Epidemiology and Control of Almond Scab and Alternaria Leaf Spot

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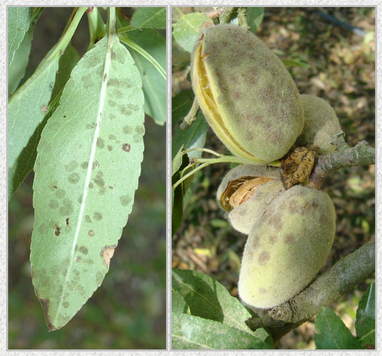
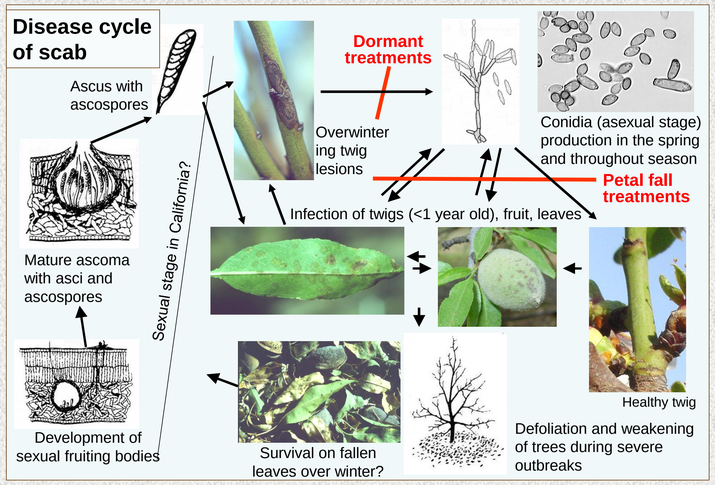
Almond Scab (*Fusicladium carpophilum*)

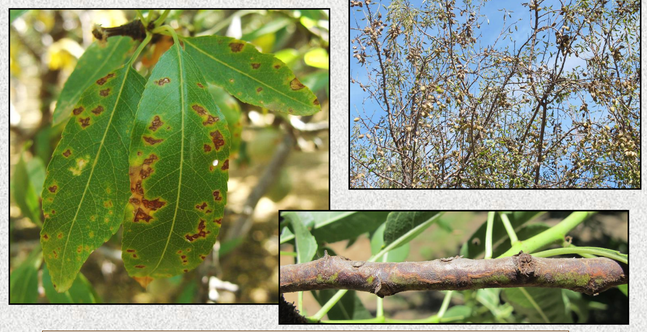


Leaf and fruit symptoms.

Disease cycle of scab



Alternaria Leaf Spot of almond (*Alternaria* spp.)



Early tree defoliation and new leaf development eventually weakens the tree. Infections mostly occur on leaves but twig infections have occasionally been found.

Scab, Alternaria leaf spot, and hull rot have increased with changes in almond production

Changing practice	Effects
High-density planting	Less air circulation, increase in shading and orchard humidity
Higher nitrogen fertilization	Rapid growth, plant tissues more susceptible
Increase in irrigation duration	Increase in orchard humidity
Planting in areas less suitable for almond production	Environments may be more favorable for disease. Increased stress on trees.

→ Conditions that weaken trees and favor plant pathogens

Field trials on scab management in 2015

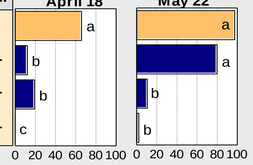
1. Dormant applications with chlorothalonil to reduce inoculum in the spring

Due to dry weather in the spring of 2015, scab sporulation on twigs and disease incidence was low.

- In multiple years of trials we established that chlorothalonil-oil is highly effective in delaying sporulation of twig lesions into late spring.
- Copper-oil is less effective
- Chlorothalonil is effective by itself, but oil significantly increases efficacy.
- Timing: Mid-December to mid-January.

Fungicide	Oil
Control	-
Kocide 3000 5 lb	+
Bravo WeatherStick 4 pts	+
Bravo WeatherStick 6 pts	+

Incidence of twig sporulation (%)



cv. Carmel, Butte Co.
Application: Jan 2013, Evaluation: April 18 and May 22.

Guidelines:

- At locations with high disease levels, a dormant or delayed-dormant application is recommended.
- Bravo WeatherStik received a Section 2(ee) registration for dormant application between Dec. 1 and Jan. 10 (before bud swell).
- Full registration is planned through IR-4 to change PHI to 60 days and rate to 6 pts/A (pending).
- Delay in sporulation synchronize scab treatments with Alternaria treatments.

Timing of scab and Alternaria treatments without and with the use of a scab dormant application

Disease	Dor-mant	Bloom			Spring		Summer	
		Pink bud	Full bloom	Petal fall	Two week	Five week	May	June
Scab	++	-	-	+	+++	+++	+/-	+/-
Scab Dormant Chlorothalonil+oil	++	-	-	-	-	+++	+++	+/-
Alternaria	-	-	-	-	-	+++	+++	+++

Note: - = no application; + = application timing slightly beneficial to +++ = application timing very beneficial,

