Efforts to Establish Alternatives to Antibiotics for Fire Blight Control

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University of California Cooperative Extension
Oregon State University
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for

Orchard Pest and Disease Conference
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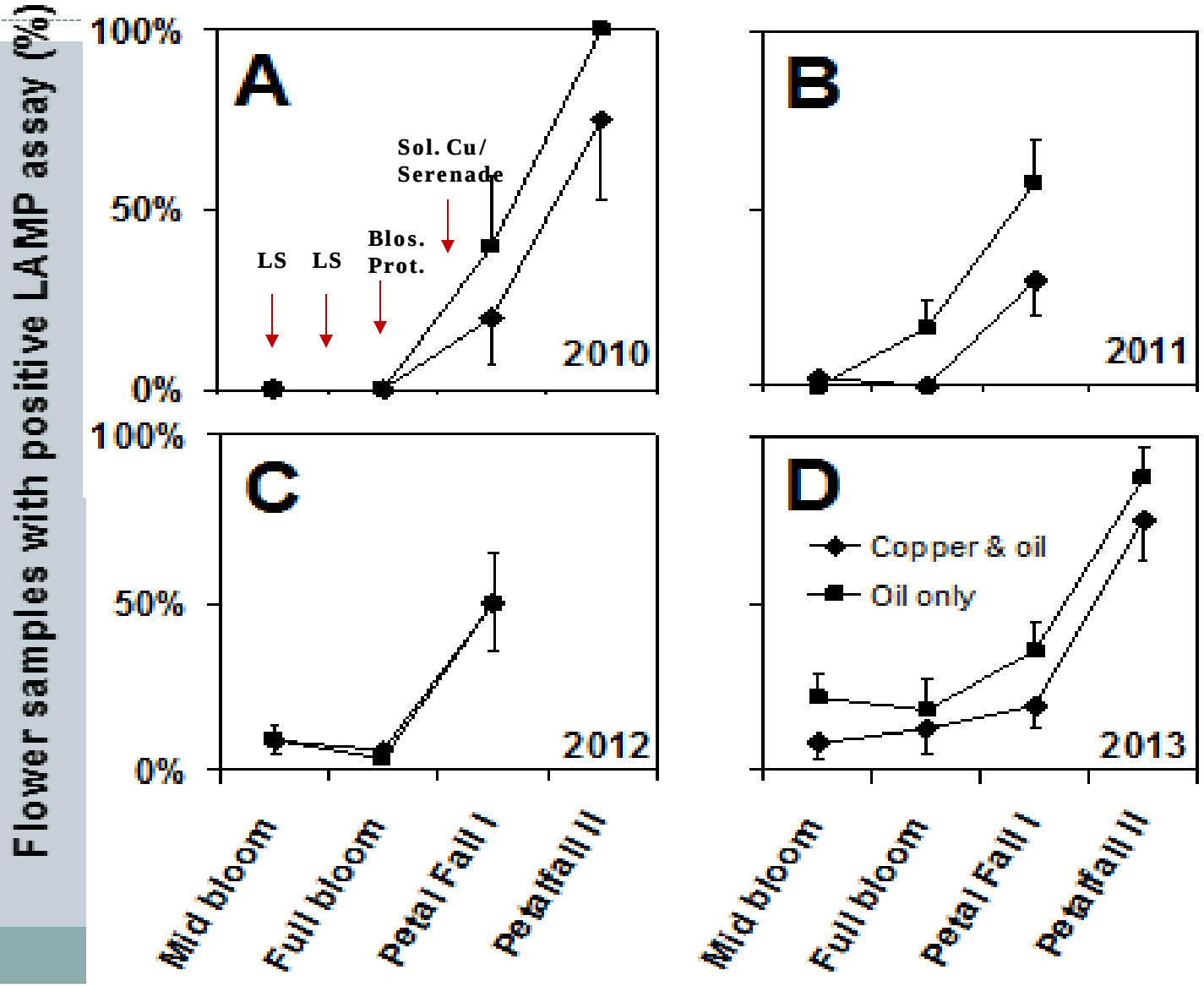
Higher incidence of detection after full bloom

