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Effects of Girdling Treatments at Different Periods and Width on Grape Quality in Yalova Çekirdeksizi (*V. vinifera* L.) Grape Variety

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Abstract: This research was carried out in 2022 and 2023 to determine the effects of different width and single–double girdling treatments on grape quality in different phenologic periods of 'Yalova Çekirdeksizi' grape variety grown in the 'Table Grape Varieties Application and Research Vineyard' located in the 'ÇOMÜ Dardanos Campus, Faculty of Agriculture, Plant Production Research and Application Unit'. Within the scope of the research, a total of 9 treatments, including the control, were carried out in two different phenologic periods pre–bloom and post–berry set, followed by two different widths of single repeated girdling treatments, and double repeated girdling treatments during the veraison period. As a result; the numeral decrease in yield in the 5 mm girdling treatments (4.33 kg grapevine^{-1}) may be due to the removal of a wider bark+phloem layer, resulting in a later closure of the wound tissues compared to the 3 mm girdling treatments (4.95 kg grapevine^{-1}), and thus a decrease in assimilate products stored in the main root and old parts. Therefore, it was concluded that although 5 mm girdling treatments continue to give positive results in terms of grape quality in many parameters, it is not appropriate to repeat them more than one year in terms of average yield.

Keywords: Girdling, phenologic period, quality, *V. vinifera* L., yield.

Yalova Çekirdeksizi (*V. vinifera* L.) Üzüm Çeşidinde Farklı Dönem ve Genişliklerde Yapılan Bilezik Alma Uygulamalarının Üzüm Kalitesi Üzerindeki Etkileri

Öz: Bu araştırmada, 'ÇOMÜ Dardanos Yerleşkesi Ziraat Fakültesi Bitkisel Üretim Araştırma ve Uygulama Birimi'ndeki 'Sofralık Üzüm Çeşitleri Uygulama ve Araştırma Bağı'nda yetiştirilen Yalova Çekirdeksizi üzüm çeşidinde, farklı fenolojik dönemlerde, farklı genişlikte ve tek–çift bilezik alma uygulamalarının üzüm kalitesi üzerindeki etkilerinin belirlenmesi amacıyla, 2022 ve 2023 yıllarında yürütülmüştür. Araştırma kapsamında, çiçeklenme öncesi ve tane tutumu sonrası iki farklı fenolojik dönemde, iki farklı genişlikte tek tekrarlı bilezik alma uygulamalarının ardından, ben düşme döneminde çift tekrarlı bilezik alma uygulamaları da yapılarak, kontrol dâhil toplam 9 uygulama gerçekleştirilmiştir. Sonuç olarak; 5 mm bilezik alma uygulamalarındaki (4.33 kg omca^{-1}) rakamsal verim azalışının, daha kalın bir kabuk+floem tabakasının çıkartılması sonucunda 3 mm bilezik alma uygulamalarına (4.95 kg omca^{-1}) kıyasla yara yerlerinin daha geç kapanması neticesinde, ana kök ve yaşlı kısımlarda depolanan rezerv maddelerdeki azalışa bağlı olarak gerçekleşmiş olabileceği düşünülmektedir. Bu nedenle, 5 mm bilezik alma uygulamalarının birçok parametrede üzüm kalitesi yönünden olumlu sonuçlar vermeye devam etse de, ortalama verim açısından bir yıldan fazla tekrarının uygun olmadığı sonucuna varılmıştır.

Anahtar kelimeler: Bilezik alma, fenolojik dönem, kalite, verim, *V. vinifera* L.

1. Introduction

Grapes (*Vitis vinifera* L.), considered one of the most important commercial fruit crops of temperate and tropical regions, have gained popularity due to many factors such as its nutrient–rich value, containing compounds beneficial to human health and the diversity of its utilization. Türkiye, which is located in the temperate climate zone ideal for grape growing worldwide, is ranked among the important countries in the viticulture sector in the world with its yield values and grape production areas. In 2022, a total of 87.615.444 tons of grape production was realized in the world, and Türkiye has an important position in terms of grape cultivation, ranking fifth in the world after Spain, France, Italy and China with 384.537 ha of vineyard area and sixth in the world after China, Italy, France,

Spain and the USA with 4.165.000 tons of grape production (FAO, 2024). Of the grape production, 50.42% is table grapes (2.099.859 tons), 40.38% is dried grapes (1.681.808 tons) and 9.20% is wine grapes (383.333 tons) (TUIK, 2024).

The aim of table grapes growing, which constitute half of the grape production in Türkiye, is to produce grapes with high yield and quality. The quality of table grapes consists of medium–sized clusters with uniformly sized berries, variety–specific skin color, aroma composition and other phytochemical contents. Consumers pay attention to the amount and content of phytochemicals that contribute to human health and come to the forefront in recent years, along with physical properties such as shape, color and form in table grapes (Kunter et al. 2013; Crupi et al., 2016; Cantürk et al., 2018a,b Nicolosi et al., 2018). For this purpose, some plant growth regulators and canopy management techniques such as crop load, shoot tipping and shoot topping removal, axillary shoot removal, cluster thinning, cluster tip cutting, etc. and some plant growth regulators are applied in vinestock to increase grape quality (Winkler, 1974; Türker & Dardeniz, 2014; Camcı & Çoban, 2016; Bahar et al., 2017; Korkutal et al., 2018; Şahin & Dardeniz, 2023). Another one of these cultural techniques to improve grape quality is girdling. Girdling is a technique for regulating phloem transport between grapevine canopy and roots by ensuring the distribution of photosynthesis products, plant regulators and nutrients. Girdling is carried out by removing the 3–6 mm width bark+phloem layer from both the trunk and the base internode of the canes of the grapevines with special clippers. In the parts where the girdling is taken, the phloem bridges take their previous form with the formation of callus, and the wound areas heal in approximately 3–6 weeks, but during the callus formation period, the nutrients that are expected to go to the roots remain in the canopy area and direct to the clusters, and their density increases. The effect of girdling varies depending on the period, environmental conditions and grape varieties (Carreño et al., 1998). Girdling treatments pre–bloom increases berry set (Jackson, 1985; Abu–Zahara, 2010) and grape yield, increases cluster sizes (Goren et al., 2004) and delays grape maturity (Rammings & Tarailo, 1998; Crupi et al., 2016). Girdling treatments post–berry set increases cluster–berry sizes (Abu–Zahara, 2010) and grape yield (Carreño et al., 1998; Gözcü & Dardeniz, 2022) and has positive effects on grape maturity (Keskin et al., 2013). During the veraison period, it increases the total soluble solids (TSS) ratio (Koshita et al., 2011) and enhanced grape maturity (Carreño et al., 1998; Çiftçi & Çelik, 2023), and improves the coloration of the berries in colored grape varieties by reducing acidity (Crupi et al., 2016). is improving (Carreño et al., 1998; Camcı & Çoban, 2016; Çiftçi & Çelik, 2023).

In the cultivation of grapes or a different species, the treatment period and repetition of the target appropriate girdling and the width of the bark+ phloem layer to be taken are of great importance. More research is needed on this subject based on grape varieties.

In this research, it was aimed to determine the effects of different width (3 mm and 5 mm) and single–double girdling treatments on grape quality in different phenologic periods (pre–bloom and post–berry set) in Yalova Çekirdeksizi grape variety grown in the 'Table Grape Varieties Application and Research Vineyard' located in the 'ÇOMÜ Dardanos Campus, Faculty of Agriculture Plant Production Research and Application Unit'.

2. Material and Method

This research was carried out in 2022 and 2023 on Yalova Çekirdeksizi grape variety grown in the 'Table Grape Varieties Application and Research Vineyard' located in the 'ÇOMÜ Dardanos Campus, Faculty of Agriculture Plant Production Research and Application Unit' located at 40° 4' 26.40" N latitude and 84 26° 21' 42.84" E longitude. The vineyard where the research was conducted was established with 2.0 da and 3.0 x 1.5 meter row spacing and intra–row spacing distances. The vines of Yalova Çekirdeksizi grape variety grafted on 5BB American grapevine rootstock have a Lenz–Moser bilateral fixed cordon system and are 19 years old as of the year the research was initiated.

In the Yalova Çekirdeksizi grape variety, a total of nine treatments, including the control, were carried out, following single repetitive girdling treatments in two different widths (3 mm ve 5 mm) in two different phenologic periods pre–bloom (EL–18; 24 May 2022; 30 May 2023) and post–berry set (EL–27; 9 June 2022; 20 June 2023), and double repetitive girdling treatments (EL–35; 19 July 2022; 24 July 2023) were made during the veraison period.

Winter pruning was carried out as cane pruning in March of the years in which the research was carried out. Within the scope of cane pruning, spurs (the base cane) was pruned from 2 nodes and canes (the upper cane) was pruned from 5 nodes. During the bloom period, all clusters on the summer shoots from the spurs were removed from the grapevine.

1. Control (CNT): No girdling treatment was

carried out.

Single Repetitive Girdling Treatments

2. 3 mm Girdling Pre–Bloom (PB SR 3mm): 3–7 days pre–bloom (EL–18), the bark+floem layer between the base internode of the canes was removed with 3 mm wide double bladed girdling clippers.

3. 5 mm Girdling Pre–Bloom (PB SR 5mm): 3–7 days pre–bloom (EL–18), the bark+floem layer between the base internode of the canes was removed with 5 mm wide double bladed girdling clippers.

