BC FoodWeb

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From orchard to market: Predicting Staccato sweet cherry quality post-harvest

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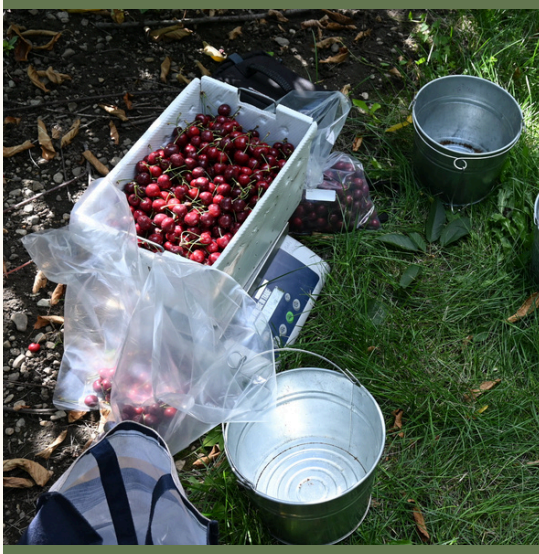

KEY TAKEAWAYS

- Scientists are creating a model that uses nutrient data from soil, leaves, and young fruit (fruitlets) to predict how well cherries will maintain their quality after storage. To see how well the model works, scientists tested its performance using data from soil, leaves, and/or fruitlets. **The best predictions come from soil tests taken before fertilization and nutrient measurements from leaves and fruitlets collected 3–4 weeks before harvest.**
- Once available, this tool will allow growers to assess post-storage fruit quality earlier in the season. This will help growers decide where to market their fruit and better prepare for domestic or international markets well before harvest.

Production Type
- Tree fruit

Practice Benefit(s)
- Earlier and more accurate predictions of fruit quality post-storage

Research Location
- Okanagan, BC

Key Terms
- *Soluble solids:* In fruit, these are primarily indicators of sugar content, but also reflect overall fruit maturity and flavour quality.
- *Titratable acidity: A* measure of the fruit's sourness; important for flavour.

How can this research be used?

Once developed, the model will help Okanagan growers determine whether their Staccato sweet cherries are best suited for **domestic or international markets**. Since the model can use a variety of inputs, from soil tests to nutrient data from young fruit, it offers flexibility to make predictions using available information.

Why was this research done?

The goal of this study was to determine if growers could use the nutrient values of soil, leaf, and fruitlets to determine whether domestic or international markets would be better suited for their sweet cherry orchard blocks. Fruits that maintain high quality after storage (which is typically 28 days at 0.5 °C) are well suited for export markets and can generate higher revenue for growers. The Okanagan Valley is among the best regions for producing premium sweet cherries. With 7,000+ acres under production, it accounts for close to 100% of Canadian cherry exports and generates well over $100 million in yearly export sales. This region's reputation as a top cherry producer has led to significant export opportunities, particularly to Asia where demand for high-quality fruit is rapidly growing.

As the overseas demand for sweet cherries grows, improved methods are needed to help growers decide when to sell cherries to domestic versus international markets. Currently, the only method growers can use to predict fruit quality post-storage is measuring fruit quality at harvest. However, fruit quality does not always hold post-storage. **The model that is being developed in this study can help growers predict post-storage fruit quality more accurately and earlier on (i.e. weeks before harvest) based on nutrient content.**

What was the outcome?

The study found that there was a strong linkage in firmness and soluble solids between fruits at harvest and fruits post-storage. For example, a cherry that's very firm and has high levels of soluble solids at harvest will be more firm and sweeter after storage than a cherry that's less firm and has less soluble solids at harvest. We also found that the nitrogen, calcium, magnesium, boron, iron, and zinc levels in leaves, and the nitrogen, calcium, magnesium, and boron levels in fruitlets were key factors for predicting post-storage fruit quality.

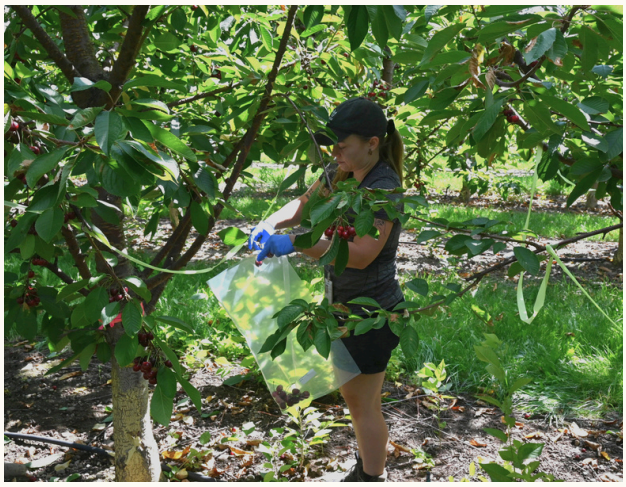

Figure 2. Stephanie Slamka collecting fruit samples for lab analysis. Photo by M. Sharifi, AAFC.

