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ORIGINAL PAPER

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IDENTIFICATION OF PHENOLOGICAL PERIODS AND YIELD, QUALITY AND VEGETATIVE CHARACTERISTICS OF SOME WINE GRAPES GROWN IN THE EASTERN MEDITERRANEAN REGION OF TURKEY

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ABSTRACT

It is possible to talk about the wine culture, from past to present, in the historical texture in the Eastern Mediterranean region of Turkey. This study was carried out in Belen district of Hatay province located in the Eastern Mediterranean region. Wine grape cultivars 'Syrah', 'Merlot', 'Sangiovese', 'Cabernet Sauvignon' and 'Sauvignon Blanc' were researched for 2 years (2016 and 2017) in terms of phenological characteristics, effective heat summation (EHS) requests and maturity time, some quality characteristics and grapevine yield and vegetative growth. Under the conditions of the study, bud break of cultivars took place at the end of March, blooming in late April-early May, and maturity in late July–early August. Bud break-maturity period EHS requests of cultivars ranged from 1540.9 to 1999.2 d.d. (day.degree). Cultivars reached the optimum total soluble solids (TSS) values under the regional conditions, while the total acidity (TA) content was low in cultivar 'Sauvignon Blanc'. In color cultivars, maturity index were found to be in the range of the optimum values. Berry weight values of the cultivars ranged from 1.06 g ('Cabernet Sauvignon') to 2.15 g ('Sangiovese'). Ravaz index values were low due to high vegetative growth. It was foreseen that this situation could be put under control via summer pruning. It was concluded that wine grape could be grown at sufficient quality and yield level with cultivars 'Sangiovese', 'Merlot', 'Cabernet Sauvignon' and 'Syrah' under the conditions of Belen where the study was conducted.

Key words: wine grape, phenology, vegetative growth, yield, quality

INTRODUCTION

With its different regions, Turkey has extremely favorable ecological areas for quality wine grape cultivation. However, in terms of evaluation methods in the country, it is seen that grape cultivation amount ranks as table, raisin and wine grape at a decreasing rate. Having an important position related to vineyards and grape production in Turkey, the Mediterranean region is at a low level in terms of wine grape cultivation and wine production. Fievez et al. [2004] informed that wine industry plays a smaller role in the regions close to the Mediterranean coast. Lavee [2000] informed that until a few years ago, table wines produced from grapes grown in hot regions were of very low quality, that a significant amount of residual sugar was detected in the majority of wines obtained from these regions in the past, and that phenolics and especially volatile aromatic compounds in ripe grape juice obtained from hot regions were low compared to those obtained from cold regions. In addition to this, it was informed that although grapes mature more rapidly in high temperature conditions, anthocyanin accumulation, and in most cases, fruit color were not found sufficient for the industry of quality red wine. Nevertheless, the researcher informed that the quality of the

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wines obtained from the vineyards in hot climates has significantly improved with the help of other advanced winemaking technologies as well as modern temperature-controlled fermentation applications, and that grapes with sufficient anthocyanin accumulation suitable for quality red wine production could be cultivated in case of use of appropriate cultivars such as 'Cabernet Sauvignon' and 'Merlot', by effectively balancing the grapevine capacity and fruit load [Lavee 2000].

In wine grape cultivation, quality depends on many factors. According to the results of different researchers; grape cultivar, cultivation area and practices affect the relationship between yield/wine quality. In addition, it is reported that the wines to be produced from the same grape cultivar grown in one region or on different slopes of a region will be different from each other, too. The important thing is to research the balance between the product amount to be obtained from any unit area and the wine quality to be achieved, for each cultivar and region [Bekar 2016].

It is possible to talk about the wine culture, from past to present, as a result of the fact that the mosaic structure depending on the difference of faith contains socio-cultural wealth in the historical texture in Hatay province located the Eastern Mediterranean region. Indeed, Fievez et al. [2004] reported that Hatay is one of the countries of Turkey, where wine production is carried out. Considering the tourism potential of the region as well, it is important to determine the performances of some wine grape cultivars in the regional ecology, in the future production as a high added value agricultural and industrial branch. No scientific study has been encountered in the region in this respect.