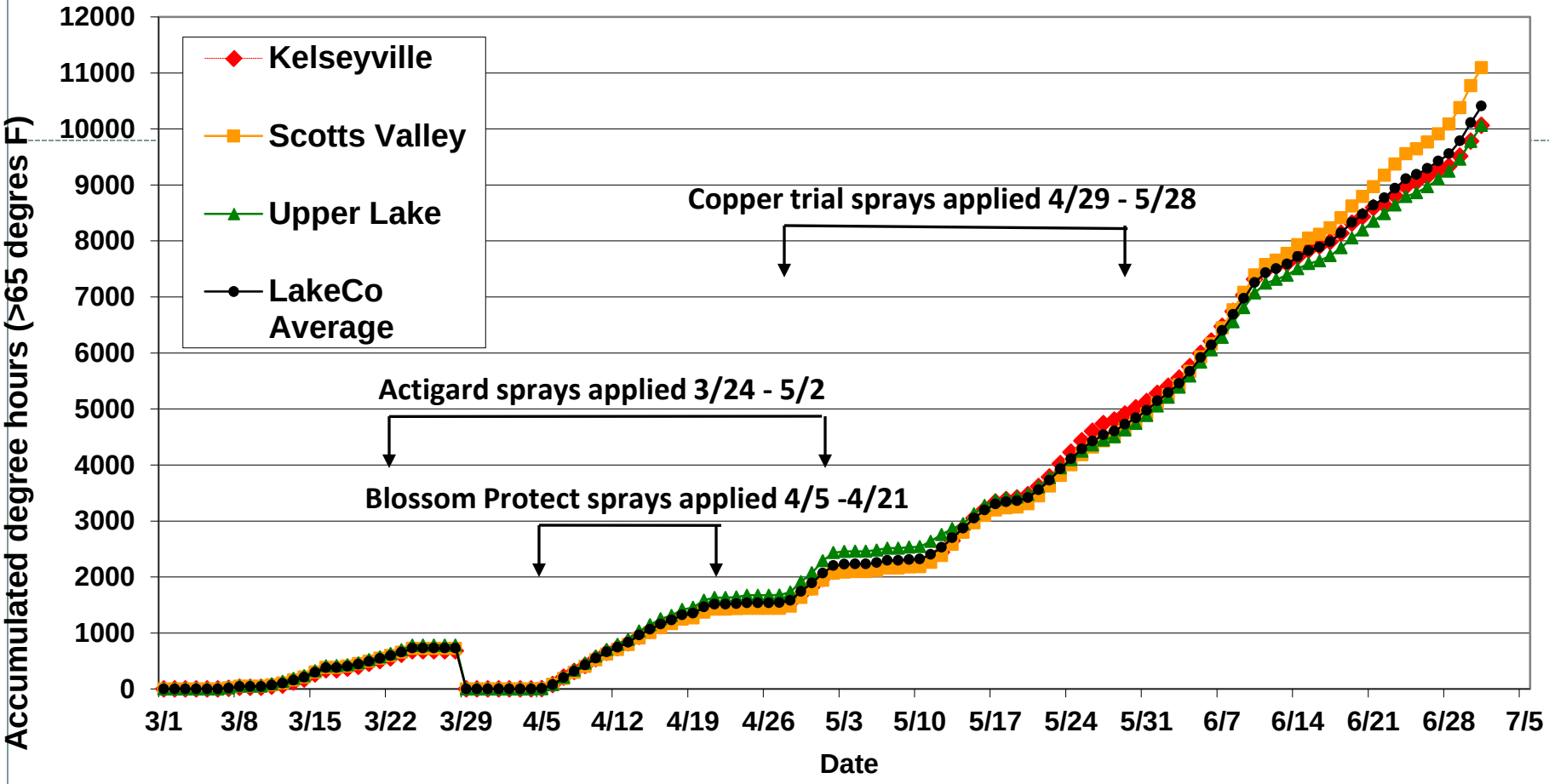
Four years of LAMP detection in pear flower samples:

Mid bloom	Full bloom	Petal fall	Rat tail
10 %	6%	25%	53%

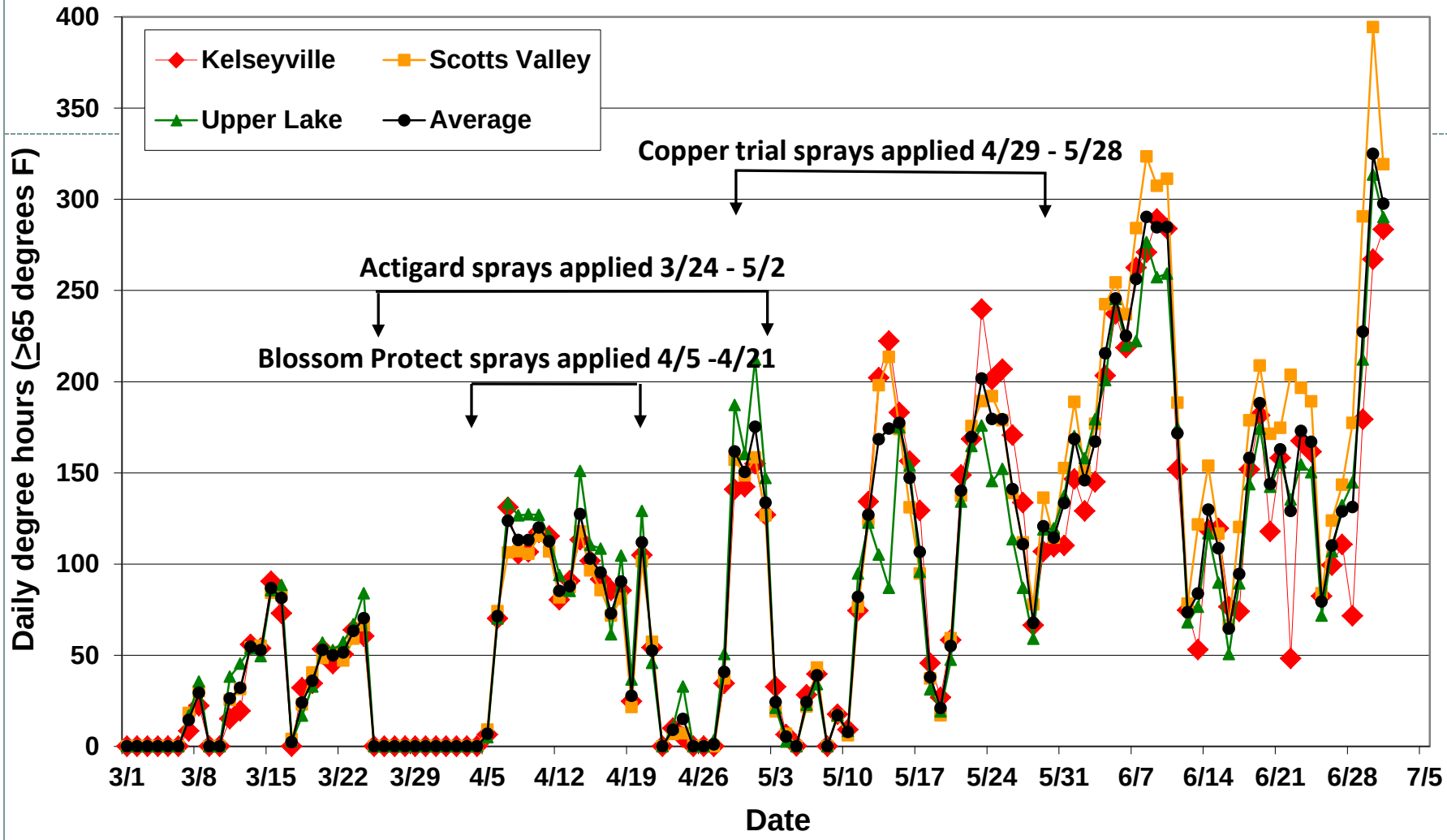
Mean % positive after combining **treated** and **untreated** blocks