4. 3 mm Girdling Post–Berry Set (PBS SR 3mm): When the berries were 2 mm in size (EL–27), the bark+phloem layer between the base internode of the canes was removed with 3 mm wide double bladed girdling clippers.

5. 5 mm Girdling Post–Berry Set (PBS SR 5mm): When the berries were 2 mm in size (EL–27), the bark+phloem layer between the base internode of the canes was removed with 5 mm wide double bladed girdling clippers.

Double Repetitive Girdling Treatments

6. Double Repetitive 3 mm Girdling Pre–Bloom (PB DR 3mm): 3–7 days pre–bloom (EL–18), the bark+floem layer between the base internode of the canes was removed with 3 mm wide double bladed girdling clippers and the same process was carried out just below this point during the veraison period (EL–35) and double repetitive girdling were realized.

7. Double Repetitive 5 mm Girdling Pre–Bloom (PB DR 5mm): 3–7 days pre–bloom (EL–18), the bark+floem layer between the base internode of the canes was removed with 5 mm wide double bladed girdling clippers and the same process was carried out just below this point during the veraison period (EL–35) and double repetitive girdling were realized.

8. Double Repetitive 3 mm Girdling Post–Berry Set (PBS DR 3mm): When the berries were 2 mm in size (EL–27), the bark+phloem layer between the base internode of the canes was removed with 3 mm wide double bladed girdling clippers and the same process was carried out just below this point during the veraison period (EL–35) and double repetitive girdling were realized.

9. Double Repetitive 5 mm Girdling Post–Berry Set (PBS DR 5mm): When the berries were 2 mm in size (EL–27), the bark+phloem layer between the base internode of the canes was removed with 5 mm wide double bladed girdling clippers and the same process was carried out just below this point during the veraison period (EL–35) and double repetitive girdling were realized.

Within the scope of the summer pruning in the grapevines, the base leaves under the clusters and all the axillary shoots of the summer shoots were removed from the bottom during the thin unripe grape period (3–4 mm). The removal shoot tipping of spurs was carried out 20–25 cm above the second shoot tying wire. The removal shoot tipping of canes was carried out above four internodes the last cluster of the summer shoot in upper node of canes, so that all summer shoots were in the same level. In the spring period, mechanical tillage was carried out the inter–rows of the trial grapevines, and hoeing was realized on the intro–rows with hand hoe.

Average yield (kg grapevine^{-1}), whole cluster and berry characteristics and berry maturity parameters were analyzed in the grapes harvested and brought to ÇOMÜ Horticulture Pomology Laboratory. In article, the most important grape quality characteristics such as cluster width (cm cluster^{-1}), cluster compactness (1–9), cluster weight (g cluster^{-1}), berry width (mm berry^{-1}), berry weight (g berry^{-1}) (OIV, 2009), Hue (Keskin et al., 2017), TSS (%), pH (Cemeroğlu, 2007) and maturity index (TTS% acidity^{-1}) parameters were evaluated.

This research was planned on a total of 81 grapevines according to the split plots trial design, with 3 replications and 3 grapevines in each replication. The data obtained were subjected to analysis of variance in JMP ® Pro 17.0.0 version statistical programme. As a result of the analysis of variance, interaction effects of control, 3 mm and 5 mm girdling treatments, pre–bloom and post–berry set periods and single–double repetitive interaction effects (P*T*R), period main effect (PME), treatment main effect (TME), repetitive main effect (RME), period treatment (P*T), period repetitive (P*R), treatment repetitive (T*R) interactions were created. The data obtained were compared with $LSD_{0.05}$ multiple comparison test and statistical analyses were performed.

3. Results and Discussion

In this research, which aims to determine the effects of girdling treatments of different widths and different phenologic periods on grape quality in Yalova Çekirdeksizi grape variety, average yield, cluster width, cluster compactness, cluster weight, berry width, berry weight, Hue value, TSS, pH and maturity index are given in Table 1, Table 2, Table 3, Table 4, Table 5, Table 6, Table 7, Table 8, Table 9 and Table 10, respectively.

There was no significant difference at the $LSD_{0.05}$ level in the PME, RME, P*T*R, T*R and P*T interactions in terms of average yield value in Yalova Çekirdeksizi grape variety in 2022. In the P*R

interaction, PBS DR girdling treatments (4.62 kg grapevine^{-1}) created the highest value and was in the first importance group, followed by PB SR (3.91 kg grapevine^{-1}) in the second importance group, and PBS SR (3.55 kg grapevine^{-1}) and PB DR (3.68 kg grapevine^{-1}) girdling treatments in the third importance group, respectively. In terms of the average yield value of 2023, 3mmME (5.36 kg grapevine^{-1}) had the highest value in the TME and was found more significant than CNTME (3.57 kg grapevine–1) and 5mmME (4.11 kg grapevine–1). There was no significant difference could be detected at the LSD0.05 level in the PME, RME, P*T*R, T*R, P*T and P*R interactions in 2023 and biennial average values. When the biennial average values were analyzed, it was determined that 3mmME

(4.95 kg grapevine–1) and 5mmME (4.33 kg grapevine–1) were the highest values in TME, respectively, and were found to be significant compared to CNTME (3.15 kg grapevine–1) (Table 1).

It has been revealed in many scientific researches that girdling treatment increases the yield of the grapevines. Carreño et al. (1998) applied 4 mm girdling treatment during berry set and veraison in Italia grape variety, Şahan and Tangolar (2013) applied 4–5 mm girdling treatment in three different periods (berry set, 2 weeks after berry set, 4 weeks after berry set) in Alphonse Lavallée and Flame Seedless grape varieties, İşçi and Altındişli (2014) applied 3–6 mm girdling treatment on canes during veraison in Alphonse Lavallée grape variety, Crupi et al. (2016) applied 4–5 mm girdling treatment on canes when berries were 3–4 mm in size in Early Red Seedless grape variety, Fawzi et al. (2019) applied 2–3 mm girdling treatment on canes when berries were 2–3 mm in size in Thompson Seedless grape variety, Gündüz et al. (2020) applied 5 mm girdling treatment on canes when berries were 3–4 mm in size in Horoz Karası grape variety, Glisic et al. (2022) applied 2–4 mm girdling treatment post–berry set in Victoria grape variety and Gözcü and Dardeniz (2022) applied 3–5 mm girdling treatment from the base internode of the canes when berries were 4–5 mm in size in Yalova Çekirdeksizi grape variety, they concluded that girdling treatments increased grape yield compared to the control. These results in the literature are in harmony with the research findings we have obtained.

There was no significant difference at LSD0.05 level in RME, P*T*R, T*R, P*T and P*R interactions in terms of cluster width value of Yalova Çekirdeksizi grape variety in 2022. In PME, PBS girdling treatments (9.15 cm cluster–1) were in the first significance group by creating higher values compared to the PB girdling treatments (8.66 cm cluster–1). In 2023, a significant difference was detected only in RME at LSD0.05 level and it was determined that DR girdling treatments (9.06 cm cluster–1) were more significant compared to SR girdling treatments (8.60 cm cluster–1). When the biennial average cluster width values were analyzed, a difference at LSD0.05 level was detected in the P*T*R interaction and TME. In P*T*R interaction, the highest cluster width was obtained from PBS DR 3 mm girdling treatment (9.65 cm cluster–1) and was in the first importance group. This was followed by the PBS SR 5 mm (9.21 cm cluster–1), PB DR 5 mm (9.15 cm cluster–1), PB DR 3 mm (9.12 cm cluster–1) and PBS DR 5 mm girdling treatments (9.12 cm cluster–1) which are in the second importance group, respectively. CNT (8.50 cm cluster–1), PB DR 3 mm (8.65 cm cluster–1), PBS SR 3 mm (8.74 cm cluster–1) and PB SR 5 mm girdling treatments (8.79 cm cluster–1) were in the third importance group and gave the lowest cluster values. In TME, 5mmME (9.07 cm cluster–1) and 3mmMET (9.04 cm cluster–1) have the highest values, respectively, and are found more important than CNTME (8.50 cm cluster–1) (Table 2).

Çoban (2001) girdling treatment in the form of a girdling on the base internode of the canes during thin unripe grape period in the Yuvarlak Çekirdeksiz grape variety, Gündüz et al. (2020) applied 5 mm girdling treatment on canes when berries were 3–4 mm in size in Horoz Karası grape variety and Gözcü and Dardeniz (2022) applied 3–5 mm girdling treatment from the base internode of the canes when berries were 4–5 mm in size in Yalova Çekirdeksizi grape variety, it was revealed that the girdling treatment increased the cluster width and caused a significant difference compared to the control clusters. These results obtained from the literature are similar to the findings of our research.

In the P*T*R interaction, the highest cluster compactness value was obtained from PB SR 3 mm girdling treatment (6.29) and was in the first importance group. PBS SR 3 mm (6.22), PBS SR 5 mm (6.04), PB SR 5 mm (5.83), PBS SR 5 mm (5.81), PBS SR 3 mm (5.72), PB SR 3 mm (5.68) and PB SR 5 mm (5.41) created different intermediate groups. CNT (5.21) was in the last importance group with the lowest cluster compactness value. In the P*R interactions, PBS SR (5.78) and PBS DR girdling treatments (5.75) were in the first importance group with the highest cluster compactness value, followed by PBS SR (5.66) in the second importance group and PBS DR girdling treatment (5.43) in the third importance group.

