

Determinations of adaptation level of wine grape varieties in terms of climatic data in wine growing regions of turkey

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Abstract. Wine grapes are adapted to a wide range of climate; the best production occurs in regions that meet certain specific climatic conditions. Temperatures during the growing season can affect grape quality and viability. Beneficial climatic conditions will improve the wine's quality. In this study it is aimed that to determine suitable wine grape varieties for the cultivation in some areas of Southeastern Anatolia Region, Eastern Anatolia, Central Anatolia Region, Central Black Sea Region, Aegean Region and Marmara Region in Turkey with related to climate requirements. For this reason, long-term climatic data were collected by meteorological stations including, Diyarbakır (Çermik, Çüngüş), Central-Elazığ, Nevşehir (Central and Ürgüp), Ankara (Kalecik) Tokat (Central, Erbaa, Niksar, İzmir (Seferihisar, Menderes, Urla) ve Denizli (Çal ve Güney), Çanakkale (Bozcaada, Bayramiç), Tekirdağ. In this study heliothermic and hydrothermic indices were calculated and evaluated for appropriate viticultural practice in this region. It was found that Boğazkere and Öküzgözü in Southeastern Anatolia Region and Eastern Anatolia Region; Kalecik Karası, Dimrit and Narince in Central Anatolia Region and Emir in Central Black Sea Region; Bornova Misketi, Cabernet Sauvignon, Syrah, Alicante Bouschet, Carignane, Kalecik Karası, Merlot, Öküzgözü, Çal Karası, Boğazkere, Sultani Çekirdeksiz in Aegean Region; Karasakız, Karalahana, Vasilaki, Cabernet Sauvignon, Merlot, Syrah, Alicante Bouschet, Semillion, Cinsaut, Yapıncak, Gamay, Merlot, Cabernet Sauvignon can be adapted and grown well in terms of climatic conditions in Marmara Region respectively.

1. Introduction

Turkey has a very rich genetic potential as it is the gene center of grapevine.

Turkey is a major producer of grapes in the world and viticulture is one of the major branches of agriculture with respect to production area and its large share of income in Turkish national economy. Grapevine is grown in almost all parts of Turkey and has been produced commercially in many regions of the country for many years.

Turkey is among the important viticulturist countries with its 478.000 ton of viticulture field and 4, 26 millions of ton of grape production. (5th one for the area and 6th one in the production) 52.9% of table grape, 36.3% to be dried, 10.8% for wort and wine [1].

The climatic conditions have a very important role in the constitution of the maturity, yield and quality values of the wine grape variety. The criterias determining the relations between the *Vitis vinifera* and the climate and if the substrate is convenient for the grape vine farming cultivation have been presented in the studies [2–7]. Specific temperature data are the basic information for any grape variety. Reaching to the phenologic phases, key for any varieties, is possible when 10 °C heat accumulation is used as base. [8, 8–10]. Each variety of grapes needs a specific heat accumulation starting from the beginning of the vegetation period until the maturity period [9]. Maturity period of grapes is closely connected to the local

climate conditions and phenological growth of the variety. Phenological growth is a genetic feature varies from variety to variety [8]. It has been detected that effective heat summation demand is between 1210 °C (Cardinal) and 1500 °C (Müşküle) in Ankara conditions; 1033 °C (Uslu) and 1538 °C (Alphonse L.) in Mediterranean conditions [11]. If a grape variety cannot mature its grape in the demanded level in ecology, it means that it cannot be recommended to be cultivated for hot region.

Oraman [12], has emphasized in the study that he has performed that regular sunshine duration is important as well as the temperature and that the annual sunshine duration of a grape wine should not be less than 1300 hours. According to Çelik et al [13] this value should not be less than 1500–1600 hours in an economical grape wine cultivation and that the vegetation duration must be more than 180 days. Other conditions apart from the vegetation are also important in the grape variety choice of regions (especially in the regions with frost risk). The resistances of the grape varieties to the lower temperatures are very different. Accordingly, it has been detected in the studies held that if the temperature is lower than –20, 5 °C in 3 or less times 10 years, that region is convenient for the grape wine cultivation [13] Not only the heat accumulation but also sunshine and amount of precipitation should also be taken into the consideration for the convenience to the environment during the vegetation period of a grape variety. according to [2–4, 14]. Karantonis [14] the temperature values of the environment is not the unique important factors for the grape cultivation; what is really

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important is the balance between the temperature and sunshine. It is stated that the heliothermic proportion ($X*12-3/H*10-3$) value 1 or higher environments are convenient for the grape cultivation. The method of detecting the varieties that might be convenient in a specific area by studying the relations between Grape varieties and environmental conditions (climate, land) has been applied in many countries of the world.

