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# Management of Citrus Brown Rot

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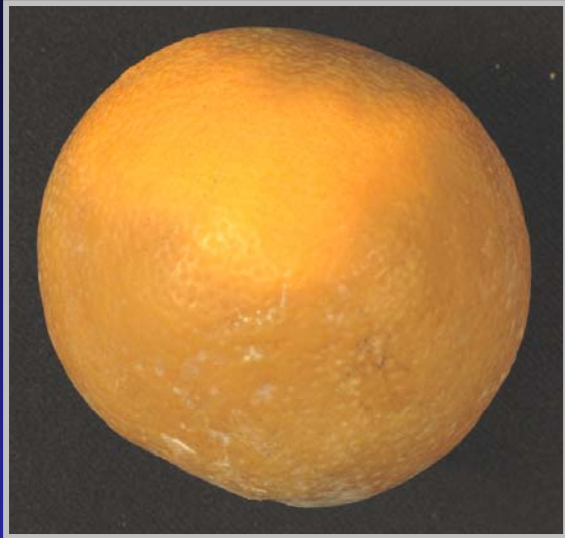
# Citrus Brown Rot

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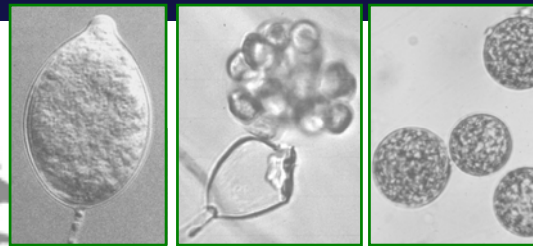
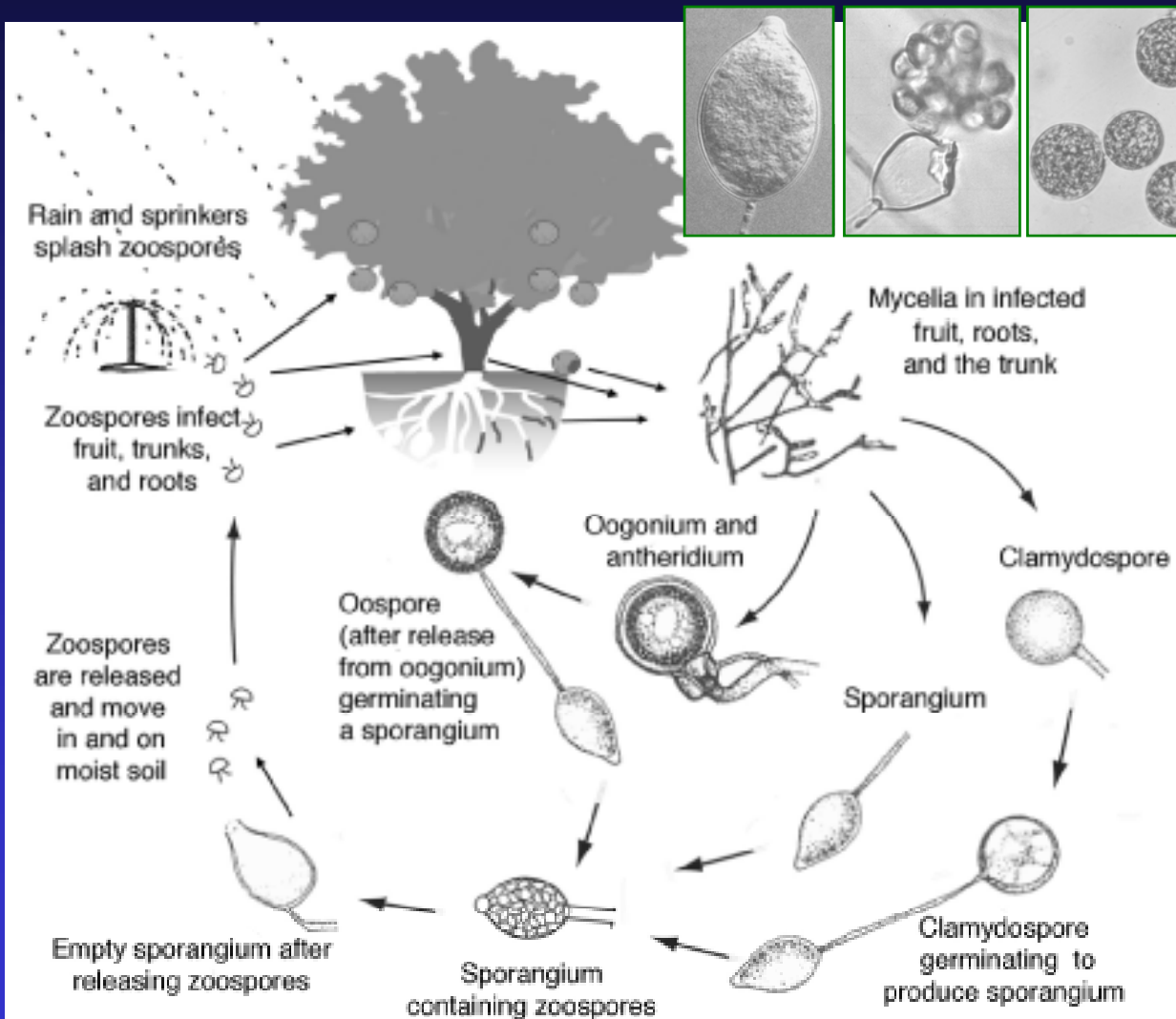
- Causal pathogens: species of *Phytophthora*
  - *P. citrophthora*
  - *P. parasitica* (*P. nicotianae*)
  - *P. syringae*
  - *P. hibernalis*
- Occur in all growing regions in CA.
- *P. citrophthora* and *P. parasitica* are most important.
- The four species also cause *Phytophthora* root rot, foot rot, and gummosis.
- Losses are associated with periods of high rainfall.