Table 1. Average yield value of Yalova Çekirdeksizi grape variety (kg grapevine^{-1})

Çizelge 1. *Yalova Çekirdeksizi üzüm çeşidine ait ortalama verim değeri (kg omca^{-1})*

Period	Treatments	SR	DR	SR	DR	SR	DR	(P*T)*		
		2022		2023		Average		2022	2023	Average
PB	CNT (P*T*R)*	2.73	2.73	3.57	3.57	3.15	3.15	2.73	3.57	3.15
	3 mm (P*T*R)	4.73	4.01	5.54	4.95	5.13	4.48	4.37	5.25	4.81
	5 mm (P*T*R)	4.29	4.29	3.73	4.24	4.01	4.26	4.29	3.98	4.14
PBS	CNT (P*T*R)*	2.73	2.73	3.57	3.57	3.15	3.15	2.73	3.57	3.15
	3 mm (P*T*R)	3.77	5.66	4.99	5.94	4.38	5.80	4.72	5.47	5.09
	5 mm (P*T*R)	4.14	5.46	4.78	3.70	4.46	4.58	4.80	4.24	4.52
$LSD_{0.05}$*		N.S.		N.S.		N.S.		N.S.	N.S.	N.S.
								PME (P)**		
PB (P*R)**		3.91 ab	3.68 b	4.28	4.25	4.10	3.96	3.80	4.27	4.03
PBS (P*R)		3.55 b	4.62 a	4.45	4.40	3.99	4.51	4.08	4.43	4.25
$LSD_{0.05}$**		0.819		N.S.		N.S.		N.S.	N.S.	N.S.
								TME (T)***		
CNTME (T*R)***		2.73	2.73	3.57	3.57	3.15	3.15	2.73 b	3.57 b	3.15 b
3mmME (T*R)		4.25	4.84	5.26	5.45	4.76	5.14	4.54 a	5.36 a	4.95 a
5mmME (T*R)		4.21	4.87	4.26	3.97	4.24	4.42	4.54 a	4.11 b	4.33 a
$LSD_{0.05}$***		N.S.		N.S.		N.S.		0.709	0.821	0.652
RME (R)****		3.73	4.15	4.36	4.33	4.05	4.24			
$LSD_{0.05}$****		N.S.		N.S.		N.S.				

PB: Pre–Bloom, PBS: Post–Berry Set, CNT: Control, CNTME: Control Main Effect, 3mmME: 3 mm Main Effect, 5mmME: 5 mm Main Effect, RME: Repetitive Main Effect, TME: Treatment Main Effect, PME: Period Main Effect, P: Period, T: Treatment, R: Repetitive, SR: Single Repetitive, DR: Double Repetitive, LSD: Least Significant Difference.

Table 2. Cluster width value of Yalova Çekirdeksizi grape variety (cm cluster^{-1})

Çizelge 2. *Yalova Çekirdeksizi üzüm çeşidine ait salkım eni değeri (cm salkım^{-1})*

Period	Treatments	SR	DR	SR	DR	SR	DR	(P*T)*		
		2022		2023		Average		2022	2023	Average
PB	CNT (P*T*R)*	8.25	8.25	8.74	8.74	8.50 b	8.50 b	8.25	8.74	8.50
	3 mm (P*T*R)	9.63	8.51	8.61	8.78	9.12 ab	8.65 b	9.07	8.70	8.88
	5 mm (P*T*R)	8.56	8.73	9.02	9.57	8.79 b	9.15 ab	8.65	9.30	8.97
PBS	CNT (P*T*R)*	8.25	8.25	8.74	8.74	8.50 b	8.50 b	8.25	8.74	8.50
	3 mm (P*T*R)	9.36	9.67	8.12	9.62	8.74 b	9.65 a	9.52	8.87	9.19
	5 mm (P*T*R)	10.02	9.37	8.39	8.87	9.21 ab	9.12 ab	9.70	8.63	9.16
$LSD_{0.05}$*		N.S.		N.S.		0.758		N.S.	N.S.	N.S.
								PME (P)**		
PB (P*R)**		8.81	8.50	8.79	9.03	8.80	8.77	8.66 b	8.91	8.78
PBS (P*R)		9.21	9.10	8.42	9.08	8.81	9.09	9.15 a	8.75	8.95
$LSD_{0.05}$**		N.S.		N.S.		N.S.		0.385	N.S.	N.S.
								TME (T)***		
CNTME (T*R)***		8.25	8.25	8.74	8.74	8.50	8.50	8.25 b	8.74	8.50 b
3mmME (T*R)		9.50	9.09	8.36	9.20	8.93	9.15	9.29 a	8.78	9.04 a
5mmME (T*R)		9.29	9.05	8.71	9.22	8.99	9.14	9.17 a	8.96	9.07 a
$LSD_{0.05}$***		N.S.		N.S.		N.S.		0.472	N.S.	0.379
RME (R)****		9.01	8.80	8.60 b	9.06 a	8.81	8.93			
$LSD_{0.05}$****		N.S.		0.355		N.S.				

PB: Pre–Bloom, PBS: Post–Berry Set, CNT: Control, CNTME: Control Main Effect, 3mmME: 3 mm Main Effect, 5mmME: 5 mm Main Effect, RME: Repetitive Main Effect, TME: Treatment Main Effect, PME: Period Main Effect, P: Period, T: Treatment, R: Repetitive, SR: Single Repetitive, DR: Double Repetitive, LSD: Least Significant Difference.

Table 3. Cluster compactness value of Yalova Çekirdeksizi grape variety (1–9)
Çizelge 3. *Yalova Çekirdeksizi üzüm çeşidine ait salkım sıklığı değeri (1–9)*

Period	Treatments	SR	DR	SR	DR	SR	DR	(P*T)*		
		2022		2023		Average		2022	2023	Average
PB	CNT (P*T*R)*	5.21 e	5.21 e	5.54	5.54	5.37	5.37	5.21	5.54	5.37
	3 mm (P*T*R)	6.29 a	5.68 cd	5.63	5.63	5.96	5.65	5.99	5.63	5.81
	5 mm (P*T*R)	5.83 bc	5.41 de	5.71	5.71	5.77	5.56	5.62	5.71	5.66
PBS	CNT (P*T*R)*	5.21 e	5.21 e	5.54	5.54	5.37	5.37	5.21	5.54	5.37
	3 mm (P*T*R)	5.72 cd	6.22 ab	5.31	5.64	5.51	5.93	5.97	5.48	5.72
	5 mm (P*T*R)	6.04 abc	5.81 bcd	5.44	5.21	5.74	5.51	5.93	5.32	5.62
$LSD_{0.05}$*		0.410		N.S.		N.S.		N.S.	N.S.	N.S.
								PME (P)**		
PB (P*R)**		5.78 a	5.43 b	5.62	5.63	5.70	5.53	5.61	5.62	5.61
PBS (P*R)		5.66 ab	5.75 a	5.43	5.46	5.54	5.60	5.70	5.45	5.57
$LSD_{0.05}$**		0.237		N.S.		N.S.		N.S.	N.S.	N.S.
								TME (T)***		
CNTME (T*R)***		5.21	5.21	5.54	5.54	5.37	5.37	5.21 c	5.54	5.37 b
3mmME (T*R)		6.01	5.95	5.47	5.63	5.74	5.79	5.98 a	5.55	5.76 a
5mmME (T*R)		5.94	5.61	5.57	5.46	5.75	5.53	5.77 b	5.52	5.64 a
$LSD_{0.05}$***		N.S.		N.S.		N.S.		0.205	N.S.	0.192
RME (R)****		5.72	5.59	5.53	5.54	5.62	5.57			
$LSD_{0.05}$****		N.S.		N.S.		N.S.				

PB: Pre–Bloom, PBS: Post–Berry Set, CNT: Control, CNTME: Control Main Effect, 3mmME: 3 mm Main Effect, 5mmME: 5 mm Main Effect, RME: Repetitive Main Effect, TME: Treatment Main Effect, PME: Period Main Effect, P: Period, T: Treatment, R: Repetitive, SR: Single Repetitive, DR: Double Repetitive, LSD: Least Significant Difference.

Table 4. Cluster weight value of Yalova Çekirdeksizi grape variety (g $cluster^{-1}$)
Çizelge 4. *Yalova Çekirdeksizi üzüm çeşidine ait salkım ağırlığı değeri (g $salkım^{-1}$)*

Period	Treatments	SR	DR	SR	DR	SR	DR	(P*T)*		
		2022		2023		Average		2022	2023	Average
PB	CNT (P*T*R)*	184.5 e	184.5 e	174.8 cd	174.8 cd	179.7 d	179.6 d	184.5	174.8	179.6
	3 mm (P*T*R)	279.2 ab	197.7 de	232.3 a	200.2 abc	255.7 ab	199.0 cd	238.4	216.3	227.4
	5 mm (P*T*R)	259.2 abc	232.3 cd	171.0 cd	204.1 abc	215.1 c	218.2 c	245.8	187.5	216.6
PBS	CNT (P*T*R)*	184.5 e	184.5 e	174.8 cd	174.8 cd	179.6 d	179.6 d	184.5	174.8	179.6
	3 mm (P*T*R)	249.6 bc	296.9 a	163.3 d	226.2 a	206.5 cd	261.6 a	273.3	194.8	234.0
	5 mm (P*T*R)	260.2 abc	241.3 bcd	189.7 bcd	177.3 cd	225.0 bc	209.3 cd	250.7	183.5	217.1
$LSD_{0.05}$*		46.55		36.61		34.39		N.S.	N.S.	N.S.
								PME (P)**		
PB (P*R)**		240.9 a	204.8 b	192.7	193.0	216.8	198.9	222.9	192.9	207.9
PBS (P*R)		231.5 ab	240.9 a	175.9	192.8	203.7	216.8	236.2	184.3	210.3
$LSD_{0.05}$**		26.88		N.S.		N.S.		N.S.	N.S.	N.S.
								TME (T)***		
CNTME (T*R)***		184.5	184.5	174.8	174.8	179.6	179.6	184.7 b	174.8 b	179.6 b
3mmME (T*R)		264.4	247.3	197.8	213.2	231.1	230.3	255.9 a	205.5 a	230.7 a
5mmME (T*R)		259.7	236.8	180.3	190.7	220.0	213.7	248.2 a	185.5 b	216.9 a
$LSD_{0.05}$***		N.S.		N.S.		N.S.		23.28	18.30	17.22
RME (R)****		236.2	222.9	184.3	192.9	210.3	207.9			
$LSD_{0.05}$****		N.S.		N.S.		N.S.				

