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EFFECTS OF CANE-GIRDLING AND CLUSTER AND BERRY THINNING ON BERRY ORGANIC ACIDS OF FOUR *Vitis vinifera* L. TABLE GRAPE CULTIVARS

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Abstract. The response of berry organic acids of four organically grown table grape cultivars to cane-girdling and cluster-berry thinning treatments were evaluated over two growing seasons. In addition pH, titratable acidity, soluble solids content and maturity index were also determined. Statistical analyses showed that individual organic acid content of the four grape cultivars were significantly affected by the treatments. Tartaric and malic acids of 'Red Globe' were mostly influenced by the cluster-berry thinning treatment. 'Alphonse Lavalleé' accumulated the highest tartaric acid and malic acid in both the girdled/thinned and the cluster-berry thinned vines, respectively. The control and girdled 'Trakya Ilkeren' vines had the most tartaric acid. Control vines also contained high malic acid amount. 'Buca Razakısı', on the other hand, had the most prominent tartaric and malic acid levels in the girdled/thinned and thinned vines, respectively. Quality parameters also showed significant differences among the cultivars in response to the treatments.

Key words: grapevine, high-performance liquid chromatography, cultural practice, quality chacteristics, phytochemical chacteristics

INTRODUCTION

Biological properties and quality of food is under the influence of agricultural practices and these should be better understood for marketing strategies and decision making in organic farming [Corrales et al. 2010]. Fruit quality is the co-occurrence of physical and chemical characteristics that result in good appearance and acceptability of the product [Kramer and Twig 1966]. It is also considered a human concept that includes sensory properties (appearance, texture, taste, and aroma), nutritional properties, chemi-

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cal compounds, mechanical and functional properties [Abbott 1999]. Grape organoleptic quality largely depends on both the content and composition of sugars and acids [Liu et al. 2007]. The content of organic acids in fruit juices influences their flavor, stability, nutrition, acceptability, and storage quality [Shui and Leong 2002]. In grape juice, tartaric and malic acids are the predominant organic acids and fumaric, succinic and citric acids are present in minor proportion with flavor enhancing characteristics [Mato et al. 2005].

'Red Globe and Alphonse Lavallée' are table grape cultivars widely grown and preferred by consumers in the world. 'Trakya Ilkeren' is a very early maturing variety that is a hybrid of 'Alphonse Lavallée and Perlette' obtained in Turkey, with blue-black clusters and round, large berries with seeds. 'Buca Razakısı' is a seeded white variety that has winged conical clusters and large berries. All the cultivars except for the 'Trakya Ilkeren' ripen in mid to late-season in Turkey.

Table grape production relies upon numerous viticultural practices to ensure good yield and superior quality. A common practice to improve berry quality is cluster or berry thinning that affects sugar content, pH, total acidity, flavor formation, and color during ripening [Ough and Nagaoka 1984, Ezzahouani and Williams 2003]. Girdling is another treatment which involves removal of a strip of phloem from either stem or cane [Winkler et al. 1974]. It improves set, increases berry size, advances ripening and improves coloring [Cirami et al. 1992].

Organic acid contents, mainly tartaric and malic acid have been extensively studied especially in wine grapes and wine [Kordis-Krapez et al. 2001, Perez-Ruiz et al. 2004, Mato et al. 2005, Conde et al. 2007], however there are rare studies in table grapes. From this perspective, the aim of our study is to evaluate influence of cane girdling and removal of entire clusters or portions of individual clusters on the individual organic acids in the berries of organically grown table grape cultivars,

MATERIALS AND METHODS

Plant material. *Vitis vinifera* L. table grape cultivars 'Alphonse Lavalleé, Red Globe, Trakya İlkeren and Buca Razakısı' were grown organically at the Application Vineyard of Department of Horticulture, Ege University, İzmir, Turkey. The vines were grafted in 2005 onto 41 B (Chasselas × *V. berlandieri* 41B Millardet Et de Grasset) rootstock planted in 2003 with 2.5 × 2 m row spaces and trained to a double guyot. Fruiting canes of the Red Globe vines were pruned to have 9–12 buds while the others contained 5 to 7 buds. The first harvest took place three years later.

