Degreening Difficult-to-Degreeen Citrus Fruit:
Can it be done?

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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 stimulated when nighttime temperatures drop below 55F
Pre-harvest Factors Against Degreening

- 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)
The Goal

- Remove **chlorophyll** (green pigment)
- Promote **carotenoids** (yellow-orange pigments)
- Temperature optimums are different for chlorophyll & carotenoids
- Degreening does not affect internal quality of the fruit
Recommended Degreening Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Florida</th>
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<tbody>
<tr>
<td>Temperature</td>
<td>28 to 29°C (82 to 85°F)</td>
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<tr>
<td>Ethylene</td>
<td>5 ppm</td>
</tr>
<tr>
<td>Humidity</td>
<td>90 to 96%</td>
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<tr>
<td>Ventilation (keep below 0.1% CO₂)</td>
<td>1 air change per hour</td>
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<tr>
<td>Air Circulation</td>
<td>100 CFM per 900 lb. bin</td>
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<td>(CFM = cubic feet per minute)</td>
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</tbody>
</table>
Potential Problems

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

- Temperatures too high – above 85F, slows rate of chlorophyll degradation, and increases fruit metabolism, decay, and breakdown
Temperature

Fig. 3.—Effect of temperature on rate of degreening of Hamlin oranges. Adapted from Grierson and Newhall (23).

Fig. 3. Effect of Temperature on Rate of Degreening of Marsh Grapefruit.
Potential Problems

- Ethylene and warm conditions promote tissue senescence.

Fig. 141. The effects of temperature on the respiratory rates of avocado and citrus fruits. (From Biale and Young, 1962.)
Potential Problems

- Temperatures too high – above 85F, slows rate of chlorophyll degradation, but increases fruit metabolism, decay, and breakdown

- Poor ventilation & air circulation = uneven temperature distribution and local buildups of CO$_2$ in the room
  - Both = uneven color development
Ventilation

• Removes waste gasses (e.g., CO$_2$ and possibly peel oil vapor)
  – 1% CO$_2$ can about stop degreening

• Continuous ventilation is better than periodically opening the room

• Excessive ventilation wastes ethylene and (when used) heating
Potential Problems

- Poor air circulation = uneven temperature distribution and local buildups of CO$_2$ in the room
  - Both = uneven color development
Potential Problems

• Temperatures too high – above 85F, slows rate of chlorophyll degradation, but increases fruit metabolism, decay, and breakdown

• Poor ventilation & air circulation = uneven temperature distribution and local buildups of CO$_2$ in the room
  – Both = uneven color development

• Too much water in the rooms – fruit stays wet = slower degreening & increased decay pressure
  – Ethylene is not very soluble in water
Use of LED Lights

Dr. LiLi Deng

• Fruit first dipped for 1 min in 1,000 ppm ethephon (releases ethylene)

• Blue LED light significantly improved coloration (hue & a/b)
  – Yes: grapefruit, Nov-harvested
  – No: Fallglo, Navel, or grapefruit harvest in Dec

• Red LED light had no effect

• Neither affected internal quality
Cold shock resulted in better peel color than the commercial control after 4 days degreening.
Cold Shock Effects Influenced by 3 Factors

• Degreening temperature

  – Cold shock was not effective when the fruit were degreened at the normal 85°F

Degreened at 85°F

Degreened at 70°F

Dr. Suming Dai
Cold Shock Effects Influenced by 3 Factors

- Degreening temperature
- Cold Shock temperature

Degreened at 70F
Cold Shock Effects Influenced by 3 Factors

- Degreening temperature
- Cold Shock temperature
- Preharvest field temperatures
  - Cold shock eventually enhanced fruit color development on Vernia fruit harvested in Dec
  - No cold shock benefit in January after cold temps in the field
Fruit from second harvest experienced cold shock in the field.

Dr. Suming Dai
Conclusions

• Depending on citrus variety, degreening at cooler temperatures can improve final color

• A 15 hr, pre-degreening cold shock (32F) could improve final peel color of ‘Vernia’
  – Only worked when degreening at 70F, not at 85F
  – No benefit after natural cold temperatures in the field
  – Even after 6 days degreening, color was still not great
Thank You!

• For more information, visit the UF Postharvest Website

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