

Outbreak of Omite-cr-Induced, Dermatitis among Orange Pickers in Tulare County, California

Outbreak of Omite-CR-Induced Dermatitis Among Orange Pickers in Tulare County, California

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An outbreak of dermatitis cases among 198 orange pickers employed by a Tulare County, California, packinghouse was investigated. Dermatitis was contracted by 114 (58%) of the 198 workers exposed when Omite-CR-treated fields were harvested. The dermatitis occurred predominantly in the exposed areas of the neck and chest. A dose-response association with dermatitis was suggested for Omite-CR exposure, but not for Carzol, Omite-CR + Carzol, or other pesticides. Because no violations of pesticide preharvest intervals or application rates were found, it appears that residue degradation was not given adequate consideration in the registration of Omite-CR, thus compromising the safety of the worker.

In the period April 30 through May 12, 1986, 114 of 198 orange pickers (six crews) who worked for a citrus packer in Tulare County, California, developed dermatitis thought to be related to Omite-CR (Uniroyal Chemical Company) exposure. These pickers typically worked a ten-hour day, six-day-a-week schedule and had harvested 80 orchards between Jan 1 and May 12, 1986. The dermatitis outbreak was important in both scope and severity. It was the largest outbreak of pesticide-

associated dermatitis reported in California,¹ and one third of the cases reported peeling (exfoliation), indicating severe dermatitis. When the outbreak was reported to the California Department of Food and Agriculture (CDFA) and the California Department of Health Services (CDHS), each agency began independent investigations of the episode. This report presents the epidemiologic investigation conducted by the CDHS, but also incorporates the leaf residue degradation function estimated by CDFA.

The main objectives of the epidemiologic investigation were to document the incidence, severity, and nature of the dermatitis, and any other related morbidity; to establish the relationship between the incidence of the dermatitis and exposure to any pesticides that might have been sprayed on the orange trees; and, to identify other risk factors that might have influenced the incidence of the dermatitis.

Background

For all cases of suspected pesticide illness, California law, beginning in 1974, has required physicians to file Pesticide Illness Reports (PIRs) with local health departments within 24 hours; these agencies must then notify the CDFA, CDHS, and the County Agricultural Commissioner within seven working days.² The PIRs for these 114 dermatitis cases provide basic information for this study as well as an official count of the dermatitis cases.

Between 1974 and 1983, 3,952 confirmed pesticide-associated skin injuries were reported among California workers, 401 of which were attributed to pesticides containing propargite.³ Propargite is the active ingredient in Omite-30W, a miticide widely used on grapes

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in California. Propargite is also the active ingredient of Omite-CR, recently formulated for use on citrus; this pesticide had just begun to receive widespread use in Tulare County when the dermatitis outbreak occurred. The dermatitis among the orange pickers was reported to be "almost identical" to the dermatitis seen among grape workers exposed to Omite-30W (personal communication, Tulare County Agricultural Commissioner). Also, Omite-CR was reported to be the pesticide common to the dermatitis cases, although it was determined that each crew was also exposed to formetanate hydrochloride (Carzol, NOR-AM), either as a tank mix with the Omite-CR or as a separate spray. For these reasons, Omite-CR was seen as the probable cause for the dermatitis outbreak, but Carzol, or an interaction between Omite-CR and Carzol, was also considered as a possible cause.

Omite-30W and Omite-CR are wettable powders containing 30% propargite (2-[4-(1,1-dimethylethyl)phenoxy]cyclohexyl-2-propynyl sulfite). Omite has an oral LD₅₀ in the rat of 2,200 mg/kg, indicating low oral toxicity.⁴ Dermal studies in the rabbit, however, have shown second-degree chemical burns when technical grade Omite (100% propargite) was occluded to the skin for 24 hours (data on file with CDFA). Eye irritation from Omite-30W has also been reported among grape workers.¹

The new formulation, Omite-CR, was developed by changing only the inert ingredients (which are the manufacturer's trade secrets). The stated purpose of this change was to prevent leaf burn when used on citrus by reducing contact between the propargite granules and the citrus leaves through a coating of inert ingredients. A 24-hour reentry and a seven-day preharvest interval are stated on the Omite-CR package label. Omite-CR was used in limited quantities in 1985, and then applied to an estimated 20% to 30% of the 90,000 acres of oranges in Tulare County in 1986 (personal communication, Office of the Tulare County Agricultural Commissioner).

