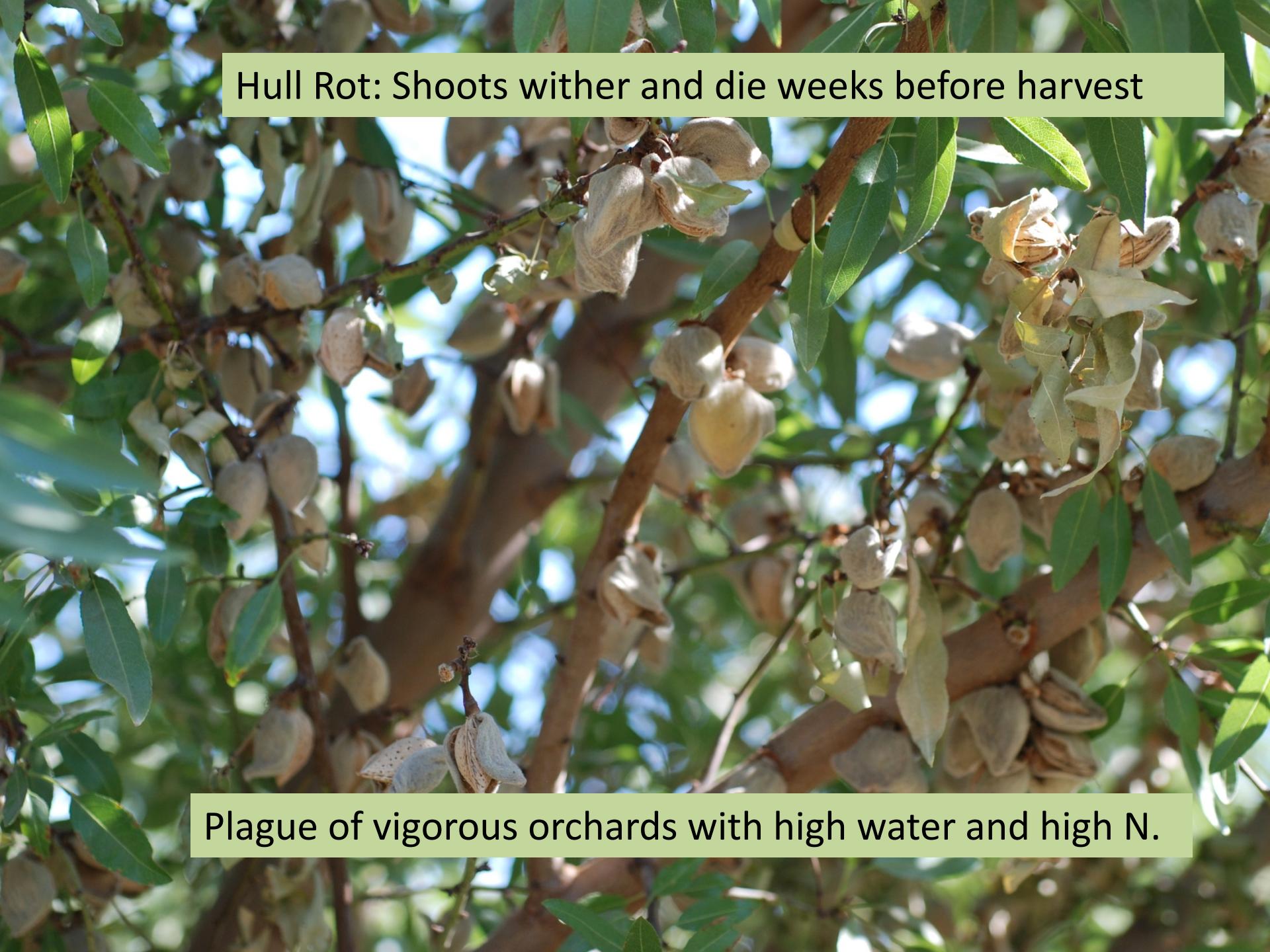


# Almond Disease Management: Hull Rot and Scab



Hull Rot: Shoots wither and die weeks before harvest



Plague of vigorous orchards with high water and high N.