# Citrus Brown Rot – Symptoms and Economic Impact



- Develops mainly on mature fruit in the lower tree canopy
- Olive-brown discoloration of the rind
- Distinctive pungent odor
- Fruit remain firm and leathery, unless invaded by secondary decay organisms.
- At a high humidity, fruit become covered by a delicate white growth of the fungus.
- The most serious aspect: Fruit infected before harvest may not show symptoms. If infected fruit get mixed with healthy fruit, the disease may spread quickly from fruit to fruit in storage and during transit.
- Citrus brown rot: pre- and postharvest losses

# Disease cycle of *Phytophthora* species



- 18 h of wetness required for sporangia production and zoospore release.
- 3 h of wetness required for infection.
- The length of the continuous rainy period is the most important predictor of brown rot epidemics.
- Zoospores produced in sporangia on the ground may be splashed up onto low-hanging fruit. Thus, brown rot mainly develops on fruit growing near the ground.

# Management of Phytophthora Brown Rot

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- Cultural practices
- Fungicidal protection
  - Preharvest
  - Postharvest

# Management of Phytophthora Brown Rot

## - Cultural practices -

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- Pruning tree skirts can significantly reduce brown rot.
- Sprinkler irrigation water should be directed away from the tree canopy.

# Management of Phytophthora Brown Rot

## - Preharvest fungicide sprays -

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- One spray of copper fungicide between October and December before or just after the first rain.
- Apply at 400-700 gal/A.
- With frequent and high rainfall after the first application, repeat applications in January or February.
- Spray the skirts to about 4 feet above ground; whole tree applications may be necessary for some varieties or in orchards with a history of the disease.
- Spraying the ground underneath the trees may also reduce brown rot infections.

