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December 4, 2001

Farm Worker Illness Following Exposure to Pesticide Drift in Kings County, California, 1999

Summary: On July 10, 1999 a crew of 25 farm workers began weeding cotton in a field that was adjacent to a field that had been sprayed by plane with a mixture of naled, chlorpyrifos, and mepiquat chloride approximately one hour earlier. Shortly after beginning work, the workers noted a strong odor and experienced headaches, nausea, and shortness of breath. Approximately 30 minutes after entering the field, the workers were directed to work in a different field that was also adjacent to a field that had been recently treated with pesticides. The workers also noticed odor in second field they worked in, and at this point, 2 ½ hours after beginning work for the day, the labor contractor gave the workers the option to go home without pay. Of the 16 workers who left work at this time, nine subsequently sought medical care independently. Eight sought care on the day of the incident and were hospitalized overnight; one did so three days later and received outpatient treatment. Eight days after the incident, 80% of the interviewed workers denied having complete resolution of their symptoms.

Conclusions: The exposure of farm workers to pesticide drift resulted in at least nine cases of pesticide-related illness. Factors that contributed to these illnesses include: (1) The toxicity of the pesticides applied; (2) The proximity of the workers to fields that were being and/or had been recently treated with pesticides; (3) Delays in decontamination and medical care for workers who had been exposed to pesticide drift.

Recommendations: To prevent farm worker illness due to pesticide drift the California Department of Health Services recommends that: (1) Growers should implement the use of non-chemical alternatives or less toxic chemicals to controlling pests, when available; (2) For application scenarios similar to this incident, regulatory agencies should consider enforcement of the Restricted Entry Interval in the ¼mile zone around the treated field as a minimum precautionary measure; (3) Employers should ensure that workers receive prompt medical care when there are reasonable grounds to suspect pesticide illness or exposure.

Background

The Sentinel Event Notification System of Occupational Risk (SENSOR) Pesticide Poisoning Prevention Project is conducted by the California Department of Health Services Occupational Health Branch (CDHS) through the support of the National Institute for Occupational Safety and Health and the US Environmental Protection Agency. The goal of the SENSOR project is to prevent pesticide poisoning among workers. SENSOR staff utilize a physician-based reporting system to conduct state-wide surveillance of pesticide illness among workers. Selected cases are followed up by a workplace investigation and interviews with workers, employers, and others involved in the incident. The investigations assess factors that may have contributed to occupational illness and make recommendations to prevent pesticide poisoning among workers.

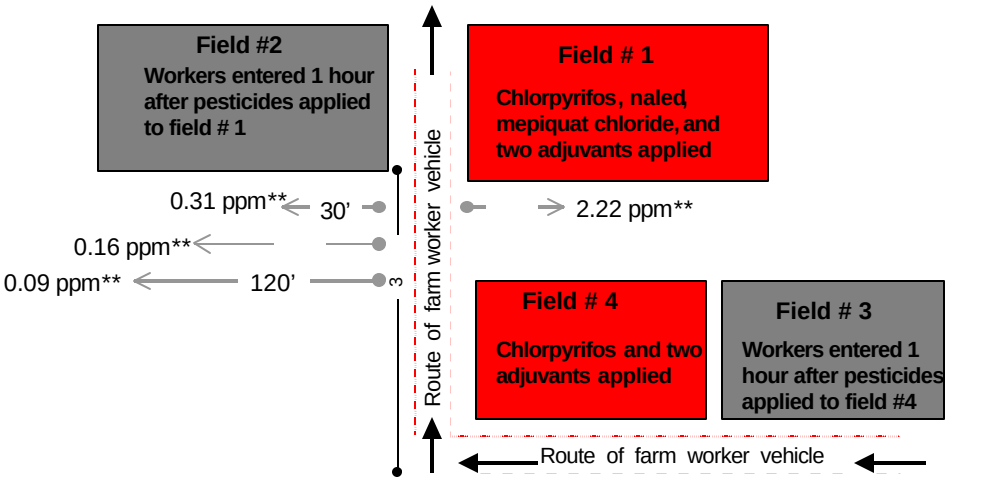
On July 13, 1999 CDHS received a Pesticide Episode Transmittal Report from the California Department of Pesticide Regulation of a pesticide exposure incident in Kings County involving a crew of 25 farm workers. An Industrial Hygienist and a Bilingual Interviewer from the SENSOR project conducted an on-site investigation (July 18-21 and July 27, 1999) in the community where the incident occurred. SENSOR staff:

- interviewed the grower, pesticide applicators, and labor contractor;
- interviewed 10 crew members;
- reviewed the medical records of all nine workers who sought medical care;
- observed and photographed the fields where the incident occurred.

