Project Title: Effects of maturity and weather on fruit quality

Report Type: Continuing Project Report

Primary PI: Lee Kalcsits
Organization: Washington State University
Telephone: 509-293-8764
Email: lee.kalcsits@wsu.edu
Address: 1100 N Western Ave.
Address 2:
City/State/Zip: Wenatchee/WA/98801

Cooperators: Barbara Blanco-Ulate (UC Davis)

Project Duration: 1-Year

Total Project Request for Year 1 Funding: $ 41,820

Other related/associated funding sources: Cherry Stem Retention II: Effects of Maturity, Weather, and Preharvest Treatment Timing on Fruit Quality
Funding Duration: 2026
Amount:
Agency Name: California Cherry Board

WTFRC Collaborative Costs: none

Budget 1
Primary PI: Lee Kalcsits
Organization Name: Washington State University
Contract Administrator: Kevin Rimes
Telephone:
Contract administrator email address: kevin.rimes@wsu.edu
Station Manager/Supervisor: Stephen Ficklin
Station manager/supervisor email address: stephen.ficklin@wsu.edu

Item	2026
Salaries	$12,046.00
Benefits	$4,818.00
Wages	
Benefits	
RCA Room Rental	
Shipping	
Supplies	$3,300.00
Travel	$1,460.00
Plot Fees	
Miscellaneous	
Total	$21,624.00

Footnotes:

Budget 2
Primary PI: Ashley Thompson and Brian Pearson
Organization Name: Oregon State University
Contract Administrator: Brian Pearson
Telephone:
Contract administrator email address: brian.pearson@oregonstate.edu
Station Manager/Supervisor: Brian Pearson
Station manager/supervisor email address: brian.pearson@oregonstate.edu

Item	2026
Salaries	$9,213.00
Benefits	$4,671.00
Wages	
Benefits	
RCA Room Rental	
Shipping	
Supplies	$5,398.00
Travel	$914.00
Plot Fees	
Miscellaneous	
Total	$20,196.00

Footnotes:
[1]Salary for 0.15 FTE for Faculty Research Assistant Niall Millar

[2]Fringe benefits calculated at 50.7% of salary

[3]Supplies include infield temperature, relative humidity sensors, and par sensors, a Nikon camera for color analysis, and miscellaneous lab supplies for field collection

[4]Travel to and from field collection sites over 8 weeks

Objectives

1. Validate maturity and fruit-quality relationships to define the optimal harvest window for ‘Coral Champagne.’

2. Evaluate the influence of environmental conditions on stem retention.

Significant Findings

Fruit quality data was acquired for all seven locations spanning 4-5 cherry fruit color stages

There were locations that lost stem retention force earlier than other sites even though fruit firmness progression was similar across all sites in OR and WA.

Fruit harvested at stage 6 for all locations had fruit with firmness above 300 g mm-1 and stem retention force of above 500 g force. However, warmer sites like Pasco South and Mattawa had higher proportions of fruit with low fruit retention force.

More locations will be sampled in 2027 including resampling of the same sites pending cooperator approval.

Methods

Cherry orchards. The study will focus on ‘Coral Champagne’ cherries. This cultivar was chosen to align with the proposed cultivar targeted by Dr. Blanco-Ulate and the California Cherry Board. WSU personnel will work with three commercial orchards located in Washington state with nearby WSU AgWeatherNetwork stations to capture meaningful differences in microclimate (heat load, canopy humidity, air movement, canopy light environment) while keeping sampling logistically feasible. Similarly, OSU will also work with three commercial orchards with nearby weather stations to measure weather data.

Orchard blocks were selected in collaboration with participating growers. Orchard identification and grower coordination will be supported by Dr. Blanco-Ulate and her UCCE collaborators (Dr. Giulia Marino and Dr. Mohammad Yaghmour). We will prioritize blocks that are commercially managed and representative of industry practice rather than experimental plots. For each selected block, we will document standard grower programs, including the use of growth regulators and nutritional sprays (e.g., gib products, Apogee, calcium programs, and any other preharvest sprays), so that these background practices can be considered during data interpretation.

