

## NÉHÁNY MAGYARORSZÁGON IS TERMESZTETT BORSZŐLŐFAJTA FAGYTŰRŐ-KÉPESSÉGÉNEK VIZSGÁLATA 2018/2019 TELÉN

Bozó Ádám – Zsófi Zsolt

### Összefoglalás

*Kutatásunk során négy borszőlőfajta téli rügyeinek fagytüdő-képességét vizsgáltuk (Kékfrankos, Ménesi Kadarka, Merlot, és Syrah). A mintákat a Kölyuktető dűlőből (Eszterházy Károly Egyetem Szőlőbirtok) gyűjtöttük közvetlenül a mérések előtt. A vizsgálat 2018 decemberétől 2019. március végéig tartott. Méréseinket egy differenciális hőelemzésre alkalmas eszközzel (DTA) végeztük, felhasználva a növényi sejten kívüli és sejten belüli víz megfagyásakor történő látens hő képződését. Eredményeink alapján a téli időszakban a Kékfrankos bizonyult a leginkább ellenállóbbnak, majd a Ménesi Kadarka, Syrah és Merlot. A rügyfakadáshoz közeledve a Ménesi Kadarka fagytüdő-képessége a többi fajtához képest nagyobb mértékű csökkenést mutatott.*

**Kulcsszavak:** borszőlő, fagytüdő-képesség, differenciális hőelemzés, DTA, téli rügy

## BUD COLD-HARDINESS OF SOME VITIS VINIFERA L. CULTIVARS DURING THE DORMANT SEASON OF 2018/2019

### Abstract

*In our research we examined the bud cold-hardiness of four Vitis vinifera L. cultivars (Lemberger, Cadarca de Minis, Merlot and Syrah). The samples were collected from vines growing outdoors in the Kölyuktető vineyard (Eszterházy Károly University). The work was conducted between December 2018 and March 2019. A Differential Thermal Analyser had been used to define the low temperature exotherms during the intracellular fluid freezing. According to our results, Lemberger showed the highest hardiness among all tested cultivars, followed by Cadarca de Minis, Syrah and Merlot. Cadarca de Minis appeared to lose hardiness more rapidly in spring, indicating it could be sensitive to spring frosts.*

**Keywords:** bud cold-hardiness, differential thermal analysis, DTA, dormant bud, grapevine

## Introduction

Bud cold-hardiness can be a limiting factor at the production of *Vitis vinifera* L. cultivars in cool climate areas, where critically low temperatures can occur during the dormant season. Frost events after budburst can cause substantial yield losses as well, but (unlike against the hard winter frosts in midwinter) we can find effective methods to protect the different plants against these events (Poling, 2008; Lakatos, 2017a). Site selection and choosing frost tolerant cultivars for planting seems a reliable way to prevent frost damages in the dormant season.

Buds are usually one of the most sensitive parts of the dormant grapevine, however they are able to avoid freezing injury by deep supercooling (Andrews et al., 1984). Frost damage occurs, when the intracellular fluid freezes and the ice crystals penetrates the cell compartments. In order to describe the bud cold-hardiness we need information about the freezing temperature of the intracellular water. According to Mills et al. (2006): “*When supercooled water freezes extracellularly, the heat released is referred to as a high-temperature exotherm (HTE); extracellular freezing is considered nonlethal. On the other hand, the freezing of intracellular water creates a similar, low-temperature exotherm (LTE) and is lethal (Burke et al., 1976)*”. These exotherms can be detected by differential thermal analysis (Quamme, 1991).

Another methodology was used by Ferguson et al. (2014) to predict the cold-hardiness of the dormant buds for 23 *Vitis* genotypes at the Washington State University. The WSU cold-hardiness model uses daily temperature data and genotype-specific parameters to predict bud cold-hardiness between 7<sup>th</sup> September and 15<sup>th</sup> May. In Hungary, the same model was used to estimate the occurrence and frequency of frost damage in autumn, winter and spring in several wine regions of Hungary (Lakatos, 2017b and Lakatos et al., 2017).

