

Almond Disease Management: Hull Rot and Scab



A close-up photograph of an almond tree branch heavily laden with almonds. The husks (infructescences) are severely damaged by Hull Rot, appearing shriveled, discolored, and partially detached from the nuts. Some green leaves are visible, but many are also showing signs of stress or damage. The background is a bright, out-of-focus blue sky.

Hull Rot: Shoots wither and die weeks before harvest

Plague of vigorous orchards with high water and high N.

Hull Rot Culprits



Monolinia

Rhizopus



Both respond well to cultural control



Rhizopus responsive to fungicides

Fungi Responsible for Hull Rot



Rhizopus stolonifer

- More common in southern SJV
- Black spores, inside hull
- Only infects after hull split



Monilinia fructicola

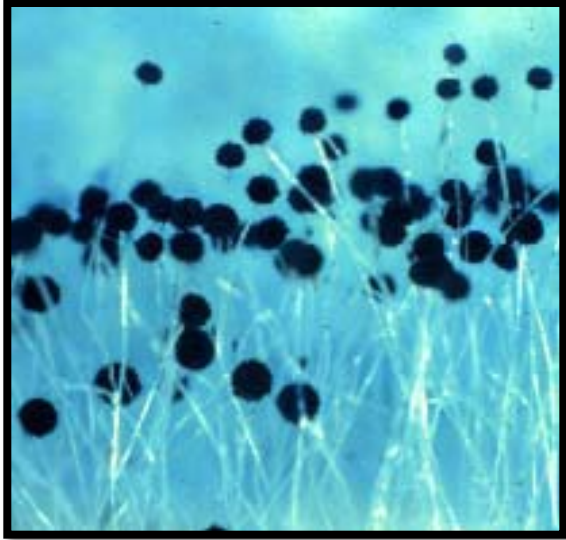
- More common in Sac Valley
- Tan spores, inside or outside hull
- Only infects after hull split

Different pathogens-similar effects

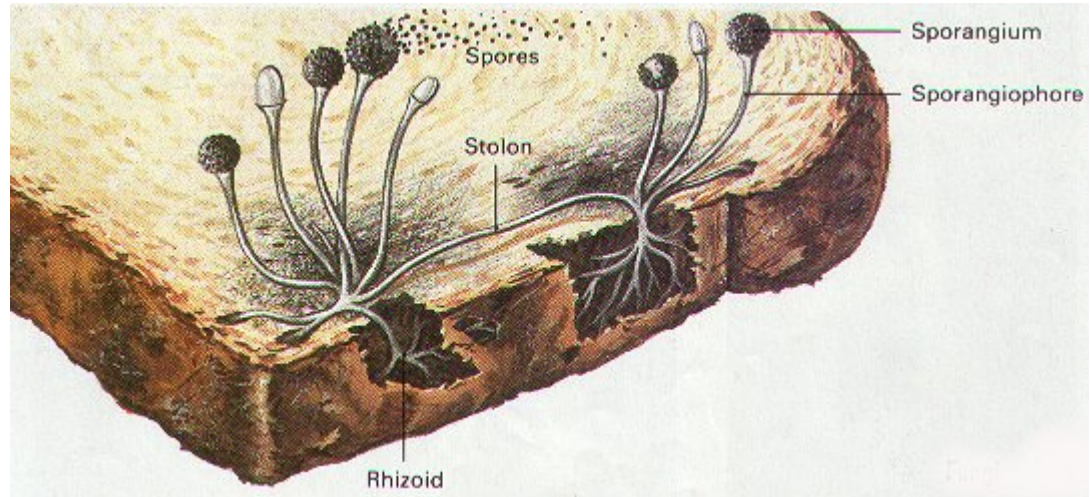


Monilinia may also infect flowers!

