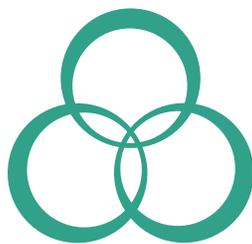


# ■ F i e l d T r i a l R e p o r t ■

## **Surround:** Preventing Sunburn and Enhancing Fruit Quality by Reducing Heat Stress on Citrus

Dan Forey, BioResearch, Fresno, CA



**NovaSource Advisory  
Council**

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2008

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Study Description:	<b>A Determination of the Effectiveness of Surround WP for Preventing Sunburn and Enhancing Fruit Quality by Reducing Heat Stress on Citrus</b>
Reference Number:	forey citrus 2008.doc
Researcher:	Dan Forey; BioResearch; 1738 N. Fowler Road; Fresno, CA 93727
Location :	Fresno, CA
Year:	2008
Trial Quality (Excellent, Good, Fair, Poor):	Good

Product(s):	Surround WP
	Sunguard
Rate(s):	Surround WP at 50 lb/A followed by 25 lb/A; Sun-Guard 60 lb/A
Adjuvant(s):	
Rate(s):	

Crop(s):	Mandarin orange
Variety:	Satsuma
Pest(s):	
Quality:	Brix (soluble solids)
Summary:	<p>Statistically significant differences in sunburn reduction were observed between both Surround and Sun-Guard and the untreated check. There were ca. 50% fewer sunburned fruit and ca. 20% more marketable fruit in the treated group compared to the untreated.</p> <p>There were no statistical differences in overall yield or quality. Numerically, there was ca. 7% increase in soluble solids (brix) in the Surround and Sun-Guard treatments compared to the untreated check. 2008 crop load was ca. 50% of normal and this appeared to allow trees to compensate for stress with the exception of direct sunburn damage.</p> <p>There were no handling or mixing problems during spray applications and no phytotoxicity was observed.</p>

# A Determination of the Effectiveness of Surround WP for Preventing Sunburn and Enhancing Fruit Quality by Reducing Heat Stress on Citrus

Bio Study No. 219-08

Research Director: Dan Forey, Bio Research

Principal Investigator: Scott Hicks, Research Biologist

Study Sponsor: NovaSource / Tessenderlo Kerley, Inc.

## Introduction

This trial was conducted to assess the effectiveness of Surround WP for preventing sunburn on citrus fruit. A site of mandarin oranges was selected for testing that was known to require protection from heat every year. There was a series of three spray applications made at approximately weekly intervals that were initiated prior to the first major heat event in June. Fruit evaluations were made near harvest. The fruit were sampled during color development because the grove was scheduled to be harvested early and gassed post-harvest to promote even coloration. Because of that, fruit were only counted as sunburn-damaged that had distinct symptoms of brown scarring or brownish leathery areas that were delineated within a yellowish concave affected portion of the rind in order to decrease statistical sampling error. The fruit damage was not rated.

## Materials and Methods

- A. Site Location:** Fresno, California
- B. Host Crop:** Mandarin orange  
Variety: Satsuma  
Age/Size: Mature trees
- C. Plot Description:**  
Plot Size: 18 x 48 feet (three trees/plot)  
Cultural Practices: Normal cultural practices for Central Valley mandarin orange production.  
Drip irrigated.  
Soil: Sandy loam.
- D. Pest History:** Normal maintenance sprays were applied to control insects and diseases.
- E. Pesticide History:** No heat-stress relieving products or anti-transpirants were applied to the test plots for the duration of the trial.
- F. Experimental Design:** Randomized complete block.
- G. Replication No. & Units:** 4, 3-tree replicates per treatment.
- H. Application Equipment:** A commercial-type tag-along airblast sprayer.  
Nozzle: D-8 45c  
PSI: 150  
GPA: 100  
Ground Speed: 3 mph

## I. Treatments:

		<b>Rate Applied</b>	<b>Timing</b>
1.	Untreated		
2.	Surround WP	50 lb/a 25 lb/a	Prior to sunburn conditions. Twice at approx. weekly intervals after the preventative spray applications.
3.	Sun-Gard	60 lb/a	Prior to sunburn conditions.