PB: Pre–Bloom, PBS: Post–Berry Set, CNT: Control, CNTME: Control Main Effect, 3mmME: 3 mm Main Effect, 5mmME: 5 mm Main Effect, RME: Repetitive Main Effect, TME: Treatment Main Effect, PME: Period Main Effect, P: Period, T: Treatment, R: Repetitive, SR: Single Repetitive, DR: Double Repetitive, LSD: Least Significant Difference.

A significant difference was determined at $LSD_{0.05}$ level in TME, and 3mmME (5.98) was in the first significance level with the highest cluster compactness value. It was followed by 5mmME (5.77) which was in the second importance level and CNTME (5.21) which was in the last importance group. In 2023, there was no significant difference at $LSD_{0.05}$ level in PME, RME, TME, P*T*R, T*R, P*T and P*R interactions. When the two–year average cluster compactness values were analyzed, a significant difference was determined only in TME at $LSD_{0.05}$ level, and 3mmME (5.76) and 5mmME (5.64) had the highest value and were found more significant than CNTME (5.37) (Table 3).

There was no significant difference at $LSD_{0.05}$ level in PME, RME, T*R and P*T interactions in terms of cluster weight value in Yalova Çekirdeksizi grape variety in 2022. In P*T*R interaction, the highest cluster weight was obtained from PBS DR 3 mm girdling treatment (296.9 g cluster^{-1}) and was in the first importance group. PB SR 3 mm (279.2 g cluster^{-1}), PBS SR 5 mm (260.2 g cluster^{-1}), PB SR 5 mm (259.2 g cluster^{-1}), PBS SR 3 mm (249.6 g cluster^{-1}), PBS DR 5 mm (241.3 g cluster^{-1}), PB DR 5 mm (232.3 g cluster^{-1}) and PB DR 3 mm girdling treatments (197.7 g cluster^{-1}) formed different intermediate groups. CNT (184.5 g cluster^{-1}) produced the lowest cluster weight value and was in the last importance group. In the P*R interactions, PB SR (240.9 g cluster^{-1}) and PBS DR girdling treatments (240.9 g cluster^{-1}) were in the first importance group with the highest cluster weight value, followed by PBS SR (231.5 kg cluster^{-1}) in the second importance group and PB DR girdling treatment (204.8 g cluster^{-1}) in the third importance group. There was a significant difference at $LSD_{0.05}$ level in TME and 3mmME (255.9 g cluster^{-1}) and 5mmME (248.2 g cluster^{-1}) had the highest cluster weight values, respectively, and were found more significant than CNTME (184.7 g cluster^{-1}). In 2023, no significant difference was detected in PME, RME, TME, T*R and P*T interactions at $LSD_{0.05}$ level. When the 2023 cluster width values were analyzed, it was determined that in the P*T*R interactions, PB SR 3 mm (232.3 g cluster^{-1}) and PBS DR 3 mm girdling treatments (226.2 g cluster^{-1}) were in the first importance group, respectively. These treatments were followed by PB DR 5 mm (204.1 g cluster^{-1}), PB DR 3 mm (200.2 g cluster^{-1}), PBS SR 5 mm (189.7 g cluster^{-1}), PBS DR 5 mm (177.3 g cluster^{-1}), CNT (174. 8 g cluster^{-1}) and PB SR 5 mm girdling treatments (171.0 g cluster^{-1}) which were in the different intermediate groups and PBS SR 3 mm girdling treatment (163.3 g cluster^{-1}), which was in the last importance group with the lowest cluster weight. In TME, 3mmME (205.5 g cluster^{-1}) had the highest cluster weight value, which was more significant than 5mmME (185.5 g cluster^{-1}) and CNTME (174.8 g cluster^{-1}), respectively. When two–year average cluster weight values were analyzed, no significant difference was detected at $LSD_{0.05}$ level in PME, RME, TME, T*R and P*T interactions. In the two–year average P*T*R interaction, PBS DR 5 mm girdling treatment (261.6 g cluster^{-1}) produced the highest cluster weight value and was in the first importance group. Different intermediate groups were formed by PB SR 3 mm (255.7 g cluster^{-1}), PBS SR 5 mm (225.0 g cluster^{-1}), PB DR 5 mm (218.2 g cluster^{-1}), PB SR 5 mm (215.1 g cluster^{-1}), PBS DR 5 mm (209.3 g cluster^{-1}), PBS SR 3 mm (206.5 g cluster^{-1}) and PB DR 3 mm (199.0 g cluster^{-1}). CNT (179.6 g cluster^{-1}) was in the last importance group with the lowest cluster weight value. In TME, 3mmME (230.7 g cluster^{-1}) and 5mmME (216.9 g cluster^{-1}) had the highest cluster weight values and were found more significant than CNTME (179.6 g cluster^{-1}), respectively (Table 4).

Çoban (2001) girdling treatment in the form of a girdling on the base internode of the canes during thin unripe grape period in the Yuvarlak Çekirdeksiz grape variety, Ahmad and Zargar (2005) applied 4 mm girdling treatment on trunk in post–berry set in the Perlette grape variety, Şahan and Tangolar (2013) applied 4–5 mm girdling treatment in three different periods (berry set, 2 weeks after berry set, 4 weeks after berry set) in Alphonse Lavallée and Flame Seedless grape varieties, Fawzi et al. (2019) applied 2–3 mm girdling treatment on canes when berries were 2–3 mm in size in Thompson Seedless grape variety, Glisic et al. (2022) applied 2–4 mm girdling treatment post–berry set in Victoria grape variety and Gözcü and Dardeniz (2022) applied 3–5 mm girdling treatment from the base internode of the canes when berries were 4–5 mm in size in Yalova Çekirdeksizi grape variety, and concluded that girdling application had an increasing effect on cluster weight. There is a similarity between these literature results and the findings of our research.

There was no significant difference at $LSD_{0.05}$ level in RME, P*T*R, T*R and P*R interactions in terms of berry width value in Yalova Çekirdeksizi grape variety in 2022, 2023 and two–year average. When 2022–year berry width values were analyzed, P*T interaction PBS 5 mm (17.65 mm berry^{-1}) and PBS 3 mm girdling treatments (17.47 mm berry^{-1}) produced the highest berry width value and was in the first importance group.

Table 5. Berry width value of Yalova Çekirdeksizi grape variety (mm berry^{-1})
Çizelge 5. *Yalova Çekirdeksizi üzüm çeşidine ait tane eni değeri (mm tane^{-1})*

Period	Treatments	SR	DR	SR	DR	SR	DR	(P*T)*		
		2022		2023		Average		2022	2023	Average
PB	CNT (P*T*R)*	15.72	15.72	12.88	12.88	14.30	14.30	15.72 bc	12.88 b	14.30 c
	3 mm (P*T*R)	15.76	14.26	13.58	13.30	14.67	13.78	15.01 c	13.44 b	14.22 c
	5 mm (P*T*R)	16.41	15.86	14.43	14.55	15.42	15.21	16.14 b	14.49 a	15.31 b
PBS	CNT (P*T*R)*	15.72	15.72	12.88	12.88	14.30	14.30	15.72 bc	12.88 b	14.30 c
	3 mm (P*T*R)	17.66	17.27	15.38	14.66	16.52	15.97	17.47 a	15.02 a	16.25 a
	5 mm (P*T*R)	17.44	17.86	15.75	14.65	16.60	16.26	17.65 a	15.20 a	16.43 a
$LSD_{0.05}$*		N.S.		N.S.		N.S.		0.855	0.735	0.742
								PME (P)**		
PB (P*R)**		15.96	15.28	13.63	13.58	14.80	14.43	15.62 b	13.60 b	14.61 b
PBS (P*R)		16.94	16.95	14.67	14.06	15.81	15.51	16.95 a	14.37 a	15.66 a
$LSD_{0.05}$**		N.S.		N.S.		N.S.		0.494	0.425	0.429
								TME (T)***		
CNTME (T*R)***		15.72	15.72	12.88	12.88	14.30	14.30	15.72 b	12.88 c	14.30 c
3mmME (T*R)		16.71	15.77	14.48	13.98	15.60	14.87	16.24 b	14.23 b	15.24 b
5mmME (T*R)		16.93	16.86	15.09	14.60	16.01	15.73	16.89 a	14.85 a	15.87 a
$LSD_{0.05}$***		N.S.		N.S.		N.S.		0.605	0.520	0.525
RME (R)****		16.45	16.12	14.15	13.82	15.30	14.97			
$LSD_{0.05}$****		N.S.		N.S.		N.S.				

