“Secrets” to successfully handling mandarins on commercial citrus packing lines

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Mandarins

• Most problematic of citrus
• Very diverse
• Prone to peel disorders
• Prone to off-flavors
BASIC MANDARIN FRUIT
POSTHARVEST BIOLOGY
Citrus

• Chilling sensitive
• Non-climacteric
Storage Temperature Requirements

- Varies with citrus type and variety
- Ranges from approximately 32F to 59F

Most Cold Tolerant: Kumquats, Mandarins, Oranges
Least Cold Tolerant: Limes, Citrons, Lemons, Grapefruit
Why are we concerned about respiration rate?

The rate of deterioration (perishability) is generally proportional to the respiration rate.
<table>
<thead>
<tr>
<th>Relative Perishability</th>
<th>Potential storage life (weeks)</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>&lt;2</td>
<td>Strawberry, Blackberry, Blueberry</td>
</tr>
<tr>
<td>High</td>
<td>2 to 4</td>
<td>Grape, <strong>Mandarin</strong>, Peach</td>
</tr>
<tr>
<td>Moderate</td>
<td>4 to 8</td>
<td>Apple, Pear, <strong>Orange</strong>, <strong>Grapefruit</strong>, <strong>Lime</strong>, Kiwifruit</td>
</tr>
<tr>
<td>Low</td>
<td>8 to 16</td>
<td>Apple, Pear, <strong>Lemon</strong></td>
</tr>
<tr>
<td>Very Low</td>
<td>&gt;16</td>
<td>Tree Nuts, Dried Fruits</td>
</tr>
</tbody>
</table>

Kader, Postharvest Biology
POSTHARVEST PROBLEMS
Fruit “burning” following degreening
SOPP Damage
Puffiness

Olleocelosis
MANDARIN PEEL DISORDER
PREHARVEST CONDITIONS
Symptoms of Mandarin Rind Disorder

Adaskaveg, Forster, Connell - 2010
Mandarin Rind Disorder

- Observed in Central Valley Mandarins (Satsumas, Clementines)
- Symptoms occur in field initially as water soaked areas, typically on exposed side of fruit on outer tree perimeter
- Symptoms progress and leads to high fruit loss after harvest

Similar symptoms in other mandarins (Encore, Fortune, clementines), oranges (Valencia rindstain) described in literature

Adaskaveg, Forster, Connell - 2010
Mandarin Rind Disorder - RECOMMENDATIONS

- Multi-year study in Fresno and Butte County
- Noted that fruit are “predisposed” prior to color break
- Noted that “water-soaking” of predisposed fruit in lab conditions triggered symptoms
- Not correlated to a specific pathogen

Treatment with a light oil, antitranspirant or Gibb prior to color break reduced incidence of disorder
Plant Growth Regulators: $\text{GA}_3$

- Delayed color break
- Delayed rind senescence, increased firmness
- Reduced navel rindstain
- Reduced puff and crease in some varieties
- Reduced susceptibility to chilling injury
- Reduced wax deposition and changes in wax structure
The influence of \( \text{GA}_3 \) on peel resistance and fruit aging in satsuma mandarin when applied on Sept. 30 (Garcia Luis et al, 1985)
Impact of handling injuries on fruit quality
Care needs to be taken during handling to minimize damage since the consequences of mechanical injury are:

- increased decay
- enhanced water loss
- may result in peel breakdown in handling
“The most common type of injury was made by ... the clippers ... many were injured by stem punctures, while others showed scratches from thorns. Other common ... injury... were from gravel and twigs in the bottom of boxes and cuts by the finger nails of the pickers.” Powell, 1908

Riverside, California
Delays Between Harvest and Processing results in increased Decay Quality (Rind Disorders)
Preharvest Fungicide Option

Quadris Top

• Syngenta
• Combination of Azoxystrobin and Difencononazole
• Can be Ground or Aerial Application
• May be applied the day of harvest
Ethylene Degreening
Button discoloration following degreening
MANDARIN FLAVOR: THE IMPACT OF STORAGE, TEMPERATURE, COATINGS AND GENETICS
Mandarins often develop off-flavor during storage

- Not fresh
- Over ripe
- Spoiled
- Strange aftertaste
- Really old
Temperature effect on off-flavor

Warm temps enhance

Time in cold storage influences response

W. Murcott
10 degrees C (50°F) also inhibits off-flavor

Flavor compounds increase rapidly in amount at warm temperatures.....off-flavor development does not take long
Date of harvest can influence the negative effect of storage on mandarin flavor.

Overall flavor decreases and off-flavor increases as the season progresses.

Corresponds to declines in internal oxygen.
Large varietal differences exist in the amount of ethanol accumulated after waxing and storage.
Response to warm storage temperature - other mandarin types

- **China S-9**
  - Hedonic Score at 5°C and 20°C over weeks following packing.

- **Okitsu Wasi**
  - Hedonic Score at 5°C and 20°C over weeks following packing.

- **Fairchild**
  - Hedonic Score at 5°C and 20°C over weeks following packing.

- **Nova**
  - Hedonic Score at 5°C and 20°C over weeks following packing.
Take Home Message

• Most problematic of citrus
• Very diverse - Need to gain better understanding of postharvest requirements when new varieties released
• Prone to peel disorders - Soft handling required at all steps from harvest through packing
• Prone to off-flavors - Temperature management critical especially after waxing
Thank you for your attention

Any questions?