When Omite-CR was submitted to the California Department of Food and Agriculture for registration, attention apparently was paid only to the fact that the active ingredient (30% propargite) remained unchanged, and that the active ingredient did not form compounds with the new inert ingredients. Therefore, the reformulation was deemed a nonsubstantive change. Registration occurred without requiring further data to be developed. No additional health and safety data for the new formulation were supplied by the manufacturer.

Omite-CR was registered as a nonrestricted pesticide in California. This allowed growers to buy the compound and use it without filing a plan or seeking prior approval for its use. However, the growers were responsible for following the package label instructions governing the crops on which it may be used, its application rate (pounds per acre), frequency of application, reentry, and preharvest intervals (time between application and harvest), as well as any state and county regulations governing its use.

In looking for a cause for the dermatitis we considered whether (1) Omite-CR alone was responsible for the dermatitis; (2) Carzol alone was responsible; or (3) an interaction between Omite-CR and Carzol was responsible. No other pesticides were used in quantity or with consistency in the orchards.

Methods

The data for the study were collected from several sources. All PIRs submitted from Tulare County covering the period April 1 to May 12, 1986, were obtained. These reports contain the employer's name; the employee's name, age, and sex; the diagnosis, including symptoms and parts of the body affected, tests ordered and treatment given; date of onset of the illness; the date the patient was seen; and the name and address of the physician making the diagnosis. A case was defined as a person who worked for the packing company with a PIR on which a diagnosis of dermatitis with onset after April 1 was recorded.

All pesticide spraying records were obtained for each field harvested, as well as the dates and hours that each crew worked in each field. The data from April 21 through May 9, 1986, were used to examine the time-order relationship between exposure to Omite-CR and onset of dermatitis and to calculate cumulative hours of exposure to Omite-CR, Carzol, Omite + Carzol, and other pesticides.

Daily temperature maximums for January through May were obtained for two weather stations nearby the harvested areas.

Representatives were interviewed from the California Department of Food and Agriculture, the Tulare County Health Department, the Tulare County Agricultural Commissioner, the management of the citrus packing-house, and Uniroyal Chemical Company, the manufacturer of Omite-CR.

Three of the six crews of orange pickers were interviewed (88 workers) using a standardized questionnaire. All interviews were conducted in Spanish, some using interpreters, others directly in Spanish. The data collected included presence and date of onset of the dermatitis; distribution and nature of the dermatitis; whether or not a physician was seen; body surfaces usually exposed while picking oranges; previous history of dermatitis; recent history of open cuts and wounds; previous atopic history (asthma and other allergic responses); description of any other illnesses, including eye irritations; and, the neck, face, and upper chest of each interviewee were examined for dermatitis.

The CDFA estimated the dislodgeable foliar residue degradation function for Omite-CR from 127 leaf samples taken one to 42 days postharvest from trees in the citrus groves associated with the dermatitis outbreak. The least-squares linear regression equation was: $Y = 3.597 - 0.084 X + e$ (personal communication, Mr. Clifford Smith, CDFA). In this equation Y is the dislodgeable foliar residue in micrograms per square centimeter of leaf surface, X is the days since application, and e is

the error term. The coefficient of determination is 0.40, indicating that 40% of the variation in dislodgable Omite-CR residues is explained by days since application. (All applications used 10.5 or 12 lb of Omite-CR mixed with approximately 1,000 gal of water per acre.) This function shows a decrease of 0.084 $\mu\text{g}/\text{cm}^2$ of Omite-CR dislodgable foliar residue per day for each day since application. It was employed in our analysis to project foliar residue concentrations on harvest days. Residue-hours of exposure on the harvest day were calculated by multiplying projected residue levels for each field by the number of hours spent harvesting. When a workday was split among several fields and involved multiple exposures to Omite-CR, the residue-hours for each field were summed. Residue-hours for Carzol were not calculated because Carzol does not degrade on citrus foliage.⁵ Spearman's rank correlation coefficient (R_s) was used to quantify the associations between the percent dermatitis incidence for each crew and crew-based indexes of residue-hours of Omite-CR and cumulative hours of exposure to Omite-CR, Carzol, Omite + Carzol, and other pesticides.