The grape varieties that might be cultivated according to the climate data of the Aegean Region and Marmara Region have been detected with the studies that have been held in our country. To improve the wine grape cultivation in Aegean Region, the climate factors of the region have seen to have accorded with the region. The studies regarding the detection not only the domestic wine grape but also qualified wine grapes of foreign origins have gained a lot importance in the recent years.

The objective of this study was to determine suitable wine grape varieties for the cultivation in some areas of Southeastern Anatolia Region, Eastern Anatolia, Central Anatolia Region, Central Black Sea Region, Aegean Region and Marmara Region in Turkey with related to climate requirements.

2. Materials and methods

2.1. Materials

In this study was the first group material was provided wine grape growers in Diyarbakır (Çermik, Çüngüş), Central-Elazığ provinces of the Southeastern Region; Nevşehir (Central and Ürgüp), Ankara (Kalecik) provinces of the in Central Anatolia Region; Denizli (Güney and Çal) and İzmir (Menderes, Seferihisar, Urla) provinces of the Aegean Region; Çanakkale (Bozcaada, Bayramiç), Tekirdağ provinces of the Marmara Region. Other materials consist of the climatic data (temperature, rain etc) of long years provided from the meteorological stations of the counties.

2.1.1. Experimental site

Çermik and Çüngüş counties in Diyarbakır provinces of the Southeastern Anatolia region; Central-Elazığ in Elazığ provinces of the Eastern Anatolia region, being the study area has 3681 km² of total area. Wine grape area of the examined study area is 53950 decare and total wine grape production amount is 43753 tons (Table 1). Central-Elazığ county has the largest viticulture field (37100 decare) and it is Central-Elazığ county that has the furthest production amount (33245 tons). Average yield of the study area is 749 kg / decare (Table 1).

Central-Nevşehir and Ürgüp counties in Nevşehir provinces; Kalecik counties in Ankara provinces of Central Anatolia Region region; Central-Tokat, Erbaa and Niksar in Tokat provinces of the Eastern Anatolia region, being the study area has 6461 km² of total area. Wine grape area of the examined study area is 105803 decare and total wine grape production amount is 72234 tons (Table 1). Central-Nevşehir county has the largest viticulture field (29900 decare) and it is Central-Nevşehir county that has the furthest production amount (23920 tons). Average yield of the study area is 661 kg / decare (Table 1).

Güney and Çal counties in Denizli provinces; Menderes, Seferihisar and Urla counties in İzmir provinces

of the Aegean region, being the study area has 329 km² of total area. Wine grape area of the examined study area is 87200 decare and total wine grape production amount is 48750 tons. (Table 1) Çal county has the largest viticulture field (400000 decare) and it is Güney county that has the furthest production amount (21250 tons). Average yield of the study area is 562 kg / decare (Table 1).

Bozcaada and Bayramiç counties in Çanakkale provinces; Şarköy counties in Tekirdağ provinces of the Marmara region, being the study area has 1793.6 km² of total area. Wine grape area of the examined study area is 42320 decare and total wine grape production amount is 33955 tons (Table 1). Şarköy county has the largest viticulture field (20000 decare) and it is Şarköy county that has the largest production amount (5625 tons). Average yield of the study area is 820 kg / decare (Table 1).