Hull Rot Pathogens



Rhizopus spores



Monilinia spores



Cultivars vary in susceptibility

HIGHEST SUSCEPTIBILITY

Kapareil
Nonpareil
Butte
Winters

(200-900 strikes/tree)

HIGH SUSCEPTIBILITY

Johyn
Price
Jenette
Sonora

(100-200 strikes/tree)

MEDIUM SUSCEPTIBILITY

Aldrich
Wood
Colony
Padre
Livingston

(1-100 strikes/tree)

LOW SUSCEPTIBILITY

Fritz
Carmel
Monterey

(0 strikes/tree)

Some varieties are
susceptible, but infection
results in minimal damage
to host

TOLERANCE

Infection and Symptoms

Tree Damage

- Death of fruiting wood
 - Reduced return bloom/yield
- Infected fruit remain on tree
 - NOW overwintering site



Hull Rot Management

Cultural Control

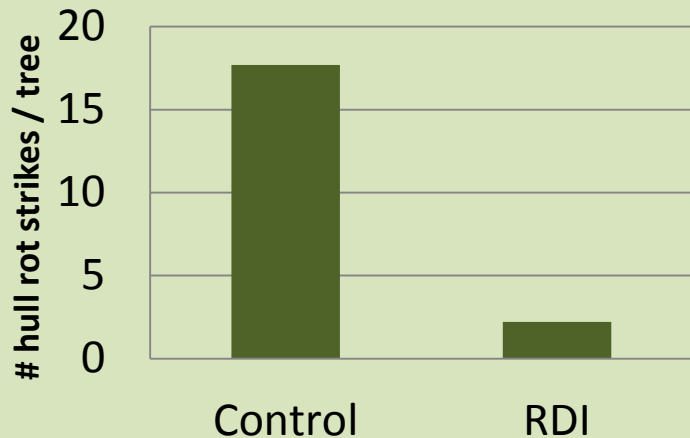
1) Regulated deficit irrigation

Prior to hull split: -7- -9 bar

Early hull split: -14- -18 bar (mild-moderate stress)

Soon after harvest: -7- -9 bar

RDI: Experimental data demonstrated ~90% reduction in strikes.



Slight H₂O stress during hull split:

Reduce Hull Rot

Achieve more uniform hull split

Shorten length of hull split

Improves nut removal/shakability

May reduce NOW

Excess water and nitrogen delay maturation

Ideal foliar N: 2.2-2.5%

Info courtesy of B. Holz





Unsplit



Initial separation stage



Deep V, unsplit



Hull split: < 3/8 inch



Initial drying stage



Completely dry stage

Fungicides

- Sterol inhibitor and Quinone outside inhibitor (strobilurins) fungicides effective for Rhizopus
- Single application at hull split, w/ NOW treatment
- May reduce incidence 60-70%.
- Integrate w/ RDI practices

**EFFICACY AND TIMING OF FUNGICIDES,
BACTERICIDES, AND BIOLOGICALS
FOR
DECIDUOUS TREE FRUIT, NUT,
STRAWBERRY, AND VINE CROPS
2011**



