Summary of Pesticide Use Report Data 2013

California Department of Pesticide Regulation
P.O. Box 4015
Sacramento, CA 95812-4015

California Environmental Protection Agency
Department of Pesticide Regulation

Edmund G. Brown Jr., Governor

Matt Rodriquez, Secretary
California Environmental Protection Agency

Brian Leahy, Director
Department of Pesticide Regulation

May 2015

For information on obtaining electronic data files, see Page ii.
This report is also available on DPR's Web site <www.cdpr.ca.gov>.
If you have questions concerning this report, call 916-445-3887.

Contents

How to Access the Summary of Pesticide Use Report Data

The *Summary of Pesticide Use Report Data* indexed by chemical or commodity reports for years 1989-2013 can be found on DPR's Web site at <www.cdpr.ca.gov>. The *Summary of Pesticide Use Report Data* is available in two formats. One report is indexed by chemical and lists the amount of each pesticide used, the commodity on which it was used, the number of agricultural applications, and the acres/units treated. The second report is indexed by commodity and lists amount of pesticide used for each chemical, the number of agricultural applications, and the acres/units treated.

The *Annual Pesticide Use Report Data* (the complete database of reported pesticide applications for 1989 to 2013) are available on CD and on DPR's FTP site at <ftp://pestreg.cdpr.ca.gov/pub/outgoing/pur_archives/>. The FTP site also includes data for years 1974 to 1989. The files are in text (comma-delimited) format.

Questions regarding the *Summary of Pesticide Use Report Data* should be directed to the Department of Pesticide Regulation, Pest Management and Licensing Branch, P.O. Box 4015, Sacramento, California 95812-4015, telephone 916-322-2152, or you may request copies of the data by contacting <Basil.Ibewiro@cdpr.ca.gov>.

1 Introduction

California's pesticide use reporting program is recognized as the most comprehensive in the world. California has had pesticide use reporting in some form since at least 1950. In 1990, California became the first state to require full reporting of agricultural pesticide use to have more realistic and comprehensive pesticide data to better inform DPR's pesticide regulatory programs. Over the years, these data have been used by many individuals and groups including government officials, scientists, growers, legislators, and public interest groups. All pesticide use data required to be reported must be sent to county agricultural commissioners (CACs), who, in turn, report the data to DPR. In the last couple of years DPR has annually collected and processed more than three million records of pesticide applications. (A single application creates more than one record if multiple pesticide products are applied at the same time.)

California has a broad legal definition of "agricultural use," so the reporting requirements include pesticide applications in production agriculture, 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. All applications made by licensed applicators and outdoor applications of pesticides with the potential to pollute ground water must be reported. The primary exceptions to the reporting requirements are home-and-garden use and most industrial and institutional uses.

California law (Food and Agricultural Code [FAC] section 12979) requires reporting on uses of pesticides and prescribes how DPR will use the reports in setting priorities for monitoring food, enforcing pesticide use, protecting the safety of farm workers, monitoring the environment for unanticipated residues, researching pest control practices, monitoring and researching public health issues, and similar activities. These uses of the data help to achieve another mandated activity of DPR: to develop an orderly program for the continuous evaluation of currently registered pesticides (FAC section 12824). Information gathered during continuous evaluation is used to gauge the performance of DPR's regulatory programs and justify additional measures, including development of new regulations or reevaluation or cancellation of pesticide registrations. Regulations (California Code of Regulations Title 3, sections 6624 et seq.) further describe pesticide use record keeping and reporting requirements.

Continuous Evaluation of Pesticides

The Pesticide Use Report (PUR) greatly increased the accuracy and efficiency of continuous evaluation of pesticides by providing details on each application, including date, location, site (e.g., crop), time, acres or units treated, and the identity and quantity of each pesticide applied. These data allow scientists and others to identify trends in pesticide use, compare use locations with other geographical information and data, and perform quantitative assessments and evaluations of risks pesticides may pose to human health and the environment to carry out DPR's mandates.

DPR uses the PUR throughout its pesticide regulatory programs in ways that can be broadly grouped as temporal (time), geospatial (place), and quantitative (amount), and often combines elements of each.

Temporal analyses can pinpoint specific applications or span many years. Investigations into suspected worker illnesses, spray drift, fish or wildlife losses, or other enforcement inquiries frequently begin with a review of the PUR to see what applications were made in an area at a particular time. Protection of ground and surface waters, assessments of risks to human health with accurate potential acute and chronic exposure scenarios, and allocation of monitoring and enforcement resources often begin with analyses of PUR data spanning many years to evaluate pesticide use trends.

Geospatial analyses may be local or expansive in scale. Local analyses are used to help set priorities for surface and ground water monitoring programs by determining pesticide use and runoff potential in specific watersheds or other defined areas. DPR scientists calculate pesticides' contributions of smog-forming volatile organic compounds (VOCs) in the atmosphere using reliable pesticide use data and emissions data on products. They further refine their analyses to specific air basins that are particularly vulnerable to air pollution and determine whether pesticide-related VOC emissions are below required targets or whether additional restrictions on use may be warranted to protect air quality. More expansive analyses relate areas of pesticide use to habitats of endangered species and provide a means to guide growers with use practices that better protect these species. The results of such analyses are very valuable when assessing regulatory responses or evaluating the performance of voluntary stewardship efforts.

Quantitative assessments are broadly used to model risks of pesticide use to humans and the environment. The quality and depth of the PUR often allows researchers to apply realistic assumptions when modeling pesticide exposures, for example, of residents near agricultural lands, workers in the field, handlers preparing and applying pesticides, or aquatic organisms inhabiting waterways that receive agricultural runoff. The result is well-informed and 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 the U.S. Environmental Protection Agency (U.S. EPA), groups representing California's various agricultural commodities, and other stakeholders. The FQPA contained a new food safety standard against which all pesticide tolerances (amounts of pesticide residue allowed by federal law to remain on a harvested crop) must be measured. DPR provides recent use data and summaries to commodity groups, University of California (UC) specialists, U.S. EPA, and other interested parties as they reassess tolerances and calculate dietary risks from pesticides.

Data on types and rates of pesticide use in various crops and at other sites help researchers understand how various pest management options are implemented and devise strategies that reduce environmental risks. Analyses of these data support and assess grant projects DPR funds to promote the development and adoption of integrated pest management practices in both agricultural and urban settings.

The PUR data are used by many state, regional, and local agencies; scientists; and public interest groups to better understand pesticide use and to find better ways to protect human health and the environment while producing food and fiber and maintaining our shelters and surroundings.

Data Collection

Partial reporting of agricultural pesticide use has been in place in California since at least the1950s. In those years, CACs required agricultural pest control operators to send monthly reports. County requirements varied, but many reports included a statement for each application that showed the grower's name; treatment location and date; crop; acres or other units treated; target pest; and the kind, strength, and amount of the pesticide applied. Only statistics on aerial pesticide applications were forwarded to the state for tabulation. In 1955, state regulators asked for reports on ground application acreage but dropped requirements for detailed reporting of pesticides used and commodities treated. In 1970, DPR required farmers to report all applications of restricted use pesticides and pest control operators to report all pesticides used, whether restricted or nonrestricted. Both kinds of reports had to include the date, location, site (e.g., crop), acres or units treated, and the identity and quantity of each pesticide applied. Production agricultural applications included records for each application and the location to a square mile area (section, township, and range); all other applications were reported as a monthly summary by county. The reports were filed with the CAC, who forwarded the data to the state, where it was entered into a database and summarized in annual publications.

The Food Safety Act of 1989 (Chapter 12001, Assembly Bill 2161) gave DPR statutory authority to require full reporting of pesticide use. That year, the department adopted regulations and full use reporting began in 1990.

The first years of full use reporting nearly overwhelmed the department's capacity to process data. Use reports were on paper, and staff had to hand-enter data representing more than a million records each year. DPR began almost immediately to search for ways to automate reporting from pesticide users to CACs and, in turn, from the counties to DPR. However, it was difficult to find an approach that suited the diversity of use reporting and differing budget resources among the counties. Starting in 1991, various automated programs were developed and modified by DPR and the CACs. Meanwhile, technological progress and increasing use of the Internet by businesses fed expectations for more Web-based functionality for pesticide use reporting.

CalAgPermits

In 2011, the counties worked together to implement a new standardized county system, called CalAgPermits, that operates over the Internet. It helps CACs issue restricted materials permits and provides an automated platform for electronically validating pesticide use reports and transmitting them to DPR. It accepts pesticide use reports electronically from individuals and subscriber-based firms and allows pesticide use reporting directly via the Web. CalAgPermits allows pesticide use data to flow back and forth electronically between DPR and CACs for quality assurance. It also offers more robust data quality assurances that prevent coding mistakes and transcription errors (e.g., drop down menus and requisite data fields that must be filled before records are accepted). CalAgPermits has enhanced the efficiency of data entry and data transfer and the accuracy and integrity of the database.

Improving Accuracy

The use report data are checked for accuracy at several steps in the process. Beginning at data entry, CalAgPermits checks for several kinds of errors. For example, if the pesticide that was used is a restricted material, CalAgPermits compares the pesticide's reported use to the grower's restricted materials permit to ensure that the pesticide is listed on the permit. Later, when data are sent to DPR to be loaded into DPR's database, more than 50 different validity checks are made against the data. In particular, the U.S. EPA or California registration number is verified, and a check is made to confirm the commodity reported is an acceptable use of the pesticide product. The database contains some products that are no longer registered since continued use is often allowed while existing stocks remain with end-users. Records with suspected errors are flagged and returned electronically to the county for resolution.

After data are transmitted to DPR, additional data checks are performed. A statistical method, developed by DPR in the late 1990s, detects probable errors in the data fields that contain values for acres treated and the pounds of pesticide used. If a reported rate of use (amount of pesticide per area treated) is so large it is probably an error, the rate is replaced with an estimated rate equal to the median rate of all other applications of the pesticide product on the same crop or site. This is still flagged as an error and sent back to the counties for checking. Since the error could have been in the amount reported or the area or unit treated, the value that is most unusual is replaced with an estimate. Although less than one percent of the reports are flagged as this type of error, some are so large that if included they would significantly affect total amount applied of the pesticide. (For example, in 2007 an application of the insecticide imidacloprid was inaccurately reported as 108,000 pounds on one acre of cabbage. The median rate of imidacloprid use in 2007 was 0.05 pounds an acre. These types of errors, while rare, can occur.)

Improving Access to the Data

The annual reports present only a summary of the use reporting database (typically a 450-megabyte file for each year's data). In the late 1990s, DPR took steps to improve public access to the data and present it in a more meaningful context. Summaries of the statewide data indexed by chemical and by commodity, previously available on paper and compact disk, were posted on DPR's Web site. Summaries of use in each of the state's 58 counties, previously available only on request, were also posted online. The entire database starting with the 1974 data is also available on DPR's Web site.

In 2003, DPR launched the Web-based California Pesticide Information Portal (CalPIP) database to increase public access to the nation's most extensive source of pesticide use information. CalPIP provides pesticide use information including date, site or crop treated, pounds used, acres treated, pesticide product name, chemical name (active ingredient), application pattern (ground, air, or other), county, ZIP code, and location where the application was made to within a one-square-mile area.

DPR also began examining trends in pesticide use, starting with the 1996 data, analyzing critical crops, pest problems and trends in pounds used, number of applications, and acres treated. Each year, the pesticide use report summary charts use of pesticides over several years in specific categories:

- Reproductive toxins.
- Carcinogens.
- Insecticide organophosphate and carbamate chemicals.
- Chemicals classified by DPR as ground water contaminants.
- Chemicals listed by DPR as toxic air contaminants.
- Fumigants.
- Oil pesticides derived from petroleum distillation. (Some may be on the state's Proposition 65 list of chemicals "known to cause cancer," but most serve as alternatives to high-toxicity pesticides).
- Biopesticides (including microorganisms, naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest, such as pheromones).

DPR scientists review changes in pesticide use for about a dozen crops selected based on the amount of pesticide used or acreage treated. To compile this information, staff reviews publications and conducts telephone interviews with pest control advisers, growers, researchers, commodity association representatives, and UC Cooperative Extension farm advisers and specialists. Based on their knowledge of pesticides, California agriculture, pests, and pest management practices, DPR scientists propose explanations for year-to-year changes in pesticide use.

Pesticide use trend analyses can help agencies understand where efforts to promote reduced-risk pest management strategies are succeeding or failing. Information on long-term trends also helps researchers better identify emerging challenges and direct research attention to finding solutions.

2 Comments and Clarifications of Data

The following comments and points should be taken into consideration when analyzing data contained in this report.

Terminology

- *Number of agricultural applications* - Number of applications of pesticide products made to production agriculture. More detailed information is given below under "Number of Applications."
- *Pounds applied* - Number of pounds of an active ingredient.
- *Unit type* - The amount listed in this column is one of the following:

  A = Acreage
  C = Cubic feet (of commodity treated)
  K = Thousand cubic feet (of commodity treated)
  P = Pounds (of commodity treated)
  S = Square feet
  T = Tons (of commodity treated)
  U = Miscellaneous units (e.g., number of tractors, trees, tree holes, bins, etc.)
- *Acres treated* - Cumulative number of acres treated. More detailed information is given below under "Acres Treated."

Agricultural and Nonagricultural Pesticide Use

Many pesticide licensing, sales, and use requirements are tied to California's definition of agricultural use, and pesticide labels differentiate between agricultural, industrial, or institutional uses. The law (FAC section 11408) identifies agricultural use as all use except that specifically identified as nonagricultural use, which is specified as:

- *Home* - Use in or in the immediate environment of a household.
- *Industrial* - Use in or on property necessary to operate factories, processing plants, packinghouses or similar buildings, or use for or in a manufacturing, mining, or chemical process. In California, industrial use does not include use on rights-of-way. Postharvest commodity fumigations at buildings or on trucks, vans, or railcars are normally industrial use.

- *Institutional* - Use in or on property necessary to operate buildings such as hospitals, office buildings, libraries, auditoriums, or schools. When a licensed structural pest control operator treats these buildings, it is structural use. Landscaping of walkways, parking lots, and other areas bordering these buildings is institutional. Landscaping of larger, more independent areas is not considered institutional.
- *Structural* - Use by licensed structural pest control operators within the scope of their licenses.
- *Vector control* - Use by certain vector control (mosquito abatement) districts.
- *Veterinarian* - Use according to a written prescription of a licensed veterinarian.

Agricultural use of pesticides includes:

- *Production agricultural use* - Any use to produce a plant or animal agricultural product (food, feed, fiber, ornamental, or forest) that will be distributed in the channels of trade. (While production agricultural use includes various agricultural products, some requirements—most notably in the worker safety and use reporting—apply only to plant product production.)
- *Nonproduction agricultural use* - Any use to areas such as watersheds, rights-of-way, and landscaped areas (such as golf courses, parks, recreation areas, and cemeteries) not covered by the definitions of home and institutional. There are some pesticide products labeled for dual-use, that is, they have both agricultural and nonagricultural uses.

The reporting requirements apply to a range of uses partly due to the California legal definition of agricultural use. With implementation of full use reporting in 1990, the following pesticide uses are required to be reported to the CAC who, in turn, reports the data to DPR:

- Production of any agricultural commodity except livestock.
- Treatment of postharvest agricultural commodities.
- Landscape maintenance in parks, golf courses, cemeteries, and similar sites defined in the FAC as agricultural use.
- Roadside and railroad rights-of-way.
- Poultry and fish production.
- Application of a restricted material.
- Application of a pesticide listed in regulation as having the potential to pollute ground water when used outdoors in industrial and institutional settings.
- Application by licensed pest control operators, which include agricultural and structural applicators and maintenance gardeners.

The primary exceptions to the use reporting requirements are consumer home-and-garden use and most industrial and institutional uses.

Operator and site identification numbers. An operator identification number (OIN), sometimes called a "grower ID," is issued by CACs to property operators. The number is needed to report pesticide use and to buy agricultural- or restricted-use pesticides. Pest control professionals do not have to get operator ID numbers. A site identification code must be assigned for each location or field where pesticides will be used for production of an agricultural commodity. This alphanumeric code is also recorded on any restricted material permit the grower gets for the location.

What must be reported. The PUR contains two kinds of records: production agricultural records and all others. For the PUR, production agricultural records represent applications made while producing agricultural commodities. Production agricultural pesticide use reports must be sent monthly by growers or seven days after the application by pest control businesses to the CAC. They include:

- Date and time of application.
- Geographic location including the section, township, range, and base line/meridian.
- Operator identification number.
- Operator name and address (although this information is not submitted to DPR).
- Site identification number.
- Commodity, crop, or site treated.
- Acres or units planted and treated.
- Whether the application was by air, ground, or other means.
- For field fumigations in ozone nonattainment areas, details on fumigation method (for example, shallow shank injection with a tarp). This is to allow the department to estimate pesticide VOC emissions. (VOCs contribute to the formation of atmospheric ozone, an important air pollutant.)
- Amount of product applied with its name and U.S. EPA registration number or, if the product was an adjuvant, its California registration number. (The U.S. EPA does not require registration of adjuvants.)

Reports of all other kinds of pesticide use, which are mostly nonagricultural, are monthly summaries that include pesticide product name, the product registration number, amount used, number of applications, the kind of site treated (for example, roadside, structure), the month of application, and county.

Commodity Codes

DPR's pesticide product label database is used to cross-check data entries to determine if the reported product is registered for use on the reported commodity. The DPR label database uses a crop coding system based on crop names used by U.S. EPA to prepare official label information. However, this system caused some problems until DPR modified it in the early 1990s to account for U.S. EPA's grouping of certain crops under generic names. Problems occurred when the label information in the database referred to a crop by one name and the use report referred to another. For example, a grower may have reported they applied a particular pesticide product to "almonds," but the actual label on the pesticide product—and the product label information coded into the database—stated the pesticide was to be used on "nuts." A cross-reference table was created associating each crop with a more general crop name that might appear on a product label. This cross-reference table also associates the crop name used in the PUR with all the different names for a crop in the label database. For example, the PUR uses one name for "cotton," but the label database has several names for cotton, such as "cotton (fiber crop)," "cotton (forage - fodder)," "cotton (all or unspec)," and "cotton, general." This system greatly reduces the number of rejected reports.

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 in 1990 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-grown plants in 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.

Unregistered Use

The report contains entries that reflect the use of a pesticide on a commodity for which the pesticide is not currently registered. This sometimes occurs because the original use report was in error; that is either the pesticide or the commodity was inaccurately reported. DPR's computer program checks that the commodity is listed on the label, but nonetheless such errors appear in the PUR, possibly because of errors in the label database. Also, the validation program does not check whether the pesticide product was registered at the time of application. For example, parathion (ethyl parathion) is shown reported on crops after most uses were suspended in 1992. (These records are researched and corrected as time and resources allow.) DPR continues to implement methods that identify and reduce these types of reporting errors in future reports. Other instances may occur because, by law, growers are sometimes allowed to use stock they have on hand of a pesticide product that has been withdrawn from the market by the manufacturer or suspended or canceled by regulatory authorities. Other reporting "errors" may occur when a pesticide is applied directly to a site to control a particular pest, but is not applied directly to the crop in the field. A grower may use an herbicide to treat weeds on the edge of a field, a fumigant on bare soil prior to planting, or a rodenticide in rodent burrows. For example, reporting the use of the herbicide glyphosate on tomatoes when it was actually applied to bare soil prior to planting the tomatoes could be perceived to be an error. Although technically incorrect, recording the data as if the application were made directly to the commodity provides valuable crop usage information for DPR's regulatory program. DPR is evaluating a solution for this problem.

Adjuvants

Data on spray adjuvants (including emulsifiers, wetting agents, foam suppressants, and other efficacy enhancers), not reported prior to full use reporting, are now included. Examples of these types of chemicals include the "alkyls" and some petroleum distillates. (Adjuvants are exempt from federal registration requirements but must be registered as pesticides in California.)

Cumulative Acres Treated

One of the measures of pesticide use in this report is cumulative area treated, where area is in units of acres. The cumulative area treated is the sum total of the area treated with an active ingredient and integrates situations where the same field may be treated with the same active ingredient more than once in a year. For example, if a 20-acre field is treated three times in a calendar year with an active ingredient, the active ingredient would have been applied to 60 acres. Thus the total cumulative area treated for a crop could be greater than the planted area of the crop.

A similar situation occurs when the product used contains more than one active ingredient. (In any pesticide product, the active ingredient is the component that kills, or otherwise controls, target pests. A pesticide product is made up of one or more active ingredients, and possibly one or more inert ingredients.) For example, if a 20-acre field is treated with a product that contains three different pesticide active ingredients, a use report is filed by the farmer correctly recording the application of a single pesticide product to 20 acres. However, the summary tables will reflect that three different active ingredients were applied—20 acres each. Adding these values results in a total of 60 acres as being treated instead of the 20 acres actually treated.

Number of Applications

The number of applications include only production agricultural applications. Applicators are required to submit one of two basic types of use reports, a production agricultural report or a monthly summary report. The production agricultural report must include information for each application. The monthly summary report, for all uses other than production agriculture, includes only monthly totals for all applications of pesticide product, site or commodity, and applicator. The total number of applications in the monthly summary reports is not consistently reported, so they are no longer included in the annual totals. (In the annual PUR reports before 1997, each monthly summary record was counted as one application.) In the annual summary report arranged by commodity, the total number of applications given for each commodity may not equal the sum of all applications of each active ingredient on that commodity. As explained above, some pesticide products contain more than one active ingredient, and one application of the product would be tallied as one application of *each* active ingredient. If the number of applications were summed for each active ingredient in such a product, the total number of applications would be more than one, even though only one application of the product was made.

3 Data Summary

This report is a summary of 2013 data submitted to DPR as of September 8, 2014. PUR data is continually being updated and corrected so the numbers in this report may differ from the final numbers, but any differences should be minor.

Pesticide Use in California

In 2013, 194 million pounds of pesticide active ingredients were reportedly used in California. Annual use has varied from year to year since full use reporting was implemented in 1990. For example, reported pesticide use was 196 million pounds in 2005, 158 million pounds in 2009, and 187 million pounds in 2012.

These fluctuations can be attributed to a variety of factors, including changes in planted acreage, crop plantings, pest pressures, and weather conditions. For example, extremely heavy rains result in excessive weeds, thus more pesticide may be used; drought conditions may result in fewer planted acres, thus less pesticide may be used.

In addition, it should be noted that the pounds of pesticides used and the number of applications are not necessarily accurate indicators of the extent of pesticide use or, conversely, the extent of use of reduced-risk pest management methods. For example, farmers may make a number of small-scale "spot" applications targeted at problem areas rather than one treatment of a large area. They may replace a more toxic pesticide used at one pound per acre with a less hazardous compound that must be applied at several pounds per acre. Either of these scenarios could increase the number of applications or amount of pounds used, respectively, without indicating an increased reliance on pesticides.

As in previous years, in 2013, the greatest pesticide use occurred in California's San Joaquin Valley (Table 1). The four counties in this region with the highest use were Fresno, Kern, Tulare, and San Joaquin.

Table 2 breaks down the pounds of pesticide use by general use categories: production agriculture, post-harvest commodity fumigation, structural pest control, landscape maintenance, and all others.

Table 1: *Total pounds of pesticide active ingredients reported in each county and rank during 2012 and 2013*

	2012 Pesticide Use		2013 Pesticide Use	
County	Pounds Applied	Rank	Pounds Applied	Rank
Alameda	289,813	39	314,537	38
Alpine	140	58	266	58
Amador	60,779	46	77,428	46
Butte	2,828,773	18	2,984,520	17
Calaveras	43,779	49	29,380	48
Colusa	2,536,185	19	2,836,263	18
Contra Costa	468,149	36	395,481	36
Del Norte	301,298	38	284,086	40
El Dorado	148,674	42	143,502	42
Fresno	33,306,325	1	34,193,393	1
Glenn	2,086,317	21	2,157,027	22
Humboldt	37,219	50	27,265	51
Imperial	5,898,441	12	4,311,787	12
Inyo	9,797	54	15,627	54
Kern	27,816,290	2	31,245,295	2
Kings	6,783,058	9	7,426,510	8
Lake	562,729	34	594,735	34
Lassen	116,780	43	136,083	43
Los Angeles	2,027,461	22	2,434,430	20
Madera	9,467,822	5	10,191,490	5
Marin	73,588	45	84,836	45
Mariposa	4,390	56	17,777	53
Mendocino	893,795	31	987,222	30
Merced	7,270,916	8	8,527,500	7
Modoc	114,997	44	87,856	44
Mono	5,489	55	11,228	56
Monterey	9,047,989	6	8,539,894	6
Napa	1,332,243	26	1,259,700	26
Nevada	46,862	48	47,547	47
Orange	992,795	28	1,075,223	29

Table 1: (continued) *Total pounds of pesticide active ingredients reported in each county and rank during 2012 and 2013*

	2012 Pesticide Use		2013 Pesticide Use	
County	Pounds Applied	Rank	Pounds Applied	Rank
Placer	325,016	37	303,083	39
Plumas	47,919	47	25,684	52
Riverside	2,851,900	17	2,456,875	19
Sacramento	3,266,080	13	3,640,608	13
San Benito	611,873	33	653,783	33
San Bernardino	534,780	35	572,458	35
San Diego	1,362,582	25	1,653,180	25
San Francisco	31,656	51	28,727	49
San Joaquin	9,562,126	4	11,017,592	4
San Luis Obispo	2,866,739	16	3,066,374	16
San Mateo	212,261	41	249,542	41
Santa Barbara	6,185,839	11	4,665,022	11
Santa Clara	906,608	30	954,486	31
Santa Cruz	1,687,988	24	1,743,083	24
Shasta	275,898	40	322,139	37
Sierra	3,307	57	4,937	57
Siskiyou	1,869,645	23	1,846,509	23
Solano	977,358	29	1,170,927	28
Sonoma	2,282,075	20	2,172,032	21
Stanislaus	6,455,449	10	6,905,458	9
Sutter	2,923,149	15	3,182,823	15
Tehama	690,489	32	854,682	32
Trinity	17,651	53	11,977	55
Tulare	14,161,509	3	14,579,963	3
Tuolumne	28,526	52	28,379	50
Ventura	7,604,327	7	6,226,684	10
Yolo	3,208,840	14	3,578,175	14
Yuba	1,129,466	27	1,244,731	27
Total	186,653,951		193,597,806	

Table 2: *Pounds of pesticide active ingredients, 1998 – 2013, by general use categories.*

Year	Production Agriculture	Post Harvest Fumigation	Structural Pest Control	Landscape Maintenance	All Others	Total Pounds
1998	207,925,103	1,760,324	5,931,440	1,407,569	6,874,111	223,898,546
1999	189,264,430	2,059,858	5,673,549	1,412,248	7,908,076	206,318,161
2000	175,718,918	2,167,778	5,187,122	1,414,848	6,854,672	191,343,338
2001	142,935,915	1,462,160	4,922,709	1,290,208	6,324,210	156,935,202
2002	159,182,866	1,852,668	5,469,430	1,449,912	6,834,190	174,789,066
2003	160,997,286	1,785,747	5,177,461	1,975,868	7,526,922	177,463,286
2004	165,867,750	1,874,210	5,120,268	1,612,069	6,995,148	181,469,444
2005	178,300,114	2,260,932	5,625,437	1,775,676	8,517,091	196,479,250
2006	168,568,682	2,216,042	5,273,692	2,286,673	10,269,025	188,614,113
2007	157,383,232	2,279,532	3,967,352	1,672,411	7,337,362	172,639,889
2008	149,339,168	2,540,189	3,202,933	1,589,054	7,237,162	163,908,506
2009	146,973,737	1,479,776	2,911,103	1,344,922	6,015,791	158,725,329
2010	159,842,444	2,164,627	3,699,128	1,734,515	8,023,008	175,463,722
2011	176,953,562	1,429,360	3,153,287	1,722,047	8,610,967	191,869,223
2012	171,442,301	1,131,477	3,466,765	1,552,859	9,060,549	186,653,951
2013	177,814,210	1,441,701	3,800,890	1,438,432	9,102,573	193,597,806

Pesticide Sales in California

Reported pesticide applications are only a portion of the pesticides sold each year. Typically, about two-thirds of the pesticide active ingredients sold in a given year are not subject to use reporting. Examples of non-reported active ingredients are chlorine (used primarily for municipal water treatment) and home-use pesticide products.

There were 603 million pounds of pesticide active ingredients sold in 2012, 619 million pounds sold in 2011, 629 million pounds sold in 2010, 594 million pounds sold in 2009, 713 million pounds sold in 2008, and 678 million pounds sold in 2007. Prior-years data are posted on DPR's Web site at <www.cdpr.ca.gov>, click "A - Z Index," "Sales of pesticides."

4 Trends in Pesticide Use in Certain Pesticide Categories

This report discusses two different measures of pesticide use: amount of active ingredient (AI) applied in pounds and cumulative area treated in acres (for an explanation of cumulative area treated see page 10). Because different AIs are often used at very different rates, the picture of pesticide use may look quite different using the two measures, amount applied and area treated.

Most pesticides are applied at rates of around 1 to 2 pounds per acre. However, some AIs are applied at rates of ounces per acre, while other AIs are applied at rates of hundreds of pounds per acre. This difference can be seen by looking at the use of different non-adjuvant pesticide types (Figures 1 and 2). By amount applied, the most-used pesticide types were fungicide/insecticides (which is mostly sulfur), fumigants, and insecticides. By cumulative area treated the most-used types were insecticides, herbicides, and fungicides. When comparing use among different AIs, area treated is often the more useful measure; using pounds will emphasize pesticides used at high rates, such as fumigants. However, the trends in use for any AI will be very similar regardless of the measure of use.

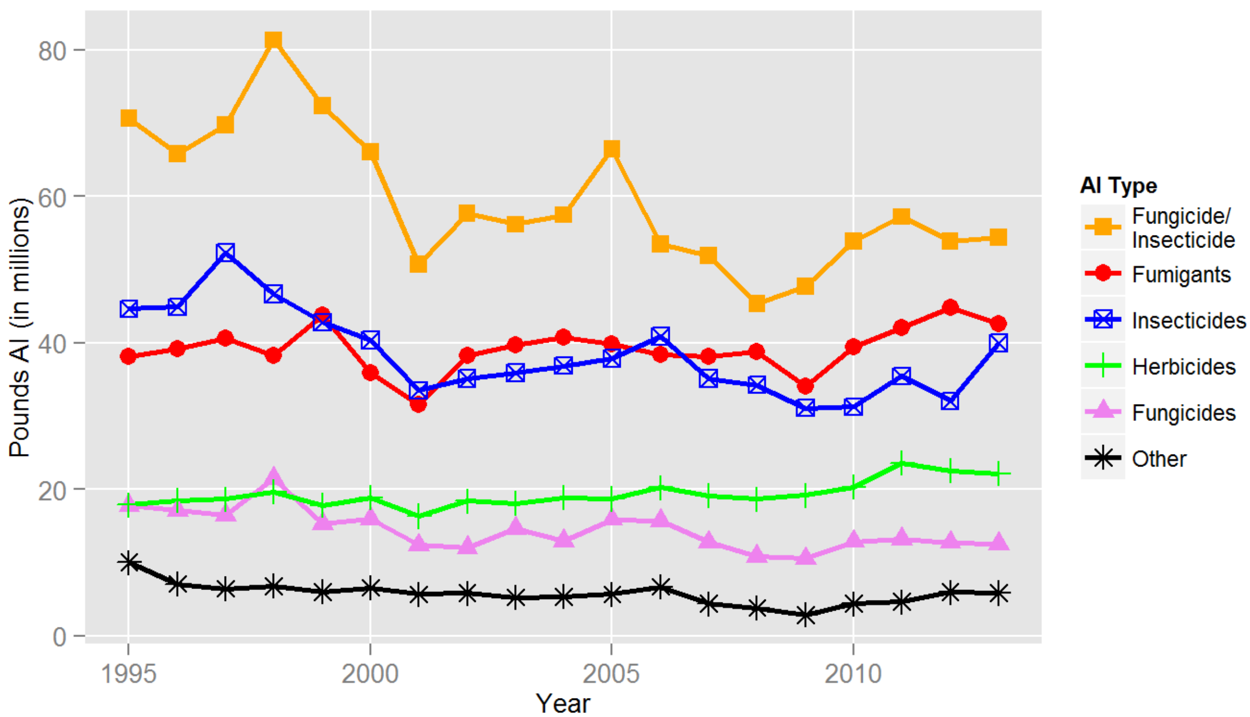

Figure 1: *Pounds of all AIs in the major types of pesticides from 1995 to 2013.*

Reported pesticide use in California in 2013 totaled 194 million pounds, an increase of 6.9 million pounds (3.7 percent) from 2012. Production agriculture, the major category of use subject to reporting requirements, accounted for most of the increase. Applications increased by 6.4 million pounds for production agriculture, 310,000 pounds for post-harvest treatments, and 334,000 pounds for structural pest control. In contrast, there was a 144,000-pound decrease for landscape maintenance. There was a 42,000-pound increase for other reported non-agricultural uses, which includes rights of way, vector control, research, and fumigation of nonfood and nonfeed materials such as lumber and furniture.

The AIs with the largest use amounts were sulfur, petroleum and mineral oils, 1,3-dichloropropene, glyphosate, and metam-potassium (potassium n-methyldithiocarbamate).

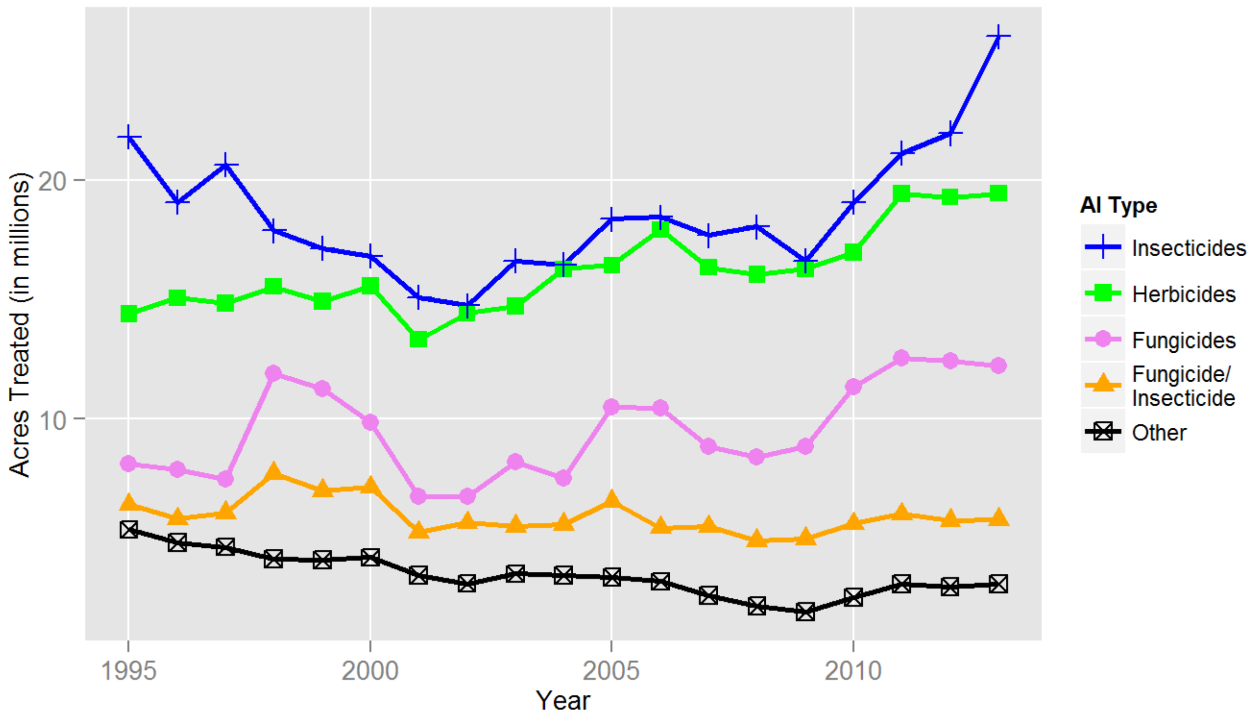

Figure 2: *Acres treated by all AIs in the major types of pesticides from 1995 to 2013.*

The amount of sulfur accounted for 24 percent of all reported pesticide use in 2013.

Reported pesticide use by cumulative area treated in 2013 was 90 million acres, an increase of 5.8 million acres (6.9 percent) from 2012. By this measure the non-adjuvant pesticides with the greatest use in 2013 were glyphosate, sulfur, petroleum and mineral oils, abamectin, and oxyfluorfen (Figures 3 and 4). The most-used fumigant by area treated was aluminum phosphide.

To provide an overview, pesticide use is summarized for eight different pesticide categories from 2005 to 2013 (Tables 3 – 18) and from 1995 to 2013 (Figures 5 – 12). These categories classify pesticides according to certain characteristics such as reproductive toxins, carcinogens, or reduced-risk characteristics. Use of pesticides in these different categories varied from 2012 to 2013. Use of pesticides identified as carcinogens, ground water contaminants, air contaminants, and fumigants decreased, and use of cholinesterase-inhibiting pesticides, oils, and biopesticides increased. Amount of reproductive toxins decreased but the area treated increased. Some of the major changes from 2012 to 2013 include:

- Chemicals classified as reproductive toxins decreased in amount applied from 2012 to 2013 (4.1-million-pound decrease, 30 percent) while increasing in area treated (78,000-acres-treated increase, 2.1 percent; Table 3 on page 21 and Table 4 on page 23). The decrease in pounds was mainly due to less use of the fumigants metam-sodium and

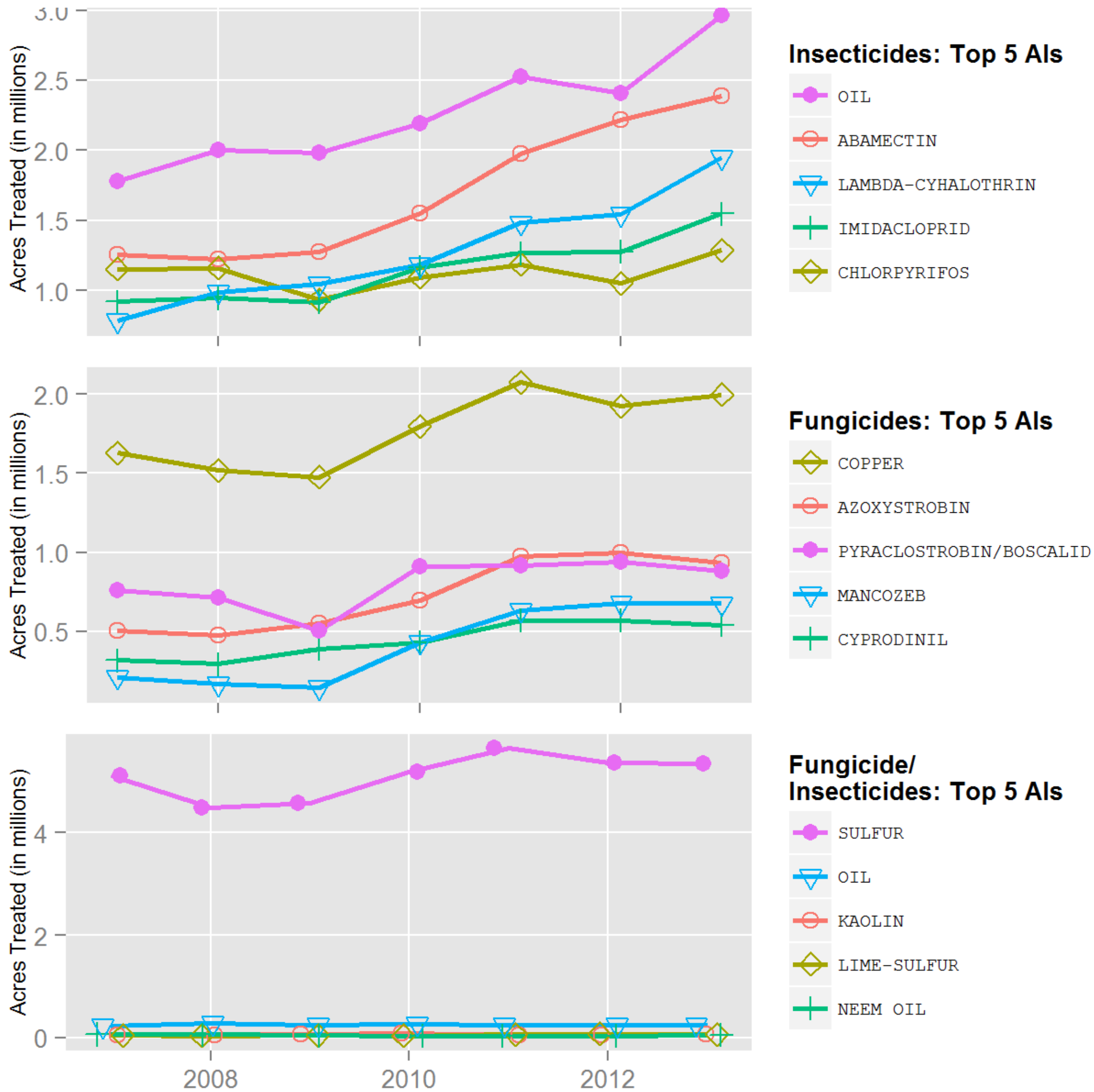

Figure 3: *Acres treated by the top 5 AIs in each of the major types of pesticides from 2007 to 2013.*

methyl bromide. The increase in area was mostly from uses of the miticide/insecticide abamectin (also called avermectin). Pesticides in this category are listed on the State's Proposition 65 list of chemicals "known to cause reproductive toxicity."

