Maintaining Citrus Fruit Quality During Degreening

Mark Ritenour
University of Florida
Indian River Research and Education Center

Why is Degreening Necessary?

- Consumers associate green citrus fruit with immaturity (poor quality).
- Fruit color is due to the interaction of chlorophyll (green) and carotenoid (red – yellow) pigments.
- Color change in the field is especially stimulated when nighttime temperatures drop below 55°F.

Climacteric vs. Non-climacteric

Climacteric have increased respiration & ethylene production during "ripening".

The Goal

- Degreening does not affect internal quality of the fruit.
- Remove chlorophyll (green pigment).
- Promote anthocyanins (yellow-orange pigments).
- Temperature optimums are different.

Recommended Degreening Conditions

Florida
- Temperature: 28 to 29°C (82 to 85°F)
- Ethylene: 5 ppm
- Humidity: 90 to 96%
- Ventilation (keep below 0.1% CO₂): 1 air change per hour
- Air Circulation: 100 CFM per 900 lb. bin
  (CFM = cubic feet per minute)

California
- Temperature: 20 to 25°C (68 to 77°F)
- Ethylene: 5 to 10 ppm
- Humidity: 90%
- Ventilation (keep below 0.1% CO₂): 1 to 2 air changes per hour
- Air Circulation: 1 room volume per minute

Temperature

Grierson & Newhall, 1953
Relative Humidity

Grierson & Newhall, 1960

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Picking Date</th>
<th>Relative Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(RH)</td>
<td>Low (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40.0</td>
</tr>
<tr>
<td>Averages</td>
<td>45.2</td>
<td>50.2</td>
</tr>
</tbody>
</table>

Ventilation removes waste gasses (e.g., CO₂ and possibly peel oil vapor).
- 1% CO₂ can about stop degreening.
- Ventilation also results in more uniform temperature thought the room.
- Both result in faster and more uniform color development within the load.
- Continuous ventilation is often better than periodically opening the room.
- Excessive ventilation wastes ethylene and (when used) heating.

Air Flow

Barrier prevents air from flowing over the top of the bin stack.

Backstop away from the wall allows air to flow under the bins.

Air should flow in-between pallet bins.

Air should not short circuit through spaces between pallet bin stacks.

Barrier prevents air from flowing behind the barrier.
Potential Problems

- Ethylene and warm conditions promote tissue senescence.

Potential Problems

- Ethylene stimulates growth of some decay pathogens, such as Diplodia stem-end rot and Anthracnose.
- The warm and humid conditions experienced during degreening promotes decay.

Potential Problems

- Ethylene can potentially be explosive (between 3% and 34%).

Potential Problems

- Temperatures too high – above 85F, slows rate of chlorophyll degradation, but increases fruit metabolism, decay, and breakdown
- Too much water in the rooms – fruit stays wet = slower degreening & increased decay pressure
  - Ethylene is not very soluble in water

Potential Problems

- Poor air circulation = uneven temperature distribution and local buildups of CO₂ in the room
  - Both = uneven color development

What Inhibits Color Development?

- Warm weather
  - particularly warm nights
  - Regreening in the Spring
- Factors that promote vigorous growth
  - high rainfall
  - high nutrient levels (esp. N & K)
- Field oil sprays
- Peel oil (e.g., from brushing)
- Some scale insects (e.g., chaff & purple scale)
Results

- Red grapefruit washed on a commercial packing line.

<table>
<thead>
<tr>
<th>Days</th>
<th>Treatment</th>
<th>ab</th>
<th>hue</th>
<th>Wt. Loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Control</td>
<td>0.09a</td>
<td>84.77b</td>
<td>1.61b</td>
</tr>
<tr>
<td></td>
<td>HPW</td>
<td>0.06b</td>
<td>86.30b</td>
<td>1.91b</td>
</tr>
<tr>
<td></td>
<td>Brush</td>
<td>0.03c</td>
<td>88.21a</td>
<td>2.81a</td>
</tr>
<tr>
<td></td>
<td>B + HPW</td>
<td>0.02c</td>
<td>88.91a</td>
<td>2.93a</td>
</tr>
</tbody>
</table>

P Value 0.0011 0.0017 <.0001

Waxing first will virtually stop further color development.

Thank You!

- For more information, visit the UF Postharvest Website

http://irrec.ifas.ufl.edu/postharvest/