Using these results, researchers **developed a series of formulas that take soil, leaf, fruitlet, and fruit-at-harvest nutrient content and characteristics to predict 13 post-storage fruit quality traits.** By having a prediction of the post-storage fruit quality, growers can decide if cherries should go to local or export markets. For example, cherries that are predicted to have low firmness after 28 days of storage would be best for local markets. The formulas have been organized into a downloadable computer program, in which growers can easily enter soil, leaf, fruitlet, and/or fruit nutrient levels to receive estimated post-storage fruit quality traits. Although incorporating all soil, leaf, fruitlet, and fruit nutrient data provides the most accurate predictions, **leaf nutrient levels showed the strongest relationship with post-storage fruit quality parameters.**

Predict Post-Storage Fruit Quality

1. Find a local lab that does cherry and soil nutrient analysis.
2. In the spring, before fertilization, collect soil samples following the lab's protocols. In addition, collect leaf and/or fruitlet representative samples from your orchard 3-4 weeks before harvest. If you would like to get a more accurate prediction, include fruit-at-harvest nutrient and fruit quality parameters.
3. Send the samples to the lab for nutrient and fruit quality analysis, making sure to follow the lab's protocol for labelling and shipping.
4. When you receive the all results back, enter values into the prediction tool.
5. The values from the prediction tool tell you the predicted fruit quality, which you can use to decide whether to sell your cherries to international or domestic markets. **Please note that the model is not 100% accurate — accuracy varies for each fruit trait and is higher when fruit-at-harvest information is provided; see Table 1 for accuracy rates.** The formulas are specifically calibrated to the Okanagan's growing conditions and may require validation for other regions or sweet cherry varieties.

Collaboration with research partners in Iran has been affected by ongoing geopolitical conditions, which has delayed progress. The tool will be released once development is complete.

Table 1. How accurately the model predicts fruit quality after storage (4 weeks at 0.5 °C) using different types of nutrient information. The table compares predictions made using: (1) leaf data only; (2) soil, leaf, and fruitlet data; and (3) soil, leaf, fruitlet, plus fruit quality measurements taken at harvest. For example, a firmness accuracy of 100% means the model correctly predicted post-storage firmness every time when those inputs were used.

Post-storage Fruit trait	Key predictors (ranked by importance)	Prediction accuracy using only leaf data (%)	Prediction accuracy using soil, leaf, and fruitlet data (%)	Prediction accuracy using all data - soil, leaf, fruitlet, and **fruit-at-harvest** data (%)
Dry matter	Harvested fruit dry matter, fruitlet calcium, leaf boron, leaf calcium	42	57	72
Fruit size (weight)	Leaf zinc, harvested fruit copper, leaf calcium	75	35	41
Firmness	Harvested fruit titratable acidity, leaf calcium, fruitlet nitrogen, fruitlet boron	19	69	83
pH	Leaf iron, leaf calcium	81	65	69
Titratable acidity	Harvested fruit copper, fruitlet nitrogen, harvested fruit colour, harvested fruit calcium, leaf zinc	19	64	76
Soluble solids	Harvested fruit dry matter, leaf iron, soil calcium, harvested fruit soluble solids	28	71	88
Colour	Harvested fruit colour, soil magnesium, fruitlet magnesium	--	62	65
Slip skin	Harvested fruit stem browning, harvested fruit slip skin, fruitlet nitrogen	--	42	69
Stem browning	Leaf calcium, harvested fruit stem browning, leaf nitrogen, harvested fruit Russet	59	45	68
Pitting	Harvested fruit slip skin, harvested fruit stem browning, leaf calcium	9	38	73
Pebbling	Harvested fruit pebbling, harvested fruit weight, leaf calcium, harvested fruit boron	21	32	57
Russet	Harvested fruit calcium, harvested fruit stem browning, harvested fruit russet, fruitlet calcium	12	37	71

What's next?

One of the challenges of the prediction process is that getting results back from a lab can take some time. We are currently looking into the use of a portable XRF unit (a handheld instrument) to take leaf nutrient readings, which would allow growers to get the information directly in the field rather than having to send samples to a lab. Leaf nutrient values are important because they had the strongest linkage to post-storage fruit quality.

How was the research done?

This was a 2-year study conducted from 2021-2022 in the Okanagan Valley of B.C. We collected samples from 30 Staccato sweet cherry orchards (on Mazzard rootstock) from Vernon (northern point of the Okanagan) to Osoyoos (southern point). Samples were taken from 3 trees per orchard block. We collected the following samples from each orchard during the growing seasons of 2021 and 2022:

- **In the spring:** soil samples from 0-30 cm depth before fertilization. A nutrient analysis was done on the soil samples to measure levels of carbon, nitrogen, nitrate, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, zinc, copper, boron, and pH (acidity).
- **3-4 weeks before harvest:** leaf and fruitlet samples were taken and analyzed for dry matter and nutrient contents
- **At harvest:** fruit samples were taken and analyzed for nutrient content, fruit quality (dry matter, acidity, soluble solids, firmness), fruit weight, and disorders (cracking, slip skin, stem browning, pitting, pebbling, and russet).

To mimic overseas shipping conditions, 9 kg of cherries per orchard were then packed into cardboard boxes with a polyethylene liner and an absorbent pad and kept in a cooler at 0.5°C for 28 days. After 28 days of storage, fruits were evaluated for the same fruit quality and disorder traits that were evaluated at harvest.

About this brief

This brief was prepared by Juliana Cao from the BC Food Web team, with the help of Mehdi Sharifi, and is based on the following scientific journal article:

- Sharifi, M., Wolk, W., Vakilian, K. A, Xu, H., Slamka, S., & Fong, K. (2024). Integrating soil, leaf, fruitlet, and fruit nutrients, along with fruit quality, to predict post-storage quality of Staccato sweet cherries. *Horticulturae 10*. https://doi.org/10.3390/horticulturae10111230

Want to learn more?

- For any questions regarding this research, contact Mehdi Sharifi at mehdi.sharifi@AGR.GC.CA

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