*ALMOND
APPLE AND PEAR
APRICOT
CHERRY
GRAPE
KIWIFRUIT*

*PEACH
PISTACHIO
PLUM
PRUNE
STRAWBERRY
WALNUT*

Jim Adaskaveg

Professor
University of California, Riverside

Doug Gubler

Extension Plant Pathologist
University of California Davis

Themis Michailides

Plant Pathologist
*University of California, Davis
/Kearney Agricultural Center*

Brent Holtz

*Farm Advisor
University of California Cooperative Extension,
San Joaquin, Co.*

UC Davis, Dept. of Plant Pathology

www.plpnem.ucdavis.edu

UC Kearney Agricultural Center

www.uckac.edu/plantpath

Statewide IPM Program

www.ipm.ucdavis.edu



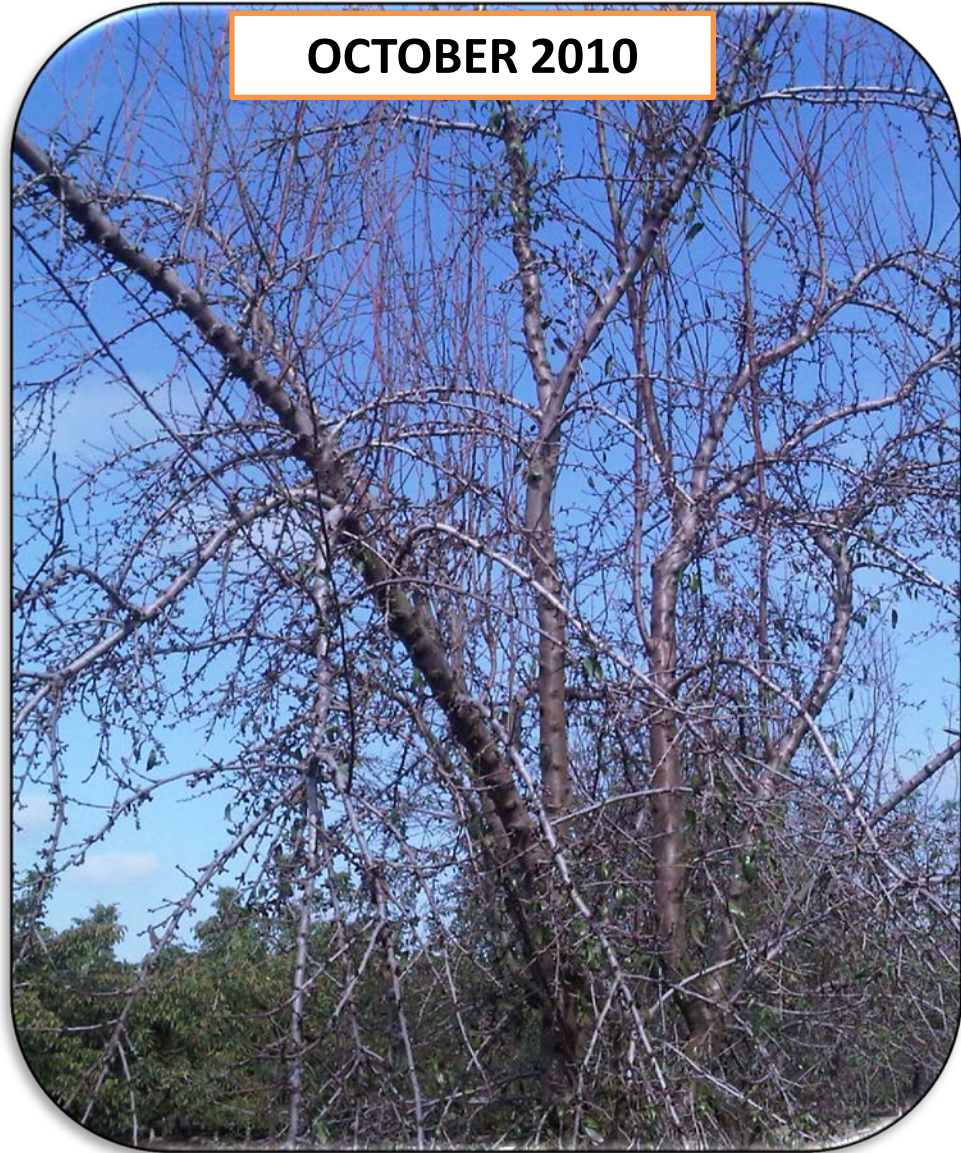
Almond Scab
(*Cladosporium carpophilum*)

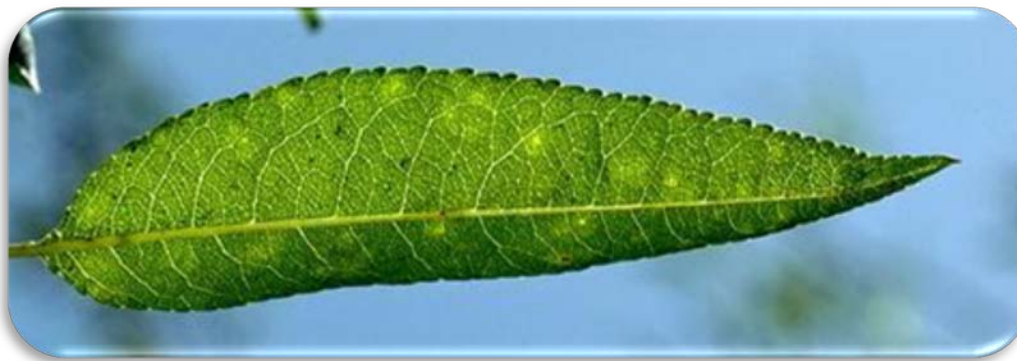
Scab: Symptom Development

JULY 2010



OCTOBER 2010





Yellow flecks
Late Spring/Early
Summer



Gray spots
Late Summer

By the time symptoms develop, it may be too late to spray.



