

FINAL PROJECT REPORT

Project Title: Investigating flower bud hardiness of new tree fruit cultivars

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Other funding sources: None

Total Project Funding:

Budget History:

Item	Year 1: 2009	Year 2:	Year 3:
Salaries	\$12,479		
Benefits	\$10,358		
Wages			
Benefits			
Equipment	\$12,163		
Supplies			
Travel			
Miscellaneous			
Total	\$35,000		

Footnotes: salaries include an Associate in Research (@ 42% FTE plus benefits at 83%) responsible for region-wide program coordination, bud collection, data collection and analyses, development of extension material, and equipment maintenance and oversight. Equipment includes a Tenney T2 temperature test chamber with installed humidity control, datalogger, thermoelectric modules and a computer.

OBJECTIVES:

The objectives of this research project directly address the second highest rated research priority of the cherry industry¹, bud hardiness.

1. Establish new fruit bud hardiness standards by phenotyping several genotypes throughout the dormant season and anthesis
2. Partner with DAS to disseminate bud hardiness data to industry as rapidly and conveniently as possible
3. Develop preliminary data and framework for pursuing federally-competitive funding for further research & outreach

SIGNIFICANT FINDINGS:

- differential thermal analysis (DTA) is an effective method for determining dormant cherry and apple bud hardiness
- cherry and apple cultivars exhibit significant variability in hardiness
- DTA is not effective when buds lose hardiness in mid-March
- we can double the capacity for DTA in the freezer from 35 plates to 70 plates
- there is tremendous variability (≈ 20 F) in hardiness among buds on a tree/limb/spur
- Delicious and Golden Delicious were advanced in flowering compared to Gala and Fuji
- Bing, Chelan, and Sweetheart were similar in flowering and advanced compared to Benton
- Overall, Sweetheart was the least hardy cultivar and Benton was the most hardy
- Fuji was overall the least hardy cultivar and Gala was the most hardy
- Hardiness is gained and lost during bloom, depending upon temperature

RESULTS AND DISCUSSION:

We have confirmed the effectiveness of differential thermal analysis for assessing apple and cherry bud hardiness, using our newly setup freezer system. Clearly discernible high and low temperature exotherms are observable (data not shown) and up to 5 dormant buds can be measured per analysis plate. With modification however we were able to double the capacity of the freezer and utilize up to 70 plates. This will allow greater replication and the ability to compare more cultivars at once, up to ca. 350 buds per freezer run. The exotherm data can be analyzed and presented as LT_{10} , LT_{50} , and LT_{90} readily (Fig. 1). From discussions with growers it is clear that LT_{10} is the most relevant data for frost protection decision-making. We posted on our website the up to date LT_{10} under the “what’s new” section.

We have identified significant differences among cherry cultivars in their minimum hardiness level (Fig. 2). It appears, from our preliminary analyses, that ‘Chelan’ is hardier than other test cultivars and that ‘Sweetheart’ is the least hardy. There is about a 12 F (6.5 °C) difference among the cultivars tested in their LT_{50} (Fig. 2). These relative differences did not persist during budbreak and flowering however.

¹ Cherry Industry Priority Setting Session, Prosser, WA, 19 August, 2008

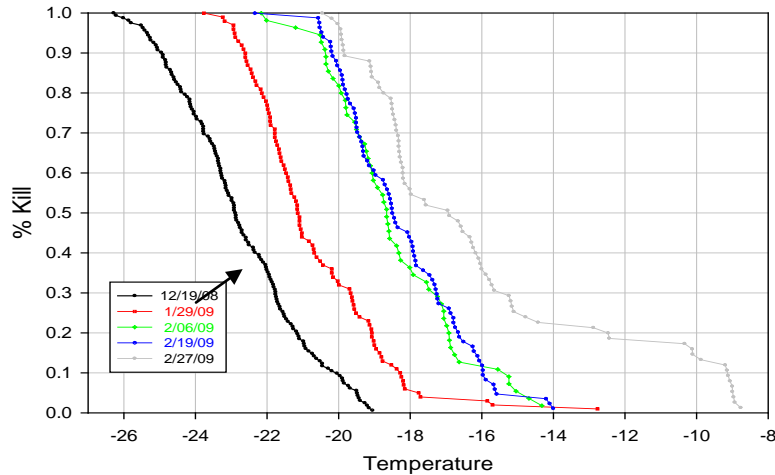


Figure 1. Variability in 'Chelan' fruit bud hardiness over time. Each data point is a recorded low temperature exotherm. Arrow indicates LT_{50} on 12 Dec.

Interestingly, we observed significant variability in hardiness of individual buds within a tree. This hardiness range was as high as 18 F (10 °C) between the temperature which killed the least hardy flower to the temperature which killed the hardest flower. Among flowers within a single bud however, there is very little variability in hardiness (i.e., all flowers are killed at a similar temperature, ± 0.2 F). This phenotypic diversity in hardiness within a tree/limb/spur is an issue we intend to pursue further.