# Management of Phytophthora Brown Rot

## - Preharvest fungicide sprays -

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### Most effective orchard sprays:

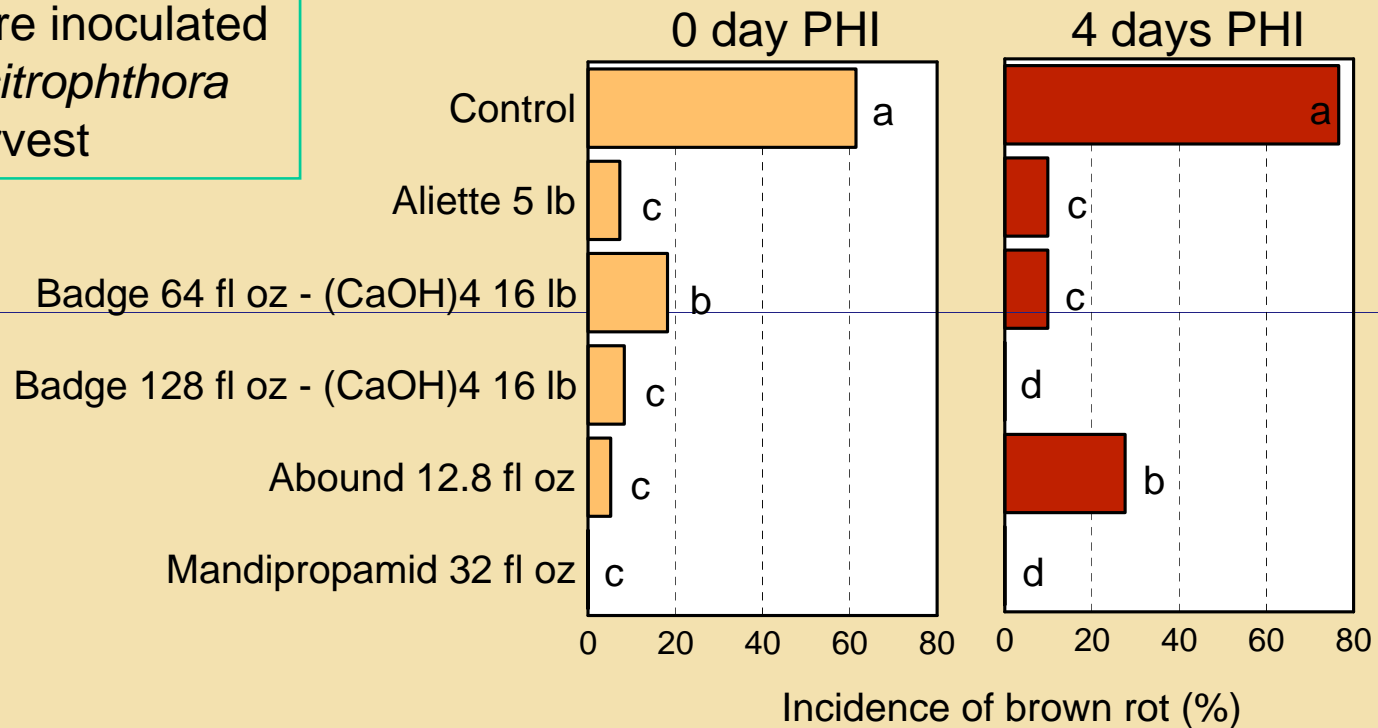
Bordeaux mixture (copper sulfate + lime)  
with 0.6 to 0.8 lb of metallic copper/100 gal.

Neutral (fixed) coppers (copper hydroxide,  
copper oxide)

- **Phosphonates** (e.g., fosetyl-al - Aliette 5 lb/A),  
potassium phosphite - Prophyt 4 pints/A, etc.)  
are systemic and provide effective control  
when applied up to 12 weeks prior to infection.

# Management of *Phytophthora* Brown Rot - Preharvest fungicide sprays -

Fruit were inoculated with *P. citrophthora* after harvest



Treatments were applied in the field at a rate of 400 gal/A on 3-5-10.

# Management of Phytophthora Brown Rot

## - Preharvest fungicide sprays -

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- Treatment timing
  - Prior to first rainy period in the fall.
  - Depending on the amount of rainfall, more than one application of copper may be necessary.
- High-volume applications (400-700 gal/A).
- Because brown rot mainly develops on fruit growing near the ground, skirt sprays of trees are acceptable if copper sprays are not done in combination with Septoria spot treatments.