Results

Exposure to Omite-CR-treated fields began April 26, 1986. The outbreak of dermatitis among these orange pickers started on April 30, 1986, and ended by May 12, 1986, when emergency extended reentry regulations for Omite-CR were introduced by Tulare County (Figure). Only 4 more cases were reported in the week following the outbreak period. For all crews, Omite-CR exposure preceded the onset of dermatitis; in five of the six crews, repetitive exposure to Omite-CR preceded the onset of dermatitis. The interval between first Omite-CR exposure and first onset of dermatitis ranged from zero to four days.

Of 198 workers, 114 fulfilled the dermatitis case

definition. The number of cases and the incidence rates of dermatitis by crew, based upon the PIR reports, are presented in Table 1. These incidence rates ranged from 23% to 78%. There were eight females among the cases. Eighty per cent were between 20 and 39 years of age. All exposed workers were of Hispanic origin.

Interviews were conducted 2 weeks after the initial onset of illnesses with 88 (95%) of the 93 pickers in three work crews, of whom 57 (65%) reported dermatitis. Some interviewees reported they had the dermatitis, but did not see a physician. Thus, the physician's PIR reports represent an undercount of the actual dermatitis incidence.

The dermatitis occurred most commonly on skin usually exposed during the workday. All workers whom we observed wore cotton gloves, canvas gauntlets from wrist to elbow, long trousers, long-sleeved shirts, and frequently wore hats, leaving only the face and varying amounts of the neck and upper chest exposed. Major dermatitis areas included the neck (81%), chest (42%), and shoulders (35%) (Table 2). In a few persons, dermatitis appeared on the arms, face (usually on the sideburn area), and on the abdomen and thighs.

The pickers with dermatitis reported the initial symptoms to be redness (74%), itching (63%), and burning (60%) (Table 3). The initial phase of the dermatitis was followed by a variable clinical course which included the formation of small papules, small vesicles, weeping, crusting, peeling (exfoliation), and change of skin color (usually hyperpigmentation).

Eye irritation was reported by 28 (32%) of the 88 workers, seven of whom required treatment by a physician. Workers with dermatitis had a higher incidence of eye irritation (37%) than workers without dermatitis (26%). However, this was not statistically significant ($\chi^2 = 1.19$, $df = 1$, $P = .26$).

The amount of exposure per crew to the different pesticides was assembled by the Tulare County Agricultural Commissioner. Each crew was ranked by cumula-

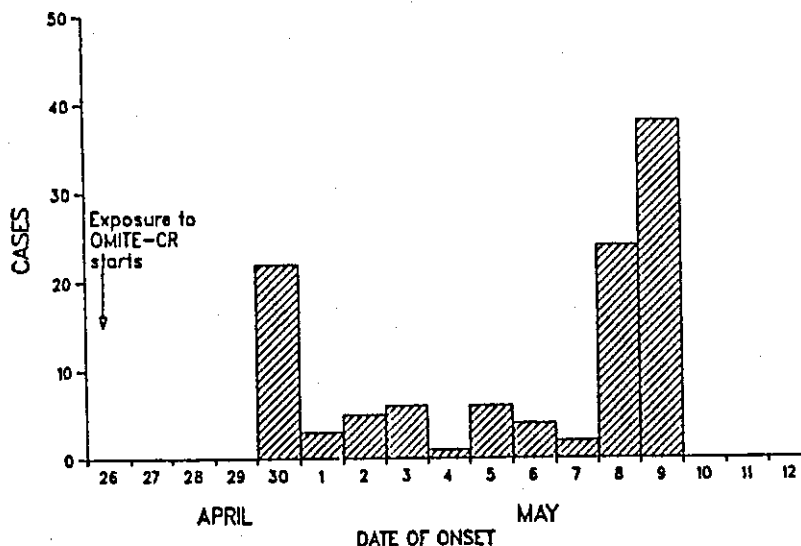


Figure. Dermatitis outbreak among orange pickers, by date of onset, Tulare County, California, April 26 to May 9, 1986.

