

Some Important Fruit and Leaf Diseases of Citrus

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Brown rot *Phytophthora* spp.

Infections develop with continued wet weather

Mostly on mature fruit

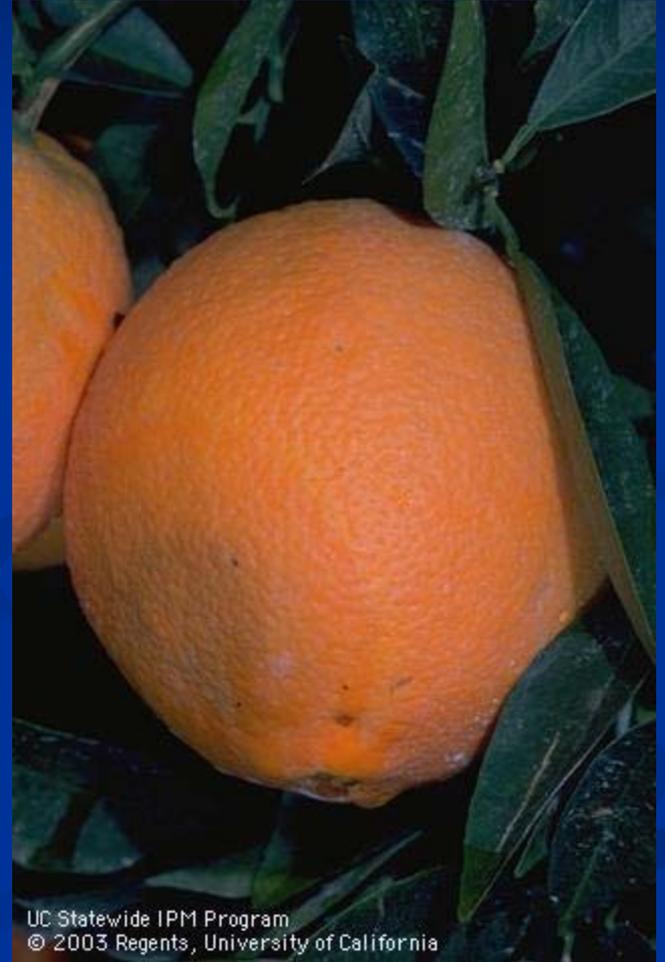
Leathery lesions, water soaked appearance

Turn soft with tan to olive brown color

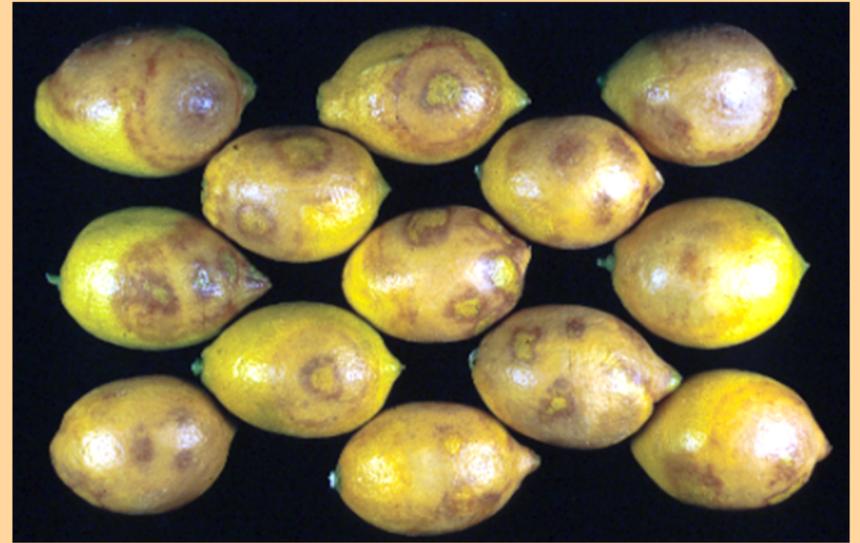
Pungent

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

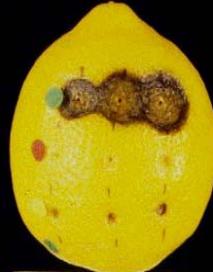
13C



20C



Less mature



More mature

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:

