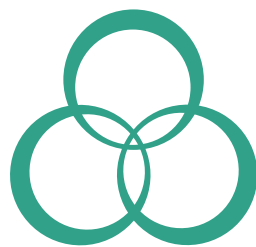


■ Field Trial Report ■

Surround: Evaluation of Surround WP, Cocoon, Eclipse and Success for Thrips Control and Heat Stress Prevention

Dan Forey, BioResearch, Fresno, CA



**NovaSource Advisory
Council**

2008



Study Description:	Evaluation of Surround WP, Cocoon, Eclipse and Success for Thrips Control and Heat Stress Prevention
Reference Number:	forey2008_1.doc
Researcher:	Daniel Forey; BioResearch; 1738 N. Fowler Road; Fresno, CA 93727
Location:	Fresno, CA
Year:	2008
Trial Quality (Excellent, Good, Fair, Poor):	Excellent

Product(s):	Cocoon, Eclipse, Surround
Rate(s):	Surround 25 lb/A; Cocoon 100 lb followed by 25 lb; Eclipse 3 gpa fb 2 gpa; Success 8 oz/A [3 applications of all treatments]
Adjuvant(s):	
Rate(s):	

Crop(s):	Tomato
Variety:	Hybrid Sun 6117
Pest(s):	Thrips
Quality:	Sunburn
Summary:	<p>This trial was conducted to evaluate Surround WP for thrips suppression and heat stress prevention when compared with label rates of Cocoon, Eclipse and conventional insect control (Success) treated processing tomatoes. Test materials were applied three times at seven-day intervals. Evaluations were conducted of thrips and other insect pest counts, the percent of sunburned fruit, and brix and fruit yield at harvest.</p> <p>Few significant differences between treatments were observed: plots that received three foliar applications of Surround WP averaged less sunburn damage than the untreated and Success groups; produced more marketable fruit than the Cocoon and Eclipse groups; and held or shared the highest brix value observed at both assessment intervals. Lastly, there was no consistent impact on the populations of western flower thrips, beet armyworm, lygus bugs or aphids by Surround, Cocoon or Eclipse during the test interval.</p>

Evaluation of Surround WP, Cocoon, Eclipse and Success for Thrips Control and Heat Stress Prevention

Research Director: Daniel Forey, Bio Research – Fresno, CA
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 Study Sponsor: NovaSource/ Tessengerlo Kerley, Inc.
 Kurt Volker, Ph.D. – Yakima, WA

Introduction

This trial was conducted to evaluate Surround WP for thrips suppression and heat stress prevention when compared with Cocoon, Eclipse and conventional insect control (Success) treated processing tomatoes. Test materials were applied three times at seven-day intervals. Evaluations were conducted of thrip and other insect pest counts, the percent of sunburned fruit, and brix and fruit yield at harvest.

Materials and Methods

- A. Site Location:** Bio Research Field Station, Fresno, CA
- B. Host Crop:** Processor Tomato
 Variety: Hybrid Sun 6117 (Sunseeds®)
 Planting Date: May 9, 2008
- C. Target Pest:** Western Flower Thrips
 Scientific Name: (*Frankliniella occidentalis*)
- D. Plot Description:**
 Plot Size: 40 row-feet on 38” beds; 1 plant-line per bed, with 12” plant spacing
 Cultural Practices: Drip irrigation; hand-weeded as needed
 Soil: Hanford sandy loam
- E. Experimental Design:** Randomized complete block
- F. Replication and Units:** 4 plots per treatment
- G. Application Equipment:** CO2 pressurized sprayer and hand wand attached to a 3-nozzle boom, with the nozzles arranged to apply a full coverage spray over the tomato plants.
- Nozzles: 3-D2 with spinners, no screen (1st application)
 3-Teejet 8002 VS, 100 mesh screen (2nd-4th applications)
- PSI: 30
- GPA: 30 Surround WP and Success
 100 Cocoon
 50 Eclipse
- H. Treatments:**
- | | Appl Code ⁽¹⁾ | | |
|----|--------------------------|-----------|-----|
| 1. | Untreated | | |
| 2. | Surround WP | 25 lb/a | ABC |
| 3. | Cocoon | 100 lb/a | A |
| | Cocoon | 25 lb/a | BC |
| 4. | Eclipse | 3 gal/a | A |
| | Eclipse | 2 gal/a | BC |
| 5. | Success | 8 fl oz/a | ABC |

(1) Appl Code: A= 1 application; B= 2nd application; C= 3rd application

I. Applications:

Application 1

Date:	July 9, 2008
Time:	10:00-11:20 a.m.
Temperature:	98.5° F
Relative Humidity:	35.5%
Wind Speed:	2.2 mph
Wind Direction:	S
Cloud Cover:	0
Plant Growth Stage:	Maturing fruit
Plant Vigor:	Good
Foliar Moisture:	Dry
Water pH:	6.5

Application 2

Date:	July 16, 2008
Time:	9:30-11:15 a.m.
Temperature:	87.8° F
Relative Humidity:	31%
Wind Speed:	1.3 mph
Wind Direction:	S
Cloud Cover:	0
Plant Growth Stage:	Maturing fruit
Plant Vigor:	Good
Foliar Moisture:	Dry
Water pH:	6.5

Application 3

Date:	July 23, 2008
Time:	7:50-9:45 a.m.
Temperature:	90° F
Relative Humidity:	35.5%
Wind Speed:	1-2 mph
Wind Direction:	S
Cloud Cover:	0
Plant Growth Stage:	Maturing fruit
Plant Vigor:	Good
Foliar Moisture:	Dry
Water pH:	6.5

Temperature, relative humidity and wind speed were taken with a Kestrel 300. The water pH was measured using a pH paper manufactured by Micro Essential Laboratory, Inc.

