International Symposium on Precision Management of Orchards and Vineyards. Palermo, Italy, October 7-11 2019.

Monitoring system for the evaluation of cold hardiness of several grapevine cultivars under climatic conditions of Eastern Canada.

Caroline Provost[1] and Alexander Campbell[1]

[1]Centre de recherche agroalimentaire de Mirabel, 9850 rue Belle-Rivière, Mirabel, Qc. Canada, J7N 2X8

email: cprovost@cram-mirabel.com

Introduction

Growing grapes in cold climates has several challenges to overcome. Cold injury to grapevines is an important problem, especially at the northern limit of culture where extensive damage to buds and cane tissues can result in severe economic losses. Grapevine health and productivity are a function of the site and climatic conditions during the growing season but also during the dormant period, which, in Eastern Canada, occurs during the winter. To help understand winter cold hardiness, methods and models to evaluate bud freezing were developed. Screening cultivars under field conditions over several years in different regions provides information on cultivar suitability to growing site and environmental conditions that contribute to injury. Controlled freeze testing was developed in order to evaluate freezing tolerance under specific controlled conditions (Fennell 2004; Mills et al. 2006).

Objectives

The main purpose of the project is to establish a monitoring system for periodic data acquisition on bud hardiness (LTE 10, 50, 90) in order to understand grapevine physiology related to cold hardiness and to support producers in optimizing frost protection methods under climatic conditions of eastern Canada.

Methods

Frozen supercooled tissues can be measured by differential thermal analysis (DTA) (Wample et al. 1990). DTA detects the heat fusion released as supercooled water in the tissues freezes. The temperature at which this occurs, referred to as the low temperature exotherm (LTE), indicates the lethal temperature for tissue survival. Monitoring systems for bud hardiness was implemented to provide information about cold hardiness (by means of tissue survival) of hybrids and *Vitis vinifera* grown in southwestern Quebec, Canada (Fig. 1, 2). Bud monitoring will be done in order to evaluate bud hardiness for two grapevine categories: 1) cold hardy hybrids during the entire dormant season; and 2) semi-hardy hybrids (frost protected) and *V. vinifera* during the end of winter and spring.

Perspective

The monitoring system determines LTE 10, 50, 90 according specific parameters like cultivar, region, cultural practice and calendar date (Fig. 3, 4, 5). Results are coupled with mean minimum winter temperature in order to show bud hardiness during the winter.

Important information will be generated that could be used for several purposes:

- These data will allow an increase of knowledge of grapevine physiology and cold hardiness. Better understanding of physiology can lead to the development of new technology and adaptations to better protect grapevines against extreme winter temperatures.
- Important information will be generated that could be used for more efficient management of frost protection systems, such as wind machines against spring frost.
- These data sets will be used for the development and validation of models concerning phenology and cold hardiness for hybrids and *V. vinifera*. These models will be available and used by agronomists, researchers and producers to ensure better field monitoring and timing for frost protection intervention periods.

Thus, the project will help to better understand vine physiology in relation to freeze tolerance. Adaptations to current frost protection systems and new technologies can be generated from the results and be used to support producers under North American northeastern conditions and ultimately help to increase yield and fruit quality.

Acknowledgement

FThanks to the Conseil des vins du Québec for funding and logistic support. Funding for this project has been provided in part through the AgriScience program-cluster on behalf of Agriculture and Agri-Food Canada.

References

Fennell, A. (2004). Freezing tolerance and injury in grapevines. Journal of Crop Improvement, 10(1-2), 201-235.

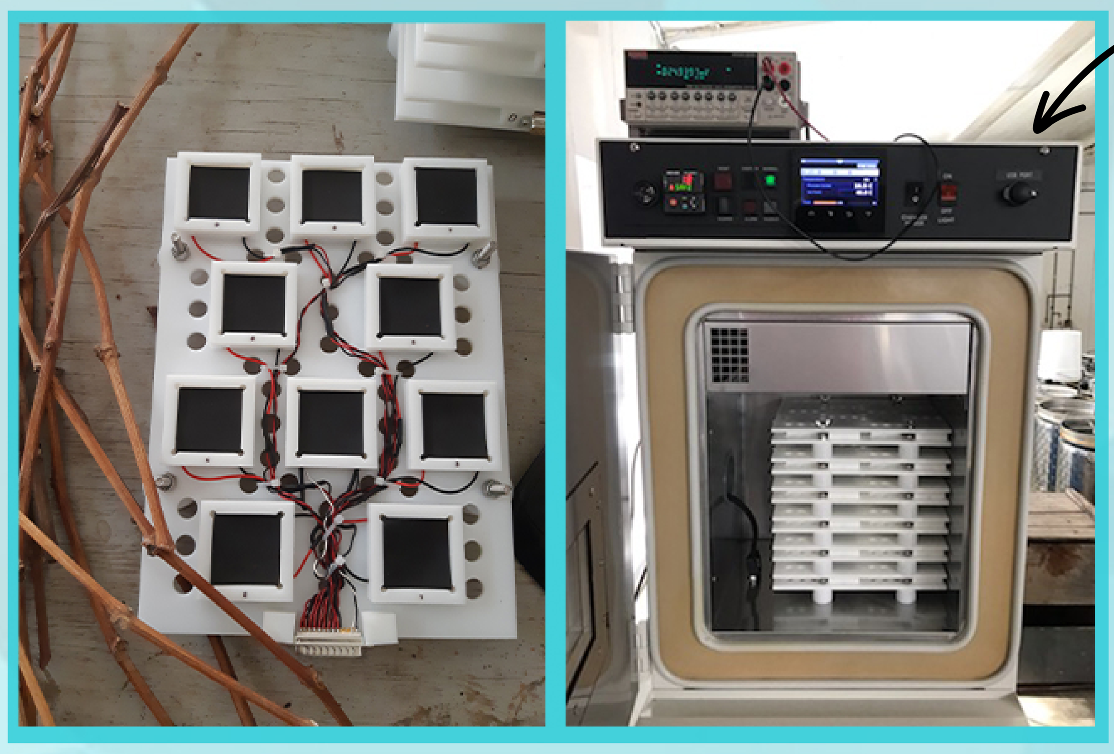
Mills, L. J., Ferguson, J. C., & Keller, M. (2006). Cold-hardiness evaluation of grapevine buds and cane tissues. American Journal of Enology and Viticulture, 57(2), 194-200.