Incident

On July 10, 1999, at 4:30 am, a cotton field (Field #1) was sprayed by plane with a pesticide mixture that included as active ingredients the organophosphate compounds naled (acute toxicity category I;[1] 1.1% of the mixture applied by weight[2]) and chlorpyrifos (toxicity category II; 1.8% by weight), mepiquat chloride (a growth inhibitor; 1.1% by weight), and two adjuvants (Figures 1 and 2). Approximately one hour later, a crew of 25 farm workers began weeding cotton in an adjacent field (Field #2) that was approximately 15 feet from the treated field (Figure 2). Shortly after beginning work, the workers noted a strong odor and experienced headaches, nausea, and shortness of breath. Approximately 30 minutes after entering the field, the workers were directed to work in a third field located about three miles away (Field #3). This field was also adjacent to a field (Field #4) that had been sprayed, with chlorpyrifos and two adjuvants, about one hour earlier. The workers also noticed odor in Field #3, and at this point, 2 ½hours after beginning work for the day, the labor contractor who employed all of the workers gave the workers the option to go home without pay. Sixteen of the 25 workers left work; the remaining nine worked for the rest of the day in yet another location.

Figure 1. Location of farm workers to fields* sprayed with pesticides



* All of the fields were owned by the same grower
** parts per million chlorpyrifos measured on foliage

Figure not to scale

Figure 2. Proximity of farm workers to pesticide treated field

Of the 16 workers who left work, nine subsequently sought medical care independently. Eight sought care on the day of the incident and were hospitalized overnight; one did so three days later and received outpatient treatment. Among the nine workers who sought care, the delay between leaving work and receiving care ranged from one to 76 hours (median = 5 hours).

Ten workers, including eight of the nine who had obtained medical care, were later interviewed by CDHS during its investigation. These 10 workers reported removing their contaminated clothing and showering between thirty minutes and 11 hours after leaving work (median delay in decontamination was two hours). Odor was detected by 8 (73%) of 11 workers who sought care or were interviewed by CDHS. Symptoms reported by these workers are listed in Table 1. Plasma and red blood cell cholinesterase (ChE) samples obtained from eight workers on the day of the incident were all within laboratory normal values; baseline ChE levels for these workers were not available for comparison.

Table 1. Symptoms and signs of pesticide intoxication among 11 farmworkers – Kings County, California, July 1999

Symptom/Sign	No.	(%)	Symptom/Sign	No.	(%)
SYMPTOMS					
Respiratory	**11**	**(100)**	**Eye**	**3**	**(27)**
Odor detected	8	(73)	Pain/irritation	3	(27)
Upper respiratory pain/irritation	6	(55)	Pruritis	1	(9)
			Lacrimation	1	(9)
Shortness of breath	5	(46)			
Cough	1	(9)	**Cardiovascular**	**2**	**(18)**
Wheezing	1	(9)	Chest pain	1	(9)
			Palpitations	1	(9)
Nervous system	**9**	**(82)**			
Headache	8	(73)	**Miscellaneous**	**1**	**(9)**
Dizziness	4	(36)	Fatigue	1	(9)
Blurred vision	3	(27)			
Fasciculations	2	(18)	**Skin**	**1**	**(9)**
Muscle weakness	2	(18)	Rash	1	(9)
Salivation	2	(18)	Irritation/pain	1	(9)
Confusion	1	(9)			
Hyperactivity/anxiety /irritability	1	(9)			
Muscle rigidity	1	(9)	**Genitourinary**	**1**	**(9)**
Tingling hands/feet	1	(9)	Oliguria/anuria*	1	(9)
			Hematuria*	1	(9)
Gastrointestinal	**9**	**(82)**			
Nausea	9	(82)	Incontinence	1	(9)
Abdominal pain/cramping	5	(46)	**SIGNS**		
Vomiting	4	(36)	Respiratory	1	(9)
Anorexia	2	(18)	Hyperventilation	1	(9)