- Oct. Nov.
- 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

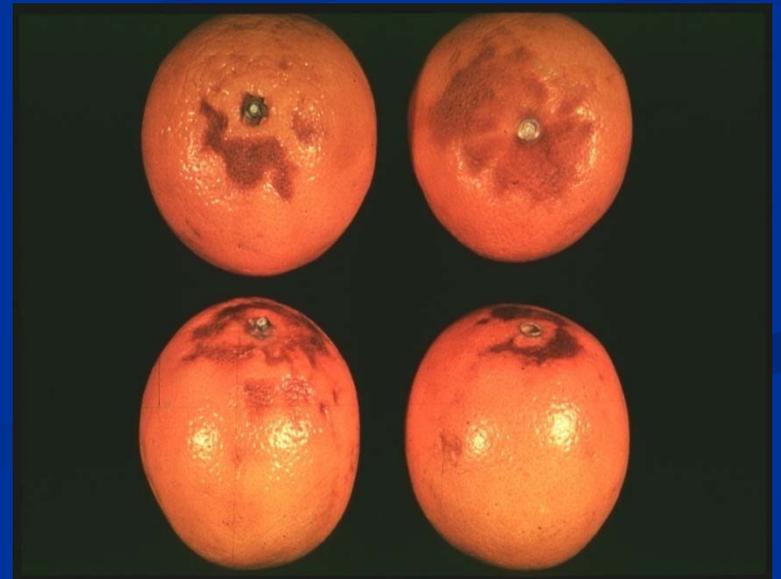
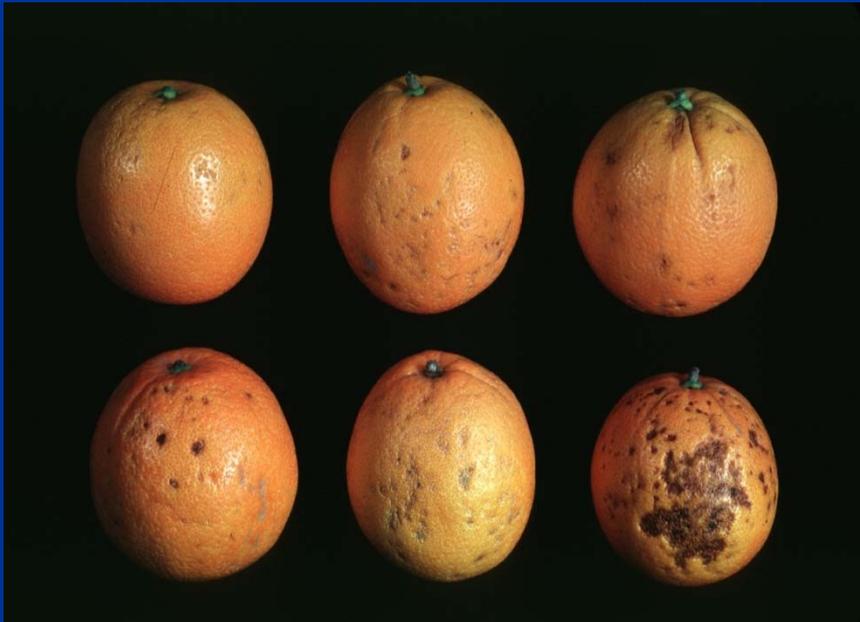
Treatment	Number of Blast Lesions on 20 trees	Avg. Number of lesions per tree
10-10-10 Bordeaux	2623	131
8-8-100 Bordeaux	3954	198
5 - 3 - 7 - 100	5754	288
COCS 4 lbs.	5825	291
Water Check	9128	456

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



Penicillium sp.



Blue Mold
P. italicum

Green Mold
P. digitatum



*Sporulation - direct loss
and necessitates repacki*

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.