# Hull Rot Culprits



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*Monolinia*



Both respond well to cultural control

*Rhizopus*



*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*

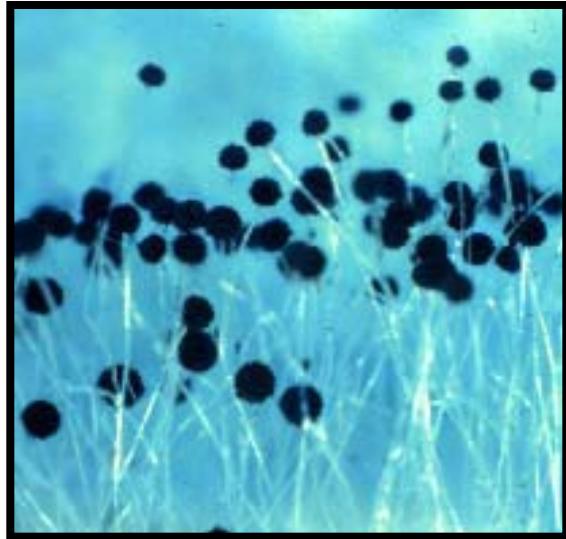
- More common in Sac Valley
- Tan spores, inside or outside hull
- Only infects after hull split

Different pathogens-similar effects

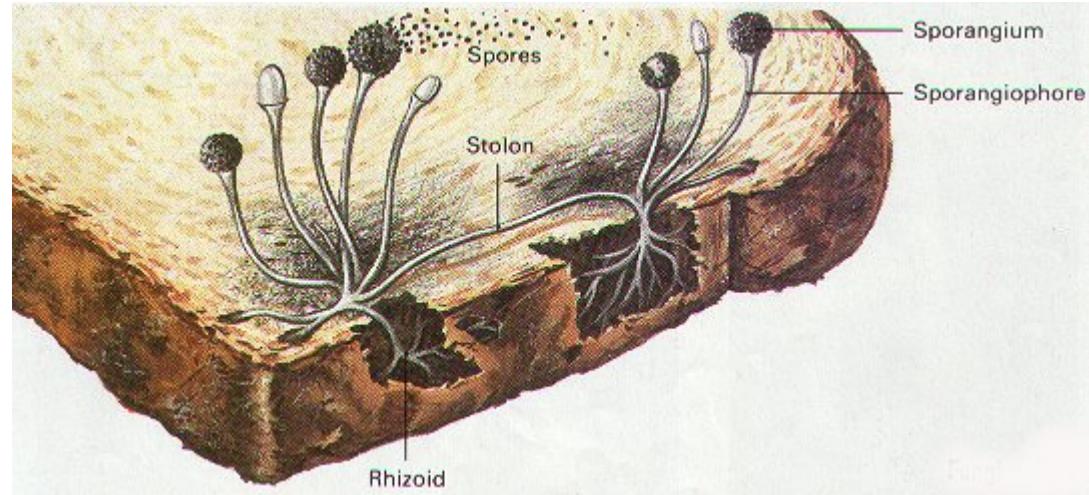


Monilinia may also infect flowers!