J. Environmental Conditions: The following weather data was recorded at California State University, Fresno approximately 5 miles northwest of the test sites (CIMIS Project) from July 8 to August 13, 2008.

Rainfall:	0.03 inches
High Temperature:	105.4° F (July 10)
Low Temperature:	73.4° F (July 21)

See Appendix I for complete weather data.

K. Test Procedures:

The test was placed in an established planting of processing tomatoes infested with western flower thrips. The tomatoes were planted May 9, with a side-dressing of Hydro Prill 15-15-15 applied in late May prior to study initiation. The plants had young developing fruit and new flowers at the time of the pretreatment insect evaluation, on July 8, one day prior to the first spray application. Each plot consisted of a single bed of tomatoes, 40-ft long, arranged in a randomized complete block design. The ends of the plots were marked with colored flags bearing the replicate number for identification.

Foliar sprays were applied on July 9, 16 and 23 with a 40-inch spray swath providing full coverage of the foliage. Insect evaluations were conducted on July 8, 16, August 6 and 18 corresponding to day 0 (pretreatment), 7 days after the first application (7DAA1), and at 14 and 26DAA3, respectively. Heat stress assessments were conducted July 31 and August 13 at 8 and 21DAA3, respectively. Harvest evaluations were conducted August 1 and 13 at 9 and 21DAA3, respectively.

L. Sampling:

Insect counts targeting Western flower thrips were conducted by selecting a terminal fruiting cluster bearing flowers and vigorously tapping the cluster against the inside wall of a 32-oz Styrofoam cup. Western flower thrips were dislodged and held to the cup wall by static electricity. Five clusters were sampled in each plot at each assessment interval. The cup was then capped with a lid marked with the plot number, and returned to the laboratory where the contents were emptied onto a white sheet of paper where all arthropod pests were identified and counted.

Sunburn damage was scored in the field on 100 fruit per plot based on a 1 to 5 rating scale, as follows:

- 1 = no damage observed
- 2 = less than 15% of the fruit surface with yellow coloration contrasting with pink or red
- 3 = 15% to 30% of the fruit surface off-color; flesh not affected
- 4 = greater than 30% of the fruit showing off-color symptoms consistent with sunburn
- 5 = flesh leathery and dry; fruit not marketable

The first harvest evaluation was conducted on August 1, 2008, with a follow-up harvest on August 13. Ten row feet of plants in each plot were first marked with colored flags so the same area could be harvested each time. All fruit showing an acceptable amount of red color was harvested. The fruit was picked into plastic tote containers in the field, then brought to a central location at the edge of the test site for evaluation. A card marked with the plot number was placed into each tote for identification. Each piece of fruit was separated into one of two groups, either marketable or culled, based on fruit size or the extent of any damage that was observed. All of the fruit in each group was then counted and weighed and the results recorded.

In addition, the percent soluble solids (brix) of five marketable ripe fruit per plot was determined July 31 and August 12, at 8 and 20DAA3, respectively.

M. Statistical Analysis:

Raw data were analyzed using LSD, CV and Duncan's New Multiple Range Test ($p = 0.05$) using Gyllings Agriculture Research Manager. In some cases the assumption of variance homogeneity was not met (failed Bartlett's test), so some potentially invalid Analysis of Variance test results were allowed in order to view trends in the data. The percent control was calculated using Henderson's Method (1955), where:

$$\text{Percent mortality} = \frac{1 - \frac{Ta \times Cb}{Tb \times Ca}}{1} \times 100$$

Where: Ta = number collected after treatment
 Tb = number collected prior to treatment
 Ca = number from the check after treatment of the test plot
 Cb = number from the check plot before treatment of the test plot

The replicate raw data for each table can be found in the Appendices.

Results and Discussion

The test was placed in an established planting of processing tomatoes that were already at early fruit set at study initiation. A total of three applications were made over a two-week period, which left most plants covered in speckles of accumulated residue. The exception to obvious signs of product residue on plants was the Success plots, which appeared to be residue-free (Figures 1-6).



Figure 1. Test site consisting of Hybrid Sun 6117 processing tomatoes planted in 200 foot rows. A Surround WP plot is in the foreground, marked by a blue flag, showing the characteristic white residue of the product.



Figure 2. A cluster of tomatoes from the untreated group on July 23, the day of the third application of test materials to the treated plots.



Figure 3. A cluster of Surround WP-treated tomatoes after the 3rd spray application on July 23. The plots were sprayed using a 3-nozzle boom, with the nozzles arranged to apply a full-coverage spray over the tomato plants.



Figure 4. Eclipse-treated tomatoes after the third spray application on July 23.



Figure 5. Cocoon-treated tomatoes after the third spray application on July 23.



Figure 6. "Residue" free Success-treated tomatoes after the third spray application on July 23.

Pest Evaluations

Insect evaluations were conducted in plots prior to the first application, the day of the second application, and at 2 and 4 weeks after the third application. The site averaged 1-2 arthropod pests per flower terminal during the test interval (Table 1). The untreated group averaged significantly more insect pests initially, the difference due to a single cluster of 9 early instar beet armyworm larvae observed on one plant. The average number of pest arthropods per terminal was similar at all subsequent evaluation periods for all treatments.

