Journal of Agricultural Sciences
Vol. 51, No 1, 2006
Pages 31- 37

UDC: 634.853:634.8.05
Original scientific paper

TOLERANCE OF THE MERLO VARIETY POPULATION TO LOW TEMPERATURES IN CONTROLLED CONDITIONS

D. Vujović[1] and Radojka Maletić[1]

Abstract: Tests were carried out on the influence of low temperatures during winter dormancy on per cent of central and lateral buds freezing in Merlot Standard and its varieties. The method applied was *in vitro* artificial freezing of cuttings of one-year-old shoots in cold storage. Three low temperatures were applied: -15^0C, -20^0C and -25^0C. Tests were performed simultaneously in all varieties three times during winter on December 25, January 25 and February 25 in 1998, 1999 and 2000.

The results indicate statistically significant differences between studied varieties and low temperatures applied. Damage of central and lateral buds was significantly lower at -20^0C than at -25^0C.

Key words: central winter bud, lateral bud, standard, variety, temperature, freezing point.

Introduction

Resistance to low temperatures is a biological trait of the cultivar; it is a genetic factor. For evaluation of the level of resistance caused by hereditary basis of the cultivar, the following factors should be equalized: location of the investigation, cultivation method, time and method of investigation. Investigation should be carried out during winter dormancy period several times (three) and over a longer period of time (several years), since the danger regarding the incidence of low temperatures is present for several months. Temperatures prior to critically low temperatures greatly influence the expression of the degree of resistance during winter dormancy period.

This problem was investigated by: Todorov (1967), Kondo (1970), Cindrić et al., (1974) and Avramov, et al., (1987).

The aim of the paper was to register differences in the degree of resistance of central winter buds and lateral buds to low temperatures between the investigated cultivar Merlot Standard and its varieties during winter dormancy period.

[1] Dragan Vujović, PhD, Assistant; Radojka Maletić, PhD, Associate Professor, Faculty of Agriculture, 11081, Belgrade-Zemun, Nemanjina 6, Serbia and Montenegro

Materials and Methods

The experimental vineyard was planted in 1991 on the experimental site of Radmilovac of the Faculty of Agriculture in Zemun. Cuts of one-year-old shoots of cultivar Merlot Standard and 11 varieties were investigated.

The method of *in vitro* artificial freezing in cold chamber was used (authors Guzun et al., 1972; Eifert, 1975 and Pogosjan, 1975) since low temperatures are very dangerous for grapevine and are not present every year in Grocka vinegrowing region.

Samples of cuts of one year old shoots (two) with 15 central buds each were taken three times: on December 25, January 25 and February 25.

Cuts were kept in cold chamber 24 hours at the temperature of -5^{0}C; temperature was gradually lowered by three degrees Celsius per hour until -25^{0}C was reached. At this temperature and according to the mentioned methodology, cuts were kept for 11 hours and after that period temperature was gradually increased by three degrees Celsius per hour until room temperature of 22^{0}C was reached. Three low temperatures were applied: -15^{0}C, -20^{0}C and -25^{0}C.

One week after freezing, using magnifying glass with ten fold magnifying ability, the degree of damage was estimated on a vertical section of central buds and lateral buds. Investigations were carried out during three years: 1998, 1999 and 2000. The mentioned investigation periods characterize the resistance of the cultivar Merlot Standard and its varieties at the beginning, during and at the end of the winter. Codes for varieties are given in Tables 1 and 2.

The obtained experimental data were processed using mathematical-statistical analysis (Hadživuković, 1991). In order to determine the statistical significance of obtained differences in regard to the percentage of frozen winter central buds and lateral buds of investigated varieties and cultivar Merlot Standard according to years and different temperatures, as well as their interactions, statistical method according to Fischer variance analysis was used. Evaluation of significance was carried out based on F-test and LSD-test for threshold of significance of 5% and 1%.

$$y_{ijk} = \mu + \alpha_i + \beta_j + \gamma_l + (\alpha\beta)_{ij} + (\alpha\gamma)_{il} + (\beta\gamma)_{jl} + (\alpha\beta\gamma)_{ijl} + \varepsilon_{ijlk}$$

(i=1,2,3; j=1,2; l=1,2,....2, k=1,2,3)

Data regarding investigated parameters for the temperature of -15^{0}C were not used in further mathematical-statistical analysis and interpretation since no damage in central buds and lateral buds was determined at this temperature (-15^{0}C) in all three investigation years.

Results and Discussion

In Table 1 average percentage of frozen winter central buds at the temperature of -20°C and -25°C for cultivar Merlot (standard) and 11 varieties of this cultivar in the period from 1998 to 2000 are presented.

In all experimental years, at the temperature of -25°C and in case of all varieties, the higher percentage of frozen central buds/eyes was registered (Tab. 1). In other words, at the temperature of -20°C average percentage of frozen winter central buds in all investigation years was approx. 44%, whereas at the temperature of -25°C it was approx. 65%.