Field treatments. The treatments were imposed over two growing seasons. Cluster-berry thinning (CBT) was performed at veraison. 'Red Globe and Trakya Ilkeren' were thinned to 25 clusters per vine, while 20 clusters were retained on the other two cultivars. Clusters left on the vine were thinned to weigh approximately 500 g. Cane girdling (CG) was performed at veraison on the fruiting canes just below the first cluster from the bottom. A 2 cm-wide ring of bark was completely removed with a double-bladed knife. Control vines of each cultivar for each treatment were left untouched. Every treatment consisted of three replicates of four vines. When the clusters on the control vines reached to about 16 °Bx, harvest was done and further analyses were carried out.

Organic acid analyses. Three samples were analyzed in duplicate for each treatment. The soluble solid content of juices was determined as Brix using a handheld temperature-compensated refractometer (Atago Pal-1, Japan). The pH of berry juices was determined with a pH meter (Mettler Toledo MP220, Zurich, Switzerland) and the titratable acidity (TA) by titrating 10 mL juice with 0.1 N NaOH to pH 8.1 and was expressed as g tartaric acid/L.

Sample preparation for high-performance liquid chromatography (HPLC). Extraction of organic acids was performed according to the modified method of Bevilacqua and Califano [1989]. One hundred g of berries were crushed with a Heidolph Silent Crusher M (Germany). Seven gram of samples which contain skin, pulp and seed of berries were homogenized with a homogenizator (A-10 Analytical Mill, Tekmar Ohio, USA) after addition of 50 mL 0.009 N H_2SO_4. Samples were mixed in a shaker (Heidolph Unimax 1010, Germany) for one hour and centrifuged (Hettich Zentrifugen Universal 32 R, Germany) at 7000 g for 5 min. Supernatant was passed once through a filter and twice through a 0.45 µm membrane filter (Millipore Millex-HV Hydrophilic PVDF, Millipore, USA).

The standard solutions were prepared individually in different concentrations with double distilled water. Organic acids (citric, l-tartaric, l-malic, succinic and fumaric) were obtained from Sigma (St. Louis, MO, USA).

HPLC conditions. Organic acids were analyzed on a HPLC (Agilent HPLC 1100 series G 1322 A, Germany) in accordance with the method of Bevilacqua and Califano [1989]. Aminex HPX – 87 H, 300 mm × 7.8 mm column (Bio-Rad Laboratories, Richmond, CA, USA) was used and the system was controlled with Agilent package program. Photodiode array detector was set to 214 and 280 nm wavelength. As a mobile phase, 0.009 N H_2SO_4 was passed through 0.45 µm membrane filter at a flow rate of 1 mL min^{-1}. Organic acid amounts were determined using peak areas with external standards and expressed as mg g^{-1}.

Statistical analysis. The data obtained over two growing seasons was analyzed for each year. After determination of non-significant differences between years, data was pooled over the years and statistical analysis was carried out. Descriptive statistics for the variables (characteristics) were presented as mean and standard error. One-way ANOVA was used to compare treatment means for each variable. Duncan's multiple comparison test was used to determine if differences existed among treatments. Statistical significance level considered was 5%. All data was analyzed using SPSS (SPSS Inc., IL., USA, ver. 13).

RESULTS AND DISCUSSION

Organic acid contents of the organically grown grapevines that received different treatments involving cane girdling and cluster-berry thinning manipulations were presented in Table 1. Likewise pH, titratable acidity, soluble solid contents and maturity index of the harvested grapes were given in Table 2.