State	County	Orchard / Site
Washington	Franklin	Pasco North
Washington	Franklin	Pasco South
Washington	Douglas	Mattawa
Washington	Grant	Orondo
Washington	Klickitat	Dallesport
Oregon	Wasco	Mosier
Oregon	Wasco	Skyline

Environmental monitoring. To understand how preharvest weather and microclimate influence stem retention, each orchard will be equipped with an in-orchard environmental monitoring unit. Stations will record air temperature and relative humidity and calculate VPD at frequent intervals. These measurements will allow us to characterize both seasonal conditions and short-term conditions in the ~10 days leading up to harvest. Weather data (temperature, RH, VPD) will be summarized daily and matched to biological data from each block. Growing degree accumulation from bloom to harvest will be calculated for each site to normalize developmental timing across orchards.

Tree selection and tagging. In each orchard, approximately 10 'Coral Champagne' trees of uniform vigor, canopy size, and crop load will be tagged for maturity and fruit-quality assessments.

Maturity and quality assessments. Cherry maturity was classified using a 10-stage color scale based on computational image analysis (Figure 1). This scale objectively quantifies skin hue and red coverage, allowing consistent maturity comparisons across orchards. Approximately 100 cherries per orchard were collected weekly from tagged trees as fruit progresses through the 10 stages, representing sun-exposed and shaded canopy positions. Data was collated across the different states and used to assess the impact of growing environment on fruit development and quality.

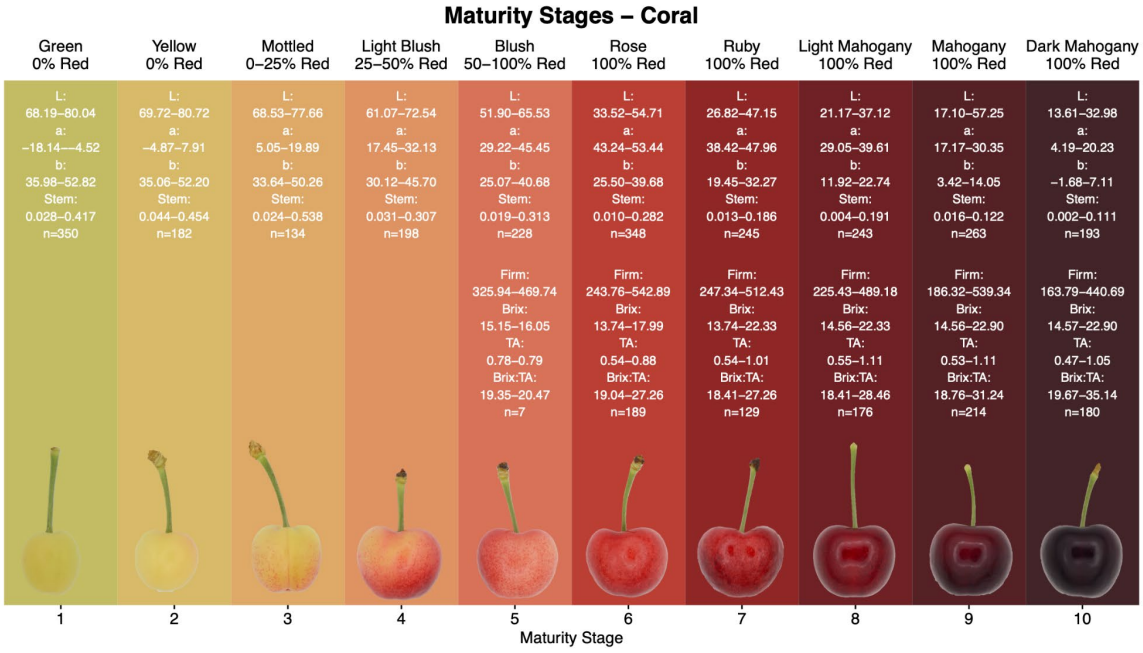


Figure 1. Maturity stages for 'Coral Champagne' cherry fruit (Blanco et al. 2025; unpublished)

Measurements included:

- Pedicel–fruit retention force (TA-XT texture analyzer)
- Firmness (FirmTech II, nondestructive)
- Soluble solids (°Brix)
- Titratable acidity (TA) and pH
- Skin and flesh color (image-based L*a*b analysis)

Results and Discussion

Fruit was picked based on fruit maturity stage to standardize comparisons across orchards. Figure 1 shows examples of maturity at stage 3, 6, and 9 for four different orchards.