Delayed dormant copper effects pathogen detectability





Accumulated degree hours (base ≥65°F with 4-day crash) for Kelseyville, Scotts Valley (Lakeport) and Upper Lake, Lake County, California, March 1 to July 1, 2014. Degree-hours calculated using data from Kelseyville-0.1P (Kel), Scotts_Valley-0.2 P (SVL), and Upper_Lake-0.1 P (UPL) (Source: UCIPM).



Daily degree hours (base ≥65°F) for Kelseyville, Scotts Valley (Lakeport) and Upper Lake, Lake County, California, March 1 to July 1, 2014 (Source: UCIPM).

Organically-approved materials versus antibiotics for fire blight control, Bartlett pear trees, Kelseyville, Lake County, California, 2014.

No.	Treatment	Rate (oz/100 gal)	Bloom Stage	Application Date(s)
1	Water	~	70%, Full Bloom, Petal Fall	4/8, 4/10, 4/17
2	Agrimycin (100) Mycoshield (200)	8.0 plus 16.0	70%, Full Bloom, Petal Fall	4/8, 4/10, 4/17
3	Oxytetracycline (200)	16.0	70%, Full Bloom, Petal Fall	4/8, 4/10, 4/17
4	Serenade Optimum (Sopt)	20.0	Full Bloom, Petal Fall	4/10, 4/17
5	Blossom Protect plus Buffer Protect	21.4, 149.6	70%	4/8
6	Blossom Protect plus Buffer Protect	21.4, 149.6	70%, Full Bloom	4/8, 4/10
7	Blossom Protect/Buffer Protect	21.4, 149.6	70%	4/8
	plus Serenade Optimum	20.0	Full Bloom, Petal Fall	4/10, 4/17
8	Blossom Protect/Buffer Protect	21.4, 149.6	70%	4/8
	plus Serenade Optimum	20.0	Full Bloom, Petal Fall	4/10, 4/17
	plus Cueva (1.5 qt.)	48.0	Full Bloom, Petal Fall	4/10, 4/17
9	Blossom Protect/Buffer Protect	21.4, 149.6	70%	4/8
	plus Serenade Optimum	20.0	Full Bloom, Petal Fall	4/10, 4/17
	plus Cueva (2.0 qt.)	64.0	Full Bloom, Petal Fall	4/10, 4/17
10	Blossom Protect/Buffer Protect	21.4, 149.6	70%	4/8
	plus Cueva (3.0 qt.)	96.0	Full Bloom, Petal Fall	4/10, 4/17

Average cfu counts in blossom samples collected from Bartlett pear trees treated with various combinations of biological agents and soluble copper, Kelseyville, Lake County, California, 2014.