In this study, it is aimed to examine the vine development, yield, quality and phenological properties of the wine grape cultivars 'Syrah', 'Merlot', 'Sangiovese', 'Cabernet Sauvignon' and 'Sauvignon Blanc' under the conditions of Belen district of Hatay province located in the Eastern Mediterranean region.

MATERIALS AND METHODS

The research was conducted in 2016 and 2017 in the Eastern Mediterranean region, in the Department of Horticulture, Faculty of Agriculture, Hatay Mustafa Kemal University. The study was conducted in the area belonging to a corporate vine and wine enterprise located in Belen district of Hatay province at 36°25'6" N latitudes, 36°15'9" E longitudes and at an altitude of around 107 m. In terms of the study area climate parameters; it was determined that the annual average temperatures in 2016 and 2017 were 18.8°C and 18.7°C, the coldest month is 6.4°C and 6.7°C, the warmest month is 29.4°C and 30.1°C, the average temperature in the summer period is 24.6°C and 24.8°C, annual sunshine duration is 1660,7 h, the annual precipitation is 478.6–446.2 mm [www.mgm.gov.tr]. EHS was measured 3306–3245 d.d. for two years. The results of physical and chemical analysis of soil samples taken from different depths in the research area were evaluated according to the limit values determined by Alpaslan et al. [1998]. At 0–30 cm depth, the soil was found to be loamy, nonsaline, alkali, moderately limey, with sufficient amounts of useful phosphorus and potassium, with an excessive total amount of calcium and magnesium, poor in organic material; at 30–60 cm depth, it was found to be clay-loamy, nonsaline, alkali, moderately limey, with sufficient amount of useful phosphorus, with an excessive total amount of calcium and magnesium, poor in organic material.

In this study, the wine grape cultivars 'Syrah', 'Merlot', 'Sangiovese', 'Cabernet Sauvignon', 'Sauvignon Blanc' grafted with 41 B rootstock were used. The planting distance of the grapevines is 2 × 1 m, and the form of cultivation is single-cane guyot. 9 ±2 pieces of buds were left on grapevines. In the trial, the EHS requests of the cultivars used as datalogger were calculated [Çelik et al. 1998]. In phenological observations, the bud break, blooming, fruit set, veraison and maturity times of cultivars were determined [Ağaoglu 2002, OIV 2009]. In each replication in the maturity time, cluster weight (g), cluster width and length (cm) and by overflowing method cluster volume (mL) were measured in 10 clusters. The average number of berry in a cluster was determined by counting the berries on clusters. Yet in each replication, weight (g) and volume (mL) were measured in a total of 100 berries.

Width and length (mm) of 20 berries were measured by using a caliper, having 2 berries from 1/3 middle part of each cluster. In the juice sample obtained by squeezing 100 berry, TSS (%), total acidity (%) and pH measurements were conducted, and maturity index were calculated. According to Rizk-Alla et al. [2011], on 5 grapevines and in 2 summer shoots on each grapevine in the veraison time within the vegetation period, the leaf size (cm^2/piece), leaf area (m^2/vine), shoot length (cm), shoot diameter (mm), number of nodes and weight of pruning weight (g/vine) were determined. Grape yield was calculated as g/vine by way of the cluster number/vine × average cluster weight (g) [Rizk-Alla et al. 2011]. In addition, Ravaz index was calculated by using yield/pruning weight values [Kurtural et al. 2013]. Trial was arranged in five replications, with each replication having five vines. The data obtained was subjected to variance analysis in compliance with Randomized Blocks Trial design, and the differences between the averages were determined at 5% significance level according to Tukey test.