The objective of this study was to examine the bud cold-hardiness of four commonly grown *Vitis vinifera* L. cultivars in the Eger Wine Region, Hungary, by using a Differential Thermal Analyser.

## Materials and methods

### *Plant materials*

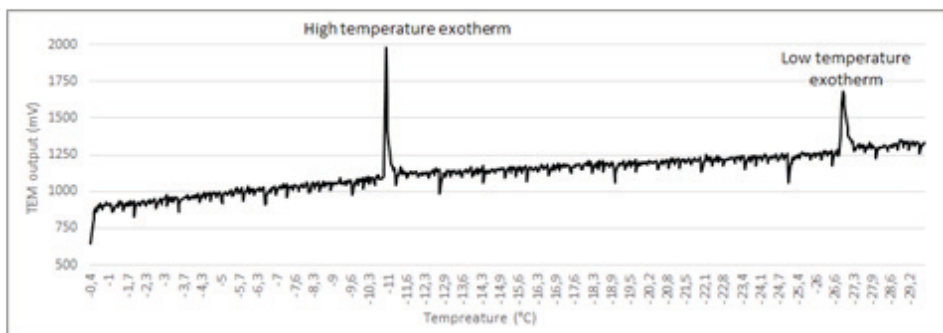
The following *Vitis vinifera* L. cultivars were examined during the experiment:

- Cadarca de Minis (convar. pontica. subconvar. balcanica.; *Ménesi Kadarka* in Hungary, which is a subvariety of *Kadarka*; Werner et al., 2013), planted in 2004
- Lemberger (convar. orientalis. subconvar. caspica.; also known as Blaufränkisch, *Kékfrankos* in Hungary), planted in 2001

- Merlot (convar. occidentalis. subconvar. gallica.), planted in 1999
- Syrah (Dureza x Mondeuse blanche; also known as Shiraz; Bowers et al., 2000), planted in 2004
- The experimental site is located in the Kőlyuktető vineyard, Eger, Hungary. For each variety a parcel including 130 plants was used to collect cane and bud samples.

### ***Bud cold-hardiness determination***

Cane samples were collected randomly from the experimental parcel just before the measurements from 5-5 different plants. One bud between the 6<sup>th</sup> - 8<sup>th</sup> nodes were removed from each cane samples respectively, by a sharp scalpel with approx. 2 mm of intact cane tissue surrounding and underlying the bud. The surface of the cuttings were coated with *Vaseline* and then the 5 buds/cultivars were placed on the thermoelectric modules inside the freezing chamber of the Differential Thermal Analyser (previous studies show that: “*thermal contact can be increased by applying silicon grease or a thermal conducting paste to the surfaces of the sensor and tissue that are in contact*”; Quamme, 1991). Two *Vitis vinifera* L. cultivars were measured at the same time (Lemberger with Cadarca de Minis and Merlot with Syrah). We used the  $-6\text{ }^{\circ}\text{C h}^{-1}$  cooling rate and the freezing process lasted for 5 hours (lowering the temperature of the freezing chamber from  $0^{\circ}\text{C}$  to  $-30^{\circ}\text{C}$  in total). The signals have been recorded at 5 sec intervals from each thermoelectric module. Low temperature exotherms were identified manually from the output curves in Excel (Fig.1). The cultivars were tested weakly between December 2018 and March 2019 (except the winter holiday season).

