



Organic and Conventional Almond Bloom Disease Control

by

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General Practices

- Start the orchard conventionally for at least the first 3-5 years. If you start transitioning to organic after the 4th leaf you will have a pretty well established orchard canopy then and a certified almond crop by your 7th leaf, just as you begin to reach your high production years.

Why Start Conventionally?

- Because you will have a much more difficult time starting your almond orchard organically than conventionally.
- Nematodes, Weeds and Rodents can severely stress young trees and reduce their growth and canopy development!

Start Conventionally

- I have observed terrible weed control problems in orchards planted and started organically. Trees can be stunted because of competing weeds.

Organic Weed Control

- Young trees can be severely damaged from propane burning typically used for weed control; their bark is thin and can be burned easily.



Start Conventional-Weed Control

- Use pre-emergent and contact herbicides in the tree row the first three years for weed control



Start Conventional-Fumigate

- Fumigate if you have high concentrations of plant parasitic nematodes before planting



Start Conventional- Ground Squirrel and Gopher Control

- If you start conventional you can also use baits and fumigates to control rodent pests in your orchards.
- Try to get them under control while you are conventional—they are hard enough to control then let alone under organic regulations.



Start Conventional- Tree Nutrition

- You can supply all the necessary nutrients you need for the rapid tree growth that accompanies the first few seasons. It is easy to get behind nutritionally in a young organic orchard.



After starting the orchard conventionally for the first 3-4 years you then transition for 3 years before becoming certified organic



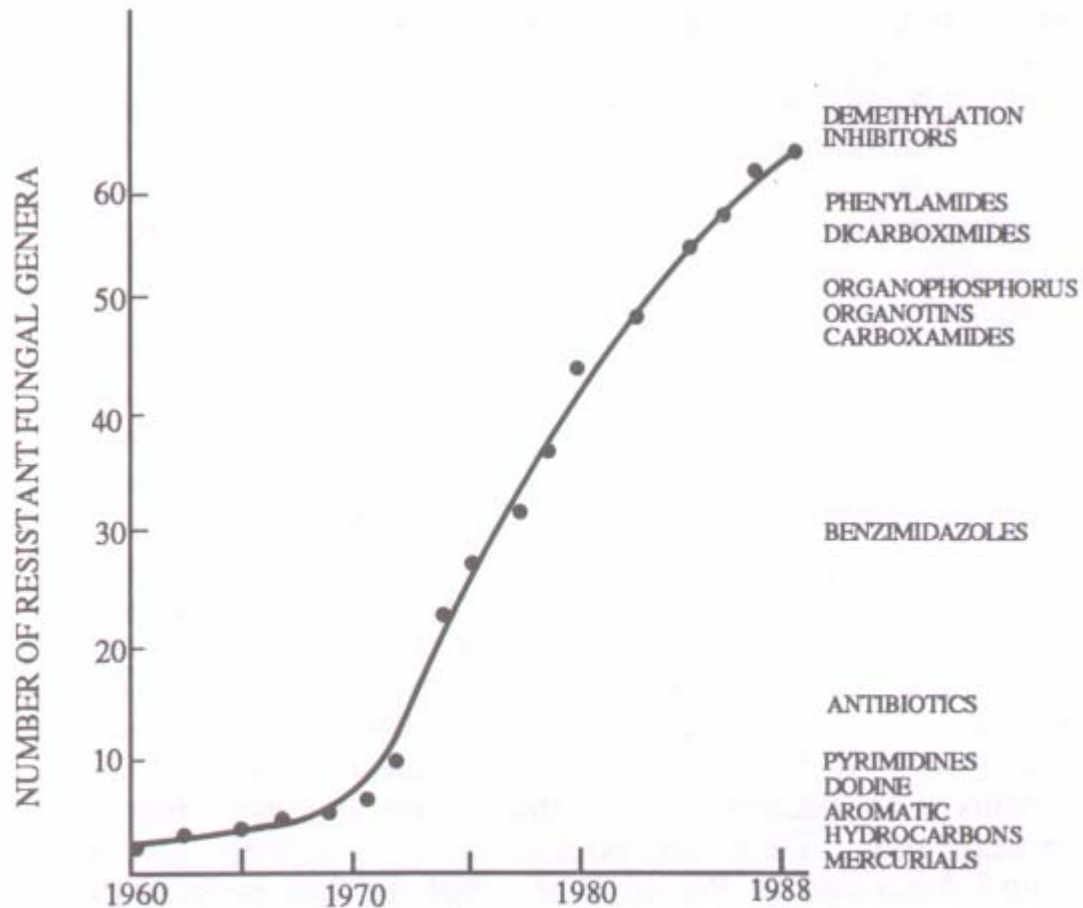
- When almond trees are blooming their flowers are susceptible to a number of plant pathogenic fungi capable of causing disease.



- Fungicides are usually applied during bloom to protect blossoms from becoming infected. Fungicides should be selected carefully to avoid resistance and to control the pathogens present.

Fungicide Resistance

- The frequency of pathogen reported resistance to fungicides has accelerated since the 1960s, which coincides with the introduction of new compounds that attack specific biochemical targets in fungal pathogens.

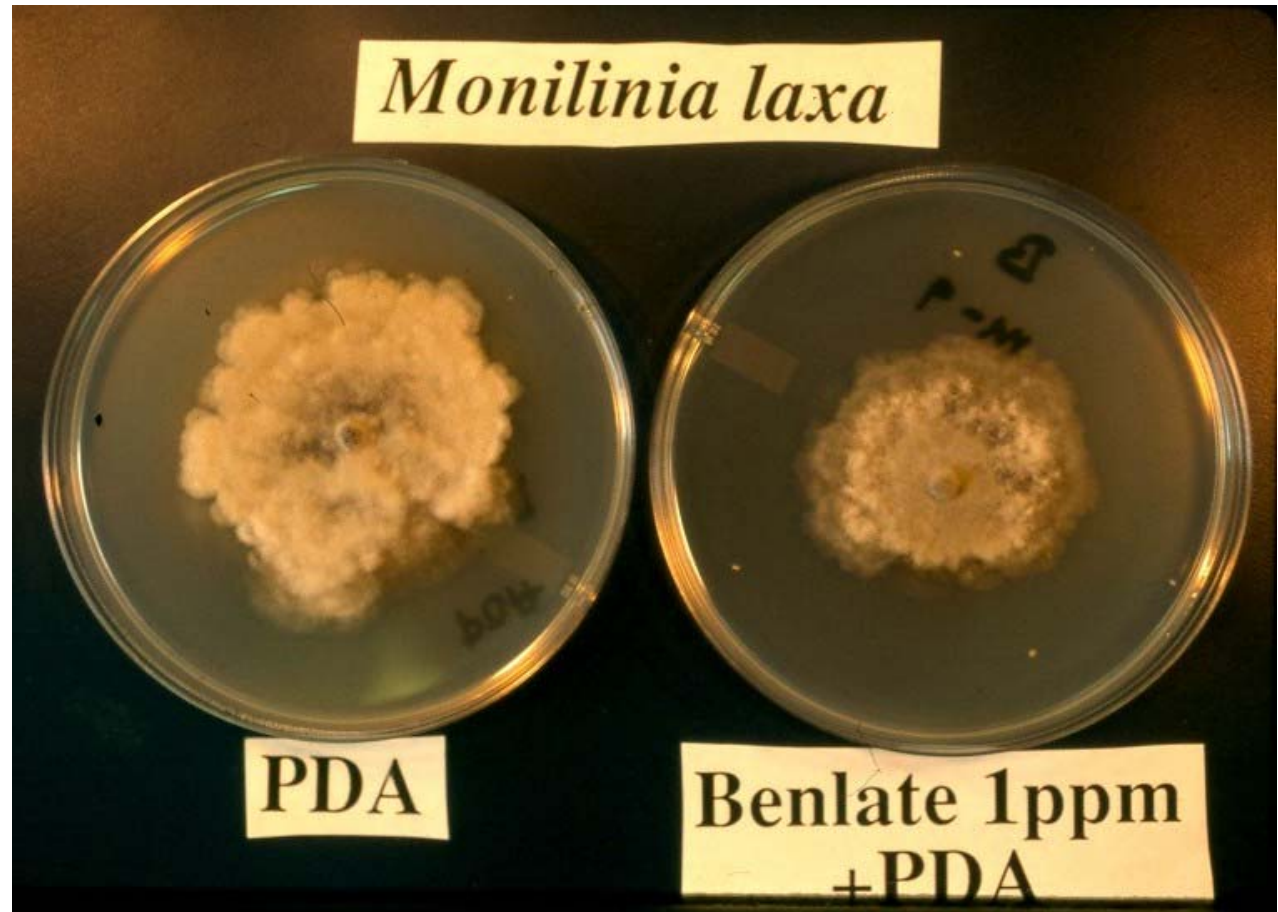


**Chronological increase in number of fungicide-resistant *fungal genera*.
Genera with multiple resistance are repeated.
(Updated by Delp from Delp, 1979)**

- Isolate of the brown rot fungus growing on PDA by itself and on PDA with 1 ppm benlate.
- Isolate is sensitive to benlate.



