

Worker Exposure to Captan Residues While Performing Cultural Practices on Table Grapes

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SUMMARY

Grapes are a labor-intensive crop, requiring workers to enter the vineyards several times during the growing season to perform various cultural practices (girdling, cane cutting, harvesting, etc.). The amount of captan applied to grapes, coupled with frequent worker entry into treated vineyards, makes grapes a desirable crop to characterize worker exposure. During the summer of 1988, studies were conducted to monitor worker exposure while performing cultural tasks in grapes. The mean measured dermal exposure for cane cutters was 7.12 ± 5.33 mg/person/day while the average exposure for workers involved in the harvest operations was 4.20 ± 2.77 mg/person/day. Harvest operations involved field packing as well as hand picking grapes. Even though dermal contact with the foliage is less for field packers, the exposure is similar. Urine samples were collected from leaf pullers and harvesters for cis-1,2-dicarboximide-4-cyclohexene. All urine samples were reported as none detected (MDL= 0.005 µg/mL).

INTRODUCTION

Captan is the accepted common name for N-trichloromethyl-thio-4-cyclohexene-1,2-dicarboximide. It is a broad spectrum protectant-eradicator fungicide registered since the early 1950's and used on a number of fruit and vegetable crops, plant seeds, and non-food products.

A special review process for captan began in 1980, following identification of possible mutagenic and oncogenic effects in several studies (EPA, 1980). Captan has been shown to be mutagenic in in vitro experiments using bacteria, eukaryotic microorganisms, and mammalian cells in culture, but the results are questionable in the in vivo experiments. The Environmental Protection Agency (EPA) has concluded that the risk to humans of heritable mutagenicity is extremely low or non-existent and for this reason is not in the process of quantitatively extrapolating mutagenic risk to humans in the case of captan. However, the EPA has classified captan as a probable human carcinogen based on evidence that it produces oncogenic effects in mice and male rats and therefore may pose a potential risk of cancer to consumers of treated commodities (EPA, 1985). Captan is also under review by the Department of Pesticide Regulation (DPR) due to its inclusion on the list of chemicals of concern generated by the Birth Defect Prevention Act of 1984.

In 1988, there were 119 captan-containing products registered for use in California. A total of 201,201 pounds of captan reported as **used** in California for the same year. Of that amount, grapes received the greatest number of applications (566) to the largest acreage (50,410 acres) for a total of 103,551 pounds applied to grapes (CDFA, 1990). There were 735,479 pounds reported as **sold** in 1988 (Pesticide Enforcement, 1989). Differences between amount used and amount sold can be explained by the fact that captan is not a restricted material and therefore was not required to be reported by non-licensed applicators.

Grapes are a labor-intensive crop, requiring workers to enter the vineyards several times during the growing season to perform various cultural practices (girdling, cane cutting, harvesting, etc.). Additionally, workers' contact with foliage during the conduct of these cultural practices can be considerable. The amount of captan applied to grapes, coupled with frequent worker entry into treated vineyards, makes grapes a desirable crop to characterize worker exposure. During the summer of 1988, the Worker Health and Safety (WHS) Branch of the California Department of Food and Agriculture conducted a series of studies to monitor worker exposure while performing cultural tasks in grapes. (WHS is now in the California Environmental Protection Agency, Department of Pesticide Regulation). Worker exposure during the captan application is reported separately (O'Connell et al., 1990). The current study has its focus primarily on the estimation of dermal exposure to captan among field workers pulling leaves, cutting cane, and harvesting table grapes and secondarily the calculation of transfer factors for each activity.

MATERIALS AND METHODS

Application:

In 1988, a large San Joaquin grower agreed to allow DPR to monitor all activities occurring in captan-treated vineyards of Red Emperor grapes. Captan-Sulfur 15-40 Dust (EPA #239-1678 279 AA) was applied at a rate of 25 pounds/acre (3.75 lb. active ingredient/acre) using duster rigs. Applications were completed in mid-July. Worker exposure studies were conducted on the following cultural practices: cutting cane and pulling leaves (63 days post-application), and harvesting (119 days post-application).

Study Characteristics:

Workers monitored during this study worked approximately eight hours each day. All workers wore long pants, shoes, a long or short-sleeved shirt, and a hat. Some persons placed bandannas underneath their hats to cover the back of their necks. For the first few hours of work, most workers wore jackets or sweatshirts over their work clothes. These garments were removed once the ambient temperature became comfortable, usually just before noon.