	Normal	Careful
Orchard A	48.1	10.2
Orchard B	35.2	6.5

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

Mandarin Rind Breakdown

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***



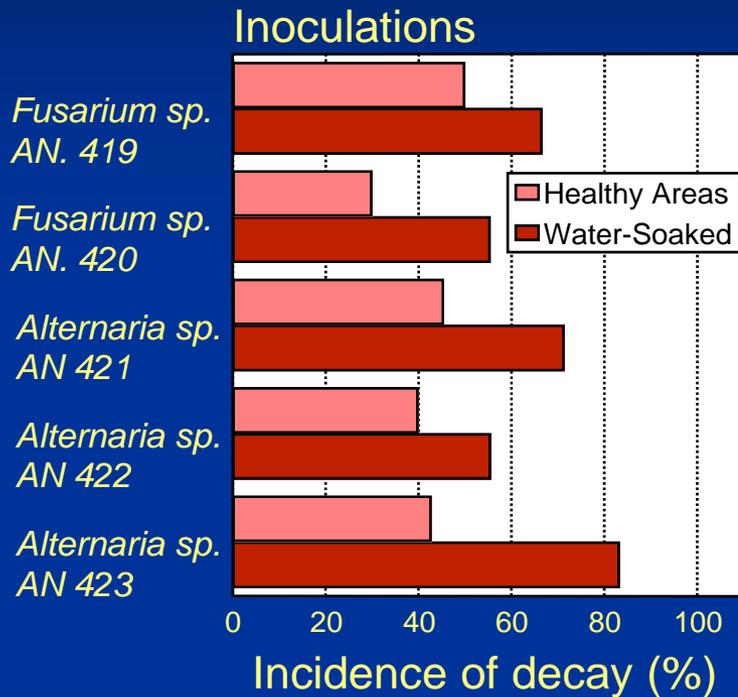
Biotic cause of mandarin rind breakdown?

- 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



Incidence of Decay in Inoculation Areas

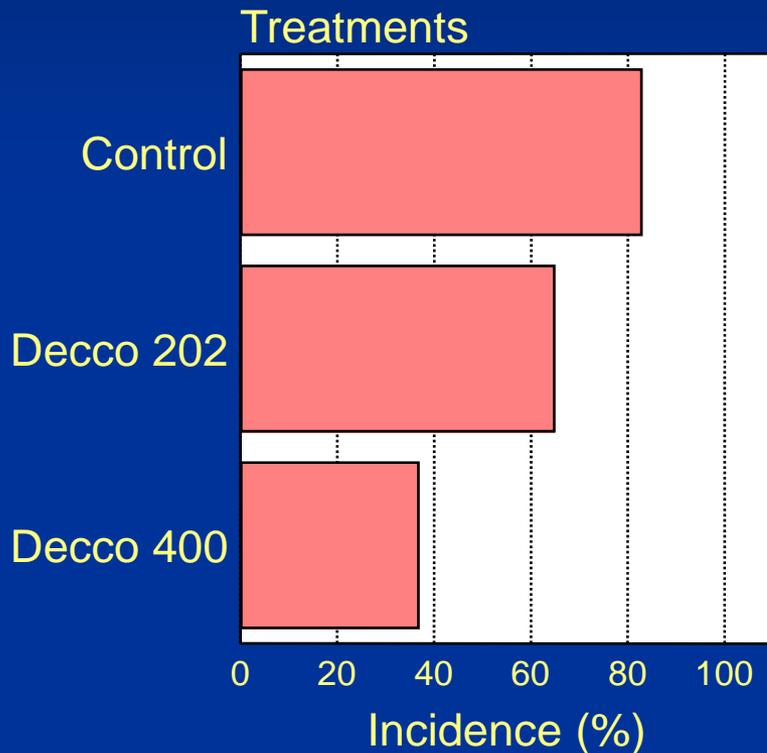
Summary:
Non-inoculated fruit did not develop symptoms, whereas fruit that were soaked in water had a higher incidence of decay than fruit inoculated in healthy areas.