- Use of chemicals classified as carcinogens decreased from 2012 to 2013 (1.7-million-pound decrease, 5.1 percent; 334,000-acre decrease, 10 percent; Table 5 on page 26 and Table 6 on page 28). The decrease in amount was mainly due to less use of the fumigant metam-sodium and the decrease in area treated mostly from less use of the herbicides diuron and oryzalin. However, the decrease in amount of metam-sodium applied was accompanied by an increase in amount of the fumigants metam-potassium (potassium n-methyldithiocarbamate) and 1,3-dichloropropene. The pesticides in this category are

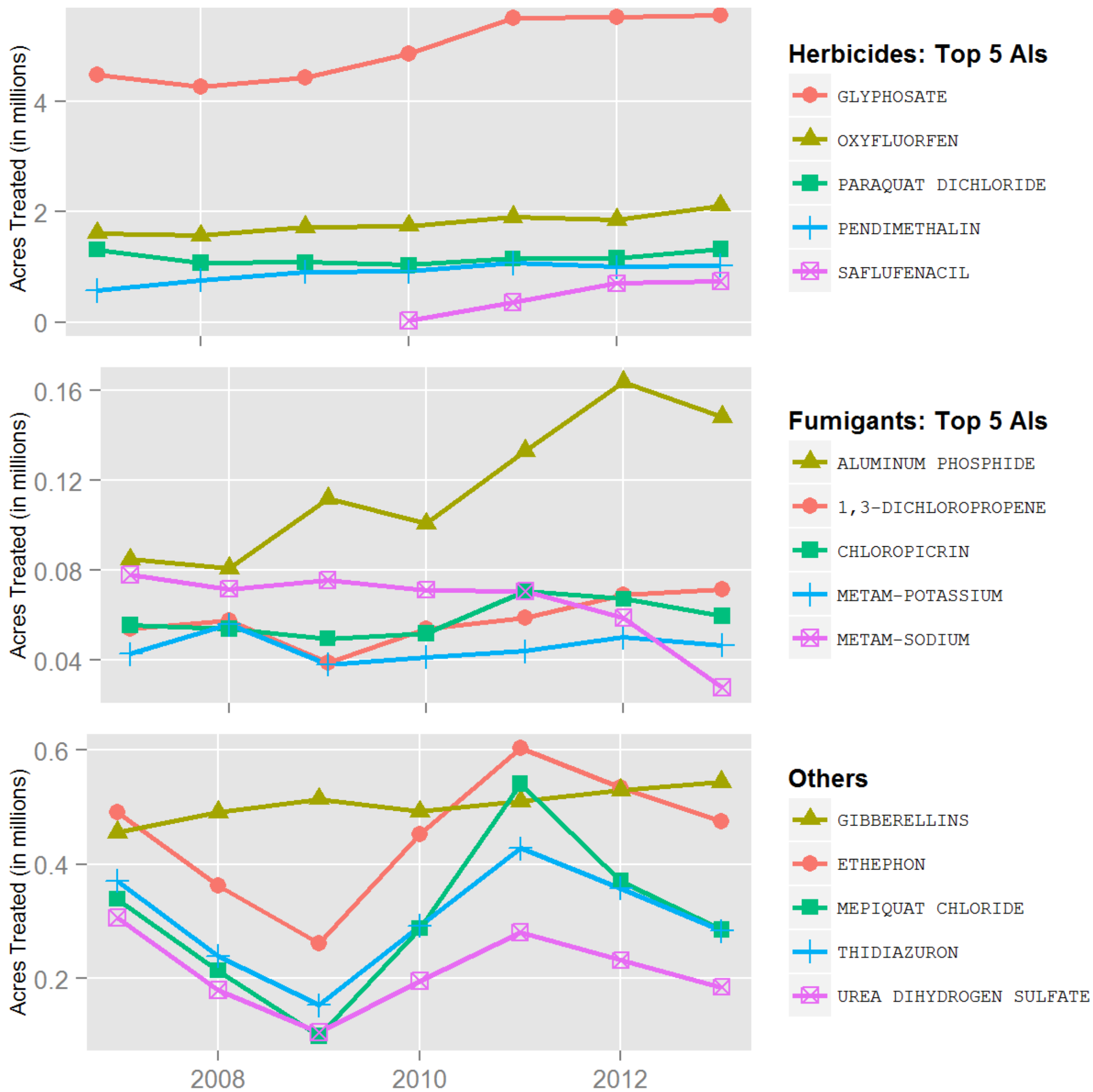

Figure 4: *Acres treated by the top 5 AIs in each of the major types of pesticides from 2007 to 2013.*

listed by U.S. EPA as A or B carcinogens or on the State's Proposition 65 list of chemicals "known to cause cancer."

- Use of cholinesterase-inhibiting pesticides (organophosphate [OP] and carbamate pesticides), which include compounds of high regulatory concern, increased from the previous year (479,000-pound increase, 5.1 percent; 377,000-acre increase, 10 percent; Table 7 on page 31 and Table 8 on page 33). Most of the increase in both amount and area treated was with the insecticide chlorpyrifos. This increase was due largely to high populations of leaffooted bugs and navel orangeworms in almonds. Other AIs with large increases were the insecticides dimethoate, naled, and acephate. Use of ethephon decreased. It is used mostly in cotton and is not a classical organophosphate and has only mild cholinergic potential.

- Use of chemicals categorized as ground water contaminants decreased in both amount and area treated (246,000-pound decrease, 23 percent; 166,000-acre decrease, 19 percent; Table 9 on page 36 and Table 10 on page 37). The decreases were mostly from less use of the herbicides diuron, simazine, bromacil, and norflurazon.

- Use of chemicals categorized as toxic air contaminants decreased (2.4-million-pound decrease, 4.9 percent; 162,000-acre decrease, 6.4 percent; Table 11 on page 39 and Table 12 on page 42). By pounds, most toxic air contaminants are fumigants which are used at high rates. The decrease was mainly from decreased uses of the fumigants metam-sodium, chloropicrin, and methyl bromide.

- Use of fumigant chemicals applied decreased in both amount and area treated (2.2-million-pound decrease, 4.9 percent; 52,000-acre decrease, 13 percent; Table 13 on page 46 and Table 14 on page 47). The largest decreases in amount were in metam-sodium, chloropicrin, and methyl bromide, and the largest decreases in area treated were metam-sodium and aluminum phosphide. Fumigants with increased amounts include metam-potassium and 1,3-dicloropropene. However, area treated with metam-potassium decreased.

- Use of oil pesticides increased in both amount and area treated (7.1-million-pound increase, 25 percent; 508,000-acre increase, 13 percent; Table 15 on page 49 and Table 16 on page 50). Oils include many different chemicals, but the category used here includes only those derived from petroleum distillation. Some of these oils may be on the State's Proposition 65 list of chemicals "known to cause cancer" but most serve as alternatives to other pesticides. Oils are also used by organic growers.

- Use of biopesticides increased in both amount and area treated (653,000-pound increase, 17 percent; 870,000-acre treated increase, 16 percent; Table 17 on page 52 and Table 18 on page 60). Use of most biopesticide AIs increased. The most-used biopesticide AI by amount was kaolin and it also accounted for most of the increase in amount. Citric acid, propylene glycol, and ammonium nitrate were the most-used biopesticides by area treated and accounted for most of the increase in area treated. Kaolin is used both as a fungicide and an insecticide and citric acid, propylene glycol, and ammonium nitrate are used as adjuvants. In general, biopesticides are derived from or synthetically mimic natural materials such as animals, plants, bacteria and minerals and fall into three major classes: microbial, plant-incorporated protectant, or naturally occurring substances that control pests by non-toxic mechanisms.

Since 1990, the reported pounds of pesticides applied have fluctuated from year to year. An increase or decrease in use from one year to the next or in the span of a few years does not necessarily indicate a general trend in use; it simply may reflect variations related to various factors (e.g. climate or economic changes). Short periods of time (three to five years) may suggest trends, such as the increased pesticide use from 2001 to 2005 or the decreased use from 2005 to 2009. However, regression analyses on use from 1996 to 2013 do not indicate a significant trend of either increase or decrease in total pesticide use.

To improve data quality when calculating the total pounds of pesticides, DPR excluded values that were so large they were probably in error. The procedure to exclude probable errors involved the development of complex error-checking algorithms, a data improvement process that is ongoing.

Over-reporting errors have a much greater impact on the numerical accuracy of the database than under-reporting errors. For example, if a field is treated with 100 pounds of a pesticide AI and the application is erroneously recorded as 100,000 pounds (a decimal point shift of three places to the right), an error of 99,900 pounds is introduced into the database. If the same degree of error is made in shifting the decimal point to the left, the application is recorded as 0.1 pound, and an error of 99.9 pounds is entered into the database.

The summaries detailed in the following use categories are not intended to serve as indicators of pesticide risks to the public or the environment. Rather, the data supports DPR regulatory functions to enhance public safety and environmental protection. (See "Continuous Evaluation of Pesticides" on page 1.)

USE TRENDS OF PESTICIDES ON THE STATE’S PROPOSITION 65 LIST OF CHEMICALS THAT ARE “KNOWN TO CAUSE REPRODUCTIVE TOXICITY.”

Table 3: *The reported pounds of pesticides used that are on the State’s Proposition 65 list of chemicals that are “known to cause reproductive toxicity.” Use includes both agricultural and reportable non-agricultural applications. Data are from the Department of Pesticide Regulation’s Pesticide Use Reports.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
1080	<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4-DB ACID	11,722	9,733	9,185	11,416	13,523	4,570	55	5,826	6,452
ABAMECTIN	9,817	10,941	12,362	12,846	16,640	19,348	26,700	32,878	39,828
AMITRAZ	0	12	0	0	7	0	0	0	1,486
ARSENIC PENTOXIDE	180,505	474,517	7,805	7,433	400	16,144	8,034	9,240	8,480
ARSENIC TRIOXIDE	<1	<1	<1	<1	<1	<1	<1	<1	0
BENOMYL	948	898	590	100	56	31	28	32	3
BROMACIL, LITHIUM SALT	1,059	2,529	1,172	1,851	896	1,835	1,486	1,422	1,145
BROMOXYNIL OCTANOATE	34,481	37,406	41,406	65,375	50,396	43,643	47,810	56,495	49,013
CARBARYL	190,633	156,997	142,010	126,742	136,141	113,160	74,944	113,900	113,773
CYANAZINE	7	0	0	0	0	0	1	<1	0
CYCLOATE	40,092	41,488	31,868	21,242	25,284	27,292	31,037	33,585	30,619
DICLOFOP-METHYL	1,413	174	157	0	15	0	7	0	0
DINOCAP	2	2	2	2	2	0	<1	0	0
DINOSEB	131	213	81	166	816	26	75	60	22
DIOCTYL PHTHALATE	708	1,016	610	340	186	453	248	262	196
DISODIUM CYANODITHIOIMIDO CARBONATE	0	0	0	0	0	0	0	80	<1
EPTC	181,825	108,228	152,707	129,470	128,993	118,509	126,059	167,166	170,146
ETHYLENE GLYCOL MONOMETHYL ETHER	2,546	4,186	2,653	1,986	2,257	5,187	4,324	3,782	6,202
ETHYLENE OXIDE	0	0	2	3	7	0	0	8	0
FENOXAPROP-ETHYL	161	196	153	219	11	<1	8	0	0
FLUAZIFOP-BUTYL	41	26	5	3	21	11	8	6	17
FLUAZIFOP-P-BUTYL	11,638	11,104	10,192	11,287	7,958	9,542	9,075	10,457	19,976
HYDRAMETHYLNON	1,381	1,231	887	825	393	609	1,096	485	444
LINURON	72,093	59,164	58,592	60,247	51,448	48,424	54,530	57,630	52,323
METAM-SODIUM	12,991,279	11,422,382	9,929,803	9,497,379	9,358,576	11,153,177	10,861,059	8,428,341	4,805,237
METHYL BROMIDE	6,509,322	6,542,161	6,448,643	5,693,325	5,627,502	4,809,251	4,014,310	3,990,028	3,522,030
METIRAM	0	<1	0	0	0	0	15	34	17
MOLINATE	171,362	141,421	75,241	19,653	12,516	24	<1	3	<1
MYCLOBUTANIL	84,102	74,365	68,403	61,550	59,057	65,604	65,404	64,441	60,869
NABAM	30,440	23,414	9,073	9,635	8,963	10,518	13,358	13,485	22,187
NICOTINE	2	<1	<1	<1	<1	<1	7	<1	0
NITRAPYRIN	171	0	9	0	84	211	0	<1	2
OXADIAZON	13,825	11,714	12,517	9,402	8,741	12,382	7,782	7,265	6,701

Table 3: (continued) *The reported pounds of pesticides used that are on the State's Proposition 65 list of chemicals that are "known to cause reproductive toxicity."*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
OXYDEMETON-METHYL	122,433	119,891	122,723	111,612	68,576	71,290	26,017	17,619	10,656
OXYTHIOQUINOX	8	90	166	170	45	6	<1	1	<1
POTASSIUM DIMETHYL DITHIO CARBAMATE	0	0	0	0	<1	0	0	0	0
PROPARGITE	1,010,039	580,630	537,439	389,492	380,651	295,309	296,384	252,510	284,365
RESMETHRIN	958	676	452	269	211	206	122	46	49
SODIUM DIMETHYL DITHIO CARBAMATE	30,440	23,414	9,073	9,800	8,963	11,053	13,358	13,485	22,187
STREPTOMYCIN SULFATE	7,862	7,598	5,809	4,394	3,233	4,040	4,651	4,053	4,793
TAU-FLUVALINATE	1,166	1,104	1,028	1,068	1,179	869	834	1,086	1,048
THIOPHANATE-METHYL	159,957	114,191	99,497	74,903	89,882	115,025	87,601	109,615	103,226
TRIADIMEFON	1,918	1,116	873	1,503	1,056	2,153	1,940	2,423	1,609
TRIBUTYLTIN METHACRYLATE	0	0	0	0	0	0	0	0	1
TRIFORINE	137	452	64	69	4	42	22	2	4
VINCLOZOLIN	3,574	402	392	512	476	217	328	464	126
WARFARIN	1	9	1	<1	<1	1	2	2	1
TOTAL	21,880,199	19,985,093	17,793,649	16,336,288	16,065,167	16,960,163	15,778,718	13,398,216	9,345,233

Table 4: *The reported cumulative acres treated with pesticides that are on the State's Proposition 65 list of chemicals that are "known to cause reproductive toxicity." Use includes primarily agricultural applications. The grand total for acres treated may be less than the sum of acres treated for all active ingredients because some products contain more than one active ingredient. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
1080	41	22	170	<1	67	176	127	<1	111
2,4-DB ACID	18,597	16,303	15,080	19,457	21,629	6,980	121	11,301	11,350
ABAMECTIN	1,076,948	1,131,758	1,257,542	1,225,216	1,278,250	1,552,520	1,980,024	2,220,165	2,390,252
AMITRAZ	0	<1	0	0	74	0	0	0	348
ARSENIC PENTOXIDE	<1	<1	<1	<1	<1	<1	<1	<1	<1
ARSENIC TRIOXIDE	1	<1	<1	<1	<1	<1	<1	<1	0
BENOMYL	2,789	1,674	568	221	162	0	26	19	1
BROMACIL, LITHIUM SALT	<1	<1	<1	<1	<1	<1	<1	<1	<1
BROMOXYNIL OCTANOATE	120,175	134,283	136,831	186,026	146,561	125,926	139,567	153,503	130,822
CARBARYL	99,086	87,789	97,016	96,136	107,934	80,082	68,272	97,177	96,554
CYANAZINE	8	0	0	0	0	0	4	<1	0
CYCLOATE	19,319	19,886	15,601	10,581	12,058	13,799	14,895	17,581	16,045
DICLOFOP-METHYL	729	186	224	0	30	0	20	0	0
DINOCAP	7	9	8	7	7	0	1	0	0
DINOSEB	310	72	16	453	304	111	427	81	55
DIOCTYL PHTHALATE	13,858	13,231	13,258	3,582	4,928	7,921	4,741	5,311	3,164
DISODIUM CYANODITHIOIMIDO CARBONATE	0	0	0	0	0	0	0	235	<1
EPTC	64,263	38,871	51,706	45,560	49,708	44,289	47,805	56,297	64,166
ETHYLENE GLYCOL MONOMETHYL ETHER	16,655	25,655	26,412	14,857	14,573	35,802	37,642	35,682	34,566
ETHYLENE OXIDE	0	0	<1	2	60	0	0	<1	0
FENOXAPROP-ETHYL	3,247	3,418	2,552	3,444	142	<1	61	0	0
FLUAZIFOP-BUTYL	3	<1	<1	6	2	80	<1	<1	40
FLUAZIFOP-P-BUTYL	35,348	34,591	31,920	31,045	25,663	27,917	27,077	35,810	56,117
HYDRAMETHYLNON	1,990	657	931	1,138	1,280	4,689	1,514	6,876	1,376
LINURON	101,987	81,535	81,041	81,244	68,750	68,058	77,029	81,948	72,560
METAM-SODIUM	97,562	102,451	78,030	71,815	75,735	71,407	70,875	58,998	27,986
METHYL BROMIDE	45,700	50,677	45,675	35,685	40,250	32,235	46,780	28,886	26,578
METIRAM	0	1	0	0	0	0	<1	<1	<1
MOLINATE	40,535	33,045	17,476	4,529	2,942	6	<1	<1	3
MYCLOBUTANIL	699,773	644,490	599,368	545,175	512,918	588,750	568,545	574,138	533,869
NABAM	<1	<1	2	1	3	12	<1	<1	<1
NICOTINE	3	<1	<1	<1	<1	<1	<1	<1	0
NITRAPYRIN	143	0	35	0	88	111	0	<1	1
OXADIAZON	2,209	2,144	2,991	2,747	1,451	1,712	927	1,159	1,489
OXYDEMETON-METHYL	173,480	164,094	161,835	140,760	82,368	86,131	27,447	18,204	12,163
OXYTHIOQUINOX	14	10	9	5	4	4	1	1	<1

Table 4: (continued) *The reported cumulative acres treated with pesticides that are on the State's Proposition 65 list of chemicals that are "known to cause reproductive toxicity."*

AI	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
POTASSIUM DIMETHYL DITHIO CARBAMATE	0	0	0	0	<1	0	0	0	0
PROPARGITE	519,412	287,261	261,953	186,581	174,063	137,106	142,352	114,331	119,619
RESMETHRIN	1	1	18	3	11	<1	6	4	436
SODIUM DIMETHYL DITHIO CARBAMATE	<1	<1	2	1	3	12	<1	<1	<1
STREPTOMYCIN SULFATE	52,061	57,295	38,468	27,011	24,453	28,966	39,190	34,894	37,996
TAU-FLUVALINATE	5,879	5,438	4,777	5,708	5,015	4,583	5,058	5,004	5,360
THIOPHANATE-METHYL	135,296	108,408	100,011	71,867	92,429	122,563	85,761	123,995	120,130
TRIADIMEFON	8,585	2,949	1,806	2,043	1,007	1,172	2,469	1,339	904
TRIBUTYLTIN METHACRYLATE	0	0	0	0	0	0	0	0	<1
TRIFORINE	181	102	373	11	10	22	3	<1	<1
VINCLOZOLIN	3,899	440	258	212	85	86	100	34	11
WARFARIN	430	473	3,165	1,118	365	290	1,290	3,115	381
TOTAL	3,360,524	3,049,219	3,047,123	2,814,244	2,745,380	3,043,506	3,390,156	3,686,090	3,764,452

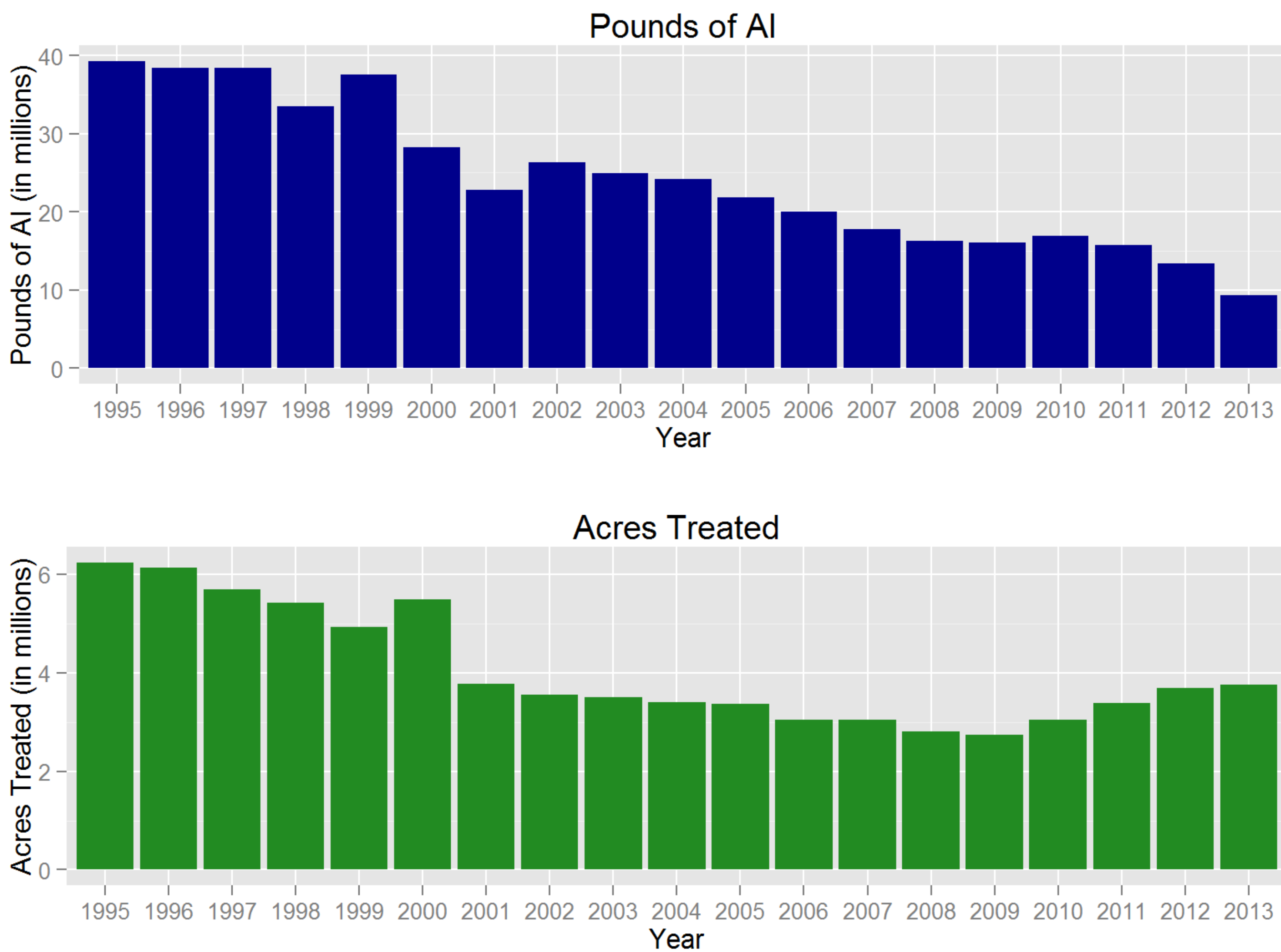

Figure 5: *Use trends of pesticides that are on the State's Proposition 65 list of chemicals that are "known to cause reproductive toxicity." Reported pounds of active ingredient (AI) applied include both agricultural and non-agricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

USE TRENDS OF PESTICIDES LISTED BY U.S. EPA AS A or B CARCINOGENS OR ON THE STATE'S PROPOSITION 65 LIST OF CHEMICALS THAT ARE "KNOWN TO CAUSE CANCER."

Table 5: *The reported pounds of pesticides used that are listed by U.S. EPA as A or B carcinogens or on the State's Proposition 65 list of chemicals that are "known to cause cancer." Use includes both agricultural and reportable non-agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1,3-DICHLOROPROPENE	9,355,308	8,735,190	9,595,625	9,706,640	6,450,106	8,777,092	10,910,167	11,863,992	12,917,296
ACIFLUORFEN, SODIUM SALT	<1	0	0	0	0	<1	0	<1	<1
ALACHLOR	21,052	13,740	3,911	4,343	6,362	9,936	9,294	9,036	6,562
ARSENIC ACID	68	3	0	0	0	0	17	0	0
ARSENIC PENTOXIDE	180,505	474,517	7,805	7,433	400	16,144	8,034	9,240	8,480
ARSENIC TRIOXIDE	<1	<1	<1	<1	<1	<1	<1	<1	0
CACODYLIC ACID	131	20	41	43	<1	3	<1	<1	0
CAPTAN	472,744	510,661	456,475	362,757	329,747	450,225	376,505	403,739	349,994
CARBARYL	190,633	156,997	142,010	126,742	136,141	113,160	74,944	113,900	113,773
CHLOROTHALONIL	765,159	824,949	736,173	566,773	715,972	957,277	1,148,079	1,181,048	1,110,415
CHROMIC ACID	252,176	662,927	10,904	10,384	559	22,555	11,224	12,908	11,847
CREOSOTE	<1	0	3	<1	<1	0	0	0	3
DAMINOZIDE	8,882	7,812	7,192	7,094	6,570	9,361	8,451	8,250	8,528
DDVP	4,914	6,577	6,376	6,859	4,164	4,169	5,164	4,630	4,613
DIOCTYL PHTHALATE	708	1,016	610	340	186	453	248	262	196
DIPROPYL ISOCINCHOMERONATE	<1	52	2	<1	<1	1	1	<1	<1
DIURON	957,462	1,054,075	860,510	734,757	623,001	588,572	674,531	554,594	412,544
ETHOPROP	18,924	24,485	24,241	26,897	20,793	5,645	7,475	2,077	2,434
ETHYLENE OXIDE	0	0	2	3	7	0	0	8	0
FENOXYCARB	30	8	4	8	5	3	3	2	1
FOLPET	<1	<1	0	<1	0	<1	0	<1	<1
FORMALDEHYDE	48,968	73,392	47,733	24,306	3,972	5,511	4,615	3,847	11,165
IMAZALIL	30,480	21,624	14,421	23,415	13,255	26,181	25,767	25,960	25,315
IPRODIONE	291,299	304,219	255,123	252,212	249,157	349,072	353,654	297,747	256,548
LINDANE	40	379	2	21	8	18	1	0	2
MANCOZEB	643,194	662,040	408,652	330,238	282,587	755,101	1,045,668	1,130,426	1,150,600
MANEB	1,135,698	1,181,738	1,061,028	861,006	657,090	370,333	53,869	6,260	1,497
METAM-SODIUM	12,991,279	11,422,382	9,929,803	9,497,379	9,358,576	11,153,177	10,861,059	8,428,341	4,805,237
METHYL IODIDE	0	0	0	0	0	0	1,157	21	0
METIRAM	0	<1	0	0	0	0	15	34	17
NITRAPYRIN	171	0	9	0	84	211	0	<1	2
ORTHO-PHENYLPHENOL	9,482	2,083	5,128	4,389	2,133	2,271	2,582	2,964	1,713
ORTHO-PHENYLPHENOL, SODIUM SALT	4,979	6,948	2,266	3,211	2,294	2,129	5,192	3,586	4,375
ORYZALIN	704,971	1,008,320	664,266	604,932	529,664	602,260	768,824	686,105	586,540
OXADIAZON	13,825	11,714	12,517	9,402	8,741	12,382	7,782	7,265	6,701

Table 5: (continued) *The reported pounds of pesticides used that are listed by U.S. EPA as A or B carcinogens or on the State's Proposition 65 list of chemicals that are "known to cause cancer."*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
OXYTHIOQUINOX	8	90	166	170	45	6	<1	1	<1
PARA-DICHLOROBENZENE	139	0	15	1	17	0	<1	18	<1
PENTACHLOROPHENOL	3	27	22	4	0	3	18	224	274
POTASSIUM DICHROMATE	40	0	0	0	0	0	0	0	<1
POTASSIUM N-METHYLDITHIOCARBAMATE	1,994,072	3,202,884	3,785,436	5,524,647	4,128,181	4,832,615	5,673,371	8,320,255	9,484,467
PROPARGITE	1,010,039	580,630	537,439	389,492	380,651	295,309	296,384	252,510	284,365
PROPOXUR	220	212	191	188	202	298	808	359	373
PROPYLENE OXIDE	147,489	133,028	110,068	105,600	111,609	300,008	421,562	346,785	400,183
PROPYZAMIDE	116,967	121,711	114,882	104,077	73,811	51,384	49,678	47,273	42,069
SODIUM DICHROMATE	0	0	0	0	0	0	0	0	0
TERRAZOLE	750	946	872	1,534	1,140	1,500	642	503	390
THIODICARB	1,872	894	686	410	511	152	472	145	156
VINCLOZOLIN	3,574	402	392	512	476	217	328	464	126
TOTAL	31,378,258	31,208,688	28,803,004	29,298,216	24,098,219	29,714,734	32,807,584	33,724,777	32,008,801

Table 6: *The reported cumulative acres treated with pesticides that are listed by U.S. EPA as A or B carcinogens or on the State's Proposition 65 list of chemicals that are "known to cause cancer." Use includes primarily agricultural applications. The grand total for acres treated may be less than the sum of acres treated for all active ingredients because some products contain more than one active ingredient. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
1,3-DICHLOROPROPENE	51,486	49,885	53,937	57,922	38,848	54,049	59,059	69,198	71,747
ACIFLUORFEN, SODIUM SALT	<1	0	0	0	0	<1	0	<1	<1
ALACHLOR	7,935	5,192	1,500	1,635	2,261	3,276	3,385	3,411	2,670
ARSENIC ACID	<1	<1	0	0	0	0	<1	0	0
ARSENIC PENTOXIDE	<1	<1	<1	<1	<1	<1	<1	<1	<1
ARSENIC TRIOXIDE	1	<1	<1	<1	<1	<1	<1	<1	0
CACODYLIC ACID	82	121	<1	<1	<1	<1	<1	<1	0
CAPTAN	252,040	262,936	215,864	198,262	173,133	245,464	209,967	209,614	188,080
CARBARYL	99,086	87,789	97,016	96,136	107,934	80,082	68,272	97,177	96,554
CHLOROTHALONIL	418,600	438,373	389,497	292,385	378,600	490,626	588,420	571,059	528,594
CHROMIC ACID	<1	<1	<1	<1	<1	<1	<1	<1	<1
CREOSOTE	<1	0	1	1	2	0	0	0	<1
DAMINOZIDE	2,376	2,220	2,291	2,471	2,111	4,357	2,441	2,981	2,508
DDVP	7,445	1,526	2,733	2,231	2,685	1,880	5,184	6,528	5,590
DIOCTYL PHTHALATE	13,858	13,231	13,258	3,582	4,928	7,921	4,741	5,311	3,164
DIPROPYL ISOCINCHOMERONATE	1	18	<1	<1	<1	19	<1	<1	<1
DIURON	894,073	886,032	702,939	514,554	405,973	517,589	691,371	555,454	439,903
ETHOPROP	4,296	4,815	4,283	4,159	4,293	1,348	1,892	541	656
ETHYLENE OXIDE	0	0	<1	2	60	0	0	<1	0
FENOXYCARB	1,398	828	210	489	353	100	106	110	37
FOLPET	<1	<1	0	<1	0	<1	0	<1	<1
FORMALDEHYDE	2	265	57	67	5	1	6	4	52
IMAZALIL	<1	<1	<1	668	<1	26	2	<1	<1
IPRODIONE	450,354	468,465	412,699	436,226	434,812	577,628	638,561	529,976	478,150
LINDANE	557	9	0	37	10	31	1	0	<1
MANCOZEB	370,266	348,360	212,349	169,422	146,402	432,118	634,445	678,937	676,800
MANEB	730,254	675,941	655,235	558,506	471,837	290,266	40,464	4,559	1,592
METAM-SODIUM	97,562	102,451	78,030	71,815	75,735	71,407	70,875	58,998	27,986
METHYL IODIDE	0	0	0	0	0	0	278	37	0
METIRAM	0	1	0	0	0	0	<1	<1	<1
NITRAPYRIN	143	0	35	0	88	111	0	<1	1
ORTHO-PHENYLPHENOL	429	65	149	22	49	58	117	85	176
ORTHO-PHENYLPHENOL, SODIUM SALT	<1	<1	<1	<1	<1	<1	<1	<1	46
ORYZALIN	359,076	400,237	313,343	272,273	236,567	217,193	294,478	263,603	203,529
OXADIAZON	2,209	2,144	2,991	2,747	1,451	1,712	927	1,159	1,489
OXYTHIOQUINOX	14	10	9	5	4	4	1	1	<1
PARA-DICHLOROBENZENE	<1	0	<1	0	<1	<1	<1	<1	<1

Table 6: (continued) *The reported cumulative acres treated with pesticides that are listed by U.S. EPA as A or B carcinogens or on the State's Proposition 65 list of chemicals that are "known to cause cancer."*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
PENTACHLOROPHENOL	3	0	10	46	0	4	1	15	170
POTASSIUM DICHROMATE	10	0	0	0	0	0	0	0	<1
POTASSIUM N-METHYLDITHIOCARBAMATE	19,670	27,299	42,988	56,009	38,277	41,444	44,078	50,361	46,861
PROPARGITE	519,412	287,261	261,953	186,581	174,063	137,106	142,352	114,331	119,619
PROPOXUR	8	2	<1	10	356	<1	3	<1	4
PROPYLENE OXIDE	185	20	<1	12	<1	<1	<1	288	9
PROPYZAMIDE	148,376	153,045	148,399	133,426	102,176	69,328	61,014	57,625	51,993
SODIUM DICHROMATE	0	0	0	0	0	0	0	0	0
TERRAZOLE	495	884	879	1,419	711	5,107	443	579	412
THIODICARB	2,965	1,293	1,196	673	680	192	656	206	247
VINCLOZOLIN	3,899	440	258	212	85	86	100	34	11
TOTAL	4,458,007	4,221,157	3,614,111	3,064,004	2,804,493	3,250,531	3,563,640	3,282,183	2,948,605

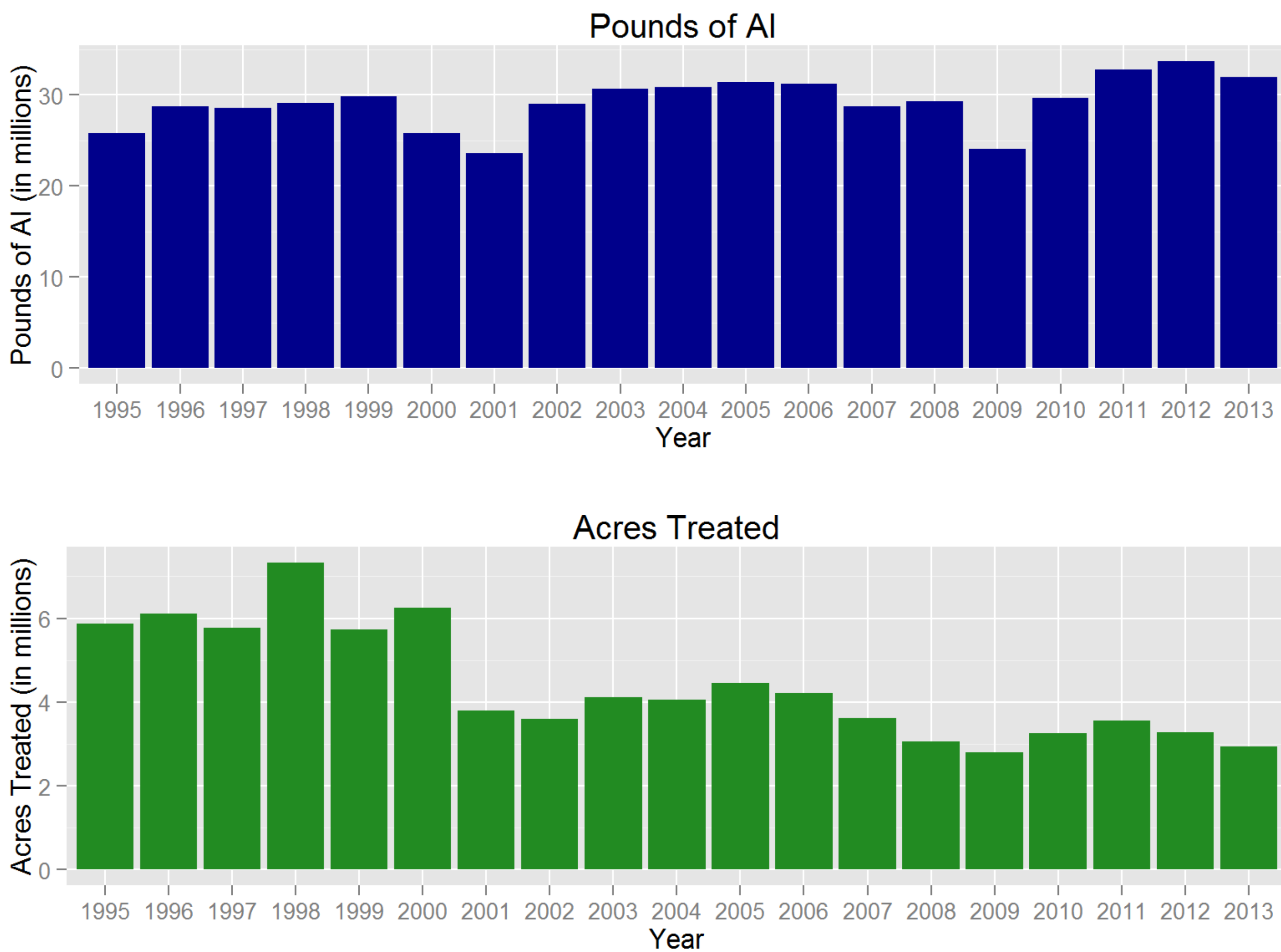

Figure 6: *Use trends of pesticides that are listed by U.S. EPA as A or B carcinogens or on the State's Proposition 65 list of chemicals that are "known to cause cancer." Reported pounds of active ingredient (AI) applied include both agricultural and non-agricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

USE TRENDS OF CHOLINESTERASE-INHIBITING PESTICIDES.