## J. Applications:

### Application 1

Date:	June 24, 2008
Time:	10:40 – 11:20 a.m.
Temperature:	84° F
Relative Humidity:	38%
Wind Speed:	0-3 mph
Wind Direction:	NW
Cloud Cover:	0%
Plant Growth Stage:	25-30 mm diameter fruit
Plant Vigor:	Good
Foliar Moisture:	Dry
Water pH:	6.5

### Application 2

Date:	July 1, 2008
Time:	12:15 – 1:00 p.m.
Temperature:	87° F
Relative Humidity:	38%
Wind Speed:	0-2 mph
Wind Direction:	NW
Cloud Cover:	0%
Plant Growth Stage:	30 mm diameter fruit
Plant Vigor:	Good
Foliar Moisture:	Dry
Water pH:	6.5

### Application 3

Date:	July 9, 2008
Time:	10:20 – 10:45 a.m.
Temperature:	92° F
Relative Humidity:	40%
Wind Speed:	0-3 mph
Wind Direction:	SE
Cloud Cover:	20%
Plant Growth Stage:	25-50 mm diameter fruit
Plant Vigor:	Good
Foliar Moisture:	Dry
Water pH:	6.0

Temperature and relative humidity were taken with a pocket sling psychrometer. Wind speed was determined using a Dwyer® Wind Meter. The water pH was measured using a pH paper manufactured by Micro Essential Laboratory, Inc.

## **K. Weather Conditions:**

The following weather data was recorded at California State University, Fresno located approximately 10 miles northeast of the test site (Statewide Weather Service, CIMIS Project Station 80) from June 24 to September 24, 2008:

Total Rainfall:	0.03 inches
High Temperature:	105.4° F (July 10)
Low Temperature:	52.5° F (September 23)

See Appendix 1 for complete environmental data.

## **L. Test Procedures:**

The test site was selected based on the availability of a commercial orange grove. Treatments were replicated and arranged down a single row using a randomized complete design. Plots were flagged with colored ribbon to identify the treatments. There were three total spray applications of the test materials. The spray applications were made on 6/24, 7/1, and 7/9/08, with the initial sprays completed just prior to a predicted heat spell. Sunburned fruit and fruit quality were evaluated at harvest on 9/24/08.

## **M. Sampling Procedures:**

At harvest, 50 fruit were examined on the center tree of each three tree replicate for distinguishable symptoms of sunburn in the field. Mature fruit were selected non-systematically from the sun-exposed south half of the canopies, where most of the damaged fruit were located. The fruit examined were in an area from ground level to approximately 6 feet above the ground. The symptoms of sunburn on the fruit consisted of a yellowish concave area on the fruit having either brownish scarring, or a brownish leathery condition on the rind of the orange. Sunburned fruit were not specifically rated for severity because color development masked symptoms, so any fruit having only yellowing areas were counted as marketable fresh fruit. In addition, 25 marketable fruit were also selected non-systematically and removed from the south side of the center tree in each plot and placed into pre-labeled fiberboard shipping boxes as bulk fruit. The boxes of fruit were kept shaded in the field before being taken back to the field test facility and weighed on a 15 kg capacity A/D brand floor scale. A sub-sample of 10 fruit were then segregated from each replicate sample and each individual orange was juiced and the soluble solids measured using an Atago brand PR-32 bench refractometer.

## **N. Statistical Analysis:**

The raw data were analyzed using 1-Way AOV, 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).

The replicate raw data are located in Appendices 2 and 3.

## **Results and Discussion**

Table 1 presents a summary of the results showing the effects of sunburn damage. Significant statistical differences were indicated between the protectant products as a group and the untreated check. There were approximately 50 percent fewer damaged fruit and approximately 20 percent more normal marketable fruit in the treated group than were observed in the untreated check. Figure 1 illustrates the effectiveness of Surround WP for preventing sunburn damage.

