Irritant Chemical Dermatitis Among Grape Workers in Fresno County, August 1995

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Abstract

In August, 1995, the Department of Pesticide Regulation (DPR), Worker Health and Safety (WHS) Branch, received a report regarding an outbreak of dermatitis (sunburn-like erythema on the chest, neck, arms and face) among crews of workers performing hand labor activities on a table grape ranch in northern Fresno County near Kerman, California. Of 202 workers (8 crews) lifting grape foliage over vine guide wires (turning cane), 65 (32.2%) sought treatment between August 9 and August 20. No rashes were reported among 54 workers (2 crews) working in the same vineyards pulling leaves. The incidence of workers seeking treatment varied from 3.7% in the crew apparently least affected to 87.5% in the crew with the largest number of reported cases. Because the crews left the Fresno area, it was not possible to determine whether the variation in reported cases reported was attributable to differences in the occurrence of rash or to differences in the likelihood of seeking treatment following onset of rash. The crews affected by dermatitis worked between 8/7 and 8/11 in blocks of Thompson seedless and Red Globe grapes. Application records showed that these blocks had received treatments with propargite, Britz Buffer, glyphosate, methomyl, dichloronitroaniline, myclobutanil, Latron B1956, gibberelin, triflumizole, elemental sulfur, and iprodione. At site 304, three dislodgeable foliar residue (DFR) samples were taken 8/15/95 by DPR Pesticide Use Enforcement (PUE)/Fresno County Agricultural Commissioner (CAC). Single samples were also taken at site 301 and site 302. Propargite levels on 8/15/95 ranged from 0.37 to 0.66 g/cm^2. Detectable residue was also found for elemental sulfur (0.16 - 1.1 µg/cm^2), iprodione (non-detect [nd] - 0.16 µg/cm^2), myclobutanil (nd - 0.16 µg/cm^2), and dichloronitroaniline (nd - 0.045 µg/cm^2). At site 301, the sulfur residue (1.1 µg/cm^2) exceeded the residue of propargite (0.66 µg/cm^2), but at other sites the sulfur residue was < 0.21 µg/cm^2. Because animal studies demonstrated that propargite is a more severe dermal irritant than the other compounds identified in the residue samples, it was considered to be the probable cause of the outbreak. The levels of dislodgeable propargite residue were well above the estimated 0.2 µg/cm^2 No-Observed-Effect-Level (NOEL) for repeated dermal exposure to propargite in nectarine harvesters. Propargite dissipation half-lives observed in follow up monitoring studies showed residue half-lives of 9.4 - 14.4 days. Although some blocks of Thompson seedless grapes on the ranch received two applications of propargite within a 10-day interval, the residue levels on this site (0.55 µg/cm^2) did not exceed the highest levels (0.66 µg/cm^2) found on blocks receiving only a single treatment. Slow dissipation of propargite, comparable to that seen in prior episodes of dermatitis associated with this compound, appeared to be the principal reason for this outbreak. Possible measures to prevent recurrent episodes, include prohibition of propargite use prior to high contact work activities and routine monitoring of propargite dissipation prior to reentry. Additional studies might also evaluate whether dissipation of propargite is affected by spray adjuvants or other materials in the application tank mixes.

Introduction

In August 1995, the Department of Pesticide Regulation (DPR), Worker Health and Safety (WHS) Branch, received a report regarding an outbreak of dermatitis among workers performing high contact hand labor activities - turning cane - in a vineyard near Fresno, California. Because initial information obtained from the County Agricultural Commissioner's office indicated there was no violation of existing reentry intervals, investigators were sent to determine the cause of the incident. The investigation included clinical examination of workers under treatment in conjunction with primary care physicians; review of pesticide application records; review of work history information and time sheets for affected and non-affected crews; dislodgeable residue sampling of involved fields; and follow up residue sampling to evaluate dissipation half-lives.

Methods

Clinical evaluation and record review:

Workers undergoing medical treatment on August 15 and August 16 were examined in conjunction with the primary care physicians. Interviews and exams were conducted in Spanish, using a brief questionnaire to identify affected workers and the day of onset of dermatitis. Because other crew members were not employed in the Fresno area in the week following the outbreak, they were not available for interview. It was therefore not possible to determine whether or not they had developed dermatitis. Doctor's First Reports and medical records were also reviewed for workers not undergoing treatment on those dates. The severity of dermatitis was scored by recording the presence and distribution of erythema, blistering, and/or post-inflammatory changes present as described previously.[1]

Work and spray histories:

Work histories were obtained for the period August 7 - 12 by reviewing signed time sheets for each crew identifying each worker by name and social security number. These sheets recorded a crop and job code, usually accompanied by a written description of the work activity. A single job code described both pulling leaves and turning cane. The crop was described according to grape variety (either Thompson seedless or Red Globe), but the block location was not recorded. Information on specific blocks worked and work activities was obtained by interviews conducted by pesticide use enforcement staff with supervisors of individual field crews (Table1). These were evaluated in conjunction with spray records that included application date, pesticide product used, and amount used/acre, as well as a block and site number (Table 2).

Residue samples:

Samples were collected from the grape foliage by cutting leaf discs with a five cm^2 punch. Each sample consisted of four discs from each of ten vines. Two samples were taken from each treated field and analyzed in the Worker Health and Safety Laboratory Section of the Center for Analytical Chemistry in Sacramento following extraction with the standard method for dislodgeable residue established by Gunther.[2] These included specific analyses for propargite, glyphosate, methomyl, dichloronitroaniline, myclobutanil, elemental sulfur, and iprodione. Chemical residue screens that detect a broad range of organophosphates, carbamates, organochlorines, fungicides, and herbicides were also conducted by gas chromatography with an ion trap detector.