- Isolate of the brown rot fungus growing on PDA by itself and on PDA with 1 ppm benlate.
- Isolate is resistant to benlate.



Fungicide Resistance

- Most highly effective fungicides are in the process of selecting pathogen derived resistance mechanisms.
- With repeated fungicide use pathogen populations are continually shifting towards less sensitivity and increased resistance.

**EFFICACY AND TIMING OF FUNGICIDES,
BACTERICIDES, AND BIOLOGICALS
FOR
DECIDUOUS TREE FRUIT, NUT CROPS,
AND GRAPEVINES**

2006

(updated 7-10-06)



*ALMOND
APPLE AND PEAR
APRICOT
CHERRY
GRAPE*

*PEACH
PISTACHIO
PLUM
PRUNE
WALNUT*

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EFFICACY: TREE CROPS

Fungicide	Brown rot	Jacket rot (Botrytis)	Shot hole	Powdery mildew	Rust	Scab		Anthracnose	Alternaria
						Almond	Apple/pear		
CONVENTIONAL FUNGICIDES									
Abound ^a	++	---	+++	++	+++	++++	+++	++++	+++
Benlate ^b	+++ ^c	+++	---	+++	++	+++	+++	---	---
Botran	++	+++	ND	NR	NR	NR	NR	NR	NR
Bravo/Echo	++	++	+++	---	++	+++	NR	++++	++
Cabrio ^e	++	---	NR	++	NR	NR	NR	NR	NR
Captan	++	++	+++	---	+	+++	++	++	----
Elevate/Judge	+++	++++	+	+	ND	ND	ND	ND	ND
Elite	++++	++	+/-	+++	+++	NR	NR	+++	++
Eminent ^e	++	---	ND	ND	ND	ND	ND	+	ND
Evito ^e	++	---	ND	ND	ND	ND	ND	ND	ND
Flint/Gem	++	---	+++	++	ID	++++	++++	++++	+++
Funginex ^c	+++	---	---	++	+	---	+++	ND	ND
Indar	+++	---	+	ND	ND	+++	---	+	---
Laredo	+++	---	++	++++	++	---	NR	++	---
Maneb	+	+	++	---	+++	++	++	++	+
Manex	+	+	++	---	+++	++	++	++	+
Orbit (Bumper)	+++	---	+/-	+++	+++	NR	NR	+++	----
Penbotec ^f	+++ ^{h,i}	++++	++	ND	ND	ND	ND	ND	++
Pristine	++++	+++	++++	+++	ND ^d	++++	ND	+++	+++
Procure	++	---	+/-	+++	ND	ND	++++	ND	ND
Quintec ^e	---	---	---	++++	---	---	---	---	---
Rally	++	---	+/-	++++	++	---	++++	++	---
Rovral	+++	+++	+++	---	---	---	NR	---	+++
Rovral + oil	++++	++++	+++	+	++	---	NR	---	+++
Rubigan	+++	---	---	++++	++	NR	++++	ND	ND
Sovran ^e	ND	ND	ND	+++	++	ND	+++	ND	ND
Scala ⁱ	+++ ^{h,i}	++++	++	ND	ND	ND	ND	ND	++
Scholar ^f	++++	++++	---	---	---	---	---	---	---
Score ^e	+++	---	+/-	+++	+++	NR	NR	+++	+++
Switch ^e	ND	+++	ND	ND	ND	ND	ND	ND	+++
Thiram	+	+	ND	---	---	NR	++	ND	ND
Topsin-M	+++ ^g	+++	---	+++	++	+++	+++	---	---
Vanguard ⁱ	++++ ^h	++++	++	ND	ND	---	+++	ND	++
Ziram	+	+	+++	---	---	+++	++	+++	+

- FRAC-fungicide resistance action committee.
- Fungicides have become an integral part of efficient food production. The loss of a fungicide to agriculture through resistance is a problem that affects us all.
- FRAC works to prolong the effectiveness of fungicides liable to encounter resistance problems and to limit crop losses should resistance appear.
- <http://www.frac.info/>



**General Properties and Efficacy of Registered and Experimental Fungicides Used on
Deciduous Tree Fruit and Nut Crops and Grapevines in California**

Trade name	Fungicide	Class	Systemic action	Mode of action (FRAC number)¹	Resistance potential
various	copper	Inorganic	No	Multi-site (M1)	Low
various	sulfur	Inorganic	No	Multi-site (M2)	Low
Maneb	maneb	Carbamate (EBDC) ^a	No	Multi-site (M3)	Low
Manex	Maneb	Carbamate (EBDC) ^a	No	Multi-site (M3)	Low
Thiram	thiram	Carbamate (DMDC) ^b	No	Multi-site (M3)	Low
Ziram	ziram	Carbamate (DMDC) ^b	No	Multi-site (M3)	Low
Rovral	iprodione	Dicarboximide	Yes	Multi-site (2)	Low
Penbotec ^c	pyrimethanil	Anilinopyrimidine	Yes	Single-site (9)	High
Scala	pyrimethanil	Anilinopyrimidine	Yes	Single-site (9)	High
Vanguard	cyprodinil	Anilinopyrimidine	Yes	Single-site (9)	High
Botran	dichloran	Aromatic hydrocarbon	Slight	Single-site (14)	High
Allisan ^c	dichloran	Aromatic hydrocarbon	Slight	Single-site (14)	High
Bravo	chlorothalonil	Aromatic nitrile	No	Multi-site (M5)	Low
Echo	chlorothalonil	Aromatic nitrile	No	Multi-site (M5)	Low
Benlate**	benomyl	Benzimidazole	Yes	Single-site (1)	Very high
Topsin-M	thiophanate-methyl	Benzimidazole	Yes	Single-site (1)	Very high
Endura*	boscalid	Carboxyanilide	Yes?	Multi-site (7)	Low
Syllit***	dodine	Guanidine	Yes	Few - multi-site (M7)	Medium
Elevate	fenhexamid	Hydroxyanilide	No	Single-site (17)	High
Judge ^c	fenhexamid	Hydroxyanilide	No	Single-site (17)	High
Captan	captan	Phthalamide	No	Multi-site (M4)	Low
Quintec	quinoxifen	Quinoline	No	Single-site (13)	Medium
Scholar ^c	fludioxonil	Phenylpyrrole	Contact	Few - multi-site (12)	Low
Bayleton	triadimefon	DMI ^d -Triazole	Yes?	Single-site (3)	High
Elite	tebuconazole	DMI-Triazole	Yes?	Single-site (3)	High
Eminent*	tetraconazole	DMI-Triazole	Yes?	Single-site (3)	High
Funginex**	triforine	DMI-Piperazine	Yes?	Single-site (3)	High
Indar	fenbuconazole	DMI-Triazole	Yes?	Single-site (3)	High
Orbit	propiconazole	DMI-Triazole	Yes?	Single-site (3)	High
Bumper*	propiconazole	DMI-Triazole	Yes?	Single-site (3)	High
Mentor ^c	propiconazole	DMI-Triazole	Yes?	Single-site (3)	High
Procure	triflumizole	DMI-Imidazole	Yes?	Single-site (3)	High
Rally/Laredo	myclobutanil	DMI-Triazole	Yes?	Single-site (3)	High
Rubigan	fenarimol	DMI-Pyrimidine	Yes?	Single-site (3)	High
Score*	difencconazole	DMI-Trizole	Yes?	Single-site (3)	High
About	azoxystrobin	Strobilurin	Yes?	Single-site (11)	High
Cabrio	pyraclostrobin	Strobilurin	Yes?	Single-site (11)	High
Evito*	fluoxastrobin	Strobilurin	Yes?	Single-site (11)	high
Flint/Gem	trifloxystrobin	Strobilurin	Yes?	Single-site (11)	High
Sovran	kresoxim-methyl	Strobilurin	Yes?	Single-site (11)	High
Pristine	pyraclostrobin + boscalid	Strobilurin + Carboxyanilide	Yes? Yes?	Single-site (11) Multi-site (7)	Medium Low
Switch	fludioxonil + cyprodinil	Phenylpyrrole + Anilinopyrimidine	Contact Yes	Single-site (12) Single-site (9)	Medium High

¹ Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions. Fungicides are a resistance management program. For more information, see <http://www.frac.info/>.