RESULTS AND DISCUSSION

The bud break–maturity period EHS requests for the cultivars included in the study were given in Table 1 by years. In the study, the bud break–maturity period EHS requests of the cultivars were found to be statistically significant. EHS of cultivars was found to be the highest in Sangiovese in the first year, while it was in 'Cabernet Sauvignon' in the second year. The lowest value was detected in 'Sauvignon Blanc' in both two years. In a study on wine cultivars, EHS values were calculated to range from 1721.3 to 1876.4 d.d. for the bud break–maturity period [Kök and Çelik 2003]. Çelik et al. [2005] found EHS values in white wine cultivars ranging from 1485 to 1821 d.d.; and in red wine cultivars from 1496 to 1835 d.d. Cangi et al. [2008] detected the same in 'Merlot' as 1633.9–1757.7 d.d., and in 'Cabernet Sauvignon' as 1629.4–1748.4 d.d. Uluocak [2010] set as 1497.9–1681.2 d.d. in 'Syrah' cultivar for the bud break–maturity period. Söğüt and Özdemir [2015] determined as 1944.8–2109.4 d.d. in 'Syrah', as 2003.2–2156.8 d.d. in 'Merlot', and as 1964.2–2059.5 d.d. in 'Cabernet Sauvignon'. It was determined that EHS value range fixed for the bud break–maturity period for all cultivars studied in our study covers EHS values determined by Kök and Çelik [2003] for wine cultivars. EHS values of white and black cultivars specified by Çelik et al. [2005] in their study were in the value ranges indicated in our study for the cultivars 'Sauvignon Blanc' and 'Syrah' and 'Merlot'. EHS values specified by Cangi et al. [2008] for cultivars 'Merlot' and 'Cabernet Sauvignon' were seen to be in the value range-obtained from our study. However, our EHS values for the cultivars 'Syrah', 'Merlot' and 'Cabernet Sauvignon' were found to be lower than those of Söğüt and Özdemir [2015].

Phenological periods of cultivars were determined to take place 1 to 2 weeks later in the second year compared to the first year of the study. Ağaoğlu [2002] stated as well that phenological stages could not occur on the same dates every year as they were in a direct relationship with the climate factor. Under the conditions of the study, according to the cultivars, bud break took place on March 18–April 2, blooming on April 24–May 7, fruit set on May 2–May 26, verai-

Table 1. EHS requests in wine grape cultivars (d.d.)

Cultivars	Bud break–Maturity	
	2016	2017
'Syrah'	1647.7 c	1822.7 c
'Merlot'	1555.9 d	1805.2 c
'Sangiovese'	1817.2 a	1950.4 b
'Cabernet Sauvignon'	1773.7 b	1999.2 a
'Sauvignon Blanc'	1540.9 e	1701.1 d
$D_{5\%}$	11.9	17.7

There is statistical difference between the averages indicated by different letters on the same column
$D_{5\%}$ value shows the difference between the means, according to the Tukey multiple comparison test

son on June 22–July 7, maturity on July 13–August 11 (Tab. 2). Generally, with a few days difference between cultivars according to the years; bud break, blooming, fruit set, and veraison occurred earlier in 'Sangiovese', and maturity in 'Sauvignon Blanc'. Phenological periods took place in cultivar 'Cabernet Sauvignon' at the latest historically. In their study, Tangolar et al. [2002 and 2005] stated that the bud break times of the same cultivars could differ in different years. Researchers reported that in the ecology of Pozantı district of Adana province, bud break occurred on April 17–May 2 in cultivar 'Syrah', and on April 19–May 4 in cultivar 'Cabernet Sauvignon'. Blooming in the same cultivars took place in June, maturity in late August and early September. Çelik et al. [2005] determined that in cultivars 'Syrah', 'Merlot' and 'Cabernet Sauvignon' blooming occurred on June 5–10, fruit set on June 10–15, veraison on July 21–August 11, maturity on August 28–September 29. Cangi et al. [2009] determined bud break time as April 11–27 in cultivar 'Merlot', and as April 12–29 in 'Cabernet Sauvignon' in the ecology of Tokat province over years. In the same cultivars, blooming occurred on June 6–13, June 5–10, fruit set on June 10–18, June 9–15, veraison on August 4–6, August 7–8, respectively. Maturity period of both cultivars were September 12 in the first year, and as September 14 in the second year. Söğüt and Özdemir [2015] reported that in cultivars 'Syrah', 'Merlot' and 'Cabernet Sauvignon' bud break occurred on April 10–20, blooming on June 1–05, veraison on August 2–8, and maturity on August 23–28 under the conditions of Diyarbakır province. In Tekirdağ, in cultivar 'Sangiovese', bud break date was determined to be April 5, blooming date as May 18, veraison date as July 15 [Bahar et al. 2017]. According to the above literature; in the ecology of our study, it was observed that bud break in cultivars occurred on a significant early date (1 week to one month). Blooming, fruit set and veraison in the cultivars occurred one month earlier as well. The latitude degree and height (altitude) were effective in the formation of the phenological stages [Ağaoğlu 2002]. As the average temperature values in the spring in the ecology of our study were higher, these periods occurred earlier. Similarly, grapes could mature at different times under the influence of different climatic factors [Winkler et al. 1974]. The maturity degree of grapes was assessed differently according to the regions. It would be appropriate to harvest grape cultivars grown in the Aegean and Mediterranean regions as the sugar concentration was high due to hot and arid climate of the region. Thus, the acid amount does not decrease and the sugar/acid ratio does not deteriorate [Aktan and Kalkan 2000]. According to the dates determined in previous studies, maturity of the grape cultivars studied under the conditions of Belen district of Hatay province occurred one and a half month earlier on average depending on the hot and arid climate of the region.