PB: Pre–Bloom, PBS: Post–Berry Set, CNT: Control, CNTME: Control Main Effect, 3mmME: 3 mm Main Effect, 5mmME: 5 mm Main Effect, RME: Repetitive Main Effect, TME: Treatment Main Effect, PME: Period Main Effect, P: Period, T: Treatment, R: Repetitive, SR: Single Repetitive, DR: Double Repetitive, LSD: Least Significant Difference.

Table 6. Berry weight value of Yalova Çekirdeksizi grape variety (g berry^{-1})
Çizelge 6. *Yalova Çekirdeksizi üzüm çeşidine ait tane ağırlığı değeri (g tane^{-1})*

Period	Treatments	SR	DR	SR	DR	SR	DR	(P*T)*		
		2022		2023		Average		2022	2023	Average
PB	CNT (P*T*R)*	2.96	2.96	2.04	2.04	2.50	2.50	2.96 bc	2.04 c	2.50 c
	3 mm (P*T*R)	3.26	2.25	2.28	2.35	2.77	2.30	2.75 c	2.31 b	2.53 c
	5 mm (P*T*R)	3.10	3.54	2.37	2.70	2.73	3.12	3.32 c	2.54 b	2.93 b
PBS	CNT (P*T*R)*	2.96	2.96	2.04	2.04	2.50	2.50	2.96 bc	2.04 c	2.50 c
	3 mm (P*T*R)	4.00	3.99	2.98	3.05	3.49	3.52	3.99 a	3.02 a	3.51 a
	5 mm (P*T*R)	4.10	4.24	2.93	2.72	3.51	3.48	4.17 a	2.82 a	3.50 a
$LSD_{0.05}$*		N.S.		N.S.		N.S.		0.429	0.255	0.305
								PME (P)**		
PB (P*R)**		3.11	2.92	2.23	2.36	2.67	2.64	3.01 b	2.30 b	2.65 b
PBS (P*R)		3.69	3.73	2.65	2.61	3.17	3.17	3.71 a	2.63 a	3.17 a
$LSD_{0.05}$**		N.S.		N.S.		N.S.		0.248	0.147	0.176
								TME (T)***		
CNTME (T*R)***		2.96 b	2.96 b	2.04	2.04	2.50	2.50	2.96 c	2.04 b	2.50 b
3mmME (T*R)		3.63 a	3.12 b	2.63	2.70	3.13	2.91	3.38 b	2.67 a	3.02 a
5mmME (T*R)		3.60 a	3.89 a	2.65	2.71	3.12	3.30	3.75 a	2.68 a	3.21 a
$LSD_{0.05}$***		0.429		N.S.		N.S.		0.304	0.179	0.215
RME (R)****		3.40	3.32	2.44	2.49	2.92	2.91			
$LSD_{0.05}$****		N.S.		N.S.		N.S.				

PB: Pre–Bloom, PBS: Post–Berry Set, CNT: Control, CNTME: Control Main Effect, 3mmME: 3 mm Main Effect, 5mmME: 5 mm Main Effect, RME: Repetitive Main Effect, TME: Treatment Main Effect, PME: Period Main Effect, P: Period, T: Treatment, R: Repetitive, SR: Single Repetitive, DR: Double Repetitive, LSD: Least Significant Difference.

These applications were followed by PB 5 mm girdling treatment (16.14 mm berry^{-1}) and CNT (15.72 mm berry^{-1}), which were in different intermediate groups, and PB 3 mm girdling treatment (15.01 mm berry^{-1}), which was in the last importance group. In PME, PBS girdling treatments (16.95 mm berry^{-1}) were in the first importance group, creating a higher value than PB girdling treatments (15.62 mm berry^{-1}). In TME, 5mmME (16.89 mm berry^{-1}) had the highest berry width value and was found to be more important than 3mmME (16.24 mm berry^{-1}) and CNTME (15.72 mm berry^{-1}), respectively. When the P*T interaction of the berry width value of 2023 year is examined, PBS 5 mm (15.20 mm berry^{-1}), PBS 3 mm (15.02 mm berry^{-1}) and PB 5mm girdling treatments (14.49 mm berry^{-1}) have the highest berry width value, respectively and was placed in the first importance group. These applications were followed by PB 3 mm girdling treatment (13.44 mm berry^{-1}) and CNT (12.88 mm berry^{-1}), which are in the last importance group. In PME, PBS girdling treatments (14.37 mm berry^{-1}) were in the first importance group, creating a higher value than PB girdling treatments (13.60 mm berry^{-1}). In TME, 5mmME (14.85 mm berry^{-1}) is in the first importance group as having the highest berry width value. This was followed by 3mmME (14.23 mm berry^{-1}) in the second importance group and CNTME (12.88 mm berry^{-1}) in the last importance group. When the D*U interaction of the two–year average berry width value was examined, PBS 5 mm (16.43 mm berry^{-1}) and PBS 3 mm girdling treatments (16.25 mm berry^{-1}) were in the first importance group with the highest berry width value, respectively. These applications were followed by PB 5 mm (15.31 mm berry^{-1}), which is in the second importance group, and CNT (14.30 mm berry^{-1}) and PB 3 mm girdling treatment (14.22 mm berry^{-1}), which are in the last importance group. In PME, PBS girdling treatments (15.66 mm berry^{-1}) were in the first importance group, creating a higher value than PB girdling treatments (14.61 mm berry^{-1}). In TME, 5mmME (15.87 mm berry^{-1}) is in the first importance group as having the highest berry width value. This was followed by 3mmME (15.24 mm berry^{-1}) in the second importance group and CNTME (14.30 mm berry^{-1}) in the last importance group, respectively (Table 5).

Çoban (2001) girdling treatment in the form of a girdling on the base internode of the canes during thin unripe grape period in the Yuvarlak Çekirdeksiz grape variety, Şahan and Tangolar (2013) applied 4–5 mm girdling treatment in three different periods (berry set, 2 weeks after berry set, 4 weeks after berry set) in Alphonse Lavallée and Flame Seedless grape varieties, Fawzi et al. (2019) applied 2–3 mm girdling treatment on canes when berries were 2–3 mm in size in Thompson Seedless grape variety, Gündüz et al. (2020) applied 5 mm girdling treatment on canes when berries were 3–4 mm in size in Horoz Karası grape variety, Söyler et al. (2020) applied 3 mm girdling treatment on trunk when berries 4 mm in size in Mevlana grape variety, Glisic et al. (2022) applied 2–4 mm girdling treatment post–berry set in Victoria grape variety and Gözcü and Dardeniz (2022) applied 3–5 mm girdling treatment from the base internode of the canes when berries were 4–5 mm in size in Yalova Çekirdeksizi grape variety, Çiftçi ve Çelik (2023) applied girdling treatment on trunk at veraison period Samancı Çekirdeksizi and Alphonse Lavallée grape varieties, and concluded that girdling application had an increasing effect on berry width. It seems that these literature results are in harmony with the research findings we have conducted.

There was no significant difference at $LSD_{0.05}$ level in RME, P*T*R and P*R interactions in terms of berry weight value in Yalova Çekirdeksizi grape variety in 2022. In the T*R interaction, DR 5mmME (3.89 g berry^{-1}), SR 3mmME (3.63 g berry^{-1}) and SR 5mmME (3.60 g berry^{-1}) had the highest berry weight value and were found to be more important than DR 3mmME (3.12 g berry^{-1}) and CNTME (2.96 g berry^{-1}), respectively. When the P*T interaction was examined, PBS 5 mm (4.17 g berry^{-1}) and PBS 3 mm girdling treatments (3.99 g berry^{-1}) were in the first importance group with the highest berry weight value, respectively.

These treatments were followed by CNT (2.96 g berry–1), which constitutes the second importance group, and PB 5 mm (3.32 g berry–1) and PB 3 mm girdling treatments (2.75 g berry–1) which are in the last importance group. In PME, PBS girdling treatments (3.71 g berry–1) were in the first importance group, creating a higher value than PB girdling treatments (3.01 g berry–1) (Table 6).

In TME, 5mmME (3.75 g berry^{-1}) was in the first importance group as having the highest berry weight value. This was followed by 3mmME (3.38 g berry^{-1}) in the second importance group and CNTME (2.96 berry^{-1}) in the last importance group. When the P*T interaction of the berry weight value of 2023 was analyzed, PBS 3 mm (3.02 g berry^{-1}) and PBS 5 mm girdling treatments (2.82 g berry^{-1}), respectively, were in the first importance group with the highest berry weight value.

