Field Trial Report

Surround: An evaluation of the Effects on Pistachio

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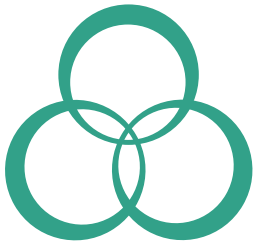


NovaSource Advisory Council

2008

Study Description:	**An Evaluation of the Effects of Surround WP on Pistachio**
Reference Number:	forey pistachio 2008.doc
Researcher:	Daniel Forey & Scott Hicks; BioResearch; 1738 N. Fowler Road; Fresno, CA 93727
Location :	Kerman, CA
Year:	2008
Trial Quality (Excellent, Good, Fair, Poor):	Fair

Product(s):	Surround WP
Rate(s):	50 lb/A fb 25 lb/A
Adjuvant(s):	
Rate(s):	

Crop(s):	
Variety:	
Pest(s):	OBLR
Quality:	Sunburn
Summary:	Even though measurable OBLR damage did not occur in the test orchard and the direct effects of sunburn were not observed, useful information was obtained on the potential for Surround WP to suppress panicle and shoot blight and possibly Alternaria late blight. Numerically, there were approximately 20% and 30% fewer infected shoots in the Surround WP-treated plots on average at 32 DA-C and 39DA-C, respectively. Surround WP was also shown to be effective at reducing bird feeding damage on the fruit. This preliminary data should be enough to warrant further investigations on these types of uses on pistachios and other susceptible cropping systems. The heat reducing effects of Surround WP did not enhance kernel quality in this trial. Occasional epicarp lesion resembling shrivel was observed related to plant bug feeding damage, but did not occur in measurable numbers. The crop was light due to alternate bearing and this year was an off year within the test orchard, so the trees were not particularly stressed. The result was that there were no statistical differences between treatments concerning kernel length, width and the weight per kernel. Surround WP did present handling problems related to weighing and loading because of the particle size and packaging of the formulated product. Mixing and spraying were not a serious problem using a commercial-type sprayer with mechanical agitation. No phytotoxicity was observed.

Processed-Kaolin Particle Film on Pistachio

Research Director:	Daniel Forey, Bio Research – Fresno, CA
Principal Investigator:	Scott Hicks
Research Technician:	Marc Brant
Study Sponsor:	NovaSource/ Tessenderlo Kerley, Inc. Kurt Volker, Ph.D. – Yakima, WA

Introduction

This trial was conducted to evaluate the effects of spray applications of Surround WP on pistachios. The trial was designed to test for control of obliquebanded leafroller (OBLR) and to determine if there were beneficial effects on kernel quality from reduced heat stress. The spray applications were initiated based on the presence of OBLR in pheromone traps within the test orchard. No OBLR were observed during field evaluations of leaves and clusters. It appeared that heat stress was not a serious factor that affected the pistachios this year. Tree canopies were more extensive because 2008 was an off-year for alternate bearing based on an equivalent response from untreated trees. However, during the field evaluations, a moderate to severe incidence of panicle and shoot blight disease was observed to have been affected by treatment, particularly on shoot stems and foliage. In addition, bird feeding damage on nuts within clusters was observed to also have been affected by spray applications of Surround WP. The results of this trial are primarily based on the latter two parameters. Kernel quality in terms of size and weight were also determined in the event there was shrivel due to heat stress.

Materials and Methods

A. Site Location: Plumas and Shields Roads
Kerman, CA

B. Target Species:

Common Name:	Obliquebanded Leafroller (OBLR)
Scientific Name:	Choristoneura rosaceana
Developmental Stage:	All
Common Name:	Panicle and Shoot Blight
Scientific Name:	Botryosphaeria dothidea

C. Host Crop: Pistachio

Variety:	Kerman
Age:	Approximately 30 yr planting

D. Plot Description:

Plot Size:	24 x 36 feet (3 trees per plot)
Cultural Practices:	Minimal cultivation, flood irrigation
Soil:	Sandy loam

E. Pest History: OBLR infestations had historically been a problem in the test orchard.

F. Pesticide History: No maintenance pesticides were applied at the test site for the duration of the trial.

G. Experimental Design: Complete randomized block design

H. Replication No. & Units: 4, 3-tree replicates per treatment.

I. Application Equipment: Ford® 1720 Diesel Tractor pulling a Rears airblast orchard sprayer, with mechanical agitation.

Nozzle:	Six D8-45 nozzles
PSI:	150
RPM:	1500
Tractor Gear:	4L
Speed:	1.3 mph
Spray Volume:	200 gpa

J. Treatments:

	Rate:	Appl. Code		
1. Untreated				
2. Intrepid		2F	12 fl oz/A	AB
3. Surround WP		100WP	50 lb/A	ABC
	Break Thru	100L	3 oz/100 gal.	