TABLE 1
Dermatitis Incidence Rates by Crew

Crew	Total No. of Pickers	Dermatitis Cases*		Dermatitis Incidence Rates (%)
		Before Omite Exposure	After Omite Exposure	
1	36	0	28	78
2	37	0	24	65
3	31	0	18	58
4	31	0	12	39
5	37	0	26	70
6	26	0	6	23
All crews	198	0	114	58

* Source: The 114 PIR reports filed with the state of California.

TABLE 2
Dermatitis Site in 57 Interviewed Workers Reporting Dermatitis

Site Reported	Percent Reporting, by Site*	Workers
Face	8.8	5
Neck	80.7	46
Chest	42.1	24
Shoulders	35.1	20
Abdomen	5.3	3
Arms	17.5	10
Hands	0	0
Legs	7.0	4
Feet	1.8	1
Workers reporting dermatitis	—	57

* Source: Workers in crews interviewed by the California Department of Health Services.

TABLE 3
Dermatitis Symptoms in 57 Interviewed Workers with Dermatitis

Symptoms Reported	Percent Reporting, by Symptom*	Workers
Redness	73.6	42
Itching	63.2	36
Burning	59.6	34
Peeling	35.1	20
Change in skin color	26.3	15
Papules	17.5	10
Small blisters	15.8	9
Weeping	15.8	9
Crusting	10.5	6
Large blisters	1.8	1
Ulcers	0	0
Workers reporting dermatitis	—	57

* Source: Workers in crews interviewed by the California Department of Health Services.

tive hours of Omite-CR, cumulative hours of Carzol, cumulative hours of Omite-CR + Carzol, and cumulative hours of other pesticides. Both indexes of Omite-CR exposure, namely residue-hours and cumulative hours of Omite-CR exposure, correlated in the predicted direction with dermatitis incidence; $R_s = 0.60$ and 0.43 , respectively. Cumulative hours of Carzol exposure were less highly correlated with dermatitis incidence, $R_s = 0.32$. An inverse association between cumulative hours of exposure to pesticides other than Omite-CR and Carzol was found, $R_s = -0.60$. Note that this correlation indicates that crews with higher exposure have lower

incidence of dermatitis. The strength of association between Omite-CR + Carzol exposure and dermatitis incidence is similar to the association with Omite-CR alone, $R_s = 0.43$.

No statistically significant associations were found between dermatitis and sex (Fisher's exact test, two-tailed, $P = .51$, interview data), age ($X^2 = 8.42$, $df = 5$, $P = .13$), or previous history of dermatitis ($X^2 = 0.05$, $df = 1$, $P = .86$, interview data).

During the period of exposure to Omite-CR, April 26 through May 12, 1986, maximum ambient temperatures on harvest days when dermatitis occurred averaged one or two degrees higher than on days when dermatitis did not occur. High temperatures during this period ranged from a low of 66 to a high of 86°F.

Discussion

Omite-CR was identified as the probable cause of the dermatitis outbreak among orange pickers in this Tulare County episode based upon the following pattern of evidence:

1. No cases of dermatitis occurred before exposure to Omite-CR. When exposure did occur, incidence rates per crew ranged from 23% to 78%. When exposure stopped due to an extended reentry period for Omite-CR-treated fields, so too did the outbreak of dermatitis. Dermatitis occurred in one crew exposed to Omite-CR prior to exposure to Carzol.

2. A dose-response relationship was suggested between the crew-based measures of Omite-CR exposure and the incidence rates of dermatitis in the six crews using two measures of exposure. Residue-hours of Omite-CR, which adds information on exposure to dislodgeable residue over and above that obtained through a knowledge of simple cumulative hours of exposure, correlated even more highly with the incidence of dermatitis than did the latter, thereby strengthening a dose-response interpretation. Measures of individual exposures were not available, therefore crew-based measures were used.

