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Environmental Factors Influence on Quality of Wine Grape Varieties in Four Different Areas of Culture

Mihai-Lucian LUNG[1)], Nastasia POP[1)], Florentina CIOBANU[1)], Anca BABES[1)], Claudiu BUNEA[1)], Simona LAZAR[1)]

[1)]Faculty of Horticulture, University of Agricultural Sciences and Veterinary Medicine, 3-5 Mănăstur Street, Cluj-Napoca, 400372, Romania; mihai2lung@yahoo.com.

Abstract. The climatic conditions, the genotype and the appropriate technology are very important for successful cultivation of vines and for obtaining quality products. To describe a viticulture climate area, climatic parameters are used, which show the binary and ternary interaction between eco-climatic conditions: light, temperature and humidity (Mursa, 2009; Pop, 2010). The research aims to characterize the influence of eco-climatic conditions on wine grapes quality in four different areas from Romania. The study was done on samples collected from didactic collection of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca (C), Timisoara (T), from the commercial plantation of Mica (M) and Batos (B). The year 2011 was a warm year, with average temperatures much above the multiannual average and with low rainfalls in all the four areas mentioned above. As a conclusion to this study, Timisoara has the best ecoclimatic conditions for viticulture. The highest quantity of sugar was accumulated by the cultivars 'Muscat Ottonel' and 'Fetească neagră', this character being mostly influenced by area.

Keywords: wine grapes, climatic conditions, temperature, humidity, sugar, acidity, pH

INTRODUCTION

Terroir can be defined as an interactive ecosystem, in a given place, including climate, soil and the vine (rootstock and cultivar) (Seguin, 1988). It has long been acknowledged as an important factor for wine quality and style in European vineyards (Falcetti, 1994). More recently, New World producers have show a growing interest in terroir. The terroir effect includes several parameters (climate, soil, cultivar), which raises the fundamental question whether a hierarchy can be dressed among them. If so, this would provide a scientific basis to a better understanding of the impact of terroir on grape composition (van Leeuwen, 2004). Occurring as a direct effect of climate, the grapevine's growth can be described by its phonological events. Understanding the phenology of a given plant system is important in determining the ability of a region to produce a crop within the confines of its climatic regime (Coombe, 1988). From a husbandry viewpoint, knowledge of a plant's growth stages is advantageous as cultural and chemical practices can be applied at optimum times in a plant's annual growth cycle. Additionally, information regarding growth stages can be useful in estimating crop yields. Therefore, there is an optimum seasonal climate regime that contributes greatly to the overall quality of a given vintage (Gregory, 2000). The effect of climate in viticulture is largely documented (Winkler *et al*., 1974; Gladstones, 1992), as is the effect of soil (Seguin, 1986; van Leeuwen and Seguin, 1994) and cultivar (Huglin and Schneider, 1998). Few experiments relate the combined effect of two parameters (soil and climate: Duteau *et al*., 1981; soil and cultivar: van Leeuwen and Seguin, 1996). Only Rankine *et al*. (1971) attempted to study the effects of soil, climate and cultivar. However, to determine the ecological vocation of the vine in a certain area, characterization of the climatic conditions of those areas is required (Pop, 2010).

This paper is proposing the evaluation in terms of thermal and hydric of four different areas of Transylvania (Cluj, Timisoara, Mica and Batos) and the analysis of quality indices (sugar, acid and pH) at several wine grape varieties (‘Fetească albă’, ‘Fetească regală’, ‘Aromat de Iasi’, ‘Muscat Ottonel’, ‘Fetească neagră’ and ‘Pinot noir’).

MATERIALS AND METHODS

To achieve the objectives four varieties of grapes for white wines: ‘Fetească albă’, ‘Fetească regală’, ‘Aromat de Iasi’, ‘Muscat Ottonel’ and two red wine grape varieties: ‘Pinot noir’ and ‘Fetească neagră’ were taken into consideration.