Cluster and berry sizes in wine cultivars varied according to cultivars, but they were generally small. Differences in a cultivar depend on cultural processes and ecological conditions. It was informed that the best wines were produced from clusters of 250–300 g and that heavier clusters generally lead to less coloration in the inner berries due to intense congestion and shade [Bucelli et al. 2010]. In terms of cluster weight

Table 2. Phenological periods in wine grape cultivars (day.month)

Cultivars	Bud break		Blooming		Fruit set		Veraison		Maturity	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
'Syrah'	21.03	26.03	28.04	07.05	09.05	18.05	26.06	01.07	18.07	31.07
'Merlot'	24.03	29.03	26.04	02.05	09.05	18.05	26.06	04.07	13.07	31.07
'Sangiovese'	18.03	25.03	24.04	02.05	02.05	13.05	22.06	03.07	26.07	06.08
'C. Sauvignon'	24.03	02.04	28.04	06.05	11.05	26.05	29.06	06.07	25.07	11.08
'S. Blanc'	21.03	24.03	27.04	05.05	05.05	16.05	24.06	07.07	13.07	25.07

and cluster volume, the highest values were achieved by the cultivars 'Sangiovese' and 'Syrah' in the first year of the study, and only by 'Sangiovese' in the second year, while the lowest values were achieved by 'Cabernet Sauvignon' in both years (Tab. 3). According to the literature findings [Köylü et al. 2002, Tangolar 2009, Uluocak 2010, Kamiloğlu and Üstün 2014, Öner 2014, Pehlivan and Uzun 2015], high values were obtained in cultivars 'Syrah' and 'Sauvignon Blanc'. In cultivar 'Cabernet Sauvignon', cluster weight was found to be partially higher than the findings of Tangolar et al. [2002] and Er [2009]; lower than those of Yaşasın [2010] and Bekar [2017]; and similar to those of Köylü et al. [2002] and Öner [2014]. Our finding related to cultivar 'Sangiovese' was higher than that of Bahar et al. [2017], and lower than that of Intrieri et al. [2008]. In both years, the value of berry number in cluster was found to be the lowest in cultivar 'Cabernet Sauvignon' (124.4 and 133.8 pieces, respectively), while this value was over 150 in the cultivars 'Syrah' (215.4), 'Merlot' (210) and 'Sangiovese' (201.8) (Tab. 3). Although there were not many studies on this characteristic in the wine cultivars; Öner [2014] informed that the berry number in cultivar 'Cabernet Sauvignon' was 113.8–136.7. It was seen that these values supported the findings we obtained in our study. Cluster width of cultivars varied according to years. Cluster length was found to be the highest in both years in the cultivars 'Sangiovese', 'Syrah' and 'Merlot', and the lowest in 'Sauvignon Blanc' (Tab. 3).

In general, grape composition varies according to berry size [Barbagallo et al. 2011]. Berry weight in the wine cultivars was a very important parameter for the wine quality to be obtained. As the berry became heavier, the surface area/volume ratio decreased, and grape phenolic content was affected adversely. The optimum value should be less than 1.8. If the extractable phenol level is higher than 1600 mg/kg, the berry weight could be range from 1.8–2.30 g [Bucelli et al. 2010]. 100-berries weight values of the cultivars ranged from 112.5 to 215.3 g. Berry weight and berry volume values were found to be the highest in Sangiovese, and low in the cultivars 'Merlot' and 'Cabernet Sauvignon' (Tab. 4). When the studies were examined, our berry weight findings vary according to cultivars, and they were similar to those of Köylü et al. [2002], Tangolar et al. [2002], Er [2009] and Uluocak [2010].

