



Pesticide Use Reporting

*An Overview of
California's Unique
Full Reporting System*

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Introduction

California's pesticide regulatory program is considered by many to be a model program, and its pesticide use reporting program is recognized as the most comprehensive in the world. In 1990, California became the first state to require full reporting of agricultural pesticide use. In the next few years, the State's Department of Pesticide Regulation (DPR) struggled with the inevitable problems of breaking new ground on a large-scale, highly complex endeavor. At the same time, other states and many public interest groups began to ask questions about the program, and in response, DPR published the first edition of this overview in June 1995. Since then, the use reporting program has evolved and DPR has made several improvements and enhancements, prompting the updating of the overview. DPR has developed this document to describe the pesticide use reporting program, and explain how it functions as an integral component of the State's pesticide regulatory system.

History of Use Reporting in California

Limited use reporting requirements have been in force in California since at least 1950. Then, the California Department of Food and Agriculture, through the county agricultural commissioners, required agricultural pest control operators to submit monthly reports of their work. The requirements of counties differed, but many required a monthly report for each pesticide application which included the location, date, crop, acres or other units treated, pest, kind of pesticide used, and the strength and amount of the spray or dust mixture applied. Only statistics on aerial pesticide applications were forwarded for statewide tabulation. In 1955, the Department of Food and Agriculture asked that ground application acreage be forwarded as well, but dropped the requirements for detailed reporting of pesticides used and commodities treated.

The regulations were changed in 1970 when the state instituted a bifurcated system, requiring that commercial pest control operators (those engaged in pest control for hire, such as ground and aerial applicators, structural applicators, and professional gardeners) report all pesticides used and that farmers report only their use of restricted materials.

Restricted materials are pesticides deemed to have a high potential to cause harm to public health, farm workers, domestic animals, honeybees, the environment, wildlife, or other crops. All federally restricted-use pesticides have been designated as restricted materials in California. In addition, California has designated additional materials as restricted-use. California's system for allowing use of these materials only through a permit process is described in the next section.

Both pest control operators and growers filed use reports with the agricultural commissioner in the county where they made the applications. These reports had to include the pesticide applied, date and location (section, township, and range) of the application, and the crop and acres treated if the application was in agriculture. The commissioners forwarded this information to the State, which entered the data into a computerized database and published annual data summaries.

Full Use Reporting Begins

Demands for more realistic and comprehensive pesticide use data to accurately estimate dietary risk as well as exposure and potential risk to workers increased dramatically during the late 1980s. DPR began the full use reporting program in 1990 in response to these concerns. Under the program, all agricultural pesticide use must be reported monthly to the county agricultural commissioner who in turn reports the data to DPR. The reports must include the date and location (section, township, and range) where the application was made, and detail the kind and amount of pesticides used. If the pesticide is applied to a crop, the type of commodity must be specified. In addition, identification numbers (IDs) for the site and the pesticide user (“operator”) were added. Planted acres were also added, which in combination with the treated acres, are useful in pesticide risk assessment. Before buying or using pesticides, every operator is required to obtain a unique operator ID from each county in which pest control work will be performed. Growers obtain a site ID from the county agricultural commissioner for each location and crop/commodity where pest control work will be performed, and it is recorded on the restricted material permit or other approved form.

California has a broad legal definition of "agricultural use," so the reporting requirements include pesticide applications to parks, golf courses, cemeteries, rangeland, pastures, and along roadside and railroad rights-of-way. In addition, all postharvest pesticide treatments of agricultural commodities must be reported, along with all pesticide treatments in poultry and fish production, as well as some livestock applications. **The primary exceptions to the full use reporting requirements are home and garden use and most industrial and institutional uses.**

Structural pest control operators, professional gardeners, and other nonagricultural pest control operators had to report all pesticide use under the earlier regulations, and these requirements did not change under the full use reporting program. The following description will focus primarily on the requirements for reporting pesticides used in agriculture.

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The State-Local Partnership

The County Agricultural Commissioners and the Pesticide Regulatory Program

The intricacies of the full use reporting system can only be understood in the context of California's overall pesticide regulatory program. DPR is responsible under State law, and delegation of authority by the U.S. Environmental Protection Agency (U.S. EPA) under the Federal Insecticide, Fungicide, and Rodenticide Act, for evaluating and registering all pesticides before sale or use in California, as well as for regulating and controlling the use of pesticides. Under the direction and supervision of DPR, the county agricultural commissioners carry out enforcement activities at the local level.

California's state/county program for regulating pesticide use is both unique and comprehensive. Besides administering the restricted materials permitting system, the county agricultural commissioners enforce other State laws and regulations relating to pesticide use at the local level. The commissioners inspect the operations and records of growers, pest control operators, pesticide dealers, and agricultural pest control advisers; register licensed pest control businesses, pest control aircraft pilots, and agricultural pest control advisers doing business in the county; conduct pesticide incident investigations; provide training to pesticide users; and, under contract with DPR, collect fresh produce samples for State pesticide residue monitoring programs. Restricted materials (with certain exceptions) may be possessed or used only by or under the supervision of licensed or certified persons, and only in accordance with an annual permit issued by the county agricultural commissioner. The restricted material permit is a key element of the local regulatory program. A commissioner may require that restricted material users employ specific use practices to mitigate potential adverse effects or may deny the permit with cause. Permits for the agricultural use of these pesticides must be specific as to site and timing of applications and are usually issued for a season or year. Before applying a pesticide, the grower or applicator must submit a notice of intent to the county agricultural commissioner at least 24 hours before the application. It must include any changes in the environmental setting that may have occurred since the permit was originally issued.