Table 7: *The reported pounds of pesticides used that are cholinesterase-inhibiting pesticides. These pesticides are organophosphate and carbamate active ingredients. Use includes both agricultural and reportable non-agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
3-IODO-2-PROPYNYL BUTYLCARBAMATE	0	0	0	0	<1	2,675	102	<1	<1
ACEPHATE	195,704	167,705	143,073	152,303	112,562	134,993	152,560	130,432	184,789
ALDICARB	231,322	176,624	115,475	75,767	31,579	64,626	24,167	1,489	1,487
AZINPHOS-METHYL	55,183	38,775	25,418	16,269	13,913	1,619	1,582	1,232	32
BENDIOCARB	6	2	8	2	<1	1	3	3	2
BENSULIDE	247,767	288,048	259,548	244,526	247,733	271,835	288,424	267,032	284,152
BUTYLATE	9,923	2,671	945	27	0	299	0	0	88
CARBARYL	190,633	156,997	142,010	126,742	136,141	113,160	74,944	113,900	113,773
CARBOFURAN	28,093	25,790	25,467	16,389	10,117	4	1	0	0
CHLORPROPHAM	2,825	3,704	1,532	4,384	4,675	6,990	3,093	2,969	27,446
CHLORPYRIFOS	2,031,348	1,928,989	1,442,521	1,368,568	1,248,584	1,288,733	1,300,202	1,104,428	1,460,672
COUMAPHOS	1	3	<1	0	0	<1	3	3	14
CYCLOATE	40,092	41,488	31,868	21,242	25,284	27,292	31,037	33,585	30,619
DDVP	4,914	6,577	6,376	6,859	4,164	4,169	5,164	4,630	4,613
DEMETON	1	<1	1	0	2	0	0	0	0
DESMEDIPHAM	4,169	2,954	1,905	1,598	1,257	1,385	1,345	1,408	989
DIAZINON	403,996	386,244	353,098	258,544	142,061	126,804	86,647	78,520	61,643
DICROTOPHOS	2	6	0	0	0	0	0	0	0
DIMETHOATE	312,144	294,736	315,358	292,119	251,926	210,128	225,672	182,890	264,761
DISULFOTON	32,349	22,601	24,558	8,028	10,233	9,085	4,351	5,479	1,924
EPTC	181,825	108,228	152,707	129,470	128,993	118,509	126,059	167,166	170,146
ETHEPHON	643,450	587,954	430,522	296,421	207,894	373,491	548,892	484,245	396,665
ETHION	261	13	0	2	28	72	<1	44	0
ETHOPROP	18,924	24,485	24,241	26,897	20,793	5,645	7,475	2,077	2,434
FENAMIPHOS	46,336	33,511	39,677	17,482	11,493	8,978	2,964	5,254	2,244
FENTHION	15	2	4	4	9	4	<1	0	0
FONOFOS	15	0	0	1	0	<1	0	0	0
FORMETANATE HYDROCHLORIDE	30,761	33,738	34,127	44,704	32,670	30,313	20,952	20,446	26,741
MALATHION	426,416	411,505	468,614	484,322	532,321	560,117	511,994	403,690	438,983
METHAMIDOPHOS	37,865	30,570	18,867	24,224	17,934	9,664	6,037	<1	55
METHIDATHION	48,857	56,691	45,666	47,203	47,319	51,190	29,545	23,396	6,375
METHIOCARB	2,460	1,798	1,767	2,068	3,093	3,506	2,710	3,783	3,678
METHOMYL	349,785	318,089	307,169	251,382	221,248	231,690	219,965	273,328	260,410
METHYL PARATHION	79,000	84,785	75,385	34,110	25,770	21,427	22,970	25,409	21,520
MEVINPHOS	160	18	30	4	9	24	118	3	<1
MEVINPHOS, OTHER RELATED	107	12	20	3	6	16	79	2	0
MEXACARBATE	0	0	0	0	0	0	0	0	1

Table 7: (continued) *The reported pounds of pesticides used that are cholinesterase-inhibiting pesticides. These pesticides are organophosphate and carbamate active ingredients.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
MOLINATE	171,362	141,421	75,241	19,653	12,516	24	<1	3	<1
MONOCROTOPHOS	0	0	0	0	0	0	0	0	0
NALED	225,863	196,369	132,528	172,658	162,530	174,280	199,203	153,063	208,918
O,O-DIMETHYL O-(4-NITRO-M-TOLYL) PHOSPHOROTHIOATE	0	<1	0	0	0	0	0	0	0
OXAMYL	153,432	123,109	45,096	100,000	48,994	118,048	136,967	52,112	72,933
OXYDEMETON-METHYL	122,433	119,891	122,723	111,612	68,576	71,290	26,017	17,619	10,656
PARATHION	855	1,542	479	33	118	285	241	370	6
PEBULATE	1,154	210	441	68	0	0	0	0	0
PHENMEDIPHAM	5,419	4,046	2,841	2,305	2,516	2,448	2,087	1,985	1,166
PHORATE	48,981	38,066	33,776	32,408	17,686	14,775	46,430	61,545	30,861
PHOSALONE	0	0	0	0	0	0	0	0	0
PHOSMET	547,822	628,892	424,874	341,422	132,647	115,008	95,776	53,587	60,829
POTASSIUM DIMETHYL DITHIO CARBAMATE	0	0	0	0	<1	0	0	0	0
PROFENOFOS	23,924	20,885	3,638	216	0	1,552	0	58	0
PROPAMOCARB HYDROCHLORIDE	0	364	137,589	116,725	106,078	99,482	92,304	107,086	94,316
PROPETAMPHOS	148	207	136	116	352	213	139	171	127
PROPOXUR	220	212	191	188	202	298	808	359	373
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	100,225	78,084	45,757	16,335	8,161	18,427	30,328	21,820	19,077
SODIUM DIMETHYL DITHIO CARBAMATE	30,440	23,414	9,073	9,800	8,963	11,053	13,358	13,485	22,187
SULFOTEP	17	1	7	4	2	0	1	0	0
SULPROFOS	0	0	0	0	0	0	0	0	0
TEMEPHOS	1,102	803	1,173	684	83	99	34	17	8
TETRACHLORVINPHOS	788	1,203	667	1,012	1,306	1,086	912	665	2,654
THIOBENCARB	448,208	310,352	289,046	263,499	320,643	258,402	246,927	280,678	289,684
THIODICARB	1,872	894	686	410	511	152	472	145	156
TRIALLATE	0	0	0	0	0	879	2,671	819	1,371
TRICHLORFON	1,222	1,003	336	961	25	34	40	29	25
TOTAL	7,542,195	6,926,282	5,814,258	5,141,773	4,381,719	4,566,278	4,593,775	4,102,458	4,581,602

Table 8: *The reported cumulative acres treated with pesticides that are cholinesterase-inhibiting pesticides. These pesticides are organophosphate and carbamate active ingredients. Use includes primarily agricultural applications. The grand total for acres treated may be less than the sum of acres treated for all active ingredients because some products contain more than one active ingredient. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
3-IODO-2-PROPYNYL BUTYLCARBAMATE	0	0	0	0	0	<1	<1	<1	<1
ACEPHATE	198,982	172,119	148,887	147,910	115,063	144,134	150,217	132,426	182,672
ALDICARB	214,260	158,000	108,892	66,829	31,977	66,192	29,363	1,451	1,882
AZINPHOS-METHYL	37,622	25,534	16,636	9,888	8,283	1,724	1,809	1,639	24
BENDIOCARB	1	<1	6	<1	<1	<1	<1	<1	<1
BENSULIDE	70,625	82,280	76,748	75,695	73,306	78,736	84,201	79,195	84,213
BUTYLATE	1,954	610	236	6	0	60	0	0	20
CARBARYL	99,086	87,789	97,016	96,136	107,934	80,082	68,272	97,177	96,554
CARBOFURAN	55,488	43,417	39,795	24,651	7,331	15	30	0	0
CHLORPROPHAM	88	115	178	147	159	38	82	76	44
CHLORPYRIFOS	1,681,634	1,538,958	1,154,681	1,162,654	935,588	1,097,107	1,188,150	1,053,936	1,288,690
COUMAPHOS	<1	2	<1	0	0	<1	<1	<1	1
CYCLOATE	19,319	19,886	15,601	10,581	12,058	13,799	14,895	17,581	16,045
DDVP	7,445	1,526	2,733	2,231	2,685	1,880	5,184	6,528	5,590
DEMETON	35	<1	10	0	10	0	0	0	0
DESMEDIPHAM	35,795	30,883	24,780	16,787	16,073	19,264	19,349	16,691	9,207
DIAZINON	440,839	439,814	422,244	310,125	140,620	104,443	71,156	48,585	34,995
DICROTOPHOS	<1	110	0	0	0	0	0	0	0
DIMETHOATE	672,935	613,479	608,819	576,286	499,991	436,233	530,918	421,593	584,209
DISULFOTON	25,320	18,926	20,315	4,723	7,591	6,167	1,621	2,595	1,042
EPTC	64,263	38,871	51,706	45,560	49,708	44,289	47,805	56,297	64,166
ETHEPHON	679,253	640,720	490,361	362,926	261,336	452,334	602,803	533,730	474,982
ETHION	66	32	0	6	15	184	81	332	0
ETHOPROP	4,296	4,815	4,283	4,159	4,293	1,348	1,892	541	656
FENAMIPHOS	29,314	18,918	22,618	10,730	7,537	5,873	2,127	2,690	1,437
FENTHION	<1	<1	<1	<1	<1	<1	<1	0	0
FONOFOS	15	0	0	<1	0	3	0	0	0
FORMETANATE HYDROCHLORIDE	31,775	35,293	35,383	45,715	32,678	30,898	22,038	21,821	27,732
MALATHION	226,729	218,196	250,823	288,852	277,706	433,352	281,026	270,465	285,047
METHAMIDOPHOS	45,835	37,585	23,022	27,532	20,408	10,731	6,464	<1	69
METHIDATHION	37,751	34,786	37,301	43,010	54,227	49,662	34,918	31,741	9,046
METHIOCARB	2,501	3,072	2,649	2,439	2,131	2,335	2,061	2,799	3,378
METHOMYL	612,989	529,347	502,384	406,030	377,954	410,186	395,732	473,027	439,544
METHYL PARATHION	49,771	51,184	45,173	21,574	15,198	13,046	13,343	15,565	12,486
MEVINPHOS	215	8	198	34	69	11	108	2	<1
MEVINPHOS, OTHER RELATED	215	8	198	34	69	11	108	2	0
MEXACARBATE	0	0	0	0	0	0	0	0	<1

Table 8: (continued) *The reported cumulative acres treated with pesticides that are cholinesterase-inhibiting pesticides. These pesticides are organophosphate and carbamate active ingredients.*

AI	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
MOLINATE	40,535	33,045	17,476	4,529	2,942	6	<1	<1	3
MONOCROTOPHOS	0	0	0	0	0	0	0	0	0
NALED	191,906	159,851	107,774	105,505	128,415	145,147	163,486	108,978	160,499
O,O-DIMETHYL O-(4-NITRO-M-TOLYL) PHOSPHOROTHIOATE	0	<1	0	0	0	0	0	0	0
OXAMYL	178,893	137,541	60,773	116,202	59,118	134,931	150,265	61,967	83,532
OXYDEMETON-METHYL	173,480	164,094	161,835	140,760	82,368	86,131	27,447	18,204	12,163
PARATHION	717	713	414	101	195	76	202	149	0
PEBULATE	297	35	163	151	0	0	0	0	0
PHENMEDIPHAM	38,675	33,208	26,762	18,198	18,837	21,366	20,767	17,920	9,592
PHORATE	35,938	27,676	23,557	10,933	10,236	8,719	32,863	47,176	22,464
PHOSALONE	0	0	0	0	0	0	0	0	0
PHOSMET	170,683	200,531	142,991	116,516	51,514	40,276	33,689	18,923	23,670
POTASSIUM DIMETHYL DITHIO CARBAMATE	0	0	0	0	<1	0	0	0	0
PROFENOFOS	25,096	20,563	4,509	289	0	1,635	0	155	0
PROPAMOCARB HYDROCHLORIDE	0	187	144,949	123,699	109,027	103,734	95,929	112,111	101,651
PROPETAMPHOS	<1	<1	<1	<1	<1	<1	<1	<1	<1
PROPOXUR	8	2	<1	10	356	<1	3	<1	4
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	74,538	52,330	31,408	10,850	7,182	15,785	27,139	21,894	22,774
SODIUM DIMETHYL DITHIO CARBAMATE	<1	<1	2	1	3	12	<1	<1	<1
SULFOTEP	9	<1	5	2	3	0	1	0	0
SULPROFOS	0	0	0	0	0	0	0	0	0
TEMEPHOS	<1	<1	<1	<1	<1	<1	<1	<1	<1
TETRACHLORVINPHOS	1,518	1	200	5	<1	5	5	8	2
THIOBENCARB	118,786	79,109	74,271	67,483	83,567	75,172	71,824	79,689	84,652
THIODICARB	2,965	1,293	1,196	673	680	192	656	206	247
TRIALLATE	0	0	0	0	0	867	1,854	546	921
TRICHLORFON	<1	<1	<1	<1	<1	<1	<1	<1	<1
TOTAL	6,362,725	5,725,402	4,976,667	4,462,290	3,600,065	4,118,697	4,182,237	3,759,685	4,136,666

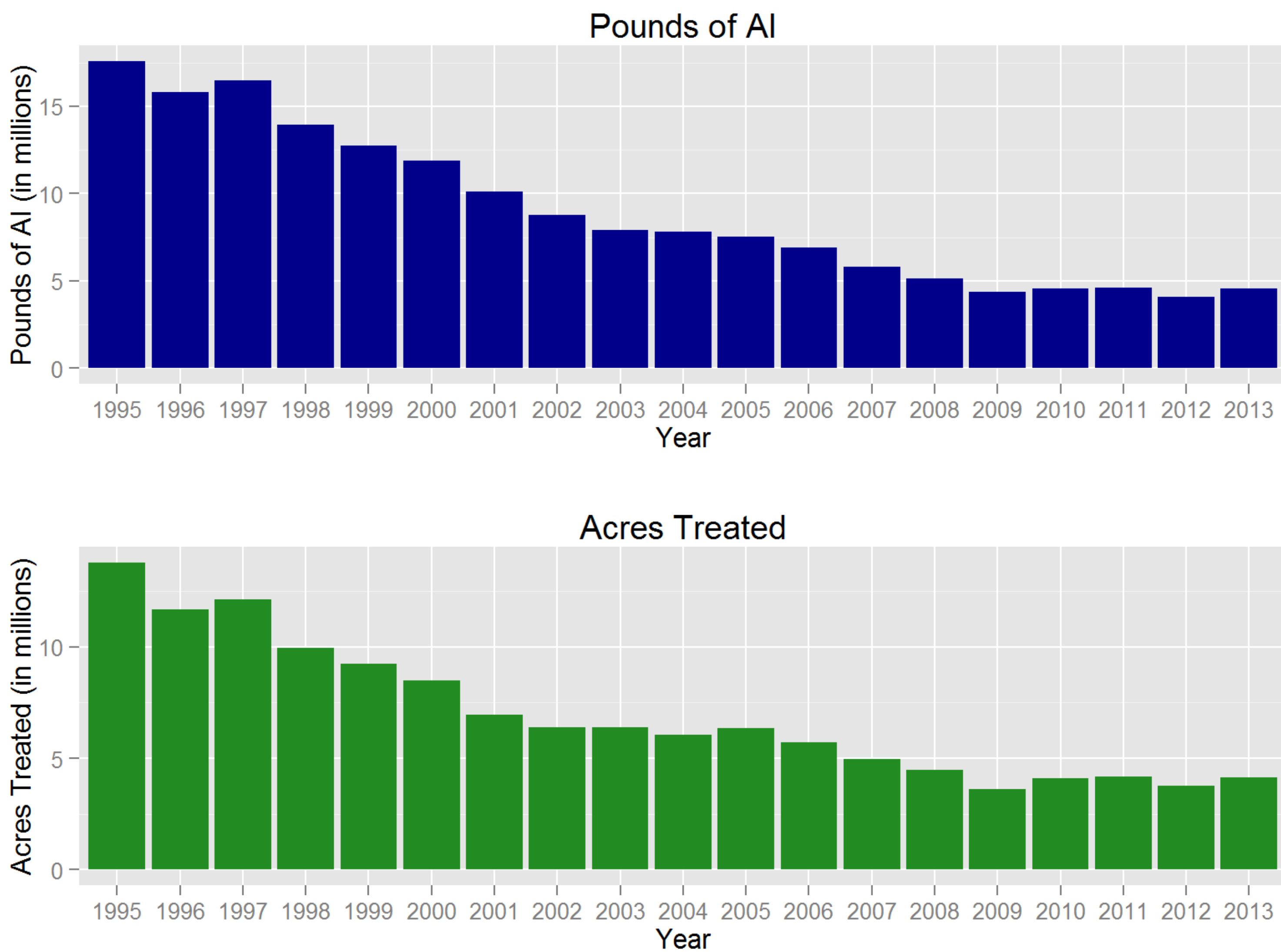

Figure 7: *Use trends of pesticides that are cholinesterase-inhibiting pesticides. These pesticides are organophosphate and carbamate active ingredients. Reported pounds of active ingredient (AI) applied include both agricultural and non-agricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

USE TRENDS OF PESTICIDES ON THE “A” PART OF DPR’S GROUNDWATER PROTECTION LIST.

Table 9: *The reported pounds of pesticides used that are on the “a” part of DPR’s groundwater protection list. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6800(a). Use includes both agricultural and reportable non-agricultural applications. Data are from the Department of Pesticide Regulation’s Pesticide Use Reports.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
ATRAZINE	33,015	35,291	27,546	28,491	23,260	28,937	22,654	32,173	23,420
ATRAZINE, OTHER RELATED	695	732	571	600	482	607	475	676	488
BENTAZON, SODIUM SALT	2,272	2,633	4,858	8,075	9,589	7,447	5,800	7,060	8,250
BROMACIL	48,929	62,774	85,097	68,162	52,049	67,784	92,437	82,485	68,265
BROMACIL, LITHIUM SALT	1,059	2,529	1,172	1,851	896	1,835	1,486	1,422	1,145
DIURON	957,462	1,054,075	860,510	734,757	623,001	588,572	674,531	554,594	412,544
NORFLURAZON	94,082	107,826	78,150	58,590	44,762	43,686	30,697	42,045	30,056
PROMETON	3	8	3	3	1	6	3	8	34
SIMAZINE	628,561	637,691	541,296	438,952	420,004	378,371	425,543	367,974	298,113
TOTAL	1,766,079	1,903,558	1,599,204	1,339,482	1,174,044	1,117,245	1,253,627	1,088,436	842,316

Table 10: *The reported cumulative acres treated with pesticides that are on the "a" part of DPR's groundwater protection list. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6800(a). Use includes primarily agricultural applications. The grand total for acres treated may be less than the sum of acres treated for all active ingredients because some products contain more than one active ingredient. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
ATRAZINE	24,085	21,834	17,382	16,766	15,767	19,990	17,236	23,827	18,283
ATRAZINE, OTHER RELATED	24,085	21,834	17,382	16,766	15,767	19,990	17,236	23,827	18,283
BENTAZON, SODIUM SALT	2,218	2,217	4,215	6,631	6,424	6,258	4,846	6,539	7,466
BROMACIL	21,886	19,132	20,455	21,471	24,420	28,757	32,183	28,746	16,564
BROMACIL, LITHIUM SALT	<1	<1	<1	<1	<1	<1	<1	<1	<1
DIURON	894,073	886,032	702,939	514,554	405,973	517,589	691,371	555,454	439,903
NORFLURAZON	81,589	91,035	74,085	58,866	44,503	45,638	30,601	31,693	23,494
PROMETON	6	168	4	35	2	20	<1	<1	234
SIMAZINE	463,244	480,142	411,719	320,992	339,302	289,031	324,475	240,390	202,349
TOTAL	1,466,859	1,483,320	1,212,529	919,200	813,118	879,354	1,069,161	858,298	692,042

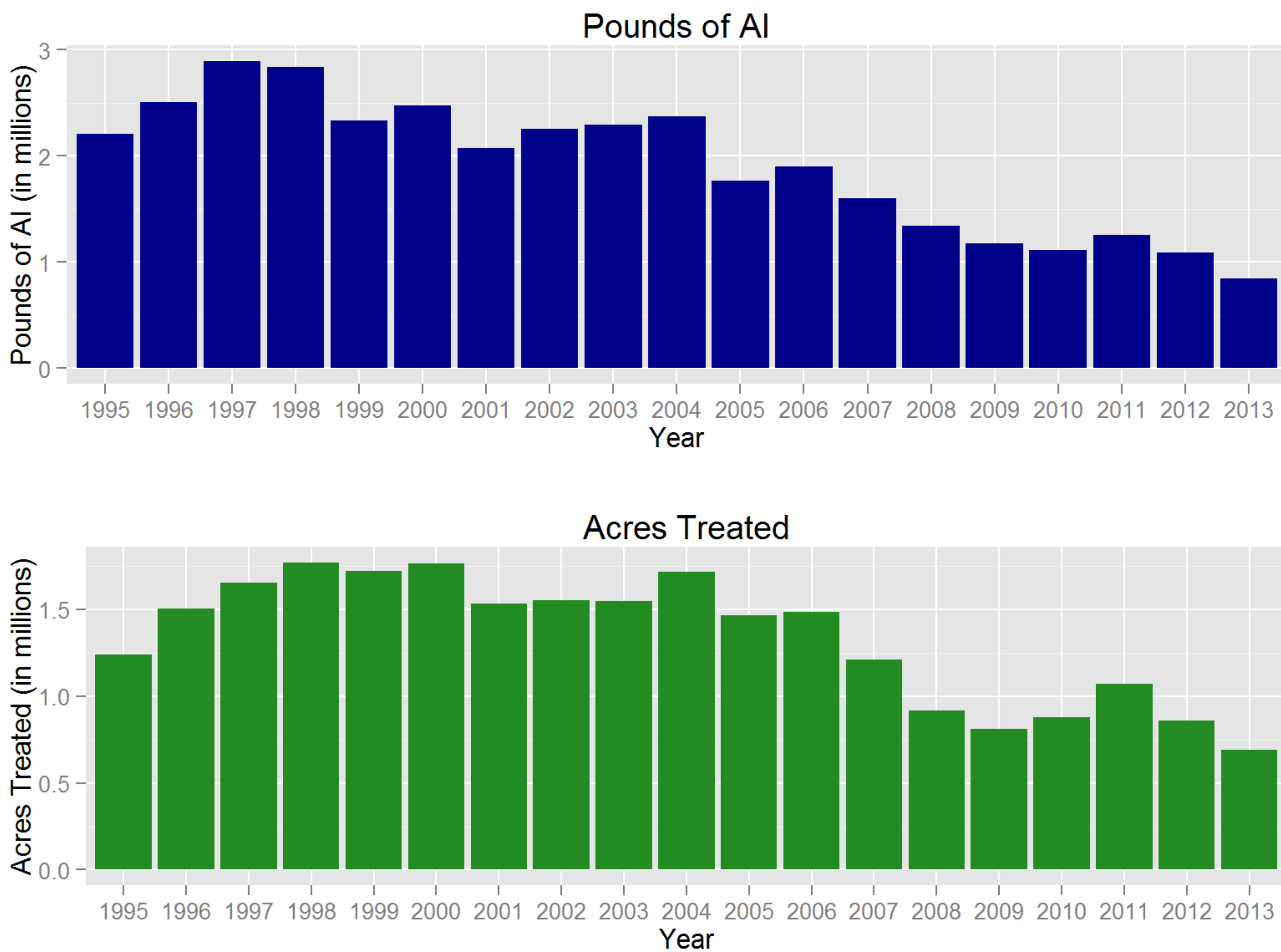

Figure 8: *Use trends of pesticides that are on the "a" part of DPR's groundwater protection list. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6800(a). Reported pounds of active ingredient (AI) applied include both agricultural and non-agricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

USE TRENDS OF PESTICIDES ON DPR'S TOXIC AIR CONTAMINANTS LIST.

Table 11: *The reported pounds of pesticides used that are on DPR's toxic air contaminants list applied in California. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6860. Use includes both agricultural and reportable non-agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1,3-DICHLOROPROPENE	9,355,308	8,735,190	9,595,625	9,706,640	6,450,106	8,777,092	10,910,167	11,863,992	12,917,296
2,4-D	1,552	1,735	2,755	11,619	10,788	12,526	5,400	4,281	5,949
2,4-D, 2-ETHYLHEXYL ESTER	26,641	21,062	15,029	20,464	15,113	74,398	25,786	27,674	25,654
2,4-D, ALKANOLAMINE SALTS (ETHANOL AND ISOPROPANOL AMINES)	458	16	29	25	131	516	1	16	18
2,4-D, BUTOXYETHANOL ESTER	8,190	1,720	843	1,775	2,751	1,368	1,757	1,807	2,988
2,4-D, BUTOXYPROPYL ESTER	0	<1	0	13	0	0	0	0	0
2,4-D, BUTYL ESTER	10	15	9	0	2	3	4	7	26
2,4-D, DIETHANOLAMINE SALT	3,961	2,947	4,025	5,533	4,913	6,872	3,165	2,649	2,848
2,4-D, DIMETHYLAMINE SALT	455,858	439,100	397,197	466,872	446,575	488,565	408,555	371,673	351,938
2,4-D, DODECYLAMINE SALT	0	0	0	0	0	0	0	0	0
2,4-D, HEPTYLAMINE SALT	0	0	0	0	0	0	0	0	0
2,4-D, ISOOCTYL ESTER	10,314	10,627	11,572	9,603	4,446	4,214	5,361	4,623	2,156
2,4-D, ISOPROPYL ESTER	11,220	10,863	10,578	10,671	13,123	11,656	19,158	12,480	11,729
2,4-D, N-OLEYL-1,3-PROPYLENEDIAMINE SALT	0	0	0	0	0	0	0	0	0
2,4-D, OCTYL ESTER	0	0	0	0	0	0	0	0	0
2,4-D, PROPYL ESTER	404	398	212	141	99	57	0	0	6
2,4-D, TETRADECYLAMINE SALT	0	0	0	0	0	0	0	0	0
2,4-D, TRIETHYLAMINE SALT	203	1,614	383	332	472	2,829	106	5	<1
2,4-D, TRIISOPROPANOLAMINE SALT	672	1,133	985	1,140	1,930	2,092	2,741	1,746	1,500
2,4-D, TRIISOPROPYLAMINE SALT	0	458	636	472	1,941	1,655	1,971	770	1,263
ACROLEIN	257,194	246,659	201,156	215,822	161,637	123,660	97,675	114,130	99,011
ALUMINUM PHOSPHIDE	137,969	151,037	105,169	132,296	108,084	108,406	155,138	138,586	131,529
ARSENIC ACID	68	3	0	0	0	0	17	0	0
ARSENIC PENTOXIDE	180,505	474,517	7,805	7,433	400	16,144	8,034	9,240	8,480
ARSENIC TRIOXIDE	<1	<1	<1	<1	<1	<1	<1	<1	0
CAPTAN	472,744	510,661	456,475	362,757	329,747	450,225	376,505	403,739	349,994
CAPTAN, OTHER RELATED	9,982	11,217	10,131	8,031	7,374	10,002	8,393	8,916	5,980
CARBARYL	190,633	156,997	142,010	126,742	136,141	113,160	74,944	113,900	113,773
CHLORINE	613,837	730,986	857,144	1,278,580	585,673	1,011,383	762,464	1,437,637	1,323,645
CHLOROPICRIN	4,872,161	5,037,770	5,502,827	5,587,045	5,692,195	6,391,512	7,313,152	8,934,088	8,216,249
CHROMIC ACID	252,176	662,927	10,904	10,384	559	22,555	11,224	12,908	11,847
DAZOMET	48,263	34,310	37,537	40,272	65,725	60,539	59,245	39,229	63,918

Table 11: (continued) *The reported pounds of pesticides used that are on DPR's toxic air contaminants list applied in California. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6860.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
DDVP	4,914	6,577	6,376	6,859	4,164	4,169	5,164	4,630	4,613
ENDOSULFAN	83,302	92,757	52,403	59,917	41,840	37,146	15,679	11,113	1,833
ETHYLENE OXIDE	0	0	2	3	7	0	0	8	0
FORMALDEHYDE	48,968	73,392	47,733	24,306	3,972	5,511	4,615	3,847	11,165
HYDROGEN CHLORIDE	14,755	2,464	1,470	4,318	3,976	2,240	504	336	395
LINDANE	40	379	2	21	8	18	1	0	2
MAGNESIUM PHOSPHIDE	3,156	3,931	5,132	10,507	8,009	12,233	12,686	11,315	11,982
MANCOZEB	643,194	662,040	408,652	330,238	282,587	755,101	1,045,668	1,130,426	1,150,600
MANEB	1,135,698	1,181,738	1,061,028	861,006	657,090	370,333	53,869	6,260	1,497
META-CRESOL	1	<1	<1	<1	<1	<1	1	2	7
METAM-SODIUM	12,991,279	11,422,382	9,929,803	9,497,379	9,358,576	11,153,177	10,861,059	8,428,341	4,805,237
METHANOL	0	0	0	0	0	0	0	0	2
METHIDATHION	48,857	56,691	45,666	47,203	47,319	51,190	29,545	23,396	6,375
METHOXYCHLOR	13	130	6	0	8	270	39	0	<1
METHOXYCHLOR, OTHER RELATED	<1	0	0	0	0	0	0	0	0
METHYL BROMIDE	6,509,322	6,542,161	6,448,643	5,693,325	5,627,502	4,809,251	4,014,310	3,990,028	3,522,030
METHYL ISOTHIOCYANATE	1,549	1,073	388	0	0	73	476	764	0
METHYL PARATHION	79,000	84,785	75,385	34,110	25,770	21,427	22,970	25,409	21,520
METHYL PARATHION, OTHER RELATED	4,155	4,447	3,960	1,792	1,355	1,127	1,195	1,334	1,131
NAPHTHALENE	<1	0	0	0	0	1	<1	0	<1
PARA-DICHLOROBENZENE	139	0	15	1	17	0	<1	18	<1
PARATHION	855	1,542	479	33	118	285	241	370	6
PCNB	38,038	32,786	30,689	29,188	24,637	37,378	11,639	17,318	26,082
PCP, OTHER RELATED	<1	3	2	1	0	<1	3	32	39
PCP, SODIUM SALT	0	0	<1	0	0	0	<1	0	0
PCP, SODIUM SALT, OTHER RELATED	0	0	<1	0	0	0	0	0	0
PENTACHLOROPHENOL	3	27	22	4	0	3	18	224	274
PHENOL	71	<1	0	0	2	0	0	0	5
PHOSPHINE	2,699	3,491	5,286	48,243	29,527	11,291	118,089	48,346	20,231
PHOSPHORUS	<1	2	<1	<1	<1	1	0	4	3
POTASSIUM N-METHYLDITHIOCARBAMATE	1,994,072	3,202,884	3,785,436	5,524,647	4,128,181	4,832,615	5,673,371	8,320,255	9,484,467
POTASSIUM PERMANGANATE	0	0	0	0	109	0	0	0	0
PROPOXUR	220	212	191	188	202	298	808	359	373
PROPYLENE OXIDE	147,489	133,028	110,068	105,600	111,609	300,008	421,562	346,785	400,183
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	100,225	78,084	45,757	16,335	8,161	18,427	30,328	21,820	19,077
SODIUM CYANIDE	3,086	2,853	2,670	3,406	2,579	2,502	1,073	2,588	2,593
SODIUM DICHROMATE	0	0	0	0	0	0	0	0	0

Table 11: (continued) *The reported pounds of pesticides used that are on DPR's toxic air contaminants list applied in California. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6860.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
SODIUM TETRATHIOCARBONATE	330,886	171,204	391,303	354,294	249,580	233,949	168,761	49,713	385
SULFURYL FLUORIDE	3,394,126	2,880,853	2,152,451	2,120,860	2,184,823	2,728,977	2,354,115	2,634,267	3,025,207
TRIFLURALIN	1,032,503	1,049,147	908,614	676,386	533,307	473,450	497,636	484,771	483,102
XYLENE	1,598	1,418	1,173	576	517	1,103	291	406	1,185
ZINC PHOSPHIDE	2,380	3,794	3,215	1,299	20,898	1,745	2,543	2,249	2,191
TOTAL	45,526,915	44,940,235	42,895,058	43,456,705	37,396,374	43,556,729	45,599,217	49,070,829	46,651,588

Table 12: *The reported cumulative acres treated with pesticides that are on DPR's toxic air contaminants list applied in California. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6860. Use includes primarily agricultural applications. The grand total for acres treated may be less than the sum of acres treated for all active ingredients because some products contain more than one active ingredient. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
1,3-DICHLOROPROPENE	51,486	49,885	53,937	57,922	38,848	54,049	59,059	69,198	71,747
2,4-D	1,466	2,824	7,405	33,344	25,244	23,856	7,565	7,764	11,406
2,4-D, 2-ETHYLHEXYL ESTER	21,360	15,303	8,362	15,047	9,020	11,797	10,360	7,769	11,533
2,4-D, ALKANOLAMINE SALTS (ETHANOL AND ISOPROPANOL AMINES)	403	6	23	55	270	172	1	36	26
2,4-D, BUTOXYETHANOL ESTER	2,950	1,600	1,297	3,648	5,110	2,542	1,206	1,054	1,609
2,4-D, BUTOXYPROPYL ESTER	0	<1	0	<1	0	0	0	0	0
2,4-D, BUTYL ESTER	8	1	10	0	6	<1	<1	7	<1
2,4-D, DIETHANOLAMINE SALT	18,739	13,826	13,339	19,085	18,931	27,009	11,075	7,033	8,782
2,4-D, DIMETHYLAMINE SALT	567,143	523,912	487,361	543,863	527,098	519,005	445,496	378,139	351,709
2,4-D, DODECYLAMINE SALT	0	0	0	0	0	0	0	0	0
2,4-D, HEPTYLAMINE SALT	0	0	0	0	0	0	0	0	0
2,4-D, ISOOCTYL ESTER	6,532	7,638	7,143	4,708	2,673	2,424	2,903	414	1,409
2,4-D, ISOPROPYL ESTER	144,377	146,090	137,055	135,797	132,302	138,424	145,544	161,009	149,629
2,4-D, N-OLEYL-1,3-PROPYLENEDIAMINE SALT	0	0	0	0	0	0	0	0	0
2,4-D, OCTYL ESTER	0	0	0	0	0	0	0	0	0
2,4-D, PROPYL ESTER	5,261	5,660	3,348	1,955	1,750	895	0	0	128
2,4-D, TETRADECYLAMINE SALT	0	0	0	0	0	0	0	0	0
2,4-D, TRIETHYLAMINE SALT	243	815	473	679	740	165	117	3	<1
2,4-D, TRIISOPROPANOLAMINE SALT	396	392	108	952	541	720	623	308	524
2,4-D, TRIISOPROPYLAMINE SALT	0	<1	204	<1	<1	<1	25	37	653
ACROLEIN	73	18	141	1,027	1,497	12	45	56	68
ALUMINUM PHOSPHIDE	63,289	79,951	84,963	80,989	112,063	100,859	133,229	163,751	148,420
ARSENIC ACID	<1	<1	0	0	0	0	<1	0	0
ARSENIC PENTOXIDE	<1	<1	<1	<1	<1	<1	<1	<1	<1
ARSENIC TRIOXIDE	1	<1	<1	<1	<1	<1	<1	<1	0
CAPTAN	252,040	262,936	215,864	198,262	173,133	245,464	209,967	209,614	188,080
CAPTAN, OTHER RELATED	251,846	262,860	215,229	198,095	173,083	245,464	209,967	205,600	144,502
CARBARYL	99,086	87,789	97,016	96,136	107,934	80,082	68,272	97,177	96,554
CHLORINE	<1	431	1,201	14,414	24,644	88,144	24,253	24,097	<1
CHLOROPICRIN	53,797	56,129	55,678	53,964	49,773	52,017	70,606	67,371	59,746
CHROMIC ACID	<1	<1	<1	<1	<1	<1	<1	<1	<1
DAZOMET	113	124	700	183	301	274	243	594	759
DDVP	7,445	1,526	2,733	2,231	2,685	1,880	5,184	6,528	5,590

Table 12: (continued) *The reported cumulative acres treated with pesticides that are on DPR's toxic air contaminants list applied in California. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6860.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
ENDOSULFAN	97,745	111,338	56,627	64,695	48,639	47,147	19,812	11,134	1,856
ETHYLENE OXIDE	0	0	<1	2	60	0	0	<1	0
FORMALDEHYDE	2	265	57	67	5	1	6	4	52
HYDROGEN CHLORIDE	17	18	4	46	49	116	<1	3	0
LINDANE	557	9	0	37	10	31	1	0	<1
MAGNESIUM PHOSPHIDE	23	29	6	143	32	145	80	29	19
MANCOZEB	370,266	348,360	212,349	169,422	146,402	432,118	634,445	678,937	676,800
MANEB	730,254	675,941	655,235	558,506	471,837	290,266	40,464	4,559	1,592
META-CRESOL	164	50	54	38	108	79	144	857	614
METAM-SODIUM	97,562	102,451	78,030	71,815	75,735	71,407	70,875	58,998	27,986
METHANOL	0	0	0	0	0	0	0	0	35
METHIDATHION	37,751	34,786	37,301	43,010	54,227	49,662	34,918	31,741	9,046
METHOXYCHLOR	26	395	43	0	75	90	58	0	<1
METHOXYCHLOR, OTHER RELATED	<1	0	0	0	0	0	0	0	0
METHYL BROMIDE	45,700	50,677	45,675	35,685	40,250	32,235	46,780	28,886	26,578
METHYL ISOTHIOCYANATE	<1	<1	<1	0	0	<1	<1	<1	0
METHYL PARATHION	49,771	51,184	45,173	21,574	15,198	13,046	13,343	15,565	12,486
METHYL PARATHION, OTHER RELATED	49,644	50,762	45,165	21,331	15,053	13,029	13,326	15,351	12,440
NAPHTHALENE	2	0	0	0	0	3	<1	0	<1
PARA-DICHLOROBENZENE	<1	0	<1	0	<1	<1	<1	<1	<1
PARATHION	717	713	414	101	195	76	202	149	0
PCNB	3,001	1,496	1,764	1,656	1,400	4,429	879	331	591
PCP, OTHER RELATED	3	0	10	46	0	4	1	15	170
PCP, SODIUM SALT	0	0	<1	0	0	0	47	0	0
PCP, SODIUM SALT, OTHER RELATED	0	0	<1	0	0	0	0	0	0
PENTACHLOROPHENOL	3	0	10	46	0	4	1	15	170
PHENOL	239	<1	0	0	15	0	0	0	114
PHOSPHINE	22	23	3	1,751	50	643	665	686	110
PHOSPHORUS	23	<1	10	<1	<1	<1	0	74	108
POTASSIUM N-METHYLDITHIOCARBAMATE	19,670	27,299	42,988	56,009	38,277	41,444	44,078	50,361	46,861
POTASSIUM PERMANGANATE	0	0	0	0	5	0	0	0	0
PROPOXUR	8	2	<1	10	356	<1	3	<1	4
PROPYLENE OXIDE	185	20	<1	12	<1	<1	<1	288	9
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	74,538	52,330	31,408	10,850	7,182	15,785	27,139	21,894	22,774
SODIUM CYANIDE	<1	<1	<1	<1	<1	<1	<1	<1	<1
SODIUM DICHROMATE	0	0	0	0	0	0	0	0	0
SODIUM TETRATHIOCARBONATE	7,977	6,170	11,485	10,725	7,180	7,301	4,826	1,672	<1

Table 12: (continued) *The reported cumulative acres treated with pesticides that are on DPR's toxic air contaminants list applied in California. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6860.*

AI	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
SULFURYL FLUORIDE	<1	78	9	57	361	130	537	532	63
TRIFLURALIN	886,258	901,629	772,753	556,306	492,498	438,710	466,992	465,820	468,980
XYLENE	2,722	1,824	2,021	1,418	1,387	609	747	1,074	2,157
ZINC PHOSPHIDE	9,038	15,284	9,301	11,478	14,512	12,751	21,417	21,685	22,186
TOTAL	3,661,116	3,571,082	3,116,678	2,807,846	2,582,596	2,733,168	2,550,448	2,533,929	2,371,890

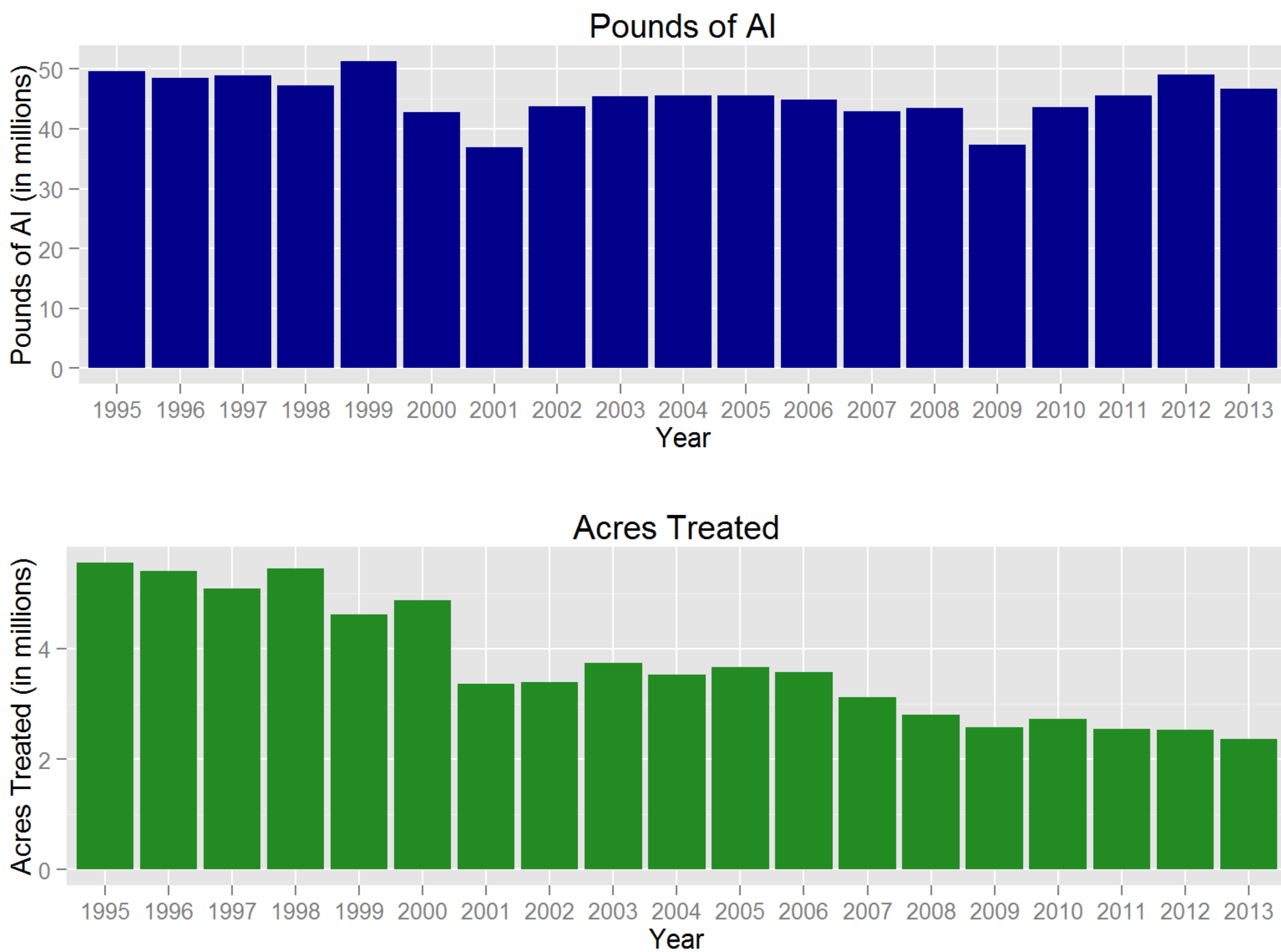

Figure 9: *Use trends of pesticides that are on DPR's toxic air contaminants list applied in California. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6860. Reported pounds of active ingredient (AI) applied include both agricultural and non-agricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

USE TRENDS OF PESTICIDES THAT ARE FUMIGANTS.