2.2. Methods

Çermik and Çüngüş counties in Diyarbakır provinces of the Southeastern Anatolia region; Central-Elazığ in Elazığ provinces of the Eastern Anatolia region; Central-Nevşehir and Ürgüp counties in Nevşehir provinces; Kalecik counties in Ankara provinces of Central Anatolia Region region; Central-Tokat, Erbaa and Niksar in Tokat provinces of the Eastern Anatolia region; Güney and Çal counties in Denizli provinces; Menderes, Seferihisar and Urla counties in İzmir provinces of the Aegean region; Bozcaada and Bayramiç counties in Çanakkale provinces; Şarköy counties in Tekirdağ provinces of the Marmara region had been the sampling area. The counties have been chosen so as to provide 50% of the wine grape production. 40 Wine grape growers from each county have been interviewed with telic sampling method.

'Effective heat summation (EHS)', being one of the efficient parameters to determine the needs of the wine grape varieties in the specific region, has been calculated. In the calculation of this value expressed as Day-Temperature, 10 °C (threshold temperature), which is accepted as the average temperature when the grape wine growth starts, has been selected as baseline (Çelik and, 1998). The assessments have been formulated as the date and day when the average of many years in several stations for 10 °C, threshold of the grape vine growth, reaches to threshold temperature (end date and day of the vegetation) and the accumulation of the temperatures that the average temperature for each day in this period is higher than the threshold temperature.

$$EHS = \sum(T - T_e)$$

EHS = accumulation of the effective temperature (°C-day)

T = daily average temperature (°C)

T_e: threshold temperature (°C).

Hydrothermic indices was calculated to determine the possibility of supplying the water need of the grape vine from the natural ways. In this calculation it will be determined that if the water consumption related to the temperature change of the varieties in the May-July period and rain, can be provided from the natural ways.

$$\text{Hydrothermic indices: } (\sum P * 10) / \sum T^{\circ}$$

$\sum P$ = Total rain (mm),

Table 1. Surface area of the counties (km²), viticulture area (decare), production (ton) and yield (kg/ decare) values (Anonym, 2010).

REGIONS	COUNTIES	Surface area of the counties (km ²)	Viticulture area (decare)	Production (ton)	Yield (kg/decare)
SOUTHEASTERN ANATOLIA REGION AND EASTERN ANATOLIA REGION	Çermik-DİYARBAKIR	991	6850	6508	950
	Çüngüş-DİYARBAKIR	472	10000	4000	400
	Central-ELAZIĞ	2218	37100	33245	896
	TOTAL	3681	53950	43753	749
CENTRAL ANATOLIA AND CENTRAL BLACK SEA REGIONS	Central – NEVSEHIR	536	29900	23920	800
	Ürgüp-NEVSEHIR	565	31950	19726	617
	Kalecik-ANKARA	1341	8500	5525	650
	Central – TOKAT	1924	17910	12537	700
	Erbaa-TOKAT	1177	11493	6896	600
	Niksar-TOKAT	918	6050	3630	600
	TOTAL	6461	105803	72234	661
AEGEAN REGION	Menderes-İZMİR	775	96500	7720	800
	Seferihisar-İZMİR	371	32500	2600	800
	Urla-İZMİR	728	8000	2200	150
	Güney-DENİZLİ	534	290000	21250	691
	Çal-DENİZLİ	1521	400000	14800	370
	TOTAL	3929	827000	48570	562
MARMARA REGION	Bozcaada-ÇANAKKALE	37.6	6420	5625	900
	Bayramiç-ÇANAKKALE	1275	15900	11130	700
	Şarköy-TEKİRDAĞ	481	20000	17200	860
	TOTAL	1793.6	42320	33955	820
TOTAL	15864,6	1029073	198512	698	

Heliothermic indices have been calculated to determine the balance between the temperature and sunshine for the grape production.

$$\text{Heliothermic indices: } X \cdot 12^{-3} / H \cdot 10^{-3}$$

X: accumulation of the effective heat temperature during the vegetation period

H: total hours of days (daytime).

3. Results and discussion

Diyarbakır (Çermik and Çüngüş) and Elazığ (Central-Elazığ) two of the cities where important wine grapes

are being produced in the Southeastern Anatolia Region and Eastern Anatolia Region, have been the study area. Terrestrial level varies from 29.2 (Central-Elazığ) –30.1 (Çüngüş) according to the geographic and topographic conditions of the study area. The effects of the variety of the terrestrial level, annual total rain and altitude difference have been observed. Average temperature value of the study area for many years have been measured between 14.6°C (Menderes) and 16.5°C in Çermik (Table 2). Extremely high temperature values are between 42.2°C (Central-Elazığ) and 46.1°C (Çermik). Peak value of the low temperatures varies between –23.4°C (Çermik) and –22.6°C (Central-Elazığ) (Table 2).

