A Review of Cherry Fruit Cracking

by

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Introduction

• Factors affecting fruit cracking
  - morphology
  - physiology
  - environment
  - genetics

• Prevention of fruit cracking
  - cultural practices
  - mineral elements
  - Plant growth regulators
Fruit Morphology

- **Cuticle composition**
  - Cutin (90-99%)
  - Hydrophobic wax (1-10%)
    - Triterpenes (~68%)
      - ursolic acid
      - oleanolic acid
    - Alkanes (~16%)
      - nonacosane
      - heptacosane

- **Cuticular fractures**
Cuticular fractures

Non-fractured

Fractured
### Fracturing class vs. Cracking index

<table>
<thead>
<tr>
<th>Fracturing class</th>
<th>Cracking index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65</td>
</tr>
<tr>
<td>2</td>
<td>70</td>
</tr>
<tr>
<td>3</td>
<td>79</td>
</tr>
<tr>
<td>4</td>
<td>92</td>
</tr>
<tr>
<td>5</td>
<td>94</td>
</tr>
</tbody>
</table>

- **1.** Apical cavity, circumference, suture line
- **2.** 1-3 minute Type I or 1-5 Type II fractures
- **3.** Some small Type I and/or many Type II fractures
- **4.** Distinct fractures cover smaller parts of the surface
- **5.** Many distinct fractures cover large parts of the surface
<table>
<thead>
<tr>
<th>Fracturing class</th>
<th>Van</th>
<th>Sunburst</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>62</td>
<td>28</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>23</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>9</td>
</tr>
</tbody>
</table>
## Rootstock effects

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Average Fractures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damil</td>
<td>2.2</td>
</tr>
<tr>
<td>Charger</td>
<td>2.1</td>
</tr>
<tr>
<td>Weihroot 13</td>
<td>1.9</td>
</tr>
<tr>
<td>Camil</td>
<td>1.8</td>
</tr>
<tr>
<td>Weihroot 10</td>
<td>1.8</td>
</tr>
<tr>
<td>Colt</td>
<td>1.7</td>
</tr>
</tbody>
</table>
## Irrigation Effects

Fractures are influenced by water from roots!

<table>
<thead>
<tr>
<th>Irrigation Type</th>
<th>Average Fractures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drip irrigation</td>
<td>2.4</td>
</tr>
<tr>
<td>Drip irrigation + water</td>
<td>2.7</td>
</tr>
<tr>
<td>Dried roots + water</td>
<td>3.2</td>
</tr>
</tbody>
</table>
Water Relations

• Sap flow → continuous

Why did you crack?

I got too much to drink!
Nutrient Effects

- **Calcium**
  - ↓ Osmotic potential
  - strengthens cell walls
  - Cuticle permeability

- **Boron → no effects**

- **CuCl$_2$, AlCl$_3$ and FeCl$_3$ → ↓ cracking**

- **pH dependency → precipitates = polar pathways**
Prevention

Rain exclusion

• Prophylactic treatments
• Water removal e.g. air blasters & helicopters
Prevention
Rain Exclusion → Covers in Norway
Tunnels - South Africa
Prevention

- Wax supplements
  - Raingard® → carnuba wax
  - Vaporgard®
  - 0.3% Vegetable oil sprays (Granger, Oz)

- Scion cultivar effects

- Rootstock effects
  - Mazzard [X]
  - MM14 (?)

- 1% Calcium chloride → osmoticum

- Calcium nutrition
Calcium Chemistry

Three distinct possibilities

- Dissociation: $\text{CaCl}_2 \rightarrow \text{Ca}^{2+} + 2\text{Cl}^-$
- Chelation: Ca-Amino
- Liganding: $\text{Ca(H}_2\text{PO}_4)_2 + \text{Ca-Acetate}$
# Calcium Trial - South Africa

(% Cracking at Harvest)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Value</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>12.42</td>
<td>± 8.99</td>
</tr>
<tr>
<td>Ca(PO₄)₂</td>
<td>5.58</td>
<td>± 2.61</td>
</tr>
<tr>
<td><strong>Double supers</strong></td>
<td>0.83</td>
<td>± 1.19</td>
</tr>
<tr>
<td>Ca propionate</td>
<td>21.50</td>
<td>± 8.35</td>
</tr>
<tr>
<td>Ca lactate</td>
<td>9.67</td>
<td>± 6.01</td>
</tr>
<tr>
<td>CALTRAC</td>
<td>8.67</td>
<td>± 7.32</td>
</tr>
<tr>
<td>Ca Amino</td>
<td>14.83</td>
<td>± 13.42</td>
</tr>
<tr>
<td>CaCl₂</td>
<td>2.42</td>
<td>± 3.52</td>
</tr>
</tbody>
</table>
Calcium Trial - Norway

% Fruit Cracking

Control  | Ca Acet Leaf | Ca Acet Soil | Seniphos | CaCl2 | Double Supers

Calcium treatment
Potassium Silicate - Hood River

Hood River

% Fruit Cracking

Control

KSi

Treatment
Potassium Silicate - Hood River

Hood River

Firmness (mm/g)

Control

KSi

Treatment

360
370
380
390
400
410
420
Potassium Silicate - Corvallis

![Graph showing % Fruit Cracking for Control and KSi treatments for Gi6 and MM14 varieties.](image-url)
Potassium Silicate - Corvallis

The bar chart displays the diameter measurements (in mm) for different treatments in Corvallis. The chart compares two treatments: Control and KSi. The data points are represented with error bars indicating variability. The y-axis shows the diameter ranging from 24 to 28.5 mm, while the x-axis categorizes the treatments as Control and KSi.
Potassium Silicate - Corvallis

![Bar chart showing firmness (mm/g) for Control and KSi treatments with MM14 and Gi6 varieties.](chart.png)
Conclusions

• Soil applications of potassium silicate did not reduce fruit cracking

• potassium silicate $\rightarrow$ increased fruit firmness

• Need an integrated approach

• Be vigilant of crop load effects

• To date there is no silver bullet!
Recommendations

- Select crack resistant cv e.g. ‘Regina’, ‘Attika’ and ‘Lapins’
- Be aware of crop load → effects of PGR’s
- Manage soil moisture content carefully
- Keep orchard humidity down → sprinklers, flood irrigation etc.
- Consider calcium chloride applications
- Consider rain protectants e.g. oils, Raingard®
Future Research

- Consider FeCl$_3$ and CuCl$_2$ applications
- Consider protectants → supplement [wax]
- Rootstock effects need to be separated from crop load
- Is fruit firmness inversely proportional to fruit cracking?
Finished