# SUMMARY OF RESULTS FROM THE CALIFORNIA PESTICIDE ILLNESS SURVEILLANCE PROGRAM - 2009 -

**HS-1886**

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## Executive Summary

This report describes illnesses identified by the Pesticide Illness Surveillance Program (PISP) of the California Department of Pesticide Regulation (DPR) in 2009. DPR identified 1,329 cases as potential health effects of pesticide exposure. This represents a 4% increase from the 1,275 cases investigated in 2008, but remains within the range typical of recent years. The California Poison Control System (CPCS) remained a major source of case identification. Of the 1,329 cases identified in 2009, CPCS transmitted reports of 509 (38%), a modest decrease from the 562 reported in 2008.

DPR scientists concluded that pesticide exposure had been at least a possible contributing factor to 918 (69%) of the 1,329 cases. Agricultural use of pesticides was the source of exposure in 252 (27%) of the 918 cases.

## Background on the Reporting System

DPR administers the California pesticide safety program, widely regarded as the most stringent in the nation. Mandatory reporting of pesticide[1] illnesses has been part of this comprehensive program since 1971. Illness reports are collected, evaluated, and analyzed by the PISP. PISP is the oldest and largest program of its kind in the nation; its scientists provide data to regulators, advocates, industry, and individual citizens.

The U.S. Environmental Protection Agency (U.S. EPA) and the National Institute for Occupational Safety and Health (NIOSH) have encouraged other states to develop programs similar to PISP. Through the NIOSH Sentinel Event Notification System for Occupational Risk (SENSOR), federal grants partially support programs in the states of Iowa, Michigan, New York, and Washington. SENSOR also provides technical assistance to the states of Arizona, Florida, Louisiana, New Mexico, North Carolina, Oregon, and Texas. In addition, it supports pesticide-related work by the Occupational Health Branch of the California Department of Public Health (CDPH), which coordinates with DPR's Worker Health and Safety (WHS) Branch.

[1] "Pesticide" is used to describe many substances that control pests. Pests may be insects, fungi, weeds, rodents, nematodes, algae, viruses, or bacteria -- almost any living organisms that cause damage or economic loss, or transmit or produce disease. Therefore, pesticides include herbicides, fungicides, insecticides, rodenticides, and disinfectants, as well as insect growth regulators. In California, adjuvants are also subject to the regulations that control pesticides. Adjuvants are substances added to enhance the efficacy of a pesticide, and include emulsifiers, spreaders, and wetting and dispersing agents.

U.S. EPA continues to rely heavily on California data for evidence of pesticide adverse effects because of the large volume of cases and long historical perspective that PISP provides.

DPR scientists participate in the national working group on pesticide illness surveillance that NIOSH convened to develop standards for information collection. In 1998, DPR expanded the PISP database and incorporated several features from the NIOSH standards. These upgrades have been applied to all data collected from 1992 through the present. Data earlier than 1992 will be presented when historical perspective is required.

The surveillance program attempts to collect information on the various mechanisms of exposure to pesticides that may cause illness. Every pesticide active ingredient has a mechanism of action by which it controls its target pests. Pesticide products may have other potentially harmful properties in addition to the qualities intended to control pests. PISP collects information on any adverse effects from any component of pesticide products, including the active ingredients, inert ingredients, impurities, and breakdown products. DPR has a mission to mitigate any pesticide exposure that compromises health or safety. This responsibility applies to all health effects including those caused by irritation, allergic reactions, through smell, or by causing fires or explosions, as well as by classical toxicological mechanisms.

## Sources of Illness Information

Under a statute enacted in 1971 and amended in 1977 (now codified as Health and Safety Code section 105200), California physicians are required to report any suspected case of pesticide-related illness or injury by telephone to the local health officer within 24 hours of examining the patient. This law applies to all types of pesticides (e.g., insecticides, herbicides, disinfectants) and to any location (e.g., farm, home, office). Each California county has a health officer with broad responsibility for safeguarding public health. A few cities employ their own health officers, with comparable responsibilities. These officials may investigate pesticide incidents to the extent necessary to fulfill their mandates. The law only requires health officers to inform the county agricultural commissioner (CAC) and to complete a pesticide illness report (PIR), which is sent to the Office of Environmental Health Hazard Assessment (OEHHA), the Department of Industrial Relations (DIR), and DPR. Unfortunately, this reporting pathway identifies only a minority of the cases investigated.

DPR strives to ensure that PISP captures the majority of significant illness incidents and records them in its database. To identify pesticide cases that may go unreported by doctors, DPR has a memorandum of understanding with DIR and the Occupational Health Branch of CDPH, under which DPR scientists review copies of the Doctor's First Report of Occupational Illness and

Injury (DFROII), documents that the California Labor Code requires workers' compensation claims payers to forward to DIR and are subsequently shared with CDPH. DPR Scientists select for investigation any DFROII that mentions a pesticide, or pesticides in general, as a possible cause of injury. Reports that mention unspecified chemicals are also investigated if the occupation or setting is one in which pesticide use is likely. From 1983 through 1998, DFROII review identified the majority of the cases investigated.

In 1999, the CPCS began assisting in pesticide illness reporting. Cooperation with CPCS identified hundreds of symptomatic exposures that otherwise would have escaped detection, but the 2002 state budget crisis prevented continuation of the contract after federal funding ended. When the state's financial footing improved, the department renewed its contract with CPCS in 2006. CPCS facilitation of illness reporting resumed in October 2006. DPR also continues to cooperate with OEHHA in efforts to provide the public and the health care community with information on pesticide safety and public health surveillance.

Agricultural commissioners investigate identified pesticide illnesses that occur in their jurisdictions, whether or not they involve agriculture. With few exceptions, they attempt to locate and interview all people with knowledge of the exposure events, collect samples when useful, and review relevant records. When appropriate, they request authorization from the affected people to obtain relevant portions of their medical records to include with the investigative reports. Medical record authorizations comply with the federal Health Insurance Portability and Accountability Act and include commitments to maintain confidentiality in accordance with the California Information Practices Act.

DPR provides instructions, training and technical support for investigators. The instructions include directions for when and how to collect samples of foliage, clothing, or surface residues to document unintended exposure or contamination of persons and/or the environment. As part of the technical support, DPR contracts with a California Department of Food and Agriculture Center of Analytical Chemistry to analyze the samples.