Table 2. Climatic data in the Study Area.

REGIONS	STATIONS	LATITUDE (°N)	LONGITUDE (°E)	ALTITUDE (m)	AVERAGE ANNUAL TEMP. (°C)	AVERAGE ANNUAL RAINFALL (kg/m ²)	TERRESTIAL LEVEL (°C)	MAX. TEMP. (°C)	MIN. TEMP. (°C)
SOUTHEASTERN ANATOLIA REGION AND EASTERN ANATOLIA REGION	Çermik-DIYARBAKIR	38°17'	39°49'	700	16.5	492.7	29.8	46.1	-23.4
	Çüngüş-DIYARBAKIR	38°13'	39°17'	1000	16.2	490.8	30.1	45.8	-22.8
	Central-ELAZIĞ	38°40'	39°13'	1093	14.6	429.6	29.2	42.2	-22.6
CENTRAL ANATOLIA AND CENTRAL BLACK SEA REGIONS	Central-NEVŞEHİR	38°37'	34°42'	1223	13.8	483.4	23.2	39.5	-21.2
	Ürgüp-NEVŞEHİR	38°37'	34°54'	602	14.2	490.0	21.8	38.9	-22.4
	Kalecik-ANKARA	40°05'	33°24'	725	14.8	485.2	22.6	40.8	-21.4
	Central-TOKAT	40°18'	36°33'	649	12.3	446.0	24.0	45.0	-22.1
	Erbaa-TOKAT	40°40'	36°33'	113	12.7	439.2	24.2	45.0	-22.1
	Niğsar-TOKAT	40°34'	36°56'	339	12.5	456.4	23.7	45.0	-2.1
AEGEAN REGION	Seferihisar-İZMİR	38°11'	26°50'	28	16.3	582	18.3	42.4	-6.2
	Menderes-İZMİR	38°16'	27°08'	53	17.8	590	18.6	40	-5.4
	Urla-İZMİR	38°19'	26°45'	75	17.2	535	18.1	41.1	-4.3
	Güney-DENİZLİ	38°09'	29°04'	847	15.3	514	21.7	37.7	-8.7
	Çal-DENİZLİ	38°05'	26°03'	911	14.5	477	22.4	39.4	-10.4
MARMARA REGION	Bozcaada-ÇANAKKALE	39°42'	26°45'	28	15.4	508	17.3	35.4	-8.2
	Bayramiç-ÇANAKKALE	39°48'	26°37'	72	14.5	655	21.4	39.8	-13.5
	Şarköy-TEKİRDAĞ	40°37'	27°04'	10	14.4	534	20.2	38.4	-11.5

Nevşehir (Central-Nevşehir and Ürgüp), Ankara (Kalecik) and Tokat (Central-Tokat, Erbaa and Niksar) three of the cities where important wine grapes are being produced in Central Anatolia and Central Black Sea Regions, have been the study area. Terrestrial level varies from 21.8 (Ürgüp) –24.2 (Erbaa) according to the geographic and topographic conditions of the study area. The effects of the variety of the terrestrial level, annual total rain and altitude difference have been observed. Average temperature value of the study area for many years have been measured between 12.3 °C (Central-Tokat) and 14.8 °C in Kalecik (Table 2). Extremely high temperature values are between 38.9 °C (Ürgüp) and 45.0 °C (Central-Tokat, Erbaa and Niksar). Peak value of the low temperatures varies between –22.4 °C (Ürgüp) and –21.2 °C (Central- Nevşehir) (Table 2).