2. In-season applications

Treatment*	Rate (/A)	4/21	5/12
Control	-----	-----	-----
Rhyme	7 fl oz	@	@
Inspire	7 fl oz	@	@
Quash	3.36 oz	@	@
EXP-1	5.14 fl oz	@	@
RON	6 fl oz	---	@
RON	4 fl oz	---	@
Kenja + IB18121	8.6 + 12.9 fl oz	@	@
Ph-D + Tebucon 45 + NF-P	6.2 + 8 + 8 fl/oz	@	@
Quash + S2200	3.36 + 3.36 oz	@	@
Fontelis + Tebucon 45	20 + 8 fl/oz	@	@
Luna Experience	6 fl oz	@	@
Luna Sensation	5 fl oz	@	@
EXP-2	7 fl oz	@	@
EXP-3	7 fl oz	@	@
Merivon	6.5 fl oz	@	@
Ph-D + Quash + NF-P	6.2 + 3 + 8 fl/oz	@	---
Fontelis + Tebucon 45 + NF-P	20 + 8 + 8 fl/oz	---	@
Bravo WeatherStik	64 fl oz	@	---
Quadris Top + DyneAmic	14 + 16 fl oz	---	@
Catamaran	64 fl oz	@	---
Viathon	64 fl oz	---	@

Scab incid. (%)

cv. Monterey, Colusa Co., 2015, NF-P = Nufilm-P

Most effective newer fungicides:
Single: Quash, Inspire, EXP-1, Ph-D, Syllit,
Pre-mixtures: Quadris Top, Inspire Super, Luna Sensation, Merivon, EXP-2, EXP-3
Rotations: including Ph-D, Quash, Fontelis, Tebucon

Summary: Management of scab with fungicides

- An effective 3-spray program includes a dormant and two applications after twig-infection sporulation
- Initiate the first in-season scab application at the beginning of twig-lesion sporulation for best efficacy.
- Multi-site fungicides with low resistance potential (chlorothalonil, mancozeb, captan, ziram) should be used at early petal fall to satisfy PHI requirement. Later in the season, rotations of captan with the newer single-site and pre-mix fungicides are suggested.
- Syllit 65WG is a new scab material and should be used at 16-32 oz/A.
- Mancozeb (Manzate) was registered in 2013 to replace maneb.
- **Single-site fungicides should not be applied once disease is developing.**

Field trials on Alternaria leaf spot management 2015

1. cv. Carmel, Colusa Co.

Treatment*	Rate (/A)	4/29	5/20	7/7
Control	-----	---	---	---
Ph-D	6.2 oz	@	@	@
Inspire + Dyn.	7 + 16 fl oz	@	@	@
Fontelis	20 fl oz	@	@	@
EXP-1	5.14 fl oz	@	@	@
Fontelis + Tebucon	20 + 8 fl/oz	@	@	@
Fontelis + Abound	20 + 12 fl oz	@	@	@
Kenja + IB18121	8.6 + 12.9 fl oz	@	@	@
Luna Experience	6 fl oz	@	@	@
Luna Sensation	5 fl oz	@	@	@
EXP-2	7 fl oz	@	@	@
EXP-3	7 fl oz	@	@	@
Merivon	6.5 fl oz	@	@	@
Fontelis	20 fl oz	@	---	---
Quash	3 oz	---	@	---
Ph-D	6.2 oz	---	---	@
Bravo WeatherStik	64 fl oz	@	---	---
Quadris Top + Dyn.	14 + 16 fl oz	---	@	@

Incidence (%)

Dyn. = DyneAmic

2. cv. Monterey, Colusa Co.

Treatment*	Rate (/A)	4/29	5/20
Control	-----	---	---
Fontelis + Kin.	20 + 8 fl oz	@	@
EXP-1	5.14 fl oz	@	@
RON + Kin.	3 + 8 fl oz	@	@
RON + Kin.	4.5 + 8 fl oz	@	@
RON + Kin.	6 fl oz + 8 fl oz	@	@
Ph-D + Fontelis + Kin.	6.2 + 20 + 8 fl/oz	@	@
Fontelis + Tebucon + Kin.	20 + 8 + 8 fl/oz	@	@
Fontelis + Abound + Kin.	20 + 12 + 8 fl oz	@	@
Luna Sensation	5 fl oz	@	@
EXP-2	7 fl oz	@	@
EXP-3	7 fl oz	@	@
Merivon	6.5 fl oz	@	@
Fontelis + Kinetic	20 + 8 fl oz	@	---
Quash	3 oz	---	@
Ph-D	6.2 oz	---	---

Incidence (%)

Kin = Kinetic

Disease pressure was low at many locations in 2015 (high incidence, but low severity). This was likely due to reduced orchard irrigation that made orchard microclimatic conditions less favorable for development of Alternaria leaf spot.

The Disease Severity Value (DSV) model

Mean temperature (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

Integrated management of flower, foliar, and fruit fungal diseases of almond in an annual 5- to 6-spray program

Dormant	Feb./March (bloom)	May	June	July (hull split)
Chlorothalonil-oil: Scab, (insect pests)	1-2 applications: Brown rot, shot hole, jacket rot	1 application: Alternaria, scab, rust, (mites)	1 application: Alternaria, scab, rust, Monilinia hull rot	1 application: Rhizopus hull rot, and insect pests (e.g., NOW)

Choose fungicides for each application timing that are active against all diseases present at an orchard site (see: www.ipm.ucdavis.edu). Some sprays can be combined with insecticide/miticide applications.

Summary: Management of Alternaria leaf spot

- Late-spring/early-summer applications based on the DSV model or calendar-based starting in May until late June/early July.
- Modification of the DSV model by using daily temperatures, dew periods, and precipitation was a less accurate predictor of infection periods than using leaf wetness duration and temperatures during wetness.
- Highly effective fungicides: Quash, Ph-D, Inspire Super, Quadris Top, Luna Sensation, Luna Experience, Merivon, Ph-D + Tebucon, Fontelis + Tebucon, EXP-1, EXP-2, EXP3 - have to be strictly used in rotations and/or mixtures for resistance management.
- Other components of an integrated approach in disease management are highly critical: row orientation with prevailing winds and pruning to improve air movement, nitrogen management on replacement schedule only to reduce excess growth, improve water penetration, and shorter irrigation periods.