

THE CHARACTERISATION OF GRAPEVINE VARIETIES FOR WINES IN THE CONTEXT OF CLIMATE CHANGE IN THE VALEA CALUGAREASCA VITICULTURAL AREA

Liliana PIRCALABU¹, Marian ION¹, Georgeta TUDOR¹, Irina BALANESCU¹

e-mail: pircalabulilialex@yahoo.com

Abstract

Climate change is a reality today and a challenge because the effects need to be evaluated and identified over time. Although it was acclimatized over times in different viticultural climates, grapevine is a plant which has its optimal limits in physiological meaning. The researches were carried out in the Valea Călugărească viticultural center within seven viticultural plantations with the varieties Olivia, Negru aromat, Mamaia, Feteasca neagra 4 VI, Columna, Grasa de Cotnari 4 Pt. In the last 30 years, the climate has changed in the sense that the thermal regime has increased on the background of an unevenly distributed and deficient pluviometric regime, during the vegetation period of the vine. The vegetation period (April) begins with higher average temperatures than the multiannual average (12.6°C compared to 11.2°C) and a high-water regime (74.8 l/square meter compared to 52.0 l/square meter), compared to the multiannual averages. There were registered, also, years with hot summers which significantly influenced the grapevine. During hot summers, vine phenology has changed in that way in which the period between two phenophases was shortened greatly. Also, grapevine evolved under conditions of heat and hydric stress.

Key words: grapevine, climatic change, phenology, phenophases

The reality of climate change is admitted by the vast majority of the scientific community (IPCC, 2014). The viticulture is highly dependent upon climatic conditions during the growing season. The climatic conditions vary from one year to the other. These variations induce the “vintage effect,” year-to-year variations in yield, quality, and typicity (Van Leeuwen T, Darnet L, 2016). Sugar accumulation increases with temperature (Coombe B.G., 1987), but certain secondary metabolites, like anthocyanins, are negatively affected by high temperature (Kliewer M., Torres R., 1972). Grape acidity, in particular the malic acid content, decreases in high temperature (Coombe B.G., 1987). The main measurable effect of climate change is a steady increase in temperature.

Grapevine phenology was modified, all phenological stages are shorter, except bud burst which appeared late. The shorter period of ripening grape berries has changed the composition of grapes sugar, the concentration has significantly increased and the acidity decreased.

MATERIAL AND METHOD

The study was realized in 2019 year, in DOC Dealu Mare-Valea Calugareasca viticultural area specialized in the cultivation of black grapes. The

analysis was performed on Olivia, Negru aromat, Mamaia, Feteasca neagra 4 VI, Columna, Grasa de Cotnari 4 Pt varieties. The soil in the experimental polygon is eumezobasic brown, with a sandy loam texture, pH weak acid (6.1), well supplied with humus (2.9%) and useful mineral elements (N, P, K).

The viticultural climate parameters analyzed were: air temperature, precipitation and insolation. The evaluation was made by comparative analysis of annual and multiannual values. The grapes were harvested at technological and phenological maturity and analyzed in terms of soluble sugar content and total acidity.

RESULTS AND DISCUSSIONS

From an ecoclimatic point of view 2019 was characterized by a moderate heliothermic regime, against the background of rich water resources, especially in April and May, when the multiannual averages were exceeded. The growing period (April) started with average temperatures higher than the multiannual average (12.6°C vs. 11.2°C) and a high water regime (74.8 l/square meter vs. 52.0 l/square meter), compared to multiannual averages (*table 1*).

¹ Research Institute for Viticulture and Enology, Valea Calugareasca

Table 1

The thermal regime in 2019				
Month	The air temperature °C			
	Average		Absolute maxima	Absolute minima
	1999-2018	2019		
I	0.3	-0.4	11.4	-0.8
II	1.9	3.7	19.0	-7.4
III	6.8	8.8	24.5	-3.2
IV	12.6	11.2	26.8	0.5
V	18.1	17.0	28.4	6.0
VI	22.0	23.6	33.7	14.2
VII	24.2	22.7	36.2	11.0
VIII	24.0	24.2	35.5	12.8
IX	18.7	19.1	33.4	6.0
Annual	14.3	14.4	36.2	-7.4