The effects on normal marketable fruit quality are summarized in Table 2. In terms of grams per 25 fruit or grams per fruit, there were no statistical differences between treatments. Overall heat stress did not appear to be a factor affecting fruit quality in this trial. Soluble solids also appeared to be unaffected based on the statistical analysis. However, numerically, there was approximately a 7 percent increase in soluble solids in the Surround WP and Sun-Gard treated plots relative to the untreated check. The crop load this year was approximately 50 percent of normal, which appeared to have allowed the trees to compensate for stress, except for direct sunburn damage on the fruit.

There were no handling or significant mixing problems during the spray applications of the test materials and no phytotoxicity was observed.

**Table 1.** Summary of harvest data showing the effects of Surround WP for preventing sunburn on mandarin oranges (var. Satsuma) grown near Fresno, CA. Spray applications were made on 6/24, 7/1, and 7/9/08 using a commercial-type airblast sprayer to apply 100 gpa. Evaluations were made on the indicated treatment evaluation interval.

Disease Code						Sunburn		Normal	
Crop Code						Citrus			
Part Rated						Fruit			
Rating Data Type						Number	Percent	Number	Percent
Rating Unit						Damaged		Normal	
Rating Date						9/24/2008			
Crop Stage						Harvest			
Crop Stage Scale						50 total			
Treatment-Evaluation Interval						77 DA-C			
Trt. No.	Treatment Name	Form Concen.	Form Type	Rate	Rate Unit				
1	Untreated					14.50a	29.00a	35.50b	71.00b
2	Surround		WP	50	lb/a	6.75b	13.50b	43.25a	86.50a
	Surround		WP	25	lb/a				
3	Sun-Gard		WP	60	lb/a	5.75b	11.50b	44.25a	88.50a
LSD (P=.05)						6.867	13.734	6.867	13.734
Standard Deviation						3.969	7.937	3.969	7.937
CV						44.1	44.1	9.68	9.68
Bartlett's X2						2.811	2.811	2.811	2.811
P(Bartlett's X2)						0.245	0.245	0.245	0.245
Friedman's X2						6.125	6.125	6.125	6.125
P(Friedman's X2)						0.047	0.047	0.047	0.047
Replicate F						2.159	2.159	2.159	2.159
Replicate Prob(F)						0.1940	0.1940	0.1940	0.1940
Treatment F						5.825	5.825	5.825	5.825
Treatment Prob(F)						0.0393	0.0393	0.0393	0.0393

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.

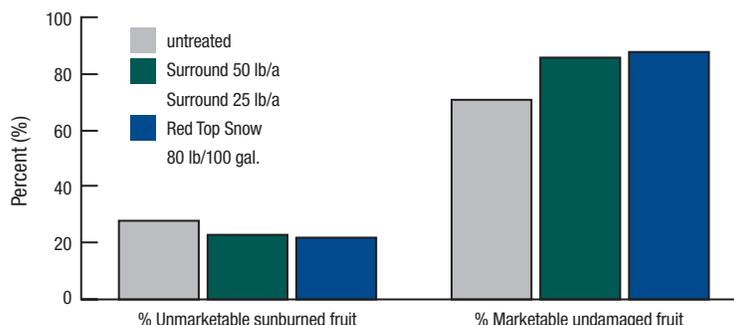
**Table 2.** Summary of fruit quality data showing the effects of Surround WP on mandarin oranges (var. Satsuma) grown near Fresno, CA. Spray applications were made on 6/24, 7/1, and 7/9/08 using a commercial-type airblast sprayer to apply 100 gpa. Evaluations were made on the indicated treatment evaluation interval.