Residue Dissipation Studies:

Follow up residue measurements were made 8/24, 8/30 and 9/6 at sites tested 8/15/95. Residue half-lives were calculated from log linear regression plots assuming first order kinetics. The same plots were also used to estimate residue deposited at the time of application. These were compared to estimated residue depositions reported from previous residue dissipation studies to determine whether the reported application history was consistent with the measured residue and residue half-lives. Estimated deposition values from published studies were recalculated excluding measurements made on day 0 and day 1, in order to exclusively estimate “settled residue” and exclude

dislodgment phase" data from the analysis. The original and recalculated estimates were then compared to evaluate the effect of the modeling procedures on the estimates of initial deposition.

Weather data for the Fresno area during June, July and August of 1995 were obtained from the Western Regional Climate center in Reno, Nevada operated by the National Oceanic and Atmospheric Administration. These data derived from the weather monitoring station at the Fresno air terminal, located approximately 10 miles south east of the ranch where the outbreak took place. Available data included maximum, minimum and average temperature, and average dew point. Mean values of the above parameters were calculated for the period between relevant applications and the day the outbreak was reported. Mean values were also calculated from 81/5 until the end of the follow up period on 9/6.

Statistical/epidemiologic evaluation:

Descriptive analyses were performed using the SPSS/PC+^{R} statistical software comparing the reported incidence of dermatitis by crew to the work histories derived from the time sheets. Formal statistical analyses were not conducted because of the lack of information about dermatitis in workers who did not seek medical treatment.

Results

Clinical Findings:

Twenty-three workers were examined on 8/16/95 at the offices of the treating physicians in Madera. The affected workers had mild to moderately severe erythema (redness) over the chest, shoulders and forearms. There was no vesiculation (blistering) and no sign of post-inflammatory changes. The rash score for this group ranged from 0 to 26.0 on the day of the exam, with a median score of 6.0 and a mean score of 8.7 (Figure 1). Most workers had already received treatment with topical steroids, but one worker, who had the highest rash score, worker was first evaluated on August 16. One worker had erythema over the face accompanied by a moderate degree of conjunctivitis. The conjunctivitis may have been a chronic condition exacerbated by a concurrent irritant exposure because bilateral pterygia were present.[a] Review of medical records conducted August 22 indicated that the distribution and character of the dermatitis for workers not directly examined strongly resembled those seen August 16.

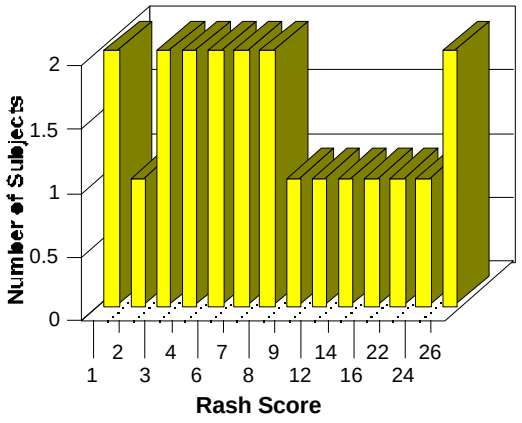

Figure 1 - Distribution of rash scores among reported cases

Distribution of dermatitis among work crews:

The number of dermatitis cases among work crews is shown in Figure 2 and Table 1, in conjunction with results of work history records. Of 202 workers (8 crews) lifting grape foliage over vine guide wires (turning cane), 65 (32.2%) sought treatment between August 9 and August 20. The largest number of cases were reported on August 9, a day the vineyard foliage was reported to have been wet with morning condensation. No rashes were reported among 43 workers (2 crews) working in the same vineyards pulling leaves. The incidence of workers seeking treatment varied from 3.4% in the crew apparently least affected to 87.5% in the crew with the largest number of reported cases. Because the crews left the Fresno area, it was not possible to determine whether the variation in reported cases was attributable to differences in the occurrence of rash or to differences in the likelihood of seeking treatment following onset of rash.

[a] A pterygium is an overgrowth of the conjunctiva from the medial canthus of the eye towards the nasal border of the iris, thought to be associated with exposure to dust and sunlight. They are recognized to be very common in farm laborers.

Lost work time and disability costs:

Of the 65 crew members with reported cases of dermatitis, 47 (72%) had known disability status the week of August 13 when they were interviewed by Pesticide Use Enforcement (PUE) staff. Of these, 44 (94%) had one or more lost work days. The median number reported lost at the time of the interview was 6 days, but 38 (86%) of the workers with temporary disability had not returned to work at the time of the interview. The ranch safety officer reported that as of May, 1996 the outbreak and related medical costs had cost $170,000, with $90,000 in insurance reserves on unclosed cases.

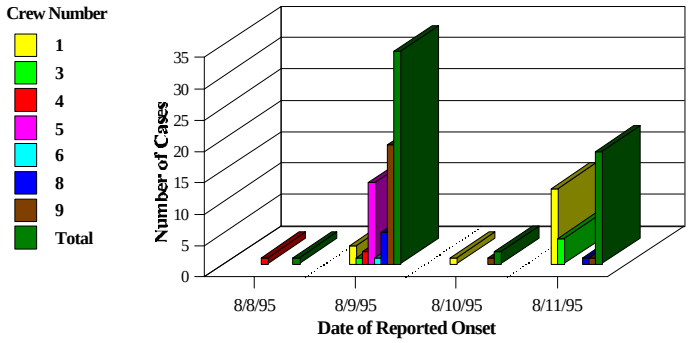

Figure 2 - Distribution of reported onset of dermatitis in cane-turning crews. No cases seen in 2 crews (2 and 10) pulling leaves.