Gray lesions
Nut infections

Defoliation





Survival in twig lesions

Primary Inoculum

- Twig infections

Disease Development

- Presence of inoculum
- Prolonged wet springs
- Sprinkler-irrigation
- Dense plantings



2010 Tulare County: low, cool, moist areas of orchards

Scab Management

Dormant sprays target primary inoculum

- Dormant / delayed dormant: Cu/oil
 - Chlorothalonil + oil (until bud swell)...
- Will kill green tissues.

J. Adeskaveg



Shot hole sprays (petal fall) may control scab

Scab Management

Spring-time sprays (2-5 weeks after petal fall)

- Protect leaves, fruit, young twigs
- If rains persist, applications may extend into May

Prevent Fungicide Resistance:

use single-site fungicides preventatively, not after disease development.

Cladosporium carpophilum

Resistance to strobilurin fungicides in northern SJV and Sacramento Valley

For More Information

Almond Pest Management Guidelines--UC IPM - Windows Internet Explorer

http://www.ipm.ucdavis.edu/PMG/selectnewpest.almonds.html

File Edit View Favorites Tools Help

Google Cladosporium carpophilum Search

Convert Select

Share Bookmarks Check Translate AutoFill Cladosporium Sign In Links

Weather CNN Maps Avery Templates

Translate web page

Home Feeds (1) Print Page Tools

University of California • Agriculture and Natural Resources

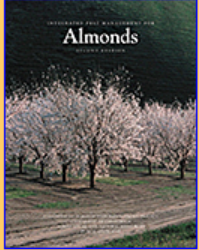
UC IPM Online

STATEWIDE INTEGRATED PEST MANAGEMENT PROGRAM

[UC IPM Home](#)

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For more information, see this UC IPM book:



Integrated Pest Management for Almonds

How to Manage Pests

Home & garden
Agriculture
Natural environments
Exotic & invasive
Weather data & products

How to Manage Pests

Almonds

Year-Round IPM Program—tells you what you should be doing throughout the year in an overall IPM program. Includes Year-Round IPM Program Annual Checklist.

[Year-Round IPM Program for Almonds](#) (3/09)

- [Dormant/Delayed Dormant](#)
- [Bloom to Postbloom](#)
- [Fruit Development](#)
- [Harvest](#)
- [Postharvest](#)

UC IPM Pest Management Guidelines—University of California's official guidelines for pest monitoring techniques, pesticides, and nonpesticide alternatives for managing pests in agriculture, floriculture, and commercial turf. [More](#)

[Authors/credits](#) | [Index to crops](#) | [PDFs to print](#) | [Recent updates](#)

General Information

- [Dormant Spur Sampling and Treatment Guidelines](#) (3/09)
- [Approximate Impact Ratings of Various Pest Management Tools Against Natural Enemies](#) (3/09)
- [General Properties of Fungicides Used in Almonds](#) (3/09)
- [Fungicide Treatment Timing in Almonds](#) (3/09)
- [Most Effective Treatment Timings for Key Disease](#) (3/09)
- [Fungicide Resistance Management](#) (6/09)

Insects and Mites

- [Ants](#) (3/09)
- [Brown Mite](#) (3/09)
- [European Fruit Lecanium](#) (3/09)
- [European Red Mite](#) (3/09)
- [Forest Tent Caterpillar](#) (3/09)
- [Leaffooted Bug](#) (3/09)
- [Leafrollers](#) (3/09)
- [Navel Orangeworm](#) (3/09)

[More crops](#)

Slide 15 of 15 Almond board temp#1

start

Inbox - Microsoft Out... Fichtner Almond Boar... Almond Pest Manage...