K. Application:

Application A

Date:	June 16, 2008
Time:	10:00 – 11:30 a.m.
Temperature:	87° F
Relative Humidity:	28%
Wind Speed:	0-3 mph
Wind Direction:	NW
Cloud Cover:	Clear
Plant Growth Stage:	Shell hardened, early nut fill
Plant Vigor:	Good
Foliar Moisture:	Dry
Water pH:	6.5

Application B

Date:	July 1, 2008
Time:	2:00 – 3:00 p.m.
Temperature:	90° F
Relative Humidity:	33%
Wind Speed:	0-2 mph
Wind Direction:	NW
Cloud Cover:	Clear
Plant Growth Stage:	Nut fill
Plant Vigor:	Good
Foliar Moisture:	Dry
Water pH:	6.5

Application C

Date:	July 25, 2008
Time:	9:00 – 10:15 a.m.
Temperature:	81° F
Relative Humidity:	40%
Wind Speed:	0-2 mph
Wind Direction:	N
Cloud Cover:	Clear
Plant Growth Stage:	Nut fill
Plant Vigor:	Good
Foliar Moisture:	Dry
Water pH:	6.5

Environmental conditions at the time spray applications were made were taken with a Kestrel® 3000 Pocket Weather Station.

L. Weather Conditions: The following weather data were recorded at Firebaugh, CA, located approximately 10 miles northwest of the test site (Statewide Weather Service – CIMIS Station 7) from June 12, 2008, to September 8, 2008:

Total Rainfall:	0.00 inches
High Temperature:	105.4°F (July 10)
Low Temperature:	52.9°F (September 2)

See Appendix 1 for complete environmental data.

M. Test Procedures:

A commercial pistachio orchard with a reported history of OBLR infestation was selected as the test site. Three-tree test plots were arranged down a single row of trees using a randomized complete block design. The trees were marked with colored flagging tape to identify the treatments. The first application of the test materials was made on June 16, 2008, after pheromone trap verification of the first moths entering the orchard. Subsequent applications were made on July 1 and July 25, 2008, at approximately 2-week or 3-week intervals after the first sprays.

Cumulative trap counts of OBLR in the test orchard by date:

4	June 12
11	June 16
24	June 20
0	June 30
12	July 25

Evaluation of OBLR larval infestations were made on June 20, July 7 (foliage), and August 26, 2008 (cluster feeding). Panicle and shoot blight evaluations on shoots and nut clusters (rachis) were evaluated on August 26 and September 2, 2008, as was bird feeding damage on the clusters. A harvest evaluation of kernel quality was completed on September 8, 2008.

N. Sampling Procedures:

The OBLR evaluation consisted of inspecting the foliage for leaves webbed together and afterwards by beating branches of foliage at various canopy heights to disturb larvae causing them to respond by hanging from the leaves on silken threads. In addition, clusters were inspected for wilting on the tree from rachis stem feeding damage due to larval activity. No live larvae and/or evidence of larval activity were observed in untreated plots to warrant further evaluation. Panicle and shoot blight was evaluated by examining 25 non-systematically selected shoot tips (3-5 leaves each) per plot for evidence of infection such as when blighted leaflets, entire leaves or entire shoots dried and turned brown. In addition Botryosphaeria infection was confirmed by inspecting petioles for elongated black lesions in streaks, plus blighted leaves having large necrotic lesions with blackened areas in the center of fungus that would not rub off, as opposed to Alternaria leaf blight which causes lesions delineated with reddish margins and sporulating fungus in the center of necrotic lesions that are blackened and rub off the leaf surface. Twenty-five clusters were also non-systematically selected and the rachis stems examined for evidence of infection. Incidence was then determined based on the presence or absence of symptoms on either shoots or clusters. In addition, severity of infection on the leaves of infected shoots was ranked on a scale of 0 to 10 where: 0 = no infection and 10 = 100% blighted. Effects on bird feeding damage were determined by inspecting the clusters visible from ground level and counting those with nuts that had been broken open and the kernels either partially or entirely consumed. Just prior to commercial harvest, clusters inspected in the field indicated no symptoms of direct sunburn, so 10 clusters per plot were non-systematically selected and brought back to the field test facility to determine effects of heat stress based on kernel quality (shrivel). Sub samples of 25 fruit (nuts) were separated non-systematically from the field samples, hulled and shelled. The kernels were set end to end in a trough and the total length measured with an inch ruler to determine average length. The same kernels were then set side to side in the trough and measured to determine average width. Afterwards, the kernel sub samples were weighed on a Sartorius GE1302 electronic balance to determine the weight per kernel.