3. The biologic plausibility for Omite-CR to cause dermatitis is suggested by the report of a rabbit dermal occlusion test in which technical grade Omite (100% propargite) produced second-degree chemical burns when occluded to the skin for a 24-hour period. Addi-

tional support is found in numerous PIR reports; 401 cases of dermatitis associated with exposure to propargite were recorded in California from 1974 to 1983.¹

4. Other exposures and factors did not appear to predict dermatitis. Neither Carzol alone, nor other pesticides, nor a past history of dermatitis, were strongly associated with current dermatitis outcome. The association between Omite-CR + Carzol and dermatitis incidence was similar to that of Omite alone. A synergistic effect of Omite and Carzol is thus not supported by the data. Higher temperatures may play a minor role in the dermatitis; however, the temperatures were not excessive during the outbreak period and days on which dermatitis occurred were only one or two degrees higher than days on which it did not occur. Although it is possible that unknown factors might provide explanation of dermatitis, the factors examined represent the major alternative etiologic hypotheses.

The site of dermatitis is consistent with direct contact with foliage, possibly repetitive, or accumulation of pesticide residue dusts in skin crevices with a focal area in the suprasternal notch, or entrapment by clothing such as the elastic arm bands of the gauntlets worn around the arms to protect against abrasion.

Based upon the evidence produced by this study, it appears that the seven-day preharvest interval specified on the Omite-CR label did not allow sufficient propargite degradation to avoid severe dermatitis among the orange pickers, especially in situations such as this where workers had as much as 60 hours of exposure per week.

The apparent failure within the CDFA pesticide registration process to recognize that the inert ingredients in the "CR" formulation could result in slower propargite degradation or other adverse change resulted in no additional registration requirements being requested

beyond that for Omite-30W. The manufacturer was aware that the product would be long-lasting, however, based upon a recent magazine advertisement describing Omite-CR as having "4 to 12 weeks of residual action."⁶

Because no apparent violations of preharvest interval, application rate, or regulation occurred, it appears that foliar residue degradation time on citrus was not given adequate consideration in the registration of Omite-CR. This episode underscores the importance of inert ingredients and their potential to compromise the safety and health of the worker.

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References

1. Pesticide Illness Reports, 1974-1985, California Dept of Food and Agriculture.
2. State of California, Health and Safety Code, Section 2950.
3. O'Malley M, Mathias CGT, Coye MG: Skin injury associated with pesticide exposure in California: 1974 to 1983, in International Symposium on Health and Safety in Agriculture Oct 10-11, 1985, Saskatoon, Saskatchewan, Canada. Cleveland, OH. CRC Press, in press 1987.
4. *Farm Chemicals Handbook '86*. Willoughby, OH, Meister Publishing Co, 1986, p C-173.
5. Hadjidemetriou DG, Iwata Y, Gunther FA: Analysis and dissipation of dislodgeable residues of acephate, dimethoate and formetanate hydrochloride on citrus foliage. *Pestic Sci* 1985;16:302-310.
6. *Citrograph*, May 1986.

Transforming a Critical Judgment

While mothers and daughters usually struggle with problems of being too intertwined, what seems to characterize the father-son relationship is difficulty bridging the gap between them. . . .

There is so much affection . . . between fathers and sons that is repressed. . . . When a son grows up and wants to get close to his father, one of the things he's afraid of is his own sadness and yearning. . . .

Freud said the death of his father was the major loss in his life. It's not uncommon for fathers to die before relationships are worked out. The son then enters into a period of grief. Numbers of men . . . think about their fathers every day, even long after they have died. Some men continue to work on the relationship after the death. The relationship can still be healed then, though it's harder. . . . but the task is the same—transforming that inner memory we carry around of our fathers from critical or judgmental to caring and nurturing.

—From "Horizons: Each Father Shapes the Life of a Son in a Different Way," a conversation with Samuel Osherson in *US News and World Report*, June 16, 1986.