Work history:

The crews affected by dermatitis worked between 8/7 and 8/11 in blocks of Thompson seedless (sites 301, 302, and 307) and Red Globe grapes (site 304). Detailed work histories are shown in Table 1 and application records for the sites worked are shown in Table 2. In summary, application records showed that the sites received either one or two treatments with propargite at 1.9 lbs active ingredient (a.i.)/acre. Other materials applied included Britz® Buffer (16.00 oz/acre); glyphosate (32 oz/acre); methomyl (0.5 lbs/acre); dichloronitroaniline (1 or 6 lbs/acre); myclobutanil (5 oz/acre); Latron® B1956 (10 oz/acre); gibberelin (0.59 lbs/acre); triflumizole (6.0 oz/acre); elemental sulfur (12 lbs/acre); and iprodione (2.0 lbs/acre). The dual applications of propargite were confined to blocks of Thompson seedless on sites # 302 and # 307. A single crew (# 9) worked at the latter site on 8/8/95. The most significant difference between the Red Globes and Thompson seedless blocks was the dual applications of propargite on Thompson seedless blocks at site 302 (6/29 and 7/7) and at site 307 (6/23 and 7/8). The Red Globe blocks (site 304) were treated with propargite only on 7/6/95 (Table 2). The Thompson seedless block at site 301 received only a single application of propargite on 7/4.

Apart from the pesticide application history described above, interviews with crew supervisors and ranch safety personnel identified wet foliage at site 304 on the morning of August 9 as a possible factor in the outbreak. The morning temperature on that date was only 0.5 F above the dewpoint. Ranch management also conjectured that a tall grass cover crop in between the rows at site 304 was responsible for the dermatitis.

Environmental sampling data:

At site 304, three DFR samples were taken 8/15/95 by DPR PUE/Fresno County Agricultural Commissioner's (CAC) office. Single samples were also taken at site 301 and site 302. Residue samples (Table 3) showed highest levels of propargite (0.66 g/cm^2) at site 301. The propargite level at site 302 (blocks 2&4) was 0.55 g/cm^2 and at site 304 ranged from on 0.34 to 0.55 g/cm^2. A sample at site 301 showed 1.06 g/cm^2 of elemental sulfur and samples from sites 302 and 304 ranged from 0.16 to 0.20 g/cm^2. Site 301 also showed detectable levels of dichloronitroaniline (0.045 g/cm^2), iprodione (0.16 g/cm^2), and myclobutanil (0.16 g/cm^2). The blocks sampled at site 304 also showed detectable levels of dichloronitroaniline (0.02 - 0.065 g/cm^2) and myclobutanil (<0.0025 g/cm^2). Residue screens (gas chromatographic analysis with an ion trap detector) were negative for compounds not listed in the application records.

Propargite Dissipation Studies:

Dissipation studies (Table 4) conducted following the outbreak at sites 301, 302 and 304 demonstrated that residue present at the time of initial sampling on 8/15 was breaking down relatively slowly (half-lives ranging from 9.4 - 14.4 days). At site 304, extrapolation of residue regression lines to date of reported applications resulted in

estimates of initial deposition that were tightly clustered (2.7 - 3.1 g/cm2). The estimated initial deposition at site 301 was 6.9 g/cm^2 and at site 302 was 10.6 g/cm^2. Estimated depositions at site 304 were well within the range reported in prior WHS studies (Table 5). At site 301, the estimated initial deposition was just above the high values reported from prior WHS studies and at site 302 the estimated deposition greatly exceeded the previously observed range. This site was reported to have received applications of propargite 6/29 and 7/7. Other sites studied were reported as having received only single applications of propargite.

The weather during the period from June 23 to August 10 (period 1) was similar to that between August 11 and September 6 (period 2). No precipitation was recorded in either time period except for a trace amount recorded on July 8, 0.01 inches on July 17 (period 1) and trace amounts on August 22 (period 2). The mean maximum daily temperature during period 1 was 97.3 degrees Fahrenheit and 96.1 degrees during period 2. Average minimum temperature was 66.3 degrees during period 1 and 64.5 during period 2. The average mean daily dewpoint was 57.2 degrees for period 1 and 52.5 degrees for period 2 (Figure 3).

Discussion

The 65 workers who sought medical treatment in this outbreak had dermatitis resembling a first degree chemical burn in a pattern consistent with grape foliage contact. The high incidence of dermatitis suggested that the etiology of the outbreak was a dermal irritant. Residue samples identified detectable levels of propargite, iprodione, myclobutanil, dichloronitroaniline (trace levels), and sulfur. Although it is apparent from review of reported reactions in pesticide applicators, that sulfur may cause some dermal irritation, safe-residue levels have not been established. The residues of sulfur were lower than residues of propargite in all samples except at site 302. The levels seen in the episode under investigation were not exceptional. In 106 day-of-reentry (DOR) grape leaf residue samples (grapes grown for table, wine, raisin, and juice products) taken by WHS between 8/10/94 and 10/18/94, 87 (82.1%) showed detectable amounts of elemental sulfur, ranging from 0.01 to 93.4 µg/cm^2 (median = 1.017µg/cm^2, mean = 6.03 µg/cm^2). Levels of iprodione residue found on the fields also resembled those seen in DOR sampling. Of 134 grape leaf punch samples collected by WHS between 7/27/94 and 10/18/94, 19 (10.7%) showed detectable residues of iprodione, ranging from 0.0034 to 0.49 µg/cm^2 (median of positive samples = 0.11 µg/cm^2; mean = 0.153 µg/cm^2).[b] Comparison of relative dermal irritation capacity data (Appendix 1) for the compounds detected in association with the Fresno outbreak indicates that propargite is by far the most potent skin irritant.