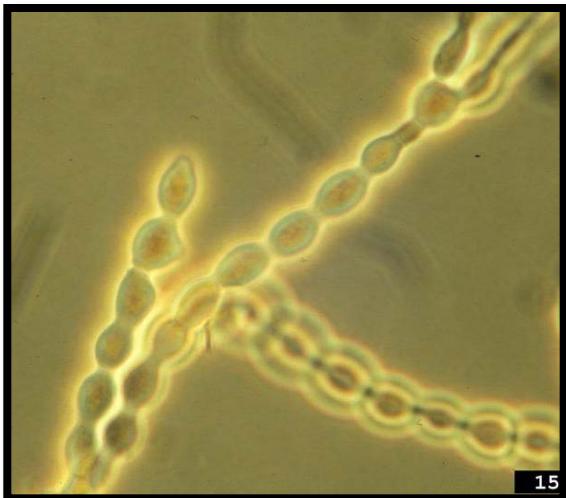
# Hull Rot Pathogens



*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

Info courtesy of B. Holz

# Infestation 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

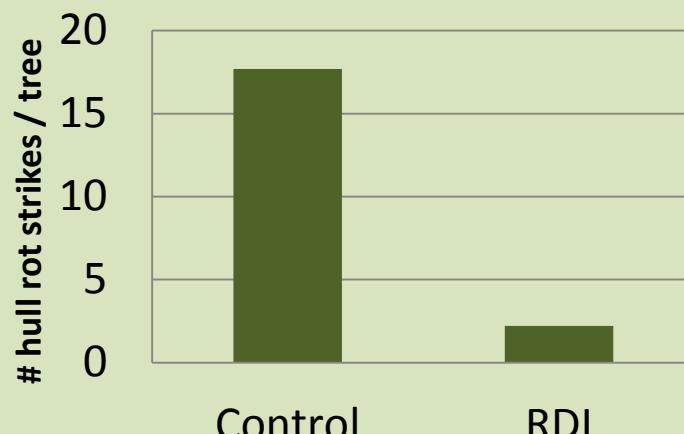
### 1) Regulated deficit irrigation

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 H<sub>2</sub>O 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



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Unsplit



Hull split: < 3/8 inch

Initial separation stage



Initial drying stage

Deep V, unsplit



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*

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**UC Davis, Dept. of Plant Pathology**

[www.plpnem.ucdavis.edu](http://www.plpnem.ucdavis.edu)

**UC Kearney Agricultural Center**

[www.uckac.edu/plantpath](http://www.uckac.edu/plantpath)

**Statewide IPM Program**

[www.ipm.ucdavis.edu](http://www.ipm.ucdavis.edu)