Table 1: Evaluation of the total pest infestation in the terminals of plants bearing flowers at 7DAA1, and 14 and 26DAA3.

Insect Code:				Overall				Posttrmt
Crop Code:				Avg. No.				
Rating Data Type:				Arthropd				
Rating Unit:				Terminal				
Rating Date:				7/8/08	7/8/08	8/6/08	8/6/08	
Trt-Eval Interval				Pretreat	7 DAA1	14 DAA3	26 DAA3	
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	25	26	27	28	29
1	Untreated			2.15a	1.25a	2.00a	1.35a	1.53a
2	Surround	25	lb/a	0.35b	2.10a	1.60a	1.85a	1.85a
3	Cocoon Cocoon	100 25	lb/a lb/a	0.35b	2.15a	22.10a	1.95a	2.07a
4	Eclipse Eclipse	3 2	gal/a gal/a	0.55b	1.15a	2.45a	1.30a	1.63a
5	Success	8	fl oz/a	0.55b	0.80a	2.00a	1.30a	1.37a
LSD (P=.05)				1.117	1.748	1.284	0.768	0.746
Standard Deviation				0.725	1.135	0.833	0.498	0.484
CV				91.75	76.16	41.06	32.15	28.63
Bartlett's X2				17.324	8.638	4.743	0.668	3.435
P (Bartlett's X2)				0.002*	0.071	0.315	0.955	0.488
Friedman's X2				7.85	2.85	2.55	6.35	4.2
P (Friedman's X2)				0.097	0.583	0.636	0.174	0.38
Replicate F				0.562	3.033	0.679	0.309	2.648
Replicate Prob(F)				0.6501	0.0709	0.518	0.8187	0.0966
Treatment F				4.477	1.132	0.530	1.671	1.280
Treatment Prob(F)				0.0192	0.3874	0.7164	0.2208	0.3313

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.

Western flower thrips populations were considered low (averaging less than 1 thrip per terminal) but uniformly distributed throughout the test site at study initiation (Table 2). Post-treatment counts revealed no statistical differences between treatments at any time during the study interval. The level of control was also negligible (Table 3), with no control shown in plots treated with Surround WP or Eclipse, and only minimal suppression in plots sprayed with Success (10%) and Cocoon (17%).

Table 2: Evaluation of Western Flower Thrips infestations in tomato flowers at 7DAA1, and 14 and 26DAA3.

Insect Code:				Thrips				
Crop Code:				Tomato				Posttrtm
Rating Data Type:				Avg. No.				
Rating Unit:				Terminal				
Rating Date:				7/8/08	7/16/08	8/6/08	8/18/08	
Trt-Eval Interval				Pretreat	7 DAA1	14 DAA3	26 DAA3	
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	1	2	3	4	5
1	Untreated			0.50a	0.50a	0.50a	0.00a	0.18a
2	Surround	25	lb/a	0.25a	1.15a	0.05a	0.15a	0.45a
3	Cocoon Cocoon	100 25	lb/a lb/a	0.15a	0.55a	0.10a	0.05a	0.23a
4	Eclipse Eclipse	3 2	gal/a gal/a	0.25a	0.60a	0.00a	0.00a	0.20a
5	Success	8	fl oz/a	0.25a	0.35a	0.00a	0.00a	0.12a
LSD (P=.05)				0.439	0.836	0.129	0.135	0.285
Standard Deviation				0.285	0.543	0.084	0.088	0.185
CV				101.85	86.12	209.17	218.9	78.12
Bartlett's X2				9.627	2.005	0.08	1.148	3.27
P (Bartlett's X2)				0.047*	0.735	0.961	0.284	0.514
Friedman's X2				0.85	4.85	1.75	2.3	4.85
P (Friedman's X2)				0.932	0.303	0.782	0.681	0.303
Replicate F				2.230	0.858	0.762	2.087	0.388
Replicate Prob(F)				0.1373	0.4889	0.5368	0.1555	0.7638
Treatment F				0.836	1.267	1.000	2.217	1.875
Treatment Prob(F)				0.5279	0.3359	0.4449	0.1283	0.1796

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 impact of treatments on the other established pests at the test site, including beet armyworm, lygus bugs and aphids, was also quite minimal. Only Success at 8 fl oz/acre provided a consistent, although modest, level of control for the trial duration, averaging 25 percent control of beet armyworm, 28 percent control of lygus bugs and 46 percent control of aphids (Tables 4-7).

Sunburn Damage

Most of the fruit was free of sunburn damage at evaluations conducted 8 and 21 days after the third application (Tables 8 and 9). A notable increase in sun-damaged fruit was evident, however, at the 21DAA3 evaluation three weeks after the last spray. Overall, no statistical differences were observed between treatments relative to damage, but two treatments, namely the Untreated control and Success groups, consistently averaged a greater percent of sun-blemished fruit compared to plots sprayed with Surround WP, Cocoon or Eclipse (Table 10, Figure 7).

