Are the fruit on your trees really ready to pick?

Christine Frisina, Janine Jaeger, John Lopresti, Dario Stefanelli
Background

- **Poor Outturn**
  - Flesh Browning, discoloration, mealy, rubbery, shrivel

- **Harvest maturity**
  - Cultivar? Maturity?
  - Firmness and Sweetness results from several cultivars

- **Fruit development**
  - Firmness, SSC results several cultivars

- **Storage trial results**
Poor Outturn

Flesh browning: flesh is browned/discoloured

Off colour: flesh isn’t brown but is off colour

Flavour Pearl nectarine 3w + 2d

Majestic Pearl nectarine 1w + 2d

Polar Princess Peach 2w + 2d
Poor Outturn

**Mealiness:**
dry, wooly, juiceless

**Rubberiness:**
fruit is very firm, often juiceless

September Bright nectarine
2w + 2d

- Mostly internal and textural
- Poor/dull skin colour
- No aroma or poor flavour
- Off odours
Outturn – Maturity

Immature fruit are more likely to express:
- Flesh browning
  visible on return to ambient temperatures
- Rubbery flesh
  noticeable after long term storage (more than 2 weeks)
- Flesh dryness
- Discoloured flesh
- Dehydration – rubberiness, sometimes shrivelled skin
- Possibly mealiness

Mature fruit are more likely to express:
- Mealiness
- Flesh browning
- Shrivel
Harvest maturity

**Harvest factors:** Colour
Size
Firmness
Sweetness

Factors measure harvest readiness, not maturity.

Fruit is harvest ready, but not ready to harvest
Physiological Maturity

Maturity needs to be a measure of whether the fruit can be harvested and progress through ontogeny – reach is full organoleptic potential.

**Physiological maturity**: measuring the actual development stage of the fruit; using factors that help understand the physiological stages within the fruit.

$\text{CO}_2$ production - not sensitive enough; Ethylene production is better measure.
### DA meter IAD maturity classes: Database

**Preliminary results on IAD Maturity classes for selected Stonefruit**

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Seasonality</th>
<th>Immature (no ethylene, not to be harvested)</th>
<th>Harvest Ready (on-set climacteric, suitable for export and domestic)</th>
<th>Mature (climacteric peak, suitable for domestic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golden May</td>
<td>Apricot - Mid</td>
<td>&gt; 1.20</td>
<td>1.19 - 0.60</td>
<td>&lt; 0.59</td>
</tr>
<tr>
<td>Angeleno</td>
<td>Plum - Late</td>
<td>&gt; 1.30</td>
<td>1.29 - 1.0</td>
<td>&lt; 0.99</td>
</tr>
<tr>
<td>Rose Bright</td>
<td>Nectarine - Early</td>
<td>&gt; 1.0</td>
<td>1.0 - 0.40</td>
<td>&lt; 0.40</td>
</tr>
<tr>
<td><strong>Snow Flame 23</strong></td>
<td>Peach - Early</td>
<td>&gt; 0.9</td>
<td>0.90 - 0.30</td>
<td>&lt; 0.3</td>
</tr>
<tr>
<td>Snow Flame 25</td>
<td>Peach - Mid</td>
<td>&gt; 1.0</td>
<td>1.0 - 0.60</td>
<td>&lt; 0.6</td>
</tr>
<tr>
<td>Summer Bright</td>
<td>Nectarine - Mid</td>
<td>&gt; 0.70</td>
<td>0.69 - 0.30</td>
<td>&lt; 0.29</td>
</tr>
<tr>
<td>Fire Sweet</td>
<td>Nectarine - Mid</td>
<td>&gt; 1.0</td>
<td>0.99 - 0.50</td>
<td>&lt; 0.49</td>
</tr>
<tr>
<td>Summer Flare 26</td>
<td>Nectarine - Mid</td>
<td>&gt; 1.0</td>
<td>0.99 - 0.60</td>
<td>&lt; 0.59</td>
</tr>
<tr>
<td>Summer Flare 34</td>
<td>Nectarine - Mid</td>
<td>&gt; 1.20</td>
<td>1.19 - 0.60</td>
<td>&lt; 0.59</td>
</tr>
<tr>
<td>August Fire</td>
<td>Nectarine - Late</td>
<td>&gt; 1.0</td>
<td>0.99 - 0.50</td>
<td>&lt; 0.49</td>
</tr>
<tr>
<td>Autumn Bright</td>
<td>Nectarine - Late</td>
<td>&gt; 1.0</td>
<td>1.0 - 0.60</td>
<td>&lt; 0.60</td>
</tr>
<tr>
<td><strong>August Bright</strong></td>
<td>Nectarine - Late</td>
<td>&gt; 0.90</td>
<td>0.90 - 0.40</td>
<td>&lt; 0.40</td>
</tr>
<tr>
<td>September Red</td>
<td>Nectarine - Late</td>
<td>&gt; 1.10</td>
<td>1.09 - 0.60</td>
<td>&lt; 0.59</td>
</tr>
<tr>
<td>September Bright</td>
<td>Nectarine - Late</td>
<td>&gt; 1.20</td>
<td>1.20 - 0.50</td>
<td>&lt; 0.50</td>
</tr>
<tr>
<td>August Flame</td>
<td>Peach - Late</td>
<td>&gt; 1.30</td>
<td>1.30 - 0.70</td>
<td>&lt; 0.70</td>
</tr>
<tr>
<td>September Sun</td>
<td>Peach - Late</td>
<td>&gt; 1.20</td>
<td>1.20 - 0.80</td>
<td>&lt; 0.80</td>
</tr>
<tr>
<td>Ice Princess</td>
<td>Peach - Mid</td>
<td>&gt; 1.30</td>
<td>1.30 - 0.50</td>
<td>&lt; 0.50</td>
</tr>
<tr>
<td>O’Henry</td>
<td>Peach - Early</td>
<td>&gt; 0.90</td>
<td>0.90 - 0.60</td>
<td>&lt; 0.60</td>
</tr>
<tr>
<td></td>
<td>Peach - Late</td>
<td>&gt; 1.20</td>
<td>1.20 - 0.70</td>
<td>&lt; 0.70</td>
</tr>
<tr>
<td>Red Haven</td>
<td>Peach - Mid</td>
<td>&gt; 1.60</td>
<td>1.60 - 0.60</td>
<td>&lt; 0.60</td>
</tr>
</tbody>
</table>