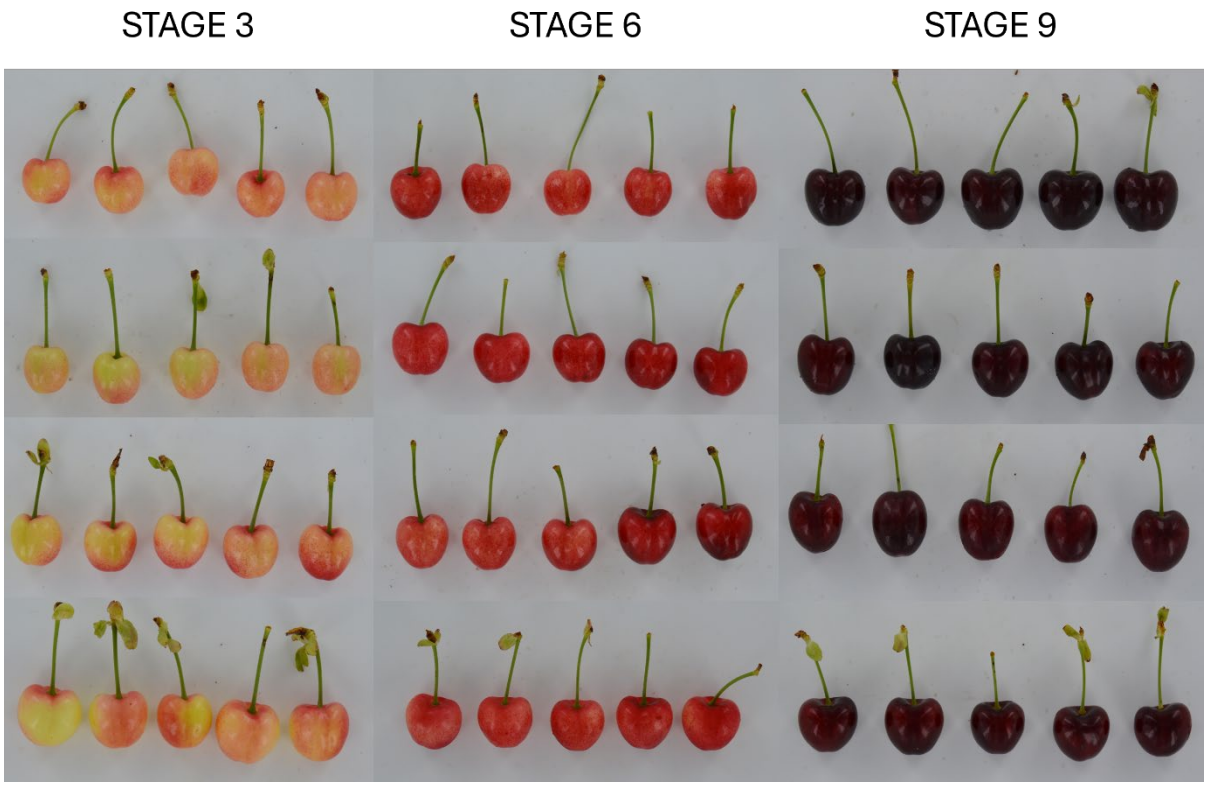


Figure 2. Photos of fruit at stage 3, stage 6, and stage 9 from Pasco North, Pasco South, Mattawa, and Orondo (Top to bottom). Note: fruit diameter not scaled for comparisons between photos (i.e. fruit at stage 3 are smaller than stage 9).

Environmental location appears to affect fruit growth more than fruit softening or stem retention. At comparable stages of development, fruit size differed among Pasco, Mattawa, and Orondo, with Orondo generally producing larger fruit later in development. In contrast, site differences in firmness and stem-pull force were greatly reduced after accounting for fruit developmental status, suggesting that much of their apparent environmental response reflects differences in maturity progression rather than a direct site effect.

Overall mean stem retention force dropper below 500 g force for three orchard locations when fruit maturity reached stage 9 and 10; Pasco North, Pasco South, and Mattawa all had low stem retention force. All sites had mean stem retention force of less than 650 g force when stage 10 was reached for fruit maturity. There was variability among fruit in the fruit retention force (Table 1). Minimal fruit had fruit retention force below 500 g force at stage 3 fruit maturity for all locations. However, there were differences among sites at stage 6, 9, and 10. It appears that the warmer sites had higher proportions of fruit with low fruit retention force compared to cooler sites.