Grape samples were collected in 2011 from four different locations: the didactic plantation of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca (C), the didactic plantation of the University of Agricultural Sciences and Veterinary Medicine Timisoara (T), from two commercial plantation: Mica (M) and Batos (B). Based on data obtained, some important climatic indicators for vines were determined: monthly and annual average temperature, highest temperature during the growing season, absolute minimum temperature for the rest periods, length of the growing season (days), global thermal balance ($\sum t^o g$), active thermal balance ($\sum t^o a$), useful thermal balance ($\sum t^o u$), monthly and annual rainfall amount, rainfall coefficient (Cp).

Collected samples were of 5 kg grapes per variety, from several vine the grapes were placed in the lower third, middle and top of each vine, and the grapes exposed to sun and shade. The samples were analyzed in the laboratory of oenology of UASVM Cluj-Napoca. For each sample three repetitions were used.

Technological parameters of ripeness, total soluble solids concentration (Brix, as SSC) was measured using an Atago 0–32 Brix temperature compensating refractometer (Atago Co., Tokyo, Japan), and pH was determined by potentiometry using a Crison electrode (Carpi, Italy). Titratable acidity (TA), expressed as g/L^{-1} H_2SO_4, was estimated using the official European Union method.

Statistical analyses were performed using the statistical software package SPSS (version 18.0; SPSS Inc., Chicago, IL, USA). Blok vine

RESULTS AND DISCUSSIONS

Analysis of the main climate data. The climatic data from Cluj in 2001-2011 show that there was an annual average temperature of 9.3°C (Tab. 1). The highest temperature for the same period was 36.3°C in July, while the absolute minimum -23.0^{o}C in January. The number of frost-free days is 238. Also, 10-year monthly average data reveal that during the growing season, the warmest month is July with an average temperature of 20.5^{o}C and the coolest month us March with 5.0^{o}C. Lowest average temperatures were recorded in January-1.9^{o}C.

In 2011 in Cluj-Napoca, the average annual temperature was 9.7^{o}C, 31.4 absolute maximum in July and absolute minimum -14.6^{o}C in February (Tab. 2).

Average annual temperatures in the period 2001-2010, in other places are as described in Tab. 1; in Timisoara are 12.3^{o}C, 10.2^{o}C in Mica and 10.4^{o}C in Batos. Hottest months proved to be June, July and August, with average monthly temperatures 25.0^{o}C in July in Timisoara, 20.5^{o}C in July to Mica and Cluj, 21.2^{o}C in July to Batos (Tab. 1)

Tab. 1

The highest temperature, absolute minimum and average temperature of the air in 2001-2010 in the four areas of grapes provenance

Area		Month												Maxim Minim Average
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Cluj	Maxim	11.3	20.0	23.0	26.5	31.0	34.4	36.3	36.0	32.7	29.3	19.5	13.3	**36.3**
	Minim	-23.0	-21.1	-16.5	-4.0	-0.9	4.2	6.1	3.0	0.5	-9.4	-18.0	-18.0	**-23.0**
	Average	-1.9	-0.3	5.0	10.2	14.9	18.4	20.5	18.8	15.5	8.5	2.5	-1.0	**9.3**
Timisoara	Maxim	16.8	18.4	26	28	33.4	36.5	38.4	38	34.1	28.2	23.2	16.1	**38.4**
	Minim	-21.4	-18.3	-17.4	-4.6	-2.0	3.6	5.0	3.6	-4.8	-9.0	-17.6	-17.0	**-21.4**
	Average	0.7	2.2	6.8	13.1	17.0	20.7	25.0	23.1	16.9	12.4	6.8	2.5	**12.3**
Mica	Maxim	11.3	20	23	26.5	31	34.4	36	36.3	32.7	29.3	20.5	13.3	**36.3**
	Minim	-20.2	-14.0	-12.5	-5.6	2.0	4.5	7.4	6.0	0.5	-6.0	-10.2	-22.2	**-22.2**
	Average	-1.5	0.6	4.8	10.8	16.5	19.0	20.5	20.0	14.3	10.8	7.0	-1.0	**10.2**
Batos	Maxim	12.0	19.1	24.2	26.6	30.4	33.7	36.1	35.4	33.7	29.7	20.9	13.2	**36.1**
	Minim	-26.3	-23.0	-16.7	-4.0	-0.9	4.2	3.1	3.0	0.5	-9.4	-18.0	-18.0	**-26.3**
	Average	-1.4	-0.1	3.2	12.8	15.3	18.4	20.6	21.2	16.6	9.9	6.5	1.5	**10.4**

