FINAL REPORT
WTFRC Project #CH-03-302 **WSU Project #14C-4164-2812**

Project title: Postharvest quality of late season cherry varieties grown in Washington State

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Objectives:
1. Refine and standardize the methodology for evaluating the quality of cherries following postharvest handling and storage.
2. Determine the quality characteristics after storage of late harvested newer cherry varieties grown in Washington State.

Significant findings:
Harvest maturity study:
- Skin and flesh color were equally good indicators of fruit maturity at harvest for all varieties tested. A color chart was developed to standardize rating of flesh color.
- At harvest, 'Bing' skin color (CTIFL 4 to 8) did not reflect changes in fruit quality but in 'Skeena,' 'Lapins' and ''Sweetheart' skin color reflected important quality changes.

Storage study:
- 'Bing' quality was best from the second or third harvest (CTIFL 6, 8).
- 'Lapins,' 'Skeena' and 'Sweetheart' quality was the best after the third harvest (CTIFL 8).

Pitting study:
- 'Sweetheart' had less pitting than 'Lapins' or 'Bing' (65%, 48% and 43% undamaged fruit, respectively) regardless of maturity.
- Less mature 'Bing' and 'Lapins' had more pitting than more mature fruit.
- 'Skeena' had the least damaged fruit in this trial, yet commercially packed 'Skeena' were very pitted.

Water study:
- Fruits submerged in 32ºF water were firmer and less susceptible to shrivel after 14 days in storage than those not submerged in water.
- There was no deterioration in the quality of 'Lapins' after submersion for 5 or 10 minutes.

MA bag atmospheres:
- Fruit quality was not influenced by MA bags under controlled conditions at 32ºF.
- Under lab conditions MA bags did not develop enough CO_2 to have an effect. Atmospheres did not change over time in storage.
- In a limited survey of commercial situations MA bags did not achieve optimal O_2 and CO_2 levels.

Methods:
Maturity and storage study:
'Bing,' 'Lapins,' 'Skeena' and 'Sweetheart' cherries were harvested three times from an orchard on Wenatchee Heights. Harvests corresponded to colors represented on a color scale produced by CTIFL

(France) at color ratings of 4, 6 and 8. A 25-fruit sample from each of five trees harvested was analyzed for quality at harvest and after storage for 7, 14 and 28 days at 32ºF. Quality analysis included stem, skin and flesh color, firmness, and size measured on every cherry. Weight, soluble solids (SS) and titratable acidity were measured by pooling all cherries in the sample.

Pitting study:
A 25-cherry sample was taken from each of five trees for pitting evaluation. Cherries were held at 38ºF for six hours after harvest, then pitting was induced using the device designed at the Pacific Agri-Food Research Centre, Summerland, B.C., to induce a standard pitting stress. Cherries were held for 14 days at 32ºF plus 24 hours at 70ºF before evaluating damage. Fruit damage assessed is expressed as the percentage of damaged fruit.

Water study:
A sample of second-harvest 'Bing' and 'Lapins' was held for 5 or 10 minutes in 32ºF water and evaluated for fruit condition and firmness after 14 days at 32ºF.

Results and discussion:
Maturity study:
'Bing' skin color (within CTIFL 4 to 8 range) was not strongly associated with SS (Figure 1), acidity (Figure 2), size (Figure 3) or firmness (Figure 4) at harvest. In 'Skeena' and 'Lapins,' SS, acidity and size increased and firmness decreased with successive harvests and were related to skin color at harvest. 'Sweetheart' size and SS increased with successive harvests but acidity and firmness declined; all three attributes were related to skin color at harvest.

Firmness was acceptable in all varieties and at all harvest times; however, 'Bing' was consistently the least firm variety. 'Lapins,' 'Skeena' and 'Sweetheart' cherries were less firm with successive harvests. Firmness was inconsistent among varieties at harvest 1 (CTIFL 4). At harvest 2 (CTIFL 6) 'Bing,' 'Lapins' and 'Sweetheart' were all of similar firmness. At harvest 3 (CTIFL 8) 'Skeena' and 'Sweetheart' were of similar firmness; likewise, 'Bing' and 'Lapins' were of similar but lower firmness.