O. Statistical Analysis: Raw data were analyzed using 1-Way ANOVA, LSD, CV, Friedman's Test and Duncan's New Multiple Range Test (p = 0.05) using Gylling's Agriculture Research Manager Program (Version 7.5.0). Percentage data were not transformed. In cases when the assumption of variance homogeneity was not met, potentially invalid Analysis of Variance test results were allowed for viewing trends in the data. The percent control was calculated using Abbott's Formula (1925):

$$\text{Percent control} = \frac{(X - Y)}{X} \times 100$$

X = disease incidence in the untreated plots
Y = disease incidence in the treated plots

The replicate raw data are located in Appendices 2-5.

Results and Discussion

Table 1 presents a summary of the results showing the effects of Surround WP on panicle and shoot blight of the shoots. There were no statistical differences between treatments and the data variation was low to moderate. Numerically, there were approximately 20% and 30% fewer infected shoots in the Surround WP-treated plots on average at 32 DA-C and 39DA-C, respectively. Transforming the data to percent control showed trends towards suppression at both evaluation intervals. Figure 1 illustrates the effects based on percent incidence and shows a consistent reduction in shoot disease incidence. The effects on disease severity shown in Table 1 showed little variation and the statistical separation was highly significant, which was also corroborated by the Friedman's Test results which indicated that a real treatment difference was likely.

Table 1: Summary of disease data showing the effects of Surround WP for preventing panicle and shoot blight (*Botryosphaeria dothidea*) on the shoots of pistachios (var. Kerman) grown near Kerman, CA. Spray applications were made on 6/16, 7/1, and 7/25/08, using a commercial-type airblast sprayer to apply 200 gpa. Evaluations were made on the indicated treatment evaluation intervals.

Insect Code:						Boytros P						
Crop Code:						Pistachio						
Part Rated:						Shoots						
Rating Data Type:						Counts	Percent	Control	Counts	Percent	Control	Rating
Rating Unit:						Incidence		%Unck	Incidence		% Unck	Severity
Rating Date:						8/26/08			9/2/08			
Crop Stage:						Incidence			Incidence			Rating
Crop Stage Scale:												Scale
Insect Stage:												0-10
Trt-Eval Interval						32 DA-C			39 DA-C			
Trt. No.	Treatment Name	Form Conc.	Form Type	Rate	Rate Unit							
1	Untreated					13.88a	55.50a	0.0a	18.8a	75.0a	0.0a	2.9a
2	NA											
3	Surround Breakthrough	100 100	WP L	50 3	lb/a oz/100 gal.	10.75a	43.00a	24.7a	13.0a	52.0a	30.5a	2.2b
LSD (P=.05)						11.087	44.349	42.43	11.43	45.71	39.86	0.40
Standard Deviation						4.928	19.710	18.86	5.08	20.31	17.72	0.18
CV						40.02	40.02	152.95	31.99	31.99	116.17	6.94
Bartlett's X2						3.214	3.214	0.0	0.292	0.292	0.0	0.021
P (Bartlett's X2)						0.073	0.073	.	0.589	0.589	.	0.884
Friedman's X2						1.0	1.0	2.25	1.0	1.0	2.25	4.0
P (Friedman's X2)						0.317	0.317	0.314	0.317	0.317	0.314	0.046
Replicate F						0.667	0.667	1.000	0.354	0.354	1.000	14.644
Replicate Prob(F)						0.6263	0.6263	0.2000	0.7919	0.7919	0.5000	0.0269
Treatment F						0.804	0.804	3.420	2.564	2.564	5.928	33.592
Treatment Prob(F)						0.4359	0.4359	0.1615	0.2077	0.2077	0.0929	0.0102

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT).
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

The effects on the incidence of blighted clusters (rachis) are summarized in Table 2. The response on the clusters was not as apparent as with the shoots and there were still no statistical differences between treatments. However, similar trends were indicated. There were approximately 12% fewer infected clusters in the Surround WP-treated plots than were counted in untreated plots. Percent control indicated possible suppression of the disease. This was most likely a result of chance because there was only a single evaluation of clusters, with low variation in the data, and the Friedman's Test results very strongly indicated that treatment differences were highly unlikely. These results are reasonable considering the difficulty of getting coverage with sufficient spray material on the clusters.

