

Investigation of Pesticide Drift Exposures at a Produce Cooling Facility in California

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Background

The California Department of Public Health, Occupational Health Branch (CDPH), is mandated to evaluate hazards in the workplace, and to make recommendations to prevent occupational illness and injury. The Occupational Pesticide Illness Prevention Program (OPIPP) within CDPH has an ongoing project to learn about pesticide drift exposures that take place at worksites that are surrounded by farm fields. OPIPP is not a regulatory agency and does not issue citations. We function as a research and health promotion program, and, essentially, we conduct workplace evaluations of conditions that may contribute to work-related illness and injury and make recommendations following our site visits. Under CDPH's mandate to conduct investigations of workplace illness (Health & Safety Code 105175), CDPH has the authority to access worksites and obtain information related to occupational safety and health including conducting interviews with employers and employees.

CDPH received a Pesticide Episode Notification Record (PENR) from the California Department of Pesticide Regulation regarding a pesticide exposure incident at a produce cooling facility. According to the PENR, a tractor sprayed a mix of pesticides on a lettuce field located 15 feet away from the cooling facility property line. A pest control business applied the pesticides. The PENR stated that a facility employee, who was operating a forklift at the time, felt a significant amount of spray on his face and hands and experienced symptoms of skin irritation, headache, nausea, sweating, vomiting, and diarrhea later that evening. This employee did not let his supervisor know about this exposure until the next day. The day after the exposure, the employer interviewed other employees who worked in the same area as the forklift worker and discovered that two more employees had illness symptoms. The employer notified the County Agricultural Commissioner (CAC) two days after the application and the CAC's subsequent investigation found that a total of seven employees had experienced symptoms.

A Google maps satellite view of the facility (see Figure 1) showed that it is surrounded by farm fields and that the fields come right up to the edge of the cooling facility

property. CDPH had noted past pesticide drift cases involving worksites surrounded by farm fields and had been interested in investigating a similar pesticide drift incident to determine whether outreach to other locations surrounded by (or almost surrounded) by farm fields would be useful for preventing pesticide-related illnesses.

Figure 1. Google Maps satellite view of the site



CDPH investigated this incident in order to better understand the extent and cause of the exposures and to determine what measures and responses could have prevented and/or mitigated the illnesses. The investigation consisted of interviewing workers with reported illnesses, key witnesses, and other parties involved in responding to and investigating this incident, including personnel from the CAC's office, a facility Distribution Manager, a company Human Resources Specialist, facility employees, and a pesticide applicator company representative in charge of the application. CDPH's investigation also consisted of a site visit. CDPH interviewed four of the seven employees who experienced symptoms. The scope of our evaluation is limited to a site visit to the facility, interviews, and a review of medical records, product labels, safety data sheets, and the CAC's final report. The limited nature of CDPH's investigation does not imply there are no other health and safety issues at the workplace.

Description of the Facility

The cooling facility is located on a roughly triangle-shaped property with several buildings including offices, a packaging facility, and a 60,000 square foot refrigerated cooler. There is also a 30,000 square foot area covered by a canopy and a pallet yard.

The main activities of this facility are to receive and offload produce from arriving trucks, inspect produce for quality, and transfer it into the cooler to prolong shelf life. At certain times of the year, during harvest, workers are present until late at night. The busiest times of year are July and August but employees are onsite throughout the year. Much of the work takes place outside and there is a great deal of forklift use. The area adjacent to the farm field where the lettuce crop was being sprayed is where workers walk back and forth between buildings and use forklifts. Figures 2 and 3 illustrate the location of the lettuce field in relation to the cooling facility. The property line of the facility is separated from the field by a 15 foot wide dirt road. During the off-season the site is used as a nursery to raise plants.

Figure 2. Google Maps satellite view of the location of the treated lettuce field relative to the facility.



Figure 3. Treated field is just beyond the chain link fence. (Lettuce crop had been disked under by the time of this photo was taken.)