The lack of correlation between 'Bing' color and quality attributes allows some flexibility in harvest timing. Most notably, 'Bing' cherries produced in different regions may be harvested over a range of color levels (CTIFL 4 to 8) without a change in quality. It is apparent that harvesting fruit with darker skin color yields higher quality fruit in 'Lapins,' 'Skeena' and 'Sweetheart.'

Pitting study:
At the first harvest, 'Bing' and 'Lapins' were more susceptible to pitting than at other harvests (Figure 5). 'Skeena' displayed the least susceptibility to pitting with less than 30% of fruit damaged. 'Sweetheart,' with the exception of the last harvest, also sustained little damage. At the last harvest date, 'Sweetheart' may have been more susceptible to damage due to sustained field heat stress.

Water study:
Cherries submerged in water were less susceptible to postharvest shrivel and were firmer than cherries placed directly into cold storage. After water treatments, there were no negative effects of water immersion on 'Bing' and 'Lapins' quality.

Storage study:
Cherries stored for 7 to 28 days did not lose significant weight, size or SS. Skin and flesh color darkened in storage. Stem color was maintained with more than 90% of all stems retaining green color through 28 days of storage, with the exception of the third harvest of 'Bing' after 28 days.

Lapins had lower acidity at harvest and at all evaluations than the other varieties. All varieties lost acidity in storage but at different rates (Figure 6). ‘Bing’ retained high acidity for seven days after harvest, then dropped to the level of ‘Skeena’ and ‘Sweetheart.’ ‘Skeena’ acidity declined immediately after storage, and evened off for a week before dropping again. Acidity of ‘Sweetheart’ and ‘Lapins’ declined at a lesser rate than the other varieties.

Because acidity is a major component of cherry flavor, decreases in acidity could help determine the shipping/storage limits of each variety. ‘Bing’ started out with more acidity than the other varieties and held acidity for seven days of storage. However, ‘Sweetheart’ retained the acidity for longer periods in storage.

Firmness differences after storage were dictated by those at harvest. Following seven days in storage ‘Skeena’ fruit was the firmest and ‘Bing’ the softest (Figure 7). Successive harvest samples of ‘Bing’ and ‘Sweetheart’ showed less decline in firmness than ‘Lapins’ and ‘Skeena’ after seven days of storage. Fruit from the third harvest of ‘Lapins’ was of marginal firmness.

Summary:
Incorporating the maturity, storage and pitting components of this study takes steps toward defining optimal harvest and storage times for each variety.

‘Bing’ may be harvested at color levels between 4 and 8 on the CTIFL chart without compromising quality. The storage study indicated that ‘Bing’ did not lose significant firmness at later harvest dates. Conversely, increased susceptibility to pitting at the first harvest (CTIFL color 4) suggests that ‘Bing’ quality is best after the second harvest (CTIFL color 6) and it can be stored without serious loss of acidity for at least seven days.

‘Lapins’ lost firmness with successive harvests; however, fruit was larger and higher in SS and acidity at the third harvest (CTIFL color 8). This variety was more susceptible to pitting at the first harvest (CTIFL color 4) than at later harvests. Acidity loss in storage was also less severe than in other varieties. ‘Lapins’ should be harvested at CTIFL color 8 in order to achieve high SS and acidity levels and avoid susceptibility to pitting at low maturity. Because there is little acid loss, this variety may be stored/shipped for up to 14 days without losing flavor.

‘Skeena’ also lost firmness with successive harvests and was larger, higher is SS and acidity at the third harvest (CTIFL color 8). In the lab environment ‘Skeena’ was less susceptible to pitting than other varieties. Storage firmness did not drop below 300 g/mm after any harvests. There were no significant losses in acidity until after 14 days of storage. This variety should be harvested at CTIFL color 8 in order to achieve large size and higher SS and acidity. Unlike ‘Lapins,’ there is no apparent danger of severe pitting at low maturity levels. This variety may be stored for up to 14 days without losing acidity.

‘Sweetheart’ developed more sugar with successive harvests but at the same time lost acidity. Fruit size increased at the third harvest (CTIFL color 8). Fruit does not appear to be susceptible to pitting to the same degree as ‘Bing’ and ‘Lapins’ unless under stressful conditions (field heat stress in the third harvest). Acidity loss over extended periods is less severe than in other varieties, and firmness values after storage are retained well at the third harvest. ‘Sweetheart’ should be harvested at CTIFL color 8, allowing time to increase in SS. They may be stored for at least 14 days with little acid loss.