When investigations are complete, CACs send reports to DPR describing their findings. These reports describe the circumstances that may have led to pesticide exposure and the consequences to the exposed individuals. In their role as enforcement agents, CACs also determine whether pesticide users complied with safety requirements. In an exception to the procedure described above, DPR recommends that CACs not contact people who attempted suicide or their families. CACs learn what they can from ancillary sources, which are often constrained by confidentiality considerations. DPR advocates respect for the privacy of people in difficult circumstances, and for that reason will forego collecting information of toxicological interest.

Along with describing exposure circumstances and other related case information, CAC investigation reports identify all people known to have been exposed. DPR staff add records to the PISP database for anyone not previously reported by other mechanisms. DPR scientists evaluate medical reports and all information the CACs gather in the investigative process. They abstract and encode basic descriptors of the event. They then undertake a complex synthesis of all available evidence to assess the likelihood that pesticide exposure caused the illness. Standards for the determination are described in the PISP program brochure, "Preventing Pesticide Illness," which can be viewed or downloaded from DPR's web site at http://www.cdpr.ca.gov/docs/whs/pisp/brochure.pdf.

## Purpose of Pesticide Illness Surveillance

DPR maintains its surveillance of human health effects of pesticide exposure in order to evaluate the circumstances of pesticide exposures that result in illness. DPR scientists regularly consult the PISP database to evaluate the effectiveness of DPR's pesticide safety regulatory programs and assess need for changes. If illness reports indicate excessive risk, DPR may implement additional restrictions on pesticide use by providing CACs with California-specific recommendations for pesticide application permit conditions or by changing regulations. For example, DPR may adjust the restricted entry interval (REI) following pesticide application, specify buffer zones or other application conditions, or require pesticide handlers to use protective equipment that meets certain standards.

In some instances, changes to pesticide labels provide the most appropriate mitigation measures. Since the U.S. EPA has exclusive authority to require label changes, DPR cooperates with U.S. EPA to develop appropriate instructions for users throughout the country or, alternatively, for a California-specific label. If an illness incident results from illegal practices, state and county enforcement staff take appropriate action to deter future incidents.

DPR scientists regularly utilize PISP data in their documents and reports. During 2009, WHS incorporated illness data into scoping documents for amitraz (Kelly, 2009a), para-dichlorobenzene (Kelly, 2009b), indoxacarb (Salomon, 2009), and acrolein (Kelly, 2009c). Scoping documents provide information needed to begin both the exposure assessment and mitigation processes. Illness data were presented extensively in a protocol for the collection of samples in investigations of 2009 fatalities suspected to involve pesticides (O'Malley, 2009).

In keeping with the focus on identification of pesticide effects on health, WHS personnel worked closely with legislative proponents of cholinesterase test reporting during the 2009-2010 legislative session. This work culminated in the 2010 passage of Assembly Bill 1963 (Nava,

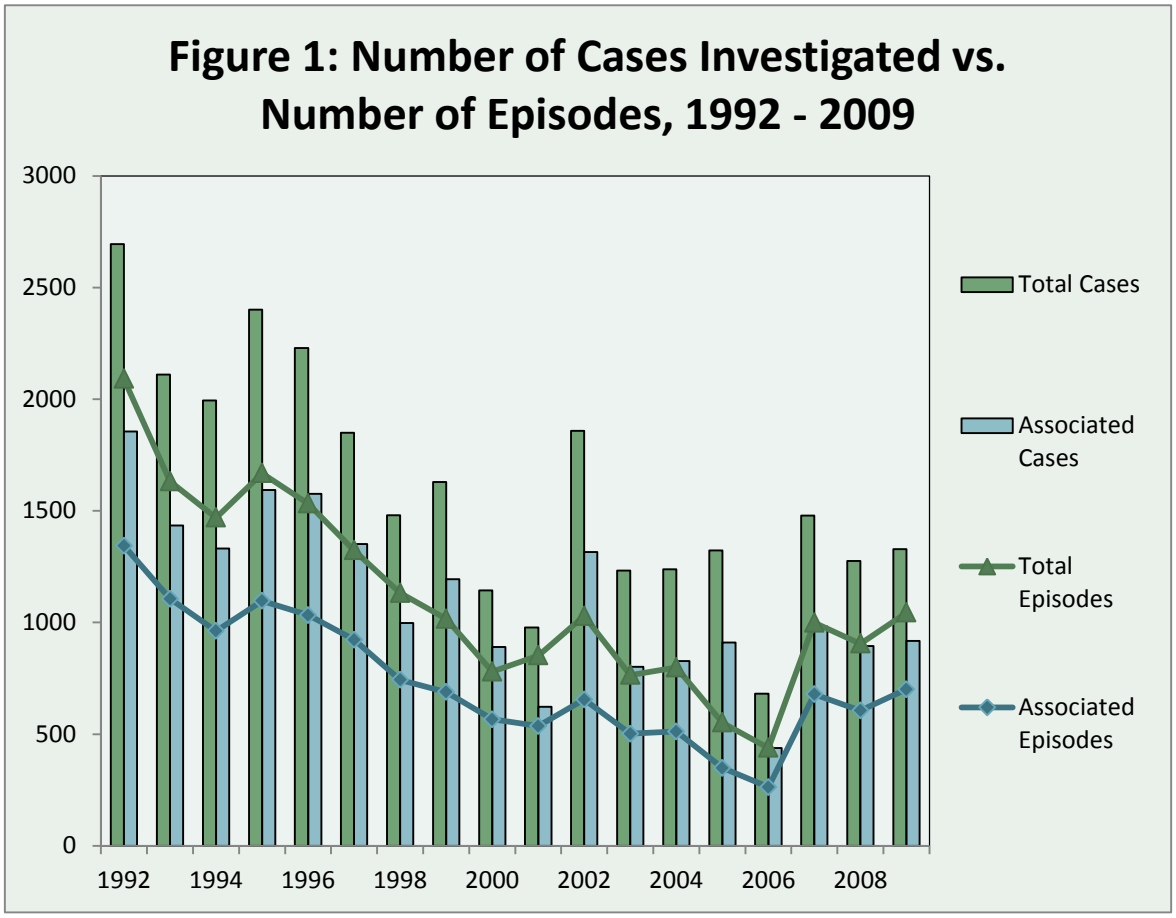
Chapter 369, Statutes of 2010). Under this law, clinical laboratories must provide DPR with the results of all cholinesterase tests performed for reasons related to pesticide exposure. DPR must collect these results in a database, share the data with the OEHHA and the CDPH, and in cooperation with OEHHA, produce a report in 2015 analyzing the significance of reported results.

