Measuring Cold Hardiness in Highbush Blueberry Grown in Two Distinct Regions of Washington State

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Introduction

- Northern highbush blueberry (*Vaccinium corymbosum*) production occurs in central and western Washington, which are geographically and climatologically distinct (Fig. 1).
- Western Washington has a maritime climate with wet and mild winters, while central Washington has dry, colder winters with greater risks of winter injury.
- Growers within both regions implement protective measures to prevent injury due to cold, particularly after bud break and the susceptibility to cold injury increases among emerging vegetative and floral tissues (Fig. 2).
- However, growers lack region- and cultivar-specific resources to guide them on critical temperatures for implementing cold protective measures across key phenological stages.
- Information is also lacking regarding the most reliable methods for assessing cold hardiness in blueberry.

Figure 1. Map of Washington State. Primary areas of commercial highbush blueberry production are in the northwestern and central regions of the state.

Figure 2. Bud break in 'Duke' blueberry. Susceptibility to cold injury increases after bud break.

Objectives

1) To determine an appropriate and reliable method for assessing cold damage in blueberries.

2) Develop cold hardiness curves for blueberry cultivars grown in central and western Washington.

Materials and Methods

Objective 1. To determine an appropriate and reliable method for assessing cold damage in blueberries, a programmable freezer, glycol bath, and differential thermal analysis (DTA) were compared in the 2014/2015 winter (Fig. 3).

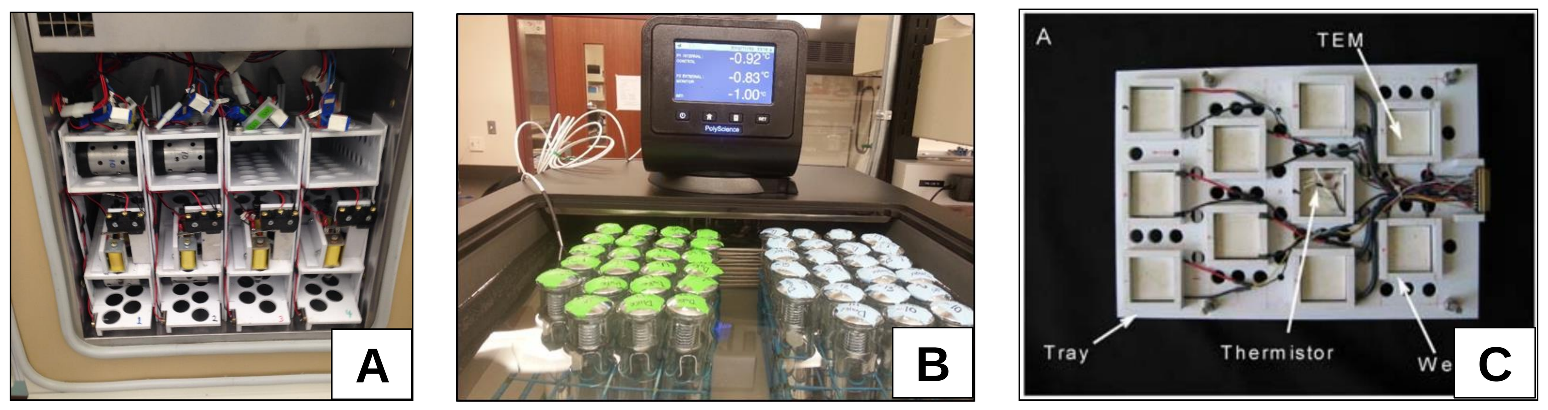

Figure 3. Equipment tested to determine an appropriate and reliable method to assess cold damage in blueberry include a programmable freezer (A), glycol bath (B), and differential thermal analysis (C).

Objective 2. The programmable freezer and glycol bath methods were comparable and subsequently used to develop cold hardiness curves for the 2016/2017 winter.