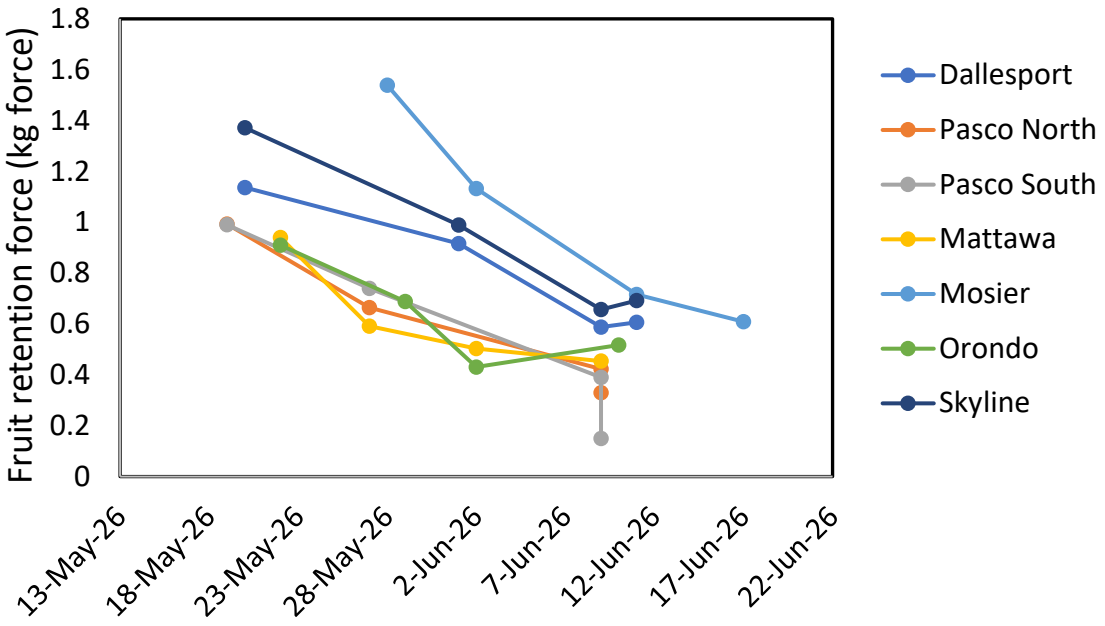


Figure 3. Fruit retention force (kg force) over time for seven orchard locations for 'Coral Champagne' cherry samples at stage 3, 6, 9, and 10 for each location.

Table 1. The percentage of fruit with fruit retention force of <500 g force for 'Coral Champagne' cherries sampled at four different maturity stages from seven orchard locations

	Maturity Stage			
Location	**S3**	**S6**	**S9**	**S10**
Dallesport	0.0%	3.0%	29.0%	22.0%
Pasco North	1.0%	6.0%	51.1%	80.9%
Pasco South	0.0%	20.0%	46.0%	100.0%
Mattawa	2.0%	30.0%	52.0%	54.2%
Mosier	0.0%	0.0%	6.0%	33.3%
Orondo	0.0%	14.3%	62.0%	42.0%
Skyline	0.0%	0.0%	12.2%	14.0%

Fruit firmness followed similar patterns across all orchard locations as fruit maturity progressed from stage 3 to stage 10 (Figure 4). None of the sites had fruit firmness fall below 200 g mm^{-1}, considered to be the minimum commercial threshold for marketable fruit (Sallato et al. 2025). Fruit was softer on average for Mosier, Dallesport, Pasco South, and Pasco North. Fruit diameter was between 26 and 28 mm in diameter for all seven sampled locations (Figure 5). Fruit was nearly finished sizing by stage 9 for most orchard locations but there were big sizing gains observed from stage 6 to stage 9 that corresponded to decreases in fruit retention force and fruit firmness (Figure 5). The influence of seasonal temperatures on fruit growth rates and final fruit size need to be analyzed and will require more locations in 2027 to have adequate sampling numbers.