In 2011, one can observe that in all localities studied, the mean annual temperature and absolute maximum (Tab. 2) are above the average of the ten preceding years. We can thus say that 2011 was a warm year, favorable for the vine culture.

Tab. 2

The highest temperature, absolute minimum and average temperature of the air in 2011 in the four areas of grapes provenance

Area		Month												Maxim Minim Media
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Cluj	Maxim	4.6	3.5	14.4	18.6	28.5	29.3	31.4	30.4	31.3	23.8	18.6	11.5	**31.4**
	Minim	-12.6	-14.6	-7.6	1.4	4.2	11.1	9.5	6.0	4.5	-9.4	-13.6	-5.9	**-14.6**
	Average	-2.7	-3.2	4.4	10.4	14.8	18.4	21.8	20.4	18.7	9.3	5.1	-1.2	**9.7**
Timisoara	Maxim	2.6	5.9	12.0	22.5	25.7	26.5	33.7	30.6	21.7	20.3	13.4	2.4	**33.7**
	Minim	-11.6	-6.9	-2.5	7.6	11.1	14.1	15.7	16.4	11.2	7.3	2.7	-2.8	**-11.6**
	Average	-0.2	3.3	7.9	12.9	17.0	21.0	24.2	22.7	17.0	10.2	10.2	1.2	**12.3**
Mica	Maxim	5.0	8.8	21.4	26.0	28.5	29.3	30.5	34.4	31.3	23.8	18.6	11.5	**34.4**
	Minim	-18.3	-13.5	-6.6	-1.7	4.7	9.9	10.1	9.5	5.7	-4	-9.0	-10.7	**-18.3**
	Average	-2.2	3.8	6.4	11.5	17.1	20.6	21.0	19.9	14.3	11.8	8.6	-2.1	**10.9**
Batos	Maxim	9.0	11.5	15.5	21.0	25.5	22.5	35.5	33.5	27.5	23.5	15.1	6.5	**35.5**
	Minim	-17.6	-15.8	-3.5	1.4	6.7	11.7	13.5	13.2	7.8	-0.6	-3.6	-9.8	**-17.6**
	Average	-2.7	-2.2	4.4	10	22.5	23.1	22.3	19.9	17.0	7.7	4.5	1.4	**10.7**

In terms of temperature, is noted that the vine dispose, in the areas studied, of this fundamental factor throughout the year, but also in the months of maximum development of the main phenophases (fruit bud differentiation, maturation accumulation of sugars in the grain or wood).

The influence of temperature was analyzed by the sum of the degrees of temperature. Thus it was determined as the bioactive air period enclosed by "biological zero" of spring and "biological zero" of autumn, basis of thermal balance calculation.

During the ten years analyzed, the longest bioactive period has been in Timisoara of 190 days, between 09 April and 20 October, and the shortest in Cluj 173 days between 17 April and 10 October (Tab. 3).

Tab. 3

Principal climatic elements of the bioactive air period in 2001-2010 and 2011 in the four areas

Area	Period	Bioactive air period	Thermal balance		
			$\sum tg^{*}$	$\sum ta^{**}$	$\sum tu^{***}$
Cluj	2001-2011	173 days 17.IV - 10.X	2882	2809	1150
	2011	181 days 16.IV - 14.X	2977	2930	1208
Timisoara	2001-2011	190 days 9.IV - 20.X	3625	3124	1411
	2011	193 days 5.IV - 18.X	3690	3243	1480
Mica	2001-2011	175 days 15.IV - 6.X	2920	2780	1171
	2011	183 days 17.IV - 17.X	3226	2838	1180
Batos	2001-2011	177 days 14.IV - 8.X	3153	2869	1210
	2011	184 days 13.IV - 14.X	3240	2872	1232

$^{*}\sum tg$ ***Global*** thermal balance - summarizes all positive daily average temperatures during the active life

$^{**}\sum$ta ***Activ*** thermal balance - summarizes the temperatures above "biological zero" or reaches it.