AB 1963 provides an opportunity to evaluate the medical supervision program, which DPR implemented more than thirty years ago. Under the medical supervision program, agricultural employers must contract with physicians to monitor employees who regularly handle toxicity category I or II pesticides that inhibit cholinesterase. The program is based on periodic blood testing to measure the level of activity of the enzyme cholinesterase. Over the years, CDPH, DPR, and OEHHA have each tried to evaluate the medical supervision program's effectiveness. Lack of critical data has limited the success of each attempt. AB 1963 addresses these limitations directly. In addition to requiring laboratories to report numeric results, it requires doctors to specify their reasons for ordering cholinesterase tests and laboratories to include those reasons with the results they send to DPR.

PISP scientists will now integrate the data into a database in a way that will link test results to the individuals tested and identify changes over time. If results indicate a likelihood of pesticide illness, the county agricultural commissioner will be informed and asked to investigate the circumstances of exposure. In time, the database should provide information on a range of issues of interest to DPH, DPR, OEHHA, and others concerned about pesticide poisoning. These questions include: the number of workers enrolled in a medical supervision program, the frequency with which the program detects potential problems, the number of doctors who offer medical supervision, and the number of tests ordered outside the medical supervision program. DPR and OEHHA will summarize their findings in a joint report due to be posted on both web sites in 2015.

**2009 Numeric Results – Totals**

In 2009, 1,329 cases were identified as potential health effects of pesticide exposure (see Figure 1). This represents a 4% increase from the 1,275 cases investigated in 2008 but remains within the range typical of recent years. Continued participation by CPCS provided 509 case reports.




A case is the Pesticide Illness Surveillance Program representation of a person whose health problems may relate to pesticide exposure.

An episode is an event in which a single source appears to have exposed one or more people (cases) to pesticides.

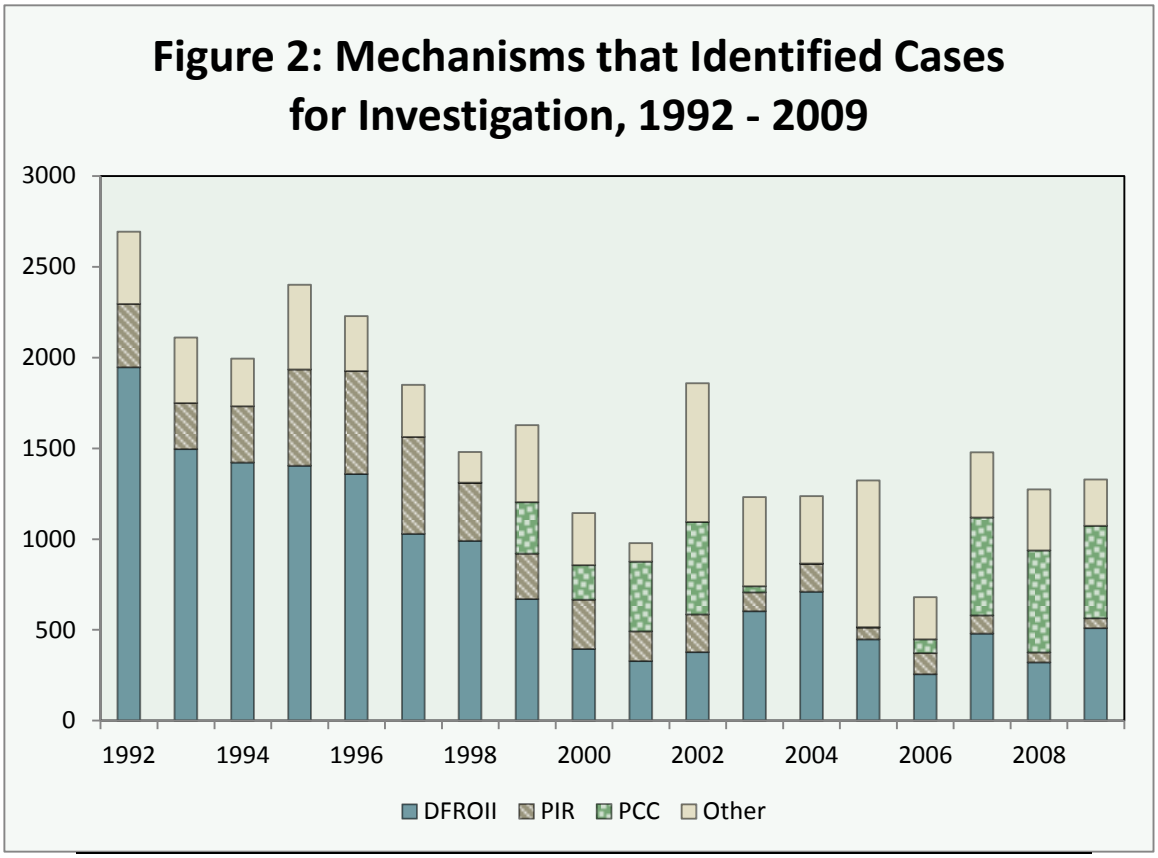
Associated cases are those evaluated as definitely, probably, or possibly related to pesticide exposure. A definite relationship indicates a high degree of correlation between the pattern of exposure and resulting symptomatology. The relationship requires both physical evidence of exposure and medical evidence of consequent ill health to support the conclusions. A probable relationship indicates a relatively high degree of correlation between the pattern of exposure and resulting symptomatology. Either medical or physical evidence is inconclusive or unavailable. A possible relationship indicates that health effects correspond generally to the reported exposure, but evidence is not available to support a relationship.

Associated episodes are those in which at least one case was evaluated as associated.

The figures in this report include 25 cases abstracted on the basis of initial notifications because DPR received no investigation report from the CAC. Eight of the 25 could not be classified, and the other seventeen are less complete and less certain than investigated cases. This marks the first time since tracking functions improved in 1998 that PISP has lacked investigations of 10 or more assigned cases. In addition to the unusually large number of cases not investigated, investigations were submitted more slowly than usual. It took two years from the date of case assignment until 95% of investigations were received. We suspect that this results from budgetary constraints that reduced the number of investigators available.