Table 1. Descriptive statistics and comparison results for organic acids of organically grown *Vitis vinifera* L. table grape cultivars exposed to different cultural practices

Org. acids mg g^{-1}	Applications	Cultivar			
		Red Globe mean ± SEM	Alphonse L. mean ± SEM	Trakya İlkeren mean ± SEM	Buca Razakısı mean ± SEM
Tartaric	control	3.61 ± 0.003 b A	3.53 ± 0.025 d A	4.98 ± 0.004 a A	4.20 ± 0.001 b A
	cane girdling	3.37 ± 0.000 c A	3.75 ± 0.001 b A	4.98 ± 0.000 a A	4.04 ± 0.004 c A
	cluster-berry rem.	4.72 ± 0.004 a A	3.60 ± 0.001 c A	3.13 ± 0.003 c A	4.28 ± 0.002 a A
	cane girdling/ cluster-berry rem.	2.21 ± 0.000 d A	3.84 ± 0.005 a A	3.27 ± 0.005 b A	3.91 ± 0.000 d A
Malic	control	0.57 ± 0.005 d B	1.74 ± 0.015 c A	1.37 ± 0.210 a A	1.40 ± 0.003 d A
	cane girdling	1.47 ± 0.000 b A	1.83 ± 0.001 b A	0.62 ± 0.004 b B	1.53 ± 0.001 c A
	cluster-berry rem	1.91 ± 0.007 a A	1.91 ± 0.010 a A	0.83 ± 0.044 b B	1.51 ± 0.000 c A
	cane girdling/ cluster-berry rem.	1.11 ± 0.000 c C	1.72 ± 0.005 c B	1.04 ± 0.002 ab C	2.02 ± 0.002 a A
Citric	control	0.09 ± 0.070 a A	0.02 ± 0.001 c A	0.06 ± 0.001 a A	0.03 ± 0.001 b A
	cane girdling	0.06 ± 0.001 a A	0.04 ± 0.005 b A	0.09 ± 0.004 a A	0.02 ± 0.003 a A
	cluster-berry rem	0.03 ± 0.000 a A	0.05 ± 0.005 b A	0.03 ± 0.000 a A	0.02 ± 0.002 b A
	cane girdling/ cluster-berry rem.	0.04 ± 0.000 a A	0.06 ± 0.001 a A	0.17 ± 0.145 a A	0.02 ± 0.000 b A
Succinic	control	0.22 ± 0.002 c B	0.66 ± 0.000 a A	0.19 ± 0.000 d B	0.64 ± 0.015 b A
	cane girdling	0.17 ± 0.000 d BC	0.52 ± 0.003 c B	0.28 ± 0.000 c BC	0.81 ± 0.002 a A
	cluster-berry rem.	0.25 ± 0.002 b B	0.29 ± 0.000 d B	0.44 ± 0.000 b AB	0.65 ± 0.000 b A
	cane girdling/ cluster-berry rem.	0.43 ± 0.002 a B	0.55 ± 0.005 b B	0.82 ± 0.005 a A	0.83 ± 0.025 a A
Fumaric	control	0.40 ± 0.000 a A	0.08 ± 0.003 c B	0.17 ± 0.001 b B	0.44 ± 0.000 a A
	cane girdling	0.22 ± 0.002 c B	0.15 ± 0.005 a C	0.19 ± 0.010 ab BC	0.41 ± 0.000 b A
	cluster-berry rem	0.22 ± 0.002 c A	0.10 ± 0.001 b B	0.21 ± 0.005 a A	0.27 ± 0.001 d A
	cane girdling/ cluster-berry rem.	0.32 ± 0.002 b A	0.16 ± 0.005 a B	0.14 ± 0.005 c B	0.35 ± 0.003 c A

↓ a, b, c – in the same column, different lower cases represent statistically significant differences for the *treatments'* means ($p < 0.05$)
→ A, B, C – in the same row, different upper cases represent statistically significant differences for the *cultivars'* means ($p < 0.05$)
SEM – Standard Error of Mean

Table 2. Descriptive statistics and comparison results for quality traits of organically grown *Vitis vinifera* L. table grape cultivars exposed to different cultural practices