$^{***}\sum tu$ ***Useful*** thermal balance **-** summarizes the differences of temperatures exceeding 10^{o}C biological threshold

In all four areas studied, the duration of the bioactive temperature of the air in 2011 was above the average of the 10 years. Thus, in Timisoara was recorded the longest bioactive period of 193 days, between 5 April and 18 October. Data recorded by the weather station of UASVM Cluj in 2011 reveals the shortest growing season (181 days), starting eight days later than in Timisoara.

As an indication of the vineyard Vocation and production, the sum of degrees of temperature - heat balance - is of crucial importance (Pop, 2010).

In the experimental year 2011, the thermal balance with the highest values was recorded in Timisoara (Global thermal balance (Σtg) 3690^{o}C, Active thermal balance (Σta) 3243^{o}C and Useful thermal balance (Σtu) 1480^{o}C). Thus in Timisoara, as well as in the other three areas in 2011 the temperatures were above average cumulative ten years prior. These results confirm once again that 2011 was particularly favorable to vine culture (Tab. 3).

Therefore we can say that the main elements of the bioactive period climate in the four experimental fields, from 2001-2011, are above the lower limit allowed for vines.

Comparing the average of the thermal balance of the ten years analyzed in the four areas with the thermal balance in other wine regions, such as the center Cozmesti - Husi Vineyard, where from 2003 - 2007, the average global thermal balance was 3914.3°C the average active thermal balance for the same period was 3462.8°C and average active thermal balance of 1469.3°C (Mursa 2009), or vineyards from Oltenia centers where active thermal balance oscillates between 3448°C to Segarcea, the Banu 3403°C Mărăcine, 3316°C to Drăgăsani, 3226°C at Sâmburesti (Popa *et al*., 2008), (Dunoiu *et al*., 2008), we find that Timisoara has the closest values to these areas falling in the areas highly favorable for vine culture. The sum of the degree of temperature within the other three areas sets those areas in the areas favorable for vine culture.

Analyzing the rainfall levels during the period 2001-2010, registered in the four areas, it appears that the highest average was achieved in Timisoara 675.4 mm (Tab. 4). But the other areas are also above the critical value of irrigated grapevine cultivation.

During the growing season (01.IV-30.IX), the average amount of rainfall in these 10 years, showed the highest values at Mica and Batos of 412 mm. Comparing these values with the average rainfall recorded during the vegetation growing in other centers, such as Sâmburesti (385 mm), Corcova (374 mm), Drăgăsani (385 mm), Vânju Mare (309 mm) (Popa *et al*., 2008), one can notice that the water requirements of vines is covered in all four areas analyzed.

Tab. 4

Average monthly and annual rainfall over the period 2001-2010 in the four areas studied (mm)

Area	Month												∑pp active	∑pp annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
C	21.2	19.5	27.0	49.6	66.3	93.8	59.7	71.2	43.3	35.8	32.4	30.8	384	551
T	40.8	47.6	38.5	85.6	58.2	59.7	50.2	92.4	51.9	40.2	57.3	53.0	398	675
M	24.3	26.0	27.6	52.5	54.6	85.2	83.1	57.2	79.8	37.6	38.5	36.6	412	603
B	14.8	30.6	17.1	94.4	52.6	76.9	66.0	88.5	33.4	30.8	33.5	38.2	412	577

Note: ∑pp active = rainfall in the active period 01.IV – 30.IX.

The rainiest months are June, August for the Cluj-Napoca area, April, August to Timisoara, June, July for Mica and April, August to Batos. The least precipitation, for the studied areas are in February, January and November.