In the study, 'Sangiovese' provided the highest values in terms of berry width and berry length, while the cultivars 'Merlot' and 'Cabernet Sauvignon' provided the lowest ones. Berry width values obtained for cultivar 'Syrah' were similar to the findings of Tangolar et al. [2005], Er [2009], Kamiloğlu and Üstün [2014]. In addition to this, the values obtained by Köylü et al. [2002] from the cultivars 'Merlot' and 'Cabernet Sauvignon' also supported our study as well. Our findings related to berry length were parallel to those determined by Köylü et al. [2002] in 'Syrah', 'Merlot' and 'Cabernet Sauvignon'; and by Tangolar et al. [2005], Kamiloğlu and Üstün [2014], Pehlivan and Uzun [2015] in 'Syrah'; and by Er [2009] in 'Syrah' and 'Sauvignon Blanc'.

The amount of TSS was one of the important parameters in determining maturity in grape culti-

Table 3. Cluster characteristics in wine grape cultivars

Cultivars	Cluster weight (g)		Cluster width (cm)		Cluster length (cm)		Cluster value (mL)		Berry number in cluster	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
'Syrah'	321.6 a	291.0 b	9.3 ab	9.4 b	16.5 a	20.0 a	289.7 a	279.6 ab	215.4 a	175.9 ab
'Merlot'	171.4 b	303.8 b	7.8 abc	11.7 a	15.9 a	19.8 a	153.4 b	285.6 ab	158.0 ab	210.0 a
'Sangiovese'	354.1 a	446.3 a	10.0 a	12.1 a	16.6 a	18.2 a	341.6 a	389.2 a	177.1 ab	201.8 a
'C. Sauvignon'	140.5 b	127.9 c	6.9 c	8.3 b	13.8 b	15.4 b	126.7 b	116.1 c	124.4 b	133.8 b
'S. Blanc'	176.3 b	191.1 bc	7.2 bc	7.9 b	11.5 c	12.4 c	159.5 b	179.9 bc	132.2 b	152.4 ab
$D_{5\%}$	102.6	128.6	2.3	2.0	1.8	2.4	110.7	112.4	60.7	62.6

Explanations – see Table 1

vars. Optimum values were determined between the range of 19.0–23.0% in white wine cultivars and 20.5–23.5% in red wine cultivars [Rieger 2006]. TSS contents of cultivars were found to between the range of 19.7–21.6% in the first year of the study and 19.4–22.2 in the second year (Tab. 5). According to our results, it was fixed that all other cultivars except 'Syrah' reached TSS values that were required in red and white wine grape cultivars, according to Rieger [2006]. In literature comparisons conducted on the basis of cultivars, values obtained from cultivar 'Syrah' were determined to be parallel to Tangolar et al. [2002, 2005], Erdem et al. [2009]; to the results of Naor et al. [2002], Uzun and Bayır [2008], Yaşasın [2010], Öner [2014] in 'Cabernet Sauvignon'; and to Bucelli et al. [2010], Filippetti et al. [2011] in 'Sangiovese'. TSS content was determined to be lower than the values of Özden and Vardin [2009] and Şan [2016] in cultivar 'Merlot', and lower than those of Şan [2016] in 'Sauvignon Blanc' at the same rate, being 20.0% and 21.7% respectively and somewhat low (Tab. 5). The TA values of cultivar 'Syrah'; were found similar to those of Tangolar et al. [2002, 2005], Özden and Vardin [2009], Er [2009], Kamiloğlu and Üstün [2014]. The acid content in 'Merlot' was higher than the findings of Özden and Vardin [2009] and Şan [2016]. It was seen that acidity values in cultivar 'Sangiovese' supported the results of Poni et al. [2013], Bahar et al. [2017], Bucelli et al. [2010], however, our values were lower compared to those of Filippetti et al. [2011], Poni et al. [2008], Intrieri et al. [2008]. For 'Cabernet Sauvignon', this characteristic was parallel to the findings of Tangolar et al. [2002, 2005], Özden and Vardin [2009], was higher than the findings of Er [2009], Öner [2014] and Şan [2016], and lower than those of Uzun and Bayır [2008] and Yaşasın [2010]. In cultivar 'Sauvignon Blanc', the results of Naor et al. [2002] and Er [2009] supported our observations.