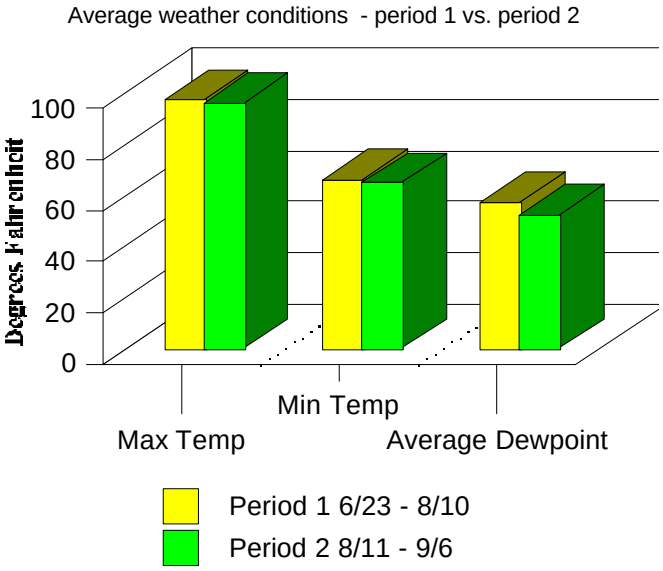

Figure 3 - Weather conditions during period before outbreak and during period of residue dissipation study

The propargite residue levels found in association with this outbreak appeared to be higher than expected based upon DOR grape leaf punch samples collected by WHS. Of 134 total DFR samples collected between 7/27/94 and 10/18/94, 24 (17.9%) showed detectable residues of propargite, ranging from 0.0017 to 0.036 µg/cm^2 (median of positive samples = 0.007 µg/cm^2; mean = 0.011 µg/cm^2). In the Fresno outbreak, propargite residues from all of the fields sampled exceeded the estimated 0.2 µg/cm^2 safe-level established for workers harvesting tree-fruit. Prior residue transfer studies have demonstrated that the exposures of workers turning cane on table grapes are markedly

[b] Samples in these series were collected for the same study, but only a portion were analyzed for sulfur. Unpublished WHS data.

higher than exposures for workers harvesting tree fruit (Table 6). It is therefore not surprising to find propargite residues between 0.34 and 0.55 µg/cm^2 associated with contact dermatitis in workers turning cane in table grapes. It is also likely that the transfer of residue from foliage to work clothing and skin was increased by wet foliage present on the ranch on the morning of August 9, the day of onset for the large majority of the reported cases (Figure 2). However, the quantitative effect of the wet foliage in increasing transfer can not be evaluated on the basis of presently available information.

Ascertaining whether the propargite residues encountered in association with the outbreak represent unreported applications depends upon interpretation of the dissipation studies conducted between August 15 and September 6. These demonstrated that the residue half-lives in the outbreak fields ranged between 10.6 and 14.4 days. Based on the observed half-lives and the measured residue on 8/15/95, initial residue deposition was estimated assuming a constant degradation. (Fresno weather records indicated there was minimal difference in daily maximum temperature, daily minimum temperature, and daily average dew points.) These yielded estimates of initial residue deposition shown in Table 4. The depositions estimated for site 304 ranged from 2.7 - 3.1 µg/cm^2. These fall well within the range of depositions observed in prior WHS residue studies (Table 5) for applications of propargite on grapes at rates between 0.9 to 2.7 lbs ai/acre (0.46 to 6.58 µg/cm^2). For site 301, the estimated initial deposition was 6.9 µg/cm^2, slightly beyond the range observed in the 1990 WHS studies. At site 302, the initial deposition estimated from the follow up studies was 10.6 µg/cm^2 - clearly beyond the range observed in the WHS propargite dissipation studies. This site received two propargite applications (6/29 and 7/7). Although the propargite label does allow two applications per season, two applications within a 10-day interval may have contributed to the occurrence of the outbreak. However, the highest residue levels encountered in samples taken on 8/15 was 0.66 g/cm^2 at site 301, which received only a single application on 7/4/95. On 8/15, residue levels at site 304, which also received only one application, ranged from 0.34 to 054 µg/cm^2, comparable to the levels at site 302.

Although the work histories available on the affected crews do not distinguish between site 301 and site 302, all of the crews worked in Thompsons at least one day. Nevertheless, it does not appear that the dual application was the principal cause of the outbreak, but rather slow residue breakdown. Although the half-lives measured in the fields associated with the Fresno outbreak were longer than those seen in WHS studies carried out in 1990 and 1991, they were comparable with those seen in outbreaks of propargite dermatitis on nectarines (11-53 days) in 1988 and oranges (7.1 to 11 days). In the limited dissipation studies conducted by the registrant of propargite, a single instance of slow dissipation was observed (11-day half-life). The periodic, unpredictable occurrence of prolonged dissipation of propargite suggests that additional measures to prevent future outbreaks of dermatitis may be required. The episode discussed here demonstrates the high cost to both employers and the workforce of large scale outbreaks of dermatitis. Possible measures to prevent recurrent episodes, include prohibition of propargite use prior to high contact work activities and routine monitoring of propargite dissipation prior to reentry. Additional studies might evaluate whether dissipation of propargite is affected by spray adjuvants or other materials in the application tank mixes.

Table 1 - Summary of work activities and number of workers seeking treatment for skin rash by crew