Tab. 5

Average monthly and annual rainfall in 2011 in the four areas studied (mm)

Area	Month												∑pp active	∑pp annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
C	29.3	12.4	5.2	23.8	32.3	94.8	80.6	25.8	49.3	56.2	25.7	10.2	307	446
T	30.0	42.0	49.0	78.8	50.2	37.8	30.4	28.0	21.2	17.4	32.3	54.5	246	472
M	35.7	18.4	15.2	29.7	21.0	31.3	114	23.1	43.8	67.0	36.1	25.2	263	461
B	11.7	13.4	16.6	15.2	21.5	48.5	53.2	98.6	54.7	28.7	21.7	10.7	292	395

Note: ∑pp active = rainfall in the active period 01.IV – 30.IX.

Analyzing the data in Tab. 5 shows that the amount of rainfall in the year 2011 in all four areas studied is below the average of the ten preceding years. The largest amounts of rainfall were recorded in Timisoara (471.6 mm) followed at a short distance from Mica (461.2). Also, rainfall during the growing season are well below average values of the years 2001-2011 with less than 152 mm in Timisoara, 149 mm in Mica, 120 mm in Batos and 77 mm in Cluj-Napoca.

We thus conclude that 2011 was a dry year, the rainfall level in the growing season being even smaller than the average of the other growing centers.

Rainfall coefficient (Cp) is the ratio of rainfall during the growing season (mm) and number of days of the growing season.

Tab. 6

Rainfall coefficient in the four analyzed areas

Area	Cp 2001-2010	Cp 2011
Cluj	2.22	1.70
Timisoara	2.09	1.27
Mica	2.35	1.44
Batos	2.33	1.59

In Tab. 6 one can notice that in the period 2001-2010 the rainfall coefficient is higher than in 2011 in all areas, this year having lower moisture resources.

Analysis of the main qualitative indicators. On the wine grape varieties, the largest amount of sugar was accumulated by 'Muscat Ottonel' grown in Timisoara (268 g/l) followed at a significant distance by Fetească neagră also grown in Timisoara (262 g/l) (Tab. 7). Outcomes of other cultivars fall away enough, especially 'Fetească regală' in Cluj and Batos with 183 g/l sugar or 187 g/l sugar, but the results turn out to be higher than those presented by (Damian and Calistru, 1992), 154 g/l in Iasi, (Bunea, 2010) 171 g/l at Gherla, (Sun, 1986, 1998 quoted in Dobrei, 2008) 173 g/l at Drăgăsani and (Moldovan, 1998) 178 g/l at Stefănesti.

Tab. 7

Sugar content, acidity and pH of the wine grape varieties in the four areas

Variety	Area	Sugar (g/l)	Acidity (g H_2SO_4/l)	pH
'Fetească albă'	Timisoara	209 ± 1.46 g	4.97 ± 0.30 de	3.22 ± 0.24 bcd
	Mica	197 ± 3.96 i	5.07 ± 0.20 de	3.26 ± 0.14 bcd
'Fetească regală'	Cluj	183 ± 3.41 l γ	6.82 ± 0.35 a α	2.99 ± 0.27 cd
	Timisoara	202 ± 1.59 h α	4.80 ± 0.13 def β	2.91 ± 0.16 d
	Mica	190 ± 2.96 jk β	5.02 ± 0.23 de β	2.94 ± 0.30 d
	Batos	187 ± 2.42 k βγ	6.45 ± 0.52 ab α	2.96 ± 0.09 d
'Aromat de Iasi'	Cluj	188 ± 0.93 k	5.10 ± 0.07 de	3.74 ± 0.15 a
'Muscat Ottonel'	Cluj	240 ± 2.75 d γ	5.01 ± 0.91 de α	3.39 ± 0.10 abc
	Timisoara	268 ± 3.51 a α	4.32 ± 0.19 ef α	3.31 ± 0.19 bcd
	Mica	251 ± 3.17 c β	4.49 ± 0.04 ef α	3.61 ± 0.25 ab
'Fetească neagră'	Cluj	221 ± 1.64 f γ	5.87 ± 0.24 bc α	3.03 ± 0.07 cd
	Timisoara	262 ± 1.48 b α	4.18 ± 0.68 f β	3.06 ± 0.22 cd
	Mica	234 ± 2.03 e β	5.30 ± 0.14 cd α	3.03 ± 0.26 cd
'Pinot noir'	Cluj	191 ± 3.29 jk β	4.64 ± 0.22 def α	3.12 ± 0.33 cd
	Timisoara	204 ± 3.71 gh α	4.14 ± 0.81 f α	3.12 ± 0.11 cd
	Mica	193 ± 1.83 ij β	4.30 ± 0.07 ef α	3.19 ± 0.29 cd
p		*<0.000*	*<0.000*	*=0.001*