Table 13: *The reported pounds of pesticides used that are fumigants. Use includes both agricultural and reportable non-agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
1,2-DICHLOROPROPANE, 1,3-DICHLOROPROPENE AND RELATED C3 COMPOUNDS	0	182	10,532	0	0	0	0	6	0
1,3-DICHLOROPROPENE	9,355,308	8,735,190	9,595,625	9,706,640	6,450,106	8,777,092	10,910,167	11,863,992	12,917,296
ALUMINUM PHOSPHIDE	137,969	151,037	105,169	132,296	108,084	108,406	155,138	138,586	131,529
CARBON TETRACHLORIDE	0	0	180	1,980	<1	0	6	90	0
CHLOROPICRIN	4,872,161	5,037,770	5,502,827	5,587,045	5,692,195	6,391,512	7,313,152	8,934,088	8,216,249
DAZOMET	48,263	34,310	37,537	40,272	65,725	60,539	59,245	39,229	63,918
ETHYLENE DIBROMIDE	0	0	3	127	<1	0	0	6	0
ETHYLENE DICHLORIDE	0	0	0	<1	0	0	0	0	0
ETHYLENE OXIDE	0	0	2	3	7	0	0	8	0
MAGNESIUM PHOSPHIDE	3,156	3,931	5,132	10,507	8,009	12,233	12,686	11,315	11,982
METAM-SODIUM	12,991,279	11,422,382	9,929,803	9,497,379	9,358,576	11,153,177	10,861,059	8,428,341	4,805,237
METHYL BROMIDE	6,509,322	6,542,161	6,448,643	5,693,325	5,627,502	4,809,251	4,014,310	3,990,028	3,522,030
METHYL IODIDE	0	0	0	0	0	0	1,157	21	0
PHOSPHINE	2,699	3,491	5,286	48,243	29,527	11,291	118,089	48,346	20,231
POTASSIUM N-METHYLDITHIOCARBAMATE	1,994,072	3,202,884	3,785,436	5,524,647	4,128,181	4,832,615	5,673,371	8,320,255	9,484,467
PROPYLENE OXIDE	147,489	133,028	110,068	105,600	111,609	300,008	421,562	346,785	400,183
SODIUM TETRATHIOCARBONATE	330,886	171,204	391,303	354,294	249,580	233,949	168,761	49,713	385
SULFURYL FLUORIDE	3,394,126	2,880,853	2,152,451	2,120,860	2,184,823	2,728,977	2,354,115	2,634,267	3,025,207
ZINC PHOSPHIDE	2,380	3,794	3,215	1,299	20,898	1,745	2,543	2,249	2,191
TOTAL	39,789,111	38,322,216	38,083,212	38,824,517	34,034,820	39,420,796	42,065,359	44,807,323	42,600,905

Table 14: *The reported cumulative acres treated with pesticides that are fumigants. Use includes primarily agricultural applications. The grand total for acres treated may be less than the sum of acres treated for all active ingredients because some products contain more than one active ingredient. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
1,2-DICHLOROPROPANE, 1,3-DICHLOROPROPENE AND RELATED C3 COMPOUNDS	0	32	108	0	0	0	0	18	0
1,3-DICHLOROPROPENE	51,486	49,885	53,937	57,922	38,848	54,049	59,059	69,198	71,747
ALUMINUM PHOSPHIDE	63,289	79,951	84,963	80,989	112,063	100,859	133,229	163,751	148,420
CARBON TETRACHLORIDE	0	0	<1	161	<1	0	<1	<1	0
CHLOROPICRIN	53,797	56,129	55,678	53,964	49,773	52,017	70,606	67,371	59,746
DAZOMET	113	124	700	183	301	274	243	594	759
ETHYLENE DIBROMIDE	0	0	<1	<1	<1	0	0	<1	0
ETHYLENE DICHLORIDE	0	0	0	160	0	0	0	0	0
ETHYLENE OXIDE	0	0	<1	2	60	0	0	<1	0
MAGNESIUM PHOSPHIDE	23	29	6	143	32	145	80	29	19
METAM-SODIUM	97,562	102,451	78,030	71,815	75,735	71,407	70,875	58,998	27,986
METHYL BROMIDE	45,700	50,677	45,675	35,685	40,250	32,235	46,780	28,886	26,578
METHYL IODIDE	0	0	0	0	0	0	278	37	0
PHOSPHINE	22	23	3	1,751	50	643	665	686	110
POTASSIUM N-METHYLDITHIOCARBAMATE	19,670	27,299	42,988	56,009	38,277	41,444	44,078	50,361	46,861
PROPYLENE OXIDE	185	20	<1	12	<1	<1	<1	288	9
SODIUM TETRATHIOCARBONATE	7,977	6,170	11,485	10,725	7,180	7,301	4,826	1,672	<1
SULFURYL FLUORIDE	<1	78	9	57	361	130	537	532	63
ZINC PHOSPHIDE	9,038	15,284	9,301	11,478	14,512	12,751	21,417	21,685	22,186
TOTAL	300,847	337,084	333,549	333,467	334,073	328,882	391,232	409,132	357,497

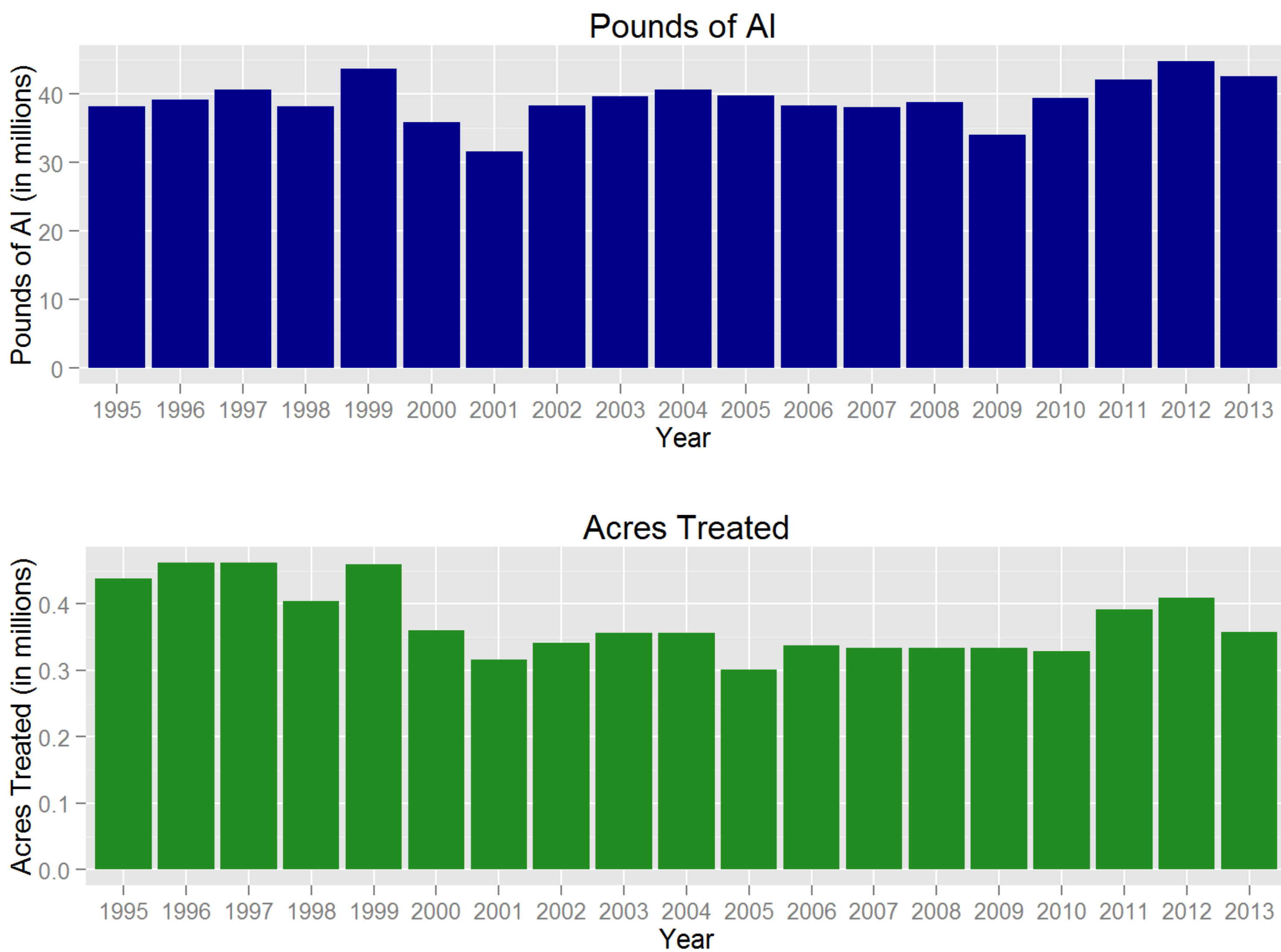

Figure 10: *Use trends of pesticides that are fumigants. Reported pounds of active ingredient (AI) applied include both agricultural and non-agricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

USE TRENDS OF OIL PESTICIDES.

Table 15: *The reported pounds of pesticides used that are oils. As a broad group, oil pesticides and other petroleum distillates are on U.S. EPA's list of A or B carcinogens or the State's Proposition 65 list of chemicals "known to cause cancer." However, these classifications do not distinguish among oil pesticides that may not qualify as carcinogenic due to their degree of refinement. Many such oil pesticides also serve as alternatives to high-toxicity chemicals. For this reason, oil pesticide data was classified separately in this report. Use includes both agricultural and reportable non-agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
COAL TAR HYDROCARBONS	0	0	0	0	0	0	0	0	0
HYDROTREATED PARAFFINIC SOLVENT	244,817	254,213	300,501	247,676	248,774	224,458	239,192	154,224	169,458
ISOPARAFFINIC HYDROCARBONS	31,183	18,997	16,859	11,250	13,007	6,628	13,823	9,525	7,290
KEROSENE	8,023	11,387	12,431	22,269	148,485	95,973	34,675	20,423	6,959
MINERAL OIL	10,617,874	12,414,370	12,859,567	12,341,868	11,667,759	11,433,496	10,314,353	11,531,202	16,097,618
MINERAL OIL, PETROLEUM DISTILLATES, SOLVENT REFINED LIGHT	0	169	139	219	124	401	11	0	0
NAPHTHA, HEAVY AROMATIC	0	0	0	0	0	0	0	0	<1
PETROLEUM DERIVATIVE RESIN	4	5	0	0	1	0	<1	0	6
PETROLEUM DISTILLATES	609,966	297,335	343,123	504,035	548,178	341,843	278,793	247,408	207,256
PETROLEUM DISTILLATES, ALIPHATIC	34,182	34,017	18,323	16,390	10,663	15,627	8,987	6,638	7,680
PETROLEUM DISTILLATES, AROMATIC	2,092	2,136	1,160	367	103	247	12	100	303
PETROLEUM DISTILLATES, REFINED	781,411	1,206,463	1,240,305	1,487,043	1,222,830	2,005,527	1,983,068	1,908,386	1,907,618
PETROLEUM HYDROCARBONS	956	1,574	1,407	184	138	177	177	27	77
PETROLEUM NAPHTHENIC OILS	48	158	240	248	254	887	1,049	518	348
PETROLEUM OIL, PARAFFIN BASED	414,094	563,646	511,255	506,839	1,049,428	618,186	749,575	982,508	1,245,354
PETROLEUM OIL, UNCLASSIFIED	16,232,621	18,241,640	13,419,141	13,583,475	12,280,816	12,490,234	17,838,947	13,417,036	15,752,026
PETROLEUM SULFONATES	0	<1	<1	<1	0	0	<1	0	0
TOTAL	28,977,272	33,046,110	28,724,451	28,721,863	27,190,559	27,233,685	31,462,662	28,277,998	35,401,992

Table 16: *The reported cumulative acres treated with pesticides that are oils. As a broad group, oil pesticides and other petroleum distillates are on U.S. EPA's list of A or B carcinogens or the State's Proposition 65 list of chemicals "known to cause cancer." However, these classifications do not distinguish among oil pesticides that may not qualify as carcinogenic due to their degree of refinement. Many such oil pesticides also serve as alternatives to high-toxicity chemicals. For this reason, oil pesticide data was classified separately in this report. Use includes primarily agricultural applications. The grand total for acres treated may be less than the sum of acres treated for all active ingredients because some products contain more than one active ingredient. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
COAL TAR HYDROCARBONS	0	0	0	0	0	0	0	0	0
HYDROTREATED PARAFFINIC SOLVENT	252,863	270,421	261,415	226,988	232,299	227,415	254,598	181,660	192,658
ISOPARAFFINIC HYDROCARBONS	55,920	39,757	27,903	19,228	22,913	13,709	19,129	14,683	8,637
KEROSENE	314,821	348,522	254,279	284,440	304,085	316,705	319,283	288,580	288,243
MINERAL OIL	488,458	607,575	823,500	875,257	1,010,297	1,193,122	1,271,012	1,380,111	1,808,584
MINERAL OIL, PETROLEUM DISTILLATES, SOLVENT REFINED LIGHT	0	959	522	1,010	850	1,255	60	0	0
NAPHTHA, HEAVY AROMATIC	0	0	0	0	0	0	0	0	<1
PETROLEUM DERIVATIVE RESIN	10	<1	0	0	<1	0	<1	0	<1
PETROLEUM DISTILLATES	171,158	180,495	280,747	422,253	277,893	238,831	215,598	175,591	175,773
PETROLEUM DISTILLATES, ALIPHATIC	22,723	34,136	31,441	28,159	30,995	58,314	75,134	32,428	36,156
PETROLEUM DISTILLATES, AROMATIC	385	658	383	107	225	445	12	170	660
PETROLEUM DISTILLATES, REFINED	117,570	200,933	231,860	288,363	258,026	273,923	254,802	243,895	256,063
PETROLEUM HYDROCARBONS	430	260	546	334	309	159	35	5	75
PETROLEUM NAPHTHENIC OILS	358	11,125	17,950	18,093	22,435	44,851	65,431	27,369	30,539
PETROLEUM OIL, PARAFFIN BASED	605,289	724,671	738,037	658,709	631,455	673,172	712,301	716,588	649,609
PETROLEUM OIL, UNCLASSIFIED	717,903	807,931	674,659	702,988	696,956	762,021	1,041,952	852,696	977,352
PETROLEUM SULFONATES	0	<1	<1	<1	0	0	<1	0	0
TOTAL	2,744,767	3,213,555	3,323,241	3,505,504	3,463,324	3,758,792	4,163,861	3,886,244	4,393,780

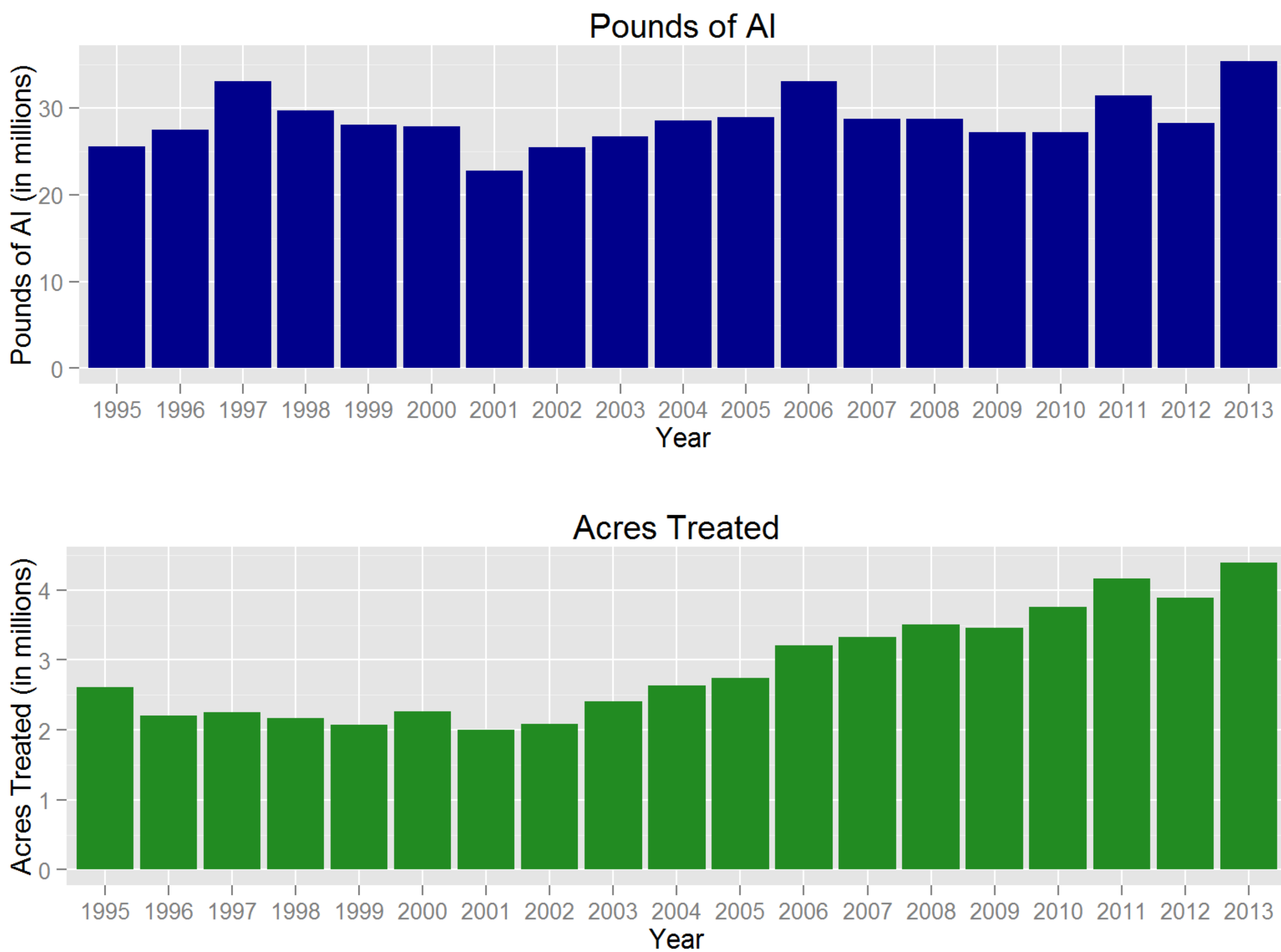

Figure 11: *Use trends of pesticides that are oils. As a broad group, oil pesticides and other petroleum distillates are on U.S. EPA's list of A or B carcinogens or the State's Proposition 65 list of chemicals "known to cause cancer." However, these classifications do not distinguish among oil pesticides that may not qualify as carcinogenic due to their degree of refinement. Many such oil pesticides also serve as alternatives to high-toxicity chemicals. For this reason, oil pesticide data was classified separately in this report. Reported pounds of active ingredient (AI) applied include both agricultural and non-agricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

USE TRENDS OF BIOPESTICIDES.

Table 17: *The reported pounds of pesticides used that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones). Use includes both agricultural and reportable non-agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
(3S, 6R)-3-METHYL-6-ISOPROPENYL-9-DECEN-1-YL ACETATE	<1	<1	0	0	<1	0	0	<1	0
(3S, 6S)-3-METHYL-6-ISOPROPENYL-9-DECEN-1-YL ACETATE	<1	<1	0	0	<1	0	0	<1	0
(E)-4-TRIDECEN-1-YL-ACETATE	68	103	113	176	80	94	0	0	0
(E)-5-DECEN-1-OL	0	0	0	0	0	0	0	<1	<1
(E)-5-DECENOL	<1	4	2	2	1	1	<1	2	3
(E)-5-DECENYL ACETATE	<1	17	7	8	4	5	2	10	7
(E,E)-9, 11-TETRADECADIEN-1-YL ACETATE	0	0	39	28	11	2	6	3	4
(E,Z)-7,9-DODECADIEN-1-YL ACETATE	0	0	0	0	0	50	249	270	24
(R,Z)-5-(1-DECENYL) DIHYDRO-2-(3H)-FURANONE	<1	0	0	0	0	0	0	0	0
(S)-KINOPRENE	289	201	238	252	276	277	191	301	280
(S)-VERBENONE	0	0	0	0	0	0	0	55	0
(Z)-11-HEXADECEN-1-YL ACETATE	5	6	2	0	681	0	1	0	0
(Z)-11-HEXADECENAL	5	6	2	0	0	0	0	0	0
(Z)-4-TRIDECEN-1-YL-ACETATE	2	3	4	6	3	3	0	0	0
(Z)-9-DODECENYL ACETATE	<1	<1	1	<1	<1	<1	<1	<1	<1
(Z,E)-7,11-HEXADECADIEN-1-YL ACETATE	0	0	0	<1	3	2	0	0	0
(Z,Z)-11,13-HEXADECADIENAL	0	0	<1	<1	0	<1	571	271	321
(Z,Z)-7,11-HEXADECADIEN-1-YL ACETATE	0	0	0	0	3	3	0	0	0
1,4-DIMETHYLNAPHTHALENE	697	599	18	837	1,544	1,152	544	893	2,155
1,7-DIOXASPIRO-(5,5)-UNDECANE	<1	<1	<1	<1	<1	<1	<1	<1	1
1-DECANOL	0	0	0	0	0	0	0	0	0
1-METHYLCYCLOPROPENE	<1	<1	<1	<1	<1	<1	<1	1	1
1-NAPHTHALENEACETAMIDE	55	30	49	55	32	25	20	20	19
2-METHYL-1-BUTANOL	0	0	0	0	0	0	0	0	<1
3,13 OCTADECADIEN-1-YL ACETATE	0	0	0	44	0	1	12	0	<1
3,7-DIMETHYL-6-OCTEN-1-OL	0	0	0	1	5	23	12	28	54
ACETIC ACID	<1	0	1	21	79	1,732	73	601	43
AGROBACTERIUM RADIOBACTER	27	291	577	32	142	124	95	28	237
AGROBACTERIUM RADIOBACTER, STRAIN K1026	<1	6	<1	<1	1	<1	<1	<1	34

Table 17: (continued) *The reported pounds of pesticides used that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
ALLYL ISOTHIOCYANATE	<1	<1	0	0	0	0	0	<1	0
ALMOND, BITTER	0	<1	<1	<1	<1	<1	<1	<1	<1
AMINO ETHOXY VINYL GLYCINE HYDROCHLORIDE	24	703	963	1,073	543	1,024	1,194	1,368	1,444
AMMONIUM BICARBONATE	<1	2	7	2	<1	9	14	7	46
AMMONIUM NITRATE	8,357	13,991	27,443	36,662	39,544	40,065	48,222	66,455	85,160
AMPELOMYCES QUISQUALIS	<1	<1	<1	0	<1	<1	0	0	0
ANIMAL GLAND EXTRACTS	0	0	0	0	0	0	0	0	0
ASPERGILLUS FLAVUS STRAIN AF36	<1	0	0	0	0	0	<1	4	4
AZADIRACHTIN	1,350	2,408	2,235	2,246	2,502	1,885	2,014	2,638	3,137
BACILLUS POPILLIAE	0	0	0	0	0	0	0	0	<1
BACILLUS PUMILUS, STRAIN QST 2808	3,567	5,646	7,062	8,138	6,987	6,783	7,535	6,747	6,206
BACILLUS SPHAERICUS, SEROTYPE H-5A5B, STRAIN 2362	34,154	45,430	20,192	21,441	18,178	13,013	10,595	9,123	10,628
BACILLUS SUBTILIS GB03	15	14	6	1	<1	<1	<1	1	1
BACILLUS SUBTILIS MBI600	0	0	0	0	0	0	0	<1	<1
BACILLUS SUBTILIS VAR. AMYLOLIQUEFACIENS STRAIN FZB24	0	0	0	0	0	0	0	3	90
BACILLUS THURINGIENSIS (BERLINER)	16	35	27	16	4	6	26	18	11
BACILLUS THURINGIENSIS (BERLINER), SUBSP. AIZAWAI, GC-91 PROTEIN	11,255	9,377	20,474	20,484	27,539	20,397	11,666	17,042	13,265
BACILLUS THURINGIENSIS (BERLINER), SUBSP. AIZAWAI, SEROTYPE H-7	2,336	1,752	2,877	2,373	894	814	819	730	357
BACILLUS THURINGIENSIS (BERLINER), SUBSP. ISRAELENSIS, SEROTYPE H-14	11,869	14,310	8,267	9,433	17,202	11,401	22,639	12,572	9,455
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI STRAIN SA-12	16,580	16,042	22,702	12,325	12,128	7,424	4,689	10,269	8,182
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A,3B	1,932	2,272	987	460	402	150	244	234	53
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN EG 2348	211	281	147	369	118	66	478	44	500

Table 17: (continued) *The reported pounds of pesticides used that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN EG2371	5	1	0	0	0	<1	<1	0	0
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN SA-11	53,895	54,236	63,866	66,612	80,565	75,036	58,242	52,424	77,571
BACILLUS THURINGIENSIS (BERLINER), SUBSP. SAN DIEGO	<1	2	2	0	<1	<1	0	0	0
BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI STRAIN BMP 123	1	3	0	764	118	14	0	0	0
BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI, GENETICALLY ENGINEERED STRAIN EG7841 LEPIDOPTERAN ACTIVE TOXIN	338	3,872	632	277	42	1	75	298	5
BACILLUS THURINGIENSIS VAR. KURSTAKI STRAIN M-200	0	0	<1	0	<1	0	0	0	0
BACILLUS THURINGIENSIS VAR. KURSTAKI, GENETICALLY ENGINEERED STRAIN EG7826	1,919	1,384	154	442	95	0	0	528	0
BACILLUS THURINGIENSIS, SUBSP. AIZAWAI, STRAIN ABTS-1857	33,336	28,905	32,529	39,464	31,043	26,250	24,281	30,572	29,858
BACILLUS THURINGIENSIS, SUBSP. AIZAWAI, STRAIN SD-1372, LEPIDOPTERAN ACTIVE TOXIN(S)	315	432	563	256	243	130	88	1	18
BACILLUS THURINGIENSIS, SUBSP. ISRAELENSIS, STRAIN AM 65-52	41,734	59,019	40,376	52,969	53,778	71,050	52,813	173,147	50,215
BACILLUS THURINGIENSIS, SUBSP. KURSTAKI, STRAIN ABTS-351, FERMENTATION SOLIDS AND SOLUBLES	57,987	53,351	71,755	78,527	69,620	96,988	83,013	95,257	83,537
BACILLUS THURINGIENSIS, SUBSP. KURSTAKI, STRAIN HD-1	3,185	6,139	2,262	2,068	3,747	3,579	2,611	3,187	2,318

Table 17: (continued) *The reported pounds of pesticides used that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
BACILLUS THURINGIENSIS, VAR. KURSTAKI DELTA ENDOTOXINS CRY 1A(C) AND CRY 1C (GENETICALLY ENGINEERED) ENCAPSULATED IN PSEUDOMONAS FLUORESCENS (KILLED)	3	<1	1	26	28	<1	<1	4	0
BACTERIOPHAGE ACTIVE AGAINST XANTHOMONAS CAMPESTRIS PV. VESICATORIA AND PSEUDOMONAS SYRINGAE PV. TOMATO	0	0	0	0	0	0	<1	<1	<1
BALSAM FIR OIL	0	0	0	0	0	<1	0	<1	<1
BEAUVERIA BASSIANA STRAIN GHA	824	571	711	569	378	357	607	1,053	1,634
BUFFALO GOURD ROOT POWDER	0	0	137	279	1	11	0	1	25
CANDIDA OLEOPHILA ISOLATE I-182	0	0	0	0	0	0	0	0	0
CANOLA OIL	1	4	29	25	17	131	26	15	28
CAPSICUM OLEORESIN	2	2	10	5	2	4	4	12	10
CARBON DIOXIDE	50,301	53,732	32,010	44,315	7,727	17,550	21,239	30,826	15,739
CASTOR OIL	79	37	4	4	21	7	<1	2	<1
CHENOPODIUM AMBROSIODES NEAR AMBROSIODES	0	0	0	0	20,367	10,336	7,897	10,231	20,206
CHITOSAN	0	0	0	0	0	0	0	0	0
CINNAMALDEHYDE	34	12	3	354	0	0	1	0	0
CITRIC ACID	41,844	45,264	41,249	57,279	56,086	74,758	89,463	94,150	126,724
CLARIFIED HYDROPHOBIC EXTRACT OF NEEM OIL	117,205	96,537	110,881	104,822	106,271	115,931	70,574	77,253	118,952
CODLING MOTH GRANULOSIS VIRUS	0	<1	<1	<1	<1	<1	<1	<1	<1
CONIOTHYRIUM MINITANS STRAIN CON/M/91-08	6	11	6	0	127	80	176	245	611
CORN GLUTEN MEAL	2	1	0	<1	0	0	0	0	0
CORN SYRUP	0	0	81	1,893	2,891	3,026	4,377	4,766	3,216
COYOTE URINE	0	0	0	0	0	<1	1	2	3
CYTOKININ	0	0	0	0	0	0	<1	<1	<1
DIHYDRO-5-HEPTYL-2(3H)-FURANONE	<1	<1	<1	<1	<1	<1	0	0	0
DIHYDRO-5-PENTYL-2(3H)-FURANONE	<1	<1	<1	<1	<1	<1	0	0	0
E,E-8,10-DODECADIEN-1-OL	2,388	2,278	2,273	2,037	4,978	1,942	1,376	1,995	2,216
E-11-TETRADECEN-1-YL ACETATE	79	99	2,399	744	312	100	172	133	142
E-8-DODECENYL ACETATE	118	229	236	265	607	898	192	270	273

Table 17: (continued) *The reported pounds of pesticides used that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
ENCAPSULATED DELTA ENDOTOXIN OF BACILLUS THURINGIENSIS VAR. KURSTAKI IN KILLED PSEUDOMONAS FLUORESCENS	7	6	32	18	18	0	1	<1	0
ENCAPSULATED DELTA ENDOTOXIN OF BACILLUS THURINGIENSIS VAR. SAN DIEGO IN KILLED PSEUDOMONAS FLUORESCENS	1	0	0	0	0	0	0	0	0
ESSENTIAL OILS	<1	4	<1	0	<1	<1	<1	1	<1
ETHYLENE	0	0	0	0	0	97	1,030	868	1,247
EUCALYPTUS OIL	50	<1	0	0	0	22	<1	0	0
EUGENOL	<1	<1	0	0	0	0	0	1	<1
FARNESOL	10	4	2	2	3	10	5	11	21
FENUGREEK	0	5	31	6	17	1	5	8	2
FERRIC SODIUM EDTA	0	0	0	0	0	0	1,979	6,278	5,851
FISH OIL	0	0	0	0	0	0	1,657	5,466	4,114
FORMIC ACID	0	1	1,509	499	280	223	241	634	77
FOX URINE	0	0	0	0	0	<1	<1	2	2
GAMMA AMINOBUTYRIC ACID	8,679	4,213	1,936	944	177	118	40	133	28
GARLIC	203	89	142	212	36	423	29	1,905	2,831
GERANIOL	0	<1	0	1	5	23	12	28	54
GERMAN COCKROACH PHEROMONE	<1	<1	<1	<1	<1	<1	<1	<1	<1
GIBBERELLINS	26,516	24,688	25,083	23,516	22,917	21,357	21,280	22,664	28,459
GIBBERELLINS, POTASSIUM SALT	<1	15	<1	<1	0	<1	<1	5	0
GLIOCLADIUM VIRENS GL-21 (SPORES)	19	1	152	945	356	945	649	1,957	3,518
GLUTAMIC ACID	8,679	4,213	1,936	944	177	118	40	133	28
HARPIN PROTEIN	127	60	32	16	14	13	11	1	1
HEPTYL BUTYRATE	0	0	0	0	0	<1	<1	<1	14
HYDROGEN PEROXIDE	5,553	17,526	11,860	20,740	21,750	69,179	59,233	36,303	46,867
HYDROPRENE	2,910	11,970	2,282	2,383	1,664	6,382	11,261	3,946	7,315
IBA	11	31	20	11	6	7	9	12	15
INDOLE	0	0	0	0	0	0	0	0	<1
IRON PHOSPHATE	1,645	1,484	1,634	1,901	1,435	2,351	2,874	2,309	2,118
KAOLIN	983,105	1,638,397	1,681,292	1,460,552	2,376,194	3,040,482	1,683,684	2,001,709	2,467,060
LACTOSE	7,903	10,667	9,019	11,341	9,191	7,967	9,285	6,554	7,098
LAGENIDIUM GIGANTEUM (CALIFORNIA STRAIN)	<1	0	<1	<1	0	0	0	5	0
LAURYL ALCOHOL	876	472	503	830	432	736	497	755	415
LAVANDULYL SENECIOATE	0	0	0	140	462	437	6,120	586	361

Table 17: (continued) *The reported pounds of pesticides used that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
LIMONENE	45,890	32,845	68,949	45,536	56,495	56,406	62,925	73,979	61,179
LINALOOL	176	170	113	63	62	1,104	95	137	72
MARGOSA OIL	0	0	0	0	0	579	7,886	9,106	12,189
MENTHOL	93	<1	0	0	0	5	<1	0	20
METARHIZIUM ANISOPLIAE STRAIN F52	0	0	0	0	0	0	0	116	89
METARHIZIUM ANISOPLIAE, VAR. ANISOPLIAE, STRAIN ESF1	<1	<1	<1	<1	0	<1	<1	0	0
METHOPRENE	9,900	6,941	3,357	2,620	1,568	1,492	1,809	1,304	1,338
METHYL ANTHRANILATE	151	449	152	118	312	343	448	300	1,237
METHYL EUGENOL	0	0	0	0	0	0	5	0	9
METHYL NONYL KETONE	<1	0	<1	<1	<1	<1	0	0	<1
METHYL SALICYLATE	0	<1	<1	0	<1	0	0	0	0
MONTOK PEPPER	0	0	0	0	0	0	0	0	0
MUSCALURE	14	15	22	19	20	15	15	16	12
MYRISTYL ALCOHOL	178	96	102	169	88	150	102	155	84
MYROTHECIUM VERRUCARIA, DRIED FERMENTATION SOLIDS & SOLUBLES, STRAIN AARC-0255	27,977	25,039	29,990	23,867	23,273	22,813	27,757	25,556	27,110
N6-BENZYL ADENINE	124	446	198	153	168	217	128	168	182
NAA	12	9	4	31	3	5	4	9	15
NAA, AMMONIUM SALT	1,543	1,100	1,253	1,193	1,203	976	839	1,400	1,055
NAA, ETHYL ESTER	3	1	2	8	3	6	23	4	3
NAA, POTASSIUM SALT	0	9	11	0	0	0	0	0	0
NAA, SODIUM SALT	8	3	3	1	2	0	0	0	2
NEROLIDOL	8	3	2	2	6	24	12	28	54
NITROGEN, LIQUIFIED	82,298	57,121	15,741	11,945	2,181	135	216	74	594
NONANOIC ACID	8,845	11,203	10,949	11,093	9,063	17,322	17,939	18,197	21,552
NONANOIC ACID, OTHER RELATED	466	590	576	584	477	912	944	958	1,134
NOSEMA LOCUSTAE SPORES	<1	<1	<1	<1	<1	<1	<1	1	<1
OIL OF ANISE	<1	<1	<1	<1	0	0	<1	<1	<1
OIL OF BERGAMOT	0	<1	0	0	0	0	0	0	0
OIL OF BLACK PEPPER	0	0	<1	<1	1	<1	<1	<1	1
OIL OF CEDARWOOD	0	0	0	0	0	<1	0	0	0
OIL OF CITRONELLA	<1	<1	<1	3	0	5	46	0	0
OIL OF CITRUS	<1	0	0	0	0	0	0	0	0
OIL OF GERANIUM	0	0	0	0	0	<1	0	0	0
OIL OF JOJOBA	3,540	9,572	7,240	12,070	3,418	4,176	1,230	507	134
OIL OF LEMON EUCALYPTUS	0	0	0	0	0	0	<1	3	0
OIL OF LEMONGRASS	<1	<1	0	0	0	0	0	0	0

Table 17: (continued) *The reported pounds of pesticides used that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
OIL OF MUSTARD	0	0	0	0	0	0	0	0	0
OIL OF PEPPERMINT	<1	0	<1	<1	0	<1	0	0	0
OXYPURINOL	<1	0	<1	0	0	0	0	0	0
PAECILOMYCES FUMOSOROSEUS APOPKA STRAIN 97	0	0	0	0	0	0	0	507	3,250
PAECILOMYCES LILACINUS STRAIN 251	0	0	0	0	0	252	515	840	4,073
PANTOEA AGGLOMERANS STRAIN E325, NRRL B-21856	0	0	0	0	33	4	1	1	1
PERFUME	0	0	0	0	0	0	0	0	0
PHENYLETHYL PROPIONATE	2	151	326	502	500	822	423	531	700
POLYHEDRAL OCCLUSION BODIES (OB'S) OF THE NUCLEAR POLYHEDROSIS VIRUS OF HELICOVERPA ZEA (CORN EARWORM)	0	0	0	<1	1	1	51	6	1
POLYOXIN D, ZINC SALT	210	237	234	331	397	1,296	3,511	4,736	6,496
POTASSIUM BICARBONATE	390,806	163,083	114,163	109,171	180,858	275,648	357,977	226,566	236,738
POTASSIUM PHOSPHITE	132,995	135,335	189,512	182,376	141,395	287,730	279,700	281,489	372,427
POTASSIUM SORBATE	551	1,262	743	0	<1	65	0	0	0
PROPYLENE GLYCOL	48,956	42,641	28,505	24,132	25,792	54,215	47,931	58,379	85,611
PSEUDOMONAS FLUORESCENS, STRAIN A506	896	1,004	614	390	328	217	274	59	92
PSEUDOMONAS SYRINGAE STRAIN ESC-11	<1	<1	0	0	0	0	0	0	0
PSEUDOMONAS SYRINGAE, STRAIN ESC-10	0	<1	0	0	0	<1	0	0	3
PUTRESCENT WHOLE EGG SOLIDS	60	69	20	1	143	3	1	1	1
PYTHIUM OLIGANDRUM DV74	0	0	0	0	0	0	<1	<1	<1
QST 713 STRAIN OF DRIED BACILLUS SUBTILIS	14,040	17,139	17,337	16,703	16,203	21,307	23,774	23,365	23,676
QUILLAJA	0	83	276	1,183	410	682	1,060	732	1,002
REYNOUTRIA SACHALINENSIS	0	0	0	0	179	8,996	14,806	14,784	15,280
S-ABSCISIC ACID	0	0	0	7	66	864	1,852	2,651	2,131
S-METHOPRENE	1,138	1,391	1,726	3,520	3,285	3,921	2,313	2,319	2,331
SALICYLIC ACID	0	<1	0	0	0	0	0	0	0
SAWDUST	<1	2	<1	1	<1	1	0	4	4
SESAME OIL	0	35	883	529	851	1,309	1,327	15	<1
SILVER NITRATE	0	0	0	0	0	<1	<1	<1	<1
SODIUM BICARBONATE	0	0	0	67	27	3	515	146	44

Table 17: (continued) *The reported pounds of pesticides used that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
SODIUM CHLORIDE	84	1,027	715	4	3	2	169	124	119
SODIUM LAURYL SULFATE	15	274	400	340	146	96	458	884	431
SOYBEAN OIL	46,199	70,398	14,747	12,005	28,801	23,805	24,098	22,022	45,688
STREPTOMYCES GRISEOVIRIDIS STRAIN K61	<1	1	<1	<1	<1	<1	<1	<1	10
STREPTOMYCES LYDICUS WYEC 108	0	<1	<1	<1	1	2	1	2	3
SUCROSE OCTANOATE	0	2	0	1,685	4,003	1,128	230	55	188
THYME	0	171	485	593	775	1,311	666	837	1,135
THYMOL	232	1,026	289	523	1,675	1,539	265	181	396
TRICHODERMA HARZIANUM RIFAI STRAIN KRL-AG2	16	24	38	20	11	504	129	158	184
TRICHODERMA ICC 012 ASPERELLUM	0	0	0	0	0	0	13	19	43
TRICHODERMA ICC 080 GAMSII	0	0	0	0	0	0	13	19	43
ULOCLADIUM OUDEMANSII (U3 STRAIN)	0	0	0	0	0	0	0	0	29
VANILLIN	0	1	5	1	3	<1	1	1	<1
VEGETABLE OIL	208,860	256,605	154,128	270,375	196,078	323,250	514,599	276,278	315,138
XANTHINE	<1	0	<1	0	0	0	0	0	0
XANTHOMONAS CAMPESTRIS PV. POANNUA	0	<1	0	0	0	0	0	0	0
YEAST	1,106	1,159	1,030	999	926	470	1,165	818	80
YUCCA SCHIDIGERA	0	0	0	7	169	634	1,649	7,147	11,679
Z,E-9,12-TETRADECADIEN-1-YL ACETATE	0	0	1	0	6,149	1	7	6	14
Z-11-TETRADECEN-1-YL ACETATE	12	14	228	9	9	9	4	8	8
Z-8-DODECENOL	21	41	41	47	106	157	33	45	44
Z-8-DODECENYL ACETATE	1,818	3,454	3,646	4,050	9,261	13,964	2,947	3,805	3,460
Z-9-TETRADECEN-1-OL	0	0	0	0	0	0	0	0	0
TOTAL	2,573,956	3,075,738	2,922,836	2,834,532	3,720,035	4,886,496	3,733,985	3,859,944	4,513,139