In the mid-1980s, DPR developed software to assist the counties in issuing permits and in managing the restricted materials permitting system. The program captures a variety of data, including:

- , permit number;
- , permittee name, address, telephone number, and contacts;

- , site ID and location description;
- , section, township, range, base, and meridian;
- , commodity/crop;
- , proposed planted acres; and
- , list of chemicals that may be used throughout the year for each commodity/crop.

Since most permits are issued at the beginning of the calendar year, the permit may be considered a planning document. If there are subsequent changes in crops or acreage to be planted, the permits are updated.

When the full use reporting program began in 1990, DPR modified the restricted materials permit software so commissioners could use it to help manage the process of issuing operator and site IDs. With a few minor exceptions, all counties now use this computerized system for issuing both restricted material permits and IDs. Commissioners also use the county pesticide regulatory computer system to manage county registration of businesses using or recommending the use of pesticides (such as structural pest control operators, landscape businesses, and other entities), and their reported pesticide use. DPR has assigned full-time staff to maintain the county computer systems, e.g., hardware and software maintenance, development of new computer applications, and training.

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What Is Reported

Under the full use reporting regulations, growers are required to report monthly the pesticides they use to the agricultural commissioner of the county in which the pest control work was done. Commercial pest control operators are required to report the use of pesticides to the county agricultural commissioner within seven days of completion of the application. The following information must be reported for each pesticide application in production agriculture:

- , month and year of the application(s);
- , county in which work was done;
- , geographic location including the section, township, range, base, and meridian;
- , field location;
- , operator ID/permit number;
- , operator name and address;
- , applicator name and address;
- , site ID;
- , commodity/crop/site treated;
- , acres or units planted;
- , acres or units treated;
- , date and time of application;
- , application method (air, ground, other);
- , U.S. EPA/California pesticide registration number¹ of the pesticide product applied;
- , pesticide product name and manufacturer;
- , amount of product applied; and
- , person who prepared the report.

Operator Identification

¹ All pesticides must be registered by U.S. EPA before they can be registered in California. In addition, California also requires the registration of spray adjuvants (substances added to enhance the efficacy of a pesticide) including emulsifiers, spreaders, and stickers. Adjuvants are subject to the same state regulations as federally registered pesticides, including use reporting requirements. If a pesticide is federally registered, DPR uses its federal registration number as its California counterpart. DPR assigns a California-only registration number to adjuvants.

Before buying or using pesticides in production agriculture, every property operator is required to obtain a unique operator ID from each county in which pesticides will be used. This 11-digit number represents:

XX - reporting county² (where work is performed);

XX - calendar year;

XX - home county² (county where grower obtains the first operator identification number);

XXXXXX - unique operator ID number assigned by the home county.

When operating in multiple counties, the grower or operator of the property must obtain a grower ID from each county. In this case, the last seven digits (home county and operator ID) obtained from the county in which the operator first registered is carried over and used by all additional counties. Only the first two digits (reporting county) would change.

Site Identification

A site ID must be obtained from the county agricultural commissioner for each location or field where pesticides will be used. This site ID is recorded on the restricted material permit or other approved form. Location-specific information (section, township, range) and commodity/crop specific information are recorded in the county database for each site. Maps for each site/field are filed with the permit and/or operator ID in the county agricultural commissioner offices to help definitively locate sites. Although there were no uniform statewide guidelines for issuing site IDs, generally two methods that meet local needs evolved during the first few years:

1. In some counties, commissioners assign a site ID to a physical plot of ground and each crop grown that year on that plot (for example, wheat, corn, and tomatoes in rotation) is assigned the same site ID, e.g., 01010001. Operators can carry site IDs over from year to year if there are no changes in the field boundaries or type of plantings. The rationale is that the data is more valuable to the county if it can be related to specific pieces of land for historical and investigative purposes.
2. In other counties, the commissioner assigns a new site ID for each crop rotation. For example, each successive planting will have sequential IDs, e.g., 01010001, 01010002, 01010003. The first six digits represent the specific plot of ground; the last two digits represent the crop rotation or planting, e.g., "broccoli-lettuce-bok choy." The site IDs are often reissued each year.

DPR adapted the site ID systems from the restricted materials permit system to reduce the impact of the new requirements on county and State data systems. It was not until use reporting data were used more extensively for trend analyses in the mid 1990s that DPR fully appreciated the need for county uniformity in the definition of site IDs. (See below for discussion of how DPR is revising the site ID system to use geographic information system [GIS] identifiers.)

² California has 58 counties that are arbitrarily assigned ordinal numbers in alphabetical order, i.e., Alameda County is "01" and Yuba is "58."

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Workload Considerations

The first year of full use reporting produced close to 300 percent more agricultural use report records, from 640,000 in 1989 to 1.6 million in 1990. (A "record" means the application of one pesticide product and all associated data recorded on the reporting form. A pesticide "application" can be a single product or a combination of multiple products, such as a tank mix.) This far exceeded estimates by DPR and the county agricultural commissioners relative to the number of applications growers made of general use (nonrestricted) pesticides.