Figure 2 demonstrates the variation in numbers of cases identified by the different sources as well as an overall downward trend. Results of investigations suggest the trend to be real, but reliance on manual processing introduces uncertainty that complicates analysis. We expect that automated means of identifying pesticide-related illnesses, such as access to electronic worker's compensation data, would improve the reliability and consistency of these data. Figure 2 also reflects the fact that PISP receives a substantial number of reports outside of the standard PIR and DFROII-based pathways. Such episodes may come to the CACs' attention via emergency response contacts, news reports, through direct citizen complaints, or by their own observations.

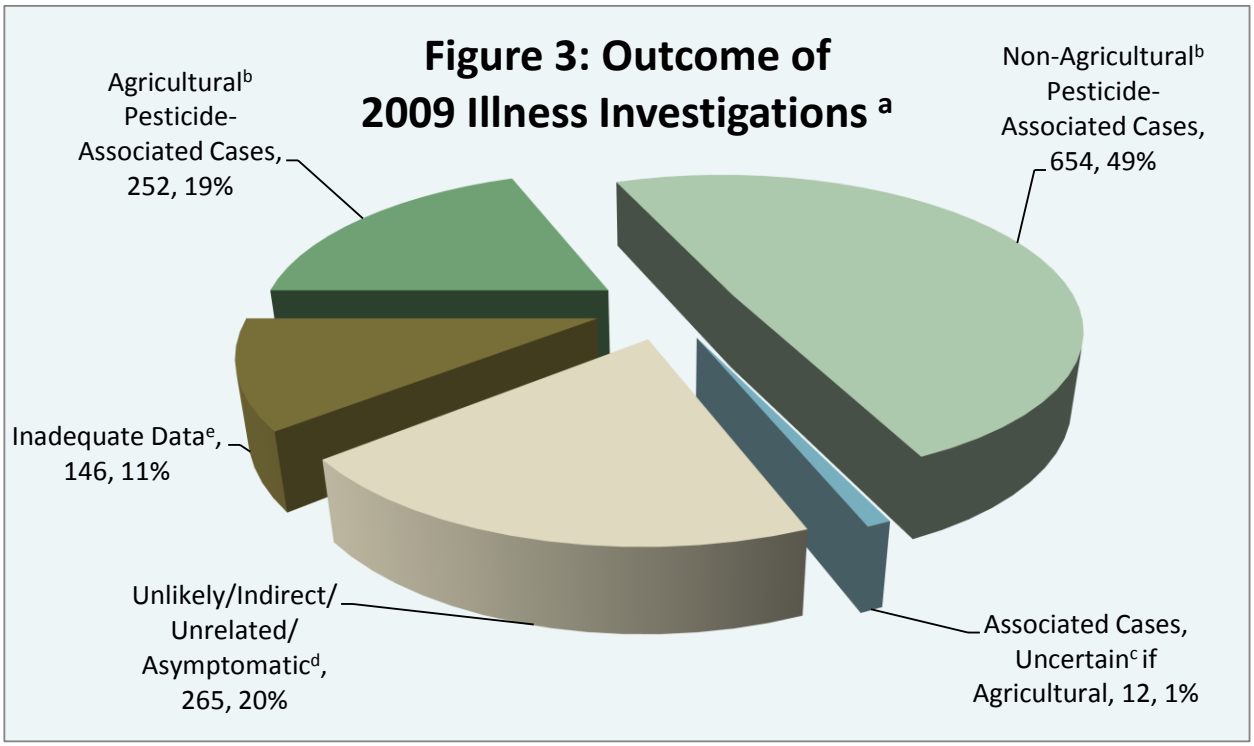
When CACs investigate episodes, they record information about all the affected people they identify. If those people had not previously been reported, they are added to the database when CAC reports reach DPR.




DFROII – Doctor's First Report of Occupational Illnesses and Injury (Workers' Compensation document).
PIR – Pesticide Illness Report (physician reporting in compliance with Health and Safety Code Section 105200).
CPCS – California Poison Control System (facilitated physician reporting).
Other – All other methods of case identification, including citizen complaints, contacts by emergency responders, and news reports.

DPR scientists found pesticide exposure to be at least a possible contributing factor to 918 (69%) of the 1,329 cases identified. PISP defines the term "pesticide-associated" as cases evaluated as definitely, probably, or possibly related to pesticide exposure. "Agricultural" is defined as involving pesticides intended to contribute to production of an agricultural commodity, including livestock. This corresponds to the regulatory definition of "production agriculture". Use in non-production agriculture (watersheds, cemeteries, etc) are designated "non-agricultural" along with structural, sanitation, or home garden use, as well as pesticide manufacture, transport, storage, and disposal.

Of the 918 pesticide-associated cases, 252 (19% of the 1,329 total cases) were attributed to pesticides used for agricultural purposes. Another 654 associated cases (49%) occurred under circumstances considered non-agricultural. Twelve of the 918 pesticide-associated cases could not be characterized as agricultural or non-agricultural due to unclear circumstances presented in investigations. Evidence indicated that pesticide exposure did not cause or contribute to ill health in 265 (20%) of the 1,329 cases assigned for investigation. Insufficient information prevented evaluation of 146 cases (11%) (Figure 3).




[a] Total cases investigated = 1,329

[b] *Agricultural* and *Nonagricultural* refer to the intended use of the pesticides definitely, probably, or possibly related to human health effects. This chart omits 12 cases that could not be characterized as agricultural or non-agricultural.

[c] *Associated Cases, Uncertain if Agricultural* refers to cases in which investigators provided little or no information, such as when victims could not be located or refused interviews.

[d] *Unlikely/Indirect/Unrelated/Asymptomatic* refers to cases in which the weight of the evidence was against pesticide causation. This occurs when exposed people did not develop symptoms, or if symptoms were not caused or were unlikely to have been caused by pesticide exposure.

[e] *Inadequate* means that there was not enough data available or reported to determine if pesticides contributed to ill health.

Table 1 shows the numbers of cases evaluated at each level of relationship. Among the 918 pesticide-associated cases, evidence established a definite relationship to pesticide exposure for 131 (14%), a probable relationship for 521 (57%), and a possible relationship for 266 (29%). See Table 1.