The Pesticide Application

At approximately 9:00 p.m., the pesticide applicator began an application of a mixture of six products – five pesticide formulations and a surfactant – to the lettuce field. The lettuce was being treated for multiple pests including mildew and insects. One of the pesticides used, methomyl, is a California Restricted Material. A Restricted Materials Permit was in place for use of methomyl on the lettuce field but the application was not supposed to take place until later, as per the timing of the notice of intent filing. According to a representative of the CAC's office, the application was not supposed to begin until after midnight.

The application was performed using an open cab tractor and a boom sprayer. The products used, their known ingredients, signal words, and possible symptoms are included in Table 1.

Table 1. Pesticide application product names, ingredients, signal words, and hazard information

Product name/ EPA registration number	Ingredients*	Label signal words**	Possible symptoms
Lannate SP Insecticide EPA Reg. No. 352- 342	Active ingredient: Methomyl 90% Other ingredients: None listed	Danger/ Poison	Weakness, blurred vision, headache, nausea, abdominal cramps, discomfort in the chest, constriction of pupils, sweating, slow pulse, tremors. ^{1,2,3}
Broadspred Organosilicone surfactant No EPA Reg. No.	Ingredients: Linear Primary Alcohol Ethoxylate 18-25% Modified polydimethyl siloxane (% not listed)	Danger	Eye damage and skin irritation. Respiratory tract and gastrointestinal tract irritation. ^{4,5}
Silencer Insecticide EPA Reg. No. 66222-104	Active ingredient: Lambda-cyhalothrin 12.7% Other ingredients: Naphtha (petroleum), heavy aromatic 76.05-80.75% Naphthalene 6-8%	Warning	Eye injury, headache, dizziness, numbness, nausea, lack of appetite, fatigue, incoordination. Skin exposures can lead to tingling, itching, burning or prickly feeling, skin irritation, and allergy. ^{6,7,8} Naphthalene listed as possibly carcinogenic to humans. Lambda-cyhalothrin listed as probably carcinogenic to humans. ⁷
ABBA Ultra Miticide/ Insecticide EPA Reg. No. 66222-226	Active Ingredient: Abamectin 3.74% Other ingredients: Butylated hydroxytoluene <1% n-Methylpyrrolidone >10%	Warning	Eye and respiratory tract irritation. Incoordination, tremors, lethargy, excitation, and pupil dilation. ^{9,10,11,12} n-Methylpyrrolidone is a reproductive hazard and is listed as a Prop 65 developmental toxicant. ^{10,12}
Previcur Flex Fungicide EPA Reg. No. 264- 678	Active ingredient: Propamocarb hydrochloride 66.5% Other ingredients: None listed	Caution	Eye and skin irritation. Lethargy, ataxia, spasm. ^{13,14}
Revus Fungicide EPA Reg. No. 100- 1254	Active ingredient: Mandipropamid 23.3% Other ingredients: Propylene glycol (% not listed)	None	Propylene glycol: anesthesia, dizziness, confusion, headache, and nausea. ^{15,16}

* Ingredients are listed per the product labels and safety data sheets and percentages listed are for the concentrated product prior to mixing.

** A signal word on each product label indicates the product's potential hazard. Caution - low toxicity; Warning - moderate toxicity; Danger - high toxicity.

The Exposure Incident and Response

At the time of the application several employees were still onsite performing various outdoor and indoor tasks such as stacking empty pallets, receiving incoming fruit, making counts in the warehouse, and walking or riding a cart to and from the engine room, office, and packaging department. Several of them noticed the tractor driving back and forth applying pesticides in the field adjacent to their location. The pesticides were being applied with a boom sprayer and the tractor was moving back and forth parallel to the fence between the two properties.

At about 9:20 p.m., one employee, who was using a forklift about 50 feet from the edge of the lettuce field, noticed a strong odor and felt spray from the application on his face and hand. At about the same time several other employees onsite noticed a strong, unpleasant odor that they attributed to the pesticide application, but none of these employees felt spray on them. Although some of the employees spoke to each other and their supervisors that evening about the application and odor, and in some cases of feeling ill, there was no notification of emergency personnel, company safety personnel, or the CAC on the evening of the application and workers were not sent to the doctor until one and two days later.