After observing both cane cutting and leaf pulling, the investigators concluded that the foliar contact was similar during these two tasks. Urine monitoring was performed for three consecutive days on a crew of 20 workers pulling leaves, while dermal monitoring was conducted on five cane-cutters. During the harvest portion of the study, a crew of 25 workers were monitored over a six day period. After obtaining the necessary volunteers it was determined that some of the workers would be field packing the grapes and some would be conducting both activities (one-half day for each activity). Urine monitoring was performed for the first three days of the study, followed by three days of dermal monitoring. Urine monitoring was conducted first to eliminate any possible effect the dosimetry and hand washing activity might have on dermal absorption.

Foliar Monitoring:

Foliar monitoring was conducted on all study days. On each day, the area where the monitored worker activity was to occur was divided into plots, with six plots randomly selected for sampling. Each sample consisted of 40 leaf disks, each 2.5 cm in diameter, taken with a Birkestrand® leaf sampler and collected in a four-ounce glass jar. The leaves were sampled from areas of the vine most likely to be contacted by the workers during their tasks. Sampling was completed before each day's activity, and then immediately after the workers were finished working in the selected plots. The purpose of the pre- and post-work sample collection was to examine the relationship of the change in dislodgeable captan residue with dermal dosimetry or biological monitoring.

Urine monitoring:

Urine was collected from persons working as leaf pullers, and from all persons monitored during the harvest study. In rat metabolism studies, approximately 84 percent of an oral dose was excreted in the urine. More than 50 percent of the dose was excreted (by all routes) within 24 hours (Fong and Krieger, 1990). Since captan metabolites are rapidly eliminated in the urine, these workers were asked to collect each day's entire urine output for a three day period. Several one liter brown Nalgene® bottles were provided daily to each worker for sample collection. Each day's sample began with the first voiding after the start of work, and continued until the first voiding the following morning. At the end of each 24- hour sampling period, the volume was recorded and an aliquot was taken and stored on dry ice. Urine was analyzed for cis-1,2-dicarboximide-4-cyclohexene (THPI). Each aliquot was also analyzed for creatinine to estimate the completeness of sample collection.

Dermal monitoring:

Dermal monitoring was conducted at the completion of the urine monitoring during the harvest study, and on persons involved in the cane-cutting operation. Each worker was monitored for three consecutive days. Long-sleeve 100% cotton T-shirts and 100% cotton socks were given to each worker to wear under their work clothes or shoes, next to the skin. Bi-layer patch dosimeters were attached to the front and rear of the pants at thigh level. Thigh dosimeters were constructed of an outer layer of polyester/cotton twill, a middle layer of 12-ply 100% cotton gauze, and an inner layer of aluminum foil. Dosimeters were encased in a foil-backed holder that allowed an exposed surface area of 23.75 cm².

Hand exposure was measured using alcohol hand wipes (Chubbs®). Hand wipes were conducted before work began each day, and at various intervals during the workday when the workers would normally wash their hands. Pre-work hand wipes were not saved for analysis, but served as a way of insuring that all persons began the workday with hands cleaned in a similar manner. Each worker was asked to clean their hands with a hand wipe until the hand wipe was visibly dirty. They were then given a second hand wipe to repeat the process. The two hand wipes were combined in a four-ounce glass jar and considered as one sample. During the leaf-puller/cane-cutter study, hand wipes were performed before the morning break and at the end of the workday. Harvesters washed their hands before their morning break, before lunch, and at the end of the workday.

At the end of each monitoring period, workers were requested to complete the following tasks in order as listed: (1) hand wipe; (2) face wipe and (3) removal of the dermal dosimetry.

The layers of each thigh patch dosimeter were separated, with the twill layers considered as one sample, and the gauze and foil layers considered as another. Matched layers from each worker's front thigh dosimeters were

combined in one four-ounce glass jar, to be analyzed as one sample. Back thigh dosimeters were treated in an identical manner.

Following removal of the T-shirt, the sleeves were cut off at the shoulder seam, and placed in a one-gallon Ziploc[®] bag. The torso was placed in a separate Ziploc[®] bag and submitted as a separate sample.

Sample Storage and Transportation:

All samples in glass jars were sealed with aluminum foil and capped. Foliage samples were stored and shipped on ice. All other samples were stored and shipped on dry ice. A set of sample blanks was submitted for analysis with the dermal field samples. The blanks were stored, shipped, and analyzed in the same manner as the actual field samples. Each evening, samples were shipped via common carrier bus to CDFA's laboratory in Sacramento. Foliage samples were extracted within 24 hours of collection. All other samples were kept frozen until analysis.