**Table 1: Relationship Evaluation of 2009 Illness Investigations**

| Relationship | Relation to Agriculture | | | Total |
|---|---|---|---|---|
| | Agricultural[a] | Non-Agricultural[b] | Unknown or Not Applicable[c] | |
| Definite[d] | 10 | 121 | 0 | 131 |
| Probable[e] | 181 | 335 | 5 | 521 |
| Possible[f] | 61 | 198 | 7 | 266 |
| **Pesticide-Associated Subtotal** | **252** | **654** | **12** | **918** |
| Unlikely[g] | 12 | 30 | 1 | 43 |
| Indirect[h] | 0 | 4 | 0 | 4 |
| Asymptomatic[i] | 44 | 10 | 0 | 54 |
| Unrelated[j] | 0 | 0 | 164 | 164 |
| Not Applicable (inadequate data)[k] | 16 | 111 | 19 | 146 |
| **Overall Total** | **324** | **809** | **196** | **1,329** |

[a] Agricultural cases are those that implicate exposure to pesticides intended to contribute to the production of agricultural commodities.
[b] Non-agricultural cases include all those in which the pesticide was not intended to contribute to production of agricultural commodities.
[c] Agricultural designation is not applicable to cases unrelated to pesticide exposure.
[d] A definite relationship indicates a high degree of correlation between the pattern of exposure and resulting symptomatology. The relationship requires both physical evidence of exposure and medical evidence of consequent ill health to support the conclusions.
[e] A probable relationship indicates a relatively high degree of correlation between the pattern of exposure and resulting symptomatology. Either medical or physical evidence is inconclusive or unavailable.
[f] A possible relationship indicates that health effects correspond generally to the reported exposure, but evidence is not available to support a relationship.
[g] An unlikely relationship indicates that a correlation cannot be ruled out absolutely. Medical and/or physical evidence suggest a cause other than pesticide exposure.
[h] An indirect relationship indicates that pesticide exposure is not responsible for symptomatology, but pesticide regulations or product label contributed in some way, (e.g., heat stress while wearing chemical resistant clothing).
[i] An asymptomatic relationship indicates that exposure occurred, but did not result in illness/injury.
[j] An unrelated relationship indicates definite evidence of causes other than pesticide exposure, including exposure to chemicals other than pesticides.
[k] A relationship of "not applicable" indicates that relationship cannot be established because the necessary information is not available to the evaluator.

Occupational exposures (those that occurred while the affected people were at work) accounted for 581 (63%) of the 918 pesticide-associated cases from 2009. Occupational exposures typically predominate among the cases PISP collects, reflecting the impact of DFROIIs (workers' compensation documents) for identifying cases. Non-occupational exposures accounted for 323 pesticide-associated cases (35% of the total). Fourteen pesticide-associated cases could not be characterized as occupational or non-occupational; nine of these 14 also could not be characterized as agricultural or non-agricultural.

Enforcement actions often are still under consideration when DPR receives the illness investigative reports, thus substantiation of violations is difficult. Based on the information available at the time of evaluation, WHS scientists concluded that 381 (42%) of the 918 pesticide-associated cases provided evidence that violation of safety requirements had contributed to exposure, and harm might have been avoided if all the people involved had adhered strictly to safety procedures already required by regulations and pesticide labels. In 146 cases (16%), violations were identified but judged not to have contributed to pesticide exposure; scientists remained uncertain whether violations contributed to 112 cases (12%). In 279 (30%) of the pesticide-associated cases, health effects were attributed to pesticide exposure in spite of apparent compliance with all applicable label instructions and safety regulations. Further evaluation of these cases is needed to determine if additional safety requirements are appropriate.

Tabular summaries presenting different aspects of the data are available online at http://www.cdpr.ca.gov/docs/whs/2009pisp.htm or by contacting the WHS Branch at (916) 445-4222 or by mail at CDPR, P.O. Box 4015, Sacramento, CA 95812-4015.

Internet users have the additional option of using the California Pesticide Illness Query program (CalPIQ) to develop reports to their own specifications. CalPIQ is available at http://apps.cdpr.ca.gov/calpiq and can retrieve any cases evaluated as definitely, probably, or possibly related to pesticides from 1992 through the most recent year completed. Users can specify which cases to retrieve based on county of occurrence, year of identification, whether or not agriculture was the source of pesticide exposure, the identity of the implicated pesticide(s), the type of location where exposure occurred (e.g., farm, school), the intended pesticide application site (e.g., grapes, food handling equipment), the manner of exposure (e.g., drift, direct spray), and/or activity of the affected people (e.g., applicator, field worker). Users can direct CalPIQ to retrieve either descriptions of each individual case or the total number of cases that match the selected criteria (summary report). If they select the summary report option, users may request subtotals by activity, county, type of exposure, type of location, and/or year of identification.

## Agricultural Field Worker Incidents

PISP defines a field worker as one who works in an agricultural field performing tasks such as harvesting, thinning, irrigating, driving a tractor (except as part of an application), field packing, and conducting cultural practices in a greenhouse. Advisors, scouts, and researchers performing similar tasks are also considered field workers. In 2009, 143 cases of field worker illness or injury were evaluated as definitely, probably or possibly related to pesticide exposure.

Eleven drift episodes affected 39 field workers, and 20 residue episodes affected 100 workers. Four field worker incidents were not related to drift or residue. One field worker unintentionally drank water contaminated with a sanitizer she had used at home. Another employee was splashed with a bleach solution used to sanitize lettuce-harvesting knives. A CAC employee involved in an entomologic research project was sprayed when he entered a nursery without notice, and one worker's mode of exposure could not be fully characterized from available information. (Figure 4).

Exposure to pesticide residue was evaluated as probably (87 cases) or possibly (13 cases) the cause of ill health in 100 field workers. One residue episode affected 81 Tulare County orange harvesters. Each of the other 19 was exposed in a one-person episode that affected no one else.