	Applications	Red Globemean ±SEM	Alphonse L. mean ±SEM	Trakya Ilkeren mean ±SEM	Buca Razakısı mean ±SEM
pH	control	3.81 ± 0.127 a A	4.02 ± 0.009 b A	3.91 ± 0.032 a A	3.59 ± 0.198 a A
	cane girdling	3.65 ± 0.323 a A	4.13 ± .009 a A	3.95 ± 0.009 a A	3.89 ± 0.058 a A
	cluster-berry rem.	3.90 ± 0.075 a A	4.10 ± 0.003 a A	3.91 ± 0.019 a A	3.82 ± 0.015 a A
	cane girdling/ cluster-berry rem.	3.84 ± 0.047 a A	4.08 ± 0.042 ab A	3.94 ± 0.040 a A	3.78 ± 0.050 a A
TA ($g\ L^{-1}$)	control	2.34 ± 0.015 c D	2.62 ± 0.060 b B	3.10 ± 0.058 ab A	2.87 ± 0.060 C
	cane girdling	2t.71 ± 0.021 b BC	2.57 ± 0.033 b C	3.17 ± 0.163 a A	2.90 ± 0.009 AB
	cluster-berry rem.	2.91 ± 0.015 a A	2.70 ± 0.058 ab B	2.79 ± 0.021 c B	2.74 ± 0.156 B
	cane girdling/ cluster-berry rem.	2.25 ± 0.029 d B	2.78 ± 0.012 a A	2.85 ± 0.078b c A	2.79 ± 0.055 A
SSC (%)	control	16.54 ± 0.119 d B	15.67 ± 0.124 b B	18.30 ± 0.048 b A	17.93 ± 0.549 A
	cane girdling	17.37 ± 0.070 b C	16.45 ± 0.064 a D	19.08 ± 0.083 a A	18.58 ± 0.295 B
	cluster-berry rem.	19.76 ± 0.069 a A	15.70 ± 0.158 b D	17.49 ± 0.092 c C	18.20 ± 0.203 B
	cane girdling/ cluster-berry rem.	17.07 ± 0.070 c B	15.81 ± 0.102 b C	18.43 ± 0.109 b A	18.75 ± 0.048 A
Maturity index **(SSC/T (A%)	control	70.68 ± 0.89 b A	59.92 ± 0.96 b B	59.06 ± 0.88 B	62.69 ± 3.24 B
	cane girdling	64.11 ± 0.64 d A	64.11 ± 0.88 a A	60.45 ± 3.08 A	64.00 ± 1.03 A
	cluster-berry rem.	67.92 ± 0.21 c A	58.23 ± 1.70 b B	62.71 ± 0.80 AB	66.88 ± 4.68 A
	cane girdling/ cluster-berry rem.	75.89 ± 0.72 a A	56.87 ± 0.55 b C	64.80 ± 1.51 B	67.24 ± 1.31 B

↓ a, b, c – in the same column, different lower cases represent statistically significant differences for the *treatments*' means ($p < 0.05$)
→ A, B, C – in the same row, different upper cases represent statistically significant differences for the *cultivars*' means ($p < 0.05$)
SEM – Standard Error of Mean

Red Globe. Tartaric acid was significantly different among the treatments. Highest level was obtained from the CBT treatments (4.72 mg g^{-1}) followed by the control, CG, and CG/CBT. Similarly, malic acid content showed statistically significant differences among the groups. Control vines in this condition had the lowest level of malic acid (0.57 mg g^{-1}). Succinic acid in the 'Red Globe' was most prominent in CG/CBT treated vines, while fumaric acid was the highest in the control vines. CBT increased titratable acidity (TA) and soluble solid content (SSC) more considerably than the other treatments. TA and SSC were lowest in the CG/CBT and control vines, respectively. Maturity index of 'Red Globe' berries were most influenced by the CG/CBT treatment. It was lower in the CG and CBT treatments compared to the control group. However, citric acid did not show any significant differences among the treatments. Likewise pH of the juice was not influenced by any of the treatments.