In grape juice, optimum pH was required to 3.1 or 3.2 for the whites and 3.4 for the reds. In case TA was

Table 4. Berry characteristics in wine grape cultivars

Cultivars	100 Berry weight (g)		Berry width (mm)		Berry length (mm)		100 Berry value (mL)	
	2016	2017	2016	2017	2016	2017	2016	2017
'Syrah'	148.6 bc	179.0 b	12.12 bc	12.82 b	13.86 b	14.59 a	137 b	176 a
'Merlot'	112.5 d	136.9 c	11.13 c	12.39 bc	11.06 d	12.40 b	106 c	121 b
'Sangiovese'	215.3 a	214.5 a	13.96 a	13.81 a	15.46 a	15.59 a	201 a	211 a
'C. Sauvignon'	123.3 cd	106.2 d	12.26 b	11.93 c	12.22 c	12.25 b	117 bc	102 b
'S. Blanc'	159.1 b	144.3 c	11.65 bc	13.16 ab	13.00 bc	15.05 a	137 b	136 b
$D_{5\%}$	30.8	21.2	1.05	0.85	1.13	1.01	27	35

Explanations – see Table 1

Table 5. TSS, pH, total acidity and maturity index values in grape wine cultivars

Cultivars	TSS (%)		Total acidity (%)		pH		Maturity index	
	2016	2017	2016	2017	2016	2017	2016	2017
'Syrah'	19.7	19.4 d	0.73 ab	0.59	3.56 ab	3.84	27.2 b	32.7
'Merlot'	20.7	21.5 ab	0.79 a	0.63	3.46 c	3.71	26.5 b	34.6
'Sangiovese'	20.2	20.7 bc	0.59 cd	0.63	3.53 bc	3.78	34.4 a	33.1
'C. Sauvignon'	21.4	22.2 a	0.64 bc	0.63	3.54 bc	3.74	34.0 a	35.1
'S. Blanc'	21.6	20.0 cd	0.53 d	0.61	3.65 a	3.55	40.7 a	32.7
$D_{5\%}$	N.S.	1.0	0.10	N.S.	0.10	N.S.	6.78	N.S.

N.S. – not significant, for other explanations – see Table 1 vignon Blanc'. In cultivar 'Merlot', our pH value was within the range of the values determined in the study of Şan [2016]. Nevertheless, the pH values that we determined in 'Sangiovese' and 'Cabernet Sauvignon' were higher than the findings of Yaşasın [2010] and those of Tangolar et al. [2002], respectively.

The maturity index ratio was a better indicator in determining maturity. If this value was within the range of 30 : 1 and 35 : 1, the wines would be very balanced [Cox 1999, Güven 2008]. In the first year of the study, maturity index of cultivars were found to be higher in 'Sangiovese', 'Cabernet Sauvignon' and 'Sauvignon' than the other two cultivars. However, there was no statistical difference between the cultivars in the second year, and the values ranged from 32.7 to 35.1 (Tab. 5). Our findings related to maturity index of cultivars were similar to those of Tangolar et al. [2002] in 'Syrah'. However, in general, the values we obtained from cultivars were seen to be higher than the literature findings [Tangolar et al. 2005, Cangi et al. 2009, Erdem et al. 2009], while these values in the second year of our study were seen to be within the optimum ranges specified by Cox [1999] and Güven [2008].

In terms of leaf size, the values obtained from 'Syrah' and 'Merlot' were seen to be greater than the other cultivars in both two years (Tab. 6). Smart et al. [1985] determined leaf size in cultivar 'Syrah' as 101–113 cm^2, Yaşasın [2010] as 150.96–153.12 cm^2 in 'Cabernet Sauvignon'. For leaf area (m^2/vine), the data followed the same pattern of behavior (Tab. 6).

It was seen that the leaf area per grapevine was larger for all cultivars in the second year. The results of the literature [Naor et al. 2002, Kurtural et al. 2012, 2013] examined have higher values than our findings. This case was understood to be related to width of planting distances in the related studies.