Table 3: Percent control of Western Flower Thrips that received three applications of Surround WP, Cocoon, Eclipse and Success

Insect Code:				Thrips			
Rating Data Type:				Percent			Avg. %
Rating Unit:				Control			
Rating Date:				7/16/08	8/6/08	8/18/08	
Trt-Eval Interval				7 DAA1	14 DAA1	26 DAA3	
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	1	2	3	4
1	Untreated			0.0a	0.0a	0.0a	0.0a
2	Surround	25	lb/a	-130.0a	0.0a	0.0a	-43.3a
3	Cocoon Cocoon	100 25	lb/a lb/a	25.0a	25.0a	0.0a	16.7a
4	Eclipse Eclipse	3 2	gal/a gal/a	-162.5a	25.0a	0.0a	-45.8a
5	Success	8	fl oz/a	29.4a	0.0a	0.0a	9.8a
LSD (P=.05)				204.94	42.20	0.00	65.93
Standard Deviation				133.01	27.39	0.00	42.79
CV				0.0	273.86	0.0	0.0
Bartlett's X2				11.042	0.0	0.0	6.643
P (Bartlett's X2)				0.012*	1.00	.	0.084
Friedman's X2				3.15	0.75	0.0	3.15
P (Friedman's X2)				0.533	0.945	1.00	0.533
Replicate F				1.733	2.667	0.000	0.397
Replicate Prob(F)				0.2133	0.0951	1.0000	0.2916
Treatment F				1.891	1.0000	0.000	1.947
Treatment Prob(F)				0.1768	0.4449	1.0000	0.1671

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.

Yield of Marketable and Culled Fruit

No statistical differences between treatments were observed in the numbers and weights of marketable and culled fruit harvested per 10-row feet on August 1, 2008 (Table 11). Perhaps the most notable trend observed was the greater number and weight of culled fruit picked in the untreated group, followed by plots sprayed with Cocoon or Eclipse. When fruit counts were converted to percentages, it was found that significantly more marketable fruit was harvested from the Success and Surround WP plots compared to the Cocoon and Eclipse plots (Table 12). This trend remained consistent relative to fruit weight, as was the converse with respect to culled fruit, (i.e., a significantly higher percentage of culls, by count and fruit weight, was harvested in the Cocoon and Eclipse plots). The Surround WP group averaged significantly more marketable fruit than all other groups during the second harvest on August 13 (Table 13). In terms of percent marketable fruit, all treatments were statistically similar. Nevertheless, the same trend observed during the first harvest was present during the second, namely that the Surround, Success and untreated plots averaged a higher percentage of marketable fruit by count and weight compared to the Cocoon and Eclipse plots, whereas the latter two groups averaged a higher percentage of culled fruit (Table 14).

Table 4: Evaluation of Beet Armyworm infestations in tomato flowers at 7DAA1, and 14 and 26DAA3

Insect Code:				Beet Armyworm				
Crop Code:				Tomato				Posttrtm
Rating Data Type:				Avg. No.				
Rating Unit:				Terminal				
Rating Date:				7/8/08	7/16/08	8/6/08	8/18/08	
Trt-Eval Interval				Pretreat	7 DAA1	14 DAA3	26 DAA3	
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	7	8	9	10	11
1	Untreated			1.40a	0.35a	0.20a	0.0a	0.18a
2	Surround	25	lb/a	0.05a	0.80a	0.25a	0.0a	0.35a
3	Cocoon Cocoon	100 25	lb/a lb/a	0.10a	1.45a	0.20a	0.0a	0.55a
4	Eclipse Eclipse	3 2	gal/a gal/a	0.00a	0.20a	0.00a	0.0a	0.07a
5	Success	8	fl oz/a	0.05a	0.00a	0.05a	0.0a	0.02a
LSD (P=.05)				1285	1.449	0.399	0.00	0.479
Standard Deviation				0.834	0.941	0.259	0.00	0.311
CV				260.52	167.99	184.89	0.0	133.2
Bartlett's X2				29.133	12.772	4.184	0.0	22.615
P (Bartlett's X2)				0.001*	0.005*	0.242	.	0.001*
Friedman's X2				1.55	4.75	1.55	0.0	4.85
P (Friedman's X2)				0.818	0.314	0.818	1.0	0.303
Replicate F				0.806	2.200	1.075	0.000	2.887
Replicate Prob(F)				0.5145	0.1409	0.3966	1.0000	0.0796
Treatment F				2.105	1.511	0.701	0.000	1.979
Treatment Prob(F)				0.1431	0.2605	0.6057	1.0000	0.1620

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.

Tables 15 and 16 present the combined data from both harvest periods. The highest percent of marketable fruit by count (88%) and weight (90%) was harvested from plots treated with Success. The Surround plots averaged the second highest percent of marketable fruit by count and weight, at 83 percent and 85 percent, respectively, which was comparable to the untreated group at 82 percent. Significantly less marketable fruit was harvested from Cocoon and Eclipse plots, ranging from 69 percent to 75 percent marketable fruit by count, and 73 percent to 78 percent marketable fruit by weight.

Brix %

No significant differences (p=0.05) between treatments were observed in the percent soluble solids (brix) of ripe tomatoes at 8 and 20DAA2 (Table 17). At the first evaluation, plots treated with Surround WP averaged the highest brix value, at 4.6, compared to the untreated and Success groups at 4.5, and the Cocoon and Eclipse groups at 4.4. Slight improvements in brix values were observed in the latter two groups at the time of the second evaluation, such that Cocoon and Surround values were now similar, as were the untreated group, Eclipse and Success.

In conclusion, while few significant differences between treatments were observed, plots that received three foliar applications of Surround WP averaged less sunburn damage than the untreated and Success groups; produced more marketable fruit than the Cocoon and Eclipse groups; and held or shared the highest brix value observed at both assessment intervals. Lastly, there was no consistent impact on the populations of Western flower thrips, beet armyworm, lygus bugs or aphids by Surround, Cocoon or Eclipse during the test interval.

References

Henderson, C. F. and E.W. Tilton. 1955. Tests with acaricides against brown wheat mite. J. Econ. Entomol. 48 (2): 157-161.