The employee who felt the spray on his face and hands did not fully decontaminate while at work. He washed his face and arms with soap and water and changed his shirt. He showered and changed when he got home.

The next day, because of lingering symptoms, the employee who had spray contact told his supervisor, who notified a manager. This employee was taken to a local medical clinic by a supervisor that same day. Company management contacted the CAC at about noon, two days after the application and exposures. By this time the company had discovered that two more employees had experienced symptoms due to pesticide exposure. The CAC immediately began their investigation. That afternoon, company personnel contacted the CAC again and said that they found four more employees who had experienced symptoms. All six of these employees were taken to the medical clinic that day.

Findings and Discussion

According to the CAC and the company, a total of seven employees were known to have experienced pesticide illness symptoms. Based on our interviews with employees and on a review of medical records and the CAC report, symptoms included nausea, headache, lightheadedness, vomiting, difficulty breathing, dry mouth, cough, throat irritation, pain with deep breath, anxiety, fatigue, dry eyes, loss of appetite, constipation, upset stomach, diarrhea, and muscle pain. Some of the symptoms were experienced before the employees left work the night of the pesticide application. Some

symptoms were persistent more than a month after the incident, including abdominal pain, loss of appetite, and constipation.

Employees reported that the wind was coming towards them from the field and they stated that the tractor seemed to be moving fast and creating a cloud. The odor was described as strong and smelling like “rotten egg,” “sewage,” “skunk,” “paint thinner,” “turpentine,” and “Raid spray.”

The CAC researched records of wind patterns in the vicinity and at the time of the application and found that the cooling facility was downwind of the application. Company management stated that there seems to always be a breeze there until late at night, with prevailing winds coming toward them from the west.

Employees felt that the speed of the tractor may have contributed to the creation of a cloud of pesticide in the air, which may have made it more likely that drift would occur. Indeed, higher tractor speeds can create more turbulence, which can potentially cause more drift.¹⁷ However, the CAC representative stated that a computer system on the tractor is used to make sure the tractor travels at a consistent speed and that there was no evidence to show that the application was conducted at an unsafe speed.

It is unclear exactly which factors combined to create the drift but since the area experiences prevailing winds and because the properties are so close together it would be prudent to use all available drift prevention methods to avoid drift. In fact, as mentioned by several people during this investigation, there was a previous drift incident at this location. A review of our records shows that in May 2007, a drift incident occurred that affected at least 14 workers at this site; diazinon and pronamide drifted from an application to a lettuce field.

Just as an employer would plan for other emergencies like earthquakes, fire, or onsite chemical releases, planning and training for a pesticide drift emergency could help prevent exposures and/or lessen the health effects of exposures. Some employees did not report their direct exposures, illness symptoms, or strong odors from the pesticide application to a supervisor. However, in the instances when supervisors were told about exposures, they did not report them to a higher management level until the next day, nor were emergency responders or the CAC notified right away. There was no systematic evacuation away from the treated field. Decontamination was not conducted, although, according to company personnel, there is an emergency drench shower onsite. Per standard practice for most hazardous chemicals, including pesticides, contaminated clothing should be removed immediately and contaminated skin should be rinsed with plenty of water for 15-20 minutes.

CDPH noted that, on the medical records, the treating clinic mentioned knowing about only two of the six products that were used. The only products mentioned in the medical records were Revus (mandipropamid, no signal word) and Silencer (lambda-

cyhalothrin, signal word “Warning”). Importantly, Lannate SP (methomyl), which is a more toxic product as noted by the signal words “Danger” and “Poison,” and Broadspred Organosilicone surfactant with the signal word “Danger,” were not mentioned. The cooling facility company was given Safety Data Sheets (SDSs) for only Revus and Silencer when they asked the neighboring property operator for information about the pesticides after the drift incident. The cooling facility company sent the SDSs for these two products to the medical clinic and was not aware that there were a total of six products in the mixture. Ideally, in order to fully evaluate whether the combination of chemicals affects the severity or characteristics of the health effects, the SDSs and labels for every product to be sprayed should be supplied to neighboring property operators prior to the application, but if that is not possible these should be supplied to the neighboring property operator and to the medical clinic after a drift incident.