According to the shoot length measurements made in veraison periods; shoot growth of cultivars increased in the second year (187.0–251.8 cm) compared to the first year (122.5–196.5 cm). In parallel to the shoot growth, there was also an increase in the node numbers of cultivars (Tab. 6). Our findings related to the shoot length were similar to the results of Naor et al. [2002] and Öner [2014]. Furthermore, in our study, the difference in development of the shoot length over years were found to be consonant with the study results of Valenti et al. [1995]. In the first and second years of the study, no statistically significant differences were found in the shoot diameters of cultivars. The values obtained in the first year ranged from 6.88 to 8.31 mm, and in the second year from 7.85 to 9.82 mm (Tab. 6). In studies with wine cultivars, the shoot diameter varied between 7.91–9.05 mm [González-Fernández et al. 2012] and 6.07–7.48 mm [Schmidt et al. 2014]. Although there were differences in terms of cultivars in our study, our findings were consistent with the above results.

In the study, grape yield values for grapevine were presented in Table 7. In the first and second year of study, the highest value was obtained from the cultivars 'Syrah' and 'Sangiovese', and the lowest value from 'Cabernet Sauvignon'. Our findings related to grapevine yield of cultivars were similar to the results of Er [2009], Yaşasın [2010] and Öner [2014] in 'Cabernet Sauvignon'. Our findings related to cultivar 'Syrah' were found to be higher than the results of

Table 6. Vegetative growth observations and measurements in grape wine cultivars

Cultivars	Leaf size (cm^2)		Leaf area (m^2/vine)		Shoot length (cm)		Shoot diameter (mm)		Number of node	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
'Syrah'	202.1 a	178.2 ab	4.74 a	5.13 ab	196.5 a	245.0	8.31	8.08	25.1	33.5 ab
'Merlot'	198.1 a	197.4 a	3.47 ab	5.53 a	145.4 ab	216.6	7.35	7.85	25.8	39.1 ab
'Sangiovese'	151.7 b	142.3 b	2.66 b	5.04 ab	139.1 b	251.8	6.88	8.27	24.3	41.2 a
'C. Sauvignon'	130.7 b	143.4 b	2.95 b	3.71 b	137.3 b	187.0	7.49	7.99	26.1	32.1 b
'S. Blanc'	141.8 b	156.4 ab	3.65 ab	5.08 ab	122.5 b	219.4	7.57	9.82	23.9	37.2 ab
$D_{5\%}$	32.2	42.1	1.56	1.76	53.6	N.S.	N.S.	N.S.	N.S.	9.0

N.S. – not significant, for other explanations – see Table 1

Table 7. Grape yield, pruning weight and Ravaz index values in grape wine cultivars

Cultivars	Grape yield (g/vine)		Pruning weight (g/vine)		Ravaz index	
	2016	2017	2016	2017	2016	2017
'Syrah'	6677.9 a	6832.8 a	1418	2525	4.7 a	3.0 ab
'Merlot'	3505.5 bc	5386.5 ab	1019	1888	3.8 ab	3.0 ab
'Sangiovese'	5052.0 ab	7664.7 a	1390	2021	4.2 a	4.1 a
'C. Sauvignon'	2384.4 c	2331.0 c	1465	2666	1.6 b	1.3 b
'S. Blanc'	3481.1 bc	3737.1 bc	948	2135	3.8 ab	1.9 ab
$D_{5\%}$	2137.6	2563.3	N.S.	N.S.	2.2	2.2

N.S. – not significant, for other explanations – see Table 1

Er [2009] and Uluocak [2010], than the results of Bilgiç et al. [2014] in 'Merlot', while they were found lower than the results of Er [2009] in 'Sauvignon Blanc'.

No statistical difference was found between vegetative growth of cultivars (Tab. 7). Pruning residue weight in the dormancy period could vary according to development power, summer pruning, fruit load, soil type, planting distances and cultivation form of the cultivar. In addition, it was understood that the study results of Smart et al. [1985], Er [2009], Yaşasın [2010], Kurtural et al. [2013] supported our findings.