Crew number - Foreman interviews conducted by Fresno CAC &district PUE - Work Records Review	Comments	# Treated	# not Treated	Total	%
Crew 1 - PUE interview: 8/10 - 21 - 23 workers in Thompsons 6½ hrs - no complaints recorded. 8/11 - 10-12 people went to doctor before entering field; other half of crew worked 4 hrs (7 - 11 am). **Work records:** 8/7 - turning cane 7½ hrs in Thompsons. 8/8 - turning cane 7½ hrs in Globes. 8/9 - worked 6 hrs in Thompsons turning cane. 8/10 - worked 6½ hrs in Thompsons turning cane. 8/11 - worked 4 hrs in Globes; activity not specified.	Thompson sites not identified in PUE interviews or work records Worked Globes 8/8 only	16	10	26	61.5
Crew 2 - PUE interview: none; reported by ranch management as pulling leaves instead of turning cane. **Work records:** 8/8 - 7½ hrs pulling leaves in Globes. 8/9 - 7 hrs work in Globes; activity not specified. 8/10 - 6 hrs work in Globes; activity not specified. 8/11 - 4½ hrs work in Globes; activity not specified.	Pulling leaves instead of turning cane	0	30	30	0.0
Crew 3 - PUE interview: 8/9 - worked 7-11 am in Thompsons. 8/10 - worked at site 301, block 3. **Work records:** 8/7 - 7½ hrs work in Thompsons, activity not specified. 8/8 - 4½ hrs turning cane in Thompsons. 8/9 - 6 hrs work in Thompsons; activity not specified. 8/10 - 6 hrs work in Thompsons; activity not specified. 8/11 - 4 hrs work in Globes work, activity not specified.	Worked principally in Thompsons	5	23	28	17.9
Crew 4 - PUE interview: none **Work records:** 8/7 - 7 hrs turning cane in Thompsons. 8/8 - 7½ hrs work in Thompsons; activity not specified. 8/9 - 7 hrs turning canes in Thompsons. 8/10 - 6 ½ hrs turning cane in Thompsons. 8/11 - 3 ½ hrs turning cane in Thompsons.	Worked in Thompsons only - sites and blocks not specified	3	20	23	13.0
Crew 5 - PUE interview: 8/9 - turning cane in site 304, block 9; block was wet; 11-12 workers reported rash; crew stopped & went home. 8/10 - ill workers to M.D.; part of crew pulling leaves in block 5, site 301 6:30 am - 1:00 pm. **Work records:** 8/7 - 7 ½ hrs turning cane in Thompsons. 8/8 - 7 ½ hrs turning cane in Globes. 8/9 - 4 hrs turning cane in Globes. 8/10 - 6 hours pulling leaves in Globes. 8/11 - picking peaches. 8/12 - picking peaches.	Principally worked in Globes (site 304) - worked in unspecified block of Thompsons 8/7	13	12	25	52.0
Crew 6 - PUE interview: 8/10 - worked in block 3, site 301. **Work records:** 8/7 - 7½ hrs work in Thompsons; activity not specified. 8/8 - 8 hrs work in Globes; activity not specified. 8/9 - 7 hrs work in Globes; activity not specified. 8/10 - 6 hrs work in Globes; activity not specified. 8/11 - 4 hrs pulling leaves in Globes. Notation "no injured reported" on time sheets for all 3 days.	Worked in globes 8/8 - 8/10 (site 304) & 8/7 in unspecified block of Thompsons	1	26	27	3.7
Crew 7 - PUE interview: none. **Work records:** 8/7 - no time sheet. 8/8 - 7½ hrs turning cane in Globes & Thompsons. 8/9 - 6 hrs turning cane in Thompsons. 8/10 - turning cane block & crop not specified. 8/11 - 3½ turning cane in Thompsons.	Worked both Thompsons and Globes	0	27	27	0.0
Crew 8 - PUE interview: 8/10 - worked in Globes, site 304 in block 13, block 14; 3 of 19 workers complained of rash on arms. **Work records:** 8/7 - 7½ hrs work in Thompsons; activity not specified. 8/8 - 7½ hrs turning cane in Globes & Thompsons. 8/9 - 4 hrs work in Thompsons; activity not specified. 8/10 - 6 hrs work in Globes; activity not specified. 8/11 - 4½ hrs picking peaches. 8/12 - 4½ hrs picking peaches.	Worked in both Globes and Thompsons	6	16	22	27.3
Crew 9 - PUE interview: 8/7 - in Thompsons, site 301, block 3. 8/8 - in Thompsons, site 307, block 23. 8/9 - in Globes, site 304 block 11; crew reported rashes about 9:30. 8/10 - ill crew members not permitted to work - others cleaned bunches, rinsed berries, leaves at site 301, block 3. **Work records:** 8/7 - 7½ hrs turning cane in Thompsons. 8/8 - 7½ hrs turning cane in Thompsons. 8/9 - 4 hrs turning cane in Globes. 8/10 - 6 hrs in Thompsons pulling leaves. 8/11 - 5 ½ hrs picking peaches. 8/12 - 4 ½ hrs picking peaches.	Worked in Globes 8/8 & 8/9; Thompsons 8/7 & 8/10	21	3	24	87.5
Crew 10 - PUE interview: none **Work records:** 8/7 - no time sheet. 8/8 - 7½ hrs pulling leaves in Globes. 8/9 - 7½ hrs pulling leaves in Globes. 8/10 - work in Globes, activity not specified. 8/11 -4½ work in Globes; activity not specified	Worked pulling leaves	0	24	24	0.0
Total		**65**	**191**	**256**	**25.4**

Table 2 - Application records for ranch where outbreak occurred*

#301 (164 acres) SE Central and Railroad

(Block 1& 3 -Thompson Seedless)

Date	Product	Acres	Application Rate
6/8	Lannate® SP	164	0.5 lbs/acre
6/8	Botran® 75 W	164	1.0 lbs/acre
6/8	Rally® 40 W	164	5 oz/acre
6/8	Latron® B1956	164	10 oz/acre
6/30	Rally® 40W	164	5 oz/acre
7/4	**Omite® 30W**	**164**	**6.25 lbs/acre (1.9 lbs a.i./acre)**
7/4	Britz® Buffer	164	16.00 oz/ac
7/31	Round-up®	164	32.00 oz/ac

#302 (166 acres) ½ Mi S Central E of Goldenrod

(Block 2& 4 -Thompson Seedless)

Date	Product	Acres	Application Rate
6/7	Pro-Gibb®	166	0.59 lbs/acre
6/7	Latron® B1956	166	10 oz/acre
6/7	Pro-Gibb®	166	0.71 lbs/acre
6/7	Botran® 75W	166	2.0 lbs/acre
6/7	Latron® B1956	166	16.oz/acre
6/18	Magic Sul® Dust	166	12 lbs/acre
6/29	**Omite® 30 W**	**166**	**6.25 lbs/acre (1.9 lbs a.i./acre)**
6/29	Procure® 50 WS	166	6.0 oz/acre
7/7	**Omite® 30 W**	**166**	**6.25 lbs/acre (1.9 lbs a.i./acre)**
7/7	Britz® Buffer	166	16 oz/acre
7/21	Botran® 6	166	25 lbs/acre

