ANALYSIS OF VULNERABILITY OF SOME WINE GRAPE VARIETIES UNDER TEMPERATURE CONDITIONS DURING VEGETATIVE RESTING STATE

IONUŢ DASCĂLU[1], NICOLETA MATEOC-SÎRB[1]
[1] Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, Romania
e-mail: dascalu_ionut91@yahoo.com, e-mail: mateocnicol@yahoo.com

Abstract: *It is well known that temperature is the main climate factor that influences the entire lifecycle of grape vine. Thus, at the same temperature level, grape vines respond differently depending on phenological phase, cultivar, age etc. In this paper, the authors present results of research pointing out the different response of wine grape vine varieties to negative thermal stress during the vegetative resting state. Research was carried out in the viticultural area Plenița - Plaiurile Drâncei grapevine plantation between 2014 and 2016, and aimed at monitoring and analysing data regarding thermal resources and negative thermal risk parameters, and cultivar vulnerability to critical temperature conditions.*

Keywords*: vulnerability, wine grape varieties, vegetative resting, negative thermal stress, viticultural area.*

INTRODUCTION

The study was carried out at the S.C. Pomiviticola S.R.L. from Plenița, Dolj County, Romania, on a young grapevine plantation (4th-5th-plantation years) covering 30 ha.

Observations and measurements focused on the assessment of potential negative thermal stress in grapevine and of the biological adaptation and resistance potential of the studied varieties at low temperatures during vegetative resting through the measurement of main and secondary damaged buds (%).

MATERIALS AND METHOD

In order to achieve our goals, we analysed seven wine grape varieties: three white wine grape varieties – Italian Riesling, the semi-flavoured Sauvignon variety, the flavoured Romanian Tămâioasă variety – and four red wine grape varieties – Merlot, Syrah, Cabernet Sauvignon and Black Fetească. These varieties have been grafted on Berlandieri x Riparia Oppenheim Selection 4 (OS4), at a planting distance of 2.2 x 1.0 m, with an average of 4545 vines/ha, in a semi-protected cultivation system, semi-high leading, Guyot cutting type, with an average load of 10-12 buds/m2.

The biological material used for analysis consisted in vine shoots sampled in the first decade of March.

The experiment was structured according to the randomised block method with seven variants (soils) and 5 vines of each grape variety (10 vines per variant).

RESULTS AND DISCUSSION

In order to monitor negative thermal stress parameters, we observed the time of the first and last frost (white frost and early fall frosts and late spring frosts), duration (days), frequency (number of days and %), and winter frost intensity (Table 1)**.**

Table 1

Early fall frosts and late spring frosts in the studied area (2014-2016)

Year	First fall frost		Last spring frost	
	Date	T min (^{0}C)	Date	T min (^{0}C)
2014/2015	5.11.2014	0,0	24.03.2015	-1,0
			20.03.2015	-3,0
2015/2016	1.11.2015	0,0	26.03.2016	-3,0
	2.11.2015	-3,0		

Source: *Processed weather data http://romanian.wunderground.com/history/airport/LRCV*

As for the negative thermal risk factors, based on the studied weather data, the earliest fall frost during 2014-2016 was on November 1st, 2015 (0°C), while the latest spring frost was on March 23rd, 2016 (-3.0°C) (Table 2).

Table 2

Duration and frequency of frosts (2014-2016)

Vegetative resting	Minimal temperatures (Tmz) ≤ 0^{0}C (days of frost)							
	Duration (days)	Frost period	Number of days per month						
			X	XI	XII	I	II	II	IV
2014/2015	86	November-April	**0**	**7**	**22**	**22**	**20**	**14**	**1**
2015/2016	64	November-March	**0**	**5**	**18**	**29**	**7**	**5**	**0**

Source: *Processed weather data http://romanian.wunderground.com/history/airport/LRCV*

As for the duration of the frost (expressed as the number of days with daily minimal temperatures ≤ 0°C) during the studied period and in the studied area, it ranged between 64 days (November 2015 - March 2016) and 86 days (November 2014 - April 2015), with a possible frost-free period of 274 days (Table 3).

Table 3

Frequency and level of critical minimal temperatures (2014-2016)

Vegetative resting	Daily minimal air temperature (Tmz) (° C)					
	-15,0… -18 ° C		-18,1… -22,0 ° C		-22,1… -24,0 ° C	
	Date	Tmz	Date	Tmz	Date	Tma
2014/2015	31.12.2014 8.01.2015 11.02.2015	-15,0 -15,0 -15,0	1.01.2015	-20,0	-	-
2015/2016	20.01.2016 21.01.2016 23.01.2016 24.01.2016 25.01.2016	- 18,0 - 18,0 - 18,0 - 18,0 - 18,0	19.01.2016	-19,0	-	-

Source: *Processed weather data http://romanian.wunderground.com/history/airport/LRCV*

Analysing the frequency of minimal critical temperatures, we see that the vegetative resting period 2015-2016 is remarkable for its duration and persistence: for three consecutive days, minimal daily temperatures reached ≤ -18 °C (19, 20 and 21 January 2016, followed by 23, 24 and 25 January 2016) (Table 4).