Extraction, Cleanup and Analysis:

Dislodgeable captan residues on leaf samples were prepared according to Gunther et al. (1973). Samples were rotated three times, for twenty minutes each, with distilled water and surfactant (dioctyl sodium sulfosuccinate) solution. The aqueous solution was extracted with ethyl acetate, then dried with sodium sulfate.

Captan residues were extracted from the dermal dosimetry, hand wipes and face wipes by separately tumbling individual samples with ethyl acetate. The extract was then dried with sodium sulfate.

The extracts of all media types were analyzed on a 12.5 m x 0.20 mm i.d. cross linked capillary column coated with methyl silicone, using a Hewlett-Packard 5880A gas chromatograph with an electron capture detector. Column temperature, injection port temperature, and detector temperature were 195, 225, and 350 °C, respectively. Using these conditions, captan has a retention time of 5.63 minutes.

Urinary THPI was determined as reported by Winterlin et al. (1984). Twenty-five mL aliquots were extracted with methylene chloride. The methylene chloride extract was passed through a solid phase extraction cartridge (Sep-Pak, Waters Associates), filtered, dried, and taken up in benzene. The extract was analyzed using a Hewlett-Packard 5880A gas chromatograph with an N/P ionization detector. The minimum detectable level of THPI in urine was 0.03 µg/mL and recoveries ranged from 80 to 89 percent.

Data Analysis:

Using EPA's value of 3820 cm² for the total surface area of the thighs (Reinart et al., 1986), the residues found on the gauze and foil layers were extrapolated to give a dermal exposure estimate for the thighs. Residues found on T-shirt, sock, face wipe and hand wipe samples provided torso, arm, lower leg, face/neck and hand dermal exposure estimates. Exposure estimates for each body region were summed to yield estimated dermal exposure. For samples found to be below the MDL, a value of one-half the MDL was used in the exposure calculations.

Hoffman et al. (1973) reported that 85 percent of the dose is eliminated in the urine with 15 percent of that eliminated as THPI. These percentages and the difference in molecular weight between captan and THPI were used to approximate the captan dose.

RESULTS

Results of the dermal monitoring can be found in Table 1 (cane cutting) and Table 2 (harvesting). The mean measured dermal exposure for cane cutters was 7.12 ± 5.33 mg/person/day. The maximum and minimum daily exposures measured were 22.5 and 2.05 mg/person, respectively. For eight of 14 cane cutters a complete set of dermal exposure measurements was available. Incomplete sets of measurements occurred as follows: on day one, none of the workers were equipped with thigh patches; worker 5 did not participate in day one of the

monitoring effort and the face wipe sample was lost for one worker on day 2. The average exposure calculated with complete data sets was 9.12 ± 5.93 mg/person and for incomplete data sets 4.46 ± 3.11 . Using one-way analysis of variance (ANOVA, SPSS, 1988), there was no significant difference between complete and incomplete data sets ($p > 0.05$). Therefore, all data sets were used in determining the exposure estimates. The results from all urine samples of the leaf pullers were reported as none detected (MDL = $0.005 \mu\text{g/mL}$).

To substantiate the initial work task observations that the exposure is similar for leaf pullers and cane cutters, hand wipe and face wipe samples were collected from all workers on day three at the completion of the work day. Mean hand exposure for leaf pullers and cane cutters was 1.73 ± 1.47 and 1.50 ± 2.02 mg/person, respectively. Face exposure averaged 0.20 ± 0.11 and 0.20 ± 0.13 mg/person, respectively. Using a two-tailed T-test (SPSS, 1988), there is no significant difference between leaf pullers or cane cutters for either face wipes or hand wipes ($p > 0.05$).

Dermal exposure for workers involved in the harvest operations (hand picking, field packing or both) averaged 4.20 ± 2.77 mg/person/day, with values ranging from 0.58 to 13.0 mg/person/day. Dermal exposure of 25 workers was monitored for three days during harvest operations for a total of 75 worker-days. For 41 of the 75 worker-days monitored there were no missing data. Of the remaining 34 worker-days, missing data included 24 worker-days with missing torso and/or sleeve samples, 9 worker-days were with missing thigh patch samples, 11 worker-days with missing sock samples and 11 worker-days with missing face wipe samples. Average daily exposure for the complete data sets was 4.25 ± 2.89 mg/person; daily exposure for incomplete data sets averaged 4.15 ± 2.66 mg/person. Using a one-way ANOVA (SPSS, 1988), average dermal exposure between complete and incomplete data sets was not significantly different ($p > 0.05$). Thus data from all worker-days were used in the harvester exposure calculations. Urine samples from the harvesters all contained non-detectable concentrations of THPI.