T a b. 1. - Average percentage of frozen winter central buds, %

Code variances and standard	Year 1998		1999		2000	
	Temperature					
	-20°C	-25°C	-20°C	-25°C	-20°C	-25°C
Merlo standard	66.28	95.62	67.33	96.75	66.84	97.37
022	40.19	66.46	43.19	69.33	41.15	67.43
023	45.08	46.85	48.00	72.97	46.08	69.31
025	32.93	68.56	36.16	69.57	33.92	68.11
026	36.73	49.50	40.06	52.69	35.85	50.54
027	43.45	62.07	45.07	63.06	46.09	65.73
028	41.73	55.68	42.88	56.82	45.34	59.33
029	43.10	57.75	44.11	58.85	47.35	61.64
030	37.66	65.79	38.81	66.56	41.75	69.26
031	44.37	65.01	45.43	65.51	48.33	68.61
033	39.04	63.52	40.05	64.48	43.30	67.07
034	36.07	60.97	37.09	62.14	39.47	64.95
$\bar{x}$	42.22	63.15	44.02	66.56	44.62	67.44
Cv (%)	19.98	19.38	18.54	16.66	18.62	16.11

Table 2 demonstrates the variation of the percentage of frozen lateral buds of cultivar Merlot (standard) and its 11 varieties at the experimental temperatures of -20°C and -25°C during three years (1998, 1999 and 2000).

Analysis of data presented in Table 2 shows that in all investigation years at the temperature of -25°C in case of all varieties considerably higher percentage of frozen lateral buds was registered compared to experimental temperature of -20°C. In all three investigation years at the temperature of -20°C, on average, the percentage of frozen lateral buds varied from 34% to 37%, and at the temperature of -25°C from 60% to 63%. Also, in case of higher temperature (-20°C) lower degree of relative variation of monitored trait/occurrence was registered (Cv approx. 9%), whereas at lower temperatures (-25°C) it was above 12%.

Percentage of frozen lateral buds is considerably higher at lower temperature (-25^{0}C) in case of all varieties and all investigation years. It can also be concluded that this percentage was considerably equal in all investigation years.

T a b . 2. - Average percentage of frozen lateral buds, %

Code variances and standard	Year 1998		1999		2000	
	Temperature -20^{0}C	-25^{0}C	-20^{0}C	-25^{0}C	-20^{0}C	-25^{0}C
Merlo standard	33.94	74.61	34.96	75.63	37.41	78.19
022	41.41	62.70	42.43	63.87	45.19	67.05
023	29.19	56.62	30.13	57.80	32.99	60.70
025	33.47	64.02	34.55	64.67	36.95	67.90
026	36.87	46.18	37.68	47.06	40.47	49.89
027	34.07	53.84	34.71	55.19	37.37	57.85
028	35.25	53.50	35.90	54.41	38.14	56.81
029	31.51	50.81	32.33	51.95	34.93	57.37
030	30.19	65.86	30.45	66.93	33.11	70.01
031	32.76	60.96	33.97	62.05	36.39	64.51
033	31.45	62.51	32.51	63.41	34.85	66.22
034	36.25	60.29	37.09	61.03	39.97	64.22
$\bar{x}$	33.86	59.32	34.72	60.33	37.31	63.14
Cv (%)	9.82	12.86	9.74	12.60	9.17	12.18

Analysis of variance produced evaluation of significance of recorded differences in regard to the percentage of frozen winter central buds and lateral buds between varieties and standard (cultivar Merlot) in investigation years and different temperatures, as well as significance of differences determined between frozen winter central buds and lateral buds under the influence of both or all three factors at the same time (interaction of factors of the first and second order). Values of F-test for individual indicators and their interactions are presented in Table 3.

Registered difference in the number of frozen winter central buds in experimental years was not statistically significant (Tab. 3), $F_{UZ} < F_{0.05}$. Defined differences in the number of frozen winter buds at different temperatures were statistically highly significant ($P< 0.01$). Also, differences between all investigated varieties were statistically highly significant ($P<0.01$). Interactions of factors, at both levels, were not statistically significant ($P >0.05$).

Concerning the number of frozen lateral buds, statistically significant difference was registered only between experimental freezing temperatures, table 3. Differences in the effect of other factors as well as their interactions had no statistically significant effect on the number of frozen lateral buds ($F_{UZ} < F_{0.05}$).

T a b. 3.- F-test values of the analyzed properties

Variation sources	F-values	
	Central winter bud	Lateral buds
Year	0.7926^{NS}	0.5910^{NS}
Temperature	93.9707^{**}	81.6744**
Variances	5.2732^{**}	0.6836^{NS}
Year x Temperature	0.0665^{NS}	0.0014^{NS}
Year x Variances	0.1080^{NS}	0.0003^{NS}
Temperature x Variances	0.7502^{NS}	0.7612^{NS}
Year x Temperature x Variances	0.0774^{NS}	0.0002^{NS}

^{NS}Stat. non significant ** Significant at the level of 1%

LSD	Year	Temperature	Variances	Year x Temper.	Yearx Variances	Temper. x Varances	Year. x Temper. x Variances
				Central winter buds			
0.05	5.4703	4.4664	10.9405	8.0801	18.9496	15.4722	26.7987
0.01	7.2006	5.8793	14.4013	10.6361	24.9437	20.3665	35.2758
				Lateral buds			
0.05	6.8086	5.5592	13.6172	10.0570	23.5857	19.2576	33.3552
0.01	8.9623	7.3176	17.9246	13.2382	31.0464	25.3493	43.9063

Conclusion

Based on the results of three-year investigations of the resistance of cultivar Merlot standard and its varieties to low temperatures under *in vitro* conditions, the following can be concluded:

At the temperature of -15^{0}C no damage caused by freezing was registered in central buds or lateral buds of cultivar Merlot Standard and its investigated varieties.