ALMOND—FUNGICIDE EFFICACY

Fungicide	Resistance risk (FRAC#) ¹	Brown Rot	Jacket rot	Anthraco-nose	Shot hole	Scab	Rust ²	Leaf blight	Alternaria	Silver leaf
Benlate ³	high (1)	++++	++++	---	---	+++	+	++++ ⁸	---	---
Pristine ²	medium (7/11)	++++	++++	++++	++++	++++	+++	ND	+++ ¹⁰	---
Rovral + oil ⁴	low (2)	++++	++++	---	+++	+/-	++	ND	+++ ¹⁰	---
Scala	high (9)	++++	++++	ND	++	---	ND	ND	+ ¹⁰	---
Topsin-M ³	high (1)	++++	++++	---	---	+++	+	+++ ⁸	---	---
Vangard	high (9)	++++	++++	ND	++	---	ND	ND	+ ¹⁰	---
Abound	high (11)	+++	---	++++	+++	++++	+++	+++	+++ ¹¹	---
Elevate	high (17)	+++	++++	---	+	ND	ND	ND	ND	---
Flint/Gem	high (11)	+++	---	++++	+++	++++	+++	+++	+++ ¹¹	---
Laredo	high (3)	+++	---	++	++	---	+	+++	---	---
Rovral	low (2)	+++	+++	---	+++	---	---	ND	+++ ¹⁰	---
Bravo/Echo ^{5,6}	low (M5)	++	NR	+++	+++	+++	NR	NR	NR	---
Captan ⁶	low (M4)	++	++	+++	+++	+++	---	+++	---	---
Maneb	low (M3)	++	+	++	++	++	+++	++	---	---
Rally ⁷	high (3)	++	---	++	+/-	---	+	+++	---	---
Ziram	low (M3)	++	+	+++	+++	+++	---	++	+	---
Copper	low (M1)	+/-	+/-	---	+ ⁸	---	---	---	ND	ND
Lime sulfur ¹³	low (M2)	+/-	NR	---	+/-	++	NR	NR	NR	NR
Sulfur ⁶	low (M2)	+/-	+/-	---	---	++	++	---	---	---
PlantShield (NR)	low	---	---	---	---	---	---	---	---	+++

Rating: +++++ = excellent and consistent, +++ = good and reliable, ++ = moderate and variable, + = limited and/or erratic, +/- = minimal and often ineffective, --- = ineffective, NR = not registered, and ND = no data

ALMOND—TREATMENT TIMING

Note: Not all indicated timings may be necessary for disease control.

Disease	Dormant	Bloom			Spring ^a		Summer	
		Pink bud	Full bloom	Petal fall	2 weeks	5 weeks	May	June
Alternaria	----	----	----	----	----	+++	+++	+++
Anthracnose ^b	----	++	+++	+++	+++	+++	+++	++
Brown rot	----	++	+++	+	----	----	----	----
Green fruit rot	----	----	+++	----	----	----	----	----
Leaf blight	----	----	+++	++	+	----	----	----
Scab ^c	+	+	+	+	+++	+++	++	+
Shot hole ^d	+ ^e	+	++	+++	+++	++	----	----
Rust	----	----	----	----	----	+++	+++	+ ^f

Rating: +++ = most effective, ++ = moderately effective, + = least effective, and ---- = ineffective.

Brown Rot Blossom Blight

Pathogen: *Monilinia laxa*; rarely *Monilinia fructicola*

- Flowers may become infected from pink bud to petal fall and are most susceptible when fully open.
- In almonds, stigma, anthers, and petals are all very susceptible to infection.



Brown Rot Blossom Blight Pathogen: *Monilinia*

- Shown are the asexual spores of the fungus, called conidia.
- Most fungicides are applied to control this spore.



Brown Rot Blossom Blight

Pathogen: *Monilinia laxa*; rarely *Monilinia fructicola*

- The fungus survives in twig cankers and on remaining diseased flower parts and spurs.



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Fungicides for Brown Rot

timing: pink bud-full bloom-petal fall

- Topsin/Benlate high risk (1) Benzimidazole
- Pristine medium (11/7) Strobilurin/Boscalid
- Rovral low risk (2) Dicarboximide
- Vangard high risk (9) Anilinopyrimidine
- Scala high risk (9) Anilinopyrimidine

- Abound high risk (11) Strobilurin
- Rally/Laredo high risk (3) Demethylation
- Elevate high risk (17) Hydroxyanilide
- Flint / Gem high risk (11) Strobilurin
- Bravo/Echo low risk (M5) Aromatic hydrocarbon
- Captan low risk (M4) Phthalamide
- Ziram/Maneb low risk (M3) Carbamate

Evaluation of fungicides for control of brown rot on almond, 2004.

Treatment rate /A (date of application)*	Mean strikes/tree**
USF 2004 500SC 3.0 fl oz (A,B,C).....	4.8 a
Rovral 4F 16.0 fl oz + Volck Supreme Oil 97.95% 1% V/V (B).....	5.4 a
Exp1000 28 oz (A,B,C).....	5.8 ab
Vanguard 75WG 5.0 oz (A,C); Abound 2.08F 12.8 fl oz (B)	6.6 ab
Flint 50WG 3.0 oz (A,B,C).....	6.6 ab
Elite 45DF 6.0 oz (A,B,C).....	6.6 ab
Exp 1000 42.4 oz (A,B,C).....	6.8 ab
Rovral 4F 16.0 fl oz + Volck Supreme Oil 97.95% 1% V/V (A,B,C)	7.6 ab
Vanguard 75WG 5.0 oz (B)	7.8 abc
Vanguard 75WG 5.0 oz (A,B); Bravo Weatherstik 6F 64.0 fl oz (C).....	7.8 abc
V-10116 1.81SC 5.7 fl oz + Induce 90% 0.06% V/V (A,B,C)	8.2 abc
USF 2010 500SC 6.0 fl oz (A,B,C).....	8.2 abc
V-10116 50WDG 2.6 oz + Induce 90% 0.06% V/V (A,B,C)	8.2 abc
Elevate 50WDG 1.5 lb (A,B,C)	8.4 abc
Exp 1000 14.4 oz (A,B,C).....	8.4 abc
Systhane 20EW 15.3 fl oz (A,B,C)	9.0 abc
Scala 600SC 18.0 fl oz (A,B,C)	9.8 abc
Pristine 38WG 14.5 oz (B).....	10.4 abc
Pristine 38WG 14.5 oz (A,B,C)	11.8 abc
Pristine 38WG 10.5 oz (A,B,C)	11.8 abc
Topsin M 70WP 1.0 lb + Volck Supreme Oil 97.95% 1% V/V (A,B); Topsin M 70WP 1.0 lb + Microthiol Disperss 80WG 6.0 lb (C).....	13.2 abc
Abound 2.08F 12.8 fl oz (B)	13.8 abc
Topsin M 70WP 1.0 lb + Volck Supreme Oil 97.95% 1% V/V (A,B); Topsin M 70WP 0.75 lb + Maneb 75DF 6.0 lb (C)	13.8 abc
Laredo 2EC 12.8 fl oz (A,C); Echo 720 6F 64.0 fl oz (B)	15.0 abc
Topsin M 4.5F 20.0 fl oz + Volck Supreme Oil 97.95% 1% V/V (A,B); Topsin M 4.5F 15.0 fl oz + Ziram 76DF 6.0 lb (C).....	15.0 abc
Rubigan 1EC 6.0 fl oz + Induce 90% 0.06% V/V (A,B,C).....	17.0 abc
Flint 50WG 3.0 oz (B)	17.4 abc
Topsin M 70WP 1.0 lb + Volck Supreme Oil 97.95% 1% V/V (A,B); Topsin M 70WP 0.75 lb + Ziram 76DF 6.0 lb (C).....	18.0 abc
Rovral 4F 16.0 fl oz + Volck Supreme Oil 97.95% 1% V/V (A).....	23.0 abc
Rubigan 1EC 12.0 fl oz + Induce 90% 0.06% V/V (A,B,C).....	28.0 bc
Echo 720 6F 64.0 fl oz (A,B,C)	30.0 c
Untreated.....	146.6 d
Fisher's least significant difference (LSD)	12.18

*Dates of fungicide applications were as follows: A = 17 Feb, B = 24 Feb, C = 5 Mar.