Of the 75 worker-days monitored, 51 were spent harvesting, 13 field packing and 11 doing both harvesting and field packing (half day each). The average measured exposures for the harvesters, packers and packer/harvesters were 4.37 ± 2.90 , 4.23 ± 3.02 and 3.42 ± 1.74 mg/person, respectively. These three average exposures are not significantly different ($p > 0.05$; one-way ANOVA, SPSS, 1988).

In some instances, workers (primarily women) wore the T-shirt and sock dosimeters over rather than under their work clothing. Again using one-way ANOVA, the shirt placement (over vs. under work clothes) had a significant effect on upper body (torso/arm) exposure ($p < 0.05$) but not on total exposure ($p > 0.05$). The placement of the socks (over or under pants) did not have a significant effect on either lower leg exposure or total exposure ($p > 0.05$).

Figure 1 presents the distribution of the measured exposure for both cane cutters and harvesters. The noted differences between the two activities might be a result of canopy management practices. During harvest, there is less foliage near the grape bundles as a result of the leaf pulling and cane cutting operations. Figure 2 graphically displays the dermal exposure of cane cutters and harvesters. (Appendices 1 and 2 contain the results from the individual samples for each worker monitored. The appendices can be obtained upon request.)

DFR in the vineyards, in general, appeared to have increased following field worker activity (Table 3). However, the results are extremely variable and not predictable. Average DFR before and after cane cutting/leaf pulling was 0.456 and $0.711 \mu\text{g/cm}^2$, respectively. Of the 12 samples collected from six plots, nine had higher residues after pulling and/or cutting than before the workers went through. Leaf-pulling and cane cutting tend to be very vigorous and dusty activities. The intensity of the activity may result in the increase in captan residue. For harvest activities, in 12 of the 18 pre- and post-harvest comparisons, the residue was lower in the post-harvest sample. However, the overall average suggests otherwise with residues of $0.292 \mu\text{g/cm}^2$ before harvest and $0.368 \mu\text{g/cm}^2$ after harvest. The large differences in two of the samples (day 2/rep 1 and day 2/rep 6) may have skewed the average.

DISCUSSION

Data from a number of in vitro and in vivo studies have estimated the dermal absorption of captan to be in the range of 1 - 31% per 24 hours. A rate of 6% per 24 hours is used by CDFA for regulatory purposes (Fong and Krieger, 1990).

Using the 6% absorption rate, an estimate of captan in the urine can be calculated assuming that 85% of a dermal dose would be eliminated in the urine, with 15% of that eliminated as THPI (Hoffman et al., 1973). This study's maximum dermal exposure of 22.5 mg for cane cutters and 13.0 mg for harvesters would theoretically yield 0.09 and 0.05 mg (13.0 mg x 6% x 85% x 15% x .05) THPI in the urine, respectively. Using the average dermal exposure estimates of 7.12 mg/person for cane cutters and 4.20 mg/person for harvesters yields a theoretical value of 0.02 and 0.015 mg THPI in the urine. These estimates are greater than the concentration found during urine monitoring. No sample collected during this study had THPI levels above the minimum detectable level of 0.005 mg/L. Winterlin et al. (1986) found no significant difference in the concentration of THPI in urine samples pre- and post-activity for both grape thinners and harvesters.

Recent work has been done to establish empirical models relating dislodgeable foliar residue levels to worker exposure. In one model, a transfer factor, is derived from the relationship of separate measurements of potential dermal exposure ($\mu\text{g/hr}$) and dislodgeable residue ($\mu\text{g/cm}^2$) (Zweig et al., 1983 and 1984 and Nigg et al., 1984). In general, a lower transfer factor is expected for persons working with low contact crops, such as lettuce and strawberries, as compared to higher contact crops such as grapes and tree crops. From registrant-supplied worker exposure studies involving the harvest of captan-treated crops, the following transfer factors were calculated: grapes - 15,633 cm^2/hour ; peaches - 3,929 cm^2/hour ; strawberries - 2,333 cm^2/hour ; tomatoes - 1,644 cm^2/hour (Fong and Krieger, 1990). Using the mean potential dermal exposure values calculated during the cane cutting (assuming dermal exposure measured and a 90% clothing protection factor) and the average DFR found before worker activity, a transfer factor of 12,253 cm^2/hr was calculated. A transfer factor of 7,384 cm^2/hr was calculated for harvest.

