Some Important Fruit and Leaf Diseases of Citrus

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UCCE Glenn County
Brown rot *Phytophthora* spp.

Infections develop with continued wet weather
Mostly on mature fruit
Leathery lesions, water soaked appearance
Turn soft with tan to olive brown color
Pungent
Fruit drop
Incipient fruit infections infect other fruit in storage
Brown Rot of Citrus Fruit Caused by Phytophthora spp.
Brown rot

*Phytophthora* spp.

- Infects from the soil to low-hanging fruit when splashed up during rain or irrigation.
- Needs wet fruit for about 3 hours at 55-75F to infect and no wound needed.
- Spreads rapidly from fruit to fruit in storage.
Brown rot

**Before harvest**
- Avoid splashing or standing water, good drainage under trees, skirt pruned up
- Prune tree to open canopy
- Prompt transport to packing line
- Copper or fosetyl-Al fungicides

**After harvest**
- Use heat in soak tanks
Brown Rot

- **Fungicide treatment – Oct. Nov.**
  - Fixed Coppers – where cu injury is a concern add .33 to 1 lb of hydrated lime/lb of dry cu fungicide
  - Zinc Sulfate/Copper Sulfate/Hydrated Lime
  - Fosetyl-Al (Alliete)
  - Bordeaux 3-4.5—100 (south) 10-10—100 (north)
Citrus (Bacterial) Blast

- *Pseudomonas syringae pv. Syringae*
Generally occurs:

- Northern counties (Butte, Glenn, Tehama, Placer, Yolo, etc.)
- With cold, wind-driven rain.
- Most severe on the exposed side of the tree (south).
Black lesions on leaf petioles caused by citrus blast.
Blasted Leaves - - -

- Bacterium enters through injured tissues or wounds.
- Usually starts at leaf petiole.
- Progresses into the leaf axil.
Blasted Leaves - - -

- Wilt rapidly, curl & dry on the tree.
- Leaf blade breaks off leaving leaf petiole stuck on the tree.
Twig dieback - - - -

- Twig lesions are covered with a reddish brown scab.
- Small twigs and vigorous shoots can be girdled and killed.
- Severe cases can cause complete defoliation the exposed side or entire trees.
Black Pit

*Pseudomonas syringae* pv. *Syringae*

- Lemons most susceptible
- Infects fruit during cool rain or foggy periods, usually associated with winds.
- Needs a wound for infection.
- Does not spread from fruit to fruit in storage.
Black Pit

Lesions stop expanding after several days, then darken

Lemons > Oranges > Grapefruit

Worse in warmer storage & with mature fruit
Cultural Control:

- Prune out diseased twigs in spring to reduce disease spread.
- Prevent excessive new fall growth by completing fertilization & pruning by late May.
- Wind break
Chemical Control:

- 10-10-10 Bordeaux
  - Full coverage
- Other fixed copper materials.
  - Nordox, Kocide, etc. If cu injury is a concern add .33 to 1 lb of hydrated lime/ lb of fixed cu
- Second spray may be necessary if wet conditions persist
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of Blast Lesions on 20 trees</th>
<th>Avg. Number of lesions per tree</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-10-10 Bordeaux</td>
<td>2623</td>
<td>131</td>
</tr>
<tr>
<td>8-8-100 Bordeaux</td>
<td>3954</td>
<td>198</td>
</tr>
<tr>
<td>5 - 3 - 7 - 100</td>
<td>5754</td>
<td>288</td>
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<td>COCS 4 lbs.</td>
<td>5825</td>
<td>291</td>
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<td>Water Check</td>
<td>9128</td>
<td>456</td>
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</table>
Post Harvest Diseases

The major post-harvest diseases of citrus are greatly affected by what is done *before* harvest to control them.
Take care in the field during harvest to minimize damage to fruit since the consequences of mechanical injury are:

- increased decay
- enhanced water loss
- possible peel breakdown in handling
Blue Mold
*P. italicum*

Green Mold
*P. digitatum*

*Sporulation - direct loss and necessitates repack.*
Green mold

*Penicillium digitatum*

The most important post-harvest disease.
Needs wounds for infection, infects at harvest and during handling through wounds. Develops slowly below 40 F. Won't spread readily from fruit to fruit in storage.
Blue mold

*Penicillium italicum*

Important in long, cold storage.

Needs wounds for infection, infects at harvest and during handling. Will slowly spread from fruit to fruit.
Impact of careful handling on the incidence of green mold on Valencia oranges after harvest.

<table>
<thead>
<tr>
<th>Orchard</th>
<th>Normal</th>
<th>Careful</th>
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<tbody>
<tr>
<td>Orchard A</td>
<td>48.1</td>
<td>10.2</td>
</tr>
<tr>
<td>Orchard B</td>
<td>35.2</td>
<td>6.5</td>
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</table>
Green and Blue molds

**Before harvest**
- Minimize wounds
- Reduce grove inoculum
- Prompt transport to the packing line

**After harvest**
- Minimize wounds and fruit drops
- Reduce packinghouse inoculum
- Use soak tanks & fungicides
- Store at 50°F or below as soon as possible
In fall 2002, an epidemic rind disorder occurred on Satsuma mandarin throughout the central valley of California from Kern to Butte Co.

The initial problem developed three to four days after an early November rain and development continued following additional rain storms.
Mandarin Rind Breakdown

Paradise, 2002
Biotic cause of mandarin rind breakdown?