These applications were followed by PB 5 mm (2.54 g berry^{-1}) and PB 3 mm girdling treatments (2.31 g berry^{-1}), which constitute the second importance group, and CNT (2.04 g berry^{-1}), which is in the last importance group. In PME, PBS girdling treatments (2.63 g berry^{-1}) were in the first importance group, creating a higher value than PB girdling treatments (2.30 g berry^{-1}). In TME, 5mmME (2.68 g berry^{-1}) and 3mmME (2.67 g berry^{-1}) had the highest berry weight values, respectively, and were found to be more important than CNTME (2.04 g berry^{-1}). When the P*T interaction of the two–year average berry weight value was examined, PMS 3 mm (3.51 g berry^{-1}) and PBS 5 mm girdling treatments (3.50 g berry^{-1}) were in the first importance group with the highest berry weight value, respectively. These treatments were followed by PB 5 mm girdling treatment (2.93 g berry^{-1}), which constitutes the second importance group, and PB 3 mm girdling treatment (2.53 g berry^{-1}) and CNT (2.50 g berry^{-1}), which are in the last importance group. In PME, PBS girdling treatments (3.17 g berry^{-1}) were in the first importance group, creating a higher value than PB girdling treatments (2.65 g berry^{-1}). In TME, 5mmME (3.21 g berry^{-1}) and 3mmME (3.02 g berry^{-1}) had the highest berry weight values, respectively, and were found to be more important than CNTME (2.50 g berry^{-1}) (Table 6). Carreño et al. (1998) applied 4 mm girdling treatment during berry set and veraison in Italia grape variety, Çoban (2001) girdling treatment in the form of a girdling on the base internode of the canes during thin unripe grape period in the Yuvarlak Çekirdeksiz grape variety, Şahan and Tangolar (2013) applied 4–5 mm girdling treatment in three different periods (berry set, 2 weeks after berry set, 4 weeks after berry set) in Alphonse Lavallée and Flame Seedless grape varieties, Camcı and Çoban (2016) girdling treatment in the form of a girdling on trunk at veraison in the Superior Seedless grape variety, Crupi et al. (2016) applied 4–5 mm girdling treatment on canes when berries were 3–4 mm in size in Early Red Seedless grape variety, Soltekin et al. (2016) applied 4 mm girdling treatments on canes at post–berry set and the beginning of veraison Flame Seedless grape variety, Fawzi et al. (2019) applied 2–3 mm girdling treatment on canes when berries were 2–3 mm in size in Thompson Seedless grape variety, Gündüz et al. (2020) applied 5 mm girdling treatment on canes when berries were 3–4 mm in size in Horoz Karası grape variety, Gözcü and Dardeniz (2022) applied 3–5 mm girdling treatment from the base internode of the canes when berries were 4–5 mm in size in Yalova Çekirdeksizi grape variety, Tóth et al. (2022) applied 4 mm girdling treatment on canes at the beginning of veraison three different table grape varieties, Çiftçi ve Çelik (2023) applied girdling treatment on trunk at veraison period Samancı Çekirdeksizi and Alphonse Lavallée grape varieties, they emphasized that girdling increased the berry weight. These literature results are parallel to the research findings.

There was no significant difference at $LSD_{0.05}$ level in PME, RME, TME, P*T*R, T*R, P*T and P*R interactions in terms of Hue value in Yalova Çekirdeksizi grape variety in 2022. When the Hue value of 2023 was analyzed by TME, 5mmME (108.4) and 3mmME (108.1) were found to be more important than CNTME (107.3) with the highest Hue values, respectively. In the P*R interaction of the two–year average Hue value, PB DR girdling treatment (109.4) constituted the highest value and was in the first importance group, followed by PBS SR (109.0) and PB SR girdling treatments (108.7), which were in the second importance group, PBS DR girdling treatment (108.5), which is in the last importance group, respectively (Table 7).

There was no significant difference at $LSD_{0.05}$ level in PME, P*T*R, T*R, P*T and P*R interactions in terms of TSS value in Yalova Çekirdeksizi grape variety in 2022. It has been determined that the TSS value is more important in terms of RME in SR girdling treatments (17.58%) compared to DR girdling treatments (16.52%). In the TME, CNTME (17.62%) was in the first importance group with the highest TSS value. This was followed by 3mmME (17.22%) in the second importance group and 5mmME (16.31%) in the last importance group. There was no significant difference at $LSD_{0.05}$ level in PME, RME, TME, P*T*R, T*R, P*T and P*R interactions in terms of TSS value in Yalova Çekirdeksizi grape variety in 2023 and two–year average (Table 8).

There was no significant difference at $LSD_{0.05}$ level in PME, P*T*R, P*T and P*R interactions in terms of pH value in Yalova Çekirdeksizi grape variety in 2022. In the T*R interaction of 2022, SR 3mmME (4.11) was in the first importance group with the highest pH value. This was followed by CNTME (4.00), SR 5mmME (3.96) and DR 3mmME (3.92) in the second importance group, and DR 5mmME (3.85) in the last importance group. It has been determined that the pH value is more important in terms of RME in SR girdling treatments (4.02) than in DR girdling treatments (3.93). In the TME, 3mmME (4.02) and CNTME (4.00) had the highest pH values and were found to be more important than 5mmME (3.91).

Table 7. Hue value of Yalova Çekirdeksizi grape variety

Çizelge 7. *Yalova Çekirdeksizi üzüm çeşidine ait Hue değeri*

Period	Treatments	SR	DR	SR	DR	SR	DR	(P*T)*		
		2022		2023		Average		2022	2023	Average
PB	CNT (P*T*R)*	110.1	110.1	107.3	107.3	108.7	108.7	110.1	107.3	108.7
	3 mm (P*T*R)	109.3	111.4	107.1	109.1	108.2	110.2	110.4	108.1	109.2
	5 mm (P*T*R)	110.7	110.0	107.8	108.6	109.3	109.3	110.3	108.2	109.3
PBS	CNT (P*T*R)*	110.1	110.1	107.3	107.3	108.7	108.7	110.1	107.3	108.7
	3 mm (P*T*R)	109.1	108.3	108.2	108.0	108.6	108.2	108.7	108.1	108.4
	5 mm (P*T*R)	110.2	109.2	109.0	108.3	109.6	108.8	109.7	108.6	109.2
$LSD_{0.05}$*		N.S.		N.S.		N.S.		N.S.	N.S.	N.S.
								PME (P)**		
PB (P*R)**		110.0	110.5	107.4	108.3	108.7 ab	109.4 a	110.3	107.9	109.1
PBS (P*R)		109.8	109.2	108.1	107.9	109.0 ab	108.5 b	109.5	108.0	108.7
$LSD_{0.05}$**		N.S.		N.S.		0.779		N.S.	N.S.	N.S.
								TME (T)***		
CNTME (T*R)***		110.1	110.1	107.3	107.3	108.7	108.7	110.1	107.3 b	108.7
3mmME (T*R)		109.2	109.8	107.7	108.6	108.4	109.2	109.5	108.1 a	108.8
5mmME (T*R)		110.4	109.6	108.4	108.5	109.4	109.0	110.0	108.4 a	109.2
$LSD_{0.05}$***		N.S.		N.S.		N.S.		N.S.	0.837	N.S.
RME (R)****		109.9	109.8	107.8	108.1	108.8	109.0			
$LSD_{0.05}$****		N.S.		N.S.		N.S.				

PB: Pre–Bloom, PBS: Post–Berry Set, CNT: Control, CNTME: Control Main Effect, 3mmME: 3 mm Main Effect, 5mmME: 5 mm Main Effect, RME: Repetitive Main Effect, TME: Treatment Main Effect, PME: Period Main Effect, P: Period, T: Treatment, R: Repetitive, SR: Single Repetitive, DR: Double Repetitive, LSD: Least Significant Difference.

Table 8. TSS value of Yalova Çekirdeksizi grape variety (%)

Çizelge 8. *Yalova Çekirdeksizi üzüm çeşidine ait SÇKM değeri (%)*

Period	Treatments	SR	DR	SR	DR	SR	DR	(P*T)*		
		2022		2023		Average		2022	2023	Average
PB	CNT (P*T*R)*	17.62	17.62	17.32	17.32	17.47	17.47	17.62	17.32	17.47
	3 mm (P*T*R)	19.07	15.06	17.20	16.94	18.13	16.00	17.06	17.07	17.07
	5 mm (P*T*R)	16.48	16.52	18.46	18.65	17.47	17.58	16.50	18.56	17.53
PBS	CNT (P*T*R)*	17.62	17.62	17.32	17.32	17.47	17.47	17.62	17.32	17.47
	3 mm (P*T*R)	17.72	17.05	17.44	17.45	17.58	17.25	17.38	17.45	17.41
	5 mm (P*T*R)	16.97	15.28	17.57	17.28	17.27	16.28	16.12	17.42	16.77
$LSD_{0.05}$*		N.S.		N.S.		N.S.		N.S.	N.S.	N.S.
								PME (P)**		
PB (P*R)**		17.72	16.40	17.66	17.64	17.69	17.02	17.06	17.65	17.35
PBS (P*R)		17.43	16.65	17.44	17.35	17.44	16.99	17.04	17.39	17.22
$LSD_{0.05}$**		N.S.		N.S.		N.S.		N.S.	N.S.	N.S.
								TME (T)***		
CNTME (T*R)***		17.62	17.62	17.32	17.32	17.47	17.47	17.62 a	17.32	17.47
3mmME (T*R)		18.39	16.06	17.32	17.20	17.86	16.63	17.22 ab	17.26	17.24
5mmME (T*R)		16.73	15.90	18.01	17.96	17.37	16.93	16.31 b	17.99	17.15
$LSD_{0.05}$***		N.S.		N.S.		N.S.		1.038	N.S.	N.S.
RME (R)****		17.58 a	16.52 b	17.55	17.49	17.56	17.01			
$LSD_{0.05}$****		0.847		N.S.		N.S.				

PB: Pre–Bloom, PBS: Post–Berry Set, CNT: Control, CNTME: Control Main Effect, 3mmME: 3 mm Main Effect, 5mmME: 5 mm Main Effect, RME: Repetitive Main Effect, TME: Treatment Main Effect, PME: Period Main Effect, P: Period, T: Treatment, R: Repetitive, SR: Single Repetitive, DR: Double Repetitive, LSD: Least Significant Difference.