#304 (120 acres) SE Central & Madera

Blocks 9a, 11a, 13a Red Globes

Date	Product	Acres	Application Rate
6/7	Lannate® SP	120	0.5 lbs/acre
6/7	Botran® 75 W	120	1 lbs/acre
6/7	Rally® 40 W	120	5 oz/acre
6/7	Latron® B1956	120	10 oz/acre
6/30	Rally® 40 w	120	5 oz/acre
7/6	**Omite® 30W**	**120**	**6.25 lbs/acre (1.9lbs a.i./acre)**
7/6	Britz® buffer	120	16.00 oz acre
7/25	Round-up®	120	32. oz/acre

 # 307 (240 acres) NW Central & Siskiyou

Date	Product	Acres	Application Rate
6/1	Pro-Gibb®	240	0.59 lbs/acre
6/1	Latron® B-1956	240	10 oz/acre
6/5	Pro-Gibb®	240	0.71 lbs/acre
6/5	Botran® 75 W	240	2.0 lbs/acre
6/17	Magic Sul® Dust	240	12.0 lbs/acre
6/23	**Omite® 30 W**	**240**	**6.25 lbs/acre (1.9 lbs a.i./acre)**
6/23	Rally® 40 W	240	5.0 oz/acre
6/23	Latron® B-1956	240	4.0 oz/acre
7/8	**Omite® 30 W**	**240**	**6.25 lbs/acre (1.9 lbs a.i./acre)**
7/8	Britz® Buffer	240	16 oz/acre
7/24	Botran® 6	240	25 lbs/acre

* **Trade names and active ingredients:** Lannate® SP = methomyl, Botran® 75 W, Botran® 6 = dichloronitroaniline (DCNA), Rally ® 40 W = myclobutanil, Omite® 30 W = propargite, Round-up® = glyphosate, Latron® B1956 = nutrient buffer, Magic Sul Dust® = elemental sulfur, Britz® buffer = spray adjuvant, Pro-Gibb® = gibberelin, Procure® = triflumizole

Table 3 Residue samples results for 8/15

Site and Block	Active ingredient*	Days since last propargite application	ug/sample**	ug/cm2
Site 301 Block 1 & 3				
	Propargite	42	264	0.66
	Sulfur		426	1.065
	DCNA		18	0.045
	Iprodione		62	0.155
	Myclobutanil		64	0.16
	Dicofol		ND	
Site 302 Block 2& 4				
	Propargite	39	218	0.55
	Sulfur		65	0.1625
	DCNA		ND	
	Myclobutanil		ND	
	Dicofol		ND	
Site 304 9A				
	Propargite	40	214	0.54
	Sulfur		68	0.17
	DCNA		8	0.02
	Myclobutanil		39	0.0975
	Dicofol		ND	
Site 304 11A				
	Propargite	40	137	0.34
	Sulfur		71	0.1775
	DCNA		26	0.065
	Myclobutanil		61	0.1525
	Dicofol		ND	
Site 304 13A				
	Propargite	40	149	0.37
	Sulfur		81	0.2025
	DCNA		17	0.0425
	Myclobutanil		ND	0
	Dicofol		ND	0

* Dicofol included in analysis to evaluate for possible unreported applications, considered possible because of heavy mite infestations during the summer of 1995

** ND - none detected

Table 4 Propargite Residue Dissipation Studies 8/15 - 9/6/95

Residue Samples	8/15 Propargite µg/cm^2	8/24 Propargite µg/cm^2	8/30 Propargite µg/cm^2	9/6 Propargite µg/cm^2	R2	t1/2	Estimated Initial Deposition
Site 301 Block 1&3 MI0815-4	0.66	0.31 - 0.28	0.21 - 0.23	0.15 - 0.19	0.95	11.9	6.9
Site 302 Block 2&4 MI0815--1	0.37	0.24 - 0.31	0.14- 0.18	0.12 - 0.14	0.96	9.4	10.6
Site 304 Block 9a MI0815--3	0.54	0.15 - 0.26	0.20 -0.26	0.15 - 0.16	0.81	14.4	3.1
Site 304 Block 11a MI0815-4	0.34	0.31 - 0.35	0.13 - 0.14	0.11 - 0.15	0.82	14.3	2.6
Site 304 Block 13a MI0815-5	0.37	0.24-0.31	0.14 - 0.18	0.12 - 0.14	0.96	14.3	2.7

Table 5 - Review of WHS and registrant studies on dissipation of propargite dislodgeable foliar residue [c]

Field	Half life - days	Estimated Initial Deposition - µg/cm^2	Estimates of Half-life (days) with Biphasic Model	Estimated Initial Deposition -(µg/cm^2) Biphasic Model
(DFR)- nectarines 1988 application rate - 2.25 pounds active ingredient/acre[5]				
1	15	1.75	-	-
2	12	1.05	-	-
3	11	1.49	-	-
4	53	0.59	-	-
Omite cr citrus 1986 application rate 2.7-3.3 pounds/acre hs-1408[6]				
A	7.1	4.5	-	-
B	14	3.48	-	-
C	6.9	8.86	-	-
D	11	10.46	-	-
E	9.5	4.481	-	-
F	8.5	4.09	-	-
G	7.7	3.32	-	-
Grape foliage -1991 Madera/Napa application rate 0.9 -1.5 lbs ai/acre hs-1590				
1	3.80	1.40	3.90	1.20
2	4.00	1.40	4.10	1.10
3	5.30	1.50	5.10	1.80
4	4.20	1.00	4.30	1.40
5	4.20	1.00	4.10	1.40
6	4.40	2.90	5.90	0.90
7	5.40	2.20	-	-
8	7.90	2.60	-	-
Unpublished 1990 propargite dissipation studies - application rates 0.9 to 2.7 lbs a.i./acre				
1	4.15	6.58		
2	4.68	1.78		
3	7.34	3.02	6.11	5.53
4	4.39	3.00	4.76	3.26
5	4.21	2.20	2.87	4.59
6	3.77	2.90	4.14	2.23
7	4.86	2.78	4.41	3.03
8	5.66	2.09		
9	6.31	3.76		
10	6.90	0.61		
11	6.35	1.20		
12	6.77	2.21		
13	7.87	1.09		
14	5.49	0.46		
15	6.89	1.41		
1988 propargite dissipation studies conducted by registrant[7] - applications at 9 lbs/acre = 3 lbs ai/acre				
1	5.20			
2	11.00			
1981 propargite dissipation study - submitted by registrant[8] - 10 lbs/acre				
1	7.50			