This increased workload impacted both DPR and the counties, and prompted DPR to analyze its operations and evaluate ways to address the problem. As a result, in 1991 DPR changed how it processed data. Rather than hire additional state employees, DPR modified data entry software so the counties could use it in conjunction with information already in their pesticide regulatory database. This significantly reduced the amount of data that must be entered. Moreover, the system can often identify potential problems in the use report when the data are entered (see section entitled "Processing the Data"). Further, county staff possess in-depth knowledge of agricultural practices in their county which proves invaluable when entering use report data. In addition, immediate contact can be made with a grower or person filing the report to solve minor problems. County data entry and electronic submittal to DPR have significantly improved the quality of the pesticide use data. The Department strives to have the data enter the system as close to the field as practicable.

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Processing the Data

Pesticide use reports are submitted to the agricultural commissioners' offices where county staff reviews them. There are two ways this information is entered into DPR's pesticide use database:

1. By mid-1997, 56 of the state's 58 counties enter all agricultural and nonagricultural pesticide use reports submitted to their offices into a computer database. (These counties represent more than 99 percent of the pesticide use in the state subject to reporting requirements. The limited pesticide use in the remaining two counties does not warrant an investment in electronic data processing.)

To process a use report, county employees enter the operator ID number. Matching grower data already in the system are displayed on the screen and the records are scanned until the correct site ID and commodity/crop combination are displayed. Data such as the site ID, commodity code, planted acreage, and location (section, township, range, base, and meridian) are copied to the use report record; information specific to the application is then entered (date and time, treated acres, application method, U.S. EPA or California registration number, and amount of pesticide used). After a record has been entered, it is transferred to a use report database on the county's computer. Extensive validity checks of the entered data are made against the grower's data files and other databases, such as the registered product database described below. Periodically, the use report data are downloaded to an electronic file that is then transferred to DPR's Pesticide Enforcement Branch via floppy disk or electronically via the Internet.

2. For the two counties not electronically processing their data, county biologists manually review the reports for completeness. The reports are then mailed to DPR where they are entered into the database.

As the use reports are loaded into DPR's database, another round of up to 50 different validity checks is made against the data. In particular, the product registration number is verified and a check is made to validate that the commodity reported is a legal use of the pesticide product. Pesticide use records passing all validation checks are transferred to the main "production" database. An error listing of records failing one or more checks is generated. If the data were entered by a county, DPR sends the reports to the county for correction. If DPR staff entered the data, the physical use report is pulled and reviewed. If there was a coding or data entry error,

it is corrected and reentered into the database. Reporting errors, such as an incorrect product registration number, are returned to the county for resolution.

The error checking typically removes less than one percent of the PUR records. Some of the remaining records have extremely high values that significantly affect total pounds applied of a pesticide. For example, the 1995 database contains one reported carbaryl application of 596,511 pounds on five acres of oranges. The median rate of carbaryl use on oranges in 1995 was 12 pounds per acre. In the past, this type of error was only identified by chance when the data were used for analytical projects.

DPR developed a statistical method to detect probable errors in the data fields for acres treated and the pounds of pesticide used. Called the outlier program, this method calculates pesticide use rates (pounds of active ingredient applied divided by acres treated) that are then examined using a variety of statistical methods. The records with highly unlikely use rates (outliers) are placed in a file which accompanies electronic versions of the annual use report, thereby serving to flag suspect pesticide use records. In addition, these records are returned to the counties for research and correction. (See Appendix A for a discussion of the creation of the outlier program.)

An integral part of the use reporting system is DPR's database on registered pesticide products (also called the product label database). Since the early 1970s, DPR has maintained a database on all pesticide products currently (and previously) registered for use in California. The database contains information on more than 45,000 pesticide products. Approximately 10,000 are active product registrations. An average of 1,000 new products is added to the database annually, and a similar number are inactivated due to nonrenewal, suspension, or cancellation. Between 2,000 and 2,500 label amendments are processed annually, many changing the kind and number of crops on the label. Data fields in the product label database include: U.S. EPA or California registration number; pesticide product name; type of registration; type of pesticide; formulation; active ingredients; percent of each active ingredient; specific gravity; all commodity/crop/sites on which the product may be used; health and environmental hazards; general categories of target pests; and application instructions. DPR staff and many outside groups use the database, which is available on DPR's web site. Non-confidential information is routinely made available to the public, registrants, county agricultural commissioners, poison control centers, the state Legislature, and other governmental agencies.

All use report data are run against the product label database as a check for accuracy and to convert the pounds of product applied to pounds of active ingredient(s), based on the formulation and percentage of each active ingredient in the product. In addition, the reported commodity/crop/site is checked against the list of registered uses on the label. Products no longer actively registered are retained in the database since continued use of those products is often allowed (while existing stocks remain with end users).

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Growing Pains

Full use reporting greatly expanded the scope and complexity of data collected by DPR. It also exposed some shortcomings in the data collection and reporting processes. The complexity of the product label and other databases accessed when pesticide reporting data is processed, and the use of these databases by other DPR programs, also prompted DPR to modify these databases to meet the challenge of full use reporting.

Because full use reporting was a major program that no other state had undertaken, it was inevitable that there were problems to be worked out. During the first few years, DPR invested its resources processing the backlog of data and enhancing the county-based computer systems. Initial implementation and processing problems included:

Timeliness of Data Processing

Even with all their collective field experience, DPR and county agricultural commissioners seriously underestimated the increase in workload associated with full use reporting. DPR staffing was inadequate and quickly fell behind in processing the data. It took several years through the government budgetary process to obtain resources to adequately fund and staff the program. Contracts with counties for electronic submission of use reports have had the greatest impact in managing the workload.

A three- to six-month lag in processing the data and making it available to outside requesters is realistic considering the numbers of reports to be processed, the numbers of individuals involved (including the thousands of pesticide users subject to reporting requirements, as well as county commissioner and DPR staff who collect, review, and process data), and the inherent delay in submitting use reports to the commissioners up to a month after pesticide application.