		Log cfu/ml		
		Sample #1	Sample #2	Combined Samples
Treatment	Bloom Stage	4/14	4/15	
Water (control)	FB, PF	0.2 c	1.1	0.6 b
Streptomycin (100)	70%, FB, PF	~	~	~
Oxytetracycline (200)	FB, PF	~	~	~
Serenade Optimum	FB, PF	2.4 ab	0.6	1.5 ab
Blossom Protect/Buffer Protect	70%	1.5 bc	2.1	1.8 ab
Blossom Protect/Buffer Protect	70%, FB	3.3 a	1.8	2.5 a
Blossom Protect/Buffer Protect then Serenade	70% then FB, PF	2.7 ab	2.0	2.4 a
Blossom Protect/Buffer Protect then Serenade & Cueva 1.5 qt.	70% then FB, PF	1.0 bc	0.8	0.9 ab
Blossom Protect/Buffer Protect then Serenade & Cueva 2 qt.	70% then FB, PF	3.8 a	1.2	2.5 a
Blossom Protect/Buffer Protect then Cueva 3 qt.	70% then FB, PF	1.3 bc	0.6	1.0 ab
ANOVA (P-value)				
Treatment		*** (≤0.001)	NS (0.25)	*** (0.001)
Interval		~	~	** (0.01)
Block		NS (0.15)	NS (0.12)	NS (0.94)

Effect of organically acceptable materials versus antibiotics on number of fire blight strikes, fruit russeting, percent fruit russet severity, and percent fruit frost damage on Bartlett pear trees, Kelseyville, Lake County, California, 2014.

No.	Treatment	Bloom Stage[1]	Fire blight Strikes (avg. per tree)	Average Russeting[2] (no. incidence)	Incidence of fruit[2] with		Frost Damage[2] (%)
					≤ 3% russet	≥ 7% russet	
1	Water (control)	FB, PF	0.0	1.36	91.8	2.7	0.0
2	Streptomycin (100)	70%, FB, PF	0.0	2.22	80.5	8.2	0.0
3	Oxytetracycline (200)	FB, PF	0.0	1.50	90.7	4.0	0.0
4	Serenade Optimum	FB, PF	0.0	1.72	85.1	6.7	0.0
5	Blossom Protect/Buffer Protect	70%	0.0	1.30	92.4	3.4	0.0
6	Blossom Protect/Buffer Protect	70%, FB	0.0	2.51	80.6	9.4	0.0
7	Blossom Protect/Buffer Protect then Serenade	70% then FB, PF	0.0	1.99	86.3	7.5	0.0
8	Blossom Protect/Buffer Protect then Serenade & Cueva® 1.5 qt.	70% then FB, PF	0.0	1.91	84.5	9.4	0.0
9	Blossom Protect/Buffer Protect then Serenade & Cueva® 2 qt.	70% then FB, PF	0.0	1.94	86.4	6.8	0.0
10	Blossom Protect then Cueva® 3 qt.	70% then FB, PF	0.0	2.34	85.9	8.1	0.0
	ANOVA (P-value)						
	Treatment		~	NS(0.41)	NS(0.65)	NS(0.75)	~
	Block		~	*(0.02)	*(0.04)	*(0.03)	~

[1] FB=Full Bloom; pF=Petal fall. [2] Samples rated August, 2014.

Average fire blight strikes, fruit russeting, percent russet severity, and percent frost damage on Bartlett pear trees treated by cooperating growers with Blossom Protect/Buffer Protect Lake County, California, 2014

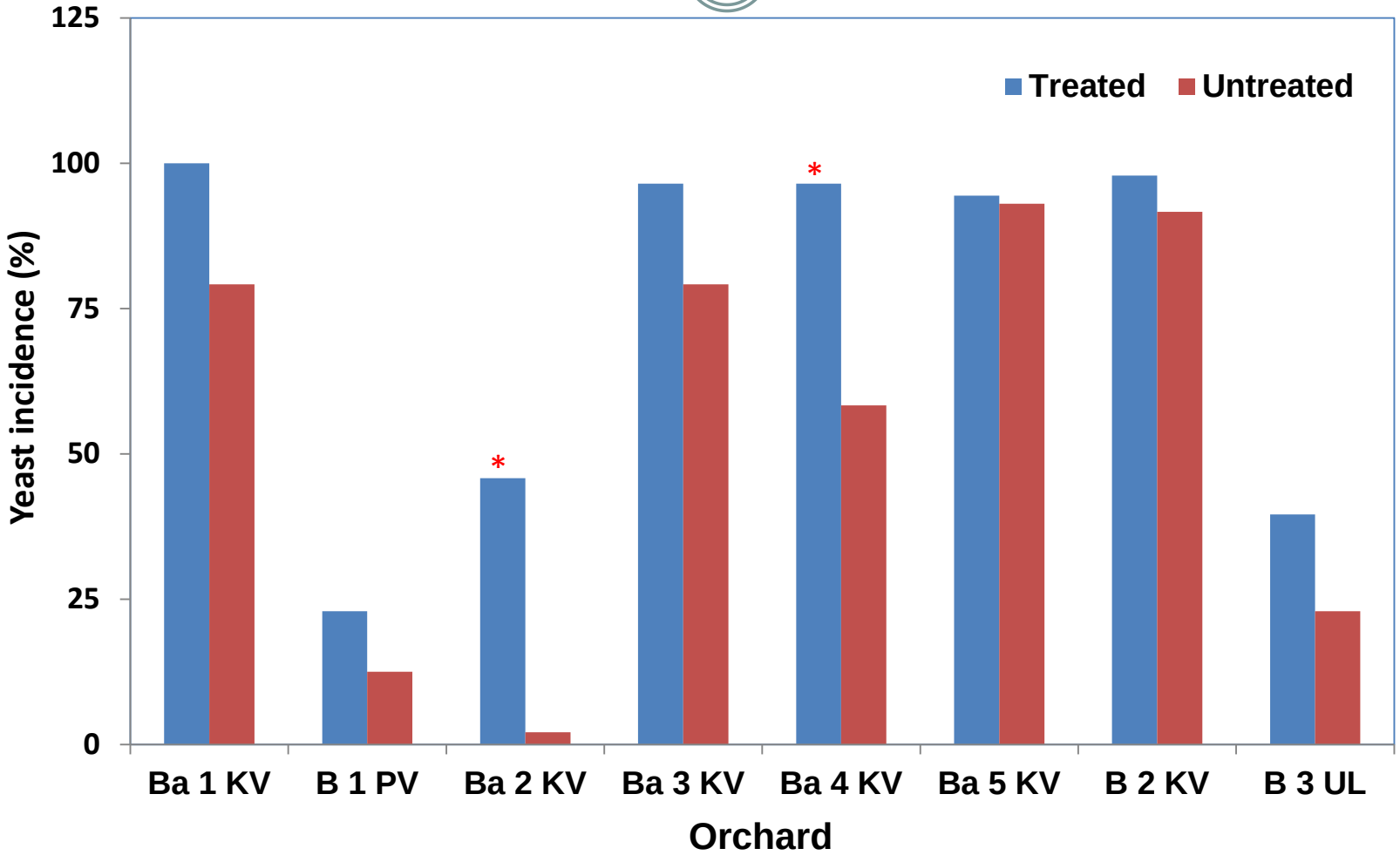
Treatment	Average Fireblight Strikes (without holdovers) (per tree)	Average Fire blight Strikes (with holdovers) (per tree)	Average Russeting (no. incidence)	Incidence of fruit with ≤3 % russet	Incidence of fruit with ≥7 % russet	Frost Damage (%)
Blossom Protect/ Buffer Protect	45.0	208.0	1.8	84.2	5.8	0.0
Control	15.0	48.5	0.6	97.5	0.8	0.0
P-Values	NS (0.59)	NS (0.53)	NS (0.07)	NS (0.06)	NS (0.20)	~