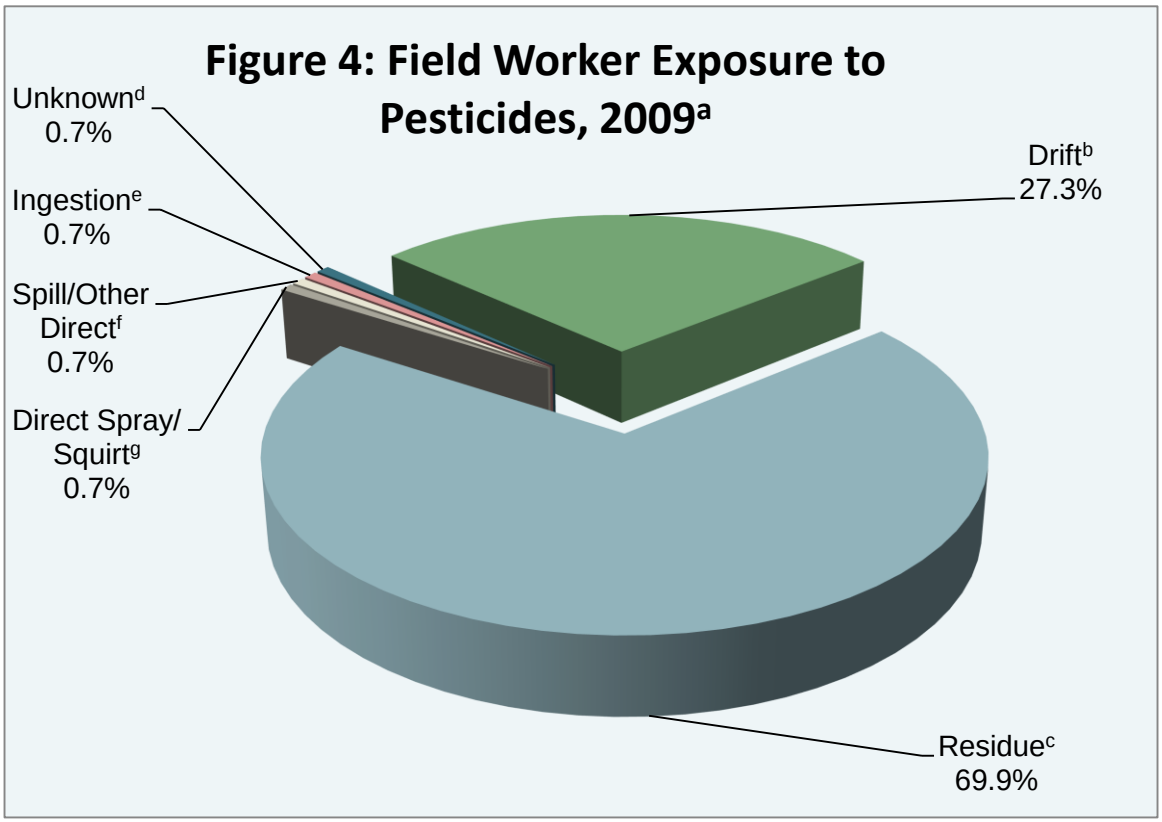
The Tulare County episode involved ten crews with a combined total of 338 workers who harvested oranges at three sites operated by the same grower. On three successive days, crews at these sites developed a constellation of symptoms suggestive of pyrethroid exposure, particularly sneezing and numbness around the mouth. The CAC interviewed 103 of the workers, and learned that 81 had experienced symptoms on at least one of the three days. The CAC also identified other potential causes of respiratory irritation: Near one of the sites, trees were being chipped at the time, sending wood dust into the air. Alfalfa harvest was in progress near another site. Alternative explanations notwithstanding, all 81 symptomatic cases were evaluated as probably related to pesticide exposure because of the consistency of symptoms with the particular pesticides involved and the absence of extraneous complaints. For instance, if wood chipping had been the primary source of problems, we would have expected coughing, which only one worker reported.

Each of the three worksites had recently been treated with fenpropathrin (a pyrethroid), spinosad (an extract of a rare soil-dwelling bacterium), and an adjuvant. Earlier, each orchard had been sprayed with *Bacillus thuringiensis* (a particular strain of a relatively common bacterium). The fenpropathrin/spinosad/adjuvant combination is widely used. Sixty different growers in Tulare County had used the same combination between May 5 and June 2, 2009.

All REIs had elapsed in the groves where harvesters developed symptoms, and the investigation identified only violations that did not contribute to exposure. Specifically, 21 workers had not received safety training, ten reported missing or inadequate decontamination materials as required by California worker safety regulations, and none had been taken for care as required when there is reason to suspect a reaction to pesticide exposure.

In 2009, drift exposure was evaluated as probably having caused or contributed to ill health in 32 field workers and possibly implicated in effects on 7 others. One drift episode affected 22 workers harvesting organic green onions in Kern County. The other 17 field workers were exposed in ten separate episodes, the largest of which involved four workers known to have been affected when investigation began. Forty nine additional field workers exposed to drift in two 2009 episodes were not reported to DPR until 2010. In each of these episodes, one worker had been identified in 2009. The CAC's investigation located additional affected workers.

In the Kern County episode, 36 workers smelled insecticides being applied to a nearby apple orchard, and 22 of them developed symptoms. Five workers were taken to hospitals for evaluation, and they each voluntarily provided the clothes they were wearing for chemical analysis. Small quantities (fractions of micrograms) of fenpyroximate were detected in each of the clothing samples. This episode also affected two emergency responders who transported affected workers to hospitals. The commissioner's office was able to expediently investigate the effects on the field workers because their employer called to report the incident on the day it occurred.




[a]Total pesticide-associated field worker cases = 142
[b] Drift refers to field worker cases associated with exposure to off-site movement of a pesticide from an application.
[c] Residue refers to field worker cases associated with exposure to residue from a previously applied pesticide.
[d] Unknown indicates that PISP Scientists could not determine how field worker exposure occurred
[e] Ingestion indicates that the field worker swallowed pesticide.
[f] Spill/Other Direct refers to contact made where the material is not propelled by application equipment.
[g] Direct spray/squirt indicates that application equipment propelled pesticide onto the worker.

### Drift Exposure

PISP defines drift exposure as exposure to pesticide "spray, mist, fumes, or odor carried from the target site by air." This definition differs from the regulatory definition in that the PISP definition includes exposures to fumigants that escape confinement. Additionally, PISP uses the drift designation to identify events in which air movement carried pesticide and caused exposure of pesticide handlers. Regulations provide specific protections for pesticide handlers, who perform tasks such as applications and preparation for applications. Airborne exposure of handlers is not drift in the usual sense, but recording it as such provides information about the mechanism of exposure to pesticide users.