Table 4

Frost duration and intensity 2015-2016

Date	Duration of frost	Temp	Cold wind	U.R. (%)	Direction of main wind	Wind speed min.-max.
2015						
1 January	12 h 00min	-14 °C...-20,0 °C	-18,9 ...- 26,5 °C	85	NNV / V	1.0 m/s - 4.1 m/s
2016						
19 January	3 h 00min	-18 °C...-19 °C	-	89		
20 January	10 h30min	-15 °C...-20 °C	-22,4 °C	90	NNE	1.0 m/s - 3.0 m/s
21 January	9 h 00min	-15 °C...-18 °C	-20 ...-24 °C	89	VNV/ VSV	1.0 m/s - 3.1 m/s
23 January	5 h 30 min	-15 °C...-18 °C	-17,7...- 21 °C	89	NNV / V	1.0 m/s - 3.1 m/s

Source: *Processed weather data http://romanian.wunderground.com/history/airport/LRCV*

The most intense frost was on January 1st 2015, when for 12 consecutive hours air temperature was below -14.0°C, with an absolute minimal temperature of -20.0°C. There was intense frost on 20 and 21 January 2016, for over 9 h, when minimal air temperature was below -15.0°C, with an absolute minimal temperature of -20.0°C.

We need to mention that, because of the cold wind at low speeds that prevented the mixture of air strata, the temperature at plant level was between -17.7 and -26.5°C (2015), -24.0°C (2016). The data were partially confirmed by the meteorological station on the plantation (that functioned intermittently).

Table 5

Vulnerability of grapevine varieties to critical temperature conditions during vegetative resting (2014/2015 - 2015/2016)

Variety	Main buds damaged (%)		Mean/ variety/ year	Secondary buds damaged (%)		Mean/ variety/ year
	2015	2016		2015	2016	
Merlot	58,34	56,71	**57,525**	31,24	23,12	**27,18**
Syrah	64,35	68,27	**66,31**	37,18	33,46	**35,32**
Cabernet Sauvignon	36,38	40,56	**38,47**	16,29	16,73	**16,51**
Black Feteasc㠔	31,26	27,42	**29,34**	18,48	20,45	**19,47**
Romanian Tămâioasă	59,27	49,61	**54,44**	29,53	28,71	**29,12**
Sauvignon	51,25	46,4	**48,825**	34,32	33,45	**33,89**
Italian Riesling	44,59	33,82	**39,205**	17,89	14,78	**16,34**
Mean/variety/year	**49,35**	**46,11**	-	**26,42**	**24,39**	-

Source: *Our own research*

The most considerable bud losses (main and secondary) were during the vegetative resting of 2014-2015. Among varieties, the highest bud losses during 2015-2016 were in the varieties Syrah (66.31% of the main buds and 35.32% of the secondary buds), Merlot (57.52% of the main buds) and Romanian Tămâioasă.

The lowest losses of buds were in the Black Feteasc㠔 (29.34% of the main buds).

Figure 1. Recovery cuts of frost affected stems in Plenița
Source: *Personal archive*

Because of the critical conditions during the fall and winter and of the high bud losses in both 2015 and 2016 we proceeded to the recovery of the stems affected by the frost using tendrils from safety vines (buried in the fall of 2014 and of 2015), respectively) and operated recovery trimming of fructification elements and compensation of damaged buds on annual tendrils.

CONCLUSIONS

- With critical temperatures of -20.0°C as absolute minimal temperature, with temperatures between -14.0…-20.0°C for 12 consecutive hours, the grapevines analysed can be grouped from the perspective of the percentage of damaged buds ad follows:
  - ***medium resistance*** (25-50% of damaged buds) – the varieties Black Fetească, Cabernet Sauvignon and Italian Riesling;
  - ***low resistance*** (50-75% of damaged buds) – the varieties Syrah, Romanian Tămâioasă, Merlot and Sauvignon.
- With ongoing and persistent frost and critical temperatures ≤ -19.0°C ranging at plant level between -17.7...- 24.0°C because of the cold, low speed wind, the grapevine varieties can be grouped from the perspective of frost resistance as follows:
  - ***medium resistance*** (25-50% of damaged buds) – the varieties Black Fetească, Cabernet Sauvignon, Italian Riesling, Romanian Tămâioasă and Sauvignon;
  - ***low resistance*** (50-75% of damaged buds) – the varieties Syrah and Merlot.
- Knowing the way each variety interacts with climate is a decisive factor in viticultural zoning.

REFERENCES

1. CICHI DANIELA DOLORIS, 2005, Cercetări privind comportarea viţei de vie la stres termic,Teza de doctorat –Univ.Craiova;
2. CICHI DANIELA DOLORIS, 2006, Modificările termice din ecosistemul viticol (cauze, efecte asupra viţei de vie), Editura Universitaria, Craiova;
3. DINU I., 2008, Orevița și Golul Drâncii- podgorii reputate pentru vinuri roșii, Editura Europa, Craiova;
4. OŞLOBEANU M., **MACICI M., GEORGESCU MAGDALENA, STOIAN V.**, 1991 - Zonarea soiurilor de viță de vie din România. Edit. Ceres, Bucureşti;
5. TEODORESCU ŞT., POPA A., SANDU GH.,1987, Oenoclimatul României. Ed. Ştiinţificã şi Enciclopedicã, Bucureşti;
6.***http://romanian.wunderground.com/history/airport/LRCV.