Uniformity

In processing the 1990 use reports, it became evident that new standards and guidelines would have to be developed for recording two of the data fields--the grower/operator and site ID. Inconsistent recording of numbers was a problem with operator IDs. For example, although an operator ID could be 30-90-3000001, it may have been recorded as 30-90-301, 30-90-30-1, 3090301, 30-1, etc. To resolve this problem, the operator ID was separated into four fields--reporting county, year, home county, and operator number. The operator number is now the last set of numbers at the right margin and the remainder of the field is filled with zeros.

Problems with the site ID revolved around naming conventions. For example, the site may be identified as "Home Ranch Smith." This became a problem in data entry as the software allows only eight characters. To address this, standard abbreviations and guidelines were developed for staff when coding the reports for data entry.

Consistent reporting of these data has been stressed in the counties and with growers, operators, Pest control operators, and others subject to reporting requirements. Today, these problems have been substantially eliminated by consistently applying the coding standards and guidelines, and by having most counties submit data electronically.

Site IDs and County Mapping Assistance

During the first ten years of full use reporting, site IDs were only unique when combined with the grower ID and often the commodity. They did not refer to parcels or specific geographic locations. Site IDs changed from year to year for the same grower, as well as with changes in land ownership and property management. Evaluating historical pesticide use geographically to the degree now required is nearly impossible under the current site ID system. To deal with this, DPR is revising the site ID system to use GIS identifiers. (See below for discussion.)

Commodity Codes

DPR's pesticide product label database is used to cross-check data entries to determine if the product reported used is registered on the reported commodity. The DPR label database uses a crop coding system based on crop names used by the U.S. EPA to prepare official label language. However, this system caused some problems until DPR modified it to account for U.S. EPA's grouping of certain crops under generic names. Problems occurred when the label language in the database called a crop by one name, and the use report used another. For example, a grower may have reported a pesticide use on "almonds," but the actual label on the pesticide product--coded into the database--stated the pesticide was to be used on "nuts." To eliminate records being rejected as "errors" because the specific commodity listed on the use report is not on the label, DPR modified the database. To designate a commodity not specifically listed on the label as a correct use, a qualifier code is appended to the commodity code in the label database. In our example above, a qualifier code would be attached to the "almond" code when nuts are only listed on the label. This system greatly reduces the number of rejections.

Plants and commodities grown in greenhouse and nursery operations represented a challenge in use reporting because of their diversity. Six commodity groupings were suggested by industry and incorporate terminology that are generally known and accepted. The six use reporting categories are: greenhouse-grown cut flowers or greens; outdoor-grown cut flowers or greens; greenhouse-grown plants in containers; outdoor container/field-grown plants; greenhouse-grown transplants/propagative material; and outdoor-grown transplants/propagative material.

Tomatoes and grapes were also separated into two categories because of public and processor interest in differentiating pesticide use. Tomatoes are assigned two codes to differentiate between fresh market and processing categories. One code was assigned to table grapes, which includes grapes grown for fresh market, raisins, canning or juicing. A second code was assigned to wine grapes.

County Error Lists

Because of the initial increase in workload both at DPR and the counties, problems arose in processing the error lists in a timely manner. With the changes in how incoming data are checked, DPR now has the ability to send error lists to the counties for their review within a week. Before returning the error lists, DPR staff first review the product label database to ensure it accurately reflects the registered label. Apparent reporting problems are returned to the county to be researched and corrected.

U.S. EPA/California Registration Numbers

The pesticide label database contains all products registered in California, whether active or inactive. In California, all products are assigned a two letter alpha code appended to the U.S. EPA registration number; both the registration number and the alpha code are recorded in the pesticide label database. Registrants may market additional brand names of a product formulation containing the same percentage of active ingredient. Each additional brand is registered as a separate product and is assigned a sequential alpha code, thus providing a unique registration number to each brand name. The alpha code in most cases is not on the physical product label and is not reported by the pesticide user. The absence of the alpha code in the pesticide use report created “errors” when the use report database was checked against the pesticide label database. The validation program was modified to eliminate the check for the alpha code, thus improving the efficiency of the checking process.

Soil Fumigants and Rodenticides

To meet the crop/commodity-specific requirements for both the restricted materials permit and full use reporting programs, the reports may record the use of a pesticide on a commodity for which the pesticide is not registered. This might occur when a pesticide is applied to a site to control a particular pest, but is not applied directly to the crop in the field. For example, a grower may apply a fumigant to bare soil before planting, or a rodenticide to treat rodent burrows in a planted field, both without contact with the crop. Although the pesticide was not used on the crop, recording the data as if the application were made directly to the commodity provides valuable crop history information, particularly for enforcement purposes and for conducting analyses of trends in pesticide use. To avoid these records being rejected as errors, these types of products are flagged in the label database so that their use on any commodity is accepted.

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California Electronic Data Transfer System

DPR developed the California Electronic Data Transfer System (CEDTS) in cooperation with the University of California, Berkeley, and the Kern County Agricultural Commissioner's Office. The CEDTS was developed in the early-1990s when modems and local telephone lines were the predominant available technology for transferring data. This program provides the basis for transferring notices of intent and pesticide use reports from pest control operators, growers, and others to the county agricultural commissioners' offices as required by regulation. CEDTS helps to overcome the problems and costs associated with the increased workload placed on all parties subject to California's full pesticide use reporting program. It also improves the quality and timeliness of the data.