Table 18: *The reported cumulative acres treated with pesticides that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones). Use includes primarily agricultural applications. The grand total for acres treated may be less than the sum of acres treated for all active ingredients because some products contain more than one active ingredient. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
(3S, 6R)-3-METHYL-6-ISOPROPENYL-9-DECEN-1-YL ACETATE	1,604	1,484	0	0	3	0	0	7	0
(3S, 6S)-3-METHYL-6-ISOPROPENYL-9-DECEN-1-YL ACETATE	1,604	1,484	0	0	3	0	0	7	0
(E)-4-TRIDECEN-1-YL-ACETATE	3,226	4,870	5,193	7,672	3,982	3,905	0	0	0
(E)-5-DECEN-1-OL	0	0	0	0	0	0	0	53	83
(E)-5-DECENOL	70	385	737	262	118	249	166	502	837
(E)-5-DECENYL ACETATE	70	385	737	262	118	249	166	555	920
(E,E)-9, 11-TETRADECADIEN-1-YL ACETATE	0	0	22	956	3	474	759	608	985
(E,Z)-7,9-DODECADIEN-1-YL ACETATE	0	0	0	0	0	5,168	18,098	22,856	2,479
(R,Z)-5-(1-DECENYL) DIHYDRO-2-(3H)-FURANONE	<1	0	0	0	0	0	0	0	0
(S)-KINOPRENE	494	440	453	575	510	490	346	506	667
(S)-VERBENONE	0	0	0	0	0	0	0	100	0
(Z)-11-HEXADECEN-1-YL ACETATE	164	183	116	0	1,622	0	49	0	0
(Z)-11-HEXADECENAL	164	423	72	0	0	0	0	0	0
(Z)-4-TRIDECEN-1-YL-ACETATE	3,226	4,870	5,193	7,672	3,982	3,905	0	0	0
(Z)-9-DODECENYL ACETATE	570	96	5,342	1,304	123	74	1,814	392	555
(Z,E)-7,11-HEXADECADIEN-1-YL ACETATE	0	0	0	1	93	1	0	0	0
(Z,Z)-11,13-HEXADECADIENAL	0	0	200	109	0	763	11,336	17,283	20,591
(Z,Z)-7,11-HEXADECADIEN-1-YL ACETATE	0	0	0	0	93	1	0	0	0
1,4-DIMETHYLNAPHTHALENE	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,7-DIOXASPIRO-(5,5)-UNDECANE	49	4	55	<1	6	<1	<1	30	43
1-DECANOL	0	0	0	0	0	0	0	0	0
1-METHYLCYCLOPROPENE	8	2	6	13	61	3	1	17	21
1-NAPHTHALENEACETAMIDE	1,100	666	927	870	607	408	315	393	343
2-METHYL-1-BUTANOL	0	0	0	0	0	0	0	0	<1
3,13 OCTADECADIEN-1-YL ACETATE	0	0	0	85	0	50	131	0	<1
3,7-DIMETHYL-6-OCTEN-1-OL	0	0	0	67	349	1,531	788	2,220	3,939
ACETIC ACID	60	0	10	2	226	110	162	3,165	3,114
AGROBACTERIUM RADIOBACTER	306	698	555	217	215	362	325	852	624
AGROBACTERIUM RADIOBACTER, STRAIN K1026	292	335	366	1,935	5,086	81	19	4,947	9,016

Table 18: (continued) *The reported cumulative acres treated with pesticides that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
ALLYL ISOTHIOCYANATE	20	<1	0	0	0	0	0	<1	0
ALMOND, BITTER	0	328	2,068	87	471	74	412	271	88
AMINO ETHOXY VINYL GLYCINE HYDROCHLORIDE	229	6,453	9,238	10,253	5,611	10,179	11,108	14,991	16,371
AMMONIUM BICARBONATE	49	4	55	<1	6	<1	<1	30	43
AMMONIUM NITRATE	280,712	433,770	503,230	643,869	679,859	726,842	814,429	865,418	1,084,560
AMPELOMYCES QUISQUALIS	247	10	14	0	22	2	0	0	0
ANIMAL GLAND EXTRACTS	0	0	0	0	0	0	0	0	0
ASPERGILLUS FLAVUS STRAIN AF36	258	0	0	0	0	0	260	48,833	89,337
AZADIRACHTIN	55,657	68,244	91,385	86,813	82,722	71,707	70,222	98,802	113,286
BACILLUS POPILLIAE	0	0	0	0	0	0	0	0	<1
BACILLUS PUMILUS, STRAIN QST 2808	34,748	64,333	79,795	91,795	75,509	72,582	84,061	76,173	67,718
BACILLUS SPHAERICUS, SEROTYPE H-5A5B, STRAIN 2362	<1	<1	<1	<1	<1	9	<1	231	60
BACILLUS SUBTILIS GB03	23	3	2	5	2	<1	6	<1	20
BACILLUS SUBTILIS MBI600	0	0	0	0	0	0	0	2	<1
BACILLUS SUBTILIS VAR. AMYLOLIQUEFACIENS STRAIN FZB24	0	0	0	0	0	0	0	406	1,702
BACILLUS THURINGIENSIS (BERLINER)	100	2,939	1,129	41	82	127	875	292	258
BACILLUS THURINGIENSIS (BERLINER), SUBSP. AIZAWAI, GC-91 PROTEIN	62,244	39,077	53,040	40,440	48,842	40,395	18,657	25,262	22,511
BACILLUS THURINGIENSIS (BERLINER), SUBSP. AIZAWAI, SEROTYPE H-7	19,190	15,784	24,379	20,510	7,888	6,847	7,800	6,219	3,283
BACILLUS THURINGIENSIS (BERLINER), SUBSP. ISRAELENSIS, SEROTYPE H-14	3,480	543	833	4,719	501	1,873	337	649	1,133
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI STRAIN SA-12	34,533	29,505	35,513	21,008	19,700	10,721	8,222	15,271	9,670
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A,3B	31,406	42,279	16,522	8,671	7,807	2,269	3,063	1,973	818
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN EG 2348	1,625	2,913	1,271	2,147	1,302	688	3,428	644	3,580

Table 18: (continued) *The reported cumulative acres treated with pesticides that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN EG2371	54	7	0	0	0	<1	<1	0	0
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN SA-11	156,026	125,390	119,055	100,581	101,522	111,686	84,065	81,628	95,190
BACILLUS THURINGIENSIS (BERLINER), SUBSP. SAN DIEGO	<1	<1	<1	0	<1	<1	0	0	0
BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI STRAIN BMP 123	20	93	0	1,898	310	73	0	0	0
BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI, GENETICALLY ENGINEERED STRAIN EG7841 LEPIDOPTERAN ACTIVE TOXIN	1,160	6,684	1,225	451	62	3	200	373	5
BACILLUS THURINGIENSIS VAR. KURSTAKI STRAIN M-200	0	0	<1	0	<1	0	0	0	0
BACILLUS THURINGIENSIS VAR. KURSTAKI, GENETICALLY ENGINEERED STRAIN EG7826	8,724	3,021	479	1,298	250	0	0	1,320	0
BACILLUS THURINGIENSIS, SUBSP. AIZAWAI, STRAIN ABTS-1857	47,071	41,546	43,209	49,890	41,724	37,209	35,252	41,581	36,812
BACILLUS THURINGIENSIS, SUBSP. AIZAWAI, STRAIN SD-1372, LEPIDOPTERAN ACTIVE TOXIN(S)	3,025	4,235	4,766	2,343	2,136	1,057	640	4	112
BACILLUS THURINGIENSIS, SUBSP. ISRAELENSIS, STRAIN AM 65-52	313	4,809	25	2,497	270	758	824	1,305	794
BACILLUS THURINGIENSIS, SUBSP. KURSTAKI, STRAIN ABTS-351, FERMENTATION SOLIDS AND SOLUBLES	109,681	100,697	133,297	134,290	120,801	162,444	152,440	164,835	149,243
BACILLUS THURINGIENSIS, SUBSP. KURSTAKI, STRAIN HD-1	29,129	23,346	20,045	15,173	20,295	18,369	16,390	15,228	10,096

Table 18: (continued) *The reported cumulative acres treated with pesticides that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
BACILLUS THURINGIENSIS, VAR. KURSTAKI DELTA ENDOTOXINS CRY 1A(C) AND CRY 1C (GENETICALLY ENGINEERED) ENCAPSULATED IN PSEUDOMONAS FLUORESCENS (KILLED)	<1	<1	<1	25	52	2	<1	10	0
BACTERIOPHAGE ACTIVE AGAINST XANTHOMONAS CAMPESTRIS PV. VESICATORIA AND PSEUDOMONAS SYRINGAE PV. TOMATO	0	0	0	0	0	0	11	25	21
BALSAM FIR OIL	0	0	0	0	0	<1	0	<1	<1
BEAUVERIA BASSIANA STRAIN GHA	3,531	2,743	2,481	2,091	2,188	1,686	2,703	4,012	6,451
BUFFALO GOURD ROOT POWDER	0	0	1,694	3,227	8	138	0	25	161
CANDIDA OLEOPHILA ISOLATE I-182	0	0	0	0	0	0	0	0	0
CANOLA OIL	2	5	33	1,388	1,541	4,786	3,872	2,329	5,791
CAPSICUM OLEORESIN	71	247	277	528	325	388	238	576	551
CARBON DIOXIDE	15	<1	<1	<1	<1	<1	26	917	5
CASTOR OIL	<1	2	<1	4	12	<1	<1	<1	<1
CHENOPODIUM AMBROSIODES NEAR AMBROSIODES	0	0	0	0	6,395	9,265	6,868	13,401	22,518
CHITOSAN	0	0	0	0	0	0	0	0	0
CINNAMALDEHYDE	18	10	2	556	0	0	<1	0	0
CITRIC ACID	830,425	852,995	815,766	919,736	903,198	1,204,588	1,331,759	1,389,495	1,534,850
CLARIFIED HYDROPHOBIC EXTRACT OF NEEM OIL	69,051	73,386	71,278	64,156	47,422	42,281	40,765	42,615	59,899
CODLING MOTH GRANULOSIS VIRUS	0	1,479	2,141	1,487	1,139	984	3,468	3,431	4,331
CONIOTHYRIUM MINITANS STRAIN CON/M/91-08	26	62	120	0	1,204	395	1,107	1,697	4,286
CORN GLUTEN MEAL	<1	<1	0	3	0	0	0	0	0
CORN SYRUP	0	0	1,132	7,991	14,316	12,877	27,721	27,760	15,992
COYOTE URINE	0	0	0	0	0	<1	12	<1	<1
CYTOKININ	0	0	0	0	0	0	199	2,409	352
DIHYDRO-5-HEPTYL-2(3H)-FURANONE	<1	<1	<1	<1	<1	<1	0	0	0
DIHYDRO-5-PENTYL-2(3H)-FURANONE	<1	<1	<1	<1	<1	<1	0	0	0
E,E-8,10-DODECADIEN-1-OL	21,896	20,728	27,784	21,585	15,309	15,283	17,872	15,879	18,241
E-11-TETRADECEN-1-YL ACETATE	7,351	6,637	6,189	5,996	5,592	5,405	1,701	4,485	4,396
E-8-DODECENYL ACETATE	33,419	37,412	49,086	54,242	46,757	49,591	45,667	49,300	47,596

Table 18: (continued) *The reported cumulative acres treated with pesticides that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
ENCAPSULATED DELTA ENDOTOXIN OF BACILLUS THURINGIENSIS VAR.KURSTAKI IN KILLED PSEUDOMONAS FLUORESCENS	33	9	35	91	37	0	<1	<1	0
ENCAPSULATED DELTA ENDOTOXIN OF BACILLUS THURINGIENSIS VAR. SAN DIEGO IN KILLED PSEUDOMONAS FLUORESCENS	0	0	0	0	0	0	0	0	0
ESSENTIAL OILS	<1	<1	1	0	<1	4	<1	<1	<1
ETHYLENE	0	0	0	0	0	4	70	49	36
EUCALYPTUS OIL	150	<1	0	0	0	2	<1	0	0
EUGENOL	<1	<1	0	0	0	0	0	<1	<1
FARNESOL	4,369	1,246	652	422	503	1,597	826	2,227	3,940
FENUGREEK	0	328	2,068	87	471	74	412	271	88
FERRIC SODIUM EDTA	0	0	0	0	0	0	3,049	8,418	8,031
FISH OIL	0	0	0	0	0	0	<1	382	252
FORMIC ACID	0	<1	1	51	10	60	1	368	5
FOX URINE	0	0	0	0	0	<1	12	<1	<1
GAMMA AMINOBUTYRIC ACID	114,189	58,586	24,697	12,905	1,786	835	542	1,811	384
GARLIC	513	363	346	288	374	1,123	1,369	12,410	14,485
GERANIOL	0	<1	0	67	349	1,531	788	2,220	3,939
GERMAN COCKROACH PHEROMONE	6	<1	<1	<1	<1	<1	<1	<1	<1
GIBBERELLINS	462,231	458,764	455,130	490,530	514,164	491,933	509,843	529,739	543,917
GIBBERELLINS, POTASSIUM SALT	65	348	32	8	0	34	150	795	0
GLIOCLADIUM VIRENS GL-21 (SPORES)	18	<1	5	1,090	716	1,401	1,076	3,172	5,412
GLUTAMIC ACID	114,189	58,586	24,697	12,905	1,786	835	542	1,811	384
HARPIN PROTEIN	12,232	6,089	3,721	1,998	1,562	1,631	1,582	115	95
HEPTYL BUTYRATE	0	0	0	0	0	<1	<1	<1	<1
HYDROGEN PEROXIDE	985	9,952	7,744	9,361	14,521	23,208	39,181	21,863	22,803
HYDROPRENE	<1	7	2	200	82	<1	<1	2	4
IBA	79	27,670	44,093	3,862	150	227	1,156	1,283	962
INDOLE	0	0	0	0	0	0	0	0	<1
IRON PHOSPHATE	3,910	4,197	7,145	6,569	4,561	6,345	5,477	6,519	6,274
KAOLIN	39,436	63,343	56,911	47,438	66,850	82,636	50,899	57,704	79,876
LACTOSE	79,734	95,549	80,366	99,526	80,355	80,387	91,936	68,442	78,695
LAGENIDIUM GIGANTEUM (CALIFORNIA STRAIN)	2	0	<1	<1	0	0	0	2	0
LAURYL ALCOHOL	6,719	5,488	9,358	7,782	4,705	5,495	6,443	6,652	7,807
LAVANDULYL SENECIOATE	0	0	0	4,316	2,375	7,025	11,754	6,666	5,869

Table 18: (continued) *The reported cumulative acres treated with pesticides that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
LIMONENE	62,359	75,333	79,012	64,151	55,465	29,621	15,514	73,329	29,333
LINALOOL	<1	<1	<1	7	1	<1	<1	<1	<1
MARGOSA OIL	0	0	0	0	0	40	4,260	7,977	9,546
MENTHOL	150	<1	0	0	0	2	<1	0	20
METARHIZIUM ANISOPLIAE STRAIN F52	0	0	0	0	0	0	0	202	133
METARHIZIUM ANISOPLIAE, VAR. ANISOPLIAE, STRAIN ESF1	<1	<1	<1	<1	0	<1	<1	0	0
METHOPRENE	<1	157	51	42	211	4	896	<1	<1
METHYL ANTHRANILATE	448	1,557	298	219	550	380	2,043	215	1,092
METHYL EUGENOL	0	0	0	0	0	0	<1	0	<1
METHYL NONYL KETONE	<1	0	<1	<1	1	<1	0	0	<1
METHYL SALICYLATE	0	<1	1	0	<1	0	0	0	0
MONTOK PEPPER	0	0	0	0	0	0	0	0	0
MUSCALURE	2,715	476	1,179	<1	739	300	68	40	49
MYRISTYL ALCOHOL	6,719	5,488	9,358	7,782	4,705	5,495	6,443	6,652	7,807
MYROTHECIUM VERRUCARIA, DRIED FERMENTATION SOLIDS & SOLUBLES, STRAIN AARC-0255	4,680	4,478	5,097	5,257	5,331	4,840	5,136	4,274	4,570
N6-BENZYL ADENINE	1,552	7,711	2,628	1,775	2,072	3,352	1,691	1,666	2,954
NAA	49	26,799	43,507	3,331	47	38	220	655	293
NAA, AMMONIUM SALT	12,569	11,174	11,709	10,445	9,024	9,140	9,075	11,922	10,611
NAA, ETHYL ESTER	<1	<1	<1	73	1	23	396	384	113
NAA, POTASSIUM SALT	0	41	41	0	0	0	0	0	0
NAA, SODIUM SALT	858	452	340	37	257	0	0	0	153
NEROLIDOL	4,369	1,246	652	422	503	1,597	826	2,227	3,940
NITROGEN, LIQUIFIED	<1	<1	<1	<1	<1	<1	<1	<1	<1
NONANOIC ACID	675	883	1,275	498	703	412	828	480	2,181
NONANOIC ACID, OTHER RELATED	675	877	1,275	498	701	412	828	460	2,181
NOSEMA LOCUSTAE SPORES	1	<1	254	30	132	12	12	1,612	1,206
OIL OF ANISE	<1	<1	<1	<1	0	0	<1	<1	<1
OIL OF BERGAMOT	0	<1	0	0	0	0	0	0	0
OIL OF BLACK PEPPER	0	0	<1	<1	<1	<1	<1	<1	<1
OIL OF CEDARWOOD	0	0	0	0	0	15	0	0	0
OIL OF CITRONELLA	<1	<1	<1	2	0	34	48	0	0
OIL OF CITRUS	<1	0	0	0	0	0	0	0	0
OIL OF GERANIUM	0	0	0	0	0	15	0	0	0
OIL OF JOJOBA	4,705	9,029	7,846	11,566	7,203	8,255	1,760	1,075	311
OIL OF LEMON EUCALYPTUS	0	0	0	0	0	0	<1	<1	0
OIL OF LEMONGRASS	20	<1	0	0	0	0	0	0	0

Table 18: (continued) *The reported cumulative acres treated with pesticides that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
OIL OF MUSTARD	0	0	0	0	0	0	0	0	0
OIL OF PEPPERMINT	<1	0	<1	<1	0	15	0	0	0
OXYPURINOL	<1	0	1	0	0	0	0	0	0
PAECILOMYCES FUMOSOROSEUS APOPKA STRAIN 97	0	0	0	0	0	0	0	2,109	12,595
PAECILOMYCES LILACINUS STRAIN 251	0	0	0	0	0	1,115	2,330	3,531	20,039
PANTOEA AGGLOMERANS STRAIN E325, NRRL B-21856	0	0	0	0	698	55	25	50	50
PERFUME	0	0	0	0	0	0	0	0	0
PHENYLETHYL PROPIONATE	<1	<1	<1	<1	94	<1	<1	<1	<1
POLYHEDRAL OCCLUSION BODIES (OB'S) OF THE NUCLEAR POLYHEDROSIS VIRUS OF HELICOVERPA ZEA (CORN EARWORM)	0	0	0	98	254	302	14,752	1,297	337
POLYOXIN D, ZINC SALT	9	<1	3	1,067	1,299	19,082	69,612	95,595	140,068
POTASSIUM BICARBONATE	143,968	61,465	47,299	41,899	69,155	101,283	118,559	74,565	84,805
POTASSIUM PHOSPHITE	44,277	42,856	52,370	49,951	36,665	92,671	82,322	115,741	131,327
POTASSIUM SORBATE	340	571	230	0	2	105	0	0	0
PROPYLENE GLYCOL	754,665	738,448	520,537	420,161	381,957	591,117	661,970	675,441	973,139
PSEUDOMONAS FLUORESCENS, STRAIN A506	7,176	11,929	4,801	1,943	2,463	1,472	1,281	372	431
PSEUDOMONAS SYRINGAE STRAIN ESC-11	<1	<1	0	0	0	0	0	0	0
PSEUDOMONAS SYRINGAE, STRAIN ESC-10	0	<1	0	0	0	3	0	0	<1
PUTRESCENT WHOLE EGG SOLIDS	<1	<1	<1	<1	33	2	<1	<1	<1
PYTHIUM OLIGANDRUM DV74	0	0	0	0	0	0	2	2	63
QST 713 STRAIN OF DRIED BACILLUS SUBTILIS	56,342	64,606	67,563	75,619	81,484	99,317	117,414	124,256	137,455
QUILLAJA	0	3,591	18,584	27,814	22,595	22,949	29,890	22,058	28,171
REYNOUTRIA SACHALINENSIS	0	0	0	0	1,297	70,363	90,497	93,997	95,944
S-ABSCISIC ACID	0	0	0	34	502	5,197	9,528	14,974	11,645
S-METHOPRENE	2,395	9,552	30,635	47,284	47,350	65,114	62,628	87,289	49,451
SALICYLIC ACID	0	<1	0	0	0	0	0	0	0
SAWDUST	23	<1	10	19	<1	<1	0	74	108
SESAME OIL	0	<1	888	846	1,448	1,912	1,938	39	1
SILVER NITRATE	0	0	0	0	0	<1	<1	5	22
SODIUM BICARBONATE	0	0	0	17	57	1	967	1,026	291

Table 18: (continued) *The reported cumulative acres treated with pesticides that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones).*

AI	2005	2006	2007	2008	2009	2010	2011	2012	2013
SODIUM CHLORIDE	7	<1	<1	<1	<1	<1	2	175	216
SODIUM LAURYL SULFATE	<1	<1	<1	14	<1	<1	<1	<1	<1
SOYBEAN OIL	6,344	3,675	3,277	2,460	4,557	6,160	3,636	3,302	4,508
STREPTOMYCES GRISEOVIRIDIS STRAIN K61	20	29	12	<1	<1	<1	1	<1	5
STREPTOMYCES LYDICUS WYEC 108	0	50	96	1,910	4,009	6,998	6,403	10,367	15,874
SUCROSE OCTANOATE	0	4	0	448	930	1,172	148	1	5
THYME	0	<1	<1	<1	68	<1	<1	<1	<1
THYMOL	151	3	52	60	50	422	12	18	1
TRICHODERMA HARZIANUM RIFAI STRAIN KRL-AG2	406	286	311	201	320	7,253	873	1,088	972
TRICHODERMA ICC 012 ASPERELLUM	0	0	0	0	0	0	86	704	606
TRICHODERMA ICC 080 GAMSII	0	0	0	0	0	0	86	704	606
ULOCLADIUM OUDEMANSII (U3 STRAIN)	0	0	0	0	0	0	0	0	19
VANILLIN	0	328	2,068	87	471	74	412	271	88
VEGETABLE OIL	211,388	275,541	144,591	231,954	211,586	292,218	458,422	266,226	350,771
XANTHINE	<1	0	1	0	0	0	0	0	0
XANTHOMONAS CAMPESTRIS PV. POANNUA	0	14	0	0	0	0	0	0	0
YEAST	4,835	5,262	4,694	4,560	3,957	1,306	5,261	3,729	325
YUCCA SCHIDIGERA	0	0	0	18	598	2,316	4,907	16,093	19,464
Z,E-9,12-TETRADECADIEN-1-YL ACETATE	0	0	44	0	1,622	<1	49	<1	<1
Z-11-TETRADECEN-1-YL ACETATE	7,351	6,637	6,166	5,040	5,589	4,931	942	3,877	3,411
Z-8-DODECENOL	33,419	37,412	49,086	54,242	46,757	49,591	45,667	49,300	47,596
Z-8-DODECENYL ACETATE	33,419	37,412	49,086	54,242	46,757	49,591	45,667	49,300	47,596
Z-9-TETRADECEN-1-OL	0	0	0	0	0	0	0	0	0
TOTAL	3,893,339	4,075,445	3,814,782	4,013,525	3,913,500	4,771,669	5,315,725	5,467,917	6,337,498

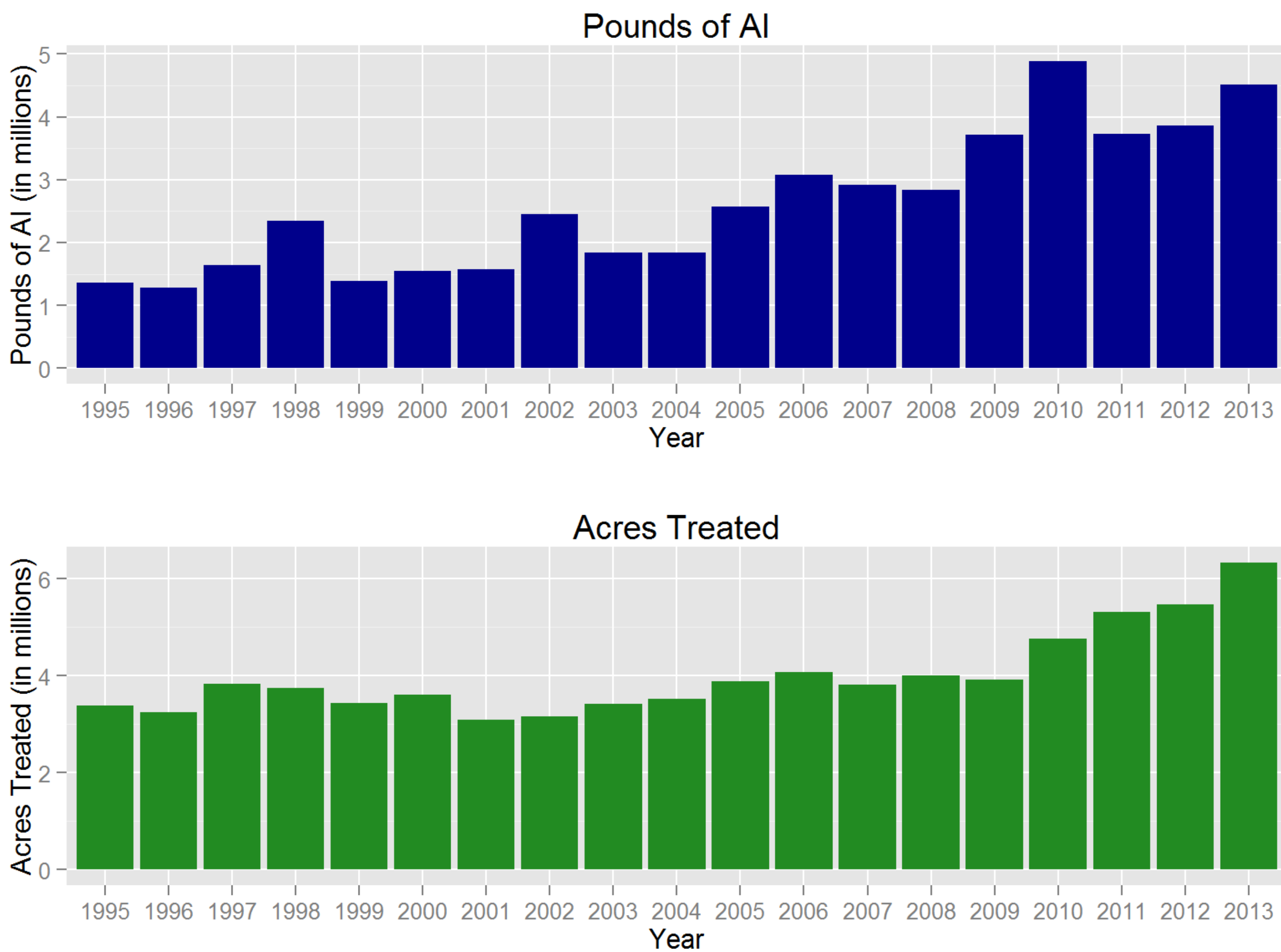

Figure 12: *Use trends of pesticides that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones). Reported pounds of active ingredient (AI) applied include both agricultural and non-agricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

5 Trends In Pesticide Use In Certain Commodities

This chapter describes possible reasons for changes in pesticide use from 2012 to 2013 in the following commodities: almond, wine grape, table and raisin grape, cotton, alfalfa, processing tomato, rice, walnut, pistachio, orange, strawberry, peach and nectarine, and carrot. These 13 commodities were chosen because each was treated with more than 3.9 million pounds of active ingredients (AIs) or treated on more than 2 million acres, cumulatively. Collectively, this represents 71 percent of the amount reported in the PUR (77 percent of total used on agricultural fields) and 74 percent of the area treated in 2013.

Information used to develop this chapter was drawn from several publications and phone interviews with pest control advisors, growers, University of California Cooperative Extension farm advisors and specialists, researchers, and commodity association representatives. DPR staff analyzed the information, using their knowledge of pesticides, California agriculture, pests, and pest management practices. However, it is important to note these explanations for changes in pesticide use are based on anecdotal information, not rigorous statistical analyses.

This report discusses two different measures of pesticide use: amount of AI applied in pounds and cumulative area treated in acres (for an explanation of cumulative area treated see page 10). Although total use increased from 2012 to 2013, the use of fumigants and fungicides and amount of herbicides decreased. The big increase was in insecticide use (Figures 1 and 2). Among the most-used non-adjuvant pesticides by amount, the insecticide chlorpyrifos had the greatest percentage increase in use. Also increasing were oils, oxyfluorfen, and kaolin. Among the most-used pesticides by area treated, the insecticide etoxazole had the greatest percentage increase in use. Also with large increases in area treated were the insecticides chlorantraniliprole, dimethoate, and methoxyfenozide. The use of most insecticides increased.

The amount of sulfur accounted for 24 percent of all reported pesticide use in 2013. Sulfur is a natural fungicide favored by both conventional and organic farmers and is used mostly to control powdery mildew on grape and processing tomato. However, it is used in some crops to suppress mites.

Petroleum and mineral oils were used mostly as insecticides on almond, orange, peach and nectarine, wine grape, and pistachio. The fumigant 1,3-dichloropropene was used mostly for strawberry, almond, carrot, sweet potato, and wine grape. Glyphosate is an herbicide used mostly for almond, rights-of-way, wine grape, and cotton. Chloropicrin is a fumigant used mostly for strawberry. In production agriculture, fumigants are usually applied to the soil before planting a crop.

The insecticide abamectin is a natural fermentation product of a bacterium. It is mostly used for controlling mites, which were a problem for some crops in 2013 because the high temperatures in

July were favorable to mite population build-ups. By far, most of the use and most of the increase in use was in almond. It is also used in wine grape, walnut, and cotton.

Chlorpyrifos is an organophosphate insecticide. DPR has recently proposed to make all pesticide products containing chlorpyrifos a California restricted material. Most of the use amount and increase in use was in almond, but most of the use by area treated was in alfalfa. It is also used in walnut, cotton, and orange. Use in almond more than doubled between 2012 and 2013, largely due to large populations of leaffooted bugs and navel orangeworms. Etoxazole is an insect growth regulator used mostly to control mites in almond, corn, and grapes. It controls mites through inhibition of chitin biosynthesis and by causing adults to lay sterile eggs. Chlorantraniliprole is a relatively new insecticide that interrupts muscle contraction in caterpillars and in some beetles and flies. Most chlorantraniliprole is used in almond, pistachio, and walnut. Use on all three crops has increased dramatically since its first use in 2008. Methoxyfenozide is an insect growth regulator that disrupts natural molting of caterpillars by mimicking the action of the insect hormone ecdysone. Methoxyfenozide will cause the insect to molt prematurely and to stop feeding, leading to its death. Most use is on almond for navel orangeworm control followed by use on pistachio, wine grape, table and raisin grape, and alfalfa.

Crops treated with the greatest amount of pesticides in 2013 were almond, wine grape, table and raisin grape, strawberry, and processing tomato. Major crops or sites with an increase in amount applied from 2012 to 2013 include almond, soil fumigation, pistachio, walnut, and processing tomato (Table 19). For all these crops, the increase in pesticide use was larger than the increase in area planted. Crops with a decrease in amount applied include strawberry, carrot, fruiting peppers, cotton, and table and raisin grape.

Table 19: *The change in pounds of AI applied and acres planted or harvested and the percent change from 2012 to 2013 for the crops or sites with the greatest increase and decrease in pounds applied.*

	Change in Use 2012–2013		Percent Change 2012–2013	
Crop Treated	Pounds	Acres	Pounds	Acres
ALMOND	6,685,251	10,000	29	1
SOIL FUMIGATION/PREPLANT	2,073,693		43	
PISTACHIO	767,455	21,000	19	12
WALNUT	767,060	10,000	18	4
TOMATO, PROCESSING	418,791	3,000	3	1
GRAPE	-366,703	7,000	-2	2
COTTON	-523,397	-87,000	-15	-24
PEPPER, FRUITING	-534,627	-500	-30	-2
CARROT	-822,503	1,000	-11	2
STRAWBERRY	-1,821,785	3,000	-13	8

DPR data analyses have shown that pesticide use varies from year to year. A grower's or applicator's decision to spray or not depends on many things, such as current pest levels and the likelihood that pest populations will increase; cost of pesticides and their application relative to the economic loss from pest damage, which depends on the expected amount of damage and the value of the crop; the availability of other methods to manage the pest; and the desire to minimize possible harm to the environment and farm workers. Pest populations are determined by many complex ecological interactions; sometimes the causes of pest outbreaks are unknown. Weather is a critically important factor and affects different pest species in different ways. For example, the winter and spring of 2013 was relatively dry and mild, conditions that reduced levels of many weeds and diseases, but helped overwintering survival of many insect pests. Insect pest populations were high in many crops in 2013. High summer temperatures, such as those seen in June and July 2013, favored spider mites build-ups.

In the following tables, use is expressed as pounds of AI applied and as cumulative number of acres treated. However, in some tables, such as the first table in each crop section, acres treated values are summed across different AIs and include data from applications of products that contain more than one AI. For those applications, the acres treated during that application are only tallied once, rather than adding acres treated for each AI in the product.

Almond

Almonds have the highest economic value of any California nut crop and have the highest export value of any American specialty crop. Almond acreage has been consistently increasing the last 15 years and was up 1 percent from 930,000 acres in 2012 to 940,000 in 2013. Of the total acreage for 2013, 840,000 acres were bearing and 100,000 acres were non-bearing. The total production in California in 2013 was about 2.01 billion nutmeat pounds, a 6.3 percent increase over 2012 production. There are three distinct almond-growing regions in California: Sacramento Valley, central San Joaquin Valley, and southern San Joaquin Valley. Weather conditions and pest pressure—and pesticide use—can vary greatly from region to region.

Table 20: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for almond each year from 2009 to 2013. Planted acres from 2009 to 2013 are from CDFA, April 2014b; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	18,925,424	20,415,787	25,844,533	22,994,378	29,679,628
Acres Treated	10,530,084	12,410,922	13,722,517	14,776,034	16,854,540
Acres Planted	840,000	855,000	875,000	930,000	940,000
Price/lb	$ 1.65	$ 1.79	$ 1.99	$ 2.58	$ 2.90

The winter of 2012-2013 was California's second driest in 50 years. The 2013 California almond production season began with a warm and dry February that created favorable bloom conditions, although the bloom period was shorter than in the previous year. The warm and dry winter favored leaf-footed plant bug and navel orangeworm (NOW) development, and these two insects were major problems in 2013. Disease pressure was minimal under the warm and dry winter conditions. The total pesticide use in almonds increased in 2013 compared to the use in 2012. In 2013 total pesticide use was close to 29.7 million pounds and 16.9 million acres treated (Table 20). Pounds of AI used increased 29.1 percent, acres treated increased 14.1 percent, planted acres increased 1 percent, and the price of almonds increased 12.4 percent from 2012 to 2013.

While fungicide and fumigant area treated decreased in 2013, insecticide and herbicide use increased dramatically. The number of acres treated with insecticides increased 40 percent, with herbicides increased 4 percent, and with fungicides decreased 10 percent (Figure 13). Fumigant use decreased 17 percent, and fungicide/insecticide use decreased 37 percent. By pounds, insecticide use increased 52 percent, herbicide use decreased 3 percent, fungicide use decreased 14 percent, and fumigant use increased 4 percent.

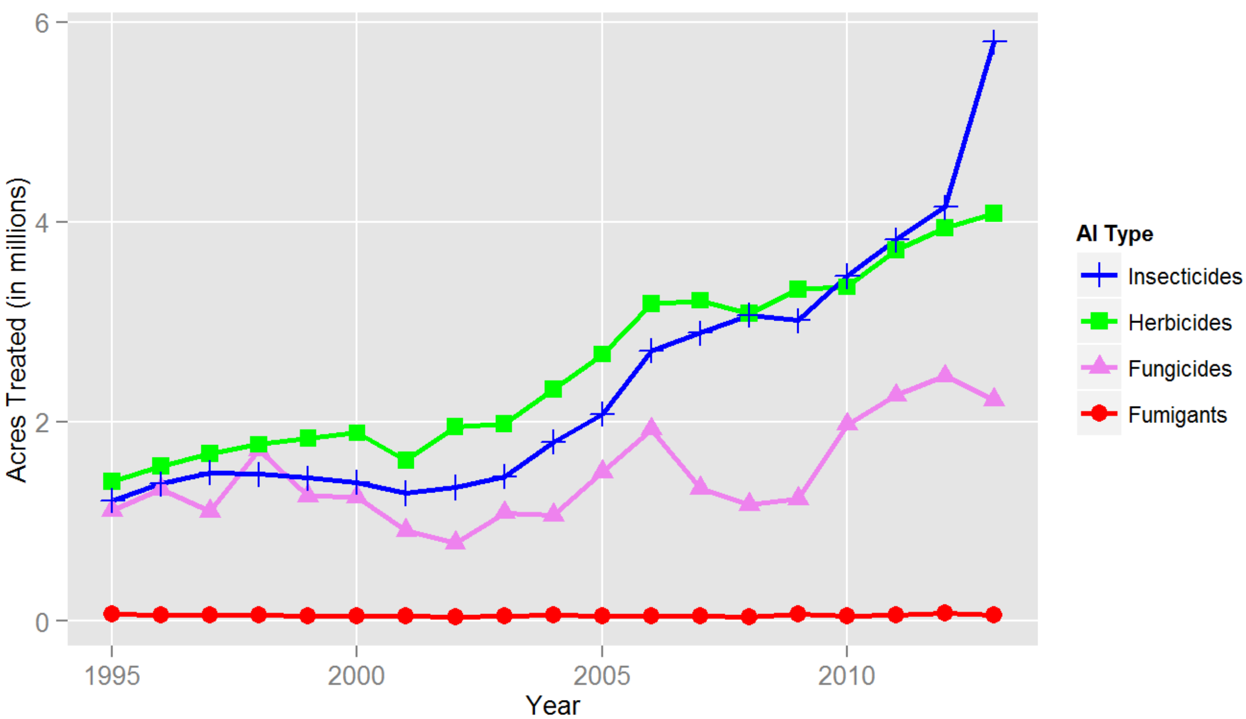

Figure 13: *Acres of almond treated by all AIs in the major types of pesticides from 1995 to 2013.*

The most prominent insecticides used in 2013, based on area treated, were oils, abamectin, methoxyfenozide, bifenthrin, chlorantraniliprole, esfenvalerate, chlorpyrifos, and etoxazole (Figure 14). Area treated with oils increased 35 percent. Pounds applied of the insecticides chlorpyrifos, methoxyfenozide, and bifenthrin increased 131, 112, and 13 percent, respectively; the high use of these insecticides was linked with heavy infestations of leaffooted bugs and NOW. Pounds applied of the miticides propargite and bifenazate increased 188 and 134 percent, respectively. Heavy insect and mite infestations may partially explain the increased use of

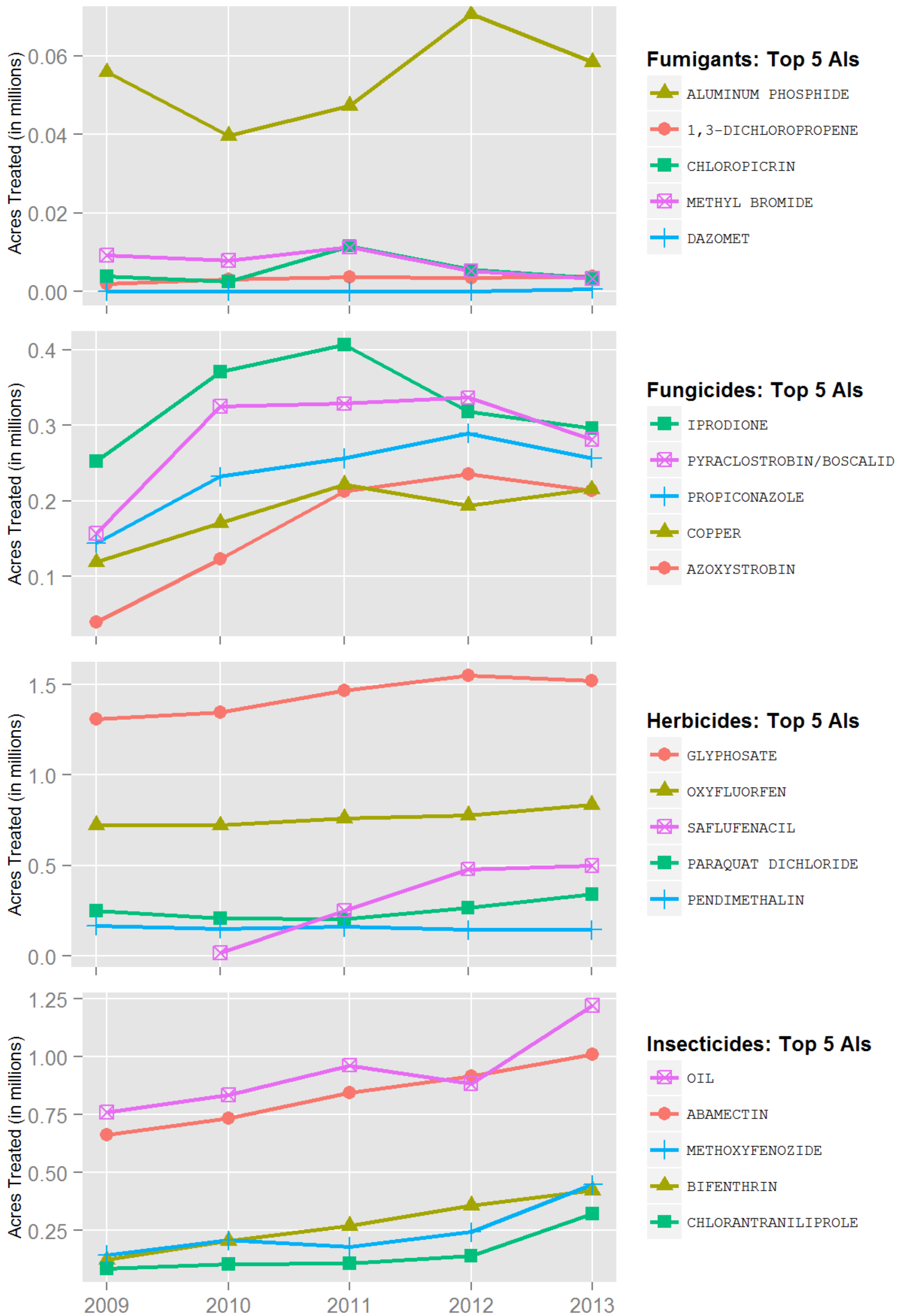

Figure 14: *Acres of almond treated by the top 5 AIs of each AI type from 2009 to 2013.*

insecticides and miticides, but because the price of almonds increased in 2013, growers may have been more averse to the risk of damage and reduced yield. Growers tend to spray more insecticides to protect a crop as the value of the crop increases. This factor is a likely cause for the increased use of bifenthrin and methoxyfenozide, insecticides that are primarily used for NOW control. Pyrethroid insecticides such as bifenthrin are often linked with outbreaks of spider mites, so their increasing use from 2009 through 2013 may help explain the increased use of the methoxyfenozide and abamectin during this period and propargite in 2013. The increased use of oil could indicate that more dormant sprays were needed to adequately manage San Jose scale (SJS) and European red mite.

