OPTIMISING APPLE AND PEAR OUTTURN QUALITY USING INDUSTRY BEST PRACTICES.

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Today’s topics:

1. Apple & pear maturity management.
2. SmartFresh™ for maximising fruit firmness and superficial scald control.
3. Flesh browning in Pink Lady™ apples.
4. Extreme hot weather effects on storage potential their implications for the future.
PURPOSE OF THE TALK

• Why it is important to harvest fruit at optimum harvest maturity.
• How pre-harvest and post-harvest management practices will influence the outturn quality of apples and pears.
• The future importance of extreme temperatures.
WHEN TO HARVEST?

• When is the fruit mature?
  Answer: When it has the capacity to ripen

• What triggers ripening?
  Answer: Ethylene

• The ideal time to harvest depends on?
  Answer: Depends on your market

Therefore, for LTCA it will be optimum maturity based mainly on starch content for apples and firmness for pears
The effect of harvesting fruit too early (immature) or too late (over mature) on fruit quality during storage.

<table>
<thead>
<tr>
<th>Too immature</th>
<th>Over mature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less red skin colour</td>
<td>Fruit softer and mealy to taste</td>
</tr>
<tr>
<td>Smaller</td>
<td>Yellow background colour</td>
</tr>
<tr>
<td>More susceptible to scald</td>
<td>Greater risk of internal browning</td>
</tr>
<tr>
<td>Not full flavour</td>
<td>More susceptible to watercore</td>
</tr>
<tr>
<td>Shrivelling</td>
<td>Rotting</td>
</tr>
<tr>
<td></td>
<td>More susceptible to bruising</td>
</tr>
</tbody>
</table>
Suggested storage schedules for Pink Lady apples based on Colin Little’s Maturity Assessments 2005\(^1\) and Ctifl/Eurofru\(^2\) colour swatch standards.

<table>
<thead>
<tr>
<th>CA (schedule)(^1)</th>
<th>FIRMNESS (kgf)(^1)</th>
<th>SUGAR (%)(^1)</th>
<th>STARCH INDEX Ctifl 10 pt. RADIAL</th>
<th>STARCH (%)</th>
<th>RED SKIN COVER (%)</th>
<th>RED SKIN COLOUR INTENSITY Ctifl(^2) colour swatch</th>
<th>GREEN COLOUR INTENSITY Ctifl(^2) colour swatch</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTCA</td>
<td>8.8 – 8.0</td>
<td>13.8 – 14.6</td>
<td>3.5 – 6.0</td>
<td>80 – 50</td>
<td>50 – 70</td>
<td>4.0 – 5.5</td>
<td>3.0 – 4.0</td>
</tr>
<tr>
<td>MTCA</td>
<td>8.0 – 7.5</td>
<td>14.5 – 14.9</td>
<td>6.1 – 7.5</td>
<td>49 – 30</td>
<td>60 – 80</td>
<td>6.0 – 6.5</td>
<td>4.5 – 5.0</td>
</tr>
<tr>
<td>STCA</td>
<td>7.6 – 7.0</td>
<td>15.0 – 15.6</td>
<td>7.6 – 8.5</td>
<td>29 – 10</td>
<td>70 – 90</td>
<td>7.0 – 8.0</td>
<td>5.5</td>
</tr>
</tbody>
</table>

- ‘Long Term CA’ (LTCA)\(^1\): to mid OCTOBER in an ‘off-season’ and to mid NOVEMBER in a good season.
- ‘Medium Term CA’ (MTCA)\(^1\): to late AUGUST.
- ‘Short Term CA’ (STCA)\(^1\): to early JULY.
Suggested storage schedules for Granny Smith apples based on Colin Little’s Maturity Assessments 2005\(^1\).

<table>
<thead>
<tr>
<th>CA (SCHEDULE)</th>
<th>FIRMNESS (KGF)</th>
<th>SUGAR (%)</th>
<th>STARCH INDEX CTIFL 10 PT.</th>
<th>STARCH (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTCA</td>
<td>7.8 – 7.3</td>
<td>10.8 – 11.8</td>
<td>4.0 - 6.0</td>
<td>80 – 60</td>
</tr>
<tr>
<td>MTCA</td>
<td>7.2 – 7.0</td>
<td>11.5 – 12.1</td>
<td>6.1 - 8.0</td>
<td>59 - 40</td>
</tr>
<tr>
<td>STCA</td>
<td>6.9 – 6.5</td>
<td>12.0 – 13.0</td>
<td>8.1 - 9.0</td>
<td>39 - 20</td>
</tr>
</tbody>
</table>

- ‘Long Term CA’ (LTCA): to late JANUARY.
- ‘Medium Term CA’ (MTCA): to mid – NOVEMBER
- ‘Short Term CA’ (STCA): to early SEPTEMBER.

Long Term CA  
Starch Index
Suggested storage schedules for WBC pears based on Colin Little’s Maturity Assessments 2005¹.

<table>
<thead>
<tr>
<th>CA schedule</th>
<th>Firmness (kgf)</th>
<th>Sugar (%)</th>
<th>Starch Flesh (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTCA</td>
<td>8.6 – 8.0</td>
<td>11.7 – 12.3</td>
<td>90 - 70</td>
</tr>
<tr>
<td>MTCA</td>
<td>7.9 – 7.0</td>
<td>12.4 – 13.9</td>
<td>69 - 60</td>
</tr>
<tr>
<td>STCA</td>
<td>6.9 – 5.6</td>
<td>13.0 – 14.2</td>
<td>59 - 50</td>
</tr>
</tbody>
</table>

- ‘Long Term CA’ (LTCA): At these bench mark standards the fruit are at the best maturity for ‘Long Term CA’, to mid JUNE.