Background

Growers and pest control operators use a variety of computer systems and software applications in their day-to-day farming and business operations. Pesticide use application information is tracked for a variety of reasons--to meet state and federal recordkeeping requirements, for accounting and invoicing, as historical reference. Generally, these data are stored in many formats and database files. Often, data are entered into these systems beginning when a grower identifies a problem that may require use of pesticides. Typically, the data captured by farm management programs exceed the requirements for full use reporting. The computer systems must pull specific data fields from various files to generate a pesticide use report. In most cases, creating the use report is a single function and a new database or file is not created for use reporting alone. For these reasons, DPR decided that it would be more appropriate to develop the specifications, file formats, and documentation that the private sector could use to develop applications rather than writing and marketing a single state-supported set of data processing applications.

DPR developed the application software the commissioners use to electronically receive and validate the pesticide use data. The host computers, located in the county offices, use commercially available modem and security software to ensure closed systems that registered growers and pest control operators can only access using a password system.

The CEDTS program does not place hardware or software requirements on industry participants, other than what is required for actual electronic transfer. The only limitations are on the data itself which must meet a specified transmission format. Detailed system requirements and

documentation are available from DPR or from the local county agricultural commissioner's office.

Project Status

The CEDTS system consists of two major components: (1) a commercially available set of programs that function as a remote terminal server to provide password and hardware security, and (2) the functional application programs that validate and process the electronically transmitted use reports.

The data received by the commissioner's office is validated via a two-stage process. First, data are checked for format (i.e., required fields and correct data types) at the time of transmission. This allows immediate feedback about invalid information to the person or business submitting the use reports via modem. Next, the data are checked against information in the county pesticide regulatory database, and county enforcement staff corrects errors by contacting the grower or operator. Data passing all validation and integrity checks are transferred to a use reporting database. The records can then be sorted by any combination of fields, and several options for printing reports are available to the counties.

Over the last three years, state and county staff have worked diligently with growers, Pest control operators, and consultants to promote the CEDTS project. Response from the counties and the pest control operators has been extremely favorable, but adoption has been slow. Currently, there are 30 counties in which DPR's CEDTS program has been installed, and which have the computer resources required to receive use report data electronically. Because data entry is closer to the source, there are fewer chances for introducing handling errors. All of the benefits envisioned are becoming reality--improved data quality, timeliness of reporting, reduced workload for counties and industry, and a reduction in ongoing operational costs.

Future Expansion: Problems, Opportunities

Many growers and pest control operators lack the time and expertise to design and write the technical programs that pull together the necessary pieces of information into a singular pesticide use application database, and one that meets DPR's standardized data requirements. The diversity of computer systems and software used by growers and Pest control operators, coupled with the diversity of data collected, are the major impediments to expansion of this program within the agricultural community.

DPR is upgrading county hardware and software to expand use of the CEDTS program and to take advantage of newer technologies. Private software providers and the counties are designing Web-based systems that use the Internet to transfer data. In addition, new Windows-based and Web-based software are being developed to expand the CEDTS program to the "nonagriculture" segment of industry. Ongoing training in the counties is also required. DPR is committed to this program and will continue to work with growers, pest control operators, and consultants to analyze, design, develop, and test the application programs required to interface with the county and state systems.

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Making Geography Count

Using Geographical Information to Identify Fields

DPR has taken a number of steps to improve the use reporting system, including working to standardize site identification. A Permit Mapping Assistance Program was established in 1995 to encourage the development and use of geographic information systems (GIS) to more accurately identify sites where pesticides will be applied. As part of this project, DPR trained county staff in standard mapping techniques, procedures, and map interpretation. The training provided the skills and materials to locate sites on large-scale (7.5-foot) U.S. Geological Survey topographic maps. This can enhance the assessment of environmental conditions at application sites for restricted materials and enable long-term tracking of applications on a geographic site-specific basis. The computerized permit programs are being revised to include GIS capabilities to capture the mapping coordinates of field sites and the supporting data. DPR has developed tools to allow field sites to be identified geographically, but with changing technological capabilities at the commissioner level, the department's primary functions are now to provide technical expertise and support to the evolving county-level GIS programs, coordinate and establish consistent guidelines statewide, and commit resources to developing improved pesticide tracking programs.

DPR created the Permit Mapping Developers Group in 1997 with representatives from the county agricultural commissioners to redesign the restricted material permit program to include a GIS component. The primary objectives of the Developers Group are to provide leadership and support to county agricultural commissioners implementing GIS technology in their business programs; develop standards that address issues of statewide consistency; improve data quality and timeliness; develop and provide GIS tools to assist in the collection, evaluation and maintenance of restricted materials permits and pesticide use reports; and provide a forum for the exchange of ideas.

The Developers Group developed recommendations for the standardization of site IDs and for the creation of consistent statewide site definitions and rules, later approved by the county commissioners. For site identification, a site is defined as a contiguous area that has only one operator and undergoes the same pest management and cultural practices, preferably consisting of a single commodity or use at a time. Exceptions to this definition (including interplanted commodities and sites of small acreage) will be left to the discretion of each commissioner. The Developers Group recommended that a site be identified using any naming or labeling scheme that provides relevance to the grower, the county, and others. However, when used in combination with the site operator's ID number, the combined label would be unique to the field

site it represents, as the label refers to a place on the earth's surface and not the commodity that is grown on that piece of ground.

The counties began implementing these guidelines and rules for identifying field sites (Appendix B) in January 2000.