Denizli (Güney and Çal) and İzmir (Menderes, Seferihisar, Urla) two of the cities where important wine grapes are being produced in the Aegean Region, have been the study area. Terrestrial level varies from 18.3 (Urla) –22.4 (Çal) according to the geographic and topographic conditions of the study area. The effects of the variety of the terrestrial level, annual total rain and altitude difference have been observed. Average temperature value of the study area for many years have been measured between 7.8 °C (Menderes) and 14.5 °C in Çal (Table 2). Extremely high temperature values are between 42.4 °C (Seferihisar) and 39.4 °C (Çal). Peak value of the low temperatures varies between –10.0 °C (Çal) and –4.3 °C (Urla) (Table 2).

Tekirdağ (Şarköy) and Çanakkale (Bozcaada and Bayramiç) two of the cities where important wine grapes are being produced in the Marmara Region, have been the study area. Terrestrial level varies from 18.3 (Bozcaada) –21.4 (Bayramiç) according to the geographic and topographic conditions of the study area. The effects of the variety of the terrestrial level, annual total rain and altitude difference have been observed. Average temperature value of the study area for many years have been measured between 14.4 °C (Şarköy) and 15.4 °C in Bozcaada (Table 2). Extremely high temperature values are between 39.8 °C (Bayramiç) and 35.4 °C (Bozcaada). Peak value of the low temperatures varies between –13.5 °C (Bayramiç) and –8.2 °C (Bozcaada) (Table 2).

We assess the bio climatic values in the climatic surface in the regard of productions of the wine grape varieties in the Southeastern Anatolia Region and Eastern Anatolia Region (Table 3). It has been detected that the vegetation period starts between 23 March (Çüngüş) and 11 April (Central- ELAZIĞ). It has been understood that the potential vegetation duration was between 220 days (Central- ELAZIĞ) and 245 days (Çermik); and the total temperature was between 4525 °C (Central- ELAZIĞ) and 5605 °C (Çüngüş). Heliothermic indices, presenting the combination of the vegetation days and temperature factor, were high in all counties examined in the scope of the wine grape cultivation and that there were important differences between counties. The heliothermic indices values are between 6.25 (Central- ELAZIĞ) and 8.53 (Çermik) and these values are appropriate for the cultivation of the varieties of the wine grape cultivation in the examined area (according to the vegetation duration and Effective temperature).

The bio climatic values in the climatic surface in the regard of productions of the wine grape varieties in the Central Anatolia and Central Black Sea Regions (Table 3). It has been detected that the vegetation period starts between 09 April (Central- TOKAT and Niksar) and 2 April (Kalecik). It has been understood that the potential vegetation duration was between 199 days (Central- NEVŞEHİR) and 211 (Kalecik); and the total temperature was between 3528 °C (Ürgüp) and 4823 °C (Central-TOKAT). The heliothermic indices values are between 6.15 (Kalecik) and 9.46 (Ürgüp) and these values are appropriate for the cultivation of the varieties of the wine grape cultivation in the examined area.

In the Aegean Region the bio climatic values in the climatic surface in the regard of productions of the wine grape varieties (Table 3) it has been detected that the vegetation period starts between 07 March (Menderes) and 06 April (Çal). It has been understood that the potential vegetation duration was between 205 days (Çal) and 255 days (Seferihisar); and the total temperature was between 4154 °C (Çal) and 6425 °C (Seferihisar). The heliothermic indices values are between 5.79 (Çal) and 9.15 (Seferihisar) and these values are appropriate for the cultivation of the varieties of the wine grape cultivation in the examined area.

The bio climatic values in the climatic surface in the regard of productions of the wine grape varieties in the Marmara Region (Table 3). It has been detected that the vegetation period starts between 25 March (Bozcaada) and 15 April (Şarköy). It has been understood that the potential vegetation duration was between 242 days (Bayramiç) and 280 days (Bozcaada); and the total temperature was between 5087 °C (Bayramiç) and 5414 °C (Bozcaada). The heliothermic indices values are between 6.47 (Bayramiç) and 7.53 (Bozcaad) and these values are appropriate for the cultivation of the varieties of the wine grape cultivation in the examined area.

A parallelism has been found between the counties of Regions of Turkey in terms of precipitation amount and dispersion in the vegetation period. It is seen that wine grape cultivation is possible in the examined regions without watering in the wine grape growing.