In 2009, DPR recorded a total of 235 individuals who reported symptoms evaluated as definitely, probably, or possibly related to exposure to drift in 158 separate episodes. This includes the 39 previously mentioned field workers known to have been exposed to drift. The 2009 total of 235 cases includes 83 pesticide handlers (8 agricultural, 75 non-agricultural) exposed to the pesticides they were using, each in an episode that affected no one else. In five drift episodes, investigations begun in 2009 identified a total of 71 additional people potentially exposed to drift, including the two episodes that affected 49 field workers. These 71 cases received case numbers for the year 2010, since the reports did not reach DPR until well into 2010.

In 75 of the 147 non-agricultural cases recorded as drift, the only person affected was the pesticide user. The pesticide category "Antimicrobials" was most often implicated in non-agricultural episodes among pesticide users as well as people not using pesticides.

Of the 34 agricultural drift episodes, eight affected one handler each and 11 others affected a total of 39 field workers. The remaining 15 agricultural drift episodes affected 41 people including five episodes that affected school children, two of which occurred on school property.

Three teachers and four students experienced irritant effects of fungicide dust that drifted into the school from a Tulare County vineyard application. Investigators arrived in time to witness and halt the application of copper, sulfur, and dicloran. They found that, among other shortcomings, the grower did not adequately train or supervise the applicator. Altogether, the grower was fined $3,120.

In Monterey County, 940 feet north of an elementary school, a helicopter was spraying a spinach field with two fungicides, fenamidone and fosetyl-aluminum, when a physical education class came out into the school yard. When they saw the helicopter, the teacher brought the students back into the building and had them wash. Eleven of the thirty-two students and the teacher developed symptoms, which included eye irritation, nausea, headache, vomiting, and skin irritation.

Copper hydroxide drifted from a Fresno County orchard onto a school bus with eight children aboard. The driver and three young riders felt ill, as did two mothers who were waiting with their children at a bus stop. Symptoms varied, but included cough, nausea, vomiting, and eye irritation. The flagger, responsible for interrupting the application when traffic approached, had left his post to get more of the fungicide. Pesticide was detected in clothing samples taken from one mother and child and a violation was issued.

Also in Fresno County, a school bus driver saw three students run across the road to avoid spray from a vineyard application of sulfur and cryolite. The two children who were interviewed said they felt mist and reported symptoms including headache, nausea, dizziness, and sore throat. The driver smelled the application and said her mouth felt dry. Foliage samples from across the road confirmed drift had occurred.

Two brothers felt mist and developed symptoms from an application of esfenvalerate and acephate as they passed by a Butte County conifer tree farm on their walk to school. The air blast applicator said that he waited until the wind subsided to begin spraying the insecticides, but the school nurse smelled pesticide on the boys' clothes and sent them home. Their symptoms included stinging eyes and a bad taste in the mouth. The younger brother also complained of headache, an upset stomach, and chest tightness. The mother was reimbursed by the tree farm for her sons' medical expenses and discarded clothing.

| Table 2: Pesticide Drift Episodes that Occurred During 2009 | | | | | |
|---|---|---|---|---|---|
| **Type of Pesticide** | **Activity of Affected Individuals [a]** | **Agricultural [b]** | | **Non-Agricultural [b]** | |
| | | **Episodes [c]** | **Affected Individuals [d]** | **Episodes [e]** | **Affected Individuals [d]** |
| **Insecticides** | | | | | |
| | Handlers | 2 | 2 | 14 | 14 |
| | Field Workers | 6 | 29 | 0 | 0 |
| | Others | 4 | 13 | 15 | 23 |
| **Herbicides** | | | | | |
| | Handlers | 1 | 1 | 2 | 2 |
| | Others | 2 | 2 | 1 | 1 |
| **Fungicides** | | | | | |
| | Field Workers | 1 | 1 | 0 | 0 |
| | Others | 4 | 15 | 1 | 1 |
| **Fumigants** | | | | | |
| | Handlers | 1 | 1 | 0 | 0 |
| | Field Workers | 1 | 4 | 0 | 0 |
| | Others | 1 | 3 | 3 | 3 |
| **Antimicrobials** | | | | | |
| | Handlers | 1 | 1 | 54 | 54 |
| | Others | 3 | 4 | 24 | 31 |
| **Miscellaneous/combinations** | | | | | |
| | Handlers | 3 | 3 | 5 | 5 |
| | Field Workers | 3 | 5 | 0 | 0 |
| | Others | 1 | 4 | 5 | 13 |
| **Overall Total** | | 34 | 88 | 124 | 147 |

[a] Describes the people's activity at the time of exposure. Handlers include people mixing, loading and applying pesticides, repairing pesticide equipment and flagging for aerial application. Field Workers are people working in agricultural fields at the time of drift exposure.

[b] Designation as agricultural indicates exposure to pesticides intended to contribute to production of an agricultural commodity, including livestock. Any other exposure situation is designated non-agricultural.

[c] Number of people who developed symptoms evaluated as definitely, probably, or possibly caused or exacerbated by pesticide exposure. A definite relationship indicates a high degree of correlation between the pattern of exposure and resulting symptomatology. The relationship requires both physical evidence of exposure and medical evidence of consequent ill health to support the conclusions. A probable relationship indicates a relatively high degree of correlation between the pattern of exposure and resulting symptomatology. Either medical or physical evidence is inconclusive or unavailable. A possible relationship indicates that health effects correspond generally to the reported exposure, but evidence is not available to support a relationship.

## Morbidity and Mortality

Among the 918 cases determined to be associated with pesticide exposure, 21 people were hospitalized and 96 people reported lost time from work or normal activity (such as going to school). Approximately 62% (13 of 21) of the people hospitalized had ingested pesticides. Seven of the 13 acknowledged suicide attempts, though one later denied it; another three people may well have meant to harm themselves, but their intent was not documented.

All five hospitalizations for rodenticide exposure followed ingestions, as did the three hospitalizations for herbicide exposure. Three of seven insecticide hospitalizations and one of four antimicrobial hospitalizations followed ingestion. One man accidentally ingested a pesticide that never was identified.