Regionally, San Joaquin Valley and Sacramento Valley showed an increase of insecticide use in 2013. NOW damage was above normal in 2013 in the southern San Joaquin Valley. The use of products such as bifenthrin, methoxyfenozide, flubendiamide, chlorantraniliprole, and lambda-cyhalothrin would have all been used for NOW control. In Kern County in particular, early season spider mites was a major concern in 2013 and contributed to the increased use of abamectin, etoxazole, fenpyroximate, spirodiclofen, hexythiazox, and oil. Abamectin use increased throughout the state, probably because abamectin is relatively inexpensive and growers are increasingly using it prophylactically rather than basing treatments on monitoring results and on strategies that conserve populations of predaceous mites.

Key pests in almonds include NOW, leaffooted plant bug, SJS, peach twig borer (PTB), web-spinning spider mites, and ants. Winter sanitation to eliminate mummy nuts (unharvested nuts that hang in trees throughout the winter) has become a standard practice to reduce overwintering NOW larva. Almond trees can be treated with oil alone in the dormant season (winter) to control low to moderate populations of SJS, brown mites, and European red mites. Additionally, it is likely that other insecticides were added to the oil to more thoroughly control SJS and PTB. Because pesticide users are not required to report target pests when they submit their pesticide use reports, it is difficult to determine what products are used for what pests. However, by examining use reports, the month a product is applied often provides a clue for determining the target pest. For example, any treatment with oils and supplemental insecticides in the dormant season or during bloom in February probably target SJS and PTB; treatments in July and August probably target NOW; treatments in May could target either NOW or PTB (most May treatments north of Fresno target PTB and south of Fresno, NOW). Treatments in April and May often target leaffooted plant bug.

Some weeds are showing resistance to glyphosate, and consequently use of other herbicides, either in tank mixes or used independently, increased. Area treated with herbicides increased by 4 percent from 2012 to 2013. The most commonly used herbicides in 2013, as determined by area treated, were glyphosate, oxyfluorfen, saflufenacil, paraquat dichloride, and pendimethalin; glyphosate use decreased 2 percent, pendimethalin use remained the same, while use of the other herbicides increased 7, 4, 27, and 107 percent, respectively, over use in 2012. On the other hand, by pounds, pendimethalin and oxyfluorfen use increased 11 and 18 percent, respectively, while paraquat dichloride and oryzalin use decreased 14 and 26 percent, respectively. The use of herbicides increased in Sacramento Valley and in San Joaquin Valley regions.

Area treated with fungicides decreased 10 percent from 2012 to 2013, reflecting low disease pressure associated with the warm and dry winter. The most commonly used fungicides in 2013 were iprodione, boscalid, pyraclostrobin, propiconazole, copper, and azoxystrobin. Interestingly, despite their popularity, the use of all of these fungicides, except for copper, decreased in 2013. The shift to a different suite of fungicides may indicate attempts to manage disease resistance to fungicides: Growers tend to rotate the use of fungicides to reduce the use of any single class of fungicides. Additionally, the decline in the use of iprodione may be because growers purposefully selected fungicides with fewer potential adverse effects.

Fungicide use is often affected by local climatic conditions. Growers in southern San Joaquin Valley used fewer pounds of fungicides per acre because disease pressure is low due to the relatively dry environment, while those in the Sacramento Valley and northern San Joaquin Valley tended to use higher amounts of fungicides due to slightly higher moisture levels.

Wine grape

In 2013, wine grape acreage in California increased from approximately 546,000 to 570,000 acres and currently accounts for roughly 65 percent of all California vineyards (Table 21). Chardonnay and Cabernet Sauvignon remained the two most widely-planted wine grape varieties in California. There are four major wine grape production regions: 1) North Coast (Lake, Mendocino, Napa, Sonoma, and Solano counties); 2) Central Coast (Alameda, Monterey, San Luis Obispo, Santa Barbara, San Benito, Santa Cruz, and Santa Clara counties); 3) northern San Joaquin Valley (San Joaquin, Calaveras, Amador, Sacramento, Merced, Stanislaus, and Yolo counties); and 4) southern San Joaquin Valley (Fresno, Kings, Tulare, Kern, and Madera counties). Pest and disease pressure may differ among these regions. The pooled figures in this report may not reflect differences in pesticide use patterns between production regions.

Table 21: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for wine grape each year from 2009 to 2013. Planted acres from 2011 to 2013 are from CDFA, April 2014a; planted acres from 2009 to 2010 are from USDA, October 2012; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	22,100,150	26,274,268	29,471,317	26,797,869	26,638,653
Acres Treated	7,741,182	8,902,314	9,703,887	9,290,075	10,179,237
Acres Planted	531,000	535,000	543,000	546,000	570,000
Price/ton	$ 613	$ 576	$ 638	$ 773	$ 753

Changes in pesticide use on wine grape are influenced by a number of factors, including weather, topography, pest pressure, evolution of resistance, competition from newer pesticide products, commodity prices, application restrictions, efforts by growers to reduce costs, and increased emphasis on sustainable farming.

By most accounts, 2013 was a good year for wine grape growers, with relatively low levels of pressure from pests and disease. The total amount of pesticide AIs applied to wine grape declined slightly, though the cumulative area treated increased in 2013 to the highest level in the past 10 years (Table 21).

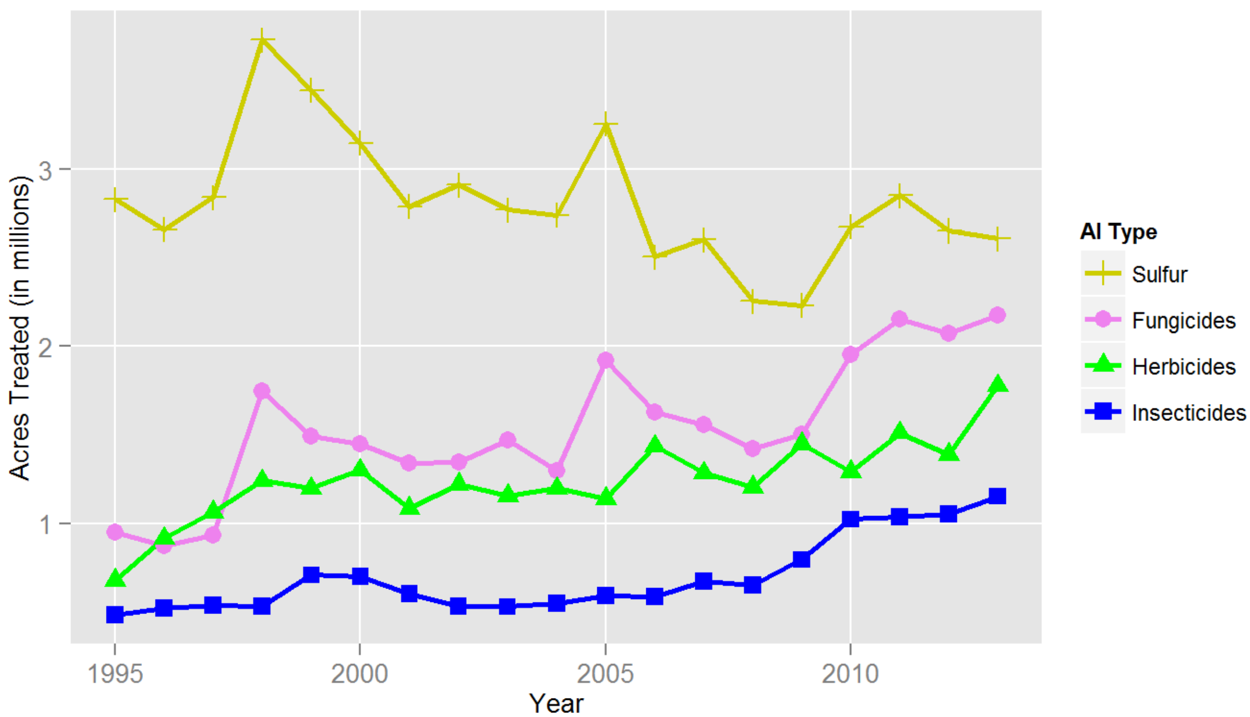

Figure 15: *Acres of wine grape treated by all AIs in the major types of pesticides from 1995 to 2013.*

Vine mealybug (VMB) continued to be a concern for growers, appearing in locations in Contra Costa County where it had not been found before. It has now been found in 17 counties in California. In the North Coast, a new pest, the Virginia creeper leafhopper, caused substantial damage in some locations. While there is effective biological control for western grape leafhopper, Virginia creeper leafhopper infestations require insecticide applications. In contrast, pest pressure from the invasive European grapevine moth lessened. The quarantine was lifted for Fresno, Mendocino, Merced, and San Joaquin counties in 2012, and trap catches continued to decrease (>100,000 in 2010, 146 in 2011, 77 in 2012, and 40 in 2013). Growers in Napa County were still advised to spray for this pest.

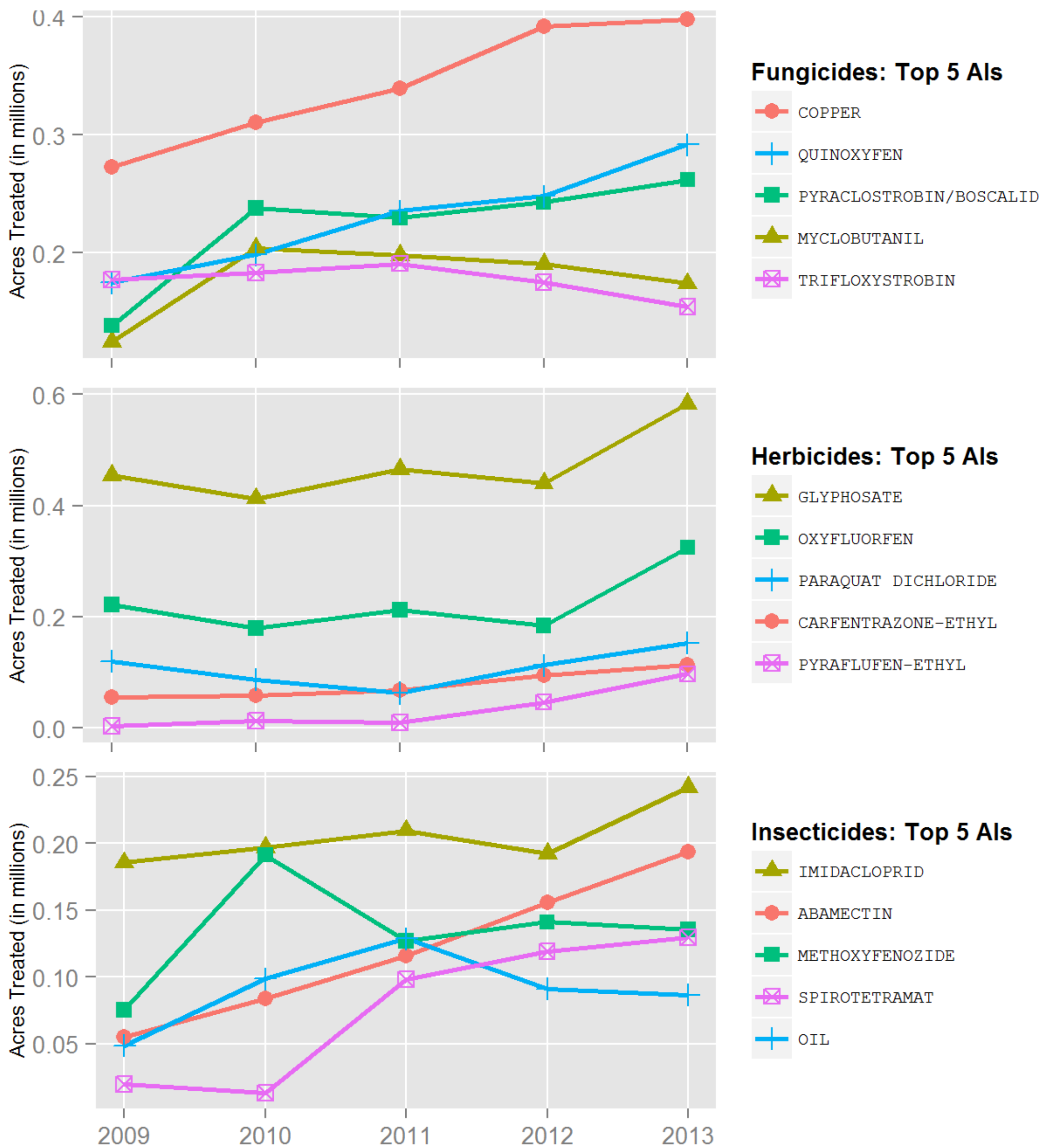

Figure 16: *Acres of wine grape treated by the top 5 AIs of each AI type from 2009 to 2013.*

Overall, the amount of insecticide applied to wine grape and the area treated increased slightly in 2013 (Figure 15). The insecticides applied to the greatest acreage in 2013 were imidacloprid, abamectin, methoxyfenozide, spirotetramat, and oils, as in 2012 (Figure 16). Other widely applied insecticides were etoxazole, chlorantraniliprole, bifenazate, and fenproximate. An increase in the use of imidacloprid and spirotetramat (Figure 16) follows from the continuing spread of VMG; these are leading chemicals in the suppression of VMB populations, as is buprofezin, which increased 104 percent. Imidacloprid may not be effective where heavy clay soils exist due to poor plant uptake; this likely explains relatively low use of this insecticide, and greater use of oils, in the North Coast, where heavy clay soils are common. The area treated with chlorpyrifos, which is also used to suppress VMB populations, declined. Use of this insecticide has trended downward in wine grapes since 2008. Chlorpyrifos was used in delayed dormant and post-harvest applications for control of mealybugs and ants. Imidacloprid and spirotetramat were used during warmer weather between bud break and harvest for suppression of mealybug infestations. Oils have many attractive, broad spectrum properties and are relatively low risk to public health and the environment. Mixed with fungicides, oils can replace a surfactant and eradicate mildew growth, as well as suppress mites and insects such as grape leafhoppers. There has been decreasing use of oils over the past three years. Though methoxyfenozide was still applied widely, the area treated decreased slightly in 2013. The area treated with chlorantraniliprole, first registered in 2008, increased 32 percent in 2012, but decreased by 17 percent in 2013. Chlorantraniliprole is relatively selective and methoxyfenozide is highly selective for lepidopteran pests. Both AIs are used in the control of the European grapevine moth. As noted above, this pest was trapped in low numbers in 2013 and is becoming less of a concern to growers. Use of the low-risk insecticide *Bacillus thuringiensis* again decreased, 26 percent, and was applied to about half the acreage that it was applied to in 2011. Besides abamectin (24 percent increase), the miticides etoxazole and bifenazate were relatively widely used; acres treated with these AIs ranged from about 33,000 (bifenazate) to about 51,000 (etoxazole). These compounds were used to suppress populations of mites that were favored by a warm early spring. Another miticide, fenproximate, increased in area treated by 245 percent, further reflecting serious problems with mites in 2013.

In general, fungal pathogens were not as big a problem as in the previous years. Due to a warm dry year, the incidence of powdery mildew was low early in the spring but pressure became moderate to severe in some places by mid-May. Fungicide use was quite similar to 2012, with only marginal decreases or increases. Quinoxyfen, however, has continued to increase in area treated since it was first registered in 2004. It was applied to 18 percent more acres in 2013 than in 2012. The area treated with sulfur declined by 2 percent (Figure 15). The fungicides applied to the largest area included sulfur, copper-based pesticides, quinoxyfen, boscalid, pyraclostrobin (boscalid and pyraclostrobin are used as a mix), myclobutanil, and trifloxystrobin (Figure 16). Other widely applied fungicides were tebuconazole, cyprodinil, and tetraconazole. The newer chemicals difenoconazole and metrafenone were applied to more acres in 2013, though the increase over the previous year was not as much as in 2012. Metrafenone has a new mode of action, is easily absorbed by the plant, and helps prevent transpiration; all factors that are likely to lead to its greater use. Fluopyram, a fungicide effective in suppression of powdery mildew, was registered in 2012 and was applied to 25,000 acres in 2013. It was generally applied as a mix with tebuconazole. Patterns of fungicide use across years may partly reflect the fact that growers are cognizant of the need to rotate AIs to delay the evolution of resistance.

Glyphosate-resistant weeds, such as horseweed, fleabane, and willow herb, continue to be a problem in vineyards. Marestail is also host to the glassy-winged sharpshooter, though this has become less of a threat over the past few years. The specter of Pierce's Disease, which the sharpshooter vectors, causes growers to remain vigilant. The area treated with herbicides increased 25 percent in 2013 (Figure 15). Glyphosate resistance issues and a reduced supply of glufosinate-ammonium, which remains in high demand in the US Midwest and South, as well as globally, may help to explain some of the observed trends in herbicide use. The herbicides applied to the greatest area in wine grape were glyphosate, oxyfluorfen, paraquat dichloride, carfentrazone-ethyl, pyraflufen-ethyl, and flumioxazin (Figure 16). Except for flumioxazin use of all these herbicides increased in 2013. Use increases ranged from 34 percent (glyphosate) to 109 percent (pyraflufen-ethyl). Growers were combining low rates of carfentrazone-ethyl, flumioxazin, and/or oxyfluorfen to improve control efforts in lieu of glufosinate-ammonium. The increase in area treated with pyraflufen-ethyl, and to a lesser extent paraquat dichloride, can be explained in similar fashion. Carfentrazone-ethyl was applied to 19,000 more acres in 2013. Its use has increased every year since 2005, when two new products containing this AI were first registered. Growers turn to its use instead of the higher risk paraquat. A new AI, indaziflam, registered in 2012, was applied to more than 40,000 acres in 2013. It is a strong pre-emergence herbicide on glyphosate-resistant weeds, and an increase in its use over the next few years is expected. However, it is only labeled for vines older than 5 years and will likely be used only a couple seasons in a row on the same vineyard, due to its long residual activity.

Largely due to a perceived shortage of grapes over the past few years, as well as the age of vineyards planted during the planting boom of the early 1990s, planting continued to increase in 2013. However, while use of fumigants increased in 2012, it decreased in 2013. With the exception of aluminum phosphide, all other fumigants were applied to fewer acres in 2013 than in 2012. About 1,600 acres were treated in all, most of these with 1,3-dichloropropene. The area treated with chloropicrin declined by 36 percent and the area treated with 1,3-dichloropropene declined by 43 percent. The largest use of a fumigant in wine grapes in 2013, as in years past, was aluminum phosphide, normally used to control rodents. Aluminum phosphide use was again especially pronounced in Monterey County (92 percent of all applications). Favorable economic conditions may have allowed growers to increase vertebrate pest management activities.

Gibberellins continue to be by far the most common plant growth regulator (PGR) used in wine grapes, accounting for 88 percent of PGR use. The area treated with gibberellins has been stable at around 15,000 acres for the three years 2011–2013. New regulations on use of high volatile organic compounds (VOCs) may lead to reduction in use of gibberellins, as they are on the list of high VOCs. The overall area treated with PGRs was about 200 acres less than in 2012.

Gibberellins are applied in early spring in order to lengthen and loosen grape clusters, which reduces vulnerability to berry splitting and bunch rot. Other PGRs that were used on a much smaller scale (400–760 acres) that increased in area treated marginally in 2013 were forchlorfenuron, ethephon, and S-abscisic acid.

Table and raisin grape

Total acreage planted to table and raisin grape increased slightly from 301,000 to 308,000 acres, reversing a trend that reflected the increasing attraction of planting almond in the southern San Joaquin Valley region (Table 22). This comprised approximately 35 percent of California's total grape acreage in 2013, the rest being wine grape. The southern San Joaquin Valley region accounts for more than 90 percent of California's raisin and table grape production. In 2013, raisin acreage was unchanged while table grape acreage increased by slightly more than 7 percent. These values tend to shift yearly depending on market conditions, since some grape varieties can be used for more than one purpose. Raisin acreage is expected to decline due to labor shortages, declining prices, and the lure of higher value crops. Thompson Seedless was again the leading raisin grape variety, while Flame Seedless was again the leading table grape variety. California produced 2,246,000 tons of raisin grape and 1,226,000 tons of table grape in 2013. Statewide raisin grape tonnage increased 24 percent and table grape tonnage increased 20 percent.

Table 22: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for table and raisin grape each year from 2009 to 2013. Planted acres from 2011 to 2013 are from CDFA, April 2014a; planted acres from 2009 to 2010 are from USDA, October 2012; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	12,839,255	14,040,724	16,372,317	14,877,689	14,498,591
Acres Treated	5,502,305	5,880,115	6,791,200	6,831,655	7,086,526
Acres Planted	312,000	307,000	305,000	301,000	308,000
Price/ton	$ 338.44	$ 354.24	$ 507.16	$ 684.56	$ 662.03

Changes in pesticide use on table and raisin grape, like those on wine grape, are influenced by a number of factors, including weather, topography, pest pressure, evolution of resistance, competition from newer pesticide products, commodity prices, application restrictions, and efforts by growers to reduce costs. Pest and disease pressure was relatively low in 2013. The total amount of AI applied decreased 1 percent, while the area treated increased 1 percent (Table 22).

The cumulative area treated with insecticides increased in 2013, surpassing 2012's distinction of reaching the highest level recorded in nearly two decades (Figure 17). The amount of insecticide applied decreased however; it was less than any of the previous 10 years and was substantially less than the 10 years prior to 2003. Growers appear to be treating more area or more frequently with a smaller amount of AI. This trend is reflected in the lower application rates of some of the

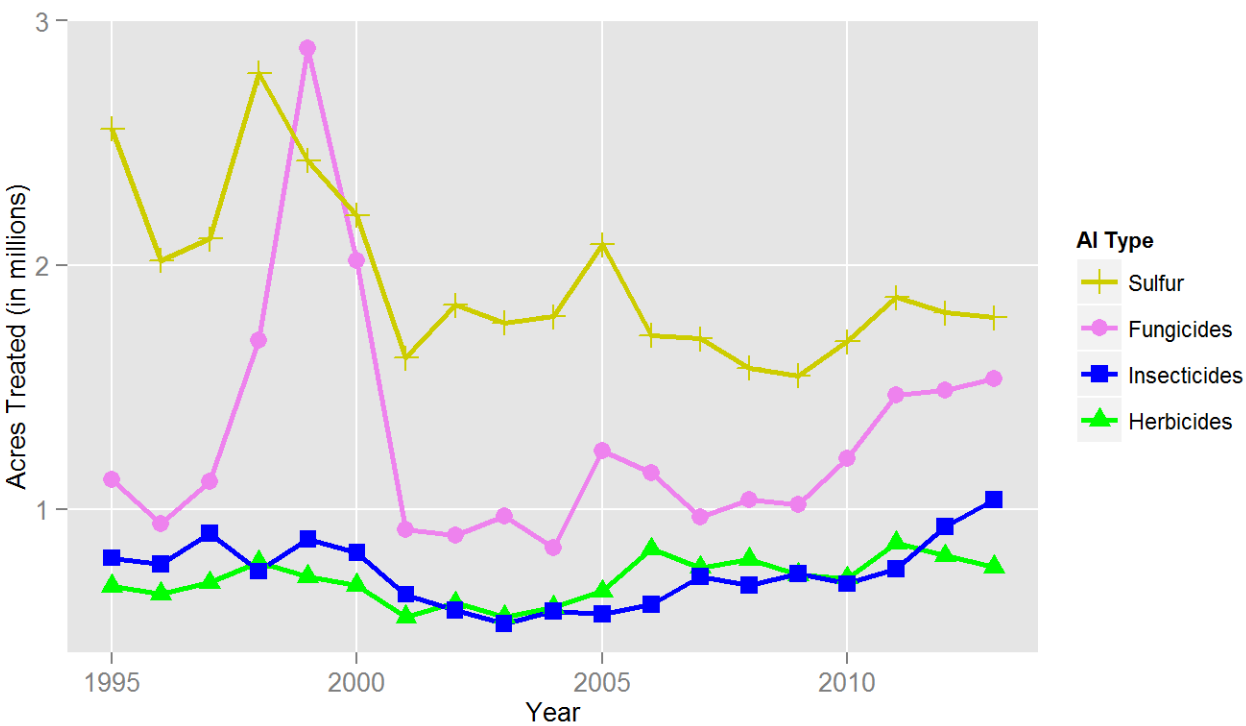

Figure 17: *Acres of table and raisin grape treated by all AIs in the major types of pesticides from 1995 to 2013.*

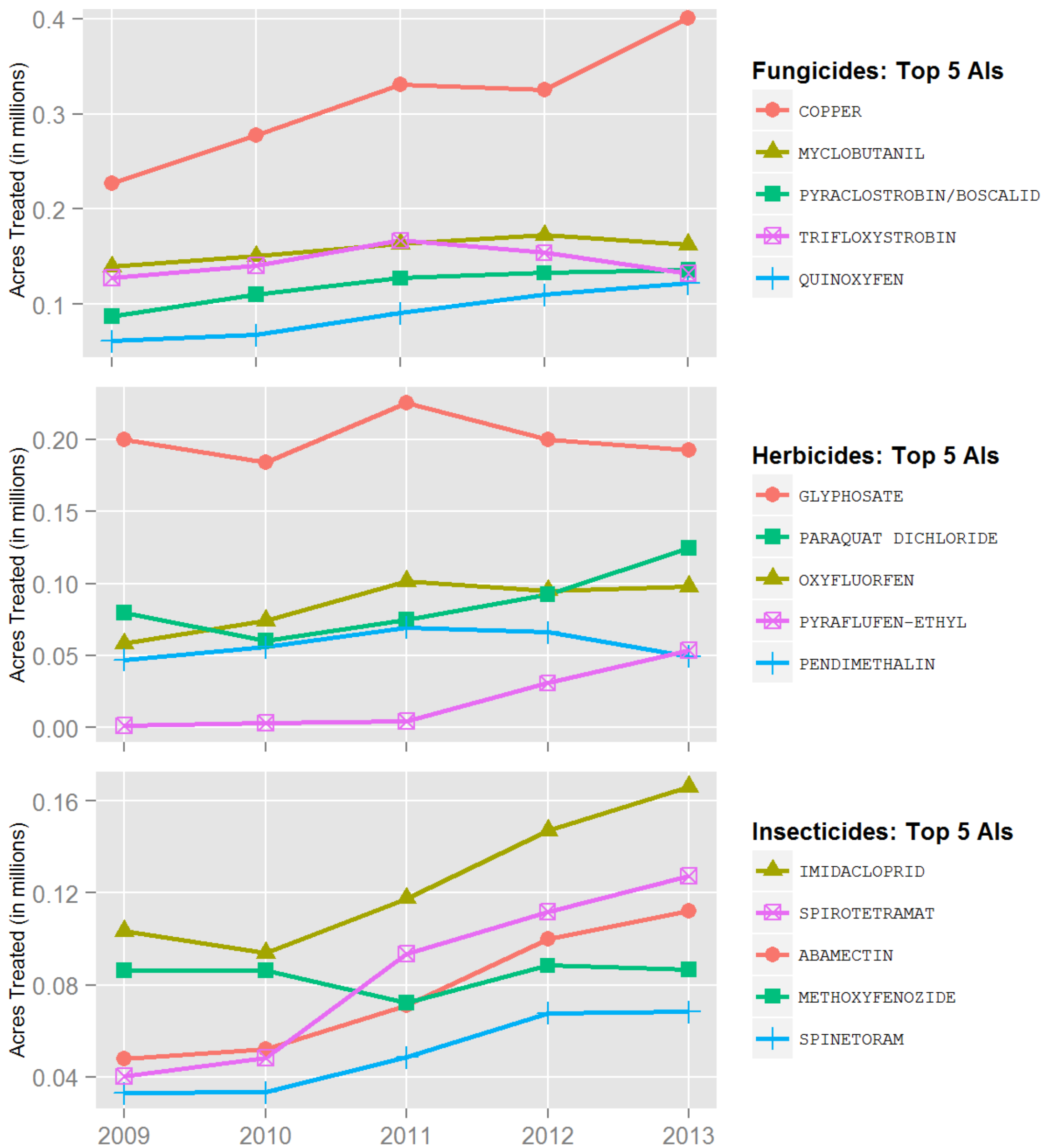

Figure 18: *Acres of table and raisin grape treated by the top 5 AIs of each AI type from 2009 to 2013.*

newer insecticides. The insecticides applied to the greatest area in 2013 were the same as in 2012: imidacloprid, spirotetramat, abamectin, methoxyfenozide, spinetoram, and *Bacillus thuringiensis* (Figure 18), the last of which was applied to 7,000 fewer acres in 2013. Other widely applied insecticides were buprofezin, cryolite, chlorpyrifos, etoxazole, spinosad, and chlorantraniliprole. Imidacloprid and buprofezin are used during warm weather between bud break and harvest to control mealybug infestations. Spirotetramat also provides control of mealybugs; its use has steadily increased in use since its registration in 2008 and was applied to 14 percent more acres in 2013 than in 2012. Buprofezin use increased substantially in 2013 (47 percent) as the warm spring temperatures allowed early build-up of vine mealybug (VMB) populations. There was a striking increase in use of chlorpyrifos (60 percent), an AI for which new regulations have been proposed by DPR. Chlorpyrifos was used as a delayed dormant or post-harvest spray to prevent a spring build-up of VMB populations. The majority of applications were in February and March. The observed increase in use of buprofezin later in the growing season suggests that delayed dormant sprays of chlorpyrifos may not have been effective in suppressing the overwintering VMB populations. Abamectin and etoxazole are used to treat for mites, which were a concern for growers due to above average temperatures early in the growing season. Etoxazole may have been favored for its capacity to control multiple life stages of mites. Cryolite use decreased again in 2013, a trend that has continued since at least 2004. Cryolite is a stomach poison applied early in the season to control lepidopteran pests such as omnivorous leafroller. Methoxyfenozide controls similar pests, but can be used later in the growing season than cryolite. Use of spinosad increased in 2013. Chlorantraniliprole treatments increased slightly in 2013; this insecticide is relatively selective for lepidopteran pests and is used to control the invasive pest European grapevine moth. This species was trapped in far fewer numbers in 2012 and 2013, and the quarantine was lifted in the southern San Joaquin region in 2012. It is likely that growers continue to be apprehensive about the damage potential of this pest.

The area treated with sulfur did not change, while the area treated with all other fungicides taken as a group only increased marginally (Figure 17). Fungicides with the greatest area treated included sulfur, copper-based pesticides, myclobutanil, boscalid, pyraclostrobin (boscalid and pyraclostrobin are used as a mix), trifloxystrobin, and quinoxyfen (Figure 18). Other commonly used fungicides were cyprodinil and tebuconazole. The area treated with lime-sulfur to suppress overwintering disease inoculum was unchanged. Use of two of three recently registered fungicides, metrafenone and fludioxonil, decreased, while the other, difenoconazole, increased by 13 percent. These AIs are seen as tools for growers as they seek to rotate AIs to delay the evolution of resistance. Reductions in applications of two of them may reflect judicious use in the context of resistance management.

Winter of 2012 - 2013 was relatively dry, which may have inhibited weed growth. The area treated with herbicides decreased in 2013 for the second year in a row (Figure 17). The herbicides applied to the greatest area were glyphosate, paraquat dichloride, oxyfluorfen, pyraflufen-ethyl, pendimethalin, and rimsulfuron. Of these, paraquat dichloride and pyraflufen-ethyl use increased substantially (35 and 74 percent) (Figure 18). Glyphosate use decreased by a small amount, likely the result of continuing concerns over weed resistance to this AI. Glufosinate-ammonium is an attractive alternative to glyphosate, but corn and soybean varieties genetically engineered for resistance to glufosinate-ammonium have been extensively planted in the Midwest and South, causing a high demand for the herbicide. Stocks of glufosinate-ammonium have been subsequently low in California for the past two years, causing a steep reduction in its use. The area treated with this AI was only 13 percent of that treated the previous year and only 6 percent of that treated in 2011. The unavailability of glufosinate-ammonium explains the increased use of paraquat dichloride and pyraflufen-ethyl. Herbicides that increased in area treated in 2012 (rimsulfuron, flumioxazin, oryzalin, and carfentrazone-ethyl) were used on fewer acres in 2013. A new AI, indaziflam, registered in 2012, was applied to almost 20,000 acres in 2013. It is a pre-emergence herbicide that is effective on glyphosate-resistant weeds, and an increase in its use over the next few years is expected. However, it is only labeled for vines older than 5 years and will likely be used only a couple seasons in a row in the same vineyard, due to its long residual activity.

Use of all fumigants greatly decreased in 2013—36 to 100 percent, depending on the AI—and only 1,298 acres were treated. This is less than half the area treated in 2012 and 13 percent of the area treated in 2011. This is the smallest area treated with fumigants in table and raisin grape in nearly 20 years. Aluminum phosphide was applied to only 528 acres, 496 of which were treated post-harvest.

The area treated with plant growth regulators (PGRs) changed little in 2013. The most commonly used PGRs were gibberellins (79 percent of the area treated), which are applied in early spring to lengthen and loosen grape clusters and increase berry size. Less compact clusters may be less vulnerable to berry splitting and bunch rot. The gibberellin-treated area increased slightly in 2013. Ethephon was the next most commonly applied PGR, though it was applied on 11 percent fewer acres than in 2012. Ethephon is applied at onset of ripening to improve berry color. Its use in conjunction with S-abscisic acid for this purpose was recently extolled, but S-abscisic acid use dropped 23 percent in 2013. Use of this mix is likely to increase in the future, especially on Crimsons, as its berries tend not to redden in high heat. PGRs that were used more widely in 2013 were hydrogen cyanamide and forchlorfenuron. Hydrogen cyanamide is applied after pruning to promote bud break, and forchlorfenuron is applied at fruit set to increase the size of berries.

Cotton

Cotton is grown for its fiber, but cottonseed can be used to produce cottonseed oil and cottonseed meal for dairy feed. Total planted acreage in 2013 was 280,000, a 24 percent decrease from 2012 (Table 23). The decrease resulted partly from an increased demand for irrigation water in higher value perennial crops, such as nuts, stone fruits, and grapes. The lower cotton acreage was planted on the best available land. The ideal weather conditions in 2013 led to some of the highest yields ever: 1,628 pounds per acre. About 67 percent of the cotton acreage was planted with the Pima variety, the remainder with upland varieties. Most cotton varieties have been genetically modified to be tolerant to the herbicide glyphosate. Most cotton is grown in the southern San

Joaquin Valley, with smaller percentages grown in Imperial and Riverside counties and a few counties in the Sacramento Valley.

Table 23: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for cotton each year from 2009 to 2013. Planted acres from 2009 to 2013 are from USDA, August 2014; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	1,449,032	3,072,498	5,049,182	3,521,497	2,998,099
Acres Treated	2,892,839	6,107,970	9,884,943	6,549,507	6,248,182
Acres Planted	190,000	306,000	456,000	367,000	280,000
Price/lb	$ 1.00	$ 1.50	$ 1.29	$ 1.11	$ 1.41

The total amount of pesticides used on cotton decreased 15 percent from 3.5 million to 3.0 million pounds from 2012 to 2013 (Table 23); however, use per acre planted increased. Use in every cotton-growing county decreased, except in Riverside and Imperial counties. The amount of harvest aids, herbicides, and fungicides used decreased but the amount of insecticides and fumigants increased (Figure 19).

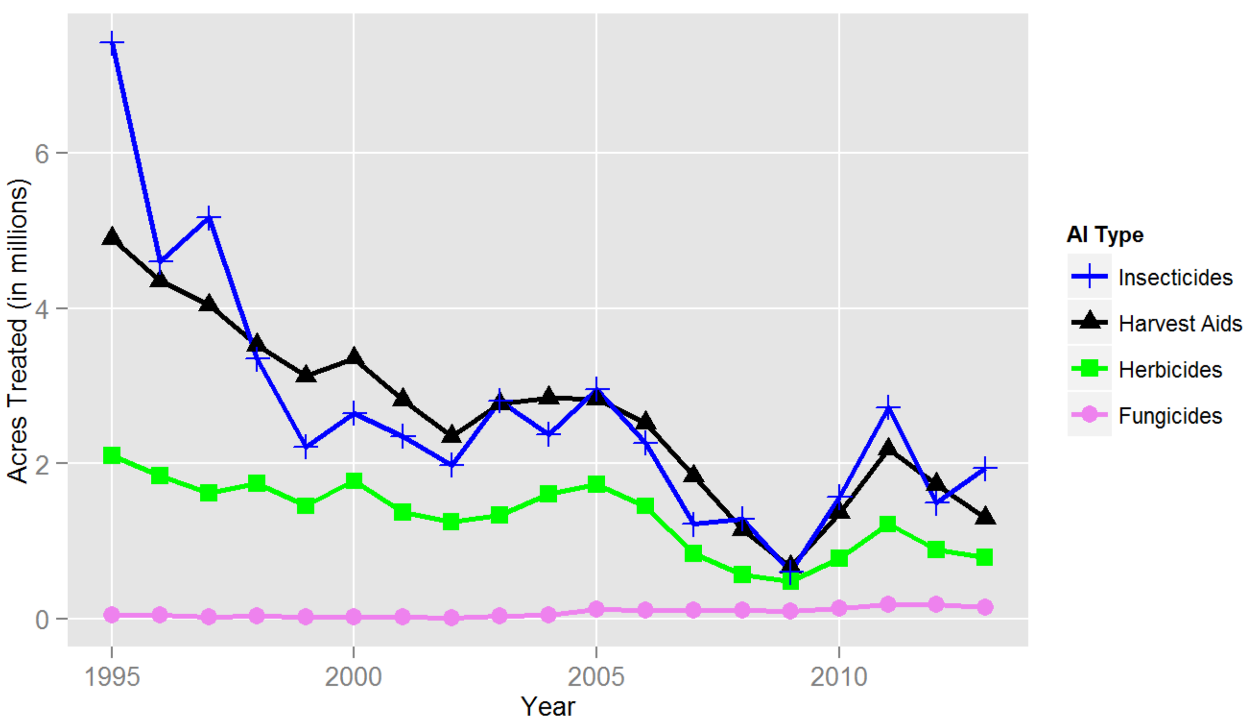

Figure 19: *Acres of cotton treated by all AIs in the major types of pesticides from 1995 to 2013.*

The major arthropod pests in cotton in 2013 were lygus bugs, spider mites, cotton aphids, whiteflies, and thrips. Arthropod populations were generally low during most of the year, but later

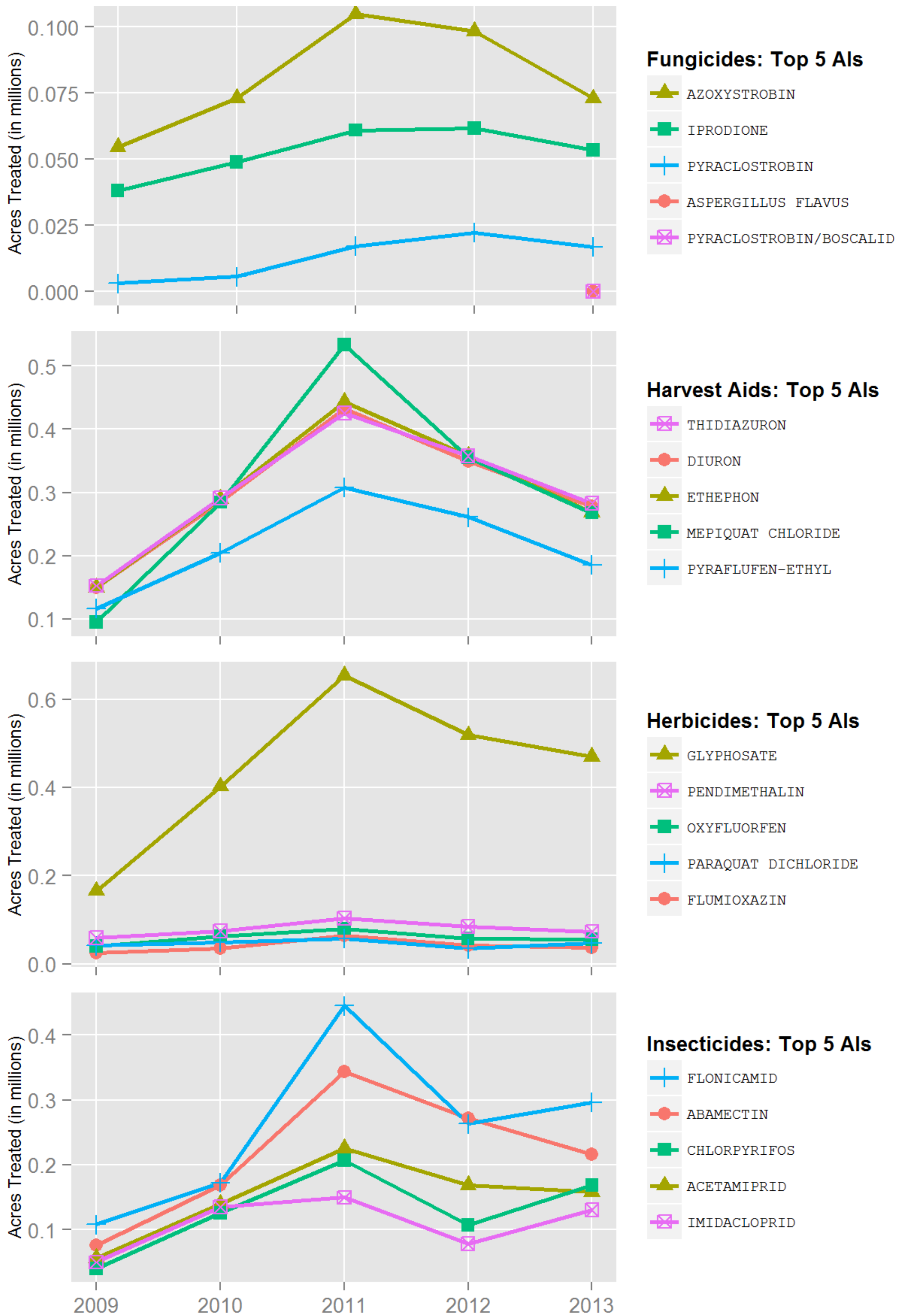

Figure 20: *Acres of cotton treated by the top 5 AIs of each AI type from 2009 to 2013.*

in the season whiteflies and aphids became a problem. Late season aphids and whiteflies are a serious concern because they produce sugary excretions, which drop onto the cotton lint creating a condition called sticky cotton. This condition causes problems when the cotton is ginned and lowers the quality of the cotton lint and thus the price the growers receive. The foothills surrounding the San Joaquin Valley were not a source for lygus bugs migrating into cotton as they have been in the past because winter and early spring rainfall patterns resulted in less than ideal vegetative habitat for lygus.