[c] **-** settled residue estimates made with biphasic model - excluded samples taken prior to day 2 post-application

Table 6 - Transfer factor estimates by work tasks

Ross et al HS -1677[9], HS 1707[10]- Estimated residue transferred to clothing	
Work Tasks	Transfer Factors
Mechanical harvest	1,000
Row Crops	5,000-9,000
Lettuce	7,000
Tomatoes	9,000
Strawberries	5,000
Tree Crops	10,000-20,000
Grapes	
Harvest: table	3,000-18,000
Harvest: wine/raisin	86,000-93,00
Girdling trunks	18,000-93,000
Girdling cane	8,000-16,000
Cane turning	8,000 - 130,000
Berry thinning	2,000-21,000
Mechanical harvest/sort	500-1,000
Welsh HS-1687[11]- estimates of residue transferred inside work clothing	
Transfer Factors for Wine Grapes (1992)	
Shoot thinning - sample 1	11,000
Shoot thinning - sample 2	15,000-25,000
Harvest	9,000-24,000
Transfer Factors for Table Grapes (1992)	
Girdling cane	8,000-16,000
Leaf Removal	9,000-25,000
Harvest	10,000
Cane turning	16,000-40,000
Transfer Factors for Table Grapes (1991)	
Berry thinning	6,000-21,000
Cane turning	11,000
Leaf removal	10,000

Appendix 1

Review of Animal Dermal Irritation/Sensitization Data I Reference to 1995 Fresno Outbreak

Residue samples combined with work and application histories from the 36-Fre-95 priority episode indicated that the crews affected were potentially three affected work crews were exposed to propargite, sulfur, myclobutanil, and iprodione. The experimental data in CDPR files on the four compounds are reviewed below:

Iprodione

Study # 1

Data from a modified Draize test using 50% wettable powder demonstrated a primary skin irritation index of 2.50 in the albino rabbit. A slight degree of irritation was noted for both intact and abraded skin. No other dermal irritation or sensitization studies are available for this compound.

Study # 2

This study was submitted by the registrant of propargite following a 1988 dermatitis episode that involved potential exposure to both compounds. It compared the dermal sensitization potential of the active ingredients iprodione and propargite using a modified version of the Buehler method. While the study had some technical deficiencies (i.e. lack of a positive control group and the use of the same animals to test both products), a number of the findings were of significance. In the range finding portion of the study it was determined that iprodione could be applied during the challenge tests at the maximum concentration allowed by the protocol (5%); propargite could only be applied at concentrations of 0.1%. During the challenge portion of the study both materials produced less reaction than during the induction phase, indicating neither material was a sensitizer under the conditions tested.

Propargite

Study # 1

Dermal patches containing 0.5 ml of a 0.4% weight/volume suspension of Omite^{R} 30 W were applied to 69 human subjects. Study subjects removed the patches after 24 hours and application sites were read at 48 hours. Following the first reading a second and third patches were applied and read according to the same procedure. The results indicated that 0.4% Omite^{R} 30W produced no irritation under the study conditions in about 2/3 of the subjects and erythematous responses in the remainder.

Study # 2

Repeated dermal study (Leary Protocol in Rabbits) - Omite^{R} 30W. Two studies were run. In the first study, dosage levels were 1000 and 2000 mg/kg. As noted in the cited data volume, "the severe corrosive type dermal response and toxic effect made it unfeasible to continue." At a 0.36% dilution the skin changes observed were characterized as moderate.

Study # 3

Omite^{R} technical was applied to intact and abraded skin of albino rabbits for 24 hours. The chemical was washed off and the rabbits observed for an additional 48 hours. Second degree skin burns were observed in all animals.

Study # 4

Paper discs, soaked in 2% solutions of either Omite^{R} 30W or Omite^{R} 57E were applied to the forearms of adult volunteers and left in contact with the skin for 24 hours. Omite^{R} 30W appeared to cause minimal irritation in this test. Any reactions disappeared within 96 hours after the paper disc was removed. Omite^{R} 57E caused more intense reactions which persisted up to a week following the removal of the disc.

Study # 5

Omite^{R} 30W and Omite^{R} technical were both tested for skin sensitization using a procedure modeled after that of E.V. Buehler. Neither material proved to be a sensitizer under the test conditions.

Appendix 1

Review of Animal Dermal Irritation/Sensitization Data I Reference to 1995 Fresno Outbreak

Study # 6

Undiluted Omite^R 30W caused moderate erythema, eschar formation, and edema to intact and abraded skin of 6 albino rabbits when applied and held in place for 24 hours. The irritation score for the test was not reported.

A modified Buehler test was performed on the Omite^R CR formulation. The induction concentration was 33% w/v of Omite^R CR; animals subsequently had a primary challenge with 5% Omite^R CR and then 5 days later were rechallenged with the same concentration. The incidence of grade 1 or greater responses in the rechallenge test groups (5 Omite^R 30W 259-015 of 20) was greater than that of the naive control group (0 of 10). The test was interpreted to mean that this material is a weak to moderate sensitizer.