- Samples were collected from mid-October 2016 to mid-May 2017.
- Central Washington - 'Duke', 'Draper', 'Liberty', and 'Aurora' were evaluated weekly using a programmable freezer; samples were collected in Prosser, WA (Fig. 1).
- Western Washington – 'Duke' and 'Draper' were evaluated twice monthly using a glycol bath; samples were collected in Burlington, WA (Fig. 2).
- For each cultivar on each sampling date, 3 shoots with $\geq$ 3 floral buds per shoot were placed in a can/test tube; there were 3 cans/test tubes per temperature treatment and these were treated as replicates (18 floral buds were evaluated per temperature treatment within a cultivar and sampling date).
- Samples were subjected to a controlled freeze:
  - -1 to -4 °C → ½ °C decrease in temperature every 30 minutes
  - -4 to -8 °C → 1 °C decrease in temperature every 30 minutes
  - -8 to -22 or 28 °C → 2 °C decrease in temperature every 30 minutes
- Samples were removed at -½ to -2 °C increments and placed on ice for 12 hours and then thawed at room temperature for 24 hours before bud dissection and analysis.
- Lethal temperature for 50% of floral buds (LT_{50}) was calculated by date and cultivar using the average mortality per shoot and accumulated mortality for each cultivar.

Results and Discussion

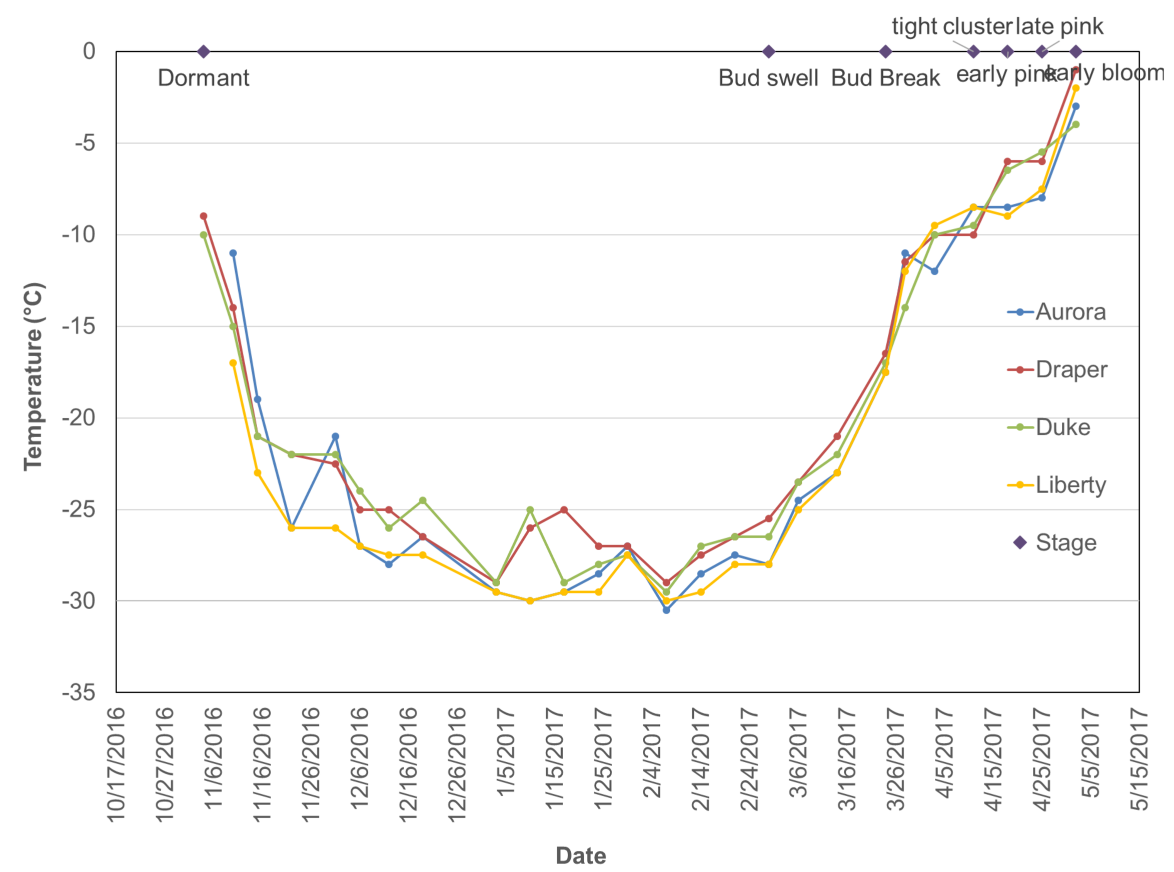

Figure 4. Lethal temperature (LT_{50}) of 'Aurora', 'Draper', 'Duke', and 'Liberty' floral buds of highbush blueberry in central Washington, 2016-2017.