CDPH finds that better drift prevention practices by the applicator, and emergency procedures for dealing with pesticide drift incidents implemented by the cooling facility, would help prevent employee pesticide illness. Even if this is a relatively rare event, the consequences of a pesticide exposure incident can have serious consequences for exposed workers. The focus of CDPH’s recommendations will touch on drift prevention but will also focus on the planning, training, and response an employer can implement knowing that their location may be at risk for experiencing drift. We feel that other, similar locations that closely abut or are surrounded by farm fields, or that have had previous drift incidents occur, may benefit from implementing these recommendations as well.

Recommendations:

Recommendations fall into two main categories: preventing drift and preparing for drift incidents.

Prevent drift:

It is the responsibility of the applicator to prevent drift. Recent followup with a representative from the cooling facility indicates that, subsequent to this drift incident, the pesticide applicator has been communicating with them prior to applying pesticides. This has allowed the applicator to find out when facility employees will be onsite to avoid spraying at those times. This procedure will indeed help prevent direct employee exposures from drift and will mitigate the potential for occupational pesticide illness. However, if objects that the employees touch are contaminated with pesticides, such as forklift controls, this can also lead to pesticide exposures through skin absorption and hand-to-mouth ingestion. If other methods can be used to prevent drift altogether, this will be more protective of employee health and safety.

Methods to prevent pesticide illness from drift could include a mix of approaches, including pest control methods that eliminate or limit the use of pesticides, substitution with safer chemicals, engineering controls, and/or administrative controls. Drift prevention is a requirement on pesticide labels and most labels for agricultural applications include methods to prevent drift. Examples of methods that can prevent pesticide illness from drift are summarized in Table 2.

Prepare for drift incidents:

To prevent pesticide illness from drift incidents, locations that closely abut or are surrounded by farm fields or that have had previous drift incidents, should:

- Include pesticide drift awareness training along with other safety and health training and instruction required by the Cal/OSHA Emergency Action Plan Standard [California Code of Regulations, Title 8, Section 3220](http://www.dir.ca.gov/Title8/3220.html), (www.dir.ca.gov/Title8/3220.html) and the Injury and Illness Prevention Program Standard [California Code of Regulations, Title 8, Section 3203](http://www.dir.ca.gov/title8/3203.html), (www.dir.ca.gov/title8/3203.html). This training should include information about potential symptoms of pesticide exposure as well as the emergency response procedures and responsibilities as listed below.
- Request from the CAC, as part of the Restricted Materials Permit, to be notified when a notice of intent has been filed for applications that will be conducted on fields bordering the facility.
- Develop emergency response procedures so that all employees, including supervisors and managers, know what to do in case of a drift incident. The procedures should include the following:
 - A system of alerting facility management and in-house emergency response team (if it exists) in case of a drift incident.
 - A system of alerting all employees onsite of a drift incident, such as through two-way radios, announcements over loudspeakers, or alarm signals.
 - Evacuation routes/shelter-in-place contingencies.
 - Contacting the proper authorities or agencies, such as the CAC in case of drift and both the CAC and emergency responders (9-1-1) in case of pesticide illness.