Although use of most major insecticides increased (Figure 20), area treated with abamectin and acetamiprid decreased. Most of the increases in insecticide use were in Kings and Riverside counties. Riverside County had the third highest area treated with insecticides among all cotton-growing counties even though only a small percent of the cotton acreage was planted there. In Riverside County the number of insecticide applications in 2013 increased to about 11 applications per field from 3 or 4 in 2012. Among the 12 most-used insecticides, the AIs with largest percentage increases were acephate, pyriproxyfen, and bifenthrin, all used primarily to control whiteflies. The increased use of acephate and bifenthrin occurred mostly in Riverside County due to localized infestations of brown marmorated stink bug, which were a problem requiring chemical applications. Increased use of pyriproxyfen occurred mostly in Kings County to suppress whitefly populations. The most-used insecticide by area treated was flonicamid, followed by abamectin and chlorpyrifos. Flonicamid is used to suppress primarily lygus and secondarily aphid populations, chlorpyrifos for aphid and whitefly populations, and abamectin is mostly used to suppress mites. There was a major problem with sticky cotton, so one would expect insecticide use in September and October to be higher than in previous years. While there was increased use in September compared to the use in September 2012, insecticide use increased every month from May through September compared to respective months in 2012; the largest increase was in June.

Use of nearly all major herbicides decreased, except for paraquat dichloride and prometryn (Figure 20). As has been the case for the last several years, glyphosate was by far the most-used herbicide and accounted for 73 percent of all herbicide use due to the large acreage of Roundup-Ready cotton, which is genetically engineered to be resistant to glyphosate. Some AIs, such as paraquat dichloride, are used both as harvest aids, chemicals used to defoliate or desiccate cotton plants before harvest, and herbicides. It is assumed that if use of these AIs occurred in August through November, they were used as a harvest aid, otherwise as an herbicide. Metolachlor and s-metolachlor use had the largest percentage decreases as measured by amount used.

Use of all harvest aids decreased close to the decrease in area planted (Figure 20): 32 percent as measured by amount of AI and 25 percent by area treated. Mepiquat chloride is included among the harvest aids, but it is actually a growth regulator and typically used mid-season.

The amount of fungicides used decreased 25 percent, and the area treated decreased 21 percent

(Figure 20). Fungicides are not widely used in cotton, but until 2013 use had been increasing because of increased incidence of seedling diseases, especially the disease caused by *Rhizoctonia solani*. The most-used fungicides were azoxystrobin, iprodione, and pyraclostrobin. Azoxystrobin and iprodione were applied to cotton fields in Kings, Kern, and Fresno counties at planting in April to control seedling diseases; pyraclostrobin was applied in Riverside and Imperial counties mostly in June and July. Most of the other fungicides were used as seed treatments, so the area treated was not reported.

Fumigants are little used in cotton fields and account for only 0.03 percent of the cumulative acreage treated. The amount of fumigants applied increased 210 percent in 2013. The main fumigants were 1,3-dichloropropene, metam-sodium, and metam-potassium and amount and area treated of all three increased. The increased use of metam-sodium and metam-potassium was nearly all in Fresno County, and the increased use of 1,3-dichloropropene was in Kern County. Use of all fumigants combined decreased by area treated, but this was due to use of aluminum phosphide. This decrease is somewhat suspect since 2012 was the only year in which there were any reported area treated with aluminum phosphide. Fumigants are used to treat the soil before planting for a range of soil pathogens, nematodes, and weeds and are also used to treat stored products. The increased use in cotton in the last few years may be the result of concern about the soil-inhabiting fungus *Fusarium oxysporum* f. sp. *vasinfectum* race 4, more commonly known as FOV race 4, which is spreading throughout the San Joaquin Valley. Some experts consider this pathogen to be one of the biggest challenges California cotton growers have faced in many years. Once a field is infected, it is impossible to achieve economic yields with many cotton varieties. The pathogen cannot be completely controlled by pesticides, but some research has shown that metam-sodium treatments can knock down inoculum populations and this may explain the increased use of fumigants. However, they will not eradicate the disease.

Alfalfa

Alfalfa is grown primarily as a forage crop, providing protein and high energy for dairy cows and other livestock. California is the leading alfalfa hay-producing state in the United States. More than half of California's alfalfa production in 2013 was in Fresno, Kern, Imperial, Merced, and Tulare counties. From 2012 to 2013, treated alfalfa acreage increased 16 percent and the acres harvested decreased 5 percent (Table 24). The price received per ton of hay remains historically high but decreased 3 percent. The decreased price for hay may be due to a downturn in the dairy industry including lower milk prices, weak economic conditions, and increased supplies from other western states that ship large quantities of hay into California to augment local production. The total amount of pesticide active ingredients (AI) applied to California alfalfa decreased one percent.

Insecticides and herbicides continued to be the most commonly used pesticide classes in California alfalfa production (Figure 21). The area treated with insecticides increased 26 percent but the amount applied decreased 20 percent. From 2012 to 2013, use of herbicides increased 5 percent as measured by area treated and 8 percent by amount AI applied. The increased uses

Table 24: *Total reported pounds of all active ingredients (AI), acres treated, acres harvested, and prices for alfalfa each year from 2009 to 2013. Harvested acres from 2009 to 2013 are from USDA, August 2014; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	3,364,941	2,728,067	3,525,852	3,529,340	3,482,546
Acres Treated	4,416,452	4,559,213	5,544,780	5,195,387	6,034,505
Acres Harvested	1,000,000	930,000	880,000	950,000	900,000
Price/ton	$ 107	$ 133	$ 239	$ 210	$ 204

resulted primarily from increased intensity of pest infestations and the premium prices received for hay.

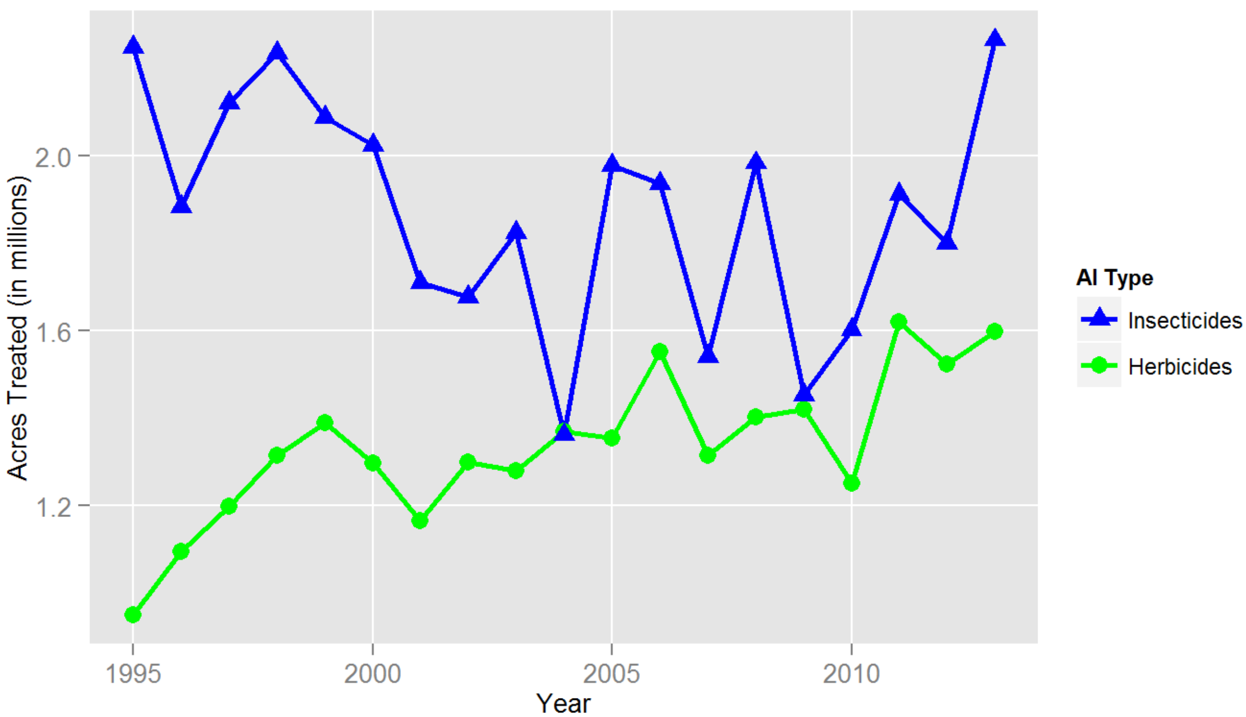

Figure 21: *Acres of alfalfa treated by all AIs in the major types of pesticides from 1995 to 2013.*

The reason the area treated with insecticides increased but the amount of AI applied decreased was because of increased use of recently registered insecticides that are applied at comparatively lower rates. Growers generally deal with three major insect pest groups in alfalfa production: the weevil complex in late winter to spring, an aphid complex starting in late fall through spring and continuing throughout summer, and a lepidopterous larvae complex in the summer. In 2013, weevil problems were severe due to the dry and warm winter and spring . The dry conditions affected emergence and development of weevil pests and resulted in high insect pressure with

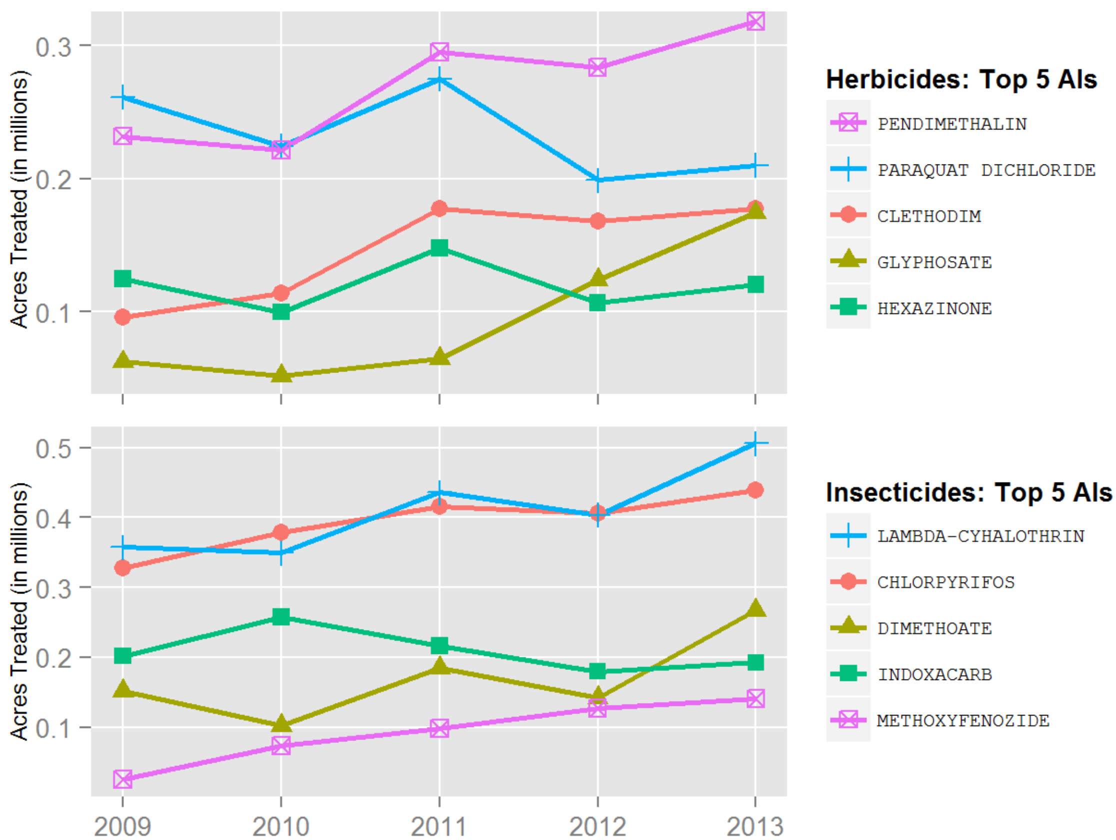

Figure 22: *Acres of alfalfa treated by the top 5 AIs of each AI type from 2009 to 2013.*

resultant increased use of some pyrethroids, specifically lambda-cyhalothrin, (s) cypermethrin, permethrin, and cyfluthrin. Blue alfalfa aphid problems were severe in the late winter, spring, and summer of 2013, especially in the Imperial, San Joaquin, and Sacramento Valleys. The increase in the use of chlorpyrifos, dimethoate, and lambda-cyhalothrin can be directly linked to the blue alfalfa aphid problems that started in Imperial County in March 2013 and spread northward throughout California. Chlorpyrifos, which is preferred by growers, indoxacarb, and pyrethroids are some of the few available products growers can use to manage aphids. Populations of the summer lepidopteran complex were higher in 2013 than in recent years and accounted for the increased use of indoxacarb, methoxyfenozide, and chlorantraniliprole. The uncertainty surrounding hay prices, water availability, and shipments from other states affected management practices for insect pests in 2013.

From 2012 to 2013, statewide herbicide use, as measured by amount used and area treated, increased 8 and 5 percent, respectively. The increase may be a result of high weed pressure and optimal hay prices received by growers. The area treated with the most-used herbicides increased except for that treated with trifluralin and imazethapyr-ammonium salt. Increased glyphosate use may be due to increased planting of Roundup Ready alfalfa, which is resistant to glyphosate. Use of paraquat dichloride increased, possibly because the use of diquat dibromide, which is applied as an alternative pre-harvest desiccant in alfalfa seed production, declined. The increase in herbicide use occurred mainly in the San Joaquin and Imperial Valleys whereas most of the decreased application of herbicides occurred in the Sacramento Valley. Although the reasons for growers selecting certain herbicides over others are unclear, efforts to use materials that are unlikely to contaminate groundwater play a role in the selection process.

Use of fungicides in alfalfa is minimal compared to the use of insecticides and herbicides.

Walnut

California produces 99 percent of the walnuts grown in the United States and around 78 percent of the world's total. The California walnut industry is comprised of over 4,000 growers who farmed approximately 280,000 bearing acres in 2013 (Table 25). In the Sacramento Valley, heavier-than-usual winter rainfall was followed by an unusually dry and warm spring in 2013, resulting in a longer bloom time. According to the Walnut Objective Measurement Report, these growing conditions were favorable for producing healthy trees with dense foliage, which were able to withstand the summer's short spells of high heat and minimize the incidence of sunburned nuts. Walnut production was estimated at 495,000 tons in 2013, slightly less than the previous year. The price per ton increased by 20 percent, with a total production value of almost 1.8 billion dollars. Bearing acreage increased by 4 percent, while the area treated with pesticides increased by 17 percent and the amount of applied AIs increased by 18 percent.

Walnut orchards in the Sacramento and San Joaquin Valleys received 99 percent of the total walnut pesticide use in 2013, both in terms of amount of AIs applied and area treated. The area treated with fungicides, insecticides, herbicides, and fumigants increased in 2013, although the

Table 25: *Total reported pounds of all active ingredients (AI), acres treated, acres bearing, and prices for walnut each year from 2009 to 2013. Bearing acres from 2009 to 2013 are from USDA, August 2014; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	3,273,441	3,992,406	3,949,259	4,252,733	5,019,793
Acres Treated	1,856,521	2,317,105	2,352,270	2,980,212	3,481,893
Acres Bearing	227,000	237,000	245,000	270,000	280,000
Price/ton	$ 1,710	$ 2,040	$ 2,900	$ 3,030	$ 3,650

amount of fumigants used decreased (Figure 23). In general, pesticide use followed similar patterns seen in the previous year, with increases in use largely reflecting the increases in walnut acreage and price per ton.

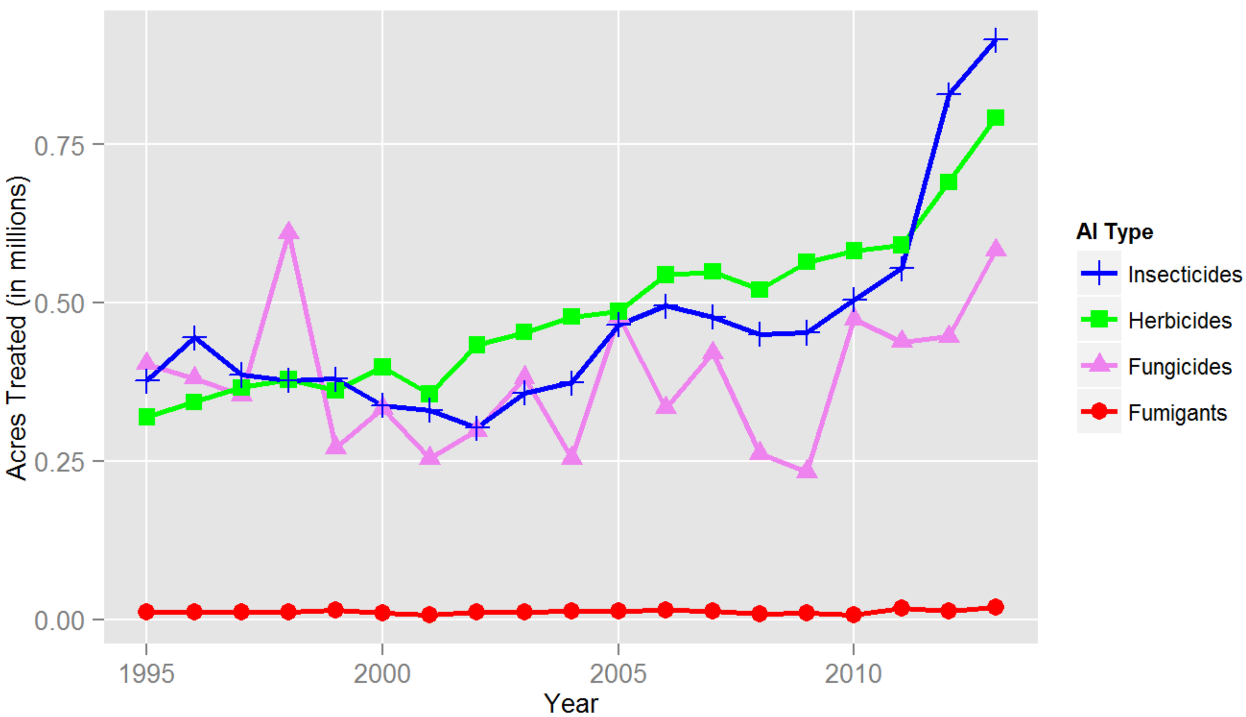

Figure 23: *Acres of walnut treated by all AIs in the major types of pesticides from 1995 to 2013.*

Insecticides, including miticides, accounted for 38 percent of the area treated with pesticides, an increase of 10 percent over use in 2012. Insecticides remained the pesticide type with the highest use in walnuts for a second year in a row, reflecting the importance growers place on managing important arthropod pests such as codling moth, walnut husk fly, navel orangeworm, aphids, and webspinning spider mites. The insecticide applied to the largest area in 2013 was the miticide abamectin (Figure 24), which is inexpensive compared to other miticides and effective when

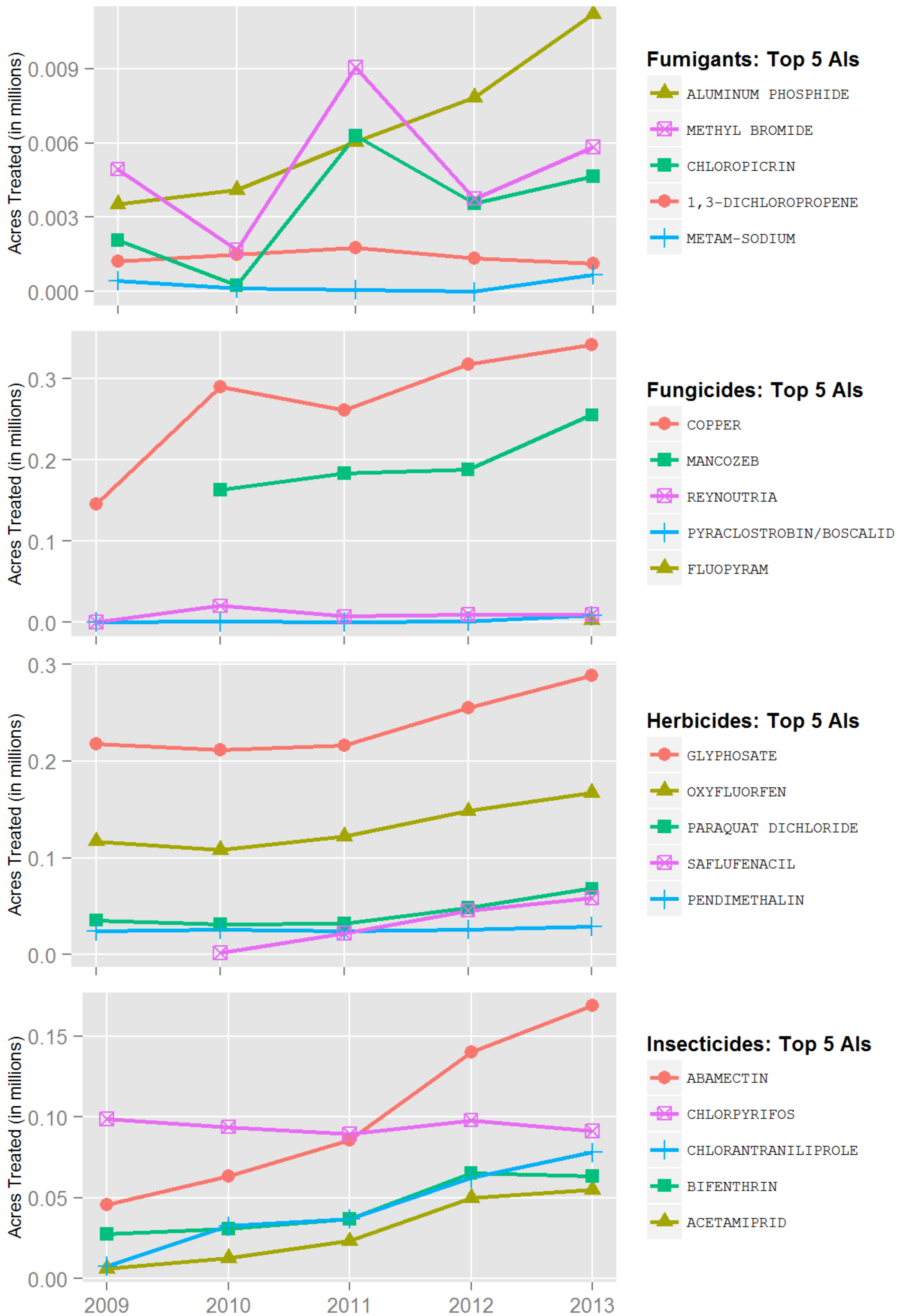

Figure 24: *Acres of walnut treated by the top 5 AIs of each AI type from 2009 to 2013.*

webspinning spider mites flare up as they did in 2013 during hot spells. Other insecticides with high use in 2013 included chlorpyrifos, chlorantraniliprole, bifenthrin, and acetamiprid, all broad spectrum pesticides capable of treating multiple walnut pests simultaneously (Figure 24). Although insecticides that are relatively low risk to human health and the environment represent a small percentage of total insecticide use, there was a notable increase in use by 7 percent in area treated and 13 percent in amount applied.

Herbicides followed insecticides as the pesticide type with the second highest use in 2013, representing 33 percent of all area treated (Figure 23). Use increased 15 percent, reflecting the increase in bearing acreage and the high walnut price; but it may also reflect concerns about water availability: Some growers may have switched from strip-spraying herbicides to spraying the entire orchard floor in an effort to minimize weed competition for water. Glyphosate remained the herbicide with the most use, likely due to its effectiveness at controlling a wide variety of weeds and its relatively low cost. However, reports of glyphosate-resistant weeds continue to surface, causing growers to take measures to delay or prevent resistance. The Sacramento Valley tends to have more glyphosate-resistant ryegrass, whereas the San Joaquin Valley has resistant populations of hairy fleabane and horseweed. The herbicides applied to the greatest area in 2013 included glyphosate, oxyfluorfen, paraquat dichloride, saflufenacil, and pendimethalin (Figure 24). Paraquat dichloride is a nonselective herbicide recommended for use with a protoporphyrinogen oxidase (PPO) inhibitor such as saflufenacil or oxyfluorfen as an alternative to glyphosate to slow or prevent glyphosate resistance. Pendimethalin is a selective herbicide for control of most annual grasses and certain broadleaf weeds. A popular new formulation of pendimethalin can be applied to bearing acreage, whereas use of earlier product formulations could only be applied in orchards with nonbearing dormant trees.

Throughout California walnut acreage, the area treated with fungicides increased by 31 percent, and fungicides made up 24 percent of the total area treated with all pesticides, making it the third largest pesticide type used in 2013 (Figure 23). Nearly 75 percent of the fungicide-treated area was in the Sacramento Valley. Copper and mancozeb fungicides had the highest use, with the amount of copper increasing by 51 percent and mancozeb increasing by 36 percent. Tank mixes of copper and mancozeb are recommended for treating walnut blight due to documented resistance of some bacterial strains to copper. Mancozeb disrupts bacterial cell membranes, preventing resistant bacteria from removing copper ions that had penetrated their cells. At relatively low rates, *Reynoutria sachalinensis*, boscalid and pyraclostrobin mixtures, and fluopyram were also applied to large areas of walnuts in 2013 (Figure 24). *Reynoutria sachalinensis* is a biofungicide that can be used alone or added to fungicides to improve control of walnut blight and other diseases. Fluopyram is a systemic fungicide with dual modes of action to forestall resistance, while the boscalid and pyraclostrobin mix products slow the onset of resistance by having a mixture of active ingredients with different modes of action.

The area treated with fumigants increased by 43 percent, although it only represented 0.8 percent of the total area treated with pesticides in 2013 (Figure 23). The top five fumigants were aluminum phosphide, methyl bromide, chloropicrin, 1,3-dichloropropene, and metam-sodium. All five fumigants increased in area treated except for 1,3-dichloropropene, which decreased by 16 percent. The San Joaquin Valley had approximately 50 percent more area treated with fumigants than the Sacramento Valley. Methyl bromide and chloropicrin were used more in the San Joaquin Valley, while aluminum phosphide, 1,3-dichloropropene, and metam-sodium had higher use in the Sacramento Valley.

Processing tomato

In 2013, processing tomato growers planted 263,000 acres, yielding 12.1 million tons, a 4 percent yield decrease from 2012. Curly top virus was a major problem in the southern growing regions, contributing to the drop in yield. About 94 percent of U.S. processing tomatoes are grown in California. At 34 percent, the U.S. is the world's top producer of processing tomatoes followed by the European Union and China. Fresno County leads the state in acreage with 38 percent (99,000 acres) of the statewide total, followed by Yolo County (35,000 acres), Kings County (27,000 acres), and San Joaquin County (21,000 acres). Significant production also occurs in Merced, Colusa, and Kern Stanislaus and Solano Counties.

Table 26: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for processing tomato each year from 2009 to 2013. Planted acres from 2009 to 2013 are from USDA, August 2014; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	14,612,913	13,803,875	14,029,293	13,456,372	13,875,163
Acres Treated	3,275,512	3,211,541	3,119,185	2,990,159	3,437,937
Acres Planted	312,000	271,000	255,000	260,000	263,000
Price/ton	$ 86.11	$ 71.40	$ 74.30	$ 75.00	$ 75.90

Overall, amount of all pesticide active ingredients (AIs) increased 3.1 percent from 2012 (Table 26). Total cumulative treated area of processing tomatoes increased 15 percent. The most-used category as measured by area treated was insecticides, which increased 36 percent from 2012 to 2013 (Figure 25). The most-used category as measured by amount AI applied was fungicide/insecticide (mostly sulfur and kaolin); amount in this category increased 12 percent. The amount of fumigant AI applied in 2013 decreased 21 percent.

Overall fungicide use, expressed as cumulative area treated, decreased 11 percent; pounds of AI decreased 18 percent. The decrease in fungicides may be attributed to a dry 2013 growing season, resulting in fewer early spring diseases and reduced mildew pressure. Bacterial speck was almost a non-existent problem in 2013. Although overall fungicide use decreased, the use of difenoconazole and azoxystrobin in acres treated increased 9 percent and 6 percent, respectively. These preventive fungicides are often applied as a pesticide product containing both AIs and used to treat black mold and powdery mildew. Since 2009, use of difenoconazole and azoxystrobin has

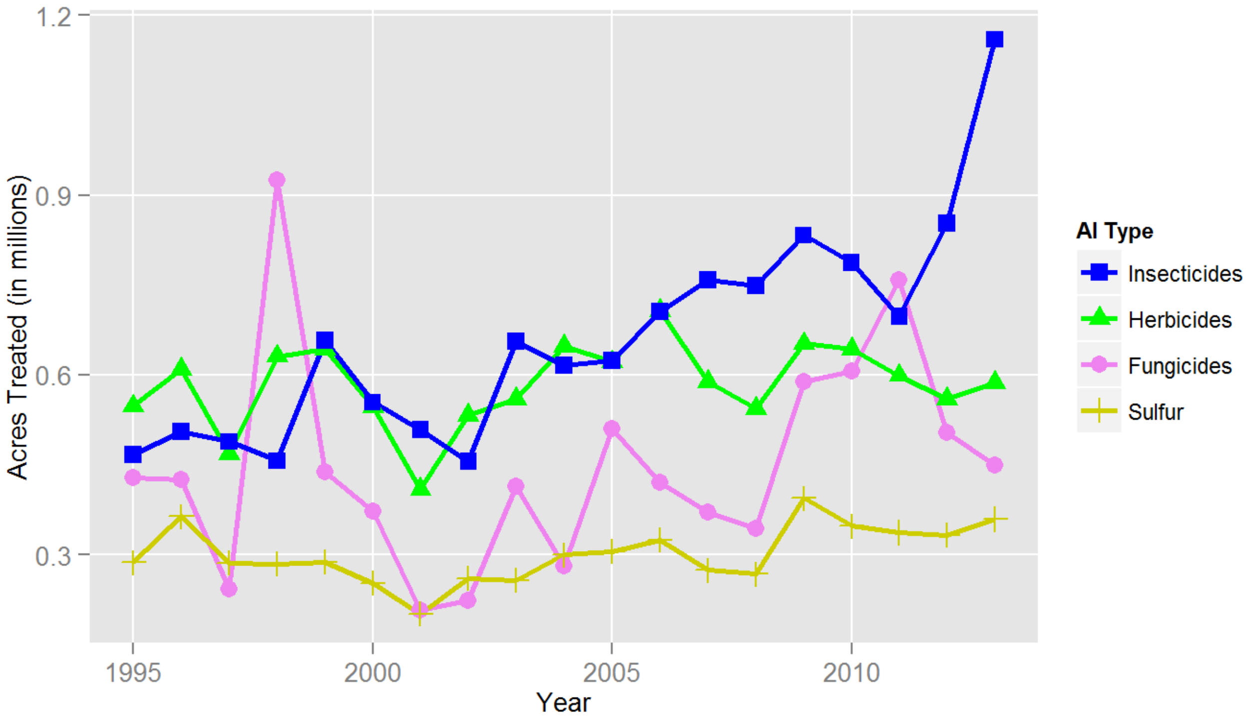

Figure 25: *Acres of processing tomato treated by all AIs in the major types of pesticides from 1995 to 2013.*

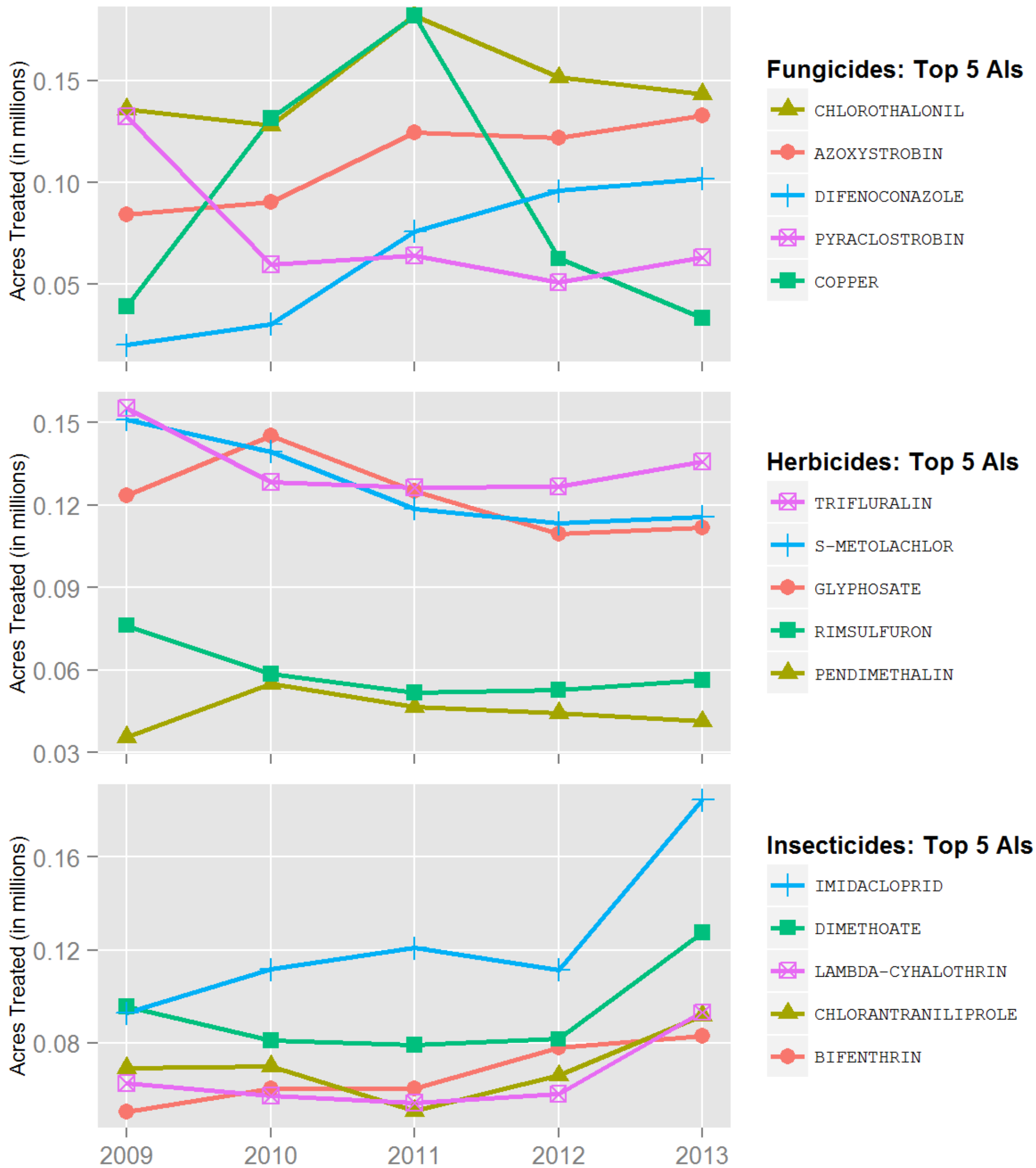

Figure 26: *Acres of processing tomato treated by the top 5 AIs of each AI type from 2009 to 2013.*

continuously increased, likely because of increasingly severe powdery mildew outbreaks in the last few years. As a result of these outbreaks, growers must now apply preventive treatments instead of treating powdery mildew as it appears. Chlorothalonil applications decreased 5 percent in terms of area treated. This may have been due in part to increased use of products containing both difenoconazole and azoxystrobin and increased use restrictions for chlorothalonil.

Since many growers are installing drip lines in fields for multi-year use, they tend to rotate out of tomatoes less frequently, which increases the bank of soilborne pests, such as Phytophthora. With an increase in the installation of drip systems, growers are moving toward pesticides that can be effectively applied via drip. Mefenoxam, used to treat Phytophthora, increased 14 percent in terms of acres treated. This increase may be due in part to increased Phytophthora pressure caused by fewer rotations. Mefenoxam use may also have increased because it is very easy to apply through a drip system.

The acreage treated with herbicides increased 5 percent from 2012 to 2013 (Figure 25); the amount used also increased 5 percent. Primary weeds of concern for processing tomatoes are nightshades and bindweed. Trifluralin and pendimethalin are used to control bindweed and are often used in combination with metolachlor. The area treated with pendimethalin decreased 7 percent, trifluralin use increased 7 percent, s-metolachlor use increased 2 percent, and metolachlor use increased 16 percent (Figure 26). Recent phytotoxicity issues with pendimethalin may have contributed in part to an increase in the use of metolachlor. Additionally, metolachlor is also used to control problem weeds such as nutsedge and nightshade and is a relatively inexpensive generic alternative to s-metolachlor. Glyphosate is a commonly used for preplant treatments in late winter and early spring; its use in acres treated increased by 2 percent.

In 2013, 1,159,441 cumulative acres were treated with insecticides, a 36 percent increase from 2012 (Figure 25). This overall increase was likely to control a population explosion of thrips, which vectors tomato spotted wilt virus. For the last 5 years growers have been treating for thrips more frequently and earlier in the season, which effectively reduces tomato spotted wilt virus. According to University of California Cooperative Extension, dimethoate, methomyl, spinetoram, and flonicamid are recommended for thrips control; use of all four AIs increased in 2013. These insecticides, as well as imidacloprid, endosulfan, and methoxyfenozide, are rotated to reduce resistance development when used for thrips control. Spinetoram, which had a 2 percent increase in acres treated, is the most effective treatment for thrips. Dimethoate, which increased 56 percent, is a broad spectrum insecticide. However, its use early in the season can disrupt natural predation and cause population explosions of other insect pests, such as leafminers, later in the season. A secondary pest increase due to the use of broad spectrum insecticides to control thrips may account for the 35 percent increase in spinosad use in 2013. Methomyl use increased 12 percent, even though growers have begun switching to pyrethroids because of worker safety issues with methomyl. Bifenthrin, which increased 6 percent, is a broad spectrum pyrethroid often used in rotation with spinosad for thrips control. Bifenthrin is also used to manage mites and stinkbugs. The area treated with lambda-cyhalothrin, also used to control thrips, increased 60 percent. The use of imidacloprid, the most-used insecticide, increased 66 percent from the previous year. This may account for the increased use of other pesticides to treat thrips.

Lepidopteran pest pressures were relatively low in 2013, contributing to a 14 percent decrease in the use of indoxacarb. Chlorantraniliprole, which increased 39 percent, is used midseason when there is low lepidopteran pressure to keep populations in check. Because chlorantraniliprole is easily applied through drip irrigation, growers may have begun to use the pesticide more frequently. Flubendiamide, a newer product that controls lepidopterous pests was applied to 50 percent more acres in 2013 than in 2012. As a relatively new product, flubendiamide has been extensively marketed by the registrants to pest control advisors who in turn recommend the product to growers. Emamectin benzoate, used to control russet mites, increased 26 percent in terms of acres treated.

Found mostly in the Sacramento Valley, consperse stinkbug populations have been increasing in new locations, primarily in western Fresno County. Although there has been a gradual increase in stink bug populations, only Fresno County has experienced heavy pest pressures. Clothianidin use more than tripled in 2013, largely because products containing the AI were only recently registered for use in California. Clothianidin was used primarily to control stink bugs.

Processing tomato growers primarily use three fumigants—metam-potassium, metam-sodium, and 1,3-dichloropropene—to manage root-knot nematodes and weeds, particularly those of the nightshade family. In 2013, the amount of fumigant applied decreased 21 percent and accounted for about 18 percent of the total amount of pesticide AIs applied. In terms of area treated, fumigant use decreased 59 percent. The overall decrease in fumigant use, particularly metam-sodium and metam-potassium, may be attributed to increasing regulations, making these products less attractive to growers. About 95 percent of processing tomatoes grown are from transplants, which have reduced the need for metam preplant weed treatments. Additionally, metam is being used more for preventive measures. Metam is being injected into drip lines for disease control more frequently, which reduces product application rates.