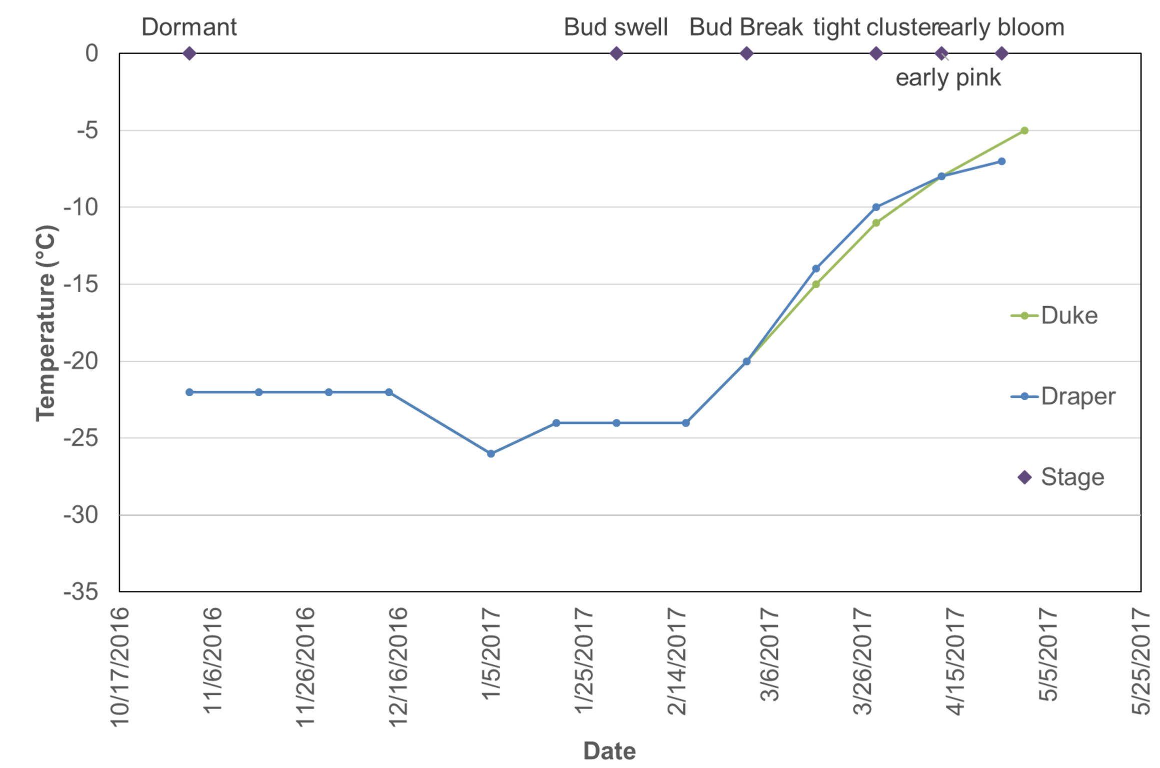

Figure 5. Lethal temperature (LT_{50}) of 'Duke' and 'Draper' floral buds of highbush blueberry in western Washington, 2016-2017.

- Blueberry floral buds acclimate rapidly to cold temperatures and are very cold hardy in the middle of winter (Figs. 4 and 5).
- After bud break, cultivars express less variation in cold hardiness (Fig. 4).
- 'Aurora' and 'Liberty' acclimation/deacclimation patterns were similar to each other, while 'Duke' and 'Draper' were similar to each other (Figs. 4 and 5).
- Future work will focus on developing a statistically robust cold hardiness model that will be validated through additional research.

Acknowledgements. Funding for this project came from the Washington Blueberry Commission. Special thanks to Richard Sakuma at Sakuma Brothers, Inc. and Keith Oliver and Marcos Atilano at Olsen Brothers Ranches for their cooperation and provision of sample materials. Also, thanks to Markus Keller, Lynn Mills, and Michelle Moyer for access to equipment. We would also like to acknowledge Jeannie Rowland and Elizabeth Ogden at USDA-ARS for assistance with methods development.