# Almond Scab

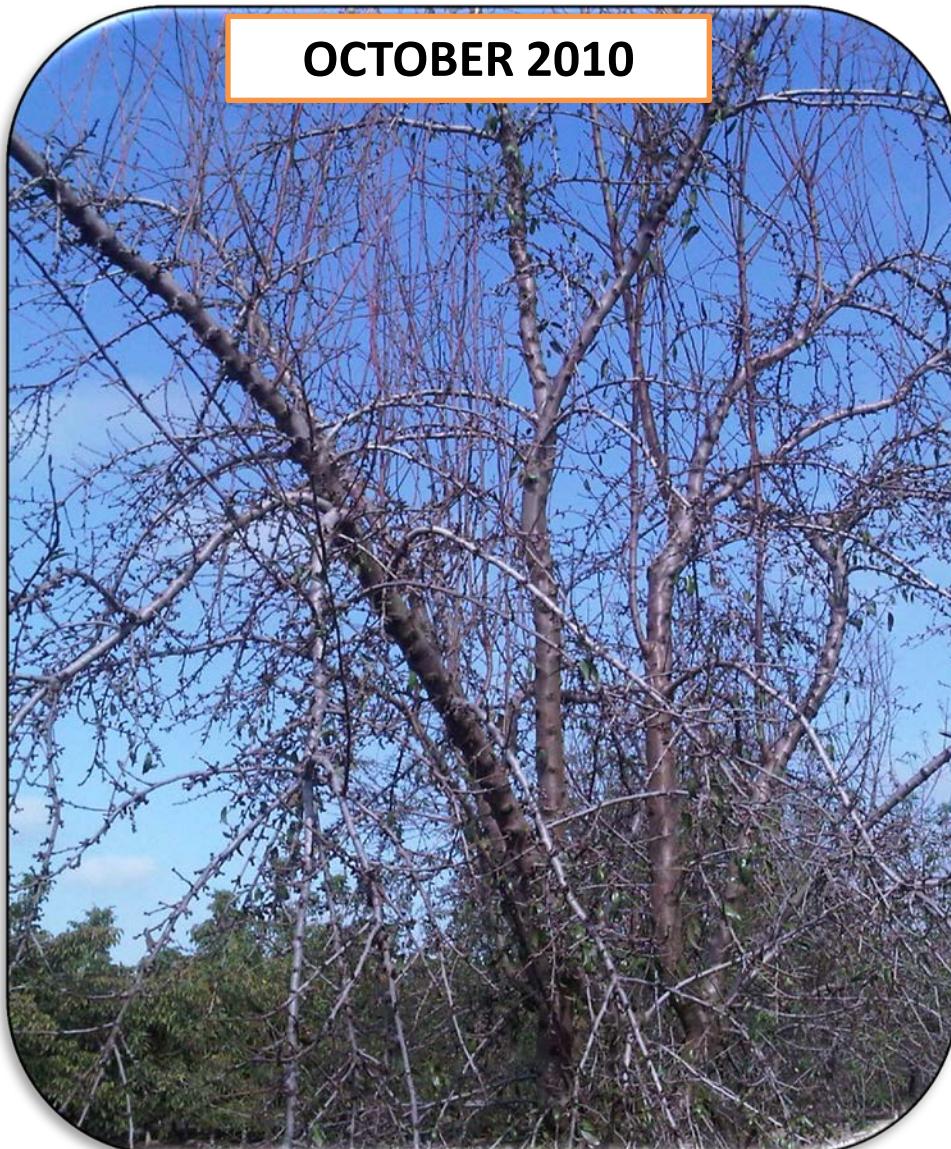
*(Cladosporium carpophilum)*

# 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



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# 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

AVERY Search Ask Weather CNN Maps Avery Templates

Almond Pest Management Guidelines--UC IPM

Translate web page Home Feeds (J) Print Page Tools

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**UC IPM Online** STATEWIDE INTEGRATED PEST MANAGEMENT PROGRAM

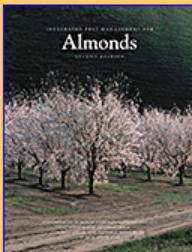
**UC IPM Home**

**How to Manage Pests**

**Almonds**

**More crops**

For more information, see this UC IPM book:



Integrated Pest Management for 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 \(3/09\)](#)

Slide 15 of 15 | Almond board temp#1 | Internet | 100% |

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# **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