Firmness – Snow Flame 23

SF23 2017-18

Climacteric
Onset
No ethylene
Firmness – August Flame

AF 2017-18

- Climacteric
- Onset
- No ethylene
Firmness – September Bright

No ethylene

Onset

Climacteric

September Bright 2017-18

Firmness

0 1 2 3 4 5 6 7 8 9 10

IAD value

0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2
Firmness – Diamond Pearl

Diamond Pearl 2019-20

![Graph showing firmness vs. I_AD value with Climacteric, Onset, and No ethylene phases marked]

- Firmness (kg)
- I_AD value

Climacteric
Onset
No ethylene
Firmness – Polar Princess

Suppressed ethylene production

Polar Princess 2019-20

?
Sweetness – Snow Flame 23

SF23 2017-18

Climacteric
Onset
No ethylene
Sweetness – August Flame

August Flame 2017-18

SSC

Climacteric

Onset

No ethylene

I_d value

0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0
Sweetness – September Bright

No ethylene

Onset

Climacteric

No ethylene

IAD value

SSC
Sweetness – Polar Princess

Suppressed ethylene production
Maturity: DA range/Firmness range

Crossover in harvest firmness between No ethylene and Onset ethylene production

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Firmness</th>
<th>DA range</th>
<th>DA values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snow Flame 23</td>
<td>9.1 – 3.9</td>
<td>No ethylene</td>
<td>≥ 1.0</td>
</tr>
<tr>
<td></td>
<td>5.9 – 1.0</td>
<td>Onset</td>
<td>0.90 – 0.30</td>
</tr>
<tr>
<td>Diamond Pearl</td>
<td>7.0 – 0.9</td>
<td>No ethylene</td>
<td>≥ 0.80</td>
</tr>
<tr>
<td></td>
<td>3.0 – 0.5</td>
<td>Onset</td>
<td>0.70 – 0.40</td>
</tr>
<tr>
<td>September Bright</td>
<td>8.9 – 6.0</td>
<td>No ethylene</td>
<td>≥ 1.30</td>
</tr>
<tr>
<td></td>
<td>7.9 – 2.5</td>
<td>Onset</td>
<td>1.20 – 0.50</td>
</tr>
<tr>
<td>August Flame</td>
<td>12.2 – 6.0</td>
<td>No ethylene</td>
<td>≥ 1.40</td>
</tr>
<tr>
<td></td>
<td>7.8 – 3.0</td>
<td>Onset</td>
<td>1.30 – 0.70</td>
</tr>
<tr>
<td>Polar Princess</td>
<td>9.9 – 5.8</td>
<td>?</td>
<td>1.8 – 0.2</td>
</tr>
</tbody>
</table>
Firmness – long term storage and shelf life

Polar Princess - firmness

No Ethylene
Onset
climacteric

Firmness (kg)

Storage time (weeks) + shelf life (days)
Firmness – long term storage and shelf life

Diamond Pearl - Firmness

- No Ethylene
- Onset

Firmness (kg)

Storage time (weeks) + shelf life (days)
Firmness – long term storage and shelf life

August Flame

No ethylene
Onset
Climacteric

Storage time (weeks) + shelf life (days)
$I_{AD}$ – long term storage and shelf life

[Graph showing the AD index for August Flame with different stages of ripeness, showing changes in the index over storage time and shelf life.]
Physiological maturity - VOCs

No ethylene production - August Flame peach

Onset ethylene production - August Flame peach

Climacteric ethylene production - August Flame peach

(3 weeks 2 °C + 3 days shelf life)
Disorders during long term storage and shelf life
What we know so far

- Fruit with the **same size, appearance, SSC, or Firmness may not be** at the same physiological development stage.

- Fruit that is **not physiologically ready** at harvest are more likely to result in disorders after short and long term storage:
  - browning, mealy, rubbery, shrivelled
  - these fruit will soften, but not ripen
  - cannot **restart** adequately

- **Ontogeny** – fruit should be harvested at a stage where it is still capable of reaching its full organoleptic potential. Taste, smell, texture

Make sure the fruit is not just harvest ready, but is ready to harvest.
Where to from here?

• Measure physiological maturity - ethylene production

• Correlate ethylene production with in field instruments:
  - $I_{AD}$ (DA meter; database of results on HIN)
  - App for downloading DA values will be available next couple months
  - Fluorescence meter – Reubens Technology, preliminary testing shows promise, further testing coming season/s

• Delayed cooling
  - Further studies to link physiological maturity with delayed cooling (stepwise cooling/preconditioning)

• Other future possibilities:
  - NIR in grading system – still under investigation (Spain, IRTA)
  - Cultivar – breeding - appropriate varieties for storage
Thank you

Questions?

Contact: Christine.Frisina@agriculture.vic.gov.au

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