Table 2: Summary of disease data showing the effects of Surround WP for preventing panicle and shoot blight (*Botryosphaeria dothidea*) on the clusters of pistachios (var. Kerman) grown near Kerman, CA. Spray applications were made on 6/16, 7/1, and 7/25/08, using a commercial-type airblast sprayer to apply 200 gpa. Evaluations were made on the indicated treatment evaluation intervals.

Insect Code:						Boytros P		
Crop Code:						Pistachio		
Part Rated:						Rachis		
Rating Data Type:						Counts	Percent	Control
Rating Unit:						Incidence		%Unck
Rating Date:						9/2/08		
Crop Stage:						Incidence		
Crop Stage Scale:								
Insect Stage:								
Trt-Eval Interval						32 DA-C		
Trt. No.	Treatment Name	Form Conc.	Form Type	Rate	Rate Unit			
1	Untreated					4.0a	16.0a	0.0a
2	NA							
3	Surround Break Thru	100 100	WP L	50 3	lb/a oz/100 gal.	3.5a	14.0a	20.0a
LSD (P=.05)						2.76	11.02	36.74
Standard Deviation						1.22	4.9	16.33
CV						32.66	32.66	163.3
Bartlett's X2						1.268	1.268	0.0
P (Bartlett's X2)						0.26	0.26	.
Friedman's X2						0.0	0.0	1.0
P (Friedman's X2)						1.00	1.00	0.317
Replicate F						0.111	0.111	1.000
Replicate Prob(F)						0.9480	0.9480	0.5000
Treatment F						0.333	0.333	3.000
Treatment Prob(F)						0.6042	0.6042	0.1817

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT).
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Statistical analysis of the bird feeding damage showed significant differences between Surround WP and the untreated check (Table 3). There were approximately 70% fewer clusters with damaged nuts in the Surround WP-treated plots than were found in the untreated check. These results showed that the test material approached being commercially effective at control, rather than suppressive. Figure 2 is a graphic representation of the response to Surround WP and the relative control compared to the untreated check.

Table 3: Summary of single nut data showing the effects of Surround WP for preventing bird feeding damage on pistachios (var. Kerman) grown near Kerman, CA. Spray applications were made on 6/16, 7/1, and 7/25/08, using a commercial-type airblast sprayer to apply 200 gpa. Evaluations were made on the indicated treatment evaluation intervals.

Insect Code:						Bird			
Crop Code:						Pistachio			
Part Rated:						Nuts			
Rating Data Type:						Counts	Control	Counts	Control
Rating Unit:						Feed Dam	% Unck	Feed Dam	% Unck
Rating Date:						8/26/08	8/26/08	9/2/08	9/2/08
Crop Stage:						Clusters		Clusters	
Crop Stage Scale:									
Insect Stage:									
Trt-Eval Interval						32 DA-C			
Trt. No.	Treatment Name	Form Conc.	Form Type	Rate	Rate Unit				
1	Untreated					3.0a	0.0b	6.0a	0.0b
2	NA								
3	Surround Break Thru	100 100	WP L	50 3	lb/a oz/100 gal.	1.1b	59.5a	1.8b	73.3a
LSD (P=.05)						1.64	38.02006529	2.0	28.72299482
Standard Deviation						0.73	16.89770486	0.89	12.765669780
CV						35.34	56.72	22.96	34.82
Bartlett's X2						1.705	0.0	0.793	0.0
P (Bartlett's X2)						0.192	.	0.373	.
Friedman's X2						4.0	4.0	4.0	4.0
P (Friedman's X2)						0.046	0.046	0.046	0.046
Replicate F						1.627	1.000	6.895	1.000
Replicate Prob(F)						0.3494	0.5000	0.0736	0.5000
Treatment F						13.235	24.867	45.632	66.000
Treatment Prob(F)						3.0358	0.0155	0.0066	0.0039

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT).
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

A summary of the kernel quality data results are presented in Table 4. The heat-reducing effects of Surround WP did not enhance kernel quality in this trial. Occasional epicarp lesion resembling shrivel was observed related to plant bug feeding damage, but did not occur in measurable numbers. The crop was light due to alternate bearing and this year was an off year within the test orchard, so the trees were not particularly stressed. The result was that there were no statistical differences between treatments concerning kernel length, width and the weight per kernel.