**Table 3: Summary of Pesticide-Associated[a] Hospitalization and Disability, 2009**

| Relationship | Total Cases | Number Hospitalized | Lost Work Time |
|---|---|---|---|
| Definite/Probable[b] | 652 | 18 | 68 |
| Possible[c] | 266 | 3 | 29 |
| **Total Cases** | **918** | **21** | **97** |

[a] Pesticide-associated cases are those in which pesticide exposure was evaluated as definite, probable, or possible contributor to ill health.
[b] A definite relationship indicates a high degree of correlation between the pattern of exposure and resulting symptomology. The relationship requires both physical evidence of exposure and medical evidence of consequent ill health to support the conclusions. A probable relationship indicates a relatively high degree of correlation between the pattern of exposure and resulting symptomology. Either medical or physical evidence is inconclusive or unavailable.
[c] A possible relationship indicates health effects correspond generally to the reported exposure, but evidence is not available to support a relationship.

PISP received two reports of children hospitalized for pesticide exposure. In one, a mother found her 14-month old child sitting at the table next to an opened ant stake with contents gone. The child vomited several times, so the mother, fearing ingestion, took the child to the hospital. Although the child remained in the hospital for 2 days, the doctor did not determine whether ingestion actually occurred.

In the second incident, a mother briefly left the kitchen where she was mopping the floor with bleach and detergent. When she returned, she found her 1-year old daughter had fallen head first into the mop bucket. She rushed the unresponsive child to a neighbor, who performed CPR. The child responded well to treatment and was released after a day.

The CACs and DPR investigated four deaths in 2009, three of which were reported by CPCS. Three of the fatalities were determined to be pesticide related.

The most definitively related was the accidental fatality of a worker at a methyl bromide formulation facility, who was exposed to methyl bromide when the canister he was filling exploded. He was transported to the hospital, where he died later that day. An investigation into the incident revealed that many of the canisters were deteriorated on the inside even though they appeared to be in good condition from the outside.

Another fatality occurred when a man committed suicide in his vehicle by mixing a pool chemical and a pesticide together to form a lethal gas, hydrogen sulfide. This method, called "Detergent Suicide," was first noted in Japan, and is now described on many easily located web sites. Two emergency responders were also exposed even though the man placed a sign on his truck warning others of the poisonous gas.

A gardening service employee's wife found her husband collapsed at their home. She called for help, but he died at the hospital within hours. The cause of death was listed as "xylene intoxication." There was some consideration that an insecticide could have been a source of the xylene and could also have contributed to his death. The source of the toxicant was never identified.

In the most ambiguous case, a man died at a hospital about ten hours after being brought there in pain. He said he ingested some pain medication along with a "purple pill" that may have been a pesticide from Mexico. A bluish pill found in his pocket was analyzed and determined not to be a pesticide. The cause of death was "cardiorespiratory failure, undetermined cause."

The latter three fatalities (two evaluated as pesticide-related and one that could not be evaluated) involved men between the ages of 22 and 26 years old.

## Phosphine Exposure

Another potentially significant event occurred at a Kern County nut processor, where rain water collected around pallets of fumigated produce and came in contact with some of the tablets that gave off the fumigant, phosphine. This accelerated the tablets' reaction and started a fire. Workers in the area had not been trained in the particular characteristics of the pesticide, so they tried to douse the fire with water, which exacerbated the problem. By the time the fire was extinguished, ten workers had developed symptoms and were taken to hospitals for evaluation. Hospital workers consulted CPCS, and were informed that phosphine inhalation could cause serious injury to the lungs that might not be apparent until hours after exposure. Following poison control recommendations, nine workers were observed overnight at three hospitals. One worker refused hospitalization. One of the hospitals performed bronchoscopy on the three

workers seen there. The results of the test did not indicate pulmonary edema (a typical result of exposure), but did observe evidence of inflammation in all three workers. DPR's clinical consultant, Dr. Michael O'Malley, has taken the lead in integrating information from CDPH and DPR for a report to be published in the scientific literature.

## Significance of CPCS Participation

CPCS report facilitation greatly strengthens illness surveillance: CPCS transmits reports more rapidly than other intermediaries, and identifies qualitatively different exposures from those the program identifies by other means. Table 4 summarizes these characteristics.

**Table 4: Characteristics of Report Sources, 2009[a]**

| | CPCS[b] | Other PIRs[c] | DFROIIs[d] | Other Sources[e] |
|---|---|---|---|---|
| Median days in transit[f] | 2 | 14 | 116 | 760 |
| Average days in transit | 5 | 33 | 129 | 540 |
| Minimum days in transit | 0 | 1 | 12 | 4 |
| Maximum days in transit | 369 | 154 | 553 | 956 |
| Occupational exposures | 109 | 29 | 380 | 199 |
| Non-occupational exposures | 329 | 20 | 0 | 55 |
| Exposures of children age < 10 | 101 | 1 | 0 | 11 |
| Hospitalizations | 27 | 1 | 3 | 0 |
| Intentional exposures | 28 | 0 | 3 | 1 |
| Deaths | 3 | 0 | 0 | 1 |

[a] Includes all case reports investigated, whether or not evaluated as associated with pesticide exposure.
[b] Cases reported via the CPCS.
[c] Cases for which physicians submitted PIRs independently of CPCS.
[d] Cases identified through review of DFROIIs
[e] Cases identified by other methods, including citizen complaints, contacts by emergency responders, and news reports.
[f] Days in transit represents the number of days elapsed between exposure and arrival of a report at DPR.

"Other" source reports have long transit times because PISP generally does not learn of them until CACs submit investigation reports in which the cases are identified. The table shows, however, that the "other" sources resemble the standard sources in that they identify primarily

adult, occupational exposures. DPR relies almost entirely on CPCS for information about exposures of children and non-occupational exposures, which account for the majority of hospitalizations and deaths from pesticide exposure. Additionally, prompt notification enables more informative investigations.

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## Appendix I: Acronyms

| | |
|---|---|
| CAC | County Agricultural Commissioner |
| CDPH | California Department of Public Health |
| CPCS | California Poison Control System |
| DFROII | Doctor's First Reports of Occupational Illness and Injury |
| DIR | Department of Industrial Relations |
| DPR | California Department of Pesticide Regulation |
| HIPAA | Health Insurance Portability and Accountability Act |
| NIOSH | National Institute for Occupational Safety and Health |
| OEHHA | Office of Environmental Health Hazard Assessment |
| PIR | Pesticide Illness Report |
| PISP | Pesticide Illness Surveillance Program |
| REI | Restricted Entry Interval |
| SENSOR | Sentinel Event Notification System for Occupational Risk |
| U.S. EPA | United States Environmental Protection Agency |
| WHS | Worker Health and Safety Branch |