* Symptoms not associated with pesticide exposure

Environmental Data

The California Department of Pesticide Regulation collected foliage samples in Fields #1 and #2 approximately 54 hours after completion of the aerial pesticide application in Field #1 to determine if a residue gradient existed, which would indicate drift of pesticide from Field #1. The samples from Fields #1 and #2 were tested for both chlorpyrifos and naled. The chlorpyrifos level in Field #1 was 2.22 parts per million (ppm) and ranged from 0.09 to 0.31 ppm in Field #2, where the workers had been assigned; in Field #2, a gradient was present, with higher levels found on foliage nearer to Field #1 (Figure 1). Clothing from three workers (a shirt from one worker and pants from two others) had chlorpyrifos residues of up to 59.0 micrograms per clothing item. Finally, three workers reported additional direct exposure to pesticide drift from the aerial application of chlorpyrifos to Field #4, which occurred while they were driving to work (Figure 1); swab samples of the interior and exterior of their vehicle showed chlorpyrifos levels up to 0.07 micrograms/sample. Naled was not detected in the foliage, clothing, or vehicle samples.

Based on environmental evidence of pesticide exposure (foliage, clothing and vehicle samples) and occurrence of symptoms consistent with organophosphate toxicity, exposure to residues from pesticide drift resulted in eight probable and one possible case of pesticide-related illness.[3] There were insufficient data to determine whether illness occurred among any of the 14 exposed workers whom CDHS did not attempt to interview and who did not seek medical care. As of eight days after the incident (when interviews by CDHS started), 80% of the interviewed workers denied having complete resolution of their symptoms.

Discussion

Pesticide drift refers to the movement of pesticides away from the site of application.[4] The incident reported here demonstrates that toxic chemical exposure that results from pesticide drift can cause acute illness among farm workers. The environmental evidence supports that all the workers in Field #2 were likely exposed through skin contact with residues of pesticide that had drifted onto the cotton they were weeding. Foliage testing and a review of pesticide application records indicate that the residues in Field #2 resulted from drift from the aerial spraying of Field #1. Some of the workers may have also been directly exposed, through both skin contact and inhalation, to pesticide drift still present in the air when they entered Field #2. The inability to detect naled in any samples (collected 54 or more hours after the spraying) is likely due to the high volatility of this chemical (vapor pressure 260 mPa @ 20^{o} C). Finally, the workers may have also been exposed to pesticides when working in Field

#3, and three workers may have had additional exposure to pesticide drift while driving to work.

The failure of the labor contractor and grower to ensure that all exposed workers received prompt medical care, including decontamination, is likely to have increased the workers' total pesticide exposure and the potential for secondary contamination of their vehicles and homes. This underscores the importance of the employer requirement to ensure that workers receive prompt medical care when there are reasonable grounds to suspect pesticide illness or exposure. [5, 6]

In this incident, several factors may have contributed to the symptoms experienced by the workers, including ChE depression, odor, and anxiety. Detection of an odor and situational anxiety may both result in nonspecific symptoms that may resemble those due to toxic effects of pesticides (e.g., shortness of breath, headache, dizziness, nausea and vomiting). The workers' ChE levels were not depressed compared to laboratory normals, but testing for follow-up ChE levels and urine organophosphate metabolites was not performed. Definitive interpretation of ChE levels requires individual baseline levels.[7] Healthcare providers should ensure appropriate follow up for workers exposed to organophosphate pesticides. Urine samples may be frozen for metabolite assays by specialized laboratories. In the absence of baseline levels, follow-up ChE levels obtained at biweekly or monthly intervals can help to make a retrospective diagnosis of illness due to ChE-inhibiting pesticides.