- Contacting the property operator and applicator responsible for the pesticide application to notify them about the drift or odors and to get all relevant SDSs and labels if these have not been sent prior to the application.
- A system to ensure that all relevant hazard and exposure information is given to emergency responders and health care providers who are treating victims of pesticide drift. SDSs and labels should be transported to the health care provider along with the patients or sent electronically and should be provided to employees at their request.
- Procedures for properly decontaminating employees in case of contact with spray or mist from a pesticide application, including use of onsite emergency drench showers and eye washes.
- Transport of exposed and ill employees for medical care. Medical care for work-related illness should be provided through workers' compensation.
- Periodic training for employees, supervisors, and management that includes information about all of the above.
- Post procedures and relevant emergency contact information in conspicuous places throughout the facility for workers to use in case of drift exposures or an observed application of pesticides that appears to be improper or has the potential to drift. An example of a reason for initiating such contact would be observing an application during windy conditions.

Educational materials and a poster that can be filled out with the relevant emergency contact information can be found on our topic page, [Preventing Illness from Pesticide Drift](http://www.cdph.ca.gov/Programs/CCDPHP/DEODC/OHB/OPIPP/Pages/Drift.aspx) (www.cdph.ca.gov/Programs/CCDPHP/DEODC/OHB/OPIPP/Pages/Drift.aspx).

Table 2. Methods for preventing pesticide illness due to drift. (Adapted from Weinberg et. al.¹⁸)

Category of control	Examples	Level of protection to workers
1. Elimination of the hazard	Grower: Where possible use non-chemical pest prevention methods such as resistant cultivars, irrigation systems that reduce humidity and leaf wetness (e.g. drip rather than sprinkler), crop rotation, biological controls, and organic methods such as soil building & cover crops, plant-based fertilizers, and compost. ^{18,19}	Most protective ↓ Least protective
2. Substitution of material	Grower/applicator: Use less toxic pesticides.	
3. Engineering controls	Grower/applicator: Make adjustments to boom height, nozzle placement and angle, droplet size (by adjusting pressure, volume, nozzle type), etc. Use equipment calibration, shielded booms, baffles, deflectors, air induction nozzles, electrostatic spray equipment, etc.	
4. Administrative controls	Facility: Written policies and emergency planning for drift incidents, provision for better communication during drift, training. Grower/applicator: Notification of neighboring properties prior to applications, scheduling spraying when workers are not present, improved monitoring for wind and other environmental conditions, controlling tractor speed to decrease turbulence, adding a buffer zone or setback, having a system in place to improve compliance with notices of intent, training.	

Summary:

CDPH finds that better drift prevention practices by the applicator, and emergency procedures for dealing with pesticide drift incidents implemented by the cooling facility, would help prevent employee pesticide illness. Mitigation procedures have already

been implemented subsequent to this drift incident in that the pesticide applicator has been communicating with the facility prior to applying pesticides to ensure that facility employees will not be present during the pesticide application. Facility management has also indicated that they have conducted additional awareness training with employees regarding what to do during a drift incident and what to do if employees experience symptoms. If other methods can be used to prevent drift altogether this will be more protective of employee health and safety.

Similar locations that closely abut or are surrounded by farm fields, or that have had previous drift incidents can also prevent employee illness by implementing response procedures and training. As outlined in the recommendations above, these include, but are not limited to:

- Requesting from the County Agricultural Commissioner that notification be a condition of the Restricted Materials permit for neighboring properties: ask for notification when a notice of intent has been filed for applications of Restricted Materials pesticides on neighboring fields.
- A system of alerting employees, management, and in-house emergency response in case of a drift incident.
- Evacuation routes/sheltering-in-place contingencies.
- Procedures for contacting authorities/agencies, the property operator, and the applicator to notify them about drift.
- A system to ensure that hazard and exposure information is given to emergency responders and health care providers.
- Procedures for decontaminating employees in case of exposure and for transport of exposed and ill employees to get medical care.
- Periodic training for employees, supervisors, and management that includes information about all of the above.

Educational materials and a poster that can be filled out with the relevant emergency contact information can be found on our topic page, [Preventing Illness from Pesticide Drift](http://www.cdph.ca.gov/Programs/CCDPPH/DEODC/OHB/OPIPP/Pages/Drift.aspx) (www.cdph.ca.gov/Programs/CCDPPH/DEODC/OHB/OPIPP/Pages/Drift.aspx).

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