The Need
• Control of postharvest decay is always a concern.
• Many factors influence the potential for decay development:
  – Preharvest field conditions.
  – Harvesting & handling practices.
  – Postharvest temperatures, relative humidity, exposure to ethylene, etc.

Options?
• Preharvest - No reliable replacement yet for Benlate or Topsin.
  – Copper, Aliette, and Phosphorous acid products to reduce Brown rot.
• Postharvest control measures.
  – Good sanitation practices
  – Careful handling
  – Use of fungicide
    • Must be effective against latent organisms such as Diplodia and Anthracnose

Currently Registered Fungicides for Citrus Postharvest Treatments
• Thiabendazole (TBZ)
• Imazalil
• Sodium o-phenylphenate (SOPP)
• Fludioxonil (Graduate)
• Fludioxonil + azoxystrobin (Graduate A+)
• Pyrimethanil (Penbotec)

Postharvest Fungicide MRLs

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>U.S. (Citrus)</th>
<th>Canada (Citrus)</th>
<th>CODEX (Citrus)</th>
<th>EU (Citrus)</th>
<th>Japan (G &amp; O)</th>
<th>Korea (G &amp; O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imazalil</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Thiabendazole</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>SOPP (2 Phenylphenol, O-phenylphenol)</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>Expiring 9/30/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thiabendazole (NAC)</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>5</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>
Thiabendazole (TBZ)
- Controls stem-end rot and green mold.
  - Some effectiveness against anthracnose.
  - Does not control sour rot or black rot.
- Recommended concentrations:
  - 1000 ppm (0.1%) as a water suspension.
  - 2000 ppm (0.2%) in a water-based wax.
- Not very soluble in water.
  - Constant agitation required.
- Include a sanitizer (e.g., chlorine) with recirculated solutions.

Imazalil
- Especially effective against green mold.
  - Diplodia and Phomopsis - generally less effective than TBZ.
  - Some activity against black rot.
  - Ineffective against sour rot and brown rot.
- Recommended concentrations
  - 1000 ppm (0.1%) as a water suspension
  - 2000 ppm (0.2%) in a water-based wax
- Not compatible with chlorine.
- Imazalil is on CA’s Prop 65
  - list of substances known to the State to Cause Cancer
  - No Significant Risk Level (NSRL) = 11 µg/day

SOPP
- Sodium o-phenylphenenate, also called
  - 2 Phenylphenol
  - O-phenylphenol (OPP)
- Effective against green mold & sour rot.
  - Little to no control of Diplodia or Phomopsis stem-end rot, or black rot.
- Recommended concentration:
  - 2% aqueous solution, pH at 11.5–12.0 is the most effective treatment.
  - Some include 0.2% sodium hydroxide for pH control, and 1% hexamine to minimize phytotoxicity.

Fludioxonil
- Effective against green mold and Diplodia stem-end rot.
- Much less green mold sporulation control compared to imazalil.
- Compatible with chlorine.
- Fludioxonil + Azoxystrobin
  - Graduate A+
  - Good sporulation control.
### Fallglo Tangerines

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Diplodia (%)</th>
<th>Total decay (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>14.36a</td>
<td>23.19a</td>
</tr>
<tr>
<td>TBZ (1000 ppm)</td>
<td>4.31b</td>
<td>11.74b</td>
</tr>
<tr>
<td>Imazalil (500 ppm)</td>
<td>5.65b</td>
<td>11.94b</td>
</tr>
<tr>
<td>Graduate A+ (600 ppm)</td>
<td>5.00b</td>
<td>11.25b</td>
</tr>
<tr>
<td>Graduate A+ (1,200 ppm)</td>
<td>1.35b</td>
<td>4.08b</td>
</tr>
<tr>
<td>TBZ (1,000 ppm) + Graduate A+</td>
<td>5.93b</td>
<td>7.96b</td>
</tr>
<tr>
<td>(300 ppm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TBZ (1,000 ppm) + Graduate A+</td>
<td>1.32b</td>
<td>5.04b</td>
</tr>
<tr>
<td>(600 ppm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance</td>
<td>***</td>
<td>*</td>
</tr>
</tbody>
</table>


Dipped 10 sec. in respective solution (all included 100 ppm chlorine except Imazalil).

Degreened for 5 d (85°F, 95% RH, 5 ppm ethylene).

Washed & waxed (carnauba) and stored at ambient temperatures for 35 d.

### Pyrimethanil

- Effective against green mold
- Much less effective against Diplodia stem-end rot.
- Not evaluated against other common Florida diseases.

Zhang, 2009

### Acknowledgments

- Jan Narciso
- Cuifeng Hu
- Sambhav
- Jordan Yancy
- Monty Myers
- Andrew Myers
- Kendra Thomason
- Kayla Thomason

### Thank You!

- For more information, visit the UF Postharvest Website

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