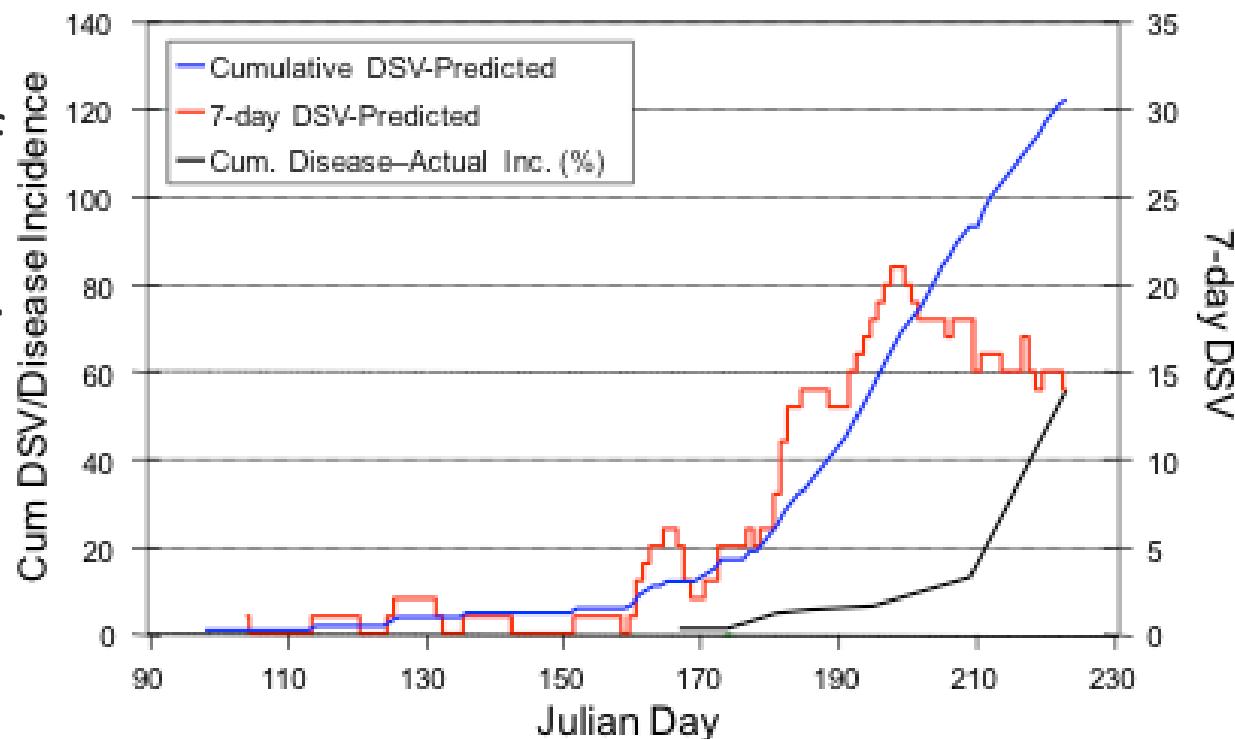
# Alternaria leaf spot Monitoring

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

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	



# Fungicides for Alternaria

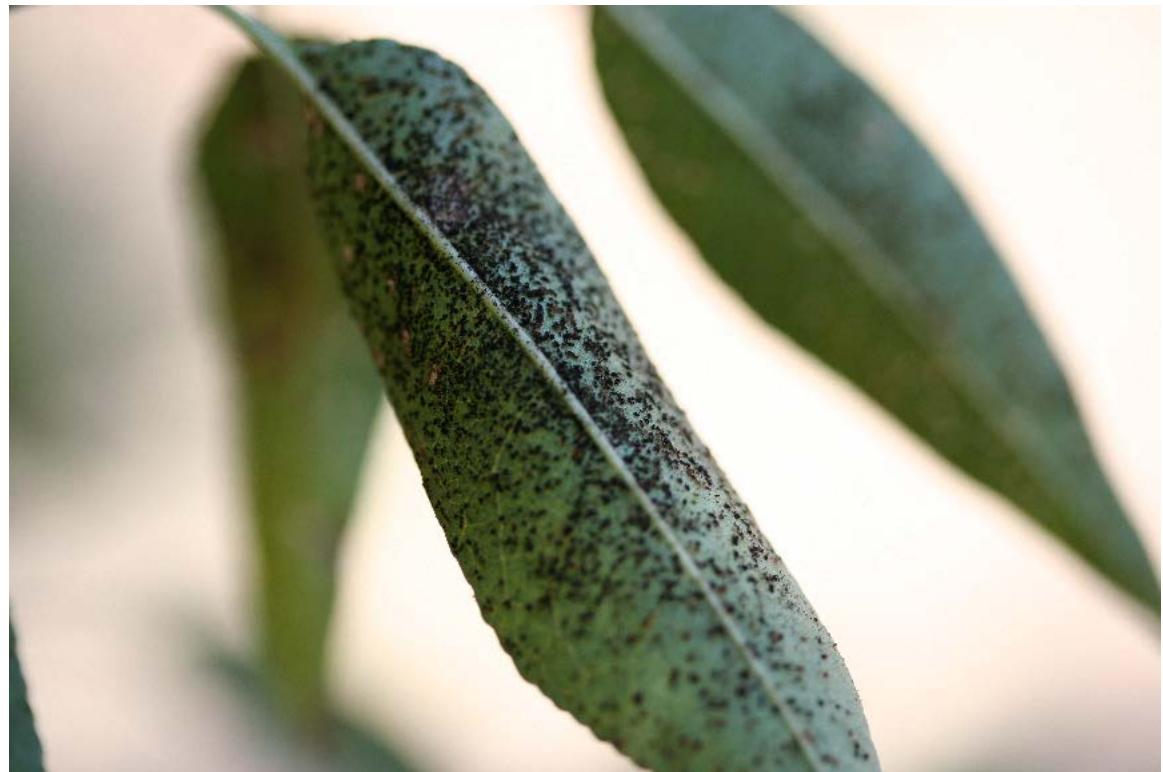
Quash	(3)	High	DMI
Pristine (11/7)		Medium	Strobilurin/Boscalid
Luna Sensation (11)	Medium		Strobilurin
Luna Experience (3/7)	Medium		DMI/Boscalid
Inspire Super (3/9)		High	DMI
Quadris Top (11/3)	Medium		Strobilurin
Abound (11)		High	Strobilurin
Rovral* (2)		Low	Dicarboximide

\*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

*Tranzchelia 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.



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# 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 <sup>1</sup>		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.**