

# Epidemiology and Management of Bacterial Spot of Almond

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## Bacterial spot of almond (*Xanthomonas arboricola* pv. *pruni*)

- Bacterial spot is common on peach in the eastern US (high moisture conditions)
- Found first in spring 2013 on almond, cherry, and possibly other stone fruit crops - Colusa, San Joaquin, Stanislaus, Merced and Madera Co. – Identification with specific PCR primers
- Fritz is one of most susceptible varieties, but isolations have also been made from Nonpareil, Butte, Carmel, and Price.
- Little is known about the disease on almond.
- Management strategies are being explored: dormant and springtime applications with bactericides.



Overwintering fruit mummy and symptoms of bacterial spot on almond fruit and leaves.

## Field trials on management of bacterial spot of almond 2014

### 1. Evaluation of in-season treatments

Treatment	Rate (A)	FB 2/19	PF 3/6	2 wk APF 3/20	4 wk APF 3/31	6 wk APF 4/18	Disease incidence (%)
Control	---	---	---	---	---	---	a
Quintec	6 fl oz	@	@	@	@	@	abc
Kasumin 2L + Kocide 3000	64 fl oz + 3.3 lb	@	---	---	---	---	abc
Kasumin 2L	64 fl oz	---	@	@	@	@	abc
Kasumin 2L + Quintec	64 + 6 fl oz	---	@	@	@	@	abc
Mycoshield	16 oz	@	@	@	@	@	bcd
Kasumin 2L + Manzate 75DF	64 + 6 lb	@	---	---	---	---	bcd
Kasumin 2L + Manzate 75DF	64 fl oz + 4 lb	---	@	@	@	@	cd
Quintec + Manzate 75DF	6 fl oz + 6 lb	@	---	---	---	---	cd
Quintec + Manzate 75DF	6 fl oz + 4 lb	---	@	@	@	@	cd
Mycoshield + Champ-Ion <sup>2+</sup>	16 oz + 3.3 lb	@	---	---	---	---	cd
Mycoshield	16 oz	---	@	@	@	@	d
Ceragenin + NuFilmP	6 fl oz	---	@	@	@	@	d

Orchard 1 - cv. Fritz, San Joaquin Co. Evaluation on May 14, 2014

Treatment	Rate (A)	FB 2/18	PF 3/5	2 wk APF 3/20	4 wk APF 4/3	Disease incidence (%)
Control	----	----	----	----	----	a
Kphite + Widespread	96 + 8 fl oz	@	@	@	@	ab
Actinovate	12 oz	@	@	@	@	abcd
Actinovate + Buffer	12 + 86 oz	@	@	@	@	bcd
Serenade Optiva	20 oz	@	@	@	@	cd
Taegro	5 oz	@	@	@	@	abc
MycoShield + Champ-Ion <sup>2+</sup>	16 oz + 3.3 lb	@	---	---	---	abcd
	16 oz + 1.6 lb	---	@	---	---	
	16 oz + 0.8 lb	---	---	@	@	
Kasumin 2L + Manzate 75DF	64 fl oz + 6 lb	@	---	---	---	d
	64 fl oz + 4 lb	---	@	@	@	
Kocide 3000 + Manzate 75DF	3.3 + 6 lb	@	---	---	---	bcd
	1.6 + 4 lb	---	@	---	---	
	0.8 + 4 lb	---	---	@	@	
Kocide 3000 + Tanos	3.3 lb + 10 oz	@	---	---	---	cd
	1.6 lb + 10 oz	---	@	---	---	
	0.8 lb + 10 oz	---	---	@	@	
Magna Bon + Manzate 75DF	64 fl oz + 6 lb	@	---	---	---	cd
	27 fl oz + 4 lb	---	@	@	@	

Orchard 2 - cv. Fritz, San Joaquin Co. Evaluation on May 21, 2014

### 2. Evaluation of mid-dormant, late-dormant, and in-season treatments

Effect of mid-dormant and timing of in-season treatments on the incidence of bacterial spot of cv. Fritz almond in San Joaquin Co. 2014

Orchard 3	In-season treatment	Timing 1		Timing 2		Timing 3		Timing 4		Timing 5		Timing 6		Treatment Avg	
		Disease <sup>^</sup>	LSD <sup>^^</sup>	Disease	LSD	Disease	LSD								
	Control	55.5	a	50.5	a	19.5	ab	45.8	a	52.8	a	37.5	a	43.6	A
	Kocide 3000 6 lb + 1% oil	6.5	b	5	b	7.3	b	15	b	3.8	b	29.3	a	11.2	B
	Kocide 3000 6 lb (no oil)	21.3	b	10.5	b	4.8	b	16.8	ab	1.8	b	28.3	a	13.9	B
	Cueva 2 gal + 1% oil	24.8	b	61.8	a	33.5	a	38.3	ab	10.8	b	24.5	a	32.3	A
	Badge 7 pt + 1% oil	9.3	b	8.5	b	2.3	b	15.8	b	2.8	b	19.3	a	9.7	B
	Cuprofix 4.5 lb + 1% oil	6	b	19.5	b	3.5	b	11	b	3	b	24.5	a	11.3	B
	Timing Avg	20.6	AB	26.0	A	11.8	B	23.8	A	12.5	B	27.2	A		

\*- D= dormant treatment, IS = in-season treatment

\*\*- Rates for in-season treatments were for Kocide 3000: 3.3 lb, 1.6 lb, 0.8 lb; for Champlon: 3.3 lb, 1.6 lb, 0.8 lb; for Cueva: 64 fl oz, 32 fl oz, 16 fl oz; for Badge X2: 3.7 lb, 1.9 lb, 0.05 lb; and for Cuprofix: 2.5 lb, 1.25 lb, 0.62 lb for the first, second, and following applications, respectively.