Search Desktop

Internet 100%

50%

10:01 PM

Summer Time Almond Diseases- Alternaria and Rust

Gurreet Brar, UCCE (Fresno & Madera)

Alternaria leaf spot

Alternaria alternata

- Brown spots on leaves,
- Turn black as the spores produced
- Develops most rapidly in June and July
- Trees can be almost completely defoliated
- Most severe where dews form, humidity is high, and air is stagnant.



Alternaria leaf spot

Alternaria alternata

- Most severe on exposed leaves.
- Trees trained to an open and spreading canopy
- East-west rows more severe disease than north-south
- Most susceptible- Carmel, Monterey, Winters, and Butte.



Photo: Gary Woods

Alternaria leaf spot

Monitoring

- Monitor for signs of the disease in April through June.
- If monitoring indicates presence of Alternaria, begin late-spring treatments about mid-April.
- In orchards with a history of the disease, treat in mid- to late April and 2 to 3 weeks later.

DSV (Disease Severity Value) Model

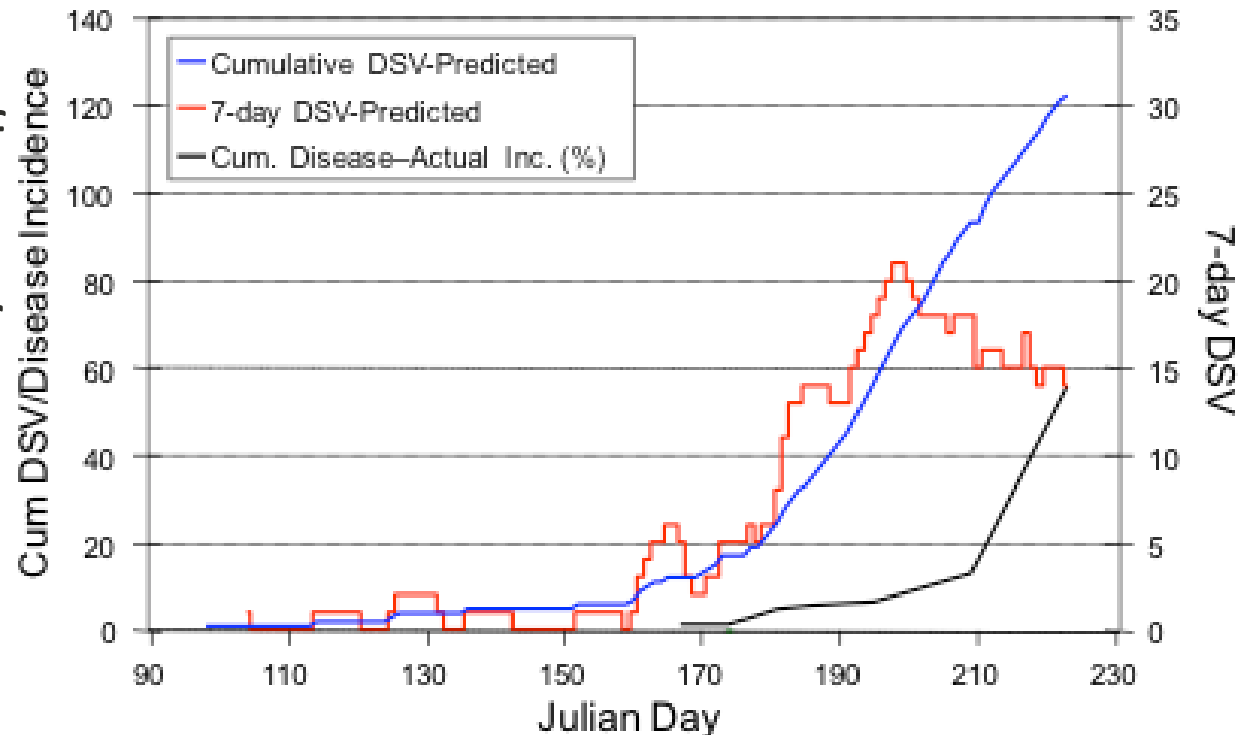
- Index values are assigned for average temp. & leaf wetness duration.