Table 5: Evaluation of Lygus Bug infestations in tomato flowers at 7DAA1, and 14 and 26DAA3

Insect Code:				Lygus Bug				
Crop Code:				Tomato				Posttrtm
Rating Data Type:				Avg. No.				
Rating Unit:				Terminal				
Rating Date:				7/8/08	7/16/08	8/6/08	8/18/08	
Trt-Eval Interval				Pretreat	7 DAA1	14 DAA3	26 DAA3	
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	13	14	15	16	17
1	Untreated			0.10a	0.35a	1.35a	1.25a	0.98a
2	Surround	25	lb/a	0.05a	0.05a	0.95a	1.40a	0.80a
3	Cocoon Cocoon	100 25	lb/a lb/a	0.10a	0.10a	1.60a	1.80a	1.17a
4	Eclipse Eclipse	3 2	gal/a gal/a	0.20a	0.30a	2.20a	1.20a	1.23a
5	Success	8	fl oz/a	0.15a	0.45a	1.65a	1.30a	1.13a
LSD (P=.05)				0.262	0.414	0.923	0.784	0.402
Standard Deviation				0.170	0.269	0.599	0.509	0.261
CV				141.91	107.58	38.66	36.59	24.56
Bartlett's X2				2.591	5.674	10.444	2.047	7.05
P (Bartlett's X2)				0628	0.225	0.034*	0.727	0.133
Friedman's X2				1.45	6.25	5.6	4.6	5.3
P (Friedman's X2)				0.835	0.181	0.231	0.311	0.258
Replicate F				1.287	1.207	2.843	0.523	3.443
Replicate Prob(F)				0.3234	0.3490	0.0824	0.6745	0.0518
Treatment F				0.448	1.590	2.326	0.824	1.762
Treatment Prob(F)				0.7719	0.2400	0.1156	0.4956	0.2013

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.

Table 6: Evaluation of Aphid infestations in tomato flowers at 7DAA1, and 14 and 26DAA3

Insect Code:				Aphids				
Crop Code:				Tomato				Posttrtm
Rating Data Type:				Avg. No.				
Rating Unit:				Terminal				
Rating Date:				7/8/08	7/16/08	8/6/08	8/18/08	
Trt-Eval Interval				Pretreat	7 DAA1	14 DAA3	26 DAA3	
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	19	20	21	22	23
1	Untreated			0.15a	0.05a	0.40a	0.10a	0.18a
2	Surround	25	lb/a	0.00a	0.10a	0.35a	0.30a	0.25a
3	Cocoon Cocoon	100 25	lb/a lb/a	0.00a	0.05a	0.20a	0.10a	0.12a
4	Eclipse Eclipse	3 2	gal/a gal/a	0.10a	0.05a	0.25a	0.10a	0.13a
5	Success	8	fl oz/a	0.10a	0.00a	0.30a	0.00a	0.10a
LSD (P=.05)				0.173	0.157	0.486	0.245	0.203
Standard Deviation				0.113	0.102	0.316	0.159	0.132
CV				160.78	203.31	105.23	132.64	83.95
Bartlett's X2				1.039	0.09	3.147	1.593	2.354
P (Bartlett's X2)				0.595	0.993	0.533	0.661	0.671
Friedman's X2				3.05	1.25	0.45	4.75	2.75
P (Friedman's X2)				0.549	0.87	0.978	0.314	0.60
Replicate F				1.000	0.194	0.348	0.211	0.218
Replicate Prob(F)				0.4262	0.8988	0.7914	0.8872	0.8817
Treatment F				1.421	0.484	0.251	1.895	0.854
Treatment Prob(F)				0.2859	0.7475	0.9036	0.1761	0.5180

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.

Table 7: Overall percent control of Beet Armyworm, Lygus and Aphids that received three applications of Surround WP, Cocoon, Eclipse and Success

Insect Code:				BAW	Lygus	Aphids
Crop Code:				Average		
Rating Data Type:				Percent		
Rating Unit:				Control		
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	46	47	48
1	Untreated			0.00a	0.00a	0.00a
2	Surround	25	lb/a	-650.00a	-12.50a	0.00a
3	Cocoon Cocoon	100 25	lb/a lb/a	0.00a	50.00a	0.00a
4	Eclipse Eclipse	3 2	gal/a gal/a	0.00a	50.00a	50.00a
5	Success	8	fl oz/a	25.00a	28.13a	45.83a
LSD (P=.05)				893.567	51.259	53.559
Standard Deviation				579.943	33.268	34.761
CV				0.0	143.86	181.36
Bartlett's X2				14.902	2.013	0.018
P (Bartlett's X2)				0.001*	0.57	0.893
Friedman's X2				1.25	4.3	3.0
P (Friedman's X2)				0.87	0.367	0.558
Replicate F				1.032	4.694	1.115
Replicate Prob(F)				0.4131	0.0216	0.3814
Treatment F				1.026	2.958	2.287
Treatment Prob(F)				0.4331	0.0649	0.1200

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.