Table 9. pH value of Yalova Çekirdeksizi grape variety
Çizelge 9. *Yalova Çekirdeksizi üzüm çeşidine ait pH değeri*

Period	Treatments	SR	DR	SR	DR	SR	DR	(P*T)*		
		2022		2023		Average		2022	2023	Average
PB	CNT (P*T*R)*	4.00	4.00	3.47	3.47	3.74	3.74	4.00	3.47 b	3.74
	3 mm (P*T*R)	4.11	3.83	3.50	3.43	3.80	3.63	3.97	3.46 b	3.72
	5 mm (P*T*R)	3.94	3.84	3.62	3.54	3.78	3.69	3.89	3.58 a	3.74
PBS	CNT (P*T*R)*	4.00	4.00	3.47	3.47	3.74	3.74	4.00	3.47 b	3.74
	3 mm (P*T*R)	4.11	4.02	3.53	3.51	3.82	3.76	4.06	3.52 ab	3.79
	5 mm (P*T*R)	3.99	3.86	3.48	3.55	3.74	3.71	3.92	3.51 ab	3.72
$LSD_{0.05}$*		N.S.		N.S.		N.S.		N.S.	0.065	N.S.
								PME (P)**		
PB (P*R)**		4.02	3.89	3.53	3.48	3.77	3.68	3.95	3.50	3.73
PBS (P*R)		4.03	3.96	3.49	3.51	3.76	3.74	3.99	3.50	3.75
$LSD_{0.05}$**		N.S.		N.S.		N.S.		N.S.	N.S.	N.S.
								TME (T)***		
CNTME (T*R)***		4.00 b	4.00 b	3.47	3.47	3.74 bc	3.74 bc	4.00 a	3.47 b	3.74
3mmME (T*R)		4.11 a	3.92 bc	3.52	3.47	3.81 a	3.69 c	4.02 a	3.49 b	3.75
5mmME (T*R)		3.96 b	3.85 c	3.55	3.54	3.76 ab	3.70 bc	3.91 b	3.55 a	3.73
$LSD_{0.05}$***		0.084		N.S.		0.059		0.059	0.046	N.S.
RME (R)****		4.02 a	3.93 b	3.51	3.49	3.77 a	3.71 b			
$LSD_{0.05}$****		0.048		N.S.		0.034				

PB: Pre–Bloom, PBS: Post–Berry Set, CNT: Control, CNTME: Control Main Effect, 3mmME: 3 mm Main Effect, 5mmME: 5 mm Main Effect, RME: Repetitive Main Effect, TME: Treatment Main Effect, PME: Period Main Effect, P: Period, T: Treatment, R: Repetitive, SR: Single Repetitive, DR: Double Repetitive, LSD: Least Significant Difference.

Table 10. Maturity index value of Yalova Çekirdeksizi grape variety (TSS% acidity%$^{-1}$)
Çizelge 10. *Yalova Çekirdeksizi üzüm çeşidine ait olgunluk indisi değeri (%SÇKM %asitlik^{-1})*

Period	Treatments	SR	DR	SR	DR	SR	DR	(P*T)*		
		2022		2023		Average		2022	2023	Average
PB	CNT (P*T*R)*	35.55	35.55	35.24	35.24	35.40	35.40	35.55	35.24 b	35.40
	3 mm (P*T*R)	40.31	26.15	38.55	36.67	39.43	31.41	33.23	37.61 b	35.42
	5 mm (P*T*R)	29.52	29.61	52.09	43.51	40.80	36.56	29.56	47.80 a	38.68
PBS	CNT (P*T*R)*	35.55	35.55	35.24	35.24	35.40	35.40	35.55	35.24 b	35.40
	3 mm (P*T*R)	38.24	37.60	35.43	36.85	36.83	37.22	37.92	36.14 b	37.03
	5 mm (P*T*R)	31.61	25.20	40.46	36.76	36.03	30.98	28.41	38.61 b	33.51
$LSD_{0.05}$*		N.S.		N.S.		N.S.		N.S.	4.269	N.S.
								PME (P)**		
PB (P*R)**		35.13	30.44	41.96	38.47	38.54	34.46	32.78	40.22 a	36.50
PBS (P*R)		35.14	32.78	37.04	36.28	36.09	34.53	33.96	36.66 b	35.31
$LSD_{0.05}$**		N.S.		N.S.		N.S.		N.S.	2.464	N.S.
								TME (T)***		
CNTME (T*R)***		35.55	35.55	35.24	35.24	35.40	35.40	35.55	35.24 b	35.40
3mmME (T*R)		39.28	31.88	36.99	36.76	38.13	34.32	35.58	36.87 a	36.23
5mmME (T*R)		30.56	27.40	46.27	40.14	38.42	33.77	28.98	43.20 a	36.09
$LSD_{0.05}$***		N.S.		N.S.		N.S.		N.S.	2.463	N.S.
RME (R)****		35.13	31.61	39.50	37.38	37.32	34.49			
$LSD_{0.05}$****		N.S.		N.S.		N.S.				

PB: Pre–Bloom, PBS: Post–Berry Set, CNT: Control, CNTME: Control Main Effect, 3mmME: 3 mm Main Effect, 5mmME: 5 mm Main Effect, RME: Repetitive Main Effect, TME: Treatment Main Effect, PME: Period Main Effect, P: Period, T: Treatment, R: Repetitive, SR: Single Repetitive, DR: Double Repetitive, LSD: Least Significant Difference

When the P*T interaction of the pH value of 2023 was examined, PB 5 mm girdling treatment (3.58) was in the first importance group with the highest pH value. This was followed by PBS 3 mm (3.52) and PBS 5 mm girdling treatments (3.51), which constitute the second importance group, and CNT (3.47) and PB 3 mm girdling treatments (3.46), which are in the last importance group. In TME, 5mmME (3.55) had the highest pH value and was found to be more important than 3mmME (3.49) and CNTME (3.47). In the T*R interaction of the two–year average pH value, SR 3mmME (3.81) was in the first importance group with the highest pH value. This was followed by SR 5mmME (3.76), CNTME (3.74) and DR 5mmME (3.70) in the second importance group, and DR 3mmME (3.69) in the last importance group. It has been determined that SR girdling treatments (3.77) are more important in terms of RME compared to DR girdling treatments (3.71) (Table 9).

There was no significant difference at $LSD_{0.05}$ level in PME, RME, TME, P*T*R, T*R, P*T and P*R interactions in terms of maturity index value in Yalova Çekirdeksizi grape variety in 2022 and two–year average. When the D*U interaction of 2023 was analyzed, PB 5 mm (47.80) was in the first importance group with the highest maturity index value. Respectively, CNT (35.24), PBS 3 mm (36.14), PB 3 mm (37.61) and PBS 5 mm girdling treatments (38.61) were found in the last importance group, creating the lowest maturity index value. In PME, PB girdling treatments (40.22) were in the first importance group, creating a higher value than PBS girdling treatments (36.66). In TME, 5mmME (43.20) and 3mmME (36.87) had the highest maturity index values, respectively, and were found to be more important than CNTME (35.24) (Table 10).

Carreño et al. (1998) applied 4 mm girdling treatment during berry set and veraison in Italia grape variety, Fawzi et al. (2019) applied 2–3 mm girdling treatment on canes when berries were 2–3 mm in size in Thompson Seedless grape variety, Gündüz et al. (2020) applied 5 mm girdling treatment on canes when berries were 3–4 mm in size in Horoz Karası grape variety, it is emphasized that girdling has a positive effect on the maturity index. The results of this literature and the findings of the research conducted in 2023 are similar.

5. Conclusion

In this research, in which the effects of girdling treatments at different periods and widths on grape quality in Yalova Çekirdeksizi (*V. vinifera* L.) grape variety were investigated, when the two–year average findings were evaluated; it was determined that 3mmME and 5mmME produced higher values in TME compared to CNTME in terms of average yield, cluster width, cluster compactness, cluster weight and berry weight values. According to the P*T*R interactions, it was concluded that the PBS DR 3 mm girdling treatment had the highest values in cluster width and cluster weight values compared to the other treatments. According to the P*T interaction, it was determined that PBS 3 mm and PBS 5 mm girdling treatments increased berry width and berry weight compared to other periods and treatments. When PME was analyzed, significant increases were determined in berry width and berry weight values obtained from PBS girdling treatments.

In this research, when the two–year average findings were evaluated; the highest berry width value in TME was realized by 5mmME. When the maturity index value was analyzed, a significant difference was detected only in PME, TME and P*T interaction in 2023, but no significant difference was detected in the two–year average findings.

As a result; in Yalova Çekirdeksizi grape variety grown under arid conditions and standard summer pruning was performed, it was determined that 3 mm and 5 mm girdling treatments produced the same average yield value in 2022, while 3 mm girdling treatments continued to increase the average yield value in 2023, while 5 mm girdling treatments slightly decreased the average yield value. The decrease in yield in the 5 mm girdling treatments may be due to the removal of a wider bark+phloem layer, resulting in a later closure of the wound tissues compared to the 3 mm girdling treatments, and thus a decrease in assimilate products to the main root and old parts. Therefore, it was concluded that although 5 mm girdling treatments continue to give positive results in terms of grape quality in many parameters, it is not appropriate to repeat them two years in a row in terms of average yield.

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Conflicts of Interest

The authors declare no conflict of interest.

Contribution Rate Statement Summary

The authors declare that they have contributed equally to the article.

References

Abu–Zahara T. (2010). Berry size of Thompson Seedless as influenced by the application of giberellic acid and cane girdling. *Pak J Bot.*, 42(3), 1755–1760.