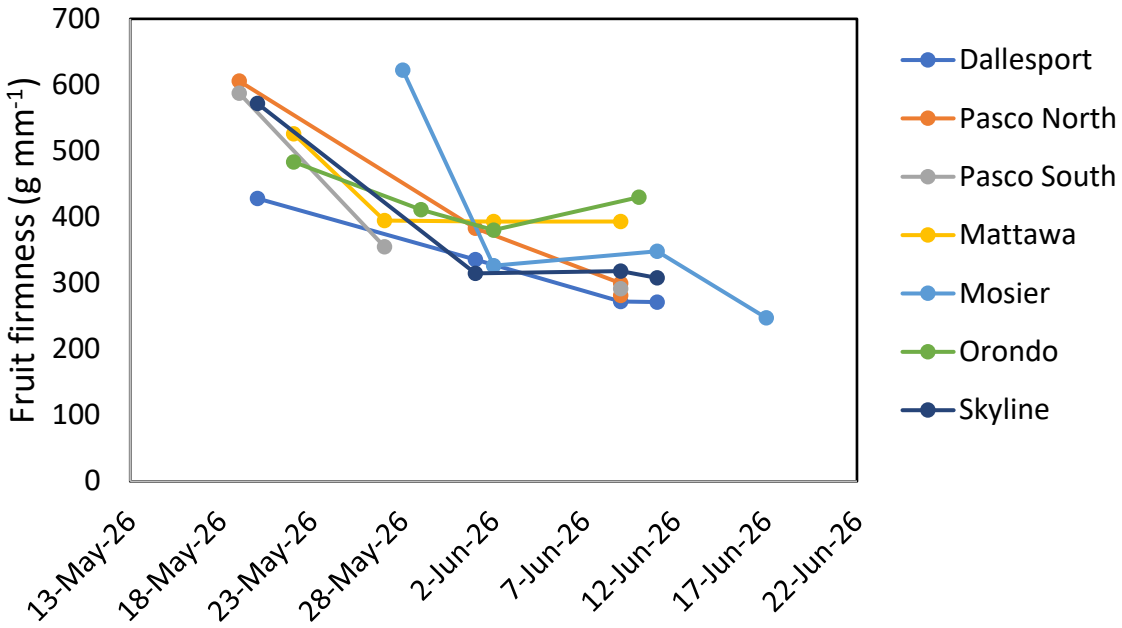


Figure 4. Fruit firmness (g mm^{-1}) over time for seven orchard locations for 'Coral Champagne' cherry samples at stage 3, 6, 9, and 10 for each location.