Mean temperatures

(C) during wetness Leaf wetness duration (hours)

| | | | | | |
|---------|-----|------|-------|-------|-----|
| 15-17 | 0-6 | 7-15 | 16-20 | 21 | --- |
| 17.1-20 | 0-3 | 4-8 | 9-15 | 16-22 | 23+ |
| 20.1-25 | 0-2 | 3-5 | 6-12 | 13-20 | 21+ |
| 25.1-29 | 0-3 | 4-8 | 9-15 | 16-20 | 23+ |
| DSV | 0 | 1 | 2 | 3 | 4 |

- Apply fungicide if accumulated index values over a 7-day period reach a value of 10 or higher.



Fungicides for Alternaria

| | | | |
|-----------------|--------|--------|----------------------|
| Quash | (3) | High | DMI |
| Pristine | (11/7) | Medium | Strobilurin/Boscalid |
| Luna Sensation | (11) | Medium | Strobilurin |
| Luna Experience | (3/7) | Medium | DMI/Boscalid |
| Inspire Super | (3/9) | High | DMI |
| Quadris Top | (11/3) | Medium | Strobilurin |
| Abound | (11) | High | Strobilurin |
| Rovral* | (2) | Low | Dicarboximide |

*Do not use later than 5 weeks after petal fall.

Almond Rust

Tranzchelia discolor

- Rust occurs sporadically throughout almond-growing areas in California.
- It often is serious on young orchards where bloom sprays have not been applied.



Almond Rust

Tranzschelia discolor

- Small, yellow spots on the upper surface of leaves.
- On the lower surface rusty red spots when the rust-colored spores erupt through the surface.



Rust Management

- In orchards with a history of rust, apply fungicides in late spring and summer to control leaf infections.
- 5 weeks after petal fall and forward
- 2-3 applications may be needed in orchards that have had severe rust problems.
- To be effective, fungicide must be applied before rust symptoms are visible.
- Micronized sulfur works well on rust, apply when not using oil
- To prevent the rust inoculum from increasing in late fall, apply zinc sulfate (20-40 lb/acre) in late October to early November to hasten leaf fall. Otherwise, the inoculum may build up, overwinter on the trees, and infect leaves the following spring.

Fungicides for Rust

timing: 5 weeks after petal fall on

- | | | |
|--------------------|-----------|----------------------|
| • Pristine (11/7) | medium | Strobilurin/Boscalid |
| • Flint / Gem (11) | high risk | Strobilurin |
| • Abound (11) | high risk | Strobilurin |
| • Maneb (M3) | low risk | Carbamate |
| • Sulfur | low risk | Inorganic |
| • Rovral (2) | low risk | Dicarboximide |

Almond: Treatment timings

| Disease | Dormant | Bloom | | | Spring ¹ | | Summer | |
|-----------------|---------|----------|------------|------------|---------------------|---------|--------|------|
| | | Pink bud | Full bloom | Petal fall | 2 weeks | 5 weeks | May | June |
| Alternaria | ---- | ---- | ---- | ---- | ---- | ++ | +++ | +++ |
| Anthracnose | ---- | ++ | +++ | +++ | +++ | +++ | +++ | ++ |
| Brown rot | ---- | ++ | +++ | + | ---- | ---- | ---- | ---- |
| Green fruit rot | ---- | ---- | +++ | ---- | ---- | ---- | ---- | ---- |
| Hull rot | ---- | ---- | ---- | ---- | ---- | ---- | ---- | +++ |
| Leaf blight | ---- | ---- | +++ | ++ | + | ---- | ---- | ---- |
| Scab | ++ | --- | --- | ++ | +++ | +++ | + | --- |
| Shot hole | 5 | + | ++ | +++ | +++ | ++ | ---- | ---- |
| Rust | ---- | ---- | ---- | ---- | ---- | +++ | +++ | + |

UC Resources

- UC IPM website:
 - <http://www.ipm.ucdavis.edu/>
- Almond Doctor Blog
 - <http://thealmonddoctor.com/>
- Fungicide Resistance Action Committee (FRAC)
 - <http://www.frac.info/>

Thank you.