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 -



Control

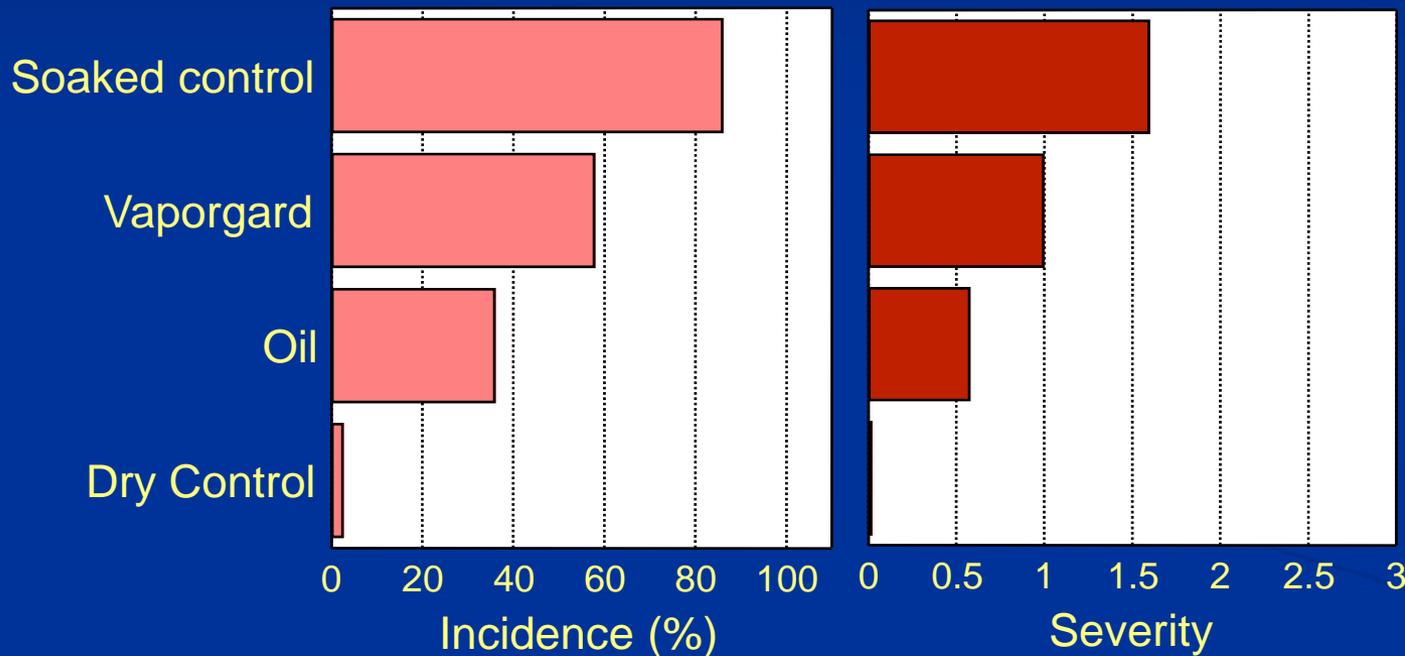
Summary:

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 -



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.

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).

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.**

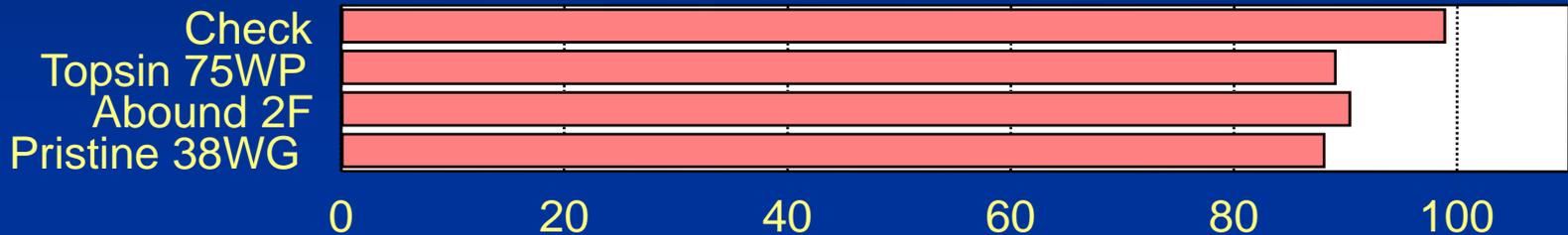
Field Trials in Butte County



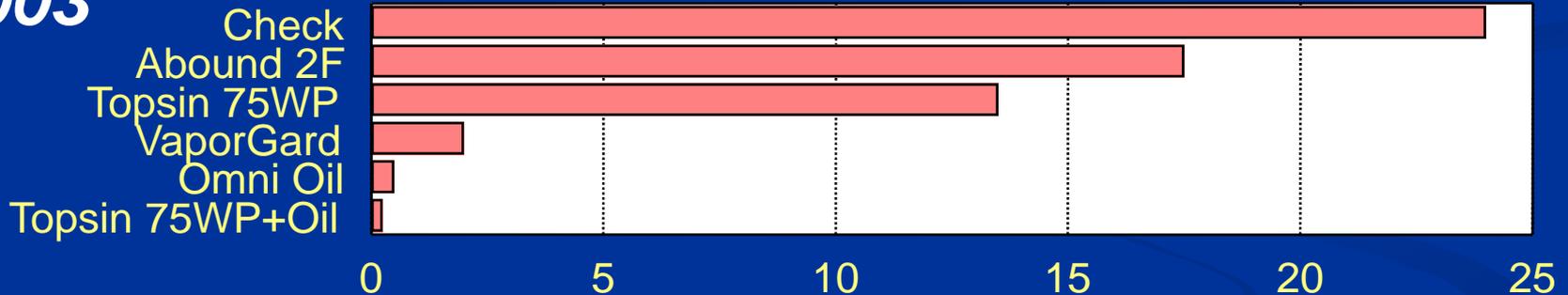
Efficacy of Fungicides in Reducing Mandarin Rind Breakdown

Butte Co.