**Means not followed by a common letter are significantly different according to Fisher's LSD (P? 0.05).

Disease Management in Organic Almond Production

Variety Selection

- Nonpareil and Peerless are very disease resistant when it comes to brown rot
- Butte, NePlus, Mission, and Padre tend to be much more susceptible to brown rot
- Carmel is very susceptible to scab

Butte and Brown Rot

- Varieties with tight flower clusters are more susceptible to brown rot (*Monilinia*) and jacket rot (*Botrytis*)





- A conventional Butte orchard that missed a full bloom brown rot spray had over 50% blossom blight despite no rain.

BIOLOGICALS, NATURAL COMPOUNDS, SARs

Copper	+	+	++	----	----	----	----	----	+/-
Cinnacure	----	----	----	++	----	----	----	----	----
Kaligreen	----	----	----	++	----	----	----	----	----
Messenger	----	----	----	++	----	----	----	----	----
Oxidate	----	----	+/-	ND	ND	----	----	----	----
Prev-am	ND	ND	ND	++	ND	----	----	----	----
Quiponin	ND	ND	ND	++	ND	ND	ND	ND	ND

Fungicide	Brown rot	Jacket rot (Botrytis)	Shot hole	Powdery mildew	Rust	Scab		Anthracnose	Alternaria
						Almond	Apple/pear		

BIOLOGICALS, NATURAL COMPOUNDS, SARs *continued...*

Serenade	+/-	+	+/-	++	ND	ND	ND	ND	ND
Sonata	+/-	+	+/-	++	ND	ND	ND	ND	ND
Sulfur	+	+	+/-	+++	+++	++	++	+	----
Trilogy	+/-	----	+	++	+/-	----	----	----	----
Sporan	+	----	+/-	++	+/-	----	----	----	----
Saf-T-Side	++	----	+/-	++	----	----	----	----	----
Stylet Oil	+/-	----	+/-	++	----	----	----	----	----
Valero	+/-	----	----	ND	ND	----	----	----	----

Rating: +++++ = excellent; +++ = very good; ++ = good; + = fair; +/- = minimal or often ineffective; - = ineffective; NR = not registered; ND = no data

Almond Varieties for Organic Production

- Some varieties are easier to farm organically than others.
- Many of us thought that the hard shell varieties would be easier to grow organically than soft shells because we wouldn't have to worry about insect and ant damage.
- We were wrong!

Nonpareil for Organic Production

- Nonpareil is susceptible to NOW and ant damage
- But Nonpareil is very resistant to brown rot when compared to other varieties
- Organic Nonpareil growers have been able to avoid brown rot and control NOW by using extremely rigid sanitation practices

Hard Shells for Organic Production

- The Hard shells are very resistant to NOW and ant damage
- But the hard shells are very susceptible to Brown Rot, Botrytis, and Scab diseases
- I know an organic grower who recently pulled his hard shells out of his organic program because of heavy losses to brown rot. But the same grower left his Nonpareil's in the program because he felt he could manage NOW.

Evaluation of fungicides for control of brown rot, 2005.

Treatment ^z Per acre rate ^y (Date of application) ^v	Mean ^x Strikes/Tree
V-10116 50WDG 2.5 oz (A,C); Pristine 38WDG 10.5 oz (B).....	0.6 a
Scala 600SC 12.8 fl oz (A,B); Gem 500SC 3.0 fl oz (C).....	0.6 a
Vanguard 75WG 5.0 oz (A); Vanguard 75WG 5.0 oz + Ziram 76DF 6.0 lb (B); Abound 2.08F 12.8 fl oz (C).....	1.0 ab
Scala 600SC 9.0 fl oz (A,B); Gem 500SC 3.0 fl oz (C).....	1.2 ab
Vanguard 75WG 5.0 oz (A,B); Abound 2.08F 12.8 fl oz (C).....	1.2 ab
Scala 600SC 18.0 fl oz (A,B); Gem 500SC 3.0 fl oz (C).....	1.2 ab
Exp 3 9.6 oz (A,B,C).....	1.4 ab
Vanguard 75WG 5.0 oz (A); Abound 2.08F 12.8 fl oz (B,C).....	1.4 ab
Rovral 4F 16.0 fl oz + Volck Supreme Oil 97.95% 1% V/V (B).....	1.4 ab
Laredo EW 15.3 fl oz (A); Laredo EW 12.8 fl oz + Ziram 76DF 6.0 lb (B); Ziram 76DF 8.0 lb (C).....	1.6 ab
Rally 40WSP 6.0 oz (A,C); Pristine 38WDG 10.5 oz (B).....	1.6 ab
Rovral 4F 16.0 fl oz + Volck Supreme Oil 97.95% 1% V/V (A,B,C).....	1.6 ab
Laredo EW 12.8 fl oz (A); Laredo EW 10.0 fl oz + Ziram 76DF 6.0 lb (B); Ziram 76DF 8.0 lb (C).....	1.8 ab
Pristine 38WDG 10.5 oz + Induce 90% 0.063% V/V(A,B,C).....	2.0 ab
V-10116 50WDG 1.75 oz (A,C); Pristine 38WDG 10.5 oz (B).....	2.0 ab
Topsin M 70W 1.0 lb + Volck Supreme Oil 97.95% 1% V/V (A,B); Topsin M 70W 1.0 lb + Ziram 76DF 6.0 lb (C).....	2.2 abc
Pristine 38WDG 14.5 oz + Induce 90% 0.063% V/V (A,B,C).....	2.6 abc
Microthiol Dispress 80WG 6.0 lb (A,B,C).....	2.8 abcd
Rovral 4F 16.0 fl oz + Volck Supreme Oil 97.95% 1% V/V (A).....	3.2 abcde
Topsin M 70W 1.0 lb + Microthiol Disperss 80WG 6.0 lb (A,B,C).....	3.6 abcde
Topsin M 4.5F 20.0 fl oz + Volck Supreme Oil 97.95% 1% V/V (A,B); Topsin M 4.5F 20.0 fl oz + Ziram 76DF 6.0 lb (C).....	3.8 bcde
Exp 3 1.0 lb (A,B,C).....	5.2 cdef
Saf-T-Side 1% V/V (A,B,C).....	5.8 def
Thymo-cide 0.25 fl oz per 1 Gal of Water (A,B,C).....	6.2 ef
Valero 1% V/V (A,B,C).....	6.2 ef
Liquid Lime Sulfur 1 G (A,B,C).....	8.2 fg
Stylet Oil 1% V/V (A,B,C).....	10.0 gh
Topsin M 70W 1.0 lb + Volck Supreme Oil 97.95% 1% V/V (A,B); Topsin M 70W 1 lb + Maneb 75DF 6.0 lb (C).....	12.8 gh
Trilogy 1% V/V (A,B,C).....	17.2 h
Untreated.....	46.4 j

Fisher's least significant difference (LSD, P<0.05) test^w

Dates of fungicide applications were as follows: A =8 Feb, B =14 Feb, C = 25 Feb.

Almond Shot Hole

Wilsonomyces carpophilus

- Spots occur on leaves, fruit, twigs, and flowers;
- Spots on young leaves usually fall out, leaving a hole (the shot hole); older leaves retain their lesions.
- Fruit spots are small with purplish margins, slightly corky, and raised. Heavy infection of young fruit may cause fruit drop or distortion and gumming of fruit.