Conclusions: A comparison of dermal irritation caused by technical formulations of propargite (Omite^R) and formetanate hydrochloride (Carzol^R) showed that the former caused 2nd degree burns in contrast to moderate degrees of irritation produced by the latter. A skin irritation test on iprodione (Rovral^R) technical material was not available, but the 50% wettable powder formulation appeared to be less irritating than the technical material used in the studies of formetanate and propargite. Omite^R 30W appeared to be less irritating in the rabbit bioassay than propargite technical material, producing only "moderate" degree of irritation. Direct comparison could not be made to the Rovral^R study since the data contained in the summary of the Omite^R 30W study did not include a skin irritation index score.

The subacute dermal toxicity study for Omite^R 30W showed that repeated applications of this material produced severe skin reactions in the test animals. A comparable study using 80% formetanate hydrochloride produced only slight degree of irritation. An inference can thus be drawn from the available data that Carzol^R is a much less potent skin irritant than Omite^R 30W. The limited data available on the Rovral^R formulation of iprodione (50% wettable powder) indicate that the material is a weak to moderate skin irritant. In the comparative dermal sensitization study reported by the registrant of propargite, the maximum tolerated concentration of propargite at challenge testing was 0.1% compared to 5% for iprodione. Although the study had some minor technical inadequacies, iprodione did not appear to be a sensitizer under the conditions tested.

Sulfur

Study # 1

0.5 ml of Formula 242 (Safer Garden Fungicide Miticide 12.0% sulfur, a.i.) was applied to 2 abraded and 2 intact areas to 6 NZW rabbits. All animals displayed well-defined erythema and slight edema at 24 hours which subsided by 48 hours. A primary irritation score of 0.93 +/- 0.28 and was classified as non to very mild irritant

Study # 2

Dissolved 0.5 g (Technical Sulfur 99.8 %) in ½ ml distilled H_20 and applied to 1 abraded and 1 intact site to 6 male rabbits. Several rabbits displayed slight or well defined erythema in both intact and abraded at 24 hours which subsided in 48 hours. A primary irritation score of 0.5 was measured.

Study # 3

0.5 ml of undiluted test material (liquid Sulfur 53 % a.i.) was applied to 1 intact site per animal with 6 rabbits tested. 4 hours occluded exposure caused no skin irritation resulting in a irritation score of 0.0.

Study # 4

0.5 ml of neat Garden Fungicide concentrate (12 % a.i.) was applied to 1 intact site per animal and semi-occlusive wrap with 4 hour exposure to 6 animals. Erythema of 1 and edema of 0-1 at 1 hour, erythema of 0-1 at 24 and 48 hours which cleared by 72 hours. Average irritation index of 0.6 with a high score of 1.7 at 1 hour with totally recovery(reversible) at 72 hours with a score of 0.

Study # 5

500 mg of 90% WP moistened with 0.3 ml deionized H_20 applied to 6 animals with 4 hour occluded exposure showing no edema and grade 1 erythema in 1 animal 24 hours after patch removal and clearing in 48 hours. An overall primary irritation index of 0.1 was reported. There was a death of one animal that reportedly was not related.

Appendix 1

Review of Animal Dermal Irritation/Sensitization Data I Reference to 1995 Fresno Outbreak

Study # 6

A dose of 0.5 ml/site of Sulfur 6L (51 % yellow liquid) with a 4 hours exposure period resulted in grade 1 erythema for 1 out of 6, at 48 and 72 hours after removing the patch. Reports no dermal irritation.

Study # 7

The Buehler methodology was utilized. Range finding was accomplished with v/v solutions of 75%, 50% and 25% diluted with distilled water using neat material for all exposure tests. The positive control was DCNB .08 % w/v diluted with 80% ethanol for Induction tests and the same diluted with acetone for the challenge tests. The challenge portion of the study produced less reaction (0.1 at 24 hours, 0.0 at 48 hours) than the induction portion (0.3 at 24 hours, 0.06 at 48 hours) indicating that the material was not a sensitizer under study conditions.

Study # 8

The test group comprised of 5 male and 5 female guinea pigs was treated with 500 mg of test material (90% Sulfur WP, moistened with 0.3 ml of deionized water for 3 induction treatments once per week for 3 weeks. After a 2 week rest period, the naive control group (5 male 5 female) and the test group were challenged with 500 mg of test material moistened with 0.3 ml of deionized water. The test material produced no irritation in animals in control group after the single treatment at challenge. No irritation was observed for the test group at challenge. Therefore, no sensitizing reaction in guinea pigs was observed.

Myclobutanil

Study # 1

0.5 g of white solid test substance (39.5 % a.i.) prepared in 1:2 saline was occluded for 4 hours under a patch. The mean irritation score of 0.2 for both erythema and edema indicates slightly irritating to skin of rabbits..

Study # 2

Technical material (91.9 % a.i.) applied as viscous liquid yielded a 72 hour mean irritation score for both erythema and edema of 0.

Study # 3

0.5 ml of technical myclobutanil (84.5%) was applied and 1 out of 6 yielded a score of 1 for erythema at 24 hours. All others were 0 for erythema and edema.

Study # 4

0.5 ml (RH-52,866 25 % a.i.) applied with a 4 hour exposure. Erythema results of grade 4 in 5 out of 6 animals at 24 hours with grade of 4 for all at 72 hours clearing by 7 days. Edema results of grade 2 or 3 in 5 out of 6 animals at 24 hours through 72 hours clearing by 7 days.

Study # 5

0.5 ml liquid test substance (RH-53,866 25 % a.i.) was occluded for 4 hours. At 72 hours the mean irritation score (sum of the mean erythema and mean edema values after dosing) was 6.3 indicating severely irritating to the skin of the rabbits.

Study # 6

There were 10 induction doses with 0.4 ml/dose with RH-53,866 (25%a.i.) applied for 6 hour periods over a 3.5 week period. 10 challenge doses with 0.4 ml 12.5%(w/v) aqueous emulsions (the highest non irritating concentration) and solvent emulsifiers. No grade 1 or greater erythema occurred in 10 non induced naive controls or 20 induced. Incidents of grade 1 erythema from 1 non induced control and 1 induced group occurred. There was no delayed contact hypersensitivity.

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