Table 8: The number of sun-damaged fruit on plants at 8DAA3

Part Rated:				Sunburn				
Rating Data Type:				Fruit				
Rating Unit:				No Damage	<15% Damage	15-30% Damage	30% + Damage	Dry Skin
Infestation Unit:				(N=100)				
Rating Date:				7/31/08				
Trt-Eval Interval				8 DAA3				
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	53	54	55	56	57
1	Untreated			96.5a	1.5a	0.0a	0.0a	0.0a
2	Surround	25	lb/a	96.0a	2.5a	1.3a	0.3a	0.0a
3	Cocoon Cocoon	100 25	lb/a lb/a	97.0a	3.0a	0.0a	0.0a	0.0a
4	Eclipse Eclipse	3 2	gal/a gal/a	95.3a	4.0a	0.8a	0.0a	0.0a
5	Success	8	fl oz/a	96.0a	3.0a	1.0a	0.0a	0.0a
LSD (P=.05)				4.51	3.11	1.68	0.34	0.00
Standard Deviation				2.93	2.02	1.09	0.22	0.00
CV				3.04	72.02	181.94	447.21	0.0
Bartlett's X2				1.682	5.169	0.673	0.0	0.0
P (Bartlett's X2)				0.794	0.27	0.714	.	.
Friedman's X2				1.75	3.4	2.15	0.5	0.0
P (Friedman's X2)				0.782	0.493	0.708	0.974	1.00
Replicate F				1.049	0.918	2.014	1.000	0.000
Replicate Prob(F)				0.4066	0.4615	0.1658	0.4262	1.0000
Treatment F				0.198	0.811	1.112	1.000	0.000
Treatment Prob(F)				0.9344	0.5412	0.3955	0.4449	1.0000

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.

Table 9: The number of sun-damaged fruit on plants at 21DAA3

Part Rated:				Sunburn				
Rating Data Type:				Fruit				
Rating Unit:				No Damage	<15% Damage	15-30% Damage	30% + Damage	Dry Skin
Infestation Unit:				(N=100)				
Rating Date:				8/13/08				
Trt-Eval Interval				21 DAA3				
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	64	65	66	67	68
1	Untreated			84.8a	9.0a	4.0a	0.8a	1.3a
2	Surround	25	lb/a	90.3a	8.0a	1.3a	0.0a	0.3a
3	Cocoon Cocoon	100 25	lb/a lb/a	91.8a	4.8a	3.0a	0.3a	0.3a
4	Eclipse Eclipse	3 2	gal/a gal/a	91.5a	5.8a	2.3a	0.3a	0.3a
5	Success	8	fl oz/a	89.3a	6.0a	3.5a	0.0a	1.5a
LSD (P=.05)				9.26	8.27	3.84	0.76	1.68
Standard Deviation				6.01	5.36	2.49	0.49	1.09
CV				6.71	80.06	88.99	196.64	155.4
Bartlett's X2				3.474	6.736	3.979	1.724	8.689
P (Bartlett's X2)				0.482	0.15	0.409	0.422	0.069
Friedman's X2				1.4	0.6	4.4	2.05	5.35
P (Friedman's X2)				0.844	0.963	0.355	0.727	0.253
Replicate F				2.891	2.551	2.470	1.862	0.507
Replicate Prob(F)				0.0793	0.1046	0.1119	0.1898	0.6848
Treatment F				0.894	0.423	0.753	1.552	1.310
Treatment Prob(F)				0.4973	0.7891	0.549	0.2496	0.3212

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.

Table 10: The overall percent of sun-damaged fruit on plants from both evaluations (8 and 21DAA3)

Crop Code:				Overall Percent Fruit Not Damaged	Overall Percent Fruit With Sun Damage	Overall Percent Fruit With <15% Damage	Overall Percent Fruit With 15-30% Damage	Overall Percent Fruit With 30% + Damage	Overall Percent Fruit With Dry Skin
Part Rated:									
Rating Data Type:									
Rating Unit:									
Crop Stage:									
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	76	77	78	79	80	81
1	Untreated			91.6a	8.4a	5.4a	2.0a	0.4a	0.6a
2	Surround	25	lb/a	93.3a	6.8a	5.3a	1.3a	0.1a	0.1a
3	Cocoon Cocoon	100 25	lb/a lb/a	94.4a	5.6a	3.9a	1.5a	0.1a	0.1a
4	Eclipse Eclipse	3 2	gal/a gal/a	92.4a	6.6a	4.9a	1.5a	0.1a	0.1a
5	Success	8	fl oz/a	92.5a	7.5a	4.5a	2.2a	0.0a	0.7a
LSD (P=.05)				6.05	6.05	5.06	2.03	0.44	0.84
Standard Deviation				3.93	3.93	3.29	1.32	0.29	0.54
CV				4.22	56.28	68.8	77.39	192.45	154.94
Bartlett's X2				1.469	1.469	3.013	3.776	2.06	8.68
P (Bartlett's X2)				0.832	0.832	0.556	0.437	0.56	0.07
Friedman's X2				1.4	1.4	0.6	1.55	1.55	4.9
P (Friedman's X2)				0.844	0.844	0.963	0.818	0.818	0.298
Replicate F				2.453	2.453	2.149	2.210	1.000	0.499
Replicate Prob(F)				0.1135	0.1135	0.1472	0.1396	0.4262	0.6901
Treatment F				0.280	0.280	0.139	0.391	0.900	1.317
Treatment Prob(F)				0.8851	0.8853	0.9643	0.8109	0.4940	0.3186

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.