Budget:
Project duration: 2003 (one-year project)
Current year: 2003
Project total (1 year): $18,390
Current year request: $18,390

Year	**Year 1 (2003)**
Total	**18,390**

Current year breakdown

Item	**Year 1 (2003)**
Salaries[1]	**9,700**
Benefits (33%)	**3,201**
Wages	**1,500**
Benefits (16%)	**240**
Equipment	**0**
Supplies[2]	**2,999**
Travel[3]	**750**
Miscellaneous	**0**
Total	**18,390**

[1] Jake Gutzwiler, Associate in Research.
[2] Supplies include updates and repair for FirmTech firmness device, fruit, modified atmosphere film, cherry packing material, lab supplies.
[3] Travel to obtain fruit samples.

Figure 1. Soluble solids content was measured at three cherry maturity levels based on CTIFL colors 4, 6, and 8 on 25-cherry samples of 'Bing,' 'Lapins,' 'Skeena' and 'Sweetheart.'

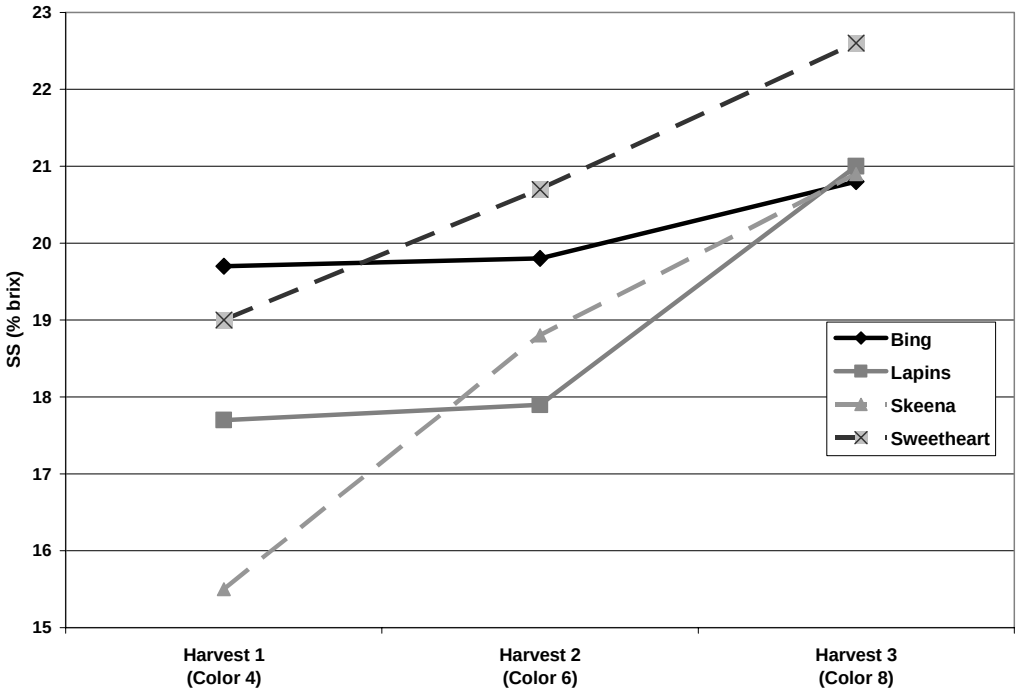

Figure 2. Titratable acidity was measured at three cherry maturity levels based on CTIFL colors 4, 6, and 8 on 25-cherry samples of 'Bing,' 'Lapins,' 'Skeena' and 'Sweetheart.'