Variety 025 demonstrated relatively high resistance of winter central buds at the temperature of -20^{0}C, and variety 026 at the temperature of -25^{0}C.

Relatively high resistance of winter central buds at the temperature of -20^{0}C was also demonstrated by varieties 026, 030 and 034, and at the temperature of -25^{0}C at the varieties 028 and 029.

Variety 023 demonstrated relatively high resistance of lateral buds at the temperature of -20^{0}C, and varieties 026 and 029 have demonstrated relatively high resistance of lateral buds at the temperature of -25^{0}C.

Relatively high resistance of lateral buds at the temperature of -20^{0}C was also demonstrated by varieties 027, 029 and 030.

At the temperature of -25^{0}C relatively high resistance of lateral buds was also demonstrated by varieties 027 and 028.

According to the results of investigation on the resistance of winter central buds and lateral buds under *in vitro* conditions, cultivar Merlot can be grown without any risk in Grocka vinegrowing region to the temperatures of -15^{0}C.

However, in the case of lower temperatures, -20°C and -25°C, damage of different intensities is present in winter central buds and lateral buds.

REFERENCES

1. Avramov, L., Žunić, D., Vučićević, R. (1987): Ocena otpornosti nekih domaćih novostvorenih standardnih i novointrodukovanih stonih sorti vinove loze na niske zimske temperature tokom 1984/85 godine u uslovima svetozarevačkog vinogorja, Jugos. vinogr. i vinarstvo, br. 1-2, str. 15-17.

2. Cindrić, P. (1984): Otpornost vinove loze prema niskim temperaturama. Fiziologija vinove loze, str. 147-174, Izdanje SANU, Beograd.

3. Guzun, N.I., Černomorec, M.V., Ćipko, M.V.(1972): Opredelenije morozostojkosti vinograda putem iskusstveno promoročivanije Sadovodstvo, vinogr. i vinodelie Moldavii, 11.

4. Hadživuković, S. (1991): Statistički metodi. Drugo prošireno izdanje, Poljoprivredni fakultet, Novi Sad.

5. Kondo, J.N. (1970): Ustoičivost vonogradnovo rastenia k morozam, zasuhe i počvenomu zasoleniju. «Kartja Mol-dovenjaske», Kišinjev.

6. Pogosjan, K.S. (1975): Fiziologičeskie osobenosti morozoustojčivosti vinogradnovo rastenija. Izd.-vo AN Armjanskoj SSSR, Erevan.

7. Todorov, H., Georgijev, Z. (1967): Izmrzavanje na lozota i vzmožnosta za plododavanie. Gradinarska i lozarka nauka, 3, p.17-29.

Received November 7, 2005
Accepted May 18, 2006

OTPORNOST VARIJETETA SORTE MERLO PREMA NISKIM TEMPERATURAMA U KONTROLISANIM USLOVIMA

D. Vujović[1] i Radojka Maletić[1]

Rezime

Ispitivan je uticaj niskih temperatura u periodu zimskog mirovanja na procenat izmrzavanja zimskih okaca i suočica kod varijeteta sorte merlo. Primenjena je *in vitro* metoda veštačkog izmrzavanja reznica jednogodišnjeg lastara u hladnoj komori. Primenjene su tri niske temperature -15°C, -20°C i -25°C. Testiranja su izvođena istovremeno kod svih varijeteta, tri puta u toku zime 25. decembra, 25. januara i 25. februara 1998, 1999 i 2000 godine.

[1] Dr Dragan Vujović, asistent, dr Radojka Maletić, vanredni profesor, Poljoprivredni fakultet, 11081 Beograd-Zemun, Nemanjina 6, Srbija i Crna Gora

Pri temperaturi od -15^{0}C nisu ispoljene štete od izmrzavanja kako na okcima, tako i na suočicama sorte merlo standard i njenih ispitivanih varijeteta.

Ustanovljeno je da postoje statistički značajne razlike između ispitivanih varijeteta i primenjenih niskih temperatura. Oštećenja okaca i suočica bila su značajno niža na -20^{0}C nego na -25^{0}C.

Prema rezultatima ispitivanja otpornosti okaca i suočica u *in vitro* uslovima sorta merlo se može bez rizika gajiti u gročanskom vinogorju do -15^{0}C. Međutim, pri nižim temperaturama -20^{0}C i -25^{0}C ispoljavaju se oštećenja različitog intenziteta na okcima i suočicama.

Primljeno 7. novembra 2005.
Odobreno 18. maja 2006.