Compared to normal (1999-2018) the average monthly air temperature showed variations between +1.4° (April), +1.1° (May), +1.5° (July) and -1.6°C (June), -0.2°C (August), -0.4°C (September). The year 2019 benefited from a very high thermal resource with multiple influences in the evolution of vegetative phenophases. The

amount of monthly precipitation in 2019 registered compared to the multiannual average (1999-2018) positive differences of 30 mm (April), 123.3 mm (May), +4.1 mm (June), as well as negative differences of -7.4 mm (July), -25.7 mm (August) and -50.6 mm (September) (table 2).

Table 2

Rainfall regime and air hygrosopicity in 2019 year							
Month	Rainfall(mm)		Number of rainy days			Higrosopicity%	
	1999-2018	2019	>0.1 mm	>5 mm	>10 mm	1999-2018	2019
I	33.5	55.2	11	2	2	68.2	86.6
II	28.0	7.8	2	1	-	68.0	74.7
III	35.3	31.4	2		2	69.5	58.3
IV	44.8	74.8	8	1	2	67.7	74.8
V	67.3	190.6	10	5	2	68.4	77.6
VI	81.5	85.6	5	1	4	70.1	70.9
VII	75.8	68.4	3	4	1	67.5	44.6
VIII	62.7	37.0	3		2	66.5	60.9
IX	54.4	3.8	2			70.7	57.9
Annual	483.3	554.6	46	14	15	68.5	67.4

Air hygrosopicity showed positive varying between in April (7.1%), May (9.2%) and June (0.8%) and negative in July (-22.9%), August (-5.6%) and September (-12.8%).

The frequency of air temperatures exceeding the critical threshold of normal development of physiological processes (30°C), in the summer

months shows varying between 71% (August), 41-50% (June-July) and only 13% in September.

Regarding the grape production, the highest values were recorded in the case of varieties: Feteasca neagra 4 VI (3.500 kg/vine), Olivia (3.480 kg/vine), Columna (3.410 kg/vine) and (table 3).

Table 3

Harvest quantity and quality obtained in the wine year 2019						
Variety	Grape production kg/vine		Sugar content g/l		Total acidity g/l sulphuric acid	
	Average 1999-2018	2019	Average 1999-2018	2019	Average 1999-2018	2019
Olivia	3.640	3.480	222.4	228.6	4.6	4.4
Negru aromat	3.420	3.100	216.6	219.8	4.2	4.0
Feteasca neagra 4 VI	3.850	3.500	227.4	238.6	4.4	4.2
Mamaia	4.220	3.450	216.8	224.2	4.6	4.4
Columna	3.530	3.410	186.9	198.6	4.8	4.7
Grasa Cotnari 4 Pt	3.715	3.320	224.8	234.6	4.3	4.2

Compared to the multiannual average, grape production decreased with 3.4% (Columna), 4.4%

(Olivia), 9.36% (Negru aromat), 10% (Grasa Cotnari 4 Pt) and 18.3% (Mamaia).

Regarding the quality of grape production, expressed by the sugar content and the acidity of the must, Feteasca neagra 4 VI variety regarded the highest concentrations of sugars in grapes. Potential accumulation of sugars, a characteristic of the variety, influenced by climatic factors during the period of ripening of the grapes, was variable, with values between 238.6 grams/litre (Feteasca neagra 4 VI) and 234.6 grams/litre (Grasa Cotnari 4 Pt).

The sugar content increased with 1.46% (Negru aromat), 4.69% (Feteasca neagra 4 VI) and 5.89% (Columna).

The total acidity in the climatic conditions of 2019 for the Feteasca neagra 4 VI. variety was 4.2 g/l sulphuric acid and 4.8 g/l sulphuric acid (Columna).

The average weight of a grape was variable, with varying between 90.56 grams (Olivia), 87.63 grams (Grasa Cotnari 4 Pt) and 98.44 grams (Feteasca neagra 4 VI) (table 4).