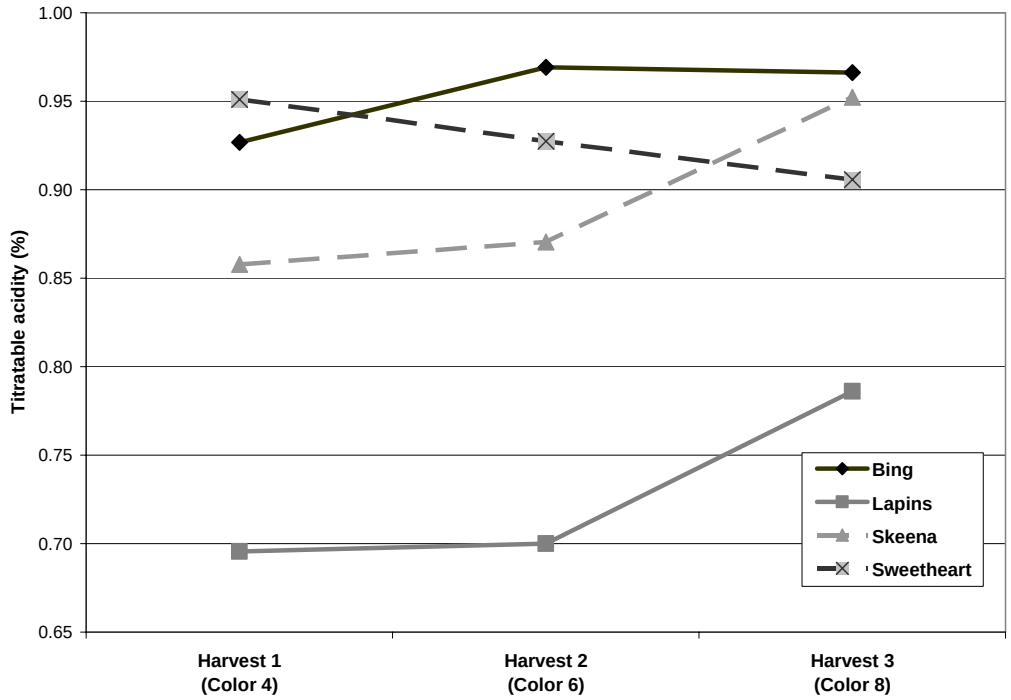

Figure 3. Cherry row size was measured at three cherry maturity levels based on CTIFL colors 4, 6, and 8 on 25-cherry samples of 'Bing,' 'Lapins,' 'Skeena' and 'Sweetheart.'

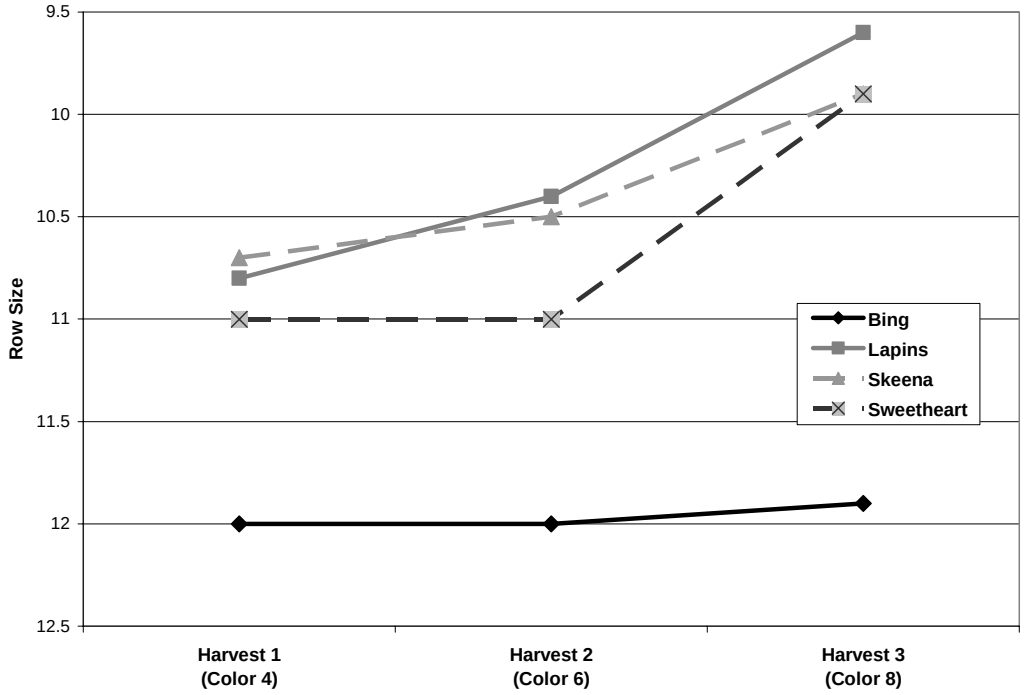

Figure 4. Firmness was measured using the FirmTech I at three cherry maturity levels based on CTIFL colors 4, 6, and 8 on 25-cherry samples of 'Bing,' 'Lapins,' 'Skeena' and 'Sweetheart.'