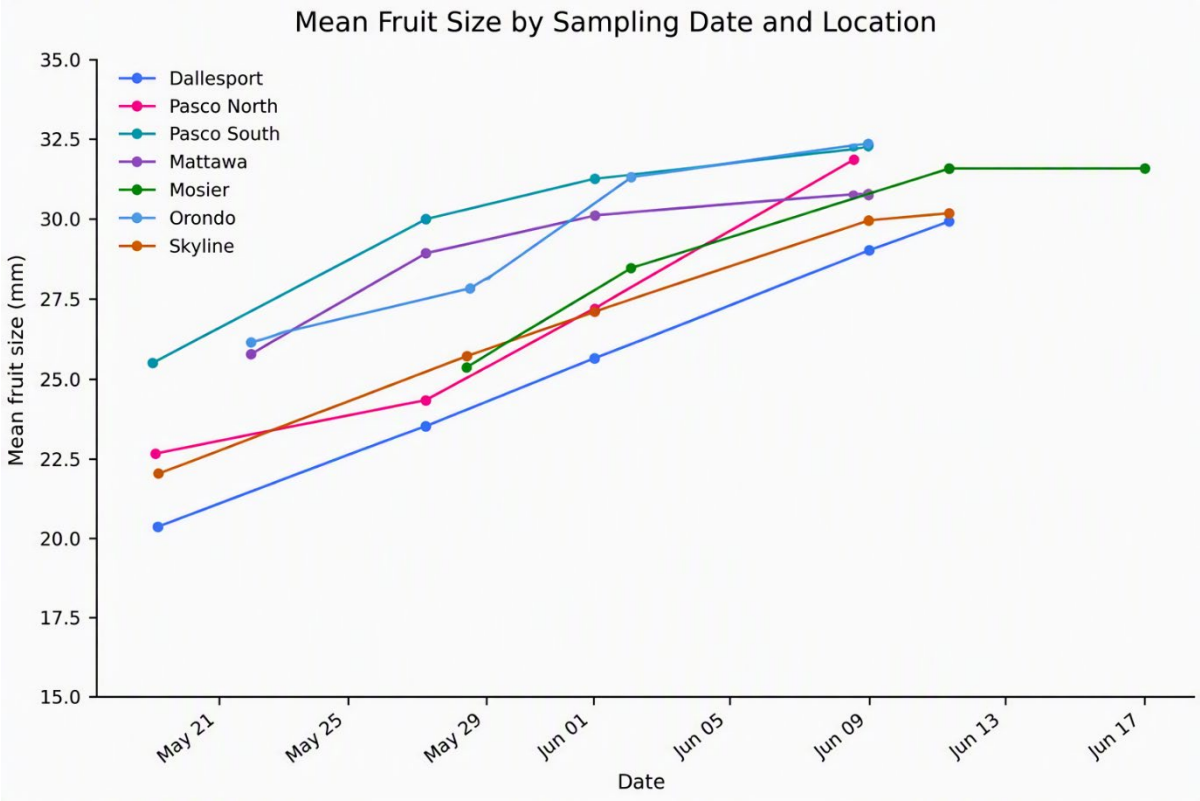


Figure 5. Fruit firmness (g mm^{-1}) over time for seven orchard locations for 'Coral Champagne' cherry samples at stage 3, 6, 9, and 10 (left to right) for each location.

Table 2. Monthly Growing Degree Day (baseline of 50 °F) accumulation for March to June at three of the Washington locations; Pasco, Orondo, and Mattawa. Environmental data from Oregon will be integrated into this dataset for 2027.

Month	Pasco	Orondo	Mattawa
March	84.5	50.4	68.6
April	173.9	147.7	137.2
May	484.3	475.2	462.4
June	600.1	597.0	584.9

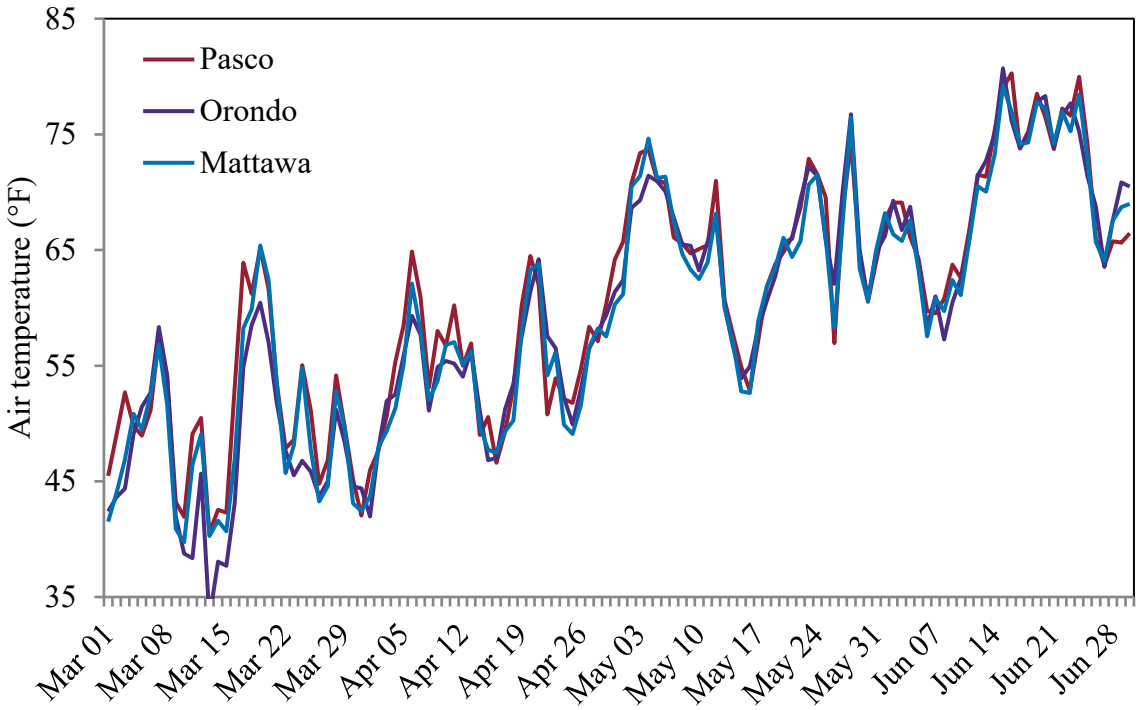


Figure 5. Air temperature from March 1 to June 30, 2026 for three locations in Washington state. Environmental data from Oregon will be integrated into this dataset for 2027.

Literature

Leisso, R, Thompson A. 2025. Sweet cherry cultivar-specific export suitability. WTFRC Cherry Review Final Report. https://www.treefruitresearch.org/wp-content/uploads/2025/02/25.-Leisso_SweetCherryExportCVs_FINAL.pdf

Sallato, B, Whiting MD, Torres C. 2025. Nutrient management for high quality cherries. WTFRC Cherry Review Final Report. https://treefruitresearch.org/report/nutrient-management-for-high-quality-sweet-cherries/