Disease Code						Quality		
Crop Code						Citrus		
Part Rated						Fruit		
Rating Data Type						Weight/	Weight/	Soluble
Rating Unit						25 Fruit	Fruit	Solids
Rating Date						9/24/2008		
Crop Stage						Grams	Grams	Brix
Crop Stage Scale								10 Fruit
Treatment-Evaluation Interval						77 DA-C		
Trt. No.	Treatment Name	Form Concen.	Form Type	Rate	Rate Unit			
1	Untreated					2649.52a	105.98a	9.00a
2	Surround		WP	50	lb/a	2624.69a	104.99a	9.65a
	Surround		WP	25	lb/a			
3	Sun-Gard		WP	60	lb/a	2479.27a	99.17a	9.53a
LSD (P=.05)						575.805	23.033	1.153
Standard Deviation						332.779	13.311	0.667
CV						12.88	12.88	7.1
Bartlett's X2						1.374	1.374	1.378
P(Bartlett's X2)						0.503	0.503	0.502
Friedman's X2						0.0	0.0	1.5
P(Friedman's X2)						1.00	1.00	0.472
Replicate F						2.557	2.557	1.387
Replicate Prob(F)						0.1512	0.1512	1.387
Treatment F						0.306	0.306	1.098
Treatment Prob(F)						0.7475	0.7475	0.3924

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 1: NovaSource Surround Citrus Sunburn**



**Appendix I – Environmental data for the duration of the study.**

Daily Weather Data for Station # 80 Fresno State, in Region SJV (San Joaquin Valley) CIMIS Project														
Date 2008	ETo. In.	Precip. In.	Solar Rad. Ly/dy	Vapor Avg. mBars	Air Temp °F			Relative Humidity %			Dew Point °F	Wind avg. mph	Wind run mi	Avg. Soil °F
					min.	max.	avg.	min.	max.	avg.				
06/24/08	0.27	0.00	649	11.7	93.4	59.3	77.1	68	14	37	48.6	4.1	100.0	76.4
06/25/08	0.26	0.00	608	12.7	90.6	60.7	75.9	63	24	42	50.9	5.1	122.0	78.1
06/26/08	0.24	0.00	592	14.3	90.3	59.6	75.1	75	26	48	54.1	3.8	92.3	79.4
06/27/08	0.27	0.00	605	16.4	96.4	63.4	81.3	84	27	45	57.9	4.3	104.3	79.4
06/28/08	0.27	0.00	625	14.8	97.5	64.3	80.2	70	18	42	55.0	4.9	117.6	79.7
06/29/08	0.27	0.00	655	12.7	99.5	62.2	79.4	75	14	37	50.8	4.2	100.8	79.4
06/30/08	0.29	0.00	670	12.6	97.0	62.3	79.3	62	17	37	50.8	5.3	127.2	79.1
07/01/08	0.29	0.00	673	14.4	93.8	61.2	77.8	78	23	44	54.3	6.3	152.1	78.9
07/02/08	0.32	0.00	666	12.3	94.5	60.5	78.9	77	14	36	50.0	6.3	151.5	78.9
07/03/08	0.31	0.00	659	13.4	93.2	63.0	79.1	61	26	40	52.4	7.0	167.8	78.3
07/04/08	0.28	0.00	613	14.1	87.3	63.9	75.7	76	30	47	53.8	8.1	194.9	78.3
07/05/08	0.29	0.00	671	14.0	92.9	61.7	78.3	78	19	42	53.5	5.8	140.0	78.0
07/06/08	0.29	0.00	657	15.5	94.6	64.3	81.5	77	26	42	56.3	4.8	115.6	78.0
07/07/08	0.27	0.00	614	18.4	103.8	68.5	85.7	79	22	44	61.2	3.6	85.8	79.1
07/08/08	0.28	0.00	597	19.8	104.6	73.4	89.6	76	22	42	63.3	4.1	99.8	82.7
07/09/08	0.29	0.00	598	20.0	105.0	75.6	90.7	74	27	41	63.5	4.3	103.5	84.9
07/10/08	0.29	0.00	534	18.1	105.4	76.3	89.8	66	20	38	60.6	5.3	127.3	85.6
07/11/08	0.26	0.00	590	16.2	96.1	66.0	82.0	76	23	44	57.6	4.2	102.2	84.8
07/12/08	0.26	0.00	590	17.7	94.7	66.5	81.2	78	30	49	60.1	5.2	126.1	84.8
07/13/08	0.27	0.00	592	16.4	95.8	69.2	82.4	58	29	43	57.9	5.1	124.3	79.1
07/14/08	0.29	0.00	587	18.3	96.6	73.2	84.2	62	31	46	61.0	6.7	161.4	82.5
07/15/08	0.28	0.00	601	17.2	94.4	67.3	80.5	69	32	48	59.2	7.0	167.9	78.5
07/16/08	0.27	0.00	593	15.5	93.1	67.0	79.6	67	26	45	56.3	6.1	147.4	79.2
07/17/08	0.30	0.00	644	13.2	96.3	65.0	81.5	69	17	36	51.9	5.7	137.1	79.8
07/18/08	0.28	0.01	649	13.6	93.8	62.3	79.1	65	24	40	52.8	4.9	119.3	79.8
07/19/08	0.29	0.00	650	13.9	98.3	64.3	82.4	76	14	37	53.3	4.7	113.7	79.7
07/20/08	0.15	0.02	332	14.0	86.1	66.2	75.5	61	33	46	53.6	5.0	120.9	80.3
07/21/08	0.27	0.00	633	13.8	87.3	60.9	73.4	69	30	49	53.1	7.7	186.8	77.4
07/22/08	0.27	0.00	633	13.4	91.4	59.1	75.5	79	23	44	52.3	5.3	127.7	76.0

