Integrated analysis for improving export of sweet cherries and how a small industry can compete by focusing on premium quality

Dr. Peter M.A. Toivonen
Pacific Agri-Food Research Centre
Summerland, BC
Challenge for the British Columbia Industry

- BC produces 5.5 million kilograms of sweet cherries
- U.S. (mostly California, Oregon and Washington) produces 154,221 million kilograms of sweet cherries

BC is a very small producer in comparison!
Quality at market is an integration of many factors beginning at the tree.

• Need to be aware that **no single factor can be optimized without ensuring that others are also optimized** – systems approach

• Research must be conducted at the industry level where the **realities of commercial operations are observed, measured and modified**

• Research must be interactive, listening openly to industry comments/concerns, **reconciling research results with experiences in the real world**
Need to keep an open mind.

The bottom line:

To identify the most limiting factor(s) and then modify practice.
Quality – how is it defined?

Sweet cherry quality is defined by both the appearance of the stem, as well as the appearance and sensory quality of the fruit. Therefore, you must consider both.
Cherry maturity – effects on quality and shipping potential

CTIFL color chart

Range 4-6
In British Columbia – focus on more mature cherries.

• Helps to differentiate quality. More mature fruit have higher sugars and acidity – better flavour!, and size!

• More mature fruit are riskier, but this is mitigated by;
  a) cultivar selection for containerized shipping.
  b) requires more attention at harvest – stem quality.
  c) more attention to harvest logistics and cooling issues.
  d) smaller orchard blocks allowing shorter time between start and finish of harvest.
Generally harvest at colour stage 5 or 6 is better for sugars and acidity.

cv. ‘Sweetheart’
Mature cherries may be slightly softer on the tree, but firm up if cooled properly.
But there may be some negative outcomes with harvesting at stage 6.
Cultivar selection

• Based partly on storage/shelf-life information

• Based on respiratory rates – determines storage potential – relates well to storage/shelf life data
Earlier work - Summerland cultivars have lower respiration at 20 °C than Bing and more mature fruit respire less.
Respiration Facility – PARC, Summerland

Incubators set at 0.5, 5 and 10 °C

Flow through respiration flasks ~25 ml min⁻¹
Respiration Data Output

\[ \text{mg CO}_2 /\text{kg/h} \times 61.2 = \text{kcal/1,000 kg/24h} \]

Specific heat of sweet cherries = 0.84 Kcal/kg°C
Simulation of temperature gain in center of assembled pallet during shipping.
Pallets packed tightly in truck – no heat removal from cherry boxes
Relationship of decay to cherry temperature?
Beginning to rate new cultivars by potential shipping life based on the model, using $5\, ^\circ\text{C}$ as threshold for acceptance.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Days to reach cherry core temperature of $5, ^\circ\text{C}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cooled to $0.5, ^\circ\text{C}$</td>
</tr>
<tr>
<td>Satin</td>
<td>31</td>
</tr>
<tr>
<td>Sweetheart</td>
<td>42</td>
</tr>
<tr>
<td>2NE-5-40</td>
<td>29</td>
</tr>
<tr>
<td>Staccato</td>
<td>38</td>
</tr>
<tr>
<td>Suite Note</td>
<td>35</td>
</tr>
<tr>
<td>Cristalina</td>
<td>32</td>
</tr>
</tbody>
</table>
These estimates are from models, and supported by experience of freight forwarders and from shipper experience.

“1 week = plus 1 °C”

NEED VERIFICATION – INT’L COLLABORATION?
Protecting cherries at harvest – potential effects on quality
Reflective tarp covers – to prevent exposure to sunlight (solarization)
Reflective tarp covers – better control of temperature and humidity

Reflective tarp covers are very important to stem quality! Hydro-cooling cannot reverse injury.
Reflective tarp covers are very important to cherry fruit quality!
Understanding logistics of harvest and cooling is key to reducing quality and defect issues at market.

Packaging type has not been found to have a significant effect, especially for firmness!
Tracked harvest to packing temperature profiles and times using temperature logging cherries (TLC’s).

“Salting” at harvest and retrieval on the line.
Real world harvest-to-packing temperature profiles.
Stem Browning (1-4 scale)

Weeks in 1°C Storage

**Important Points:**

1. Co-operator C – no protection with reflective tarps at harvest.

2. Co-operator A – 6 hour delay in delivery to cooling.

3. Co-operator F – Good logistics, but stems were yellow on the tree.
Consequences of delays in packing/cooling on internal sweet cherry quality (cv Sweetheart).

<table>
<thead>
<tr>
<th>Time to final cooling</th>
<th>Soluble solids (%)</th>
<th>Significance</th>
<th>Titratable acidity (mg malic acid per mL)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At harvest</td>
<td>After storage</td>
<td>At harvest</td>
<td>After storage</td>
</tr>
<tr>
<td>~ 1 hour</td>
<td>22.1</td>
<td>22.0</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>~ 24 hours</td>
<td>19.3</td>
<td>20.1</td>
<td>ns</td>
<td>**</td>
</tr>
</tbody>
</table>

Reduced flavor
Cherry temperature in the box from hydro-cooling can range from 2-6 °C (36-43 °F)
Firmness is #1 issue for shipping! Temperature the biggest factor.
Temperature in the box important to avoid soft fruit!
Smaller blocks – can harvest more mature fruit since less time from start to finish of to harvest

\[ \Delta 6 \text{ d} \]

\[ \Delta 4 \text{ d} \]
Conclusions:

1) A small industry needs to have premium quality, i.e. more mature fruit

2) Mature fruit requires greater care for harvest and cooling

3) Mature fruit does not need to be soft or have brown stems (two major reasons for claims)

4) Limitations to quality are not due to lack of technology, but cultivar selection can have impact (respiration rates).

5) Containerized shipping – we need to understand basic thermodynamics of living product when palletized
Acknowledgements

Monashee Co-operative and Sunfresh Co-operative (now amalgamated within the Okanagan Tree Fruit Company)

BC Cherry Association

AAFC’s Matching Investment Initiative and Growing Forward - Developing Innovative Agri-Products Initiative

Dr. Frank Kappel and Dr. Cheryl Hampson - Breeders

Brenda Lannard and Sabina Stan