The ratio between grape yield of grapevine and pruning residue weight was a determining factor in identification of grapevine balance [Wood 2011]. While the fruit load was the amount of fruit per grapevine, vegetative growth was defined as the pruning residue. The fact that this ratio was below 4 (excess vegetative growth) or over 8 (overproduction) refers to an unbalanced situation. Differences between cultivars were found to be statistically significant in terms of this characteristic. 'Cabernet Sauvignon' provided the lowest values in both two years. The highest value was obtained from 'Syrah' and 'Sangiovese' in the first year, and only from cultivar 'Sangiovese' in the second year (Tab. 7). In their study, Scienza et al. [1995] determined this characteristic for 'Cabernet Sauvignon' in different soil types in the range of 2.0–5.1, Van Leeuwen et al. [2004] in the range of 3.09–3.86 in terms of cultivars ('Merlot', 'Cabernet Sauvignon', 'Cabernet Franc'); 2.53–4.43 in terms of years; and 2.79–3.95 in terms of soil type. In a study using shoot pinching and cluster thinning treatment, Mota et al. [2010] found this characteristic in the range of 1.42–3.78 in 'Cabernet Sauvignon', 3.84–10.3 in 'Merlot'; in irrigation and kaolin applications, Shellie and Glenn [2008] in the range of 5.74–6.37 in 'Merlot'; Kurtural et al. [2013] in the range of 3.71–7.00 in the same cultivar; González-Fernández et al. [2012] as 2.57 in 'Merlot', and as 3.26 in 'Cabernet Sauvignon'. Our findings related to Ravaz index were in the range of the values obtained by Scienza et al. [1995] in 'Cabernet Sauvignon', and by Kurtural et al. [2013] in 'Syrah'. The results of Shellie and Glenn [2008] for 'Merlot', those of Mota et al. [2010] for 'Cabernet Sauvignon' were higher than our findings. The results of González-Fernández et al. [2012] for 'Merlot' were lower than our findings. The fact that Ravaz index value was below 4 in the cultivars other than 'Sangiovese' in our study indicates that vegetative growth in grapevines too much in proportion to the product obtained. Depending on the fruit load in cultivars in terms of regional cultivation, taking control of vegetative growth via summer pruning could be effective for Ravaz index to reach the desired ranges. In addition, it was thought that this situation could contribute to the biochemical structure of berry, depending on lightning and aeration the micro-climate in corolla.

CONCLUSIONS

Under the conditions of wine grape cultivation in the Eastern Mediterranean region of Turkey, bud break–maturity period EHS of cultivars ranged from 1540.9 to 1999.2 d.d. Phenologically, bud break occurred at late March, blooming at late April–early May, between veraison and maturity ranged from 17 to 36 days in cultivars. The earliest maturity was detected in 'Sauvignon Blanc', while the latest in 'Cabernet Sauvignon'.

In terms of the quality of wine grapes, TSS content was 20% or above in cultivars (except 'Syrah'], and the TA content was in the optimum range in colorful cultivars. Maturity index of cultivars (except 'Sauvignon Blanc') were found in the optimum value range. Berry weight of cultivars varied between 1.06–2.15 g. While the smallest berries were obtained in 'Cabernet Sauvignon', it was concluded that the berries of 'Sangiovese' were larger than those of other cultivars. It was found that yield values per grapevine were sufficient in 'Cabernet Sauvignon' and 'Sauvignon Blanc', and high in 'Syrah', 'Sangiovese' and 'Merlot'. However, it was probable to increase the quality by regulating yield per grapevine. Indeed, under today's conditions, significant improvements could be achieved in wine quality through wine technologies that could be applied to products obtained from similar climates. It was seen that soil and climatic characteristics had an effect to increase vegetative growth level of cultivars, and this was reflected in the weight of pruning residue. Indeed, Ravaz index values were seen to be below the desired level for cultivars.

As a result; according to the data obtained under the conditions of the study; it was possible to grow wine grapes for yield with the cultivars 'Sangiovese', 'Merlot', 'Cabernet Sauvignon', 'Sauvignon Blanc' and 'Syrah'. The most appropriate sugar-acid balance could be obtained by following the maturity period of cultivars and through some cultural practices. By establishing new grapevine facilities in places with higher altitude, it was maturity at late July–early August. Duration possible to reach quality related results in cultivars. In addition to this, studies should be carried out in order to bring the rare local wine genotypes into cultivation, to compare the same with foreign cultivars and to reveal their wine characteristics.

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