**Appendix I – Environmental data for the duration of the study.**

Date 2008	ETo. In.	Precip. In.	Solar Rad. Ly/dy	Vapor Avg. mBars	Air Temp °F			Relative Humidity %			Dew Point °F	Wind avg. mph	Wind run mi	Avg. Soil °F
					min.	max.	avg.	min.	max.	avg.				
07/23/08	0.28	0.00	654	13.0	95.9	60.6	79.9	81	16	37	51.5	3.9	94.4	77.7
07/24/08	0.29	0.00	644	12.9	96.5	62.4	81.2	68	17	36	51.4	5.0	120.3	77.6
07/25/08	0.30	0.00	638	13.3	97.6	61.3	81.5	72	18	36	52.1	5.3	128.0	77.9
07/26/08	0.30	0.00	622	13.3	98.2	63.0	82.4	76	17	35	52.2	5.0	119.8	78.2
07/27/08	0.29	0.00	616	12.6	95.4	64.3	80.0	62	19	36	50.8	6.1	146.7	78.3
07/28/08	0.27	0.00	605	13.1	92.3	61.3	77.4	71	24	41	51.6	5.5	132.6	78.2
07/29/08	0.28	0.00	593	12.1	92.0	61.7	77.7	69	21	37	49.5	6.3	153.1	78.1
07/30/08	0.27	0.00	646	11.8	93.3	58.3	77.3	73	18	37	48.8	4.6	110.6	72.6
07/31/08	0.29	0.00	634	12.7	94.7	61.5	80.5	72	18	36	50.8	5.5	132.9	74.6
08/01/08	0.30	0.00	634	10.8	94.0	61.2	79.2	56	21	32	46.6	5.8	139.0	77.2
08/02/08	0.30	0.00	633	13.3	95.1	62.1	80.8	71	20	37	52.2	5.9	141.8	78.5
08/03/08	0.29	0.00	630	12.8	96.5	64.2	80.9	58	20	35	51.0	5.6	134.1	77.6
08/04/08	0.27	0.00	616	13.5	96.6	61.2	80.6	71	22	38	52.5	4.5	109.6	77.8
08/05/08	0.28	0.00	590	12.5	94.8	65.7	81.3	60	21	34	50.5	5.2	125.0	79.0
08/06/08	0.28	0.00	600	12.7	96.5	65.2	81.5	62	20	35	51.0	4.9	118.5	78.9
08/07/08	0.28	0.00	599	13.4	98.2	65.5	82.3	64	21	36	52.3	5.0	120.6	78.8
08/08/08	0.27	0.00	599	13.5	96.9	63.6	80.4	59	22	38	52.6	5.0	120.0	78.7
08/09/08	0.28	0.00	611	11.9	91.5	62.3	76.7	60	22	38	49.2	6.3	152.0	78.5
08/10/08	0.27	0.00	615	12.7	93.4	59.5	78.0	76	21	39	50.8	5.1	122.3	77.9
08/11/08	0.27	0.00	612	12.6	96.6	60.5	80.1	78	13	36	50.7	4.1	98.4	77.5