An evaluation of the dermal exposure measured during harvest activities (hand picking grapes and field packing grapes) suggests that some mechanism other than direct transfer of pesticide residue from the leaf surface to the body is in operation. The field packers' exposure does not normally involve foliar contact.

In addition, it would appear that timing of the DFR sample collection might have an effect on exposure as estimated by transfer factors. Adams et al, (1976) states that contaminated soil through the action of wind or mechanical agitation can serve as a source for foliar contamination. Thus as the cane cutters and leaf pullers are hustling through the vineyard, they may be stirring up dust for redeposition on the foliage and deposition on their bodies. These results suggest further study of the mechanism of field workers' exposure is needed.

CONCLUSIONS

The exposures measured and transfer factors calculated in this work are in the same range as those found by other investigators. As expected, the dermal exposure measured during cane cutting activities was higher than that measured during harvest activities. However, the foliar transfer factor theory does not explain the measured exposure of the harvest workers whose activity involved field packing grapes. These workers have little or no foliar contact. Thus, the mechanisms of worker exposure need further evaluation.

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TABLE 1:

CANE CUTTER DERMAL EXPOSURE TO CAPTAN
(micrograms)

Worker /Day	Upper Body Exposure	Lower Body Exposure	Hand Exposure	Face Exposure	Total Exposure	Incomplete (I) or Complete (C)
1/1	2563	102	1403	405	4473	I
1/2	3944	1145	2592	162	7843	C
1/3	3366	2471	6547	181	12566	C
2/1	1402	111	1253	163	2929	I
2/2	2091	1203	2885	250	6429	C
2/3	1764	815	2823	177	5580	C
3/1	1125	280	591	134	2130	I
3/2	8857	1004	484	NS	10345	I
3/3	1594	1752	1667	201	5213	C
4/1	3671	98	933	108	4810	I
4/2	2343	1575	1049	189	5156	C
4/3	1372	101	472	104	2049	I
5/1	NS	NS	NS	NS	NS	I
5/2	3119	2902	1509	98	7628	C
5/3	10112	5796	6187	427	22522	C

TABLE 2

HARVESTER DERMAL EXPOSURE TO CAPTAN (micrograms)

Worker /Day	Upper Body Exposure	Lower Body Exposure	Hand Exposure	Face Exposure	Total Exposure	Activity	Incomplete (I) or Complete (C)
1/1	306	168	2722	160	3303	Pick	C
1/2	NS	78	1474	96	1648	Pick	I
1/3	1299	445	733	4	2482	Pick	C
2/1	1067	579	375	230	2250	Pick	C
2/2	1256	242	1463	45	3006	Pick	C
2/3	4398*	292	1234	45	5925	Pack PM	C
3/1	3609	6069	2805	197	9080	Pick	I
3/2	NS	141	5247	77	5465	Pick	I
3/3	2550*	870	2685	27	6133	Pick	C
4/1	2048	258	6257	360	8923	Pick	I
4/2	1139	236	3962	120	5457	Pick	I
4/3	1061	470	668	6	2206	Pick	C
5/1	549	344	4326	708	5927	Pick	C
5/2	356	734	1529	63	2682	Pick	I
5/3	814	199	8869	5	9889	Pick	C
6/1	109	589	2145	57	2901	Pick	I
6/2	812	354	3435	320	4921	Pick	I
6/3	1390	205	748	3	2346	Pick	C
7/1	255	51	2237	11	2544	Pick	C
7/2	NS	112	3393	48	3553	Pack AM	I
7/3	808*	24	654	2	1487	Pack PM	I
8/1	2155	495	2179	154	4982	Pick	C
8/2	1517	545	3691	351	6104	Pick	I
8/3	1693	618	341	2	2655	Pick	C
9/1	2723	622	2221	113	5679	Pick	I
9/2	1536	911	2914	87	5448	Pick	I
9/3	233	250	943	2	1427	Pack PM	I
10/1	1302	465	455	15	2237	Pick	C
10/2	NS	265	1524	109	1898	Pack PM	I
10/3	6596	450	1445	6	8497	Pick	C
11/1	428	232	1455	6	2121	Pick	C
11/2	517	178	2268	92	3055	Pick	I
11/3	372	80	129	1	582	Pick	C
12/1	905	97	4806	NS	5809	Pack	I
12/2	916*	175	1915	99	3105	Pack	I
12/3	2420*	279*	565	1	3265	Pack	I