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Maintaining the Databases

DPR had been collecting and processing pesticide use data for more than 20 years before moving to full use reporting in 1990. Significant investments in staff, funding, and other resources had already been made in the development and maintenance of both the pesticide product label and use report databases. Therefore, when full DPR began full use reporting in 1990, the Department did not need to modify the structure of the use report database and existing programs.

DPR provides support for the full use reporting program in the following areas: development and maintenance of the product label and PUR databases; programming, training, and hardware and software support for the counties; coding and data entry tasks; reporting/publication; and special database queries.

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Program Funding

DPR's cost to administer data collection, perform computer processing, provide county information technology support, and publish data summaries is approximately \$1.8 million annually. This includes \$850,000 paid to the counties for data entry. These figures do not include maintaining the pesticide product label database since it is also used extensively by other DPR programs.

The total cost to fund the state's pesticide regulatory program is approximately \$50 million annually. Of that, \$13 million is directed to the county agricultural commissioners to fund local enforcement. It is important to note that DPR's existing pesticide regulatory program provides the infrastructure base on which the full use reporting program is built. Without this base, which includes both county and state activities and personnel, full use reporting costs would be substantially higher.

Although not directly related to the full use reporting program, the following figures reflect annual state funding to all counties for local pesticide regulatory programs, which are intricately tied to California's total pesticide regulatory program.

- \$ 2,881,000 Restricted materials program required under state law and regulations; includes such activities as permit issuance, review notices of intent, evaluate current environmental conditions against the permit, presite inspections.
- \$ 9,129,000 Amount varies annually; provides funding for investigations (e.g., human health effects, environmental, property damage/loss); pest control operator registrations; private grower certifications; training; agricultural and structural inspections (for example, equipment, field worker safety, mixer/loader, business records, headquarters, dealer records, headquarter safety, fumigation); and the nearly 300 percent workload increase related to implementation of full use reporting.
- \$ 172,000 Workload associated with fulfilling requirements for pesticide residue sampling/monitoring contracts.
- \$ 34,000 Dealer licensing.
- \$ 850,000 Pesticide use data entry reimbursements.

\$13,066,000 Total DPR Funding to Counties for Pesticide Regulatory Program

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Using the Data

DPR undertook the expansion of use reporting primarily in response to concerns of many individuals and groups, including government officials, scientists, farmers, legislators, and public interest groups. It was generally acknowledged that the system for estimating dietary exposure to pesticide residues did not provide sufficient data on which to make realistic assessments; this often resulted in overestimates of risk. Farm worker representatives were also demanding more information to determine exposure and potential risk to those who handle pesticides or who work in treated fields.

There are several key areas in which data generated by full use reporting are proving beneficial:

Risk Assessment

Without information on actual pesticide use, regulatory agencies conducting risk assessment assume all planted crop acreage is treated with many pesticides, though most crops are treated with just a few chemicals. If the assumptions used by regulatory agencies are incorrect, regulators could make judgments on pesticide risks that are too cautious by several orders of magnitude, reducing the credibility of risk management decisions. The use report data, on the other hand, provides actual use data so DPR can better assess risk and make more realistic risk management decisions.

After the passage of the federal Food Quality Protection Act (FQPA) in 1996, complete pesticide use data became even more important to commodity groups in California and to the U.S. EPA. The Act contains a new food safety standard against which all pesticide tolerances must be measured. The increased interest in the state's pesticide use data, especially for calculating percent crop treated, came at a time when DPR was increasing the efficiency with which it produced its annual report. DPR was able to provide up-to-date use data and summaries to commodity groups, University of California specialists, U.S. EPA programs and other interested parties as they developed the necessary information for the reassessment of existing tolerances.

Worker Health and Safety

Under the reporting regulations, pest control operators must give farmers a written notice after every pesticide application that includes the date and time the application was completed, and the reentry and preharvest intervals (respectively, the intervals between the time a pesticide is applied and when workers may enter the field, and the time of application and when a commodity can be

harvested). This notice gives the farmer accurate information to help keep workers from entering fields prematurely, and also lets the farmer know the earliest date a commodity can be harvested.

DPR's Worker Health and Safety Branch also uses the data for worker exposure assessment as part of developing an overall risk characterization document.

Public Health

The expanded reporting system provides DPR and the State Department of Health Services with complete pesticide use data for evaluating possible human illness clusters in epidemiological studies

Endangered Species

DPR is working with the commissioners to combine site-specific use report data with GIS-based data on locations of endangered species. The resulting database helps commissioners resolve potential conflicts over pesticide use when endangered species may occur. DPR and the commissioners can also examine patterns of pesticide use near habitats to determine the potential impact of proposed use limitations. With location-specific data on pesticide use, restrictions on use can be better designed to protect endangered species while still allowing necessary pest control.

Water Quality

In meeting the requirements of the Pesticide Contamination Prevention Act of 1985, site-specific records help track pesticide use in areas known to be susceptible to ground water contamination. Determinations can also be made from the records on whether a contaminated well is physically associated with agricultural practices. These records also provide data to help researchers determine why certain soil types are more prone to ground water contamination.

Since 1983, DPR has had a program to work with the rice industry and the Central Valley Regional Water Quality Control Board to reduce contamination of surface water by rice pesticides. Using PUR data to help in pinpointing specific agricultural practices, more precise alternative use recommendations can be made to assure protection of surface water.