Alphonse Lavalleé. All the treatments resulted in significant differences in terms of organic acid contents in this cultivar. Tartaric acid was most increased in the CG/CBT treated vines followed by CG, CBT, and the control vines, respectively. Malic acid was the highest in CBT vines. CG/CBT vines had the same level of malic acid with the control vines. This group of vines also had the highest level of citric acid, and the control vines had the lowest. Highest contents of succinic and fumaric acid were obtained in the control and in the CG and CG/CBT vines, respectively.

pH in the juice was in similar levels in all the treatments, however, it was always higher in the vines that were either girdled or manipulated at cluster level. Vines exposed to CG/CBT and CBT had comparably elevated TA in the berries. SSC was not affected by the CBT, CG/CBT or control treatments. Cane girdling resulted in sweeter berries. Only cane girdled vines had higher maturity index than the other treatments.

Trakya Ilkeren. Control and the CG vines had the most prominent tartaric acid levels. Lowest tartaric acid was obtained from the CBT vines. Malic acid was not different from each other in the treatments to the extent of tartaric acid. It was 1.37 and 1.04 mg g^{-1} in the control and in the CG/CBT vines, respectively. There were no statistically significant differences in the citric acid levels with the treatments. Control vines had the lowest succinic acid, while the vines that were both girdled and cluster manipulated had the highest level. The vines that received either cane girdling or cluster manipulation showed similar level of fumaric acid. When the vines got both treatments at the same time, it reached a minimum.

pH was not affected by the treatments. Girdled vines had higher TA along with the control vines. CBT and CG/CBT vines showed considerably low TA. Girdling of the fruit canes resulted in the sweetest berries, while the control and CG/CBT vines had similar SSC levels. Maturity index was unaffected by the treatments.

Buca Razakısı. Highest levels of organic acids varied according to the treatments. CG/CBT and CBT resulted in the highest tartaric acid (4.28 mg g^{-1}) and malic acid (2.02 mg g^{-1}) levels, respectively. CG vines had the most citric acid (0.02 mg g^{-1}), while the other treatments were in similar levels. Cane girdled vines with or without cluster manipulation provided the most prominent succinic acid levels, (0.83 and 0.81 mg g^{-1}, respectively). Fumaric acid on the other hand was at the highest level in the control vines.

Juice pH was not greatly influenced. All the treatments had berries with similar pH levels. TA was highest in CG/CBT vines, within the same group with CBT. On the other hand, control and CG vines had similar titratable acidity. Treatments other than CG resulted in lower SSC. Treatments had no effect on the maturity index.

Differences between among the cultivars. Significant variations among the cultivars were observed in the malic, citric, succinic and fumaric acids. 'Red Globe' berries had the lowest malic acid content in the control and CG/CBT vines. All the cultivars except for 'Trakya Ilkeren' contained more malic acid in the girdled vines with or without berry thinning. Succinic and fumaric levels stayed at the highest level in the 'Buca Razakısı' berries independent of the treatments. The difference between the control group and the treatments were not distinctive in the other cultivars.

Treatments did not influence pH level of the cultivars. The differences in the TA were greatest at the control groups of the cultivars. 'Red Globe' berries had the highest and lowest TA in the CG and CG/CBT treatments, respectively. The effects of the same treatments on the other cultivars were indistinguishable. 'Trakya Ilkeren and Buca Razakısı' vines contained greater soluble solids in their berries in the control, CG and CG/CBT groups. Maturity index did not change in the girdled cultivars, while it was the highest in the 'Red Globe' control and CG/CBT vines.

Organic acids are important constituents of grape-derived products (must, wine, brandy, or vinegar). They are not quantitatively significant because they occur in small concentrations only; it is instead their substantial effect on such important properties as the products` organoleptic characteristics (color, aroma, flavor, and taste) and their stability, or the control of microbiological quality [López-Tamames et al. 1996] that makes their quantitative determination very important.