Samples rated August, 2014

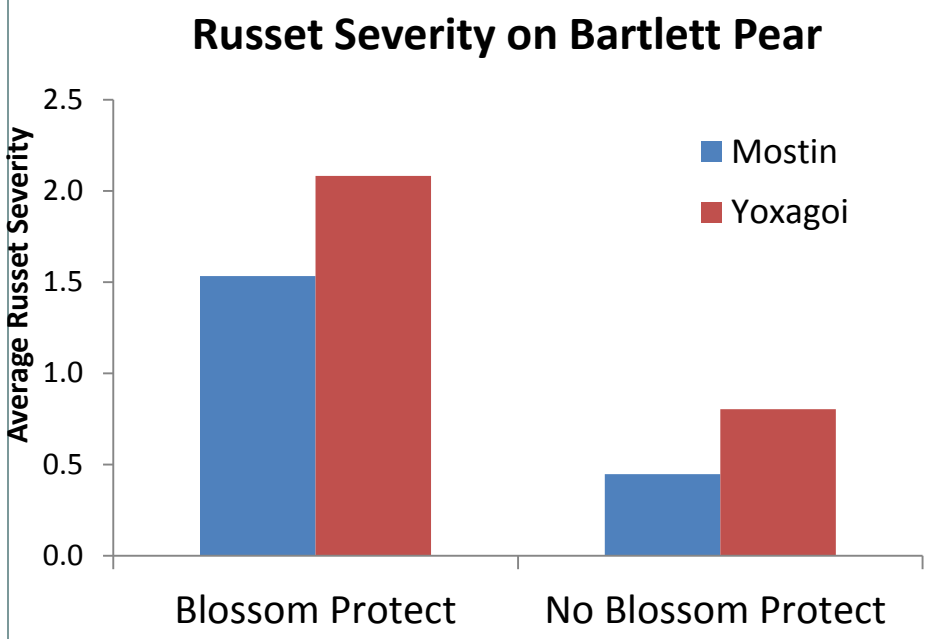
Mean yeast (log cfu/ml) and incidence of (% blossoms) in samples collected from Bartlett (5 orchards) or Bosc (3 orchards) pear trees, Lake and Mendocino Counties, California, April 2014