Almond Shot Hole

Wilsonomyces carpophilus

- When the fungus sporulates, the fruiting structure appears as a small dark speck (the sporodochium) in the center of the spot; this is a diagnostic characteristic of shot hole disease.



Almond Shot Hole

Wilsonomyces carpophilus

- The fungus survives on infected twigs and as spores in healthy buds.
- Spores are moved by water to new sites; prolonged periods of wetness, either due to rain or sprinkler irrigation, are required for the disease to develop.



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Fungicides for Shot Hole

timing: petal fall till 2-5 weeks after bloom

- Pristine (11/7) medium Strobilurin/Boscalid
- Captan (M4) low risk Phthalamide
- Ziram (M3) low risk Carbamate
- Rovral (2) low risk Dicarboximide
- Bravo/Echo (M5) low risk Aromatic nitrile
- Abound (11) high risk Strobilurin
- Flint (11) high risk Strobilurin
- Gem (11) high risk Strobilurin

- Vangard (9) high risk Anilinopyrimidine
- Scala (9) high risk Anilinopyrimidine
- Laredo (3) high risk DMI-Triazole

Evaluation of Fungicides for Control of Shot Hole, 2003.

Table 1. Number of Shothole infected nuts (Severity) as affected by in-season fungicide applications.

Treatment ^z (Date of application) ^y	Rate ^y	Severity ^x	
Flint (A); Abound (B); Echo 720 (C,D,E).....	4.0 oz; 12.8 fl oz; 64 fl oz....	12.2	f
Pristine (A,B,C,D,E).....	0.658 lb.....	13.0	fe
V-10116 (A,B,C,D,E).....	6.1 fl oz.....	15.6	fed
Pristine (A,B,C,D,E).....	0.92 lb.....	15.8	fedc
Topsin M + Rovral 4F (A,B); Ziram 76 DF (C,D,E).....	0.7 lb + 11.2 fl oz; 8.0 lb.....	17.0	fedcb
Echo 720 (A,B,C,D,E).....	64 fl oz.....	17.2	fedcb
Topsin M + Microthiol Dispress (A,B); Ziram 76 DF (C,D,E).....	1.0 lb + 5.0 lb; 8.0 lb.....	17.6	fedcba
Rovral 4F + Volck Supreme Oil (A,B); Ziram 76 DF (C,D,E).....	11.2 fl oz + 1% V/V; 8.0lb...	18.0	fedcba
V-10116 + Induce (A,B,C,D,E).....	6.1 fl oz + 0.06% V/V.....	18.0	fedcba
Bravo Ultrex (A,B,C,D,E).....	3.6 lb.....	18.2	fedcba
Topsin M (A,B); Ziram 76 DF (C,D,E).....	1.0 lb; 8.0 lb.....	18.4	fedcba
Scala (A,B,C,D,E).....	27.4 fl oz.....	18.6	fedcba
USF 2004 (A,B,C,D,E).....	2.97 fl oz.....	19.0	fedcba
Rovral 4F (A,B,C,D,E).....	16 fl oz.....	19.4	edcba
Abound (A,C,D,E); Bravo Ultrex (B).....	12.8 fl oz; 2.0 lb.....	19.6	edcba
Topsin M + Microthiol Dispress (A); Topsin M + Ziram 76 DF (B); Ziram 76 DF (C,D,E).....	1.0 lb + 5.0 lb; 1.0 lb + 8.0 lb; 8.0 lb.....	20.0	edcba
Sythane 20 EW (A,B,C,D,E).....	15.3 fl oz.....	20.2	dcba
V-10116 (A,B,C,D,E).....	8.2 fl oz.....	20.2	dcba
Topsin M + Rovral 4F (A,B); Ziram 76 DF (C,D,E).....	0.5 lb + 11.2 fl oz; 8.0 lb.....	20.6	dcba
Vanguard 75 WG + Bravo Ultrex (A,B); Abound (C,D,E)....	5.0 oz + 2.0 lb; 12.8 fl oz.....	20.6	dcba
QRD 141 (A,B,C,D,E).....	3.3 lb.....	20.8	dcba
Bravo Ultrex (A,B); Abound (C,D,E).....	2.0 lb; 12.8 fl oz.....	21.2	dcba
TD-2247 4.2 F (A,B); Ziram 76DF(C,D,E).....	21.3 fl oz; 8.0 lb.....	21.6	dcba
Untreated.....		21.6	dcba
Elite 45DF (A,B,C,D,E).....	6.0 oz.....	21.6	dcba
Sythane 20 EW (A,B,C,D,E).....	12.0 fl oz.....	21.6	dcba
Untreated.....		21.8	dcba
V-10116 (A,B,C,D,E).....	4.1 fl oz.....	22.0	dcba
USF 2010 (A,B,C,D,E).....	5.98 fl oz.....	22.4	dcba
Bravo Ultrex (A); Abound (B,C,D,E).....	3.6 lb; 12.8 fl oz.....	22.4	dcba
Laredo EC (A,B,C,D,E).....	12.8 fl oz.....	22.8	cba
Laredo EC (A,B,C,D,E).....	10.0 fl oz.....	22.8	cba
QRD 137 (A,B,C,D,E).....	6.0 lb.....	23.8	ba
QRD 131 (A,B,C,D,E).....	192 fl oz.....	24.6	a
Fisher's least significant difference (LSD, P<0.05) test ^w			7.07645

EVALUATION OF OMNI APPROVED FUNGICIDES FOR CONTROL OF SHOT HOLE

Table 1. Number of Shot Hole infected nuts (Incidence) as affected by in-season fungicide applications.

Treatment ^z (Date of applications) ^y	Rate ^y	Incidence ^x	
Hydrated Lime + Microthiol Dispress + Champ DF (A,B,C,D,E).....	10.0 lb + 3.0 lb + 3.0 lb.	15.4	b
Hydrated Lime (A,B,C,D,E).....	10.0 lb.....	16.4	b
Champ DF (A,B,C,D,E).....	3.0 lb.....	17.8	ba
Cuprofix Dispress 20 DF (A,B,C,D,E).....	3.0 lb.....	18.4	ba
MZ Organic + Fish Oil (A,B,C,D,E).....	96.0 fl oz + 64.0 fl oz....	18.6	ba
Fish Oil (A,B,C,D,E).....	32.0 fl oz.....	21.4	ba
Liquid Lime Sulfur (A,B,C,D,E).....	128 fl oz.....	21.6	ba
Untreated.....	21.6	ba
Microthiol Dispress (A,B,C,D,E).....	3.0 lb.....	22.8	ba
Trilogy (A,B,C,D,E).....	256 fl oz.....	23.2	a
MZ Organic (A,B,C,D,E).....	96.0 fl oz.....	23.4	a
Saf-T-Side (A,B,C,D,E).....	128.0 fl oz.....	24.0	a
Fish Oil (A,B,C,D,E).....	64.0 fl oz.....	24.0	a
Fisher's least significant difference (LSD, $P \leq 0.05$) test ^w		7.40267	

^zSprays were applied to all treatments.

^yProducts were applied in 400 gallons of water per acre.

^xNumber of infected nuts per 25 sampled. (an average of the five replicates)

^wMeans not followed by a common letter are significantly different according to Fisher's LSD ($P \leq 0.05$)
7.40267

^vDates of fungicide applications were as follows: A = 24 Feb, B = 3 Mar, C = 13 Mar, D = 2 Apr, E = 5 May.

Almond Scab

Cladosporium carpophilum



Gray-black, oil-like soft looking spots form on leaves, fruit, and twigs.

Almond Scab

Cladosporium carpophilum

- Young lesions are indistinct small yellow specks, best seen by holding a leaf up to the light.
- Lesions usually are not visible until late spring or early summer.



Almond Scab

Cladosporium carpophilum

- The fungus survives in twig lesions, and spores are spread by wind or rain.
- Scab is favored by prolonged wet spring weather,



Almond Scab

Cladosporium carpophilum

- Severe scab infections can cause early defoliation
- If left uncontrolled for several years, infected trees become weakened.