Average value ± standard deviation (n = 3). Greek letters represent significant difference ($p < 0.05$) in the same variety grown in different areas. Roman letters represent significant difference ($p < 0.05$) between varieties. The difference between any two values, followed by at least one common letter, is insignificant. ANOVA for: Sugar: FR ($F_{3,8}$= 29.67; $p < 0.000$); MO ($F_{2,6}$ = 63.6; $p<0.000$); FN ($F_{2,6}$ = 464.66; $p<0.000$); PN ($F_{2,6}$ = 16.58; $p = 0.004$). Acidity; FR ($F_{3,8}$= 26.53; $p < 0.000$); MO ($F_{2,6}$ = 1.34; $p=0.330$); FN ($F_{2,6}$ = 12.33; $p=0.007$); PN ($F_{2,6}$ = 0.83; $p = 0.48$.

Analyzing the reaction of the same variety grown in different areas, it can be seen that the largest sugar accumulation is achieved in Timisoara followed at significant distances by Mica and Cluj.

From the interaction variety x region, we can see that most total acidity has 'Fetească regală' in Cluj (6.82 g H_2SO_4/l), followed at a slight distance also by 'Fetească regală' in Batos (6.45 g H_2SO_4/l). Similar values to 'Fetească regală' were obtained in Transylvania also by the authors (Bunea, 2010) 6.4 g H_2SO_4/l Gherla and (Baractaru, 1986 quoted in Dobrei, 2008) 6.2 g H_2SO_4/l at Blaj.

The lowest values of total acidity were recorded Fetească neagră and 'Pinot noir', both grown in Timisoara with g H_2SO_4/l and 4.14 g H_2SO_4/l (Tab. 7). Comparing the acidity of the same variety in different areas we see that between 'Muscat Ottonel' and 'Pinot noir' does not appear a statistically significant difference; instead Fetească regală from Batos and Cluj were significantly higher than in Timisoara and Mica. Also 'Fetească neagră' has statistically lowest acidity in Timisoara (4.18 g H_2SO_4/l).

The highest pH was found in 'Aromat de Iasi' from Cluj (3.74) and the lowest pH values, significantly lower than the first, has 'Fetească regală' in all four areas (Tab. 7).

Regardless the variety, the largest amount of sugar was accumulated in Timisoara (235 g/l) significantly higher than in Cluj (209 g/l). In Mica no significant differences appear from the first two areas (Tab. 8). Regarding the variety, 'Muscat Ottonel' obtained an average of 254 g/l sugar in three zones, significantly higher than the next cultivar, 'Fetească neagră' 240 g/l. 'Fetească albă' has the lowest quantity of sugar 192 g/l, which is why depending on the area of culture, from this variety only table white wines, high quality white wines or sparkling wines are produced.

Regarding total acidity, significantly higher values are recorded in Cluj (5.57 g H_2SO_4/l) and in the other three zones the variety 'Fetească regală' achieved the highest acid content averaging 5.55 g H_2SO_4/l (Tab. 8). This cultivar is known as one of which wines with relatively high acidity is obtain, so that the result is not surprising.