Ahmad, M. F., & Zargar, G. H. (2005). Effect of trunk girdling, flower thinning, GA3 and ethephon application on quality characteristics in grape cv. Perlette under temperate Kashmir valley conditions. *Indian Journal of Horticulture*, 62(3), 285–287.

Bahar, E., Korkutal, İ., & Kabataş, İ. E. (2017). Sangiovese üzüm çeşidinde farklı yaprak su potansiyelleri (Ψyaprak) ve salkım seyreltme uygulamalarının salkım ve tane özellikleri üzerine etkileri. *Akdeniz Üniversitesi Ziraat Fakültesi Dergisi*, 30(2), 85–90.

Camcı, H., & Çoban, H. (2016). Superior Seedless (*Vitis vinifera* L.) üzüm çeşidinde GA3, salkım ucu kesme ve bilezik alma uygulamalarının üzüm verim ve kalitesine etkileri. *Ege Üniversitesi Ziraat Fakültesi Dergisi*, 53(3), 351–358. https://doi.org/10.20289/zfdergi.390114

Canturk, S., Kunter, B., & Coksari, G. (2018a). Effects of kaolin and dicarboxylic acid–based stress inhibitors on aroma composition of two table grape cultivars (*V. vinifera* L.). *Acta Scientiarum Polonorum. Hortorum Cultus,* 17(5), 37–46. DOI: 10.24326/asphc.2018.5.4

Canturk, S., Kunter, B., & Keskin, N. (2018b). Aromatic composition of pink skinned grape cultivar: Gülüzümü (*V. vinifera* L.). *Yüzüncü Yıl Üniversitesi Tarım Bilimleri Dergisi*, 28 (special issue), 40–44.

Carreño, J., Faraj, S., & Martinez, A. (1998). Effects of girdling and covering mesh on ripening, colour and fruit characteristics of Italia grapes. *The Journal of Horticultural Science and Biotechnology*, 73(1), 103–106. https://doi.org/10.1080/14620316.1998.11510951

Cemeroğlu, B. (2007). *Gıda Analizleri*. Gıda Teknolojisi Derneği Yayınları. Ankara. Yayın No: 34.

Crupi, P., Antonacci, D., Savino, M., Genghi, R., Perniola, R., & Coletta, A. (2016). Girdling and gibberellic acid effects on yield and quality of a seedless red table grape for saving irrigation water supply. *European Journal of Agronomy*, 80, 21–31. https://doi.org/10.1016/j.eja.2016.06.015

Çiftçi, H., & Çelik, M. (2023). Bazı sofralık üzüm çeşitlerinde farklı yaz budama uygulamalarının verim ve kalite üzerine etkileri. *Adnan Menderes Üniversitesi Ziraat Fakültesi Dergisi*, 20(2), 211–218. https://doi.org/10.25308/aduziraat.1307733

Çoban, H. (2001). Sofralık üzüm kalitesini artırıcı bazı kültürel uygulamaların etkileri üzerine araştırmalar. *Anadolu Ege Tarımsal Araştırma Enstitüsü Dergisi*, 11(2), 76–88.

FAO, 2024. https://www.fao.org/faostat/en/#data/QCL (Erişim Tarihi: 18.01.2024).

Fawzi, M. I. F., Hagagg, L. F., Shahin, M. F. M., & El–Hady, E. S. (2019). Effect of hand thinning, girdling and boron spraying application on, vegetative growth, fruit quality and quantity of Thompson seedless grapevines. *Middle East J. of Agri. Res*, 8(2), 506–513.

Glišić, M., Matijašević, S., Bešlić, Z., Ranković–Vasić, Z., Glišić, I., & Ćirković, D. (2022). Effect of early berry thinning and girdling on grape quality of cv. Victoria. Analele Universităţii din Craiova, seria Agricultură–Montanologie–Cadastru (Annals of the University of Craiova–Agriculture, Montanology, Cadastre Series) Vol. 52/1/2022, 52 (1). https://doi.org/10.52846/aamc.v52i1.1331

Goren, R., Huberman, M., & Goldschmidt, E. (2004). Girdling: physiological and horticultural aspects. *Hortic Rev.*, 30, 1–36. DOI:10.1002/9780470650837

Gözcü Ü., & Dardeniz, A. (2022). Yalova Çekirdeksiz üzüm çeşitlerinde farklı çizi açma ve bilezik alma uygulamalarının üzüm verim ve kalitesine etkileri. *Lapseki Meslek Yüksekokulu Uygulamalı Araştırmalar Dergisi*, 3(5), 49–57.

Gündüz, H. İ., Atlı, H. S., & Kazankaya, A. (2020). Horoz Karası üzüm çeşidinde, bilezik alma ve gibberellik asit uygulamalarının verim ve kalite üzerine etkileri. *Munzur Zirvesi 2. Uluslararası Uygulamalı Bilimler Kongresi*. 31 Mayıs. 156–171. Tunceli.

İşçi, B., & Altındişli, A. (2014). Organik olarak yetiştirilen Alphonse Lavallée ve Trakya İlkeren (*Vitis vinifera* L.) cv. üzüm çeşitlerinde bazı kültürel uygulamaların verim ve kalite üzerine etkileri. *Gaziosmanpaşa Üniversitesi Ziraat Fakültesi Dergisi*, 31(3), 91–100.

Jackson, D. I. (1985). Increasing fruit set using CCC and girdling. Southern horticulture. *Grape grower and Winemaker*, 2, 72–73.

Keskin, M., Setlek, P., & Demir, S. (2017). Use of color measurement Systems in food science and Agriculture. *International Advanced Researches & Engineering Congress*. Osmaniye/Türkiye.

Keskin, N., İşçi, B., & Gökbayrak, Z. (2013). Effects of cane–girdling and cluster and berry thinning on berry organic acids of four *Vitis vinifera* L. table grape cultivars. *Acta Sci. Pol., Hortorum Cultus*., 12(6), 115–125.

Korkutal, İ., Bahar, E., & Bayram, S. (2018). Farklı toprak işleme ve yaprak alma uygulamalarının Syrah üzüm çeşidinde su stresi, sürgün ve yaprak özellikleri üzerine etkileri. *Tekirdağ Ziraat Fakültesi Dergisi*, 15(1), 1–13.

Koshita, Y., Yamane, T., Yakushiji, H., Azuma, A., & Mitani, N. (2011). Regulation of skin color in 'Aki Queen' grapes: Interactive effects of temperature, girdling, and leaf shading treatments on coloration and total soluble solids. *Sci. Hortic*., 129, 98–101. https://doi.org/10.1016/j.scienta.2011.03.014

Kunter B., Cantürk S., & Keskin, N. (2013). Üzüm tanesinin histokimyasal yapısı. *Iğdır Üni. Fen Bilimleri Enst. Der*., 3(2), 17–24.

Nicolosi, E., Ferlito, F., Amenta, M., Russo, T., & Rapisarda, P. (2018). Changes in the quality and antioxidant components of minimally processed table grapes during storage. *Sci Hortic*., 232, 175–183. https://doi.org/10.1016/j.scienta.2017.12.050

OIV, 2009. 2nd Edition of the OIV Descriptor List for Grape Varieties and Vitis Species. Organisation Internationale de la vigne et du vin. 18, rue d'Aguesseau 7500 Paris. 178 pp.

Rammings, D. W., & Tarailo, R. (1998). 'Black Emerald': an early–maturing, black seedless grape for the fresh market. *Hort Sci*., 33, 353–354.

Soltekin, O., Candemir, A., & Altindisli, A. (2016). Effects of cane girdling on yield, fruit quality and maturation of (*Vitis vinifera* L.) cv. Flame Seedless. *In BIO Web of Conferences* (Vol. 7, p. 01032). EDP Sciences. https://doi.org/10.1051/bioconf/20160701032

Söyler, K., Altındişli, A., & İşçi, B. (2020). The Effects of Different Crop Load and Summer Pruning Application on Grape Yield and Quality Parameters of 'Mevlana' Cultivar

(*Vitis vinifera* L.). *Erwerbs–Obstbau*, 62(Suppl 1), 125–130. https://doi.org/10.1007/s10341-020-00519-5

Şahan, E., & Tangolar, S. (2013). Flame Seedless ve Alphonse Lavallée üzüm çeşitlerinde bilezik alma ve salkım seyreltmesi uygulamalarının bazı salkım ve tane özellikleri üzerine etkileri. *Ç.Ü Fen ve Mühendislik Bilimleri Dergisi*, 29(3), 88–97.

Şahin, E., & Dardeniz, A. (2023). Atasarısı üzüm çeşidinde farklı yaz budaması uygulamalarının tane tutum özellikleri ile verim ve kalite üzerindeki etkileri. *Bahçe*, 52(Özel Sayı 1), 175–181.

Tóth, A. M., Zsófi, Z., & Veres, S. (2022). Cane girdling influence on the berry texture properties of three table grape varieties. *Horticulturae*, 8(12), 1101. https://doi.org/10.3390/horticulturae8121101

TÜİK, 2024. https://data.tuik.gov.tr/Kategori/GetKategori?p=tarim–111&dil=1 (Erişim Tarihi: 18.01.2024).

Türker, L., & Dardeniz, A. (2014). Sofralık üzüm çeşitlerinde farklı düzeylerdeki koltuk alma uygulamalarının verim ve kalite özellikleri üzerindeki etkileri. *ÇOMÜ Ziraat Fakültesi Dergisi*, *2*(2), 73–82.

Winkler, A. J. (1974). *General Viticulture*. Univ of California Press. 633 pp. Berkeley.