Wample, R. L., Reisenauer, G., Bary, A., & Schuetze, F. (1990). Microcomputer-controlled freezing, data acquisition and analysis system for cold hardiness evaluation. HortScience, 25(8), 973-976.

Typical winter snowfall covering hardy hybrids at the experimental vineyard in Oka, Quebec. Snow accumulation is a welcome natural insulator during the cold months, though remains an obstacle for field sampling.

Fig. 1: Oka experimental vineyard in December.

Fig. 2: Frontenac, Frontenac blanc, ice covered bud in the spring (left to right)



The plates are connected to electrodes that measure the electrical output as supercooled tissues freeze. A total of 6 trays can be loaded at once, meaning that 6 different cultivars can be tested and output LTE data.

Fig. 3: Loading plates within LTE trays (left). Voltmeter and freezer with loaded trays (right).

Bud mortality will occur when the outside temperature curve (purple) intersects LTE curves (yellow, orange, red). Here, 50% of Pinot noir buds were susceptible to mortality at 3 different instances in 2012.

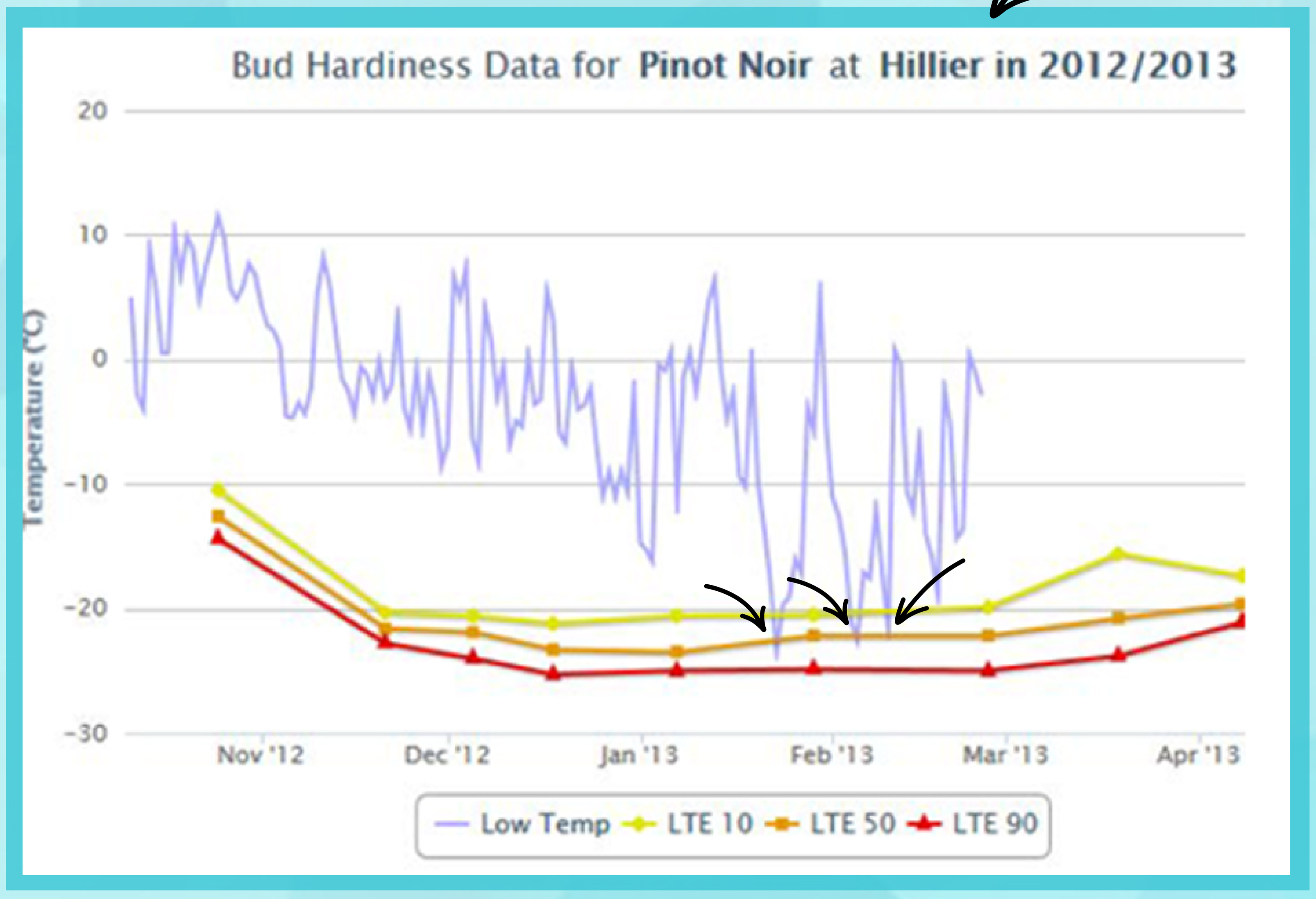


Fig. 4: Bud hardiness for Pinot Noir during winter in Ontario, Canada (source: CCOVI- Brock University)