Tab. 8

The influence of cultivar and area on pH, acidity and sugar content in four wine varieties from three areas

Variety	Average		
	Sugar (g/l)	Acidity(g H_2SO_4/l)	pH
'Fetească regală'	192 ± 9.01 c	5.55 ± 0.98 a	2.95 ± 0.22 b
'Muscat Ottonel'	254 ± 12.9 a	4.61 ± 0.56 bc	3.44 ± 0.21 a
'Fetească neagră'	240 ± 18.7 b	5.12 ± 0.83 ab	3.04 ± 0.17 b
'Pinot noir'	197 ± 6.8 c	4.36 ± 0.48 c	3.14 ± 0.23 b
p	*< 0.000*	*= 0.001*	*< 0.000*
Area	Area average		
Cluj	209 ± 24.1 B	5.59 ± 0.98 A	3.13 ± 0.25 A
Timisoara	235 ± 32.8 A	4.36 ± 0.54 B	3.10 ± 0.21 A
Mica	206 ± 21.5 AB	4.87 ± 0.47 B	3.05 ± 0.27 A
p	*= 0.031*	*= 0.001*	*= 0.761*

Average value ± standard deviation (variety n = 9, area n = 12). Different latin letters indicate significant difference ($p < 0.05$). The difference between any two values, followed by at least one common letter, is insignificant.

The data in Tab. 8 shows that the area had a significant influence on pH value also the from the average of the four varieties, 'Muscat Ottonel' has the highest pH value of 3.44 at a significant distance from other varieties.

We can thus conclude that between the wine grape varieties studied, both sugar and total acidity accumulation are primarily influenced by the area of culture and then of cultivar. Regarding the pH the area had no statistically significant influence.

CONCLUSION

In the didactic plantation of the University of Agricultural Sciences and Veterinary Medicine from Cluj-Napoca, the daily average temperature over the past decade was 9.3 ºC with a maximum of 36.3 ºC and a minimum of -23.0 ºC. The average number of days with active temperatures is 173. In 2011 the average daily temperature was 9.7 ºC and a number of 181days with active temperatures. In the didactic plantation of the University of Agricultural Sciences and Veterinary Medicine of Timisoara, the average daily temperature in 2001-2010 was 11.4 ºC with a maximum of 37.3 ºC and a minimum of -19.4 ºC. The active period for vines had an average of 190 days. In 2011 the average daily temperature was 12.3 ºC and a number of 193 days with active temperatures. In Mica commercial plantation, the last ten years have registered an average temperature of 10.2 ºC. Minimum and maximum temperature over the same period was 36.3 ºC and -20.6 ºC respectively, and was an active

period of 175 days. In 2011 the average temperature was 10.9 ºC with a maximum of 34.4 ºC and a minimum of -18.3 ºC.

In commercial plantation from Batos, there was an average of 10.4 ºC in 2001-2010 and 10.7 ºC in 2011. The active period was of 177 days in the last ten years and 184 days in 2011. From the four areas analyzed in terms of climate, the highest average temperature was recorded at Timisoara, in the period 2001-2010 (11.4 ºC) and in 2011 (12.3 ºC). Also the longest bioactive period was in Timisoara 190 days and 193 days respectively. In all four areas analyzed, the average daily temperatures and bioactive period were higher in 2011 compared with 2001-2010.

Analyzing the year 2011 in terms of rainfall, we can say that it was very dry in all areas studied, with the amount of the rainfall well below average for the preceding ten years.

From the interaction variety x area, the largest amount of sugar on the wine grape varieties, was accumulated by 'Muscat Ottonel' (Timisoara) 265 g/l, and the lowest 'Fetească regală' in Cluj (183 g/l) and 'Aromat de Iasi' in Cluj (188 g/l). Analyzing the same variety in different areas, it is observed that the highest values are always in Timisoara and in Cluj the lowest. The highest influence of the sugar content was exerted by zone followed by variety.

The acidity of wine varieties showed the highest value in 'Fetească regală' (Cluj) (6.82 g H_2SO_4/l), followed by 'Fetească regală' from Batos (6.45 g H_2SO_4/l). Regarding the varieties acidity, the highest influnce was from the variety folloed by the area.

The pH of wine varieties had similar values between variants statistically speaking, remarking 'Aromat de Iasi' by 3.74.

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