08/12/08	0.27	0.00	609	13.1	99.0	61.8	82.0	77	13	35	51.6	4.0	96.1	77.4
08/13/08	0.26	0.00	582	15.8	100.9	64.4	83.6	84	20	40	56.9	3.6	85.9	77.5
08/14/08	0.26	0.00	564	46.3	103.3	67.4	86.7	80	19	37	57.7	3.9	93.8	78.0
08/15/08	0.29	0.00	580	13.5	102.7	69.2	86.4	60	12	31	52.5	4.8	114.9	78.4
08/16/08	0.28	0.00	556	14.2	101.2	69.0	85.2	64	16	34	53.9	5.0	121.6	78.4
08/17/08	0.25	0.00	558	14.3	97.1	66.3	81.1	70	20	39	54.0	4.8	116.9	78.3
08/18/08	0.25	0.00	570	15.2	92.6	63.2	77.3	79	24	48	55.9	6.0	143.7	78.0
08/19/08	0.25	0.00	550	13.1	86.2	59.6	73.3	77	24	47	51.8	7.7	184.7	77.6
08/20/08	0.23	0.00	564	14.4	88.2	58.7	74.9	82	28	49	54.4	6.1	147.6	77.1
08/21/08	0.24	0.00	555	18.0	92.1	66.7	79.6	82	33	52	60.5	5.3	127.4	77.3
08/22/08	0.25	0.00	552	15.2	95.3	65.5	80.8	71	27	42	55.8	4.9	119.1	77.7
08/23/08	0.25	0.00	555	15.8	97.9	64.8	81.6	76	24	43	56.9	4.7	114.4	77.7
08/24/08	0.25	0.00	550	16.1	98.9	65.1	82.8	78	21	42	57.4	4.2	100.8	77.9
08/25/08	0.28	0.00	558	14.4	97.1	64.9	82.4	75	18	38	54.2	6.3	152.5	78.8
08/26/08	0.24	0.00	555	12.6	94.5	62.3	78.9	56	23	37	50.6	4.4	105.8	80.2
08/27/08	0.23	0.00	545	14.7	97.1	63.2	80.6	77	23	41	55.0	3.3	80.8	76.0
08/28/08	0.23	0.00	536	15.9	99.1	66.0	83.4	81	20	41	57.0	3.1	74.6	78.3
08/29/08	0.24	0.00	545	16.2	102.7	67.2	85.5	77	20	39	57.5	3.7	89.6	79.2
08/30/08	0.28	0.00	544	13.5	100.7	68.6	85.5	73	13	32	52.6	5.3	128.7	80.6
08/31/08	0.28	0.00	579	9.4	85.2	58.9	73.3	74	20	34	42.9	7.4	179.5	78.8
09/01/08	0.21	0.00	576	9.8	83.4	53.7	68.2	75	20	42	44.1	4.0	97.0	74.9
09/02/08	0.23	0.00	558	10.3	92.3	54.1	73.9	74	18	36	45.3	3.9	95.2	73.5
09/03/08	0.22	0.00	545	11.5	96.2	56.2	75.5	78	16	38	48.3	2.9	70.4	73.8