2002



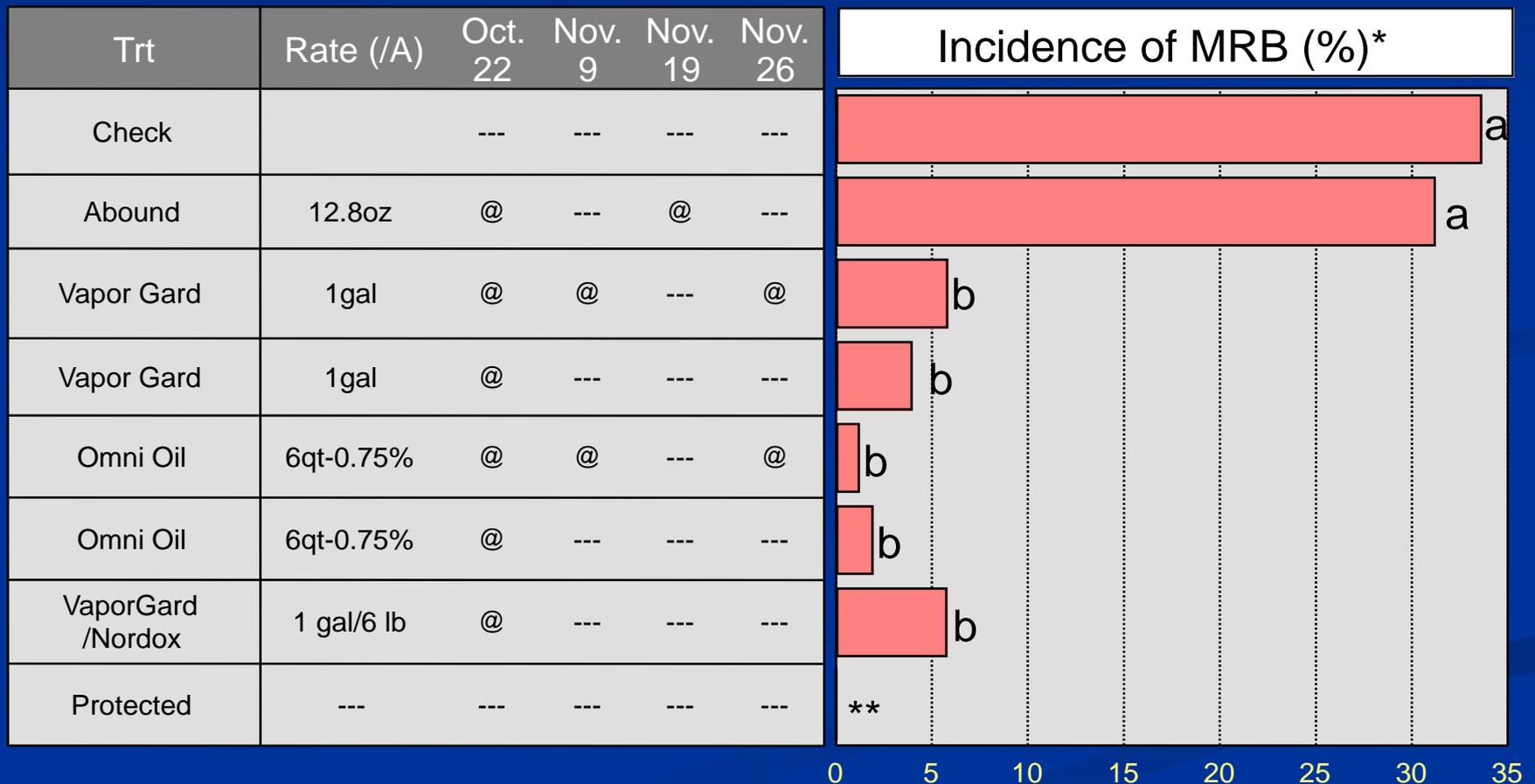
2003



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.