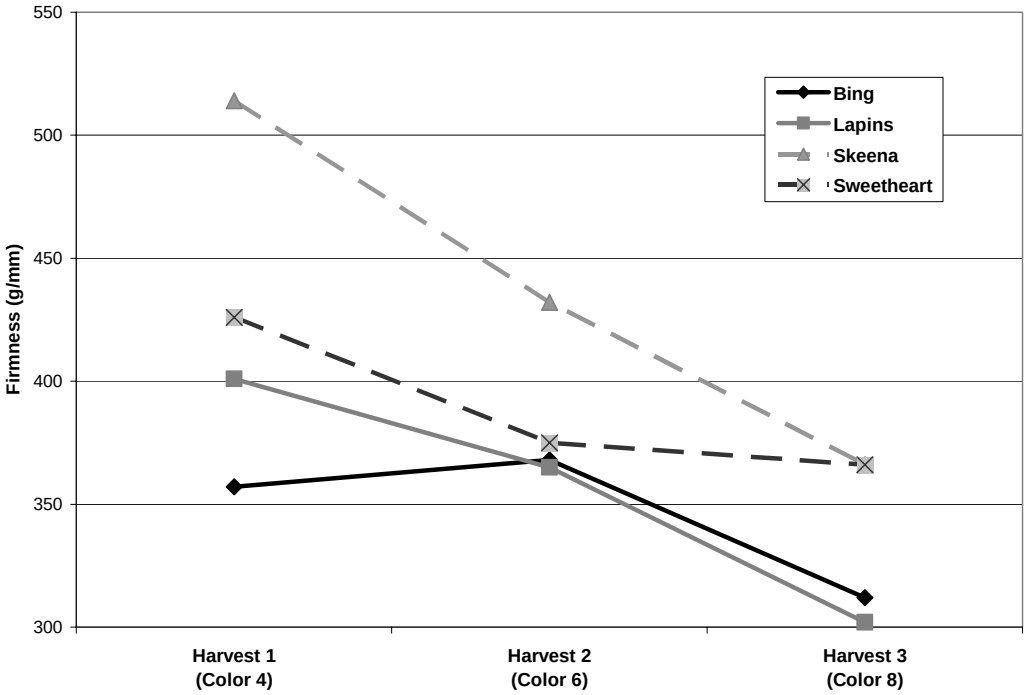

Figure 5. Pitting was induced at three cherry maturity levels based on CTIFL colors 4, 6, and 8 on 25-cherry samples of 'Bing,' 'Lapins,' 'Skeena' and 'Sweetheart,' then evaluated as percentage of fruit damaged after 14 days in storage.