**Appendix I – Environmental data for the duration of the study.**

Date 2008	ETo. In.	Precip. In.	Solar Rad. Ly/dy	Vapor Avg. mBars	Air Temp °F			Relative Humidity %			Dew Point °F	Wind avg. mph	Wind run mi	Avg. Soil °F
					min.	max.	avg.	min.	max.	avg.				
09/04/08	0.23	0.00	553	11.4	96.7	56.5	76.9	76	15	36	47.9	3.0	72.6	74.6
09/05/08	0.23	0.00	529	12.2	97.0	59.6	78.9	73	19	36	49.8	3.7	89.1	74.6
09/06/08	0.23	0.00	524	13.8	98.4	60.9	80.3	79	19	39	53.1	3.5	85.3	74.9
09/07/08	0.24	0.00	521	12.9	100.6	62.3	81.6	82	13	35	51.4	4.1	98.6	75.2
09/08/08	0.23	0.00	513	11.6	97.8	61.4	80.3	65	16	33	48.4	4.1	99.4	75.2
09/09/08	0.20	0.00	503	13.2	90.6	58.1	73.8	76	22	46	51.9	4.2	100.6	75.0
09/10/08	0.18	0.00	502	13.6	84.9	55.8	69.8	86	28	54	52.7	4.8	115.0	74.7
09/11/08	0.18	0.00	497	14.5	90.2	57.6	73.6	87	26	51	54.5	2.8	67.9	74.4
09/12/08	0.21	0.00	500	12.9	93.8	60.2	76.4	84	16	42	51.4	3.6	86.0	74.3
09/13/08	0.18	0.00	457	12.7	88.4	56.5	71.8	79	27	48	50.9	3.8	92.1	73.9
09/14/08	0.18	0.00	482	13.4	91.6	56.8	73.3	83	22	48	52.4	3.0	72.3	73.6
09/15/08	0.19	0.00	468	13.8	92.7	57.3	75.5	85	23	46	53.1	3.0	73.2	73.6
09/16/08	0.17	0.00	434	14.5	95.9	58.1	77.1	89	21	46	54.5	2.9	68.8	73.7
09/17/08	0.19	0.00	457	13.2	86.3	60.7	71.8	70	29	50	52.0	5.8	139.6	73.9
09/18/08	0.16	0.00	469	12.5	92.2	53.3	69.1	80	24	52	50.5	3.7	88.1	73.3
09/19/08	0.17	0.00	419	12.3	83.8	56.0	68.2	74	32	52	50.0	6.7	160.7	73.2
09/20/08	0.17	0.00	459	14.2	79.7	56.6	67.7	91	35	61	54.0	6.7	162.8	73.0
09/21/08	0.17	0.00	449	12.8	80.7	53.4	67.6	91	31	56	51.2	5.2	124.4	72.8
09/22/08	0.16	0.00	465	12.0	83.3	52.8	67.3	85	25	53	49.4	3.6	86.2	72.6
09/23/08	0.17	0.00	450	12.1	89.7	52.5	70.1	86	21	48	49.6	2.9	70.7	72.3
09/24/08	0.18	0.00	450	11.9	95.1	53.7	74.3	86	17	41	49.1	2.7	64.6	72.3

ly/day\* .484=W/sq.m in. \*25.4=mm (F-32 \*5/9=c mph\* .447=m/s mBars\* .1=kPa)

A-hist. avg. C-not collected E-one sensor hist. avg. F-out of normal range H-missing hourly I-ignore M-missing Q-related sensor miss. S-not in service

**Appendix 2 – Replicate raw data in support of Table 1.**

Disease Code:			Sunburn		Normal	
Crop Code:			Citrus			
Part Related:			Fruit			
Rating Data Type:			Number	Percent	Number	Percent
Rating Unit:			Damaged		Normal	
Rating Date:			September 24, 2008			
Crop Stage:			Harvest			
Crop Stage Scale:			50 Total			
Disease Stage:			Fruit			
Trt-Eval Interval			77 DA-C			
Trt. No.	Treatment Name	Plot	1	2	3	4
1	Untreated	101	23.0	46.0	27.0	54.0
		203	11.0	22.0	39.0	78.0
		302	8.0	16.0	42.0	84.0
		401	16.0	32.0	34.0	68.0
		Mean	14.5	29.0	35.5	71.0
2	Surround	102	13.0	26.0	37.0	74.0
		201	4.0	8.0	46.0	92.0
		303	5.0	10.0	45.0	90.0
		402	5.0	10.0	45.0	90.0
		Mean	6.8	13.5	43.3	86.5
3	Sun-Gard	103	5.0	10.0	45.0	90.0
		202	9.0	18.0	41.0	82.0
		301	4.0	8.0	46.0	92.0
		403	5.0	10.0	45.0	90.0
		Mean	5.8	11.5	44.3	88.5