As a result of the assessment made in Southeastern Anatolia Region and Eastern Anatolia Region it was seen that the the effective heat summation (EHS) was between 2315 °C and 2914 °C (Table 3). The temperature need of Boğazkere grape variety was 1252 °C (Table 4) and temperature need of Öküzgözü grape variety was 1542 °C. Total efficient temperature in Çermik county was 2874 °C and EHS of Çüngüş county was 2914 °C in Diyarbakır. The total efficient temperature of Central-ELAZIĞ in Eastern Anatolia Region county was 2315 °C and the total temperature needs of the varieties were as follows: Öküzgözü 1542 °C, Boğazkere 1525 °C (Table 4). The effective heat summation need of these grape varieties demand a lower total temperature than in Southeastern Anatolia Region and Eastern Anatolia Region effective heat summation values.

In the Central Anatolia and Central Black Sea Regions it was seen that the EHS was between 2137 °C and 2961 °C (Table 3). EHS in Central-Nevşehir county was 2874 °C and EHS of Ürgüp county was 2914 °C in Nevşehir. The EHS need of grape varieties were as follows: 1400 °C

Table 3. Potential bioclimatic values of the study area in terms of wine grape cultivation (daily average temperature $\geq 10^{\circ}\text{C}$ Period) Hydrothermal.

REGIONS	STATIONS	BUDBURST (DATE)	TIME (DAYS)	$\sum T (^{\circ}\text{C})$		AVERAGE TEMP. ($^{\circ}\text{C}$)	RAINFALL (mm)	HELIOTERMIC INDICE	HYDROTHERMIC INDICE (May-July)
				TOTAL	EFFICIENT				
SOUTHEASTERN ANATOLIA REGION AND EASTERN ANATOLIA REGION	Çermik-DIYARBAKIR	29.3	245	5245	2874	22.3	203.5	8.53	0.32
	Çüngüş-DIYARBAKIR	23.3	241	5605	2914	23.1	198.9	8.49	0.30
	Central-ELAZIĞ	11.4	220	4525	2315	21.8	168.6	6.25	0.39
	Diferance	19	25	2339	599	1.3	34.9	2.28	0.09
	Central-NEVŞEHİR	10.4	199	3686	2198	20.1	208.6	9.43	0.27
CENTRAL ANATOLIA AND CENTRAL BLACK SEA REGIONS	Ürgüp-NEVŞEHİR	10.4	204	3528	2137	19.9	215.2	9.46	0.22
	Kalecik-ANKARA	12.4	211	3902	2145	19.8	199.8	6.15	0.35
	Central-TOKAT	09.4	205	4823	2961	21.8	213.9	8.23	0.23
	Erbaa-TOKAT	10.4	202	4798	2872	22.4	224.4	8.27	0.24
	Niksar-TOKAT	09.4	203	4812	2854	20.9	221.6	8.32	0.25
Diferance	3	12	1195	824	2.6	24.6	3.31	0.13	
AEGEAN REGION	Seferhisar-İZMİR	11.3	255	6425	3875	25.2	207.9	9.15	0.85
	Menderes-İZMİR	07.3	254	6042	3502	23.7	245.2	8.40	0.72
	Urla-İZMİR	10.3	252	6125	3605	24.3	227.3	7.53	0.83
	Güney-DENİZLİ	02.4	207	4460	2390	21.5	210.7	6.49	0.50
	Çal-DENİZLİ	06.4	205	4154	2104	20.2	212.0	5.79	0.45
Diferance	22	50	2271	1771	50	34.5	3.36	0.40	
MARMARA REGION	Bozcaada-ÇANAKKALE	20.3	280	5414	3964	24.8	223.9	7.53	0.22
	Bayramiç-ÇANAKKALE	03.4	242	5087	3447	25.4	254.8	6.47	0.35
	Şarköy-TEKİRDAĞ	05.4	250	5151	3533	24.3	236.7	6.66	0.34
	Diferance	21	58	327	517	0.6	40.9	1.07	0.12

Table 4. Features of some grape wine varieties and their temperature needs (Çelik at all, 1988a).