The airborne dispersal of toxic chemicals, including pesticides, is a dangerous work process that can affect multiple populations. Drift accounted for 1,599 (22.8%) of the 7,023 cases of acute work-related pesticide illness reported in California between 1991 and 1998; 638 (39.9%) of these drift-related illnesses occurred among employees of agricultural firms (California Department of Pesticide Regulation, unpublished data, 2001). In 1998-99, exposure to pesticide drift in California resulted in illness among varied occupational groups, including agricultural workers, teachers, construction workers, bus drivers, meter readers, laborers, and janitors, as well as community members (CDHS SENSOR project, unpublished data, 2001).

Workers likely to enter or to walk within one-quarter mile of a pesticide-treated field during application or during the Restricted Entry Interval (REI) must be notified of the application in a manner that the person can understand.[8] In this incident, the workers were not notified of the applications in the immediately adjacent fields. However, compliance with this regulation would not have prohibited the workers from entering the adjacent field and, thus, may not have prevented these illnesses. In this incident – assuming that the REI for the application site is protective –

enforcement of the REI in the ¼mile zone adjacent to the treated field would have prevented exposure to these workers. CDHS recommends that for application scenarios similar to this incident, regulatory agencies should consider enforcement of the REI throughout the ¼mile zone around the treated field as a minimum precautionary measure.

To prevent pesticide illness, alternatives to the use of toxic chemicals for pest control should be assessed. Growers should implement the use of non-chemical alternatives or less toxic chemicals to controlling pests, when available. In recognition of the public health impacts of pesticide drift, the California Medical Association has called for strengthening efforts to protect schools and residential areas from pesticide drift and for a reduction in the use of pesticides with significant acute and chronic toxicity that have the capacity to drift to schools and residential areas.[9]

Summary of Findings and Recommendations

Factors that contributed to pesticide illness in this incident include:

- The toxicity of the pesticides applied;
- The proximity of the workers to the fields that were being and/or had been recently treated with pesticides;
- Delays in decontamination and medical care of workers who had been exposed to pesticide drift.

To prevent farm worker illness due to pesticide drift CDHS recommends that:

- Growers should implement the use of non-chemical alternatives or less toxic chemicals to controlling pests, when available;
- For application scenarios similar to this incident, regulatory agencies should consider enforcement of the REI in the ¼mile zone around the treated field as a minimum precautionary measure;
- Employers should ensure that workers receive prompt medical care when there are reasonable grounds to suspect pesticide illness or exposure.

References

[1] The US EPA ranks pesticides into four acute toxicity categories. The most acutely toxic pesticides are in category I (highly toxic, signal word DANGER) and category II (very toxic, signal word WARNING). Moderately toxic pesticides are in category III (signal word CAUTION) and the least toxic pesticides are in category IV (signal word CAUTION).

[2] According to the Pesticide Use Report for Field #1, chlorpyrifos was applied to the [299 acres] field at a rate of 1.50 pint per acre, naled at a rate of 0.50 pints per acre and mepiquat chloride at 6.00 ounces per acre.

[3] Council of State and Territorial Epidemiologists. Inclusion of acute pesticide-related illness and injury indicators in the National Public Health Surveillance System (NPHSS). Atlanta, GA: The Council; 1999. Available from: URL: http://www.cste.org/ps1999/ENV3.doc . Accessed September 14, 2000.

[4] Marer PJ, Flint ML, Stimmann MW. The safe and effective use of pesticides. University of California, Statewide Integrated Pest Management Project, Division of Agriculture and Natural Resources Publication 3324. 1988 page 227.

[5] Caifornia Code of Regulations, Division 6, Chapter 3, Subchapter 3, Article 3, Section 6766 (c).

[6] 40 CFR Subpart B §170.160

[7] Lessenger JE, Reese BE. Rational use of cholinesterase activity testing in pesticide poisoning. J Am Board Fam Pract. 1999;12:307-14.

[8] California Code of Regulations Division 6, Chapter 3, Subchapter 2, Article 1, Section 6618.

[9] California Medical Association. Resolution 114-00 “Agricultural Pesticide Drift”, March 2000.