**Appendix 3 – Replicate raw data in support of Table 2.**

Disease Code:			Quality		
Crop Code:			Citrus		
Part Related:			Fruit		
Rating Data Type:			Weight	Weight	Soluble
Rating Unit:			25 Fruit	Fruit	Solids
Rating Date:			September 24, 2008		
Crop Stage:			Grams		Brix
Crop Stage Scale:			25 Total		10 Total
Disease Stage:			Fruit		
Trt-Eval Interval			77 DA-C		
Trt. No.	Treatment Name	Plot	7	8	9
1	Untreated	101	3390.81	135.63	7.30
		101			7.00
		101			8.50
		101			8.60
		101			9.10
		101			9.10
		101			7.40
		101			9.00
		101			9.10
		101			9.00
		203	2057.19	82.92	10.30
		203			10.10
		203			9.30
		203			9.50
		203			11.30
		203			10.30
		203			8.80
		203			9.40
		203			8.30
		203			6.60
		302	2582.13	103.29	8.30
		302			9.10
		302			8.10
		302			9.50
		302			9.10
		302			8.30
		302			9.30
		302			10.60
		302			9.10
		302			10.00
		401	2567.94	102.72	9.50
		401			8.60
		401			9.40
		401			8.50
		401			8.50
		401			9.60
		401			9.00
		401			7.90
		401			9.10
		401			10.30
Mean			2649.52	105.98	9.00

**Appendix 3 (cont.) – Replicate raw data in support of Table 2.**

Disease Code:			Quality		
Crop Code:			Citrus		
Part Related:			Fruit		
Rating Data Type:			Weight	Weight	Soluble
Rating Unit:			25 Fruit	Fruit	Solids
Rating Date:			September 24, 2008		
Crop Stage:			Grams		Brix
Crop Stage Scale:			25 Total		10 Total
Disease Stage:			Fruit		
Trt-Eval Interval			77 DA-C		
Trt. No.	Treatment Name	Plot	7	8	9
2	Surround	102	3021.84	120.88	10.20
		102			8.40
		102			9.70
		102			8.30
		102			11.40
		102			11.40
		102			10.30
		102			10.60
		102			10.60
		102			11.30
		201	2340.94	93.64	10.00
		201			9.90
		201			10.90
		201			9.50
		201			10.60
		201			9.50
		201			9.70
		201			10.80
		201			10.60
		201			10.50
		303	2312.56	92.50	9.90
		303			10.00
		303			9.40
		303			10.70
		303			9.10
		303			8.00
		303			10.50
		303			10.10
		303			10.50
		303			8.00
		402	2923.31	112.93	9.10
		402			8.40
		402			8.20
		402			9.60
		402			8.30
		402			8.60
		402			7.30
		402			8.80
		402			8.90
		402			8.50
		Mean	2624.69	104.99	9.65

**Appendix 3 (cont.) – Replicate raw data in support of Table 2.**

Disease Code:			Quality		
Crop Code:			Citrus		
Part Related:			Fruit		
Rating Data Type:			Weight	Weight	Soluble
Rating Unit:			25 Fruit	Fruit	Solids
Rating Date:			September 24, 2008		
Crop Stage:			Grams		Brix
Crop Stage Scale:			25 Total		10 Total
Disease Stage:			Fruit		
Trt-Eval Interval			77 DA-C		
Trt. No.	Treatment Name	Plot	7	8	9
3	Sun-Gard	103	2312.56	92.50	10.60
		103			11.20
		103			9.50
		103			10.10
		103			9.30
		103			9.40
		103			9.60
		103			9.20
		103			9.40
		103			10.50
		202	2255.81	90.23	10.00
		202			10.60
		202			8.80
		202			10.70
		202			10.50
		202			10.10
		202			10.40
		202			10.50
		202			11.00
		202			11.10
		301	2482.81	99.31	9.50
		301			9.40
		301			9.60
		301			9.00
		301			6.30
		301			7.90
		301			5.80
		301			9.20
		301			8.60
		301			8.30
		403	2865.88	114.64	9.40
		403			9.90
		403			10.70
		403			6.50
		403			10.00
		403			10.30
		403			9.40
		403			9.30
		403			9.50
		403			10.00
Mean			2479.27	99.17	9.53