Table 11: The number and weight of marketable and culled fruit per 10-row feet during the first harvest on August 1, 2008

Crop Code:				Tomato	Tomato	Tomato	Tomato
Part Rated:				Number	Wt-Lbs	Number	Wt-Lbs
Rating Data Type:				Mktble	Mktble	Culled	Culled
Rating Unit:				Fruit	Fruit	Fruit	Fruit
Rating Date:				8/1/2008	8/1/2008	8/1/2008	8/1/2008
Trt-Eval Interval:				9 DAA3	9 DAA3	9 DAA3	9 DAA3
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	70	71	72	73
1	Untreated			96.0a	15.45a	15.0a	3.40a
2	Surround	25	lb/a	84.5a	13.65a	12.3a	1.80a
3	Cocoon Cocoon	100 25	lb/a lb/a	47.5a	7.01a	18.8a	2.12a
4	Eclipse Eclipse	3 2	gal/a gal/a	62.8a	9.45a	23.3a	2.66a
5	Success	8	fl oz/a	89.5a	14.54a	7.3a	0.99a
LSD (P=.05)				77.27	13.631	12.83	2.328
Standard Deviation				50.15	8.847	8.32	1.511
CV				65.94	73.62	54.37	68.97
Bartlett's X2				13.717	17.654	6.678	12.586
P (Bartlett's X2)				0.008*	0.001*	0.154	0.009*
Friedman's X2				3.4	4.0	5.55	3.75
P (Friedman's X2)				0.493	0.406	0.235	0.441
Replicate F				2.078	1.863	4.271	5.955
Replicate Prob(F)				0.1567	0.1896	0.0287	0.0100
Treatment F				0.653	0.670	2.158	1.430
Treatment Prob(F)				0.6358	0.6250	0.1360	0.2832

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.

Table 12: Percent marketable and culled fruit by number and weight, per 10-row feet, during the first harvest on August 1, 2008

Crop Code:				Percent Mktble Fruit By No. 8/1/2008 9 DAA3	Percent Mktble Fruit By Wt. 8/1/2008 9 DAA3	Percent Culled Fruit By No. 8/1/2008 9 DAA3	Percent Culled Fruit By Wt. 8/1/2008 9 DAA3
Part Rated:							
Rating Data Type:							
Rating Unit:							
Rating Date:							
Trt-Eval Interval:							
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	74	75	76	77
1	Untreated			82.97ab	83.55bc	17.03ab	16.45ab
2	Surround	25	lb/a	87.42a	88.64ab	12.58b	11.36bc
3	Cocoon	100	lb/a	73.24b	77.89c	26.76a	22.11a
	Cocoon	25	lb/a				
4	Eclipse	3	gal/a	73.77b	78.92c	26.23a	21.08a
	Eclipse	2	gal/a				
5	Success	8	fl oz/a	91.75a	93.04a	8.25b	6.96c
LSD (P=.05)				12.279	8.027	12.280	8.027
Standard Deviation				7.970	5.209	7.970	5.210
CV				9.74	6.17	43.86	33.41
Bartlett's X2				6.23	11.426	6.23	11.426
P (Bartlett's X2)				0.183	0.022*	0.183	0.022*
Friedman's X2				9.4	11.0	9.4	11.0
P (Friedman's X2)				0.052	0.027	0.052	0.027
Replicate F				2.028	4.559	2.028	4.559
Replicate Prob(F)				0.1637	0.0236	0.1637	0.0236
Treatment F				4.247	6.110	4.247	6.109
Treatment Prob(F)				0.0227	0.0064	0.0227	0.0064

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.

Table 13: The number and weight of marketable and culled fruit per 10-row feet during the second harvest on August 13, 2008

Crop Code:				Tomato	Tomato	Tomato	Tomato
Part Rated:				Number	Wt-Lbs	Number	Wt-Lbs
Rating Data Type:				Mktble	Mktble	Culled	Culled
Rating Unit:				Fruit	Fruit	Fruit	Fruit
Rating Date:				8/13/2008	8/13/2008	8/13/2008	8/13/2008
Trt-Eval Interval:				21 DAA3	21 DAA3	21 DAA3	21 DAA3
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	79	80	81	82
1	Untreated			55.0b	5.95a	14.3a	1.47a
2	Surround	25	lb/a	76.5a	9.52a	22.5a	2.62a
3	Cocoon Cocoon	100 25	lb/a lb/a	49.0b	5.05a	23.8a	2.39a
4	Eclipse Eclipse	3 2	gal/a gal/a	57.8ab	6.51a	18.5a	2.20a
5	Success	8	fl oz/a	65.5ab	8.05a	12.5a	1.37a
LSD (P=.05)				18.68	3.083	13.92	1.834
Standard Deviation				12.13	2.001	9.03	1.190
CV				20.09	28.53	49.37	60.4
Bartlett's X2				5.881	2.456	2.386	5.797
P (Bartlett's X2)				0.208	0.652	0.665	0.215
Friedman's X2				7.55	8.55	6.75	4.6
P (Friedman's X2)				0.11	0.065	0.15	0.331
Replicate F				2.178	0.523	1.041	0.946
Replicate Prob(F)				0.1436	0.6743	0.4095	0.4491
Treatment F				3.407	2.147	1.194	0.858
Treatment Prob(F)				0.0441	0.0550	0.3629	0.5161

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.