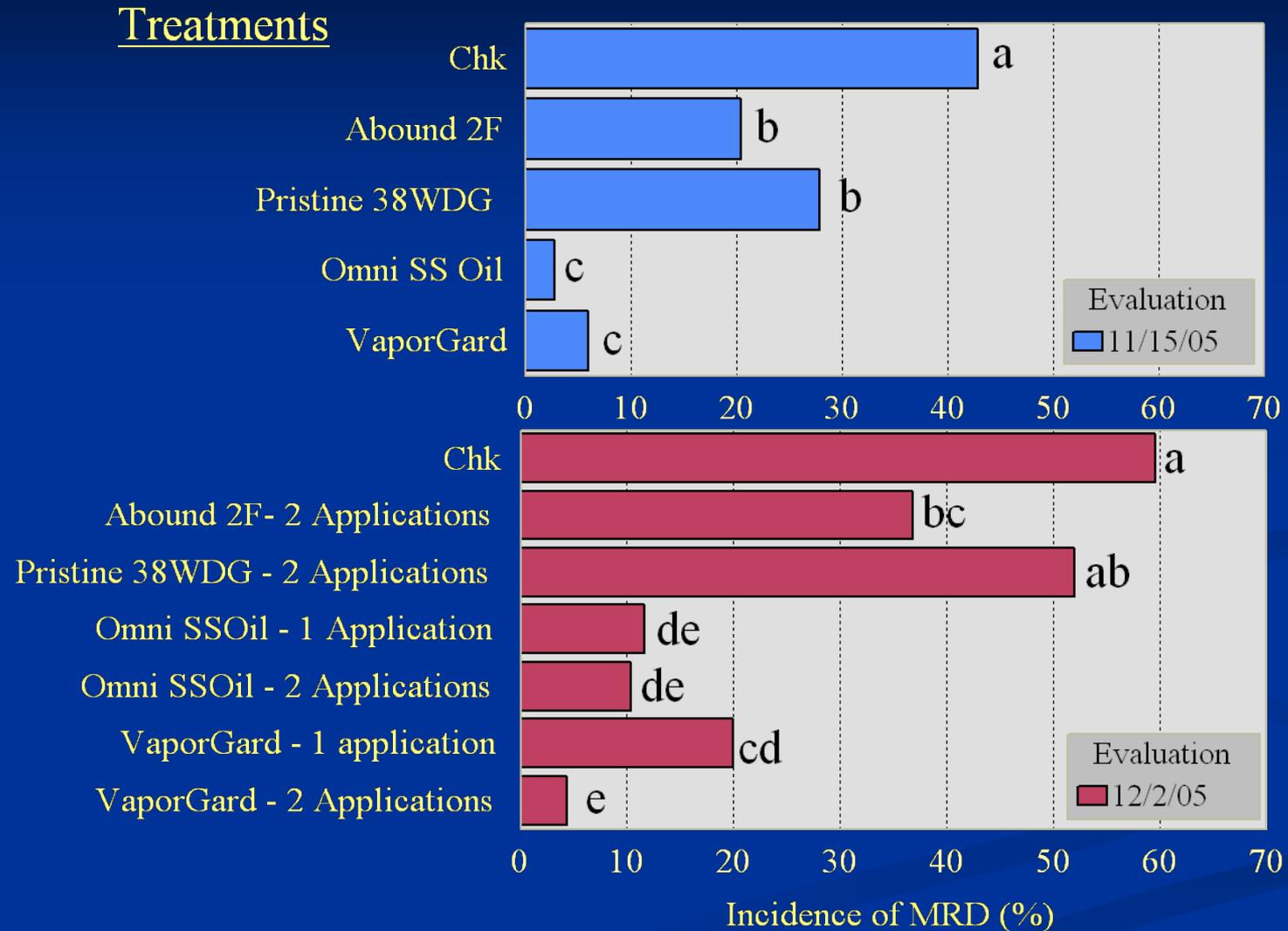
Effect of fungicides and water repellants on the incidence and severity of rind breakdown of mandarins in field trials

Field trial, Butte Co. 2004



2005 Season

Efficacy of preharvest treatments in reducing MRB in California



A commercial Satsuma mandarin orchard in Butte Co., CA. Treatments were applied using an air-blast sprayer on 10-25-05 and 11-15-05.

Summary

Management of mandarin rind breakdown

- ✓ **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