Fungicides for Scab

timing 2-5 weeks after petal fall

- Pristine (11/7) medium Strobilurin/Boscalid
- Flint / Gem (11) high risk Strobilurin
- Abound (11) high risk Strobilurin

- Captan (M4) low risk Phthalamide
- Ziram (M3) low risk Carbamate
- Bravo/Echo (M5) low risk Aromatic nitrile
- Topsin (1) high risk Benzimidazole

- Maneb (M3) low risk Carbamate
- Lime Sulfur low risk

Evaluation of fungicides for control of almond scab, 2005.

Treatment ^z Per acre rate ^y (Date of application) ^v	Mean ^x Rating/Tree ^w
V-10116 50WDG 3.5 oz (A,B,C)	1.0 a
Scala 600SC 9.0 fl oz (A); Gem 500SC 3.0 fl oz (B,C)	1.0 a
Scala 600SC 18.0 fl oz (A); Gem 500SC 3.0 fl oz (B,C)	1.0 a
Topsin M 70W 1.0 lb + Microthiol Disperss 80WG 6.0 lb (A,B); Microthiol Dispress 80WG 6.0 lb + Ziram 76DF 6.0 lb (C)	1.0 a
Vanguard 75WG 5.0 oz + Ziram 76DF 6.0 lb (A); Abound 2.08F 12.8 fl oz (B,C)	1.0 a
Scala 600SC 12.8 fl oz (A); Gem 500SC 3.0 fl oz (B,C)	1.0 a
Topsin M 4.5F 20.0 fl oz + Volck Supreme Oil 97.95% 1% V/V (A); Topsin M 4.5F 20.0 fl oz + Ziram 76DF 6.0 lb (B); Ziram 76DF 6.0 lb (C)	1.2 a
Echo Ultimate 3.6 lb (A,B,C)	1.2 a
V-10116 50WDG 2.5 oz (A,B,C)	1.2 a
Topsin M 70W 1.0 lb + Volck Supreme Oil 97.95% 1% V/V (A); Topsin M 70W 1.0 lb + Ziram 76DF 6.0 lb (B); Ziram 76DF 8.0 lb (C)	1.2 a
Echo 720 64.0 fl oz (A,B,C)	1.4 ab
Laredo EW 12.8 fl oz + Ziram 76DF 6.0 lb (A); Ziram 76DF 8.0 lb (B,C)	1.4 ab
Pristine 38WDG 14.5 oz + Induce 90% 0.063% V/V (A,B,C)	1.4 ab
Topsin M 70W 1.0 lb + Volck Supreme Oil 97.95% 1% V/V (A); Topsin M 70W 1 lb + Maneb 75DF 6.0 lb (B); Maneb 75DF 8.0 lb (C)	1.4 ab
Vanguard 75WG 5.0 oz (A); Abound 2.08F 12.8 fl oz (B,C)	1.4 ab
V-10116 50WDG 1.75 oz (A,B,C)	1.4 ab
Pristine 38WDG 10.5 oz + Induce 90% 0.063% V/V(A,B,C)	1.6 ab
Liquid Lime Sulfur 1 G (A,B,C)	1.6 ab
Saf-T-Side 1% V/V (A,B,C)	1.8 abc
Exp 3 9.3 oz (A,B,C)	1.8 abc
Abound 2.08F 12.8 fl oz (A,B); Bravo Weatherstik 64.0 fl oz (C)	2.0 abcd
Rovral 4F 16.0 fl oz + Volck Supreme Oil 97.95% 1% V/V (A,B); Ziram 76DF 8.0 lb (C)	2.0 abcd
Stylet Oil 1% V/V (A,B,C)	2.0 abcd
Laredo EW 10.0 fl oz + Ziram 76DF 6.0 lb (A); Ziram 76DF 8.0 lb (B,C)	2.4 bcde
Exp 3 1.0 lb (A,B,C)	2.8 cde
Microthiol Dispress 80WG 6.0 lb (A,B,C)	2.8 cde
Sporan EC 96 fl oz (A,B,C)	3.0 de
Trilogy 1% V/V (A,B,C)	3.2 ef
Valero 1% V/V (A,B,C)	3.4 efg
Untreated	4.3 fg
Fisher's least significant difference (LSD, P<0.05) test ^w	12.182

Dates of fungicide applications were as follows: A =23 Feb, B =3 Mar, C = 31 Mar.

Evaluation of Fungicides for Control of Almond Scab, 2003.

Table 1. Number of Almond Scab infected nuts as affected by in-season fungicide applications.

Treatment ^z (Date of application) ^y	Rate ^y	Mean ^x /Tree	
Topsin M + Rovral 4F (A,B); Ziram 76 DF (C,D,E).....	0.5 lb + 11.2 fl oz; 8.0 lb.....	0.4	i
Flint (A); Abound (B); Echo 720 (C,D,E).....	4.0 oz; 12.8 fl oz; 64 fl oz.....	0.4	i
Topsin M + Microthiol Dispress (A,B) Ziram 76 DF (C,D,E)	1.0 lb + 5.0 lb; 8.0 lb.....	0.4	i
V-10116 (A,B,C,D,E).....	8.2 fl oz.....	0.4	i
V-10116 + Induce (A,B,C,D,E).....	6.1 fl oz + 0.06% V/V.....	0.4	i
Bravo Ultrex (A); Abound (B,C,D,E).....	3.6 lb; 12.8 fl oz.....	0.6	i
Echo 720 (A,B,C,D,E).....	64 fl oz.....	0.6	i
Abound (A,C,D,E); Bravo Ultrex (B).....	12.8 fl oz; 2.0 lb.....	0.6	i
Topsin M (A,B); Ziram 76 DF (C,D,E).....	1.0 lb; 8.0 lb.....	0.8	i
Vanguard 75 WG + Bravo Ultrex (A,B); Abound (C,D,E)....	5.0 oz + 2.0 lb; 12.8 fl oz.....	0.8	i
USF 2004 (A,B,C,D,E).....	2.97 fl oz.....	0.8	i
V-10116 (A,B,C,D,E).....	6.1 fl oz.....	0.8	i
Bravo Ultrex (A,B,C,D,E).....	3.6 lb.....	1.0	hi
V-10116 (A,B,C,D,E).....	4.1 fl oz.....	1.0	hi
Pristine (A,B,C,D,E).....	0.92 lb.....	1.0	hi
Topsin M + Microthiol Dispress (A); Topsin M + Ziram 76 DF (B); Ziram 76 DF (C,D,E).....	1.0 lb + 5.0 lb; 1.0 lb + 8.0 lb; 8.0 lb.....	1.4	ghi
Elite 45 DF (A,B,C,D,E).....	6.0 oz.....	1.6	fghi
USF 2010 (A,B,C,D,E).....	5.98 fl oz.....	1.8	efghi
Pristine (A,B,C,D,E).....	0.658 lb.....	1.8	efghi
TD-2247 4.2 F (A,B); Ziram 76 DF (C,D,E).....	21.3 fl oz; 8.0 lb.....	2.0	efghi
Bravo Ultrex (A,B); Abound (C,D,E).....	2.0 lb; 12.8 fl oz.....	2.0	efghi
Rovral 4F + Volck Supreme Oil (A,B); Ziram 76DF (C,D,E)	11.2 fl oz + 1% V/V; 8.0lb...	2.2	efghi
Topsin M + Rovral 4F (A,B); Ziram 76DF (C,D,E).....	0.7 lb + 11.2 fl oz; 8.0 lb.....	3.2	defghi
Sythane 20 EW (A,B,C,D,E).....	15.3 fl oz.....	5.0	cdefgh
QRD 131 (A,B,C,D,E).....	192 fl oz.....	5.4	bcdefg
Sythane 20 EW (A,B,C,D,E).....	12.0 fl oz.....	5.6	bcdef
Laredo EC (A,B,C,D,E).....	12.8 fl oz.....	5.8	bcde
Scala (A,B,C,D,E).....	27.4 fl oz.....	6.4	abcd
Untreated.....		6.6	abcd
Laredo EC (A,B,C,D,E).....	10.0 fl oz.....	7.4	abc
QRD 137 (A,B,C,D,E).....	6.0 lb.....	7.6	abc
Rovral 4F (A,B,C,D,E).....	16 fl oz.....	7.6	ab
QRD 141 (A,B,C,D,E).....	3.3 lb.....	9.2	ab
Untreated.....		10.0	a
Fisher's least significant difference (LSD, P<0.05) test ^w			4.022

^zNumber of infected nuts per 25 sampled. (an average of the five replicates)

^wMeans not followed by a common letter are significantly different according to Fisher's LSD (P<0.05) 4.022.