Organic acids of the grape cultivars were found to be under the influence of both cane girdling and cluster-berry removal treatments. Effects of these cultural practices showed cultivar differences. For instance, cluster/berry removal resulted in high tartaric acid levels in the 'Red Globe and Buca Razakısı', while it was the combination of girdling and thinning that caused 'Alphonse L.' to have the highest tartaric acid in the berries. Girdling seemed to have a more direct effect on increasing it in the early ripening cultivar, 'Trakya Ilkeren'. Malic acid content also showed differences in the cultivars and by the treatments. 'Red Globe and Alphonse L.' had the most prominent levels of malic acid when their vines were exposed to thinning, while the combination of both treatments had the same effect on the 'Trakya Ilkeren and Buca Razakısı' vines. In the literature, studies regarding to the effects of cultural practices on berry organic acid composition of organically grown grapes are very limited. Studies generally were carried out in the conventionally cultivated grapes. Park et al. [2009] reported that girdled 'Campbell Early' vines had organic acids that decreased more rapidly as compared to the control vines. López-Tamames et al. [1996] found that citric, malic and galacturonic acids were influenced by the climate. Sabır et al. [2010] reported that in the grape cultivars, malic acid content of the fruit at the ripe stage was significantly lower than tartaric acid content. Da Mota et al. [2010] reported that in 'Cabernet Sauvignon' tartaric, citric and malic acids were not affected by cluster thinning in the no-shoot trimmed vines. Malic acid was lower in quantity in comparison to tartaric acid, which is the result of being used as an energy source during the ripening stage [Kliewer 1966, Conde et al. 2007, Melino et al. 2009]. This research also confirms that malic and tartaric acids account for the biggest part of total acidity in berries [Lamikanra et al. 1995, Esteban et al. 1999, Conde et al. 2007, Sweetman et al. 2009].

The responses of the cultivars to the treatments in terms of the citric, succinic and fumaric acid indicated significant differences. Citric acid levels in the 'Red Globe and Trakya Ilkeren' were unaffected by the treatments. Citric acid is important in that it contributes to the acidity of must [Mato et al. 2005] and is accumulated at low concentrations [Mullins et al. 1992]. The range of organic acids, mainly tartaric and malic acids greatly differed from one cultivar to another. For instance, the extent of organic acid change in ‘Red Globe’ was wider compared to the ‘Alphonse L.’ Similar situation was observed between ‘Trakya Ilkeren and Buca Razakısı’.

Effect of crop load levels on fruit quality when girdling was applied was reported to be greater [Yamane and Shibayama 2006]. Quality parameters such as pH, titratable acidity, and soluble solids contents demonstrated varying responses to the girdling and/or thinning. Thinning and girdling resulted in ‘Alphonse L.’ the highest tartaric acid and titratable acidity, and moderate malic acids and soluble solids contents. They caused low tartaric acids, moderate malic acid and titratable acidity and soluble solids in the ‘Red Globe’ vines. These results were found consistent with the findings of Bravdo et al. [1985], Reynolds [1989], and Wolpert et al. [1983] who studied the effect of crop loading. Titratable acidity and SSC of ‘Red Globe’ berries were more under the effect of cluster/berry thinning. ‘Alphonse L.’, on the other hand, had more concentrated soluble solids when exposed to cane girdling only. Its titratable acidity was similar in the thinned and girdled vines. Dokoozlian et al. [1995] found that girdled ‘Crimson Seedless’ had lower SSC when girdled at fruit set or berry softening. Halbrooks and Mortensen [1987] reported lower SSC in the cane-girdled ‘Orland Seedless’ vines. Girdling and berry thinning resulted in no change in the soluble solids in ‘Yaghooti’ [Tafazoli 1977] and a decrease in ‘Himrod’ [Zabadal 1992]. On the other hand, Ahmad et al. 2005 showed increased Brix, titratable acidity and brix to acidity ratio values with the girdling. Dokoozlian and Hirschfelt [1995] found that cluster-thinned vines of ‘Flame Seedless’ had higher fruit soluble solids. Guidoni et al. [2002] reported higher soluble solids with cluster thinning in ‘Nebbiolo’ grapes. °Brix values were higher in cluster thinned vines of ‘Aki Queen’ [Yamane and Shibayama 2006], in ‘Cabernet Sauvignon’ [Bravdo et al. 1985], and in ‘Chardonnay’ [Reynolds et al. 2007]. Titratable acidity was found lower in the cluster thinned vines of ‘Riesling’ [Reynolds 1989], Chardonnay [Reynolds et al. 2007], and Vidal Blanc [Wolpert et al. 1983] and higher in ‘Cabernet Sauvignon’ [Bravdo et al. 1985] and unchanged in ‘Aki Queen’ [Yamane and Shibayama 2006] vines.