Air Quality

Many pesticide products contain volatile organic compounds (VOCs) that contribute to the formation of smog. DPR worked with the state Air Resources Board to put together a State Implementation Plan under the federal Clean Air Act to reduce emissions of all sources of VOCs, including pesticides, in nonattainment areas of the state. DPR's contribution to the plan included accurate data on the amount of VOCs contained in pesticides and the ability to inventory the use of those pesticides through pesticide use reporting.

Pest Management

The Department uses the PUR database to understand patterns and changes in pest management practices. This information can be used to determine possible alternatives to pesticides that are subject to regulatory actions and to help determine possible impacts of different regulatory actions on pest management.

The PUR is used to help meet the needs of FQPA, which requires pesticide use information for determining the appropriateness of pesticide residue tolerances. As part of this process many commodity groups have created crop profiles, which include information on the pest management practices and available options, both chemical and non-chemical. Pesticide use data is critical to developing these lists of practices and options.

DPR manages several grant programs that fund projects to develop, implement, and demonstrate reduced-risk pest management strategies. One of these programs is the Pest Management Alliance Grants. This program provides grant money to growers, commodity boards, farm advisors, urban site representatives, researchers, and state government to identify critical pest management needs, environmental or human exposure issues resulting from pesticide use, and to develop a program to solve the critical problems. To help the groups in their evaluations of current pest management practices, DPR provides data on use of all pesticides on the Alliance crop or site. DPR and other funding agencies can also use the PUR to help evaluate the effectiveness of the programs they have funded.

Recently, DPR has published general analyses of statewide pesticide use patterns and trends. The first analysis covered the years 1991 to 1995, and the second more detailed analysis covered 1991 to 1996. These analyses identified high-use pesticides, the crops to which those pesticides were applied, trends in use, and the pesticides most responsible for changes in use. In addition, since 1997, the annual reports Summary of Pesticide Use Report Data include summary trends of pesticides in several different categories such as carcinogens, reproductive toxins, and groundwater contaminants.

Processor and Retailer Requirements

Food processors, produce packers, and retailers often require farmers to submit a complete history of pesticide use on crops. DPR's use report form often satisfies this requirement.

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Public Access to the Data

Annually, DPR publishes two versions of the Statewide Summary of Pesticide Use Report Data. DPR's target date for release of the data summaries is July of the succeeding year. These data summaries include a brief narrative overview and a breakdown of pounds of pesticide use, one volume indexed by chemical and the second by commodity. These summary reports may be purchased in print or on floppy disk, or may be downloaded from DPR's external home page at <www.cdpr.ca.gov>.

However, this summary document represents only a fraction of the total data gathered under full use reporting. The full database provides a much more accurate and complete picture for in-depth analytical purposes. The full database and supporting documentation can be purchased on CD-ROM for all years beginning with the 1990 data. The CD-ROM is available with the data in one of two formats: ASCII text or arc interchange (.e00 extension). A third CD-ROM with spatial representation of statewide Public Land Survey System sections is also available; when linked with the pesticide use data, this third CD-ROM makes spatial display and analysis possible.

In addition, requests can be made for specific data, such as all reports for one county, one commodity, specific section-township-range, in any combination of data fields.

To improve use of the PUR as an analytical tool, DPR is surveying county agricultural commissioners on their PUR implementation practices from 1990 to 1999. DPR will use the survey data and other information to analyze implementation issues and practices within the counties as well as any changes counties adopted to deal with issues such as the issuance of site IDs. Survey results are expected to be published in 2000.

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Final Notes

A few final comments about the full use reporting program will provide a more realistic perspective of DPR's goals for this program.

First, it should be recognized that with the complexity of the program, coupled with the large volume of data being processed, 100 percent accuracy will never be achieved. The error rates for counties processing their own use reports have dropped to 0.5 to 1.0 percent. This is a significant improvement over data processed in-house. It reflects a statistically acceptable level of accuracy for a program of this size. DPR recognizes that even a few errors often reflect negatively on the value of the program. Therefore, as part of its continuous improvement efforts, DPR systematically identifies and carries out new data validations to further reduce the error rates.

Secondly, a great deal of the success in the implementation of the full use reporting program can be attributed to several factors: an existing regulatory program including limited pesticide use reporting; the county agricultural commissioner system has primary responsibility for the local program; existing computer systems including hardware and application software that were being used by most the counties for their restricted materials program; and the exceptional commitment by all county and department staff to make the program work.

Finally, because of the variety of and changes in topography, weather and soil conditions, pest and disease pressures in California, the agricultural practices vary from region to region and year to year. New integrated pest management systems are being developed and used and reduced-risk pesticide and biological products are being marketed to address food safety, health and environmental issues. These factors influence pesticide use in California; what was once considered the norm is no longer the "norm." Change will continue to occur at even a more rapid pace; pesticide use patterns and trends will fluctuate. Our challenge is to be aware of these issues in analyzing PUR data and in designing systems to effectively and efficiently manage programs and resources.

DPR remains fully committed to improving the quality and usefulness of the pesticide use data. DPR welcomes all constructive suggestions for improving and streamlining the program and will respond as part of its ongoing review and analysis of the program.

Glossary

Notice of Completion - Notification from the agricultural pest control business/operator to the operator of the property within 24 hours of completion of the pesticide application.

Notice of Intent - Notification of intent to apply a restricted material from the operator of the property to the agricultural commissioner 24 hours prior to commencing the use of a pesticide.

Operator IDs - A unique ID required to be obtained from the county agricultural commissioner by every property operator before buying or using pesticides for production agriculture.

Pest Control Operator (Pest control operators) - Those in the business of applying pesticides, such as aerial applicators, structural fumigators, and professional gardeners.