Wine Grape Varieties	Temperature Needs (°C)
Alicante Bouschet	1398
Boğazkere	1525
Bornova Misketi	1250
Cabernet Sauvignon	1382
Carignan	1547
Cinsaut	1453
Çal Karası	1395
Dimrit	1400
Emir	1502
Gamay	1363
Kalecik Karası	1421
Karalahana	1535
Karacakız	1522
Merlot	1402
Semilion	1382
Narince	1418
Sultani Çekirdeksiz	1380
Syrah	1399
Vasilaki	1435
Yapıncak	1545

(Dimrit), 1502 °C (Emir) and 1421 °C (Kalecik Karası) (Table 4). EHS of Kalecik county was 2145 °C. The temperature need of Kalecik Karası grape variety was 1421 °C (Table 4). EHS in Central TOKAT county was 2961 °C and EHS of Erbaa county was 2872 °C and EHS of Niksar county in Tokat. The temperature need of Narince grape variety was 1418 °C (Table 4). The effective heat summation need of these grape varieties demand a lower total temperature than effective heat summation values of in the Central Anatolia and Central Black Sea Regions.

In Aegean region it was seen that the EHS was between 2104 °C and 3875 °C (Table 3) and the temperature need of Alicante Bouschet grape variety was 1398 °C (Table 4) and temperature need of Carignan grape variety was 1547 °C. Total efficient temperature in Urla county was 3605 °C and the needs of grape varieties were as follows: Cabernet Sauvignon 1382 °C, Syrah 1399 °C and Alicante Bouschet 1398 °C (Table 4). EHS of Güney county in Denizli was 2390 °C and the temperature needs of the varieties are as follows: Syrah (1399 °C), Kalecik Karası (1421 °C), Boğazkere (1525 °C), Merlot (1402 °C), Öküzgözü (1542 °C), Cabernet Sauvignon (1382 °C), Çalkarası (1395 °C) and Sultani Çekirdeksiz (1380 °C) and the temperature need of these grape varieties demand a lower total temperature than these values. The total efficient temperature of Çal county was 2104 °C and the total temperature needs of the varieties were as follows: Öküzgözü 1542 °C, Çal Karası (1395 °C), Boğazkere 1525 °C, Merlot 1402 °C and Sultani Çekirdeksiz (1380 °C) (Table 4). The effective heat summation need of these grape varieties demand a lower total temperature than effective heat summation values of Aegean region.

In Marmara region it was seen that the EHS was between 3447 °C and 3964 °C (Table 3). The effective heat summation of Bozcaada county in Çanakkale was 4964 °C and the effective heat summation need of grape varieties were as follows: Alicante Bouschet, 1398 °C, Cabernet Sauvignon 1382 °C, Karalahana 1535 °C, Karacakız 1522 °C, Merlot 1402 °C, Syrah 1399 °C, and Vasilaki 1435 °C (Table 4). The effective heat summation of Bayramiç county in Çanakkale was 3447 °C and the effective heat summation need of grape varieties were as follows: Cabernet Sauvignon 1382 °C, Karacakız 1522 °C. The total efficient temperature of Şarköy county in Tekirdağ was 3533 °C and the effective heat summation need of grape varieties were as follows: Cabernet Sauvignon 1382 °C, Cinsaut 1453 °C, Gamay 1363 °C, Merlot 1402 °C Semilion 1382 °C, Yapıncak 1545 °C, (Table 4). The effective heat summation need of these grape varieties demand a lower total temperature than effective heat summation values of Marmara region.

According to the climatic data from the meteorological station and the evaluation carried out with the wine grape growers has been found that Boğazkere, and Öküzgözü in the region of Southeastern Anatolia and Eastern Anatolia Region; Kalecik Karası, Dimrit and Narince in Central Anatolia Region and Emir in the Central Black Sea Region; Bornova Misketi, Cabernet Sauvignon, Syrah, Alicante Bouschet, Carignane, Kalecik Karası, Merlot, Öküzgözü, Çal Karası, Boğazkere, Sultani Çekirdeksiz in Aegean Region; Karacakız, Karalahana, Vasilaki, Cabernet Sauvignon, Merlot, Syrah, Alicante Bouschet, Semillion, Cinsaut, Yapıncak, Gamay, Merlot, Cabernet Sauvignon can be adapt and grow well in terms of climatic conditions in Marmara Region respectively.

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