Great differences between conventional and organic farming have been reported to have affects on nutrient composition of plants [Worthington 2001, Mitchell et al. 2007]. Apart from the cultivar differences, cultural practices employed in organic production, mainly soil fertility management, create variances in the berry composition of grapes. Organic acids such as malic and citric acids in grape must were found to be in a correlation with temperature, rain and atmospheric pressure [López-Tamames et al. 1996]. Cane girdling, a treatment that causes photosynthates to allocate in the clusters above the girdling site led to different reactions in the accumulation of the individual organic acids depending on the cultivars.

CONCLUSION

According to the results obtained from this present study, it can be concluded that cultural practices such as cane-girdling and cluster and berry thinning were able to change organic acids in table grape cv. in Turkey. Especially, significant increases in tartaric, malic and succinic acids and a significant reduction of fumaric acid have been observed. Similarly, it can also be concluded that cane-girdling and cluster and berry thinning can be reasonable for sustainable viticulture practices in terms of organic products. However, it should be noted that more detailed studies need to be undertaken in the future.

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WPŁYW OBRĄCZKOWANIA ORAZ PRZYCINANIA GRON NA ZAWARTOŚĆ KWASÓW ORGANICZNYCH W JAGODACH CZTERECH ODMIAN WIONOGRON *Vitis vinifera* L. PRZEZNACZONYCH DO BEZPOŚREDNIEGO SPOŻYCIA

Streszczenie. Oceniono reakcję zawartości kwasów organicznych w czterech odmianach winogron przeznaczonych do bezpośredniego spożycia na zabiegi obrączkowania i przycinania w okresie dwóch okresów wegetacyjnych. Poza tym określono pH, kwasowość miareczkowaną, zawartość substancji rozpuszczalnych sałych oraz indeks dojrzałości. Analizy statystyczne pokazały, że na indywidualną zawartość kwasów organicznych czterech odmian wymienione zabiegi wpływały istotnie . Zabieg przycinania gron najbardziej wpłynął na zawartość kwasu winowego i kwasu jabłkowego odmiany 'Red Globe'. Odmiana 'Alphonse Lavalleé' gromadziła najwięcej kwasu winowego i kwasu jabłkowego odpowiednio w winoroślach opaskowanych/przycinanych i w winoroślach z przycinanymi gronami. Winorośle 'Trakya Ilkeren' kontrolne i przycinane miały największą zawartość kwasu winowego. Winorośle kontrolne również zawierały dużą ilość kwasu octowego. Natomiast odmiana 'Buca Razakısı' miała najbardziej wyróżniającą się zawartość kwasu winowego i octowego odpowienio w opaskowanych/przycinanych oraz przycinanych winoroślach. Paramentry jakościowe także wykazywały istotne różnice między odmianami w reakcji na zabiegi.

Słowa kluczowe: winorośl, wysokosprawna chromatografia cieczowa, praktyka hodowlana, cechy jakościowe, cechy fitochemiczne

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