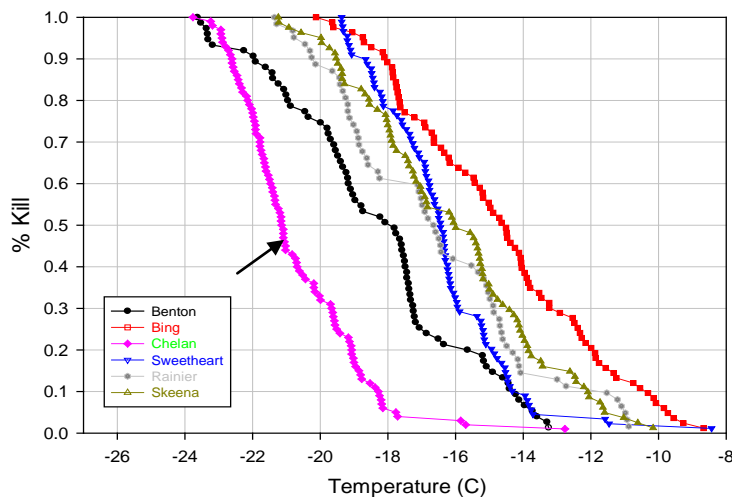


Figure 2. Comparison of fruit bud hardiness among sweet cherry cultivars. Hardiness was assessed on 29 Jan. 2009. Each data point is a recorded low temperature exotherm. Arrow indicates LT_{50} of 'Chelan'.

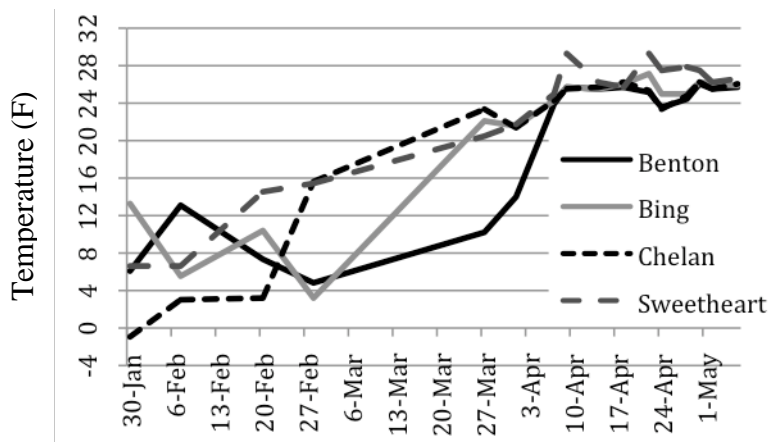


Figure 3. Comparison of LT_{10} of fruit bud and pistils among sweet cherry cultivars. Data prior to 26 March are low temperature exotherms. Data after 26 March are observational for pistil death.

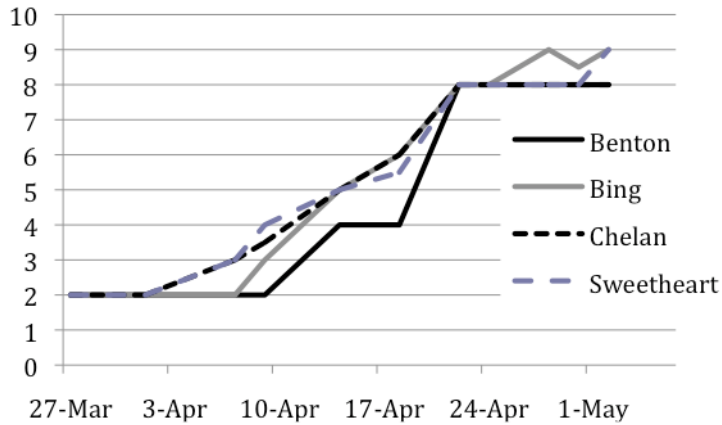


Figure 4. Comparison of fruit bud/flower development among sweet cherry cultivars.

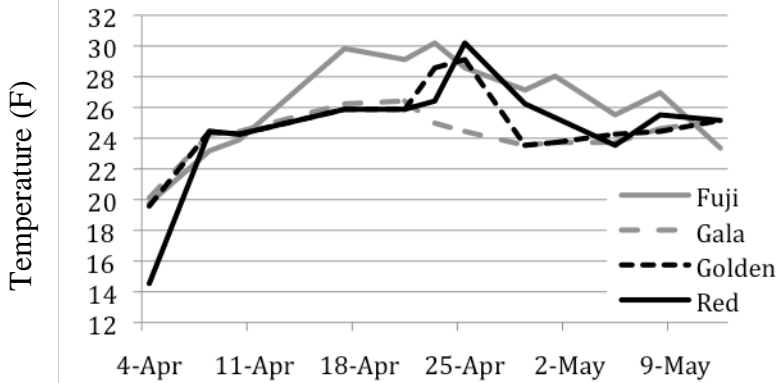


Figure 5. Comparison of LT₁₀ of fruit bud and pistils among apple cultivars. Data are observational for pistil death.

We recorded subtle variability among apple cultivars in their hardiness prior to bloom (Fig. 5). Differences became apparent in mid-April with Fuji losing hardiness rapidly compared to other cultivars. Interestingly, the warm weather in mid-April caused a loss of hardiness for Delicious and Golden Delicious but not for Fuji and Gala.

EXECUTIVE SUMMARY

This project has documented the hardiness of dormant buds of economically important apple and cherry cultivars. We have built and utilized a system for determining dormant tissue hardiness by differential thermal analysis. We have documented variability in minimal hardiness level among cherry cultivars with Chelan exhibiting the greatest hardiness and Sweetheart the least. We have identified a range in bud hardiness of ca. 18 F among buds sampled on the same date. The next steps for this research are to 1) model bloom development with appropriate environmental data, 2) relate stage of bloom development with susceptibility to cold damage, 3) better understand factors accounting for the variability in hardiness among buds/flowers, and 4) disseminate hardiness data effectively.