The 37 percent increase in 1,3-dichloropropene use is likely due to increased incidence of resistance-breaking nematodes in nematode-resistant tomato cultivars. Limited fields have been involved, but resistance-breaking nematode strains continue to surface and are becoming more widespread. Growers are rotating out of tomatoes less often, which increases the number of soilborne pests, particularly nematodes. Over the last 10 years growers have been moving away from furrow irrigation and converting to buried drip, which produces higher crop yields. Because of the transition to buried drip, there has been increased tomato damage from nematodes due to more localized plant roots and the consistent moisture in the soil.

Pistachio

In 2013, California accounted for more than 203,000 bearing acres of pistachio, or almost 99 percent of the U.S. crop (Table 27). Worldwide, the U.S. has become the top pistachio producer, followed by Iran. In California, pistachios are grown in 22 counties, from San Bernardino County in the south to Tehama County in the north. In 2013, 97 percent of all pistachio acreage in California was located in the San Joaquin Valley (Kern, Madera, Fresno, Tulare, Kings, Merced, Stanislaus, Alameda, San Joaquin, and Contra Costa counties), 2 percent in the Sacramento Valley (Colusa, Glenn, Butte, Yolo, Tehama, and Sutter counties), and 1 percent in Santa Barbara, San Bernardino, San Luis Obispo, Placer, Calaveras, and Riverside counties. In 2013, the counties with the highest number of bearing acres were Kern, Fresno, and Madera, which had 37, 22, and 14 percent, respectively, of the state's production.

Table 27: *Total reported pounds of all active ingredients (AI), acres treated, acres bearing, and prices for pistachio each year from 2009 to 2013. Bearing acres from 2009 to 2013 are from USDA, August 2014; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	3,029,545	2,829,026	4,039,211	3,945,689	4,713,144
Acres Treated	1,769,140	2,167,672	2,364,014	2,778,875	3,369,266
Acres Bearing	126,000	137,000	153,000	182,000	203,000
Price/lb	$ 1.67	$ 2.22	$ 1.98	$ 2.61	$ 2.20

Pistachio trees usually alternate between high and low production each year. Projected as a good year for most trees, California's 2013 pistachio crop had a total production and yield of nearly 470 million pounds, down 15 percent from 2012's record yield. During early 2013, ample winter chilling encouraged adequate bloom and pollination. From 2012 to 2013, the number of bearing acres increased 12 percent (Table 27). This increase is projected to continue during the next few years due to a surge in planting around 2005.

Pesticide use on pistachio fluctuated from 2009 through 2013 (Table 27). Combined use of insecticides, fungicides, and herbicides, as measured by area treated, increased 20 percent from 2012 to 2013, reflecting the 12 percent rise in bearing acres and higher pest pressure resulting from drought conditions (Table 27). Use of sulfur, a miticide, increased 27 percent.

During 2013, the top insecticides used as measured by area treated were lambda-cyhalothrin, bifenthrin, chlorantraniliprole, methoxyfenozide, and permethrin (Figure 28). Sulfur was the dominant miticide used. The main fungicides used were *Aspergillus flavus*, fluopyram, metconazole, trifloxystrobin, and pyraclostrobin/boscalid. *Aspergillus flavus* strain AF36 is lumped with the fungicides, but is actually a fungal inoculant that serves as a biological control agent and prevents contamination of nuts by aflatoxins. As in 2012, three herbicides dominated: glyphosate, oxyfluorfen, and saflufenacil. Aluminum phosphide, which is used for burrowing rodents, was the only fumigant.

Insecticide use, as measured by pounds, increased 29 percent from 2012 to 2013, primarily due to additional bearing acres and higher pest pressure by navel orangeworm. During 2013,

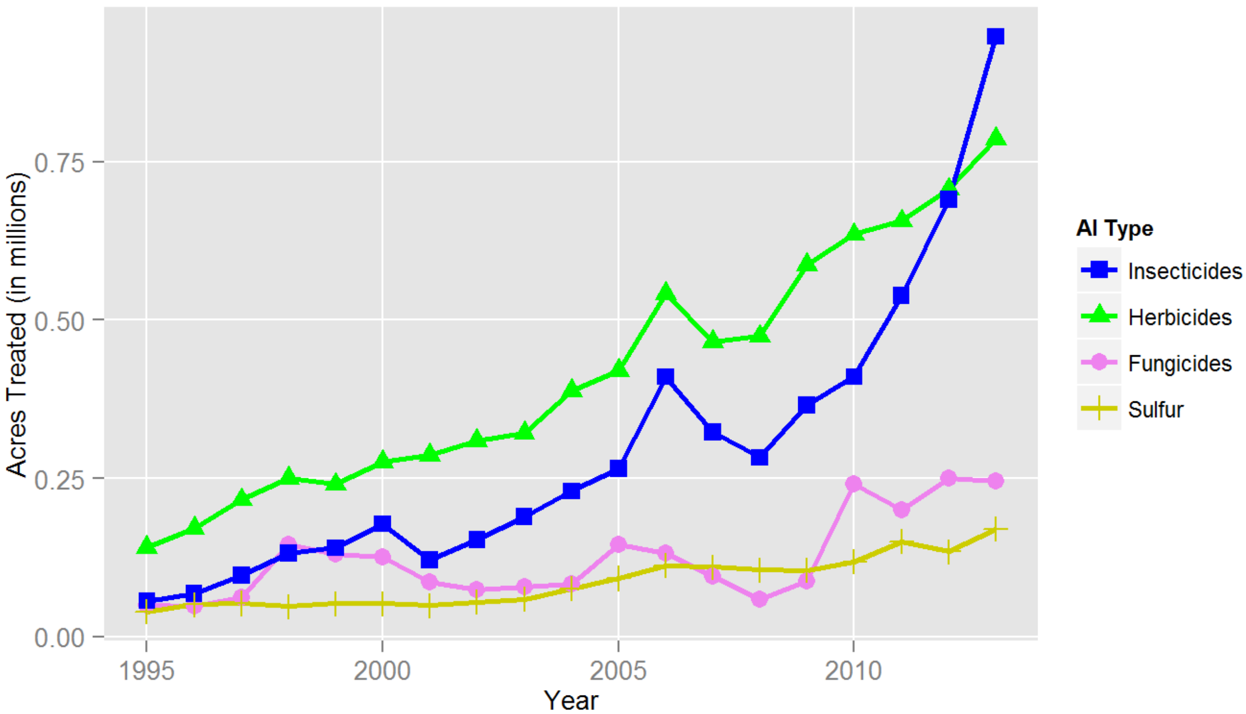

Figure 27: *Acres of pistachio treated by all AIs in the major types of pesticides from 1995 to 2013.*

early-season populations of true bugs were much higher than they had been in 2012. Several species of true bugs cause early- and late-season damage to nuts. In early spring, plant bugs such as lygus will fly into pistachio orchards and may cause epicarp lesion, characterized by direct damage to the nut as shells harden during May. Like lygus bugs, false chinch bugs may also migrate to pistachio orchards from cruciferous weeds during spring. Feeding can lead to leaf drop. Feeding by the leaffooted plant bugs can cause epicarp lesion to the nuts shortly after bloom and lead to kernel necrosis after shell hardening in June, darkening and ruining the flavor of the nutmeat. These bugs usually appear late in the season during August and September. Stink bugs can also be late-season pests, causing kernel necrosis during July and August. Often growers apply pyrethroids, primarily lambda-cyhalothrin and permethrin, preemptively for all of the bugs before they can do much damage. As during 2012, use of lambda-cyhalothrin and permethrin peaked during May. Overall use of lambda-cyhalothrin from 2012 to 2013 by area treated increased 24 percent and use of permethrin increased 11 percent.

Two lepidopteran pests can cause late-season damage. From June through August, the obliquebanded leafroller (OBLR) can feed on the stems of the nut clusters, causing them to dry and shrivel, thus reducing crop yield. The navel orangeworm (NOW) causes much more damage than OBLR by feeding directly on the nutmeat. As the larvae feed, they leave behind copious frass (or excrement), a substrate for the fungi *Aspergillus flavus* and *A. parasiticus*. NOW attacks nuts beginning in July, but insecticide sprays target the third generation that coincides with the

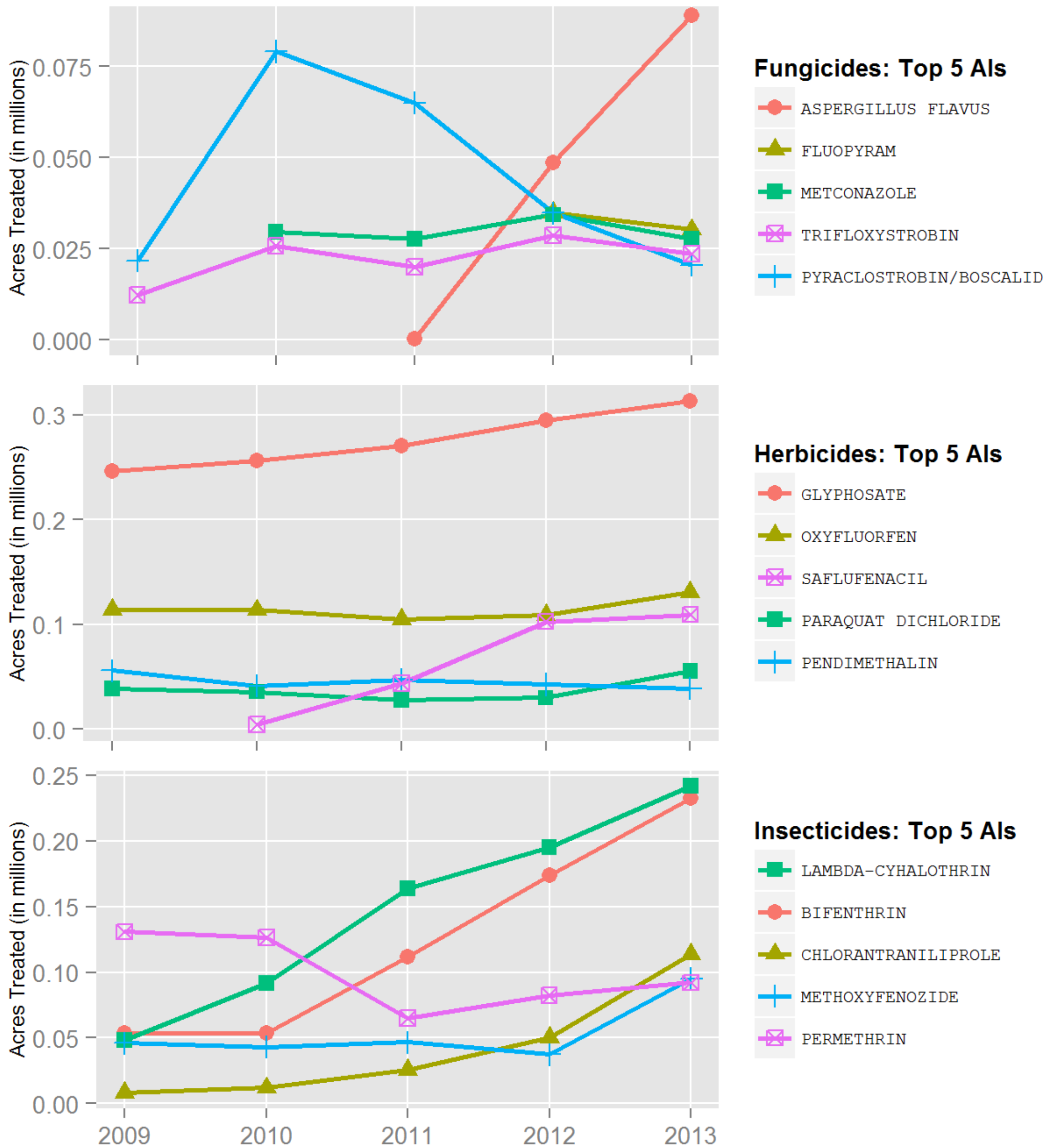

Figure 28: *Acres of pistachio treated by the top 5 AIs of each AI type from 2009 to 2013.*

beginning of the nut harvest. NOW pressure was higher in 2013 than in 2012, and according to several observations, was at the highest level since 2007, exacerbated by drought conditions. The NOW larvae overwinter in mummy nuts on the ground, and during dry winters, they avoid the fungal diseases that would normally kill them under wet conditions. The harvest in 2013 was later than average, which is why higher-than-average spraying for NOW extended through September. Growers applied 34 percent more bifenthrin, as measured by area treated, and 126 percent more chlorantraniliprole than they did in 2012. The latter is also used for OBLR. From April through September, use of permethrin increased 11 percent from use in 2012 to target both true bugs and late-season NOW.

Oils comprise 89 percent of insecticide use and 28 percent of total pesticides used by pounds. From 2012 to 2013, amount of oils increased 30 percent. Horticultural oil, considered a low-risk material, sharpens bloom when applied in late January to early February, and suppresses scale insects when used during the dormant stage and in-season. Its label specifies use of several pounds per acre. Growers applied about half of the oils used throughout theyear during the dormant season.

Use of buprofezin for Gill's mealybug climbed 9 percent from 2012 to 2013. Most applications were made in May and June and targeted immature crawlers moving into the clusters.

Sulfur use increased 27 percent from 2012 to 2013, as measured by area treated (Figure 28). Used as a low-risk miticide, sulfur is applied at several pounds per acre. Citrus flat mite feeds on the stems of nut clusters as well as the nut hulls and nuts themselves, which can lead to shell stain. As the weather warms up in June, mite populations thrive and peak in late July and August. In 2013, growers began applying sulfur for mites in April, applied most in July and August, and continued applications through November.

The fungi, *Aspergillus flavus* and *A. parasiticus*, grow on pest-damaged nuts and produce aflatoxins, which are both toxic and carcinogenic. About half of the strains of *A. flavus* found in the orchard are atoxigenicthat is, they do not produce aflatoxin. However, almost all *A. parasiticus* strains produce aflatoxins. When applied to orchards, the harmless, atoxigenic strain of *Aspergillus flavus*, AF36, crowds out aflatoxin-producing strains and drastically reduces aflatoxin levels in the nuts. AF36 is technically not a fungicide, but an organically acceptable biological control agent. From 2012 to 2013, use of AF36 nearly doubled, from 49,000 acres to 89,000 acres, or 44 percent of all bearing trees.

From 2012 to 2013, fungicide use decreased 22 percent as measured by pounds. As in 2012, spring conditions were dry and warm, and growers in the San Joaquin Valley made few fungicide applications. During 2013, growers applied most fungicides from April through July. Use amount of the pyraclostrobinboscalid product fell 44 percent because pyraclostrobin lacks efficacy against Alternaria, and fungal resistance to boscalid is becoming more widespread. During 2012, a new fungicide, fluopyram, was used on more than 34,000 acres. During 2013, its use by area treated decreased 13 percent, but still exceeded that of other fungicides. Growers used two combination products, one containing trifloxystrobin and fluopyram and another with tebuconazole and fluopyram; both reportedly have outstanding efficacy for Alternaria, Botryosphaeria, and Botrytis.

Herbicide use by area treated climbed 12 percent from 2012 to 2013 (Figure 28), consistent with the 12 percent increase in acreage. The post-emergence herbicide glyphosate is applied year-round, but mostly during the summer months to manage weeds such as field bindweed and cheeseweed. From 2012 to 2013, use by area treated of glyphosate increased 6 percent. Use of the pre-emergence herbicide oxyfluorfen increased 20 percent from 2012 to 2013, Saflufenacil, a post-emergence burn-down herbicide first used in 2010, effectively treats spring and summer weeds such as nettle, puncturevine, and Russian thistle. Its use from 2012 to 2013 increased 7 percent. Use of paraquat dichloride, a post-emergence burn-down herbicide increased 85 percent from 2012 to 2013. Paraquat is used year-round for both grasses and broadleaves. Use of pendimethalin, a pre-emergence herbicide for cool-weather weeds, decreased 10 percent.

Rice

Six counties in the Sacramento Valley (Colusa, Sutter, Glenn, Butte, Yuba, and Yolo) grow ninety five percent of California's rice. Approximately 500,000 acres in the Valley are of a soil type restricting the crops to rice or pasture. From 2012 to 2013, pesticide use, measured by pounds of AI, decreased 0.5 percent and area treated increased 4 percent (Table 28). Planted acreage increased 0.7 percent and the price received dropped 11 percent.

Table 28: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for rice each year from 2009 to 2013. Planted acres from 2009 to 2013 are from USDA, August 2014; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	5,644,179	4,677,241	4,880,965	5,336,952	5,310,788
Acres Treated	2,811,696	2,640,766	2,969,077	2,979,796	3,089,357
Acres Planted	561,000	558,000	585,000	562,000	566,000
Price/cwt	$ 19.61	$ 21.00	$ 18.60	$ 18.60	$ 16.60

Herbicides were the most-used pesticide class on rice in 2013 (Figure 29). Herbicides accounted for 73 percent of non-adjuvant pesticide cumulative area treated and 67 percent of the total amount of AIs applied. In 2013, the area treated with herbicides increased 3 percent and the total amount of herbicide AI applied increased 10 percent. Among 15 pesticides with the largest change in area treated, 9 were herbicides. Greater incidence of resistance may account for increased herbicide use, and new resistance has been seen in sprangletop to clomazone and cyhalofop; sedge to propanil, in addition to their established resistance to acetolactate-(ALS-)inhibiting herbicides such as bensulfuron methyl; and certain watergrass biotypes to propanil. Area treated with carfentrazone-ethyl, clomazone, penoxsulam, and 2,4-D, decreased 3,

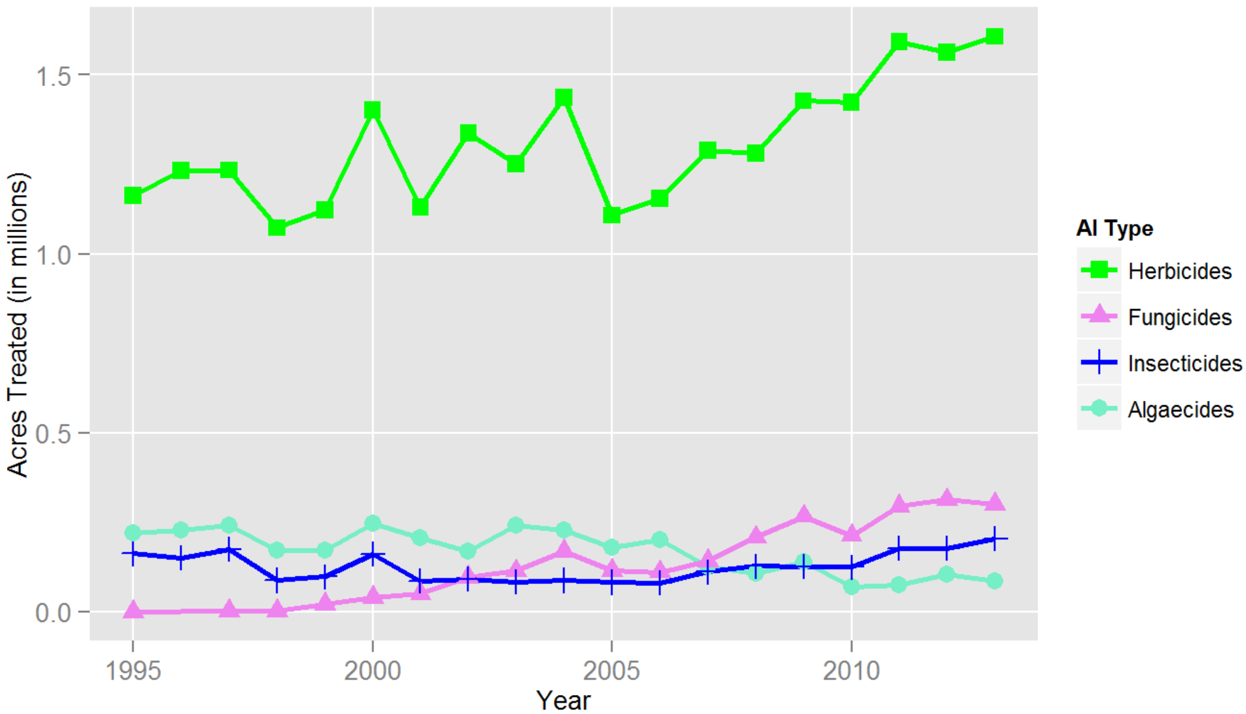

Figure 29: *Acres of rice treated by all AIs in the major types of pesticides from 1995 to 2013.*

5, 12, and 54 percent, respectively, while the area treated with cyhalofop-butyl, propanil, thiobencarb, triclopyr (triethylamine salt), and bispyribac-sodium increased 4, 6, 6, 7, and 26 percent (Figure 30). Use of thiobencarb increased probably because sprangletop evolved resistance to cyhalofop-butyl and clomazone; both herbicides are alternatives to thiobencarb for sprangletop control. It is not clear why penoxsulam use decreased, perhaps due to pricing, the introduction of the formulated mixture of thiobencarb and imazosulfuron in 2013, and resistance issues. Although penoxsulam is an ALS-inhibiting herbicide, resistance among sedges and broadleaf weeds to penoxsulam is not as widespread as it is to other ALS-inhibiting herbicides. Decreased bensulfuron methyl use may be due to widespread resistance in sedges and the 2013 introduction of the formulated mixture of thiobencarb and imazosulfuron, which controls bensulfuron methyl resistance sedges.

The area treated with fungicides decreased 4 percent. Azoxystrobin was the major fungicide used on rice in California, accounting for 77 percent of all the area treated with fungicides, but the area treated with azoxystrobin decreased 7 percent and the total amount applied decreased 8 percent. The area treated with propiconazole and trifloxystrobin increased 33 and 32 percent, respectively. Propiconazole, azoxystrobin, and trifloxystrobin are reduced-risk fungicides often used for preventative treatments. There was an unexpected increase in disease pressure in recent years. Growers were probably better prepared and treated fields where high levels of blast disease were previously documented. The two strobilurin fungicides (azoxystrobin and trifloxystrobin) are used

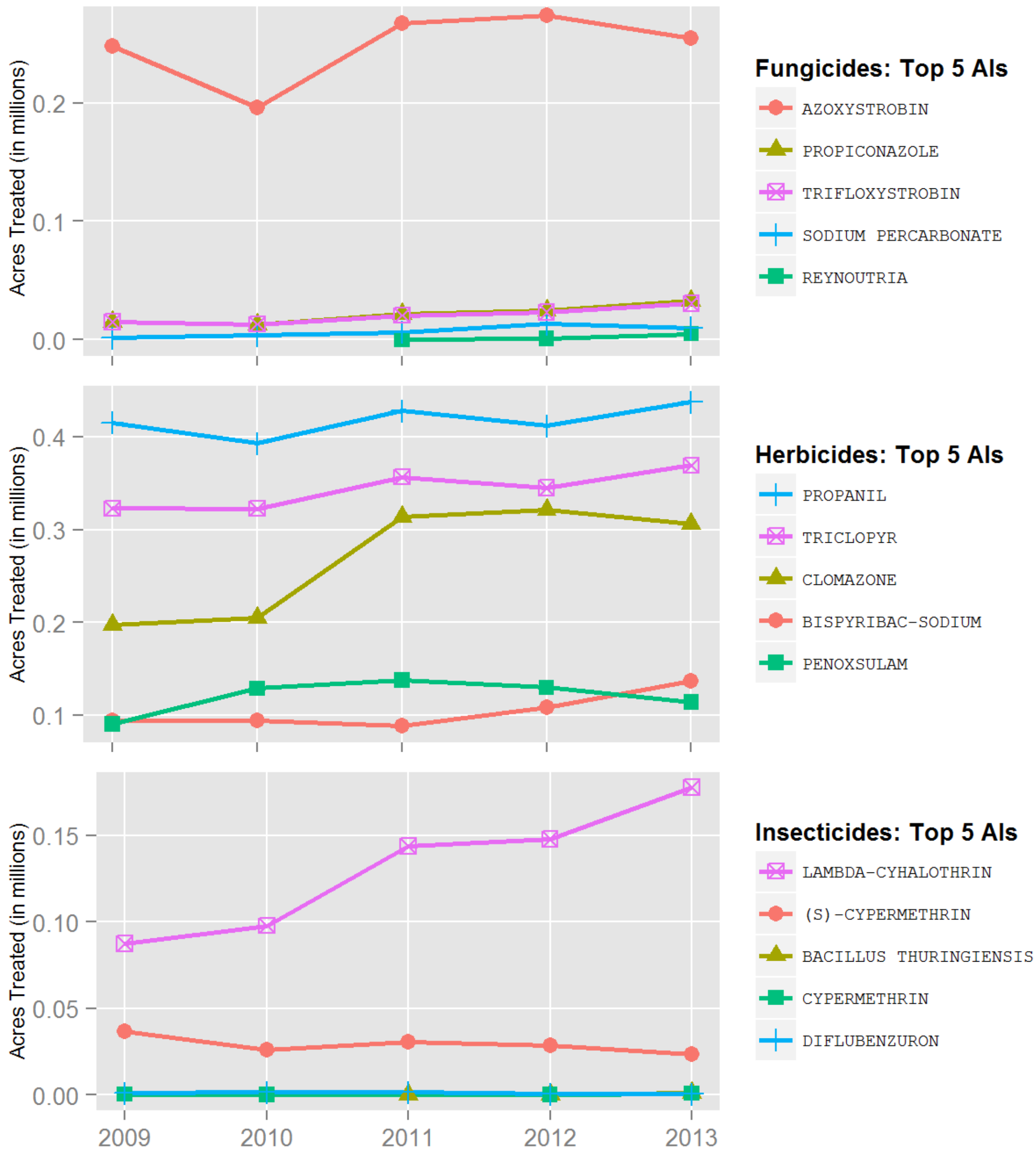

Figure 30: *Acres of rice treated by the top 5 AIs of each AI type from 2009 to 2013.*

due to their effectiveness and their ability to increase yields when used in preventative treatments.

Copper sulfate has been the key algaecide registered for rice in California, but its use had fluctuated since 2004. In 2013 the cumulative area treated with copper sulfate decreased 18 percent and the amount of AI decreased 19 percent. Copper sulfate is used primary for algae control in rice fields, but also doubles as a control for tadpole shrimp in both conventional and organic production. Copper sulfate is known to bind to organic matter such as straw residue, potentially reducing its efficiency as an algaecide. As a result, growers are shifting management practices in an attempt to control algae.

In 2013, the total area treated with insecticides increased 15 percent and the amount used increased 20 percent. Only one insecticide, lambda-cyhalothrin, was among the 15 pesticides with the largest change in area treated. Lambda-cyhalothrin increased 20 percent and (s)-cypermethrin, the second most-used insecticide, decreased 16 percent. Lambda-cyhalothrin and (s)-cypermethrin are used primarily for rice water weevil control and secondarily for armyworm and tadpole shrimp. Rice water weevil is the major insect pest on California rice. Growers have limited options among insecticides and often rely on the two active ingredients for weevil and tadpole shrimp control soon after flooding. Insect pressures are usually low on California rice, and insecticides are used on relatively few acres. Lambda-cyhalothrin is inexpensive with several generic products competing in the marketplace, and product labels allow use in preflood situations those (s)-cypermethrin do not. This probably accounts for why use of lambda-cyhalothrin went up while use of (s)-cypermethrin went down.

Strawberry

In 2013 California produced 2.3 billion pounds of strawberries—over 88 percent of the total U.S. production—valued at more than $2.6 billion. Market prices determine how much of the crop goes to fresh market and how much is processed, and in 2013, about 75 percent of the crop went to fresh market. About 41,500 acres of strawberries were planted and harvested in 2013, primarily along the central and southern coast, with smaller but significant production occurring in the Central Valley.

Table 29: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for strawberry each year from 2009 to 2013. Planted acres from 2009 to 2013 are from USDA, August 2014; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	10,046,005	11,076,752	12,101,620	13,846,030	12,024,245
Acres Treated	1,661,396	2,000,637	1,975,612	2,209,634	2,562,262
Acres Planted	39,800	38,600	38,000	38,500	41,500
Price/cwt	$ 69.4	$ 70.1	$ 75.2	$ 77.1	$ 79.8

Total acreage treated with pesticides increased 16 percent from 2012 to 2013 as planted acreage increased 8 percent (Table 29), but the amounts of pesticide applied decreased 13 percent. Fungicides, followed by insecticides, account for the largest proportion of pesticides applied on a per acre basis (Figure 31). The total area treated with fungicides increased 0.5 percent, while use of insecticides increased 19 percent. The area treated with fumigants decreased 19 percent, and the area treated with herbicides increased 39 percent. The major pesticides with greatest percent increase in area treated from 2012 to 2013 were *Chromobacterium subtsugae*, *Bacillus amyloliquifaciens*, tetraconazole, cyflufenamid, and flubendiamide. The major pesticides with the largest percent decrease were pyraclostrobin, boscalid, and fenhexamid.

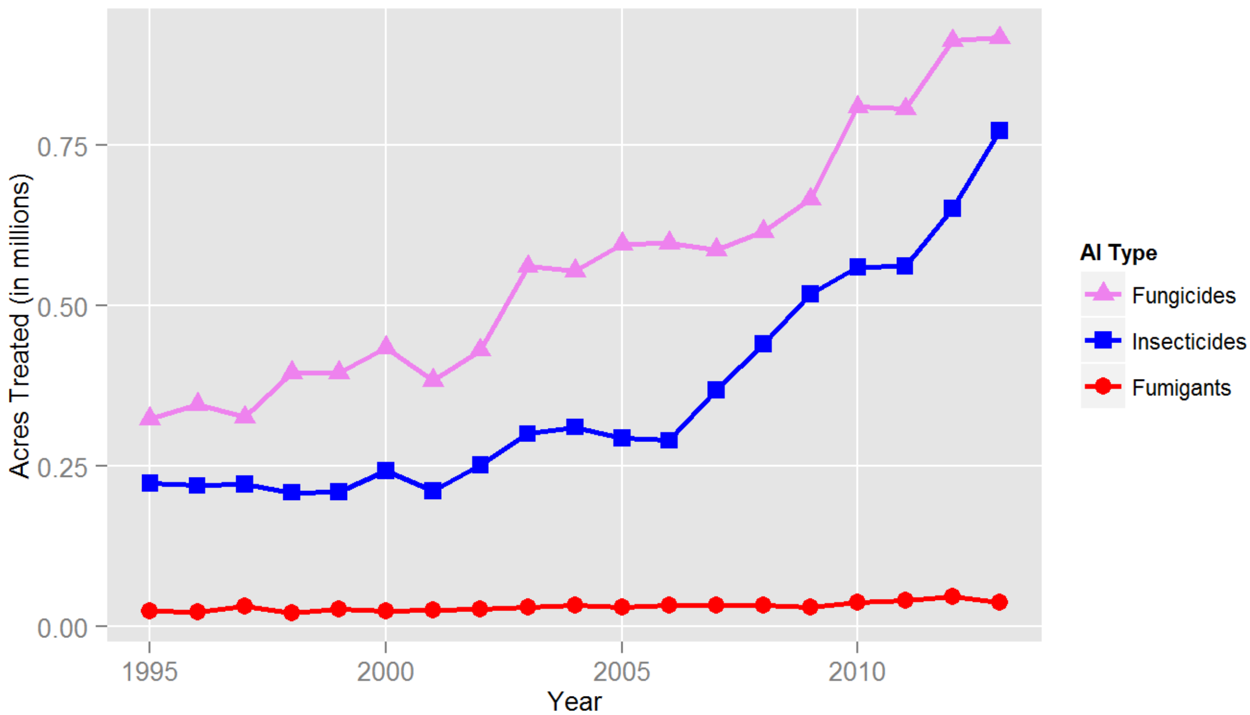

Figure 31: *Acres of strawberry treated by all AIs in the major types of pesticides from 1995 to 2013.*

The major insect pests of strawberries are lygus bugs and worms (various moth and beetle larvae), especially in the Central and South Coast growing areas. Until recently, lygus bugs were not considered a problem in the South Coast, but lygus has become a serious threat probably due to warmer, drier winters and increased diversity in the regional crop complex that supports this pest.

Major insecticides with the greatest percent increase in area treated from 2012 to 2013 were pyrethrins (87 percent), azadirachtin (86 percent), acequinocyl (69 percent), and chlorantraniliprole (68 percent). Area treated with flonicamid increased from no use in 2012 to 41,000 acres in 2013; it was newly registered for use in California strawberries in 2013 and can be

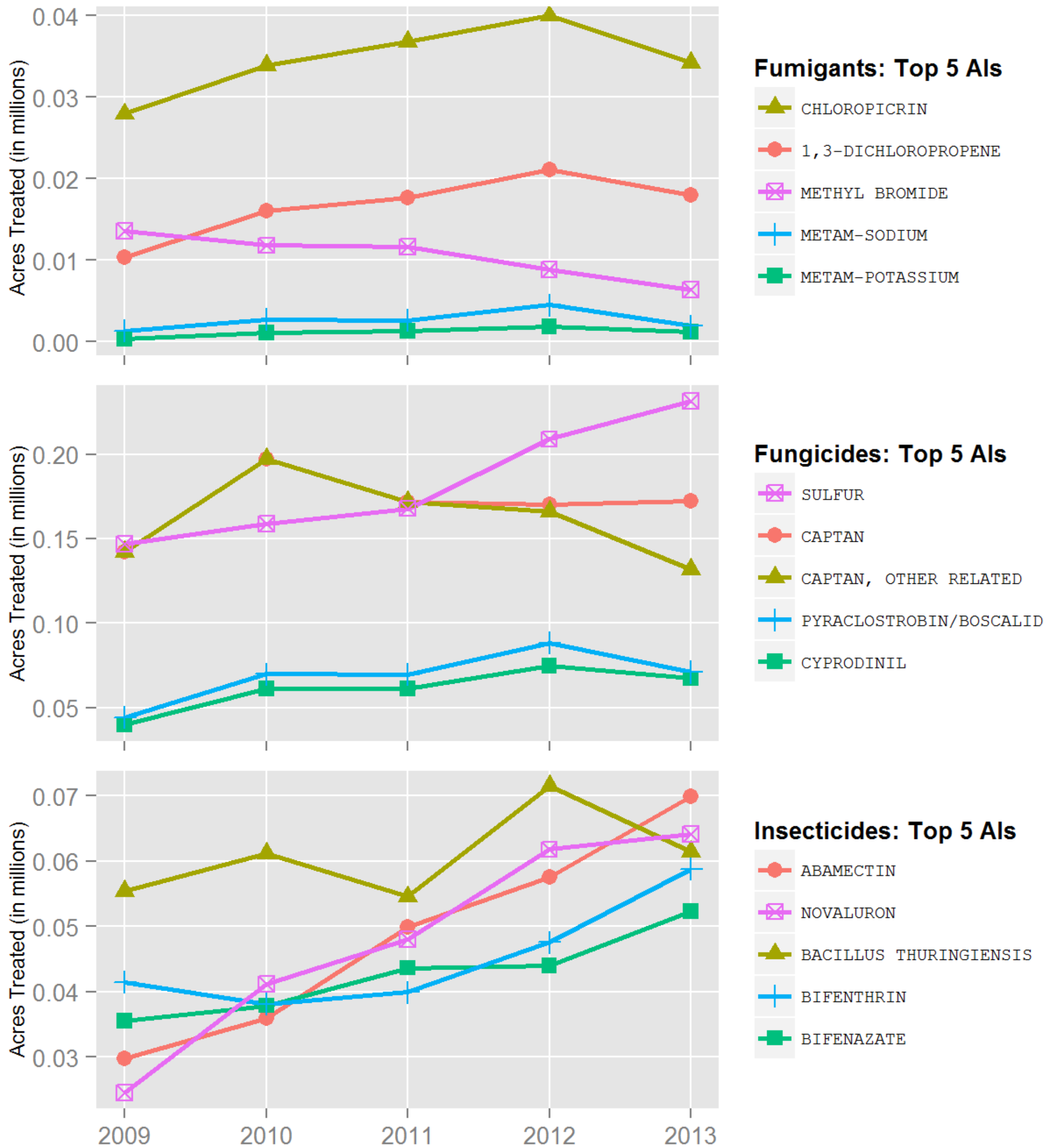

Figure 32: *Acres of strawberry treated by the top 5 AIs of each AI type from 2009 to 2013.*

used to control lygus bugs and aphids. Insecticides with decreased use include chlorpyrifos (35 percent), naled (15 percent), malathion (14 percent), and *Bacillus thuringiensis* (14 percent).

The increase in herbicide use in 2013 was primarily due to increases in the area treated with two herbicides: flumioxazin (67 percent increase) and pendimethalin (80 percent increase). These herbicides, when used in combination with clear plastic mulches, can be more cost-effective in controlling certain weeds than hand-weeding or multiple fumigant applications. The area treated with glyphosate increased by 84 percent in 2013.

Fungicides continue to be the most-used pesticides, as measured by area treated. Fungicides with significant increases in area treated in 2013 include sulfur (11 percent), mefenoxam (56 percent), tetraconazole (1,550 percent), and pyrimethanil (19 percent). Tetraconazole is used to treat powdery mildew, leaf spot, and leaf blight. Several major fungicides had decreased use, including pyraclostrobin (19 percent), boscalid (19 percent), trifloxystrobin (19 percent) , and propiconazole (29 percent). Pyraclostrobin is frequently used in combination with boscalid. For these two fungicides, both area treated and amount of active ingredient applied decreased in 2013 amid concerns about their declining efficacy.

Strawberry production relies on several fumigants. Fumigants accounted for about 82 percent (as measured by pounds applied) of all pesticide AIs applied to strawberries in 2013, but less than two percent of the total cumulative acreage. However, most strawberry fields are fumigated. The area treated with fumigants in 2013 decreased 19 percent. Area treated with each fumigant registered for use in strawberries decreased in 2013 as follows: chloropicrin (14 percent), methyl bromide (28 percent), 1,3-dichloropropene (15 percent), metam-sodium (57 percent), and potassium n-methyldithiocarbamate (32 percent). Methyl bromide is used primarily to control pathogens and nutsedge. Metam-sodium is generally more effective in controlling weeds, but less effective than 1,3-dichloropropene or 1,3-dichloropropene plus chloropicrin against soilborne diseases and nematodes. Fumigants usually are applied at higher rates than other pesticide types, such as fungicides and insecticides, in part because they treat a volume of space rather than a surface such as leaves and stems of plants. Thus, the amounts applied are large relative to other pesticide types even though the number of applications or number of acres treated may be relatively small.

Orange

California's citrus industry ranks first in the United States in terms of value. California accounts for 32 percent of the citrus production in the United States, Florida produces 65 percent, and Arizona and Texas produce the remaining 3 percent. Oranges on average account for about two-thirds of California's citrus crop, and California oranges comprise 21 percent of the United States orange crop. Eighty-two percent of California's orange crop is fresh market compared to only 5 percent of Florida's crop. California exports approximately 40 percent of its citrus crop, predominately to Japan, China, Canada, Hong Kong, Korea, and France.

Citrus is grown in four major areas in California. The San Joaquin Valley Region comprises nearly 65 percent of the state's acreage and is characterized by hot, dry summers and cold, wet winters. The Interior Region is marginally affected by the coastal climate, and it includes Riverside and San Bernardino counties and inland portions of San Diego, Orange, and Los Angeles counties. The Coastal-Intermediate Region is from Santa Barbara County south to the San Diego County/Mexico border and has a mild climate that is influenced by marine air. The Desert Region includes the Coachella and Imperial valleys where temperatures fluctuate greatly.

California accounted for 175,000 bearing acres of oranges in 2013, a decline of 1 percent from 2012 (Table 30). The price per box decreased only 0.5 percent in 2013, following a 25 percent increase in 2012.

Table 30: *Total reported pounds of all active ingredients (AI), acres treated, acres bearing, and prices for orange each year from 2009 to 2013. Bearing acres from 2009 to 2013 are from USDA, August 2014; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	8,513,622	8,788,874	10,024,901	8,842,933	8,826,554
Acres Treated	2,255,474	2,415,687	2,445,258	2,344,649	2,357,449
Acres Bearing	186,000	183,000	180,000	177,000	175,000
Price/box	$ 12.91	$ 12.54	$ 10.50	$ 13.19	$ 13.13

There were record low freezing temperatures in January across the state followed by heavy winds that dropped a lot of fruit. However, citrus suffered only minimal freeze damage. Weak storm systems brought little rain and warm temperatures through spring, and the Imperial Valley had one of the warmest Aprils on record. Drought continued to be an issue and above normal temperatures persisted through the summer. Santa Ana winds in the fall brought fire concerns. Extreme low temperatures in December were problematic as water was also scarce for use as frost protection.

Pesticide use on oranges has fluctuated from 1995 through 2013 (Figure 33). The cumulative area treated with pesticides increased 0.5 percent from 2012 to 2013 predominately due to an increase in insecticide use. The area treated in 2013 differed from the five-year average by only 0.3 percent, and the bearing acreage decreased nearly 3 percent from the five-year average.

The area treated with insecticides increased 21 percent between 2012 and 2013, and the amount of insecticides increased 6 percent. Oils, spinetoram, abamectin, imidacloprid, thiamethoxam, pyriproxyfen, and chlorpyrifos were the insecticides used on the greatest acreage (Figure 34). The area treated with each of these seven insecticides increased in 2013; notably, the area treated with oils increased 16 percent. Oils is a class of broad spectrum pesticides that kills soft-bodied insects such as aphids, immature whiteflies, immature scales, psyllids, immature true bugs, thrips, and some insect eggs, as well as mites. Oils also control powdery mildew and other fungi.