<sup>^</sup>- Fruit were evaluated for the presence of bacterial spot on 5-27-14.

<sup>^^</sup>- Statistical comparisons for values in the shaded area are by column using lower case letters. Treatment averages are values for treatments over all timings and are compared by column. Timing averages are values for each timing for all treatments and are statistically compared within the row.

Effect of late dormant and timing of in-season treatments on the incidence of bacterial spot of cv. Fritz almond in San Joaquin Co. 2014

Orchard 4	In-season treatment	Timing 1		Timing 2		Timing 3		Timing 4		Timing 5		Timing 6		Treatment Avg	
		Disease <sup>^</sup>	LSD <sup>^^</sup>	Disease	LSD	Disease	LSD								
	Control	12.3	a	18.8	a	8	a	19	a	4.3	a	37.8	a	16.7	A
	Kocide 3000 6 lb	12.8	a	31.3	a	7.3	a	7	a	6	a	16.8	b	13.5	AB
	Kocide 3000 6 lb + Manzate 6 lb	11	a	14.8	a	7.5	a	11.8	a	3.8	a	9.5	b	9.7	B
	Timing Avg	12.0	B	21.6	A	7.6	BC	12.6	B	4.7	C	21.3	A		

\*- D= dormant treatment, IS = in-season treatment with 64 fl oz Kasumin + 3.5 lb Manzate 75DF/A

<sup>^</sup>- Fruit were evaluated for the presence of bacterial spot on 5-21-14.

<sup>^^</sup>- Statistical comparisons for values in the shaded area are by column using lower case letters. Treatment averages are values for treatments over all timings and are statistically compared by column. Timing averages are values for each timing for all treatments and are statistically compared within the row.

## Materials for Managing Bacterial Spot of Almond

### Inorganics and Conventional Synthetics

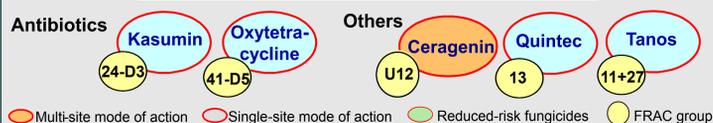


### Natural Products and Biocontrols

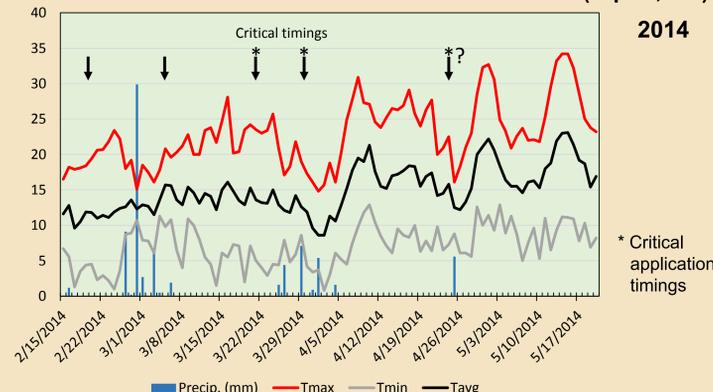
Regalia, Actinovate, Serenade Max, Serenade Optimum, Taegro

Natural products/biocontrols with antibacterial or SAR characteristics for organic almond production

### Experimental Products under Evaluation



## Environmental conditions near field trial locations (Ripon, CA) 2014



Critical timings were before and during a period with several rain events just before an increase in temperatures. Thus, a major infection period occurred between mid- and late March. Still, it took over five weeks for first symptoms to develop.

## Summary

- In 2014, we verified the presence of the disease at previous and additional locations.
- The pathogen overwinters in fruit mummies on the tree.
- Isolates evaluated to date were all rated as copper-sensitive with growth occurring at 20 ppm, but not at 30 ppm.
- Field trials indicated that late dormant treatments (but not mid- or early dormant treatments) with copper, copper-mancozeb, or copper-mancozeb-captan significantly reduced the incidence of disease.
- In-season treatments were most effective when timed around rain events and before temperatures started to rise.
- A major infection period was identified between mid- and late March 2014.
- All copper products significantly reduced disease
- Experimentals – Kasumin, Fireline/Mycoshield, Serenade Optiva, and the bacterial membrane disruptor Ceragenin were also effective.
- The most effective management program will include a late dormant application to reduce inoculum and at least one in-season application around rainfall events and rising temperatures to prevent new infections.