# Management of Phytophthora Brown Rot

## - Postharvest fungicide treatments -

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- Currently registered fungicides with activity against Phytophthora brown rot:

### **Graduate A+**

- New developments of postharvest treatments:

**Phosphonates** - potassium phosphate - phosphorous acid (Prophyt, Fungi-phite, etc.)

# Efficacy of selected compounds against brown rot of navel oranges caused by *P. citrophthora* in laboratory studies

Treatment of fruit 15 h after inoculation



Control

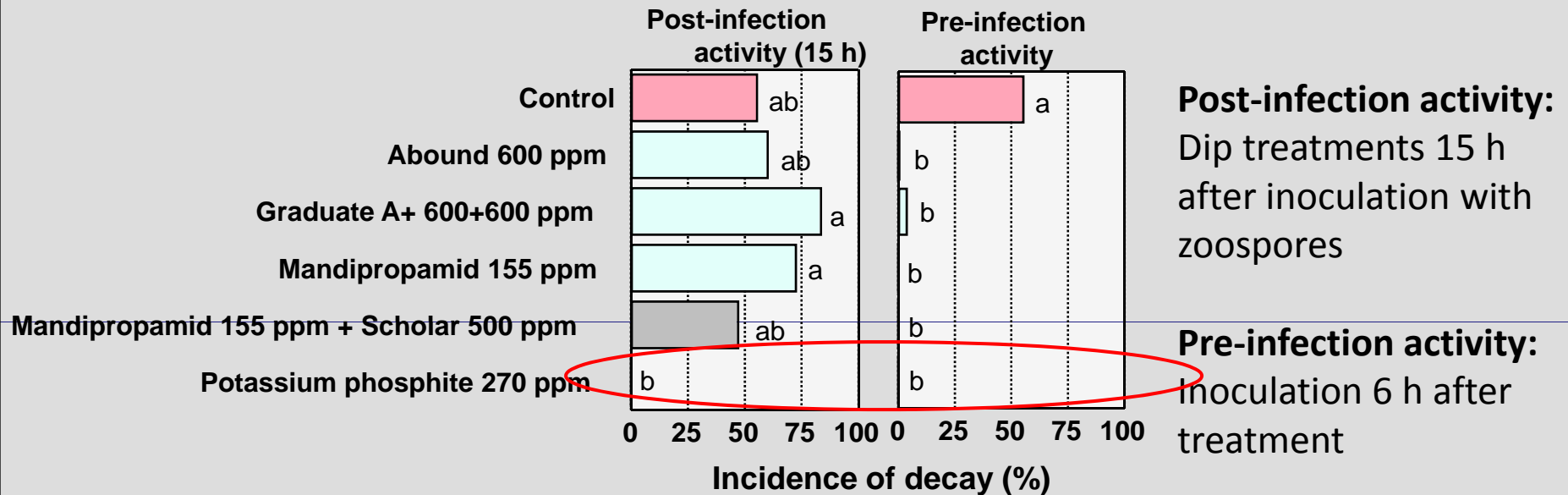


ProPhyt



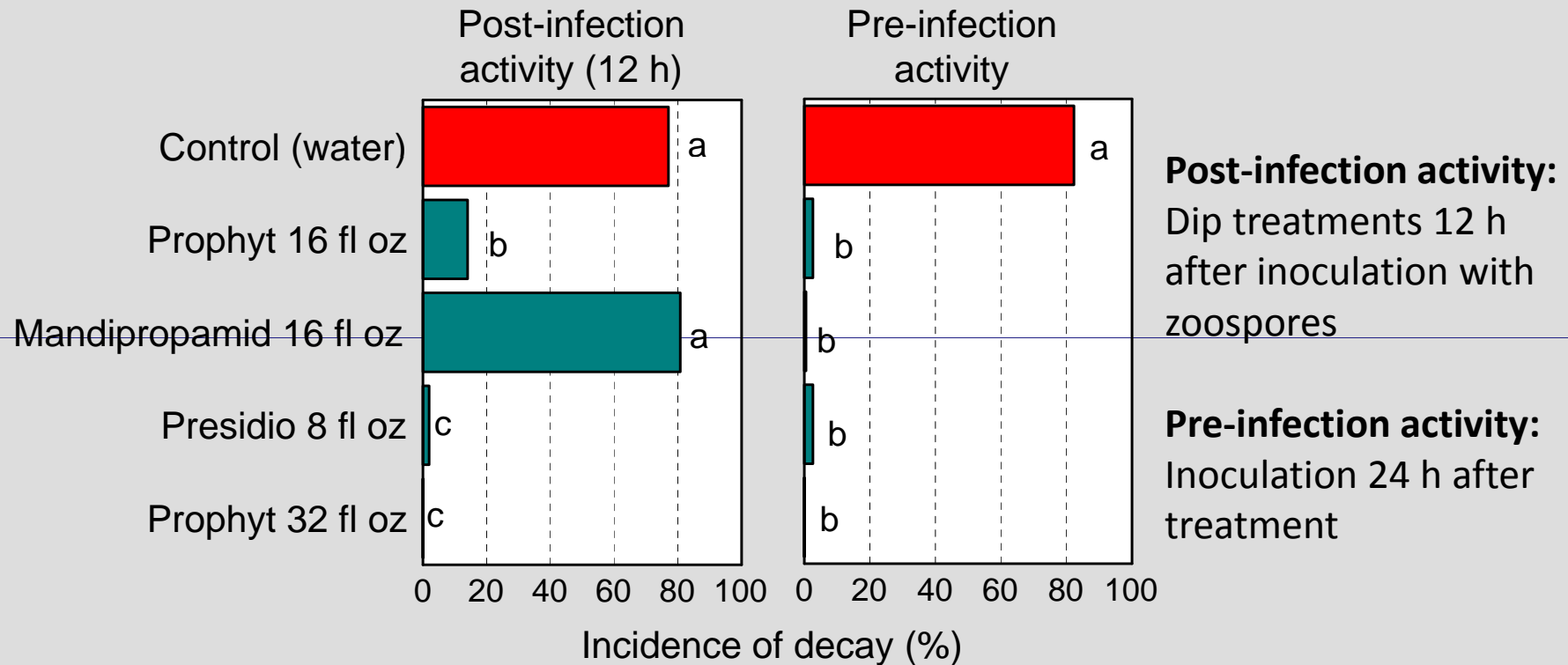
Mandipropamid (Revus)

# Efficacy of selected compounds against brown rot of navel oranges caused by *P. citrophthora* in laboratory studies



- All treatments evaluated including Abound, Graduate A+, mandipropamid (Revus), mandipropamid-Scholar mixtures, and potassium phosphite (phosphorous acid; Nutriphite, Prophyt) were highly effective as pre-infection treatments
- Potassium phosphite was the only compound that was effective as a post-infection treatment in this trial.
- Potassium phosphite was also highly effective against brown rot caused by *P. hibernalis* in other studies.

# Efficacy of selected compounds against brown rot of navel oranges caused by *P. citrophthora* in laboratory studies



- All treatments evaluated including mandipropamid (Revus), fluopicolide (Presidio), and potassium phosphite (Prophyt – 630 & 1260 ppm) were highly effective as pre-infection treatments
- Potassium phosphite and fluopicolide were also effective as a post-infection treatment.

## *Summary: New treatments against Phytophthora brown rot of citrus*

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- Potassium phosphite was highly effective against *Phytophthora* brown rot and can be used for preharvest and potentially as a postharvest treatment to prevent decay from pre-existing infections that occur before harvest in the orchard.
- Other materials such as the postharvest fungicide Graduate A+ can also be used as a protective treatment and prevent the spread of brown rot. Additional materials (mandipropamid, fluopicolide, etc.) also have protective activity but do not have post-infection activity.
- Several registrants of potassium phosphite and other formulations support a postharvest registration including service companies. IR-4 residue studies have been approved and are being done to obtain international MRLs/FAT (Some countries consider phosphites as pesticides). As always, check MRL databases for the limits for a specific export country.