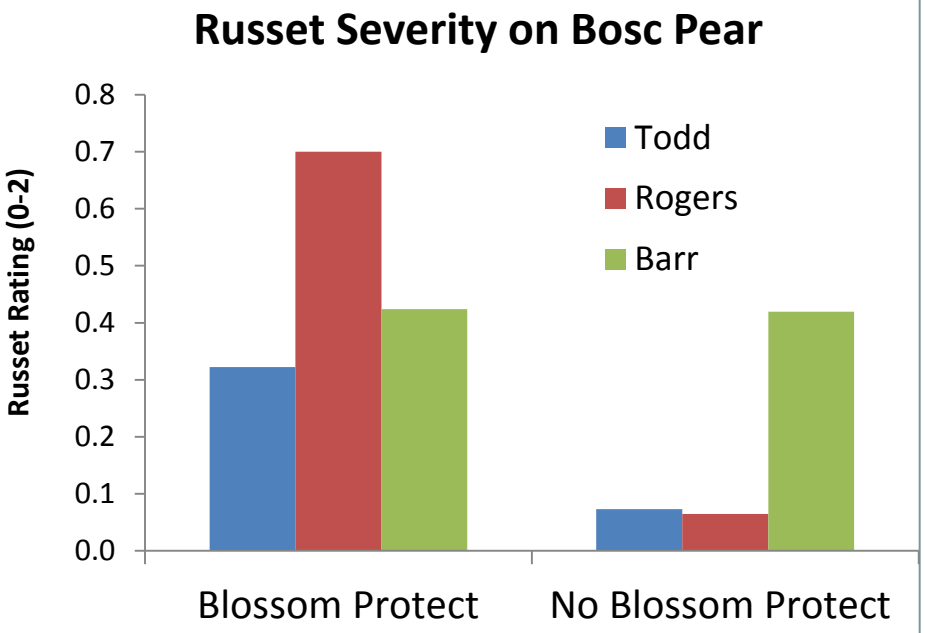
Orchard	Colony forming units (Log cfu/ml)	Yeast incidence (%)
Bartlett		
Blossom Protect	2.5	77.9
Control	1.7	68.1
P-Value	0.33	0.65
Bosc		
Blossom Protect	1.5	53.5
Control	1.1	41.4
P-Value	0.75	0.76
Bartlett and Bosc Combined		
Blossom Protect	2.1	68.8
Control	1.5	58.4
P-Value	0.33	0.57

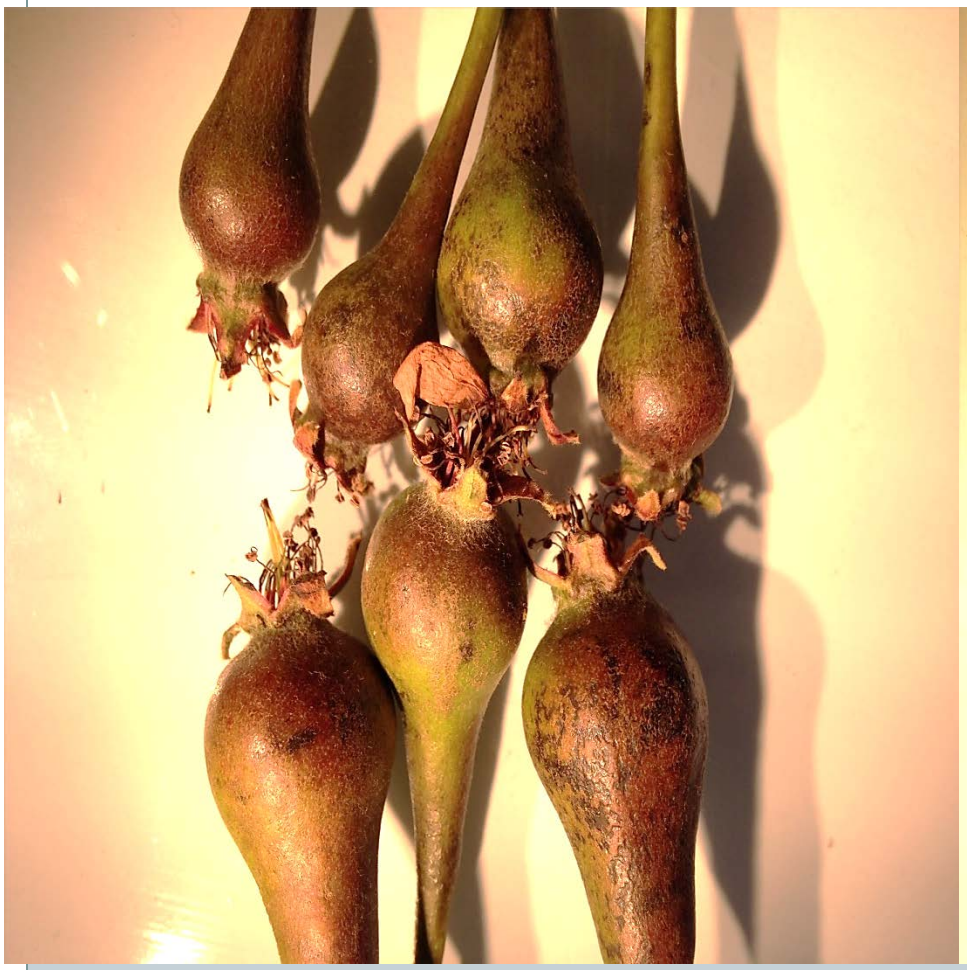
Incidence (% blossoms with colonies present) of *Aureobasidium pullulans* per 300 blossom clusters collected from Bartlett (5 orchards) or Bosc (3 orchards) pear trees. Lake and Mendocino Counties, April 2014.