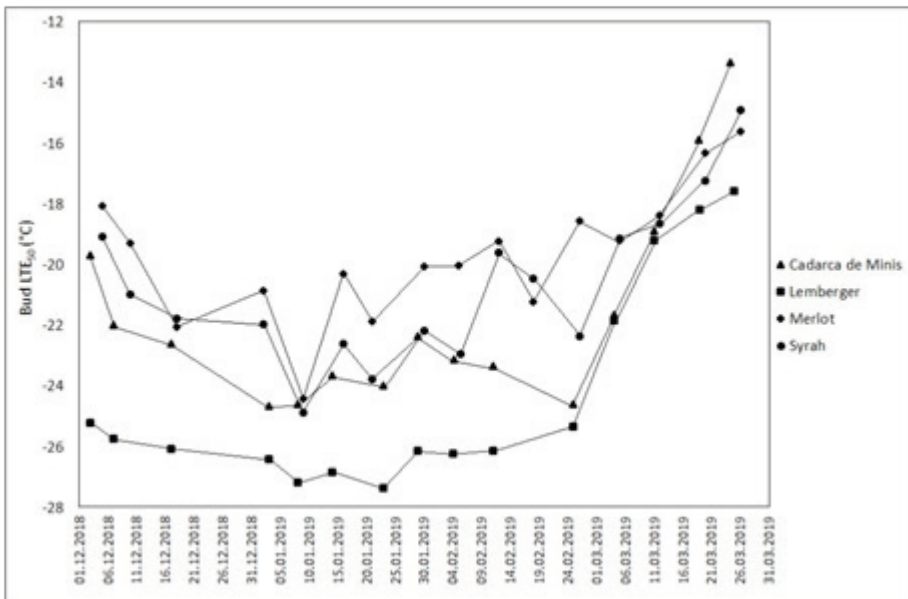


**Fig.1: The identification of the Low Temperature Exotherms (LTE)**

Source: *Ádám Bozó*

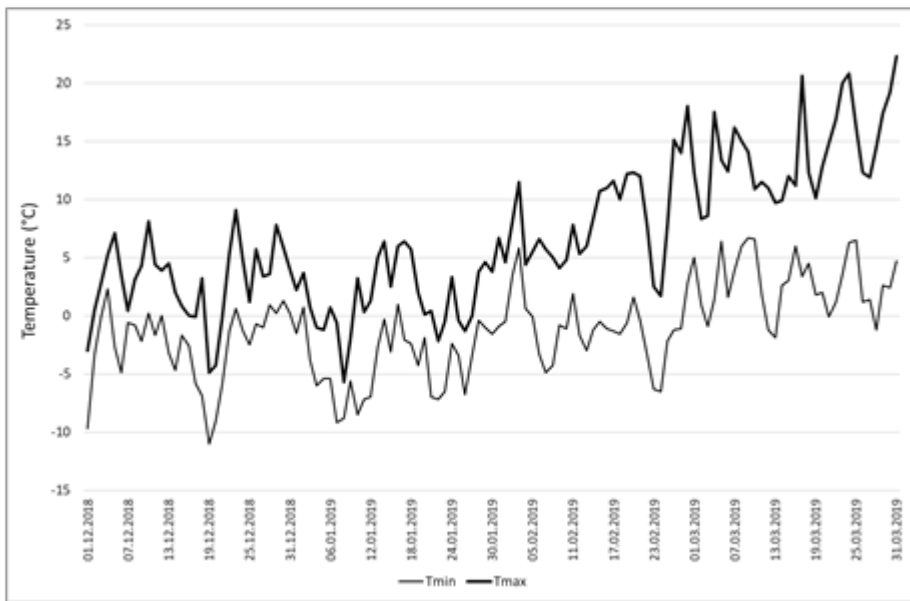
## Results

Bud cold-hardiness for all tested cultivars increased from December to January in the dormant season and decreased from February (Fig.2). All four varieties gained maximum hardiness levels during a cooling period at the beginning of January (daily temperature data on Fig.3). Lemberger presented the highest cold-hardiness among the tested cultivars. Lemberger LTEs were approx. 4°C lower in December and January compared to the other cultivars. Bud cold-hardiness of Syrah and Merlot were similar to each other in December and March, but in midwinter Syrah acquired higher hardiness. Cadarca de Minis buds had a stronger cold-hardiness than Syrah in the dormant season, however this behaviour was disappearing more rapidly than any other cultivars from the end of February, indicating the sensitiveness to spring frosts of this variety.