^yDates of fungicide applications were as follows: A = 24 Feb, B = 3 Mar, C = 13 Mar, D = 2 Apr, E = 5 May.

Scab Control

- Dormant applications of liquid lime sulfur at 8-10 gallons per acre in 100 gallons of water have shown efficacy against scab
- Hydrated lime has also looked good in an organic scab trial we performed last year



EVALUATION OF OMNI APPROVED FUNGICIDES FOR CONTROL OF ALMOND SCAB, 2003

Table 1. Number of Almond Scab infected nuts (Incidence) as affected by in-season fungicide applications.

Treatment ^z (Date of applications) ^v	Rate ^y	Incidence ^x	
Hydrated Lime (A,B,C,D,E).....	10.0 lb.....	1.4	b
Saf-T-Side (A,B,C,D,E).....	128.0 fl oz.....	1.8	b
MZ Organic + Fish Oil (A,B,C,D,E).....	96.0 fl oz + 64.0 fl oz....	2.0	b
Hydrated Lime + Microthiol Dispress + Champ DF (A,B,C,D,E).....	10.0 lb + 3.0 lb + 3.0 lb.	2.4	b
MZ Organic (A,B,C,D,E).....	96.0 fl oz.....	3.4	b
Fish Oil (A,B,C,D,E).....	64.0 fl oz.....	4.4	b
Microthiol Dispress (A,B,C,D,E).....	3.0 lb.....	4.4	b
Trilogy (A,B,C,D,E).....	256 fl oz.....	4.8	ba
Fish Oil (A,B,C,D,E).....	32.0 fl oz.....	6.0	ba
Champ DF (A,B,C,D,E).....	3.0 lb.....	6.4	ba
Cuprofix Dispress 20 DF (A,B,C,D,E).....	3.0 lb.....	7.6	ba
Liquid Lime Sulfur (A,B,C,D,E).....	128 fl oz.....	7.6	ba
Untreated.....	12.0	a
Fisher's least significant difference (LSD, $P \leq 0.05$) test ^w		7.40267	

^xNumber of infected nuts per 25 sampled. (an average of the five replicates)

^wMeans not followed by a common letter are significantly different according to Fisher's LSD ($P \leq 0.05$)
7.40267

^vDates of fungicide applications were as follows: A = 24 Feb, B = 3 Mar, C = 13 Mar, D = 2 Apr, E = 5 May.

No	Treatment	Timing	Product	23 July 2007		1 Aug 2007	
				% Incidence	% Severity	% Incidence	% Severity
1.	Trilogy	1,2,3,4	2 Gal	32.6 ab	14.1 ab	30.9 abcd	28.8 ab
2.	Sporan	1,2,3,4	3 pt	24.9 abc	29.6 a	35.3 ab	28.0 a
3.	Sporan	1,2,3,4	6 pt	30.0 ab	20.8 ab	41.0 ab	32.3 a
4.	Saf-T-Side	1,2,3,4	2 Gal	20.1 bc	20.7 ab	31.6 bcd	25.7 ab
5.	Cuprofix Ultra 40 Disperss	1,2,3	4 lb	5.8 de	8.3 bc	9.9 cde	15.3 c
	Cuprofix Ultra 40 Disperss	4	1 lb				
6.	Microthiol Disperss	1,2,3,4	10 lb	1.1 e	0.8 c	3.1 e	3.4 c
7.	Microthiol Disperss	1,2,3,4	20 lb	1.1 e	1.3 c	2.3 e	1.5 c
8.	Liquid Lime Sulfur	1,2,3,4	3 Gal	12.3 cd	7.0 bc	13.8 de	14.4 bc
9.	UTC			36.5 ab	26.4 a	49.4 ab	36.3 a
10.	Sonata ASO	1,2,3,4	96 fl oz	24.6 bc	18.0 ab	40.8 abc	28.8 a
11.	Seacide	1,2,3,4	2 Gal	30.1 ab	15.7 ab	35.8 abcd	34.2 a
12.	OmegaGrow	1,2,3,4	4 Gal	44.7 a	26.9 a	30.9 a	22.2 ab
13.	Serenade Max 14.6WP	1,2,3,4	2 lb	32.0 ab	14.8 ab	34.8 abcd	34.7 ab
14	UTC			19.89 bc	21.2 ab	45.8 ab	36.7 a

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

- Rust appears as small, yellow spots on the upper surface of leaves.
- On the lower surface of the leaf these spots take on a rusty red appearance when the rust-colored spores produced in the lesions erupt through the surface.



Rust Management

- In orchards with a history of rust, apply fungicides in late spring and summer to control leaf infections. 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.
- 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 Anthracnose

Colletotrichum acutatum

- Infected nuts show round, orange, sunken lesions on the hull.
- Symptoms may appear 3 weeks after petal fall;
- Profuse gumming occurs as the infection progresses into the kernel.



Almond Anthracnose

Colletotrichum acutatum

- Symptoms include spur and limb dieback.
- Leaves on infected spurs develop marginal necrosis, beginning with water-soaked areas that fade in color; leaves die but remain attached to branches.



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Fungicides for Anthracnose

timing: bloom to summer if wet

- Pristine (11/7) medium Strobilurin/Boscalid
- Flint/Gem (11) high risk Strobilurin
- Abound (11) high risk Strobilurin

- Captan (M4) low risk Phthalamide
- Ziram (M3) low risk Carbamate
- Bravo/Echo (M5) low risk Aromatic nitrile

- Maneb (M3) low risk Carbamate
- Rally/Laredo(3) high risk DMI-Triazole

Organic Anthracnose Control?

- Prune out infected limbs if the disease is just getting started
- Repeated applications of OMRI approved fungicides if we have wets spring conditions and it continues to rain
- Sulfur at 10-20 lbs per acre is probably your best organic application.

Almond Powdery Mildew





- *Podosphaera tridactyla* was reported on almond in 1956, but has not been commonly observed. Rusty Spot on peach is caused by the apple powdery mildew fungus *Podosphaera leucotricha*.



- In NJ observations have shown that peach orchards with rusty spot are usually next to apple orchards that are infected with powdery mildew.
- In CA symptoms observed in almond orchards were also next to apple orchards.



- Most infections occur from petal fall to one month after shuck fall.
- There does not seem to be any relationship between weather conditions and the number of diseased fruit.

Peach Rusty Spot in NJ

- Furman et al. 2003 (Plant Dis. 87:366-374) showed that disease increased from shuck off stage of fruit development until 60 days after full bloom.
- Fungal activity typically lasted from 17-30 days during this period of rapid cell division. At pit hardening fungal growth significantly slowed.



- Powdery mildew trial was conducted on Carmel but it turned out that Nonpareil was more susceptible. The grower believes this orchard has lost 10-15 % of its production since symptoms have been observed.

2006 Almond Powdery Mildew Study

Treatment	Product/Acre	Spray Timing	Percent Incidence	Yield lb/tree	% nut shrivel
Laredo	12.8 fl oz	1,2,3	3.76 a	20.671 a	5.4
Topsin + Microthiol	1 + 10 lb	1,2,3	8.53 ab		
Gem	3 fl oz	1,2,3	11.99 abc		
Laredo	12.8 fl oz	1,3	22.13 bc		
Pristine	14.5 oz	1,2,3,	26.08 c		
V-10118	9.5 fl oz	1,2,3,	48.73 d		
Scala	8 fl oz	1,2,3	58.80 de		
Control			72.11 e	14.497 b	8.3

^yProducts were applied in 330 gallons of water per acre.

^xYield was determined in the Laredo and control treatments to examine the effect of disease (5 single tree replicates per treatment).