Table 2 (con't)

Worker /Day	Upper Body Exposure	Lower Body Exposure	Hand Exposure	Face Exposure	Total Exposure	Activity	Incomplete (I) or Complete (C)
13/1	2112	835*	9919	88	12954	Pack	C
13/2	564	1044	2152	109	3870	Pick	I
13/3	649	1250	5702	73	7675	Pick	C
14/1	310	128	1008	3	1448	Pack	C
14/2	346	244	1604	119	2313	Pick	I
14/3	810*	500	627	1	1938	Pack PM	C
15/1	1041	140	965	6	2152	Pack	C
15/2	442	51*	1878	11	2382	Pack	I
15/3	3364*	242*	1029	6	4642	Pack	C
16/1	499	266	5199	77	6042	Pack	I
16/2	534	218	3075	244	4061	Pack AM	I
16/3	1079*	64	2909	39	4091	Pack	I
17/1	381	76	4383	NS	4840	Pack	I
17/2	NS	94	2060	206	2359	Pack	I
17/3	1531*	108*	1310	1	2950	Pack AM	C
18/1	4392	313	4798	160	9664	Pick	C
18/2	2787	841	4761	346	8736	Pick	I
18/3	3471	1188	692	1	5344	Pick	C
19/1	398	277	1719	122	2516	Pick	C
19/2	782	89	1571	231	2673	Pick	I
19/3	2084*	455	355	13	2907	Pack AM	C
20/1	1652	99	2512	14	4276	Pick	C
20/2	782	148	3796	55	4781	Pick	I
20/3	830	207	4551	1	5589	Pack AM	C
21/1	738	328	136	56	1258	Pick	C
21/2	1238	599	265	52	2153	Pick	I
21/3	824	344	106	2	1276	Pick	C
22/1	836	417	549	82	1884	Pack	C
22/2	254	272	647	51	1224	Pick	I
22/3	790	78	252	1	1122	Pick	I
23/1	347	337	253	12	948	Pick	I
23/2	371	134	729	15	1249	Pick	I
23/3	3571	1096	1212	1	5879	Pack AM	C
24/1	658	938	7102	1183	9881	Pick	C
24/2	846	845	10666	336	12693	Pick	I
24/3	363	251	1795	2	2471	Pick	C

25/1	228	1193	4931	552	6904	Pick	C
25/2	463	517	3850	132	4962	Pick	I
25/3	184	316	1607	2	2109	Pick	C

Table 3:

CAPTAN DISLODGEABLE FOLIAR RESIDUE

Cane Cutter/Leaf Puller Monitoring

Monitoring Day/Plot/Rep	Captan Residue (ug/cm ²)			Difference (ug/cm ²)
	Pre-sample	Post Cutting	Post Pulling	
1/1/A	0.676	1.240	1.250	-0.574
1/1/B	0.874	1.190	1.300	-0.426
1/2/A	0.076	0.063	0.185	-0.109
1/2/B	0.086	0.046	0.113	-0.207
1/3/A	0.501	0.563	0.676	-0.175
2/1/A	0.198		0.133	-0.065
2/1/B	0.279		0.353	-0.074
2/2/A	0.760		0.444	0.316
2/2/B	1.320		0.518	0.800
2/3/A	0.217		1.510	-1.293
2/3/B	0.110		1.360	-1.250
Average	0.456	0.606	0.711	-0.255

Harvester Exposure Monitoring

Monitoring Day/Replicate	Captan Residue (ug/cm ²)		Difference (ug/cm ²)
	Pre-Harvest	Post-Harvest	
1/1	0.676	0.664	0.012
1/2	0.137	0.093	0.044
1/3	0.375	0.0355	0.020
1/4	0.242	0.206	0.036
1/5	0.091	0.061	0.030
1/6	0.174	0.196	-0.022
Day 1 Average	0.283	0.263	0.020
2/1	0.427	1.560	-1.133
2/2	0.126	0.182	-0.056
2/3	0.281	0.207	0.074
2/4	0.163	0.089	0.074
2/5	1.250	0.221	1.029
2/6	0.147	1.100	-0.953
Day 2 Average	0.399	0.560	-0.161
3/1	0.311	0.040	0.271
3/2	0.030	ND	0.030
3/3	0.314	0.177	0.137
3/4	0.129	ND	0.129
3/5	0.096	ND	0.096
3/6	ND	ND	0
Day 3 Average	0.176	0.109	0.068
Overall Average	0.292	0.368	-0.056