**Fig.2: Bud cold-hardiness of four *Vitis vinifera* L. cultivars from December 2018 through March 2019**

Source: Ádám Bozó



**Fig.3: Daily minimum and maximum temperature in the Kőlyuktető vineyard, Eger from December 2018 through March 2019**

Source: *Ádám Bozó*

## Conclusions

In this study the bud cold-hardiness of four *Vitis vinifera* L. cultivars has been examined. Our research showed similar results to previous studies. We are planning to validate our future results by the examination of dormant buds suffered frost damage on the field, if a considerable freeze event occurs in the future seasons. Our study was undertaken to provide information to viticulturists and winemakers that will reduce the risks involved in decisions on cultivar and site selection.

## Literatures cited

- [1.] Andrews, P.K. - Sandridge, C.R. - Toyoma, T.K. (1984): Deep supercooling of dormant deacclimating *Vitis* buds. *American Journal of Enology and Viticulture* 35 (3): pp. 175-177.

- [2.] Bowers, J.E. - Siret, R. - Meredith, C.P. - This, P. - Boursiquot, J.M. (2000): A single pair of parents proposed for a group of grapevine varieties in Northeastern France. *Acta Horticulturae* 528: pp. 129-132.  
<https://doi.org/10.17660/ActaHortic.2000.528.15>
- [3.] Burke, M.J. - Gusta, L.V. - Quamme, H.A. - Weiser C.J. - Li, P.H. (1976): Freezing and injury in plants. *Annual Review of Plant Physiology* 27: pp. 507-528.  
<https://doi.org/10.1146/annurev.pp.27.060176.002451>
- [4.] Ferguson, J.C. - Moyer, M.M. - Millis, L.J. - Hoogenboom, G. – Keller, M., (2014): Modeling Dormant Bud Cold Hardiness and Budbreak in Twenty-Three *Vitis* Genotypes Reveals Variation by Region of Origin. *American Journal of Enology and Viticulture*, 65 (1): pp. 59-71.  
<https://doi.org/10.5344/ajev.2013.13098>
- [5.] Lakatos, L. (2017a): Tavaszi fagykárok és az ellenük való védekezés lehetőségei Magyarországon. *Agrofórum - A Növénytermesztők és Növényvédők Havilapja* 28 (4), pp. 110-113.
- [6.] Lakatos, L. (2017b): Téli fagyok és fagykárok Magyarországon. *Agrofórum - A Növénytermesztők és Növényvédők Havilapja* 28 (2), pp. 14-16.
- [7.] Lakatos, L. - Molják, S. - Nagy, R. (2017): Analyzes of Autumnal, Winter and Spring Frost Damage at the Wine Regions of Hungary. In: Serban, G. - Croitoru, A. - Tudose, T. - Batinas, R. - Horvath, Cs. - Holobaca, I. (szerk.) *Air and water components of the environment*, Kolozsvár, Románia: Casa Cartii de Stiinta, (2017), pp. 69-76.  
[https://doi.org/10.24193/AWC2017\\_09](https://doi.org/10.24193/AWC2017_09)
- [8.] Mills, L.J. - Ferguson, J.C. - Keller, M. (2006): Cold-Hardiness Evaluation of Grapevine Buds and Cane Tissues. *American Journal of Enology and Viticulture* 57 (2): pp. 194-200.
- [9.] Poling, E.B. (2008): Spring Cold Injury to Winegrapes and Protection Strategies and Methods. *HortScience* 43 (6): pp. 1652-1662.  
<https://doi.org/10.21273/HORTSCI.43.6.1652>
- [10.] Quamme, H.A. (1991): Application of thermal analysis to breeding fruit crops for increased cold hardiness. *HortScience* 26 (5): pp. 513-517.  
<https://doi.org/10.21273/HORTSCI.26.5.513>
- [11.] Werner J. - Tóth-Lencsés A.K. - Veres A. - Kiss E. - Kozma P. (2013): Morphological and molecular characterization of varieties and selected clones of 'Kadarka' grape. *Mitteilungen Klosterneuburg* 63 (1): pp. 38-50.

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