Recognizing and Managing Almond Trunk and Scaffold Diseases

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Orchard Tree Diseases
Ceratocystis Canker in Almond

Fungal Disease caused by *Ceratocystis fimbriata*

Transferred around the orchard by fruit flies and beetles

Associated with injuries that expose the tree's cambium
- Shaker Damage
- Pruning Wounds
- Limb Breakage

Typically found on scaffolds
Ceratocystis Canker in Almond
Ceratocystis Canker in Almond

Disease Control – Canker Prevention --

Avoid tree damage at harvest:
  Insure orchards are relatively dry prior to harvest
  Reduce bark damage, used skilled shaker operators

Adjust Pruning Schedule:
  Prune mature orchards in early fall to avoid cool, rainy weather
  Prune nonbearing trees late to avoid rainy periods
  Pull pruned branches from trees with caution to avoid wounding

Disease Control – Canker Removal--

If choosing to surgically remove cankers, perform actions in the spring to avoid rainy periods.

Topical applications of various fungicides and bark penetrants have not (yet) provided control of canker growth.
Botryosphaeria Canker in Almond

Fungal disease caused by *Botryosphaeria dothidea*

Causes cankers on trunks, scaffolds, and branches

Infests trees through natural openings and wounds

Spores are spread through the air

Becoming an emerging disease, with no control yet determined
Band Canker in Almond
Botryosphaeria Canker in Almond
Scaffold and Branch Canker

Lenticel & growth crack infections
Pruning Wound Infections by *B. dothidea*
## Sources of Inoculum

**Primary**

- Airborne spores moving in from outside of the orchard
  - Neighboring orchards with infections
  - Other hosts which include Walnut, Pistachio, Eucalyptus, Olive (just about everything…)

- Infected plants within almond rows
  - Water splashed; airborne spores

**Secondary**

- Spores from previously infected trees and trunks
- Spores from current infections within the orchards
  - Water splashed; airborne spores
Multiple Year Infection by *B. dothidea*
Secondary Inoculum Sources
Points of Infection for *B. dothidea*

1) Growth crack in trunks
2) Pruning Wounds
3) Lenticels
4) Rough bark
5) Cracks at the base of shoots

Timing of infection is unknown. Most likely occurs in the winter- spring or when excessive moisture is present.
Botryosphaeria Canker Management

1. Major pruning wounds need to be protected

2. Infected trees need to be removed entirely

3. Protecting the tree trunk with fungicides may be effective; curing the cankers seems very difficult
   - Liquid limed sulfur and copper fungicides are ineffective against *Botryosphaeria* pathogens

4. Avoiding wetting the tree trunks (sprinklers or micro-sprinklers) reduces band canker
Hull Rot in Almond

Fungal disease caused by

*Monilinia fructicola*
- Sacramento Valley and Northern San Joaquin

*Rhizopus stolinifer*
- San Joaquin Valley

Causes yield loss, spur loss, and limb death

Infects trees through the hull, translocating toxins up the branch

Spores are spread through the air
Hull Rot in Almond
<table>
<thead>
<tr>
<th>Highly Susceptible:</th>
<th>Moderately Resistant:</th>
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<tbody>
<tr>
<td>Butte</td>
<td>Aldrich</td>
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<tr>
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<td>Morley</td>
</tr>
<tr>
<td>Nonpareil</td>
<td>Yokut</td>
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<tr>
<td>Winters</td>
<td>Padre</td>
</tr>
<tr>
<td></td>
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<td>Moderately Susceptible:</td>
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<td>Rosseta</td>
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<td>Jeanette</td>
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<td>Sano</td>
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<td>Wood</td>
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<tr>
<td>Sonora</td>
<td>Mission Colony</td>
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<tr>
<td>25-75</td>
<td></td>
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<tr>
<td>Highly Resistant:</td>
<td></td>
</tr>
</tbody>
</table>
Hull Rot Management

*Rhizopus* and *Monilinia* can only infect the hull after it splits.

Management practices to reduce the timing of hullsplit

- Nitrogen
- Water
Hull Rot Management - Nitrogen

Leaf Nitrogen Content (%)

- 1992: 0.003
- 1993: 0.001
- 1994: 0.010
- 1995: 0.020

Linear: P = 0.003 0.001 0.010 0.020
Hull Rot Management - Nitrogen

Hull Rot Strikes per Tree

LINEAR $P = 0.004$  

1992: 0.004  
1993: 0.001  
1994: 0.001  
1995: 0.020
Hull Rot Management - Water

Water Coming Out
(Artists conception)

Magnifying Glass

(Pressure Gauge)

Air Pressure

(Plastic bag)
Hull Rot Management - Water

Proposed benefits of regulated deficit irrigation for almonds during hull split:
1) Reduce Hull rot
2) Reduce Stick-tights (Improve Harvestability)
3) Save Water

Prescription:
1) Measure stress using midday Stem Water Potential (SWP)
2) Prior to hull split: -7 to -9 bars SWP (fully irrigated baseline)
3) During hull split: -14 to -18 bars SWP (mild to mod. stress)
4) After hull split: -7 to -9 bars (as close to harvest as possible)
Hull Rot Management - Water

Keating, Madera Co. RDI/Hull rot plot

2004 Hull Rot Trial

Rhizopus Strikes/Tree

- Control
  - 17.7

- RDI
  - 2.2

Figure 2
Hull Rot Management

No need to apply fungicides, can be controlled through cultural practices

Avoid excessive nitrogen; maintain leaf nitrogen levels to 2.2-2.5%

Induce a mild water stress at hullsplit; allow trees to drop to -14 bars on stem water potential before watering

- Use a pressure chamber for measurements and your intuition as double-check
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