- Fungal isolations fall/winter
  - Grove 1 (Fresno Co.)
    - 66% of lesions *Alternaria* sp.
    - 34% of lesions *Fusarium* sp.
  - Grove 2 (Tulare Co.)
    - 70% of lesions *Ulocladium* sp.
    - 20% of lesions *Fusarium* sp.
  - Grove 3 (Butte Co.)
    - 18% of lesions *Alternaria* sp.
    - 41% of lesions *Fusarium* sp.
    - 29% of lesions *Macrophomina* sp.
    - 6% of lesions *Cladosporium* sp.
  - Grove 4 (Fresno Co.)
    - 83% of lesions *Alternaria* sp.
  - Grove 5 (Fresno Co.)
    - 80% of lesions *Alternaria* sp.

* Isolations show no consistent pathogen from orchards with the disorder.

Fungi isolated are common air-borne or soil-borne fungi. These fungi are commonly found on plant surfaces.
Laboratory Fruit Inoculations with Fungal Isolates from Mandarin Rind Breakdown

Non-inoculated fruit did not develop symptoms, whereas fruit that were soaked in water had a higher incidence of decay than fruit inoculated in healthy areas.

Fruit were soaked in water for 6 hr and rind symptoms developed in approximately 5 hr. Inoculations were done using aqueous spore preparations of each fungal isolate (10^5) either on healthy fruit surfaces or in symptomatic areas after the water soaking treatment. Inoculated fruit were kept at 100% humidity for three days.
Fruit Treatments - - -

Initial Lab Evaluations
Effect of Postharvest Fruit Coatings in Reducing Symptoms of MRB in Water-Soaked Fruit

- Laboratory Study -

Summary:
Fruit coatings decreased the incidence of the rind disorder. Furthermore, non-water soluble (e.g., Decco 400) coatings developed less symptoms than water soluble coatings (e.g., Decco 202).

Fruit were treated using labeled preparations of fruit coatings and dried at 30 C for 30 min. Treated fruit did not develop symptoms after 24 hrs. Fruit were then soaked in water for 6 hr, placed in a humidity chamber for 18 hrs, and evaluated.
Effect of Oil and Anti-Transpirants in Reducing Symptoms of MRB in Water-Soaked Fruit

- Laboratory Study -

Fruit were treated at labeled preparations of the treatments and air-dried for 24 hrs. Fruit were soaked in water for 10 hr, placed in a humidity chamber for 48 hrs, and then evaluated. Severity was a scale of 0-3 (0 = no symptoms and 3 symptoms greater than 25% of the fruit surface area.

Summary:
Non-water soluble fruit treatments decreased the incidence of the rind disorder. These products are registered on citrus as anti-transpirants or insecticides and could be used as water repellants.
Conclusions – Objective 1

Cause of mandarin rind breakdown and reproduction of the disease

- Trials indicated rind breakdown symptoms primarily resulted from environmental factors causing oil gland injury.
- Epiphytic fungi including Alternaria spp. were not found to be virulent pathogens of healthy tissue.
- The disorder was reproduced in the lab by soaking orange-colored fruit in water for several hours.
- The disorder can be reduced with water repellents.
Objectives

2. Evaluate the effect of fungicides and water repellants on the incidence and severity of rind breakdown of mandarins.

- Initiated field trials in selected mandarin orchards.
- Compared fungicides, water repellants, and combinations on the incidence of rind breakdown of Satsuma mandarins.
Field Trials in Butte County

To evaluate fungicides and water repellants (oils and anti-transpirants)
Air-blast sprayer calibrated to 100 gal/A. Four quadrants of each replication tree (5 replication/treatment) were evaluated for the incidence of MRB. Symptoms were observed on the exposed portion of outside fruit in all quadrants of the trees.
Effect of fungicides and water repellants on the incidence and severity of rind breakdown of mandarins in field trials

Field trial, Butte Co. 2004

<table>
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<tr>
<th>Trt</th>
<th>Rate (/A)</th>
<th>Oct. 22</th>
<th>Nov. 9</th>
<th>Nov. 19</th>
<th>Nov. 26</th>
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<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Abound</td>
<td>12.8oz</td>
<td>@</td>
<td>---</td>
<td>@</td>
<td>---</td>
</tr>
<tr>
<td>Vapor Gard</td>
<td>1gal</td>
<td>@</td>
<td>@</td>
<td>---</td>
<td>@</td>
</tr>
<tr>
<td>Vapor Gard</td>
<td>1gal</td>
<td>@</td>
<td>---</td>
<td>---</td>
<td>---</td>
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<tr>
<td>Omni Oil</td>
<td>6qt-0.75%</td>
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<tr>
<td>Omni Oil</td>
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<tr>
<td>Vapor Gard/Nordox</td>
<td>1 gal/6 lb</td>
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<tr>
<td>Protected</td>
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</table>

Incidence of MRB (%)*

0 5 10 15 20 25 30 35

* a

b

b

b

b

**
Efficacy of preharvest treatments in reducing MRB in California

2005 Season

Treatments

- Chk
- Abound 2F
- Pristine 38WDG
- Omni SS Oil
- VaporGard

Incidence of MRD (%)

Evaluation

Chk
- Abound 2F - 2 Applications
- Pristine 38WDG - 2 Applications
- Omni SS Oil - 1 Application
- Omni SS Oil - 2 Applications
- VaporGard - 1 application
- VaporGard - 2 Applications

A commercial Satsuma mandarine orchard in Butte Co., CA. Treatments were applied using an air-blast sprayer on 10-25-05 and 11-15-05.
MRB symptoms on Satsuma mandarins can be reduced using an anti-transpirant or an oil.

Fungicides were ineffective in Butte Co. trials done over four seasons.

The disorder begins to occur at the color break stage of fruit development.
Other Sources of Information

- UC IPM Web Site – www.ipm.ucdavis.edu
- Glenn County Web Site – ceglenn.ucdavis.edu