- ‘Medium Term CA’ (MTCA): At these bench mark standards the fruit are at the best maturity for ‘Medium Term CA’, to early APRIL.

- ‘Short Term CA’ (STCA): At these bench mark standards the fruit are at the best maturity for ‘Short Term CA’, to early MARCH.
FORECASTING APPLE MATURITY?

- Accumulated degree days
- T-test
- Days from full bloom to harvest

- Length of the flowering period, full bloom date and the temperature conditions during flowering and the first 30-50 days after full bloom (DAFB) are a major guide to harvest maturity uniformity.
• KEEP ANNUAL RECORDS OF FULL BLOOM DATE

• HOW DO YOU CHECK WHEN FULL BLOOM HAS OCCURRED?
Full bloom is the description of when **80% of the flowering spur on a limb** have all but one of the florets open (at anthesis). ie only 1 of the 6-7 florets remain unopened (see arrow in figure adjacent).

All three of the flower clusters in this figure are at, or passed full bloom stage.

The flowering spur opposite has not yet reached full bloom as more than one floret remains unopened (see arrows)
FACTORS AFFECTING APPLE MATURITY?

- Fruit position on the tree
- Crop load
- Nutrition
- Tree management
- Ethylene inhibitions
HOW TO SAMPLE APPLES FOR MATURITY TESTING?

• Maturity variation is greater within a tree than between trees. Sampling method is important!
Delicious apples grown in the USA
SMARTFRESH™
Ethylene molecule

Ethylene receptor

Activation of signalling pathway

1-MCP molecule

Message - ripen

Blocked ethylene receptor

Regenerated ethylene receptor
Effect of SmartFresh™ (1-MCP) on Pink Lady™ apples taken from 12 orchards in the Goulburn Valley and assessed in the UK October 2002.
SmartFresh™ Storage Trial Granny Smith Apples

Superficial scald in Granny Smith apples.

• Apples were untreated or treated with SmartFresh™ before storage
• Stored in CA for up to 8 months at 0°C
• Simulated marketing: 7 days at 20°C

Plus SmartFresh™, after 8 months storage

No SmartFresh™, after 5 months storage
INTERNAL BROWNING OF ‘CRIPPS PINK’ APPLES
<table>
<thead>
<tr>
<th>TYPE</th>
<th>PHYSIOLOGICAL DESCRIPTION</th>
<th>CLIMATIC REGION WHERE SYMPTOMS OCCUR</th>
<th>Districts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffuse</td>
<td>Chilling Injury</td>
<td>Cool Regions &lt; 1100 GDD</td>
<td>Tasmania Yarra Valley</td>
</tr>
<tr>
<td>Radial</td>
<td>Senescent breakdown</td>
<td>Warm Regions &gt; 1100 GDD</td>
<td>Yarra Valley Manjimup Batlow Goulburn Valley</td>
</tr>
<tr>
<td>CO$_2$ injury</td>
<td>High CO$_2$ Injury</td>
<td>All Cripps Pink apples susceptible</td>
<td>All</td>
</tr>
</tbody>
</table>

GDD: Accumulated growing degree days above 10°C during the growth period from full bloom to harvest.
### Recommendations to reduce the risk of flesh browning in ‘Cripps Pink’ apples

<table>
<thead>
<tr>
<th></th>
<th>DIFFUSE FLESH BROWNING</th>
<th>RADIAL FLESH BROWNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maturity</strong></td>
<td>SPI 3.5</td>
<td>SPI 3.5</td>
</tr>
<tr>
<td><strong>Storage</strong></td>
<td>3°C</td>
<td>1°C or Stepwise cooling in high risk seasons</td>
</tr>
<tr>
<td><strong>atmosphere</strong></td>
<td>&lt;1% CO₂</td>
<td>&lt;1% CO₂</td>
</tr>
<tr>
<td><strong>Orchard</strong></td>
<td>Ensure calcium levels adequate</td>
<td>Best commercial practice</td>
</tr>
<tr>
<td><strong>management</strong></td>
<td>&lt;950 GDD avoid long storage &gt;5 months</td>
<td>Best commercial practice</td>
</tr>
</tbody>
</table>

**SPI starch pattern index using CTIFL 10 POINT scale**
In the UK, 2002

Internal Browning incidence (%)

Orchard

Control

SmartFresh

LSD (P=0.05)
GLOBAL WARMING OR SEASONNAL EXTREME TEMPERATURE EFFECTS ON FRUIT STORAGE QUALITY?
• **High Chill** - Williams, Buerre Bosc, Winter Nelis, Comice, Lemon Bergamot Gala, Delicious, Golden Delicious, Jonagold, Fuji, Braeburn
• **Medium Chill** - Packham's, Josephine Granny Smith, Sundowner, Pink Lady
• **Low Chill** – Corella
EXTREME TEMPERATURE EFFECTS

• Reduced winter chilling
• Increased infrastructure costs: shading
• Increased incidence of pests and diseases
• Higher requirement for water
• A reduction in fruit quality
• Increased energy requirements
MAJOR CONCLUSIONS

• The key to optimising fruit outturn quality is ethylene management. This assumes that nutritional levels are adequate, trees were not stressed, crop loads were moderate, best practice temperature and controlled atmospheres are used to maintain low respiration rates.

• In the future, if extreme heat and water stress conditions continue this will impact on the selection of new varieties and cultural practices.
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