Russet severity in Bartlett and Bosc pears treated with blossom protect, Lake County, 2014







Untreated

Treated

Copper fire blight/russet trial treatment and application information, Bartlett pear trees, Scotts Valley, (Lakeport), Lake County, California, 2014

No.	Treatment	Rate/Acre	Bloom Stage	Copper Application Date(s)	No. Applications Copper	No. Applications Antibiotics
1	Untreated Control	~	~	~	~	
2	Agristrep and Mycoshield (antibiotic grower control)	4.8 oz./136 g, 16 oz./454 g	50%, Full bloom, Petal fall	4/16, 4/23, 4/29, 5/7, 5/13, 5/20, 5/28	-	7
3	GWN-10073 alternated w/antibiotics	32 oz./0.95L	50%, Full bloom, Petal fall	4/16, 4/29, 5/13, 5/28	4	3
4	GWN-10073 alternated w/antibiotics	64 oz./1.9 L	50%, Full bloom, Petal fall	4/16, 4/29, 5/13, 5/28	4	3
5	GWN-10073 alternated w/antibiotics	30 oz./1.9 L	Petal fall	5/7, 5/13, 5/28	3	1
6	GWN-10073 alternated w/antibiotics	64 oz./0.95L	Petal fall	5/7, 5/13, 5/28	3	1
7	GWN-10073 alone	64 oz./1.9 L	50%, Full bloom, Petal fall	4/16, 4/23, 4/29, 5/7, 5/13, 5/20, 5/28	7	-
8	Copper-Count-N alone	32 oz./0.95L	Full bloom, Petal fall	4/29, 5/7, 5/13, 5/20, 5/28	5	-
9	Copper-Count-N alone	64 oz./1.9 L	Full bloom, petal fall	4/29, 5/7, 5/13, 5/20, 5/28	5	-

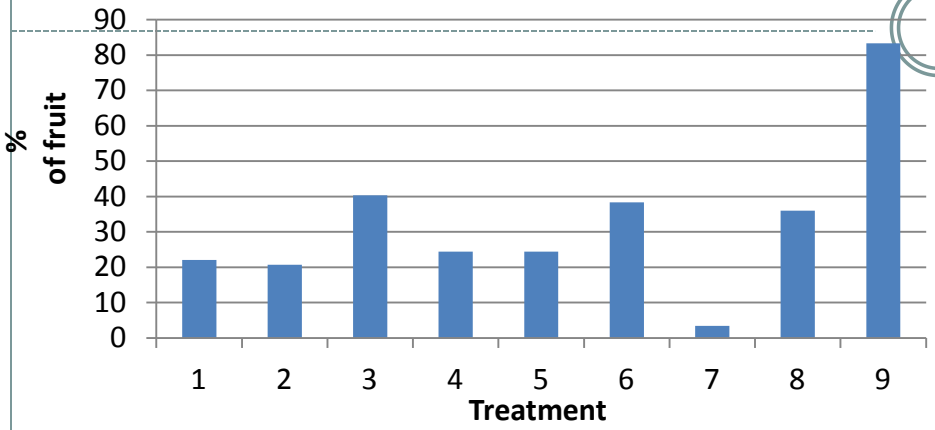
**** Note** Treatments 3 & 4 alternated with Agristrep and Mycoshield on 4/23, 5/7, 5/20. Treatments 5 & 6 alternated with Agristrep and Mycoshield on 5/20.**

Effect of copper products versus antibiotics on average fire blight strikes, average fruit russeting, percent russet severity, and percent frost damage, Bartlett pear trees, Scotts Valley, (Lakeport), Lake County, California, 2014

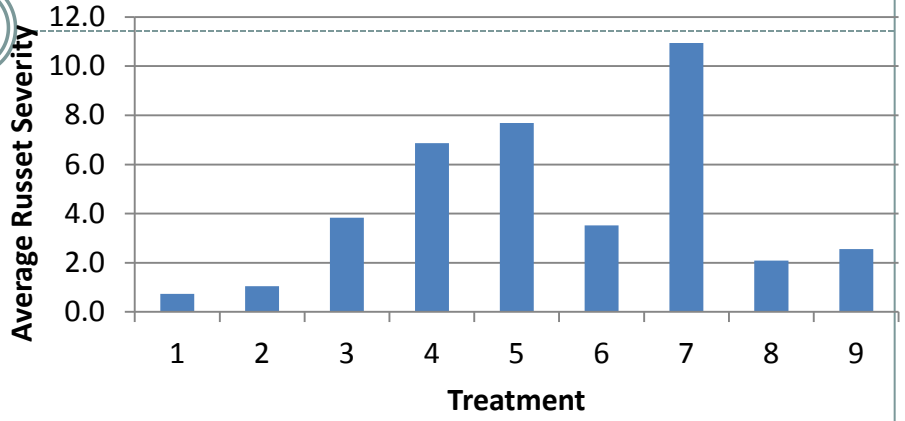
No.	Treatment	Bloom Stage[1]	Average Fire blight Strikes[2] (per tree)	Average Russeting[3] (no. incidence)	Incidence of fruit[3] with ≤3 % russet	Incidence of fruit[3] with ≥7 % russet	Frost Damage[3] (%)
1	Control	~	22.7	0.73 d	94.2 a	2.5 d	0.0
2	Grower standard (antibiotics)	50% FB, PF	11.7	1.02 d	90.3 a	6.4 cd	0.0
3	GWN-10073@ 32 oz/ac. alternated	50% FB, PF	18.7	3.80 bcd	61.8 ab	17.5 bcd	1.5
4	GWN-10073@ 64 oz/ac. alternated	50% FB, PF	17.7	6.72 abc	33.4 bc	46.8 abc	2.2
5	GWN-10073@ 32 oz/ac. alternated	PF	16.2	3.53 bcd	69.1 ab	20.0 bcd	0.0
6	GWN-10073@ 64 oz/ac. alternated	PF	17.0	7.70 ab	30.3 bc	56.8 ab	2.3
7	GWN-10073@ 64 oz/ac. alone	50% FB, PF	14.0	10.84 a	5.8 c	84.8 a	0.8
8	C-C-N 32oz/ac. alone	FB, PF	26.7	1.96 cd	84.3 a	9.9 cd	0.0
9	C-C-N 64oz/ac. alone	FB, PF	13.2	1.81 cd	84.8 a	7.2 cd	1.6
	ANOVA (P-value)						
	Treatemnt		NS (0.38)	***(≤0.001)	***(≤0.001)	***(≤0.001)	NS (0.73)
	Block		NS (0.08)	NS(0.42)	NS(0.29)	NS(0.28)	NS (0.31)