Table 14: Percent marketable and culled fruit by number and weight, per 10-row feet, during the second harvest on August 13, 2008

Crop Code:				Percent Mktble Fruit By No. 8/13/2008 21 DDA3	Percent Mktble Fruit By Wt. 8/13/2008 21 DDA3	Percent Culled Fruit By No. 8/13/2008 21 DDA3	Percent Culled Fruit By Wt. 8/13/2008 21 DDA3
Part Rated:							
Rating Data Type:							
Rating Unit:							
Rating Date:							
Trt-Eval Interval:							
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	83	84	85	86
1	Untreated			78.97a	79.20a	21.03a	20.80a
2	Surround	25	lb/a	78.38a	80.79a	21.62a	19.21a
3	Cocoon Cocoon	100 25	lb/a lb/a	66.07a	68.38a	33.93a	31.62a
4	Eclipse Eclipse	3 2	gal/a gal/a	75.83a	76.88a	24.17a	23.12a
5	Success	8	fl oz/a	82.79a	84.79a	17.21a	15.21a
LSD (P=.05)				15.207	13.466	15.207	13.467
Standard Deviation				9.870	8.740	9.870	8.740
CV				12.92	11.2	41.84	39.74
Bartlett's X2				0.772	0.496	0.772	0.496
P (Bartlett's X2)				0.942	0.974	0.942	0.974
Friedman's X2				7.0	7.8	7.0	7.8
P (Friedman's X2)				0.136	0.099	0.136	0.099
Replicate F				1.979	1.914	1.979	1.914
Replicate Prob(F)				0.1709	0.1811	0.1709	0.1812
Treatment F				1.626	1.953	1.626	1.953
Treatment Prob(F)				1.2314	0.1662	0.2314	0.1662

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.

Table 15: The total number and weight of marketable and culled fruit per 10-row feet

Crop Code:				Total Number Mktble Fruit	Total Wt-Lbs Mktble Fruit	Total Number Culled Fruit	Total Wt-Lbs Culled Fruit
Part Rated:							
Rating Data Type:							
Rating Unit:							
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	88	89	90	91
1	Untreated			151.0a	21.39a	29.3a	4.86a
2	Surround	25	lb/a	161.0a	23.17a	34.8a	4.42a
3	Cocoon Cocoon	100 25	lb/a lb/a	94.5a	12.06a	42.5a	4.51a
4	Eclipse Eclipse	3 2	gal/a gal/a	120.5a	15.96a	41.8a	4.51a
5	Success	8	fl oz/a	155.0a	22.58a	19.8a	2.36a
LSD (P=.05)				84.21	15.697	23.20	3.483
Standard Deviation				54.65	10.188	15.06	2.260
CV				40.07	53.53	44.82	54.31
Bartlett's X2				10.34	17.57	4.185	6.726
P (Bartlett's X2)				0.035*	0.001*	0.382	0.151
Friedman's X2				7.4	7.45	4.6	1.4
P (Friedman's X2)				0.116	0.114	0.331	0.844
Replicate F				2.244	1.688	2.103	3.676
Replicate Prob(F)				0.1356	0.224	0.1533	0.0436
Treatment F				1.062	0.900	1.577	0.821
Treatment Prob(F)				0.4168	0.4943	0.2431	0.5360

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.

Table 16: The overall percent marketable and culled fruit by number and weight per 10-row feet

Crop Code:				Percent Number Mktble Fruit	Percent Wt-Lbs Mktble Fruit	Percent Number Culled Fruit	Percent Wt-Lbs Culled Fruit
Part Rated:							
Rating Data Type:							
Rating Unit:							
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	92	93	94	95
1	Untreated			81.75ab	81.89ab	18.25bc	18.11bc
2	Surround	25	lb/a	83.13ab	85.45ab	16.87bc	14.55bc
3	Cocoon Cocoon	100 25	lb/a lb/a	68.86c	73.15c	31.14a	26.85a
4	Eclipse Eclipse	3 2	gal/a gal/a	74.83bc	78.04bc	25.17ab	21.96ab
5	Success	8	fl oz/a	87.99a	90.11a	12.01c	9.89c
LSD (P=.05)				11.054	7.859	11.054	7.859
Standard Deviation				7.175	5.101	7.175	5.101
CV				9.05	6.24	34.68	27.92
Bartlett's X2				2.219	5.425	2.219	5.425
P (Bartlett's X2)				0.696	0.246	0.696	0.246
Friedman's X2				9.6	11.8	9.6	11.8
P (Friedman's X2)				0.048	0.019	0.048	0.019
Replicate F				1.842	2.991	1.842	2.991
Replicate Prob(F)				0.1933	0.0733	0.1933	0.0733
Treatment F				4.374	6.587	4.374	6.586
Treatment Prob(F)				0.0207	0.0048	0.0207	0.0048

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.

Table 17: Percent soluble solids (°brix) during the harvest period on July 31 and August 12, 2008

Rating Data Type:				°Brix Score/ 5-Fruit 7/31/2008 8 DAA3	°Brix Score/ 5-Fruit 8/12/2008 20 DAA3
Rating Unit:					
Infestation Unit:					
Rating Date:					
Trt-Eval Interval:					
Trt. No.	Treatment Name	Product Rate	Product Rate Unit	59	61
1	Untreated			4.5a	4.5a
2	Surround	25	lb/a	4.6a	4.6a
3	Cocoon Cocoon	100 25	lb/a lb/a	4.4a	4.6a
4	Eclipse Eclipse	3 2	gal/a gal/a	4.4a	4.5a
5	Success	8	fl oz/a	4.5a	4.5a
LSD (P=.05)				0.37	0.47
Standard Deviation				0.24	0.31
CV				5.31	6.74
Bartlett's X2				0.501	9.923
P (Bartlett's X2)				0.973	0.042*
Friedman's X2				3.95	2.2
P (Friedman's X2)				0.413	0.699
Replicate F				2.023	0.935
Replicate Prob(F)				0.1645	0.4537
Treatment F				0.585	0.213
Treatment Prob(F)				0.6796	0.9263

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.

Figure 7: Evaluation of sunburn-damaged fruit, with data compiled from two assessment periods (8 and 21 DAA3)