^wMeans followed by the same letter are not significantly different, Fisher's LSD ($P \leq 0.05$)

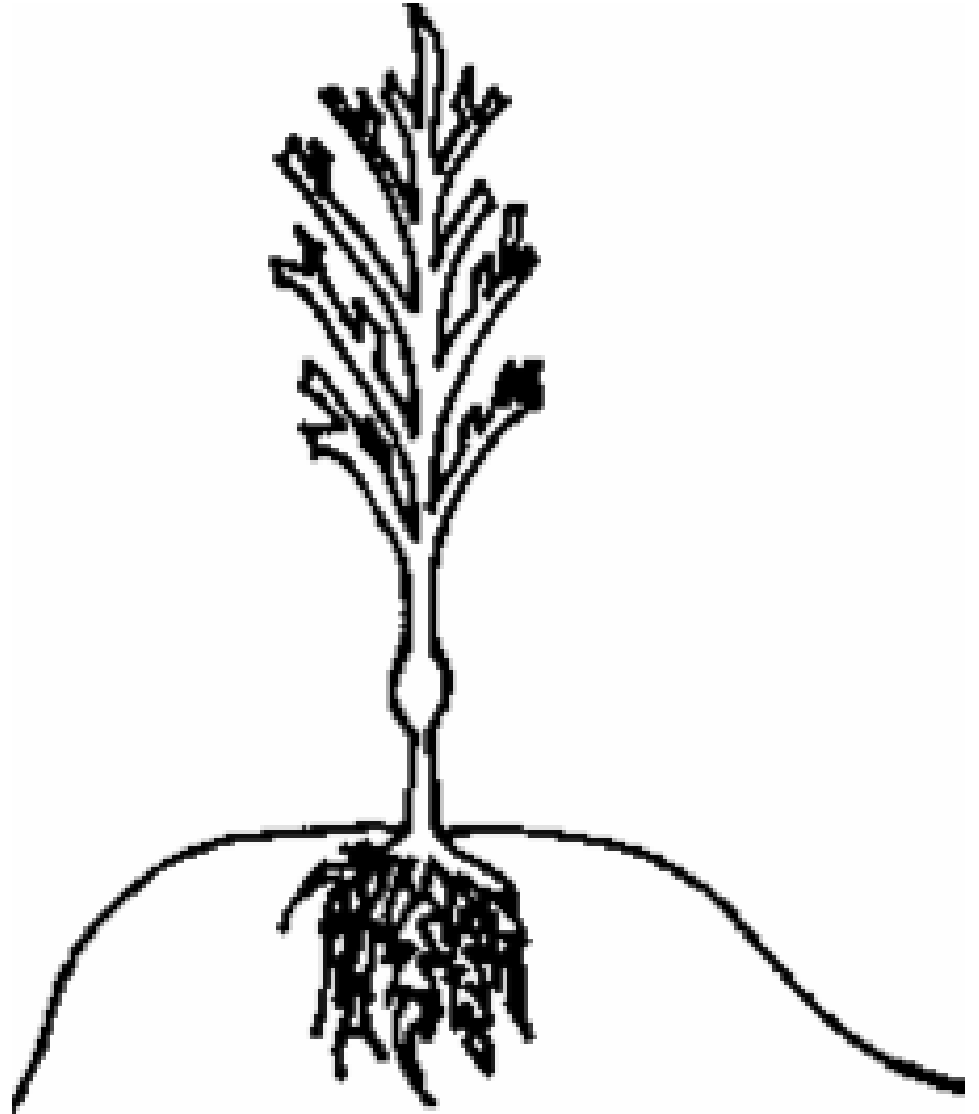
^vDates of fungicide applications were as follows: 1 = 7 April, 2 = 21 April, 3 = 4 May?



- Phosphorous acid has been shown to provide almond trees resistance to *Phytophthora* but may not yet be OMRI approved?

Phytophthora-Prevention

- Plant trees high on the berm and make sure that the graft union is not buried or touching the soil line



Crown Gall Control

- *Agrobacterium radiobacter* K-84 (Galltrol) is a biological control agent that can be sprayed on roots before planting as a preventative treatment. It does not eradicate existing galls.



Crown Gall Control

- In orchards with established crown gall infections I would replant with potted trees in the hopes of having less root wounds and entry sites for crown gall



Bacterial Canker

- Pre-plant fumigation is important
- Peach/Almond hybrid rootstocks are prone to bacterial canker



HULL ROT

MONILINIA FRUCTICOLA

RHIZOPUS STOLONIFER







HULL ROT MANAGEMENT

**NITROGEN
IRRIGATION**

- *Rhizopus* can only infect almond hulls after hull split— not before!!

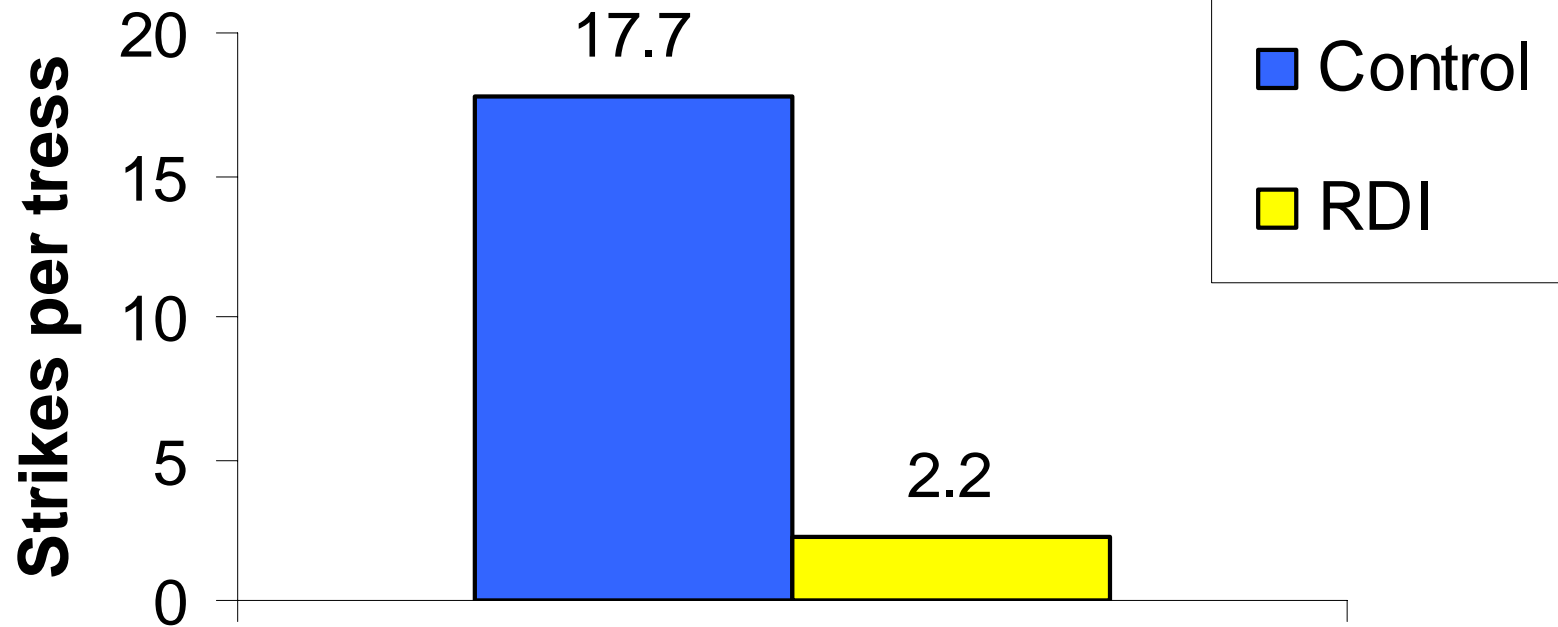


Reduced Deficit Irrigation for almonds during hull split

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)

Effect of RDI on Hull Rot 2003



HULL ROT MANAGEMENT

IRRIGATION

- MAINTAIN ORCHARD AT -7 to -9 BARS
- AT FIRST HULL SPLIT, STOP WATER
- RESUME IRRIGATION AT -14 TO -18 BARS

HULL ROT MANAGEMENT

SLIGHT WATER STRESS AT HULL SPLIT

- REDUCES HULL ROT
- MORE UNIFORM HULL SPLIT
- SHORTENS LENGTH OF HULL SPLIT
- IMPROVES NUT REMOVAL
- CAN REDUCE NAVEL ORANGE WORM

