**			**Yield (kg/vine)**			**Inflorescence/shoot (n)**			**Pruning weight (g)**		
	Year 1	Year 2	Mean	Year 1	Year 2	Mean	Year 1	Year 2	Mean	Year 1	Year 2	Mean
Control	22.13	22.79	22.46 B	5.038	3.655	4.346	1.06	1.73	1.39	581.7	974.2	777.9
1/12 tipping	24.21	23.41	23.81 AB	4.806	3.678	4.242	1.17	1.71	1.44	549.3	952.3	750.8
1/6 tipping	24.20	28.67	26.44 AB	4.847	3.333	4.090	1.16	1.70	1.43	577.4	893.1	735.2
1/3 tipping	27.32	28.03	27.68 A	4.639	3.416	4.027	1.27	1.72	1.49	650.0	1170.8	910.4
Mean	24.47	25.73		4.832 a	3.521 b		1.17 b	1.72 a		589.6	997.6	

Cluster tipping levels had significant effects on the weight and number of berry per cluster of both cultivars. An approximate increase of 1 g was observed in both cultivars when the tipping level rose up. However, number of berries/cluster showed an inverse relation to the applications by resulting the highest number in control treatment of vines.

Quality characteristics were found generally under the influence of the applications but independent to the years factor. Soluble solid contents and maturity index showed an increase while the acidity had got lower when the tipping was more severely applied.

Yield was not affected by the applications but found under the more influence of years. The difference in Uslu was found more dramatic as compared to Cardinal. The yield of Uslu was almost decreased in the rate of one third and/or one fourth during the first year of research work. Although Cardinal did not show any kind of decrease to this extent even continued this declination in the second year. The reason of this declination was the adverse effect of climatic conditions.

Effects of the applications on the inflorescences per shoot and pruning weight of the cultivars in the following seasons of the applications showed that treatments did not affect them and but the years were effective on inflorescences per shoot. Treatments resulted in 3–5 days early ripening in the cultivars.

The grape cultivars in this study responded the similar way on the cluster tipping applications. Cluster characteristics of Uslu were more affected by the applications as compared to Cardinal, which showed no effects in cluster width and weight. The weight and number of berry per cluster exhibited a dependence on the cluster tipping. Quality characteristics of the cultivars were also influenced by the applications, and cultivars ripened 3–5 days earlier. Yield was not affected by the treatments and it was compensated with the increased berry weight.

Earliness in the cultivars due to cluster tipping and berry thinning practices were reported by Çoban (2001), Ateş and Karabat (2006), and our results were also justified the results of them. Increase in berry weight was also in consistent with the findings of Morando et al. (1991), Moon and Lee (1996) and Ikeda et al. (2004). Cus et al. (2004) reported that the yield did not change as a result of the thinning applications and our results also supported that. Morando et al. (1991) also stated that they have obtained lower yield in their study work due to the application date of tipping in Barolo and Barbaresco cultivars. Increase in soluble solid contents and decrease in total acidity along with the elevated intensity of tipping was consistent with the results of Cus et al. (2004) and Morando et al. (1991).

Conclusions

As a consequence, through the cluster tipping (1/12, 1/6, and 1/3 of the cluster length) performed in Uslu and Cardinal when berries were 5–7 mm, more uniform clusters with bigger berries were obtained. Removing the last flowering and setting part of a cluster resulted in shorter, wider, more uniform and attractive clusters with 3–5 days earliness. Finally, it is suggested that the cluster tipping on a level of 1/3 and 1/6 of cluster length could be applied in Uslu and Cardinal grape cultivars, respectively.

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