Table 4

Harvest quantity and quality obtained in the wine year 2019

Variety	The average weight of grape g		Weight of 100 berry, g	
	Average 1999-2018	2019	Average 1999-2018	2019
Olivia	95.28	90.56	132.6	118.4
Negru aromat	92.64	86.24	124.6	112.8
Feteasca neagra 4 VI	104.56	98.44	114.8	102.2
Mamaia	98.82	90.48	106.6	96.4
Columna	88.56	79.26	98.2	89.4
Grasa Cotnari 4 Pt	94.64	87.63	128.6	116.8

Compared to the multiannual average, the average weight of a grape has diminished with 4.95% in case of Olivia variety, 7.41% (Grasa Cotnari 4 Pt) and 10.5% (Columna).

The average weight of 100 berry was variable, with varying between ranging from 118.4 grams (Olivia variety), 116.8 grams (Grasa Cotnari 4 Pt variety) and 102.2 grams (Feteasca neagra 4 VI). The average weight of 100 grains compared to

the multiannual average decreased by 95 in case of Columna variety, 9.5% at Negru aromat variety, 10.7% (Olivia variety) and 11% (Feteasca neagra 4 VI).

The leaf area required for the production of one gram of grapes in the conditions of maximum accumulations of sugars when harvesting Olivia grapes was 11.72 square centimeter/vine (table 5).

Table 5

The relationship between leaf area / production

Variety	Leaf area square meter		Grape production kg/vine		Area required for ripening one gram of fruit (square centimeters / g)	
	Average 1999-2018	2019	Average 1999-2018	2019	Average 1999-2018	2019
Olivia	4.36	4.08	3.640	3.480	11.98	11.72
Negru aromat	3.24	2.86	3.420	3.100	9.47	9.23
Feteasca neagra 4 VI	4.12	3.46	3.850	3.500	10.70	9.89
Mamaia	3.23	3.76	4.220	3.450	9.43	9.36
Columna	3.54	3.26	3.530	3.410	10.03	9.56
Grasa Cotnari 4 Pt	4.06	3.48	3.715	3.320	10.93	10.48

For the Fetească neagră 4 VI. variety, the leaf area of 3.46 square meter/vine can ensure the maturation of a production of 3.500 kg of grapes, the leaf area necessary to achieve a gram of ripe fruit having value of 9.89 square centimeters/g, at a sugar content of 238.6 g/l of must. The leaf area of varieties has been reduced with 6.42% (Olivia), 11.73% (Negru aromat), 16.02% (Feteasca neagra) and 18.84% (Mamaia).

CONCLUSIONS

High temperatures and precipitation in lower quantities have affected grape production and vegetative growth is lower.

The grape production and must content are influenced by climate change. The highest production was obtained in the case of Feteasca neagra 4 VI variety (3.500 kg/vine) followed by Grasa Cotnari 4 Pt variety (3.320 kg/vine).

In order to achieve the production of 3.500 kg/vinethe Feteasca neagra 4 VI varirty requires a leaf area of 3.46 square meter/vine.

Potential accumulation of sugars, a characteristic of the variety, was variable, with values between 238.6 grams/litre (Feteasca neagra 4 VI) and 234.6 grams/litre (Grasa Cotnari 4 Pt). The sugar content increased with 1.46% (Negru aromat), 4.69% (Feteasca neagra 4 VI) and 5.89% (Columna).

REFERENCES

Ball S.T., 1998 - Alfalfa Growth Stages, New Mexico State University, Guide A-330, available on-line at: <http://lubbock.tamu.edu/>.

Coombe B.G., 1987 - *Influence of temperature on composition and quality of grapes*. In: Proceedings of the Symposium on Grapevine Canopy and Vigor Management. Acta Hortic. 206, 23–35.

Cornelis van Leeuwen and Philippe Darriet, 2016 - *The impact of climate change on viticulture and wine quality*, Jurnal of wine ecomics, 11(1):150-167, doi:10.1017/jwe.2015.21

Kliewer M., and Torres R., 1972 - *Effect of controlled day and night temperatures on grape coloration*. American Journal of Enology and Viticulture, 23(2):71–77.

Seguin B., 2009 - *Le changement climatique: Etat des connaissances et première approche des conséquences pour viticulture*. Revue Francaise d'oenologie, bimestriel no. 235, avril/mai, p. 2-9.