In conclusion, even though measurable OBLR damage did not occur in the test orchard and the direct effects of sunburn were not observed, useful information was obtained on the potential for Surround WP to suppress panicle and shoot blight and possibly Alternaria late blight. Surround WP was also shown to be effective at reducing bird feeding damage on the fruit. This preliminary data should be enough to warrant further investigations on these types of uses on pistachios and other susceptible cropping systems.

Table 4: Summary of kernel data showing the effects of Surround WP on quality parameters at maturity of pistachios (var. Kerman) grown near Kerman, CA. Spray applications were made on 6/16, 7/1, and 7/25/08, using a commercial-type airblast sprayer to apply 200 gpa. Evaluations were made on the indicated treatment evaluation interval.

Insect Code:						Boytros P		
Crop Code:						Pistachio		
Part Rated:						Rachis		
Rating Data Type:						Kernel		
Rating Unit:						Length	Width	Weight
Rating Date:						9/8/08		
Crop Stage:						MM	MM	Gram
Crop Stage Scale:						Per Kern	25 Nuts	Per Kern
Trt-Eval Interval						45 DA-C		
Trt. No.	Treatment Name	Form Conc.	Form Type	Rate	Rate Unit			
1	Untreated					17.0a	251.8a	0.79a
2	Intrepid	2	F	12	fl oz/a	17.4a	256.3a	0.90a
3	Surround Break Thru	100 100	WP L	50 3	lb/a oz/100 gal.	16.8a	258.8a	0.85a
LSD (P=.05)						1.32	20.20	0.245
Standard Deviation						0.77	11.67	0.142
CV						4.5	4.57	16.72
Bartlett's X2						2.532	2.359	2.565
P (Bartlett's X2)						0.282	0.307	0.277
Friedman's X2						0.5	0.125	1.5
P (Friedman's X2)						0.779	0.939	0.472
Replicate F						0.636	0.590	0.142
Replicate Prob(F)						0.6188	0.6436	0.9310
Treatment F						0.686	0.369	0.552
Treatment Prob(F)						0.5391	0.7259	0.6027

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT). Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Surround WP did present handling problems related to weighing and loading because of the particle size and packaging of the formulated product. Mixing and spraying were not a serious problem using a commercial-type sprayer with mechanical agitation. No phytotoxicity was observed.

Figure 1: Effects of Surround WP on *Botryosphaeria Panicle* and Shoot Blight on Pistachios

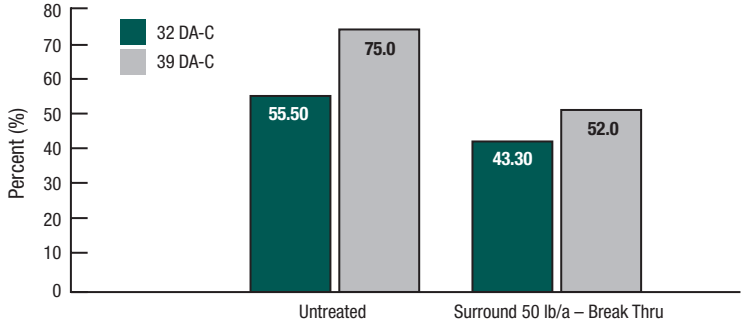
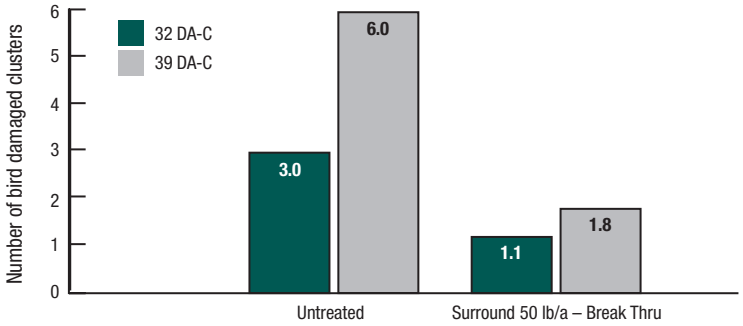


Figure 2: Effects of Surround WP on Bird Feeding Damage on Pistachios



References

Abbott, W.S. 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol. 18 (2): 265-267.