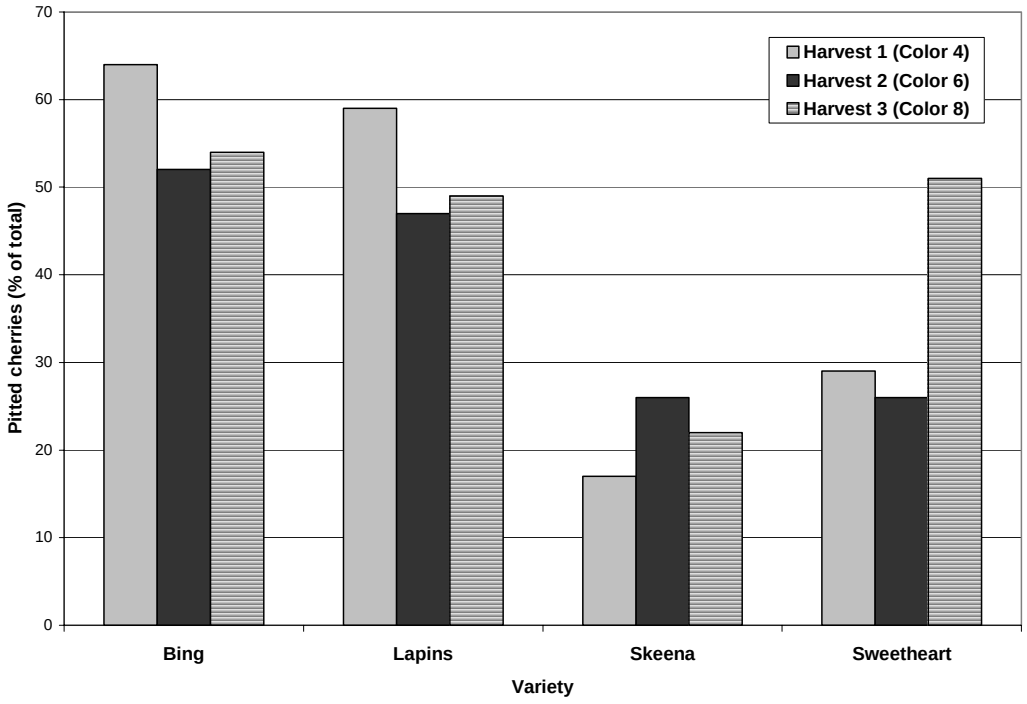

Figure 6. Titratable acidity was measured after storage at 32ºF for 0, 7, 14 and 28 days in storage on 25-cherry samples of 'Bing,' 'Lapins,' 'Skeena' and 'Sweetheart.'

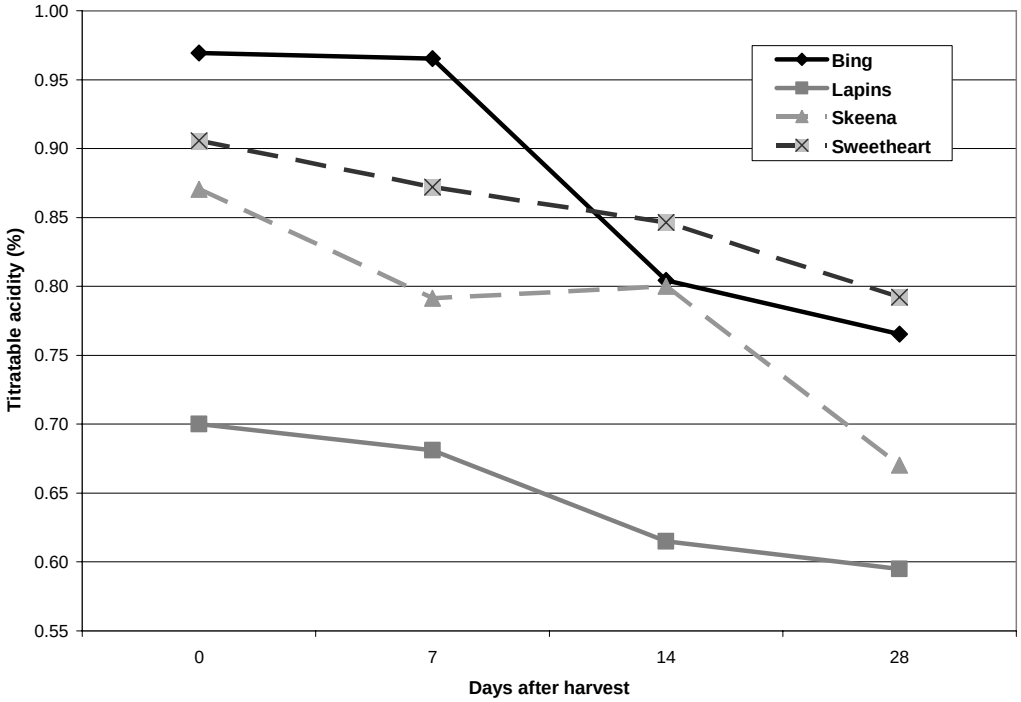

Figure 7. Firmness was measured using the FirmTech I at three cherry maturity levels based on CTIFL colors 4, 6, and 8 on 25-cherry samples of 'Bing,' 'Lapins,' 'Skeena' and 'Sweetheart' after 7 days of storage at 32ºF.