Preharvest Interval - The interval between the time the application is made and when the commodity can be harvested.

Reentry Interval - The interval between the time a pesticide is applied and when workers may enter the field.

Restricted Material - A pesticide that is designated as restricted by the federal or state pesticide regulatory program because of its potential to be harmful to public health, farm workers, domestic animals, honeybees, the environment, wildlife, or other crops.

Site ID - An ID obtained from the county agricultural commissioner for each location/field where pest control work will be performed that is recorded on the restricted material permit or other approved form.

Appendix A:

Methods for Identifying Data Outliers

To improve data quality, we flagged values for rate of use which are so large they are probably errors. Errors occur, for example, when those reporting pesticide use shift decimal points during data entry. We used three different criteria to identify outliers by comparing each use rate with an estimate of the maximum rate for that type of use.

Rate of use is not one of the fields in the PUR table. Rates are calculated by dividing the pounds of pesticide used by the acres or unit treated. Thus, an error in rate of use could occur through an error in recording either pounds or unit treated.

Only extremely large rates are flagged, not extremely small ones, because only large values will have a major influence on statistics involving pounds of pesticide use. What value to use for the maximum rate in each criterion is somewhat arbitrary; the value determines how conservative one wants to be. We chose maximum rates to be close to what were considered obvious outliers by a group of scientists in a survey described below in the description of the neural network criteria.

There are many possible methods for determining if a value is an outlier. If we knew the maximum label rates for particular uses, then rates in the PUR could be compared to these maximum rates, but unfortunately this information is not available in the PUR or in the Pesticide Label Database. The other methods to identify outliers involve looking at the distribution of the actual use rates. If the values are normally distributed, then one can identify outliers using a number of statistical procedures. If the values have an unknown or nonstandard distribution, then there exist no standard statistical procedures for identifying outliers. Nevertheless, people can look at a distribution and usually say with different degrees of confidence whether some value is an outlier. This suggests there should be some kind of procedure that can be developed to make similar judgments.

For most of the pesticide use data, distributions of rates are not even close to normal. They may have several different peaks (multi-modal). They can have either very broad or very narrow distributions. None of the standard statistical measures of outliers are very useful for these data. The best single method is the one based on neural networks. However, each different criterion will catch different outlier values so it is usually best to use all three criteria. It should be noted that these criteria are not perfect. They are conservative, meaning a value must very extreme to be flagged and so they will miss some errors. On the other hand, they may occasionally flag an extreme value that is actually correct. Because the criteria are conservative these later kinds of errors are minimized.

Criterion 1: Pounds per acre of active ingredient is larger than 200 (for non-fumigants), or 1000 (for fumigants).

Records were flagged in the PUR by criterion 1 if the pounds per acre of a non-fumigant active ingredient were greater than 200 or if the pounds per acre of a fumigant active ingredient were greater than 1000 (column ai_a_1000_200 in the outlier table). These limit values were chosen based on what is known about typical rates of use for most pesticides.

Note that this criterion uses the pounds of active ingredient. Also, this criterion only applies to records where the unit treated is acres. The other criteria use pounds of pesticide product and apply to any unit treated, such as square feet or cubic feet.

Criterion 2: Pounds per unit treated of a product is larger than 50 times the median.

Records were flagged by criterion 2 if the pounds of pesticide product per unit treated were greater than 50 times the median value of all rates with similar types of use (column prd_u_50m in the outlier table). The median, like the mean (average), is a measure of the location of a set of values and is defined as the value in the set that has an equal number of values above and below it. It was used rather than the mean because it is not as likely to be affected by a few extreme outliers. The median was calculated from the set of all use rates of the same pesticide product and uses as that of each record being examined. By the same uses, we mean the uses of a product on the same crop or site, same unit treated, and same record type. A record type is basically either an agricultural or non-agricultural use.

Criterion 3: Pounds per unit of product is larger than a value generated using a neural network.

Records were flagged by criterion 3 if the pounds of a pesticide product per unit treated were greater than a limit value calculated using a neural network procedure (column nn4 in the outlier table).

A neural network is a special kind of function that calculates a set of output values from a set of input values. This function has a large number of parameters that must be determined so that the function will give the correct outputs for every possible set of inputs. The values for these parameters are found by a training procedure that involves presenting to the neural network program data consisting of many sets of input and corresponding output values. The program then adjusts the parameters in the neural network function until it produces the correct output values for each input set. Once the neural network has been successfully trained, it can then be used to produce appropriate output values for any input data set provided to it.

The data used to train the neural network used in the PUR outlier program were generated from frequency distributions of the pounds of pesticide product per unit treated for a selected set of pesticides and sites. Groups of pesticides and sites were chosen that included a wide range of types of distributions, including many unusual distributions. Two hundred frequency distributions were plotted and then these plots were examined independently by 12 scientists in DPR who marked rates on each plot they thought were outliers.

The results of this survey were summarized by finding an outlier maximum rate for each distribution. The maximum rate was set at a value where all 12 scientists thought higher rates were obvious outliers. These maximum rates were used as the output values for training the neural network. The input values were a set of statistical measures that described the frequency distributions. These sets of input and output values were used to train the neural network. After

the neural network was successfully trained, it was used to find the outlier maximum rate for all sets of pesticide use types in the PUR.

For a more detailed explanation of the procedures used to identify outliers, see the report "A Computer Program to Identify Outliers in the Pesticide Use Report Database", L. Wilhoit, April 1998, DPR report PM 98-01.