[1] FB=Full Bloom; PF=Petal fall. [2] Fire blight strikes counted 7/21/2014. [3] Samples rated August, 2014.

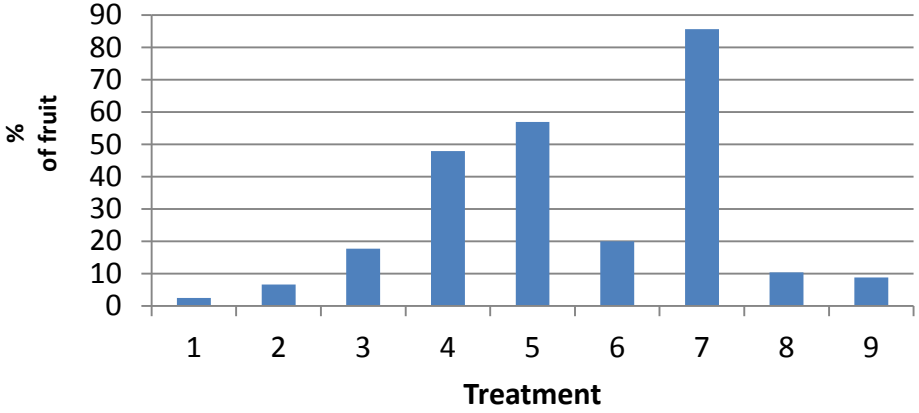
Russet Severity Less than 3
Scotts Valley, Lake County - 2014



Russet Severity on Pear Fruit
Scotts Valley, Lake County - 2014



Russet Severity Greater than 7
Scotts Valley, Lake County - 2014



Treatments

1 Untreated
2 Grower Standards/Antibiotics
3 GWN-10073 @32 oz./acre (50% bloom)
4 GWN-10073 @64 oz./acre (50% bloom)
5 GWN-10073 @64 oz./acre (petal fall)
6 GWN-10073 @32 oz./acre (petal fall)
7 GWN-10073 @64 oz./acre (alone)
8 CCN @32 oz./acre
9 CCN @32 oz./acre

Bartlett pears treated with Previsto and CCN

Weather conditions relevant to fire blight infection and russet formation during early fruit development, Lake and Mendocino Counties, California, April and May 2014

Location	Air Temperature						Moisture							
	Minimum (°F)		No. days ≤ 32°F		No. Hours 70-85°F		Precipitation (Total inches)		Average Relative Humidity (%)		Maximum Relative Humidity (%)		Leaf Wetness (Total hours)	
	April	May	April	May	April	May	April	May	April	May	April	May	April	May
Kelseyville[1]	39.2	41.6	0	1	120.6	132.0	1.01	0.00	61	52	86	67	100.4	4.4
Scotts Valley[2]	35.9	38.5	7	3	120.2	147.2	0.96	0.02	72	64	98	82	231.2	96.3
Upper Lake[3]	39.6	42.5	0	0	115.1	148.5	1.36	0.01	72	63	98	80	204.0	59.6
Ukiah[4]	41.3	43.3	0	0	97.8	107.6	0.25	0.01	63	54	87	73	169.4	53.7

[1] Location of single-tree shared protocol trial, three grower-applied Blossom Protect and four grower-applied Actigard trials

[2] Location of single-tree GWN-10073 (Previsto® and Copper Count-N trial and one grower-applied Actigard trial

[3] Location of (one each) grower-applied Blossom Protect and Actigard trials

[4] No formal trial at this location; informational purposes only

Effect of systemic acquired resistance (SAR) (Actigard®) applied at 20% bloom and petal fall on average number of fire blight strikes in pear orchards treated by cooperating growers in Lake County, CA, 2014.

	Average Fire Blight Strikes (per tree)	
Treatment	with holdovers	without holdovers
Control	13.6	5.6
Actigard	26.0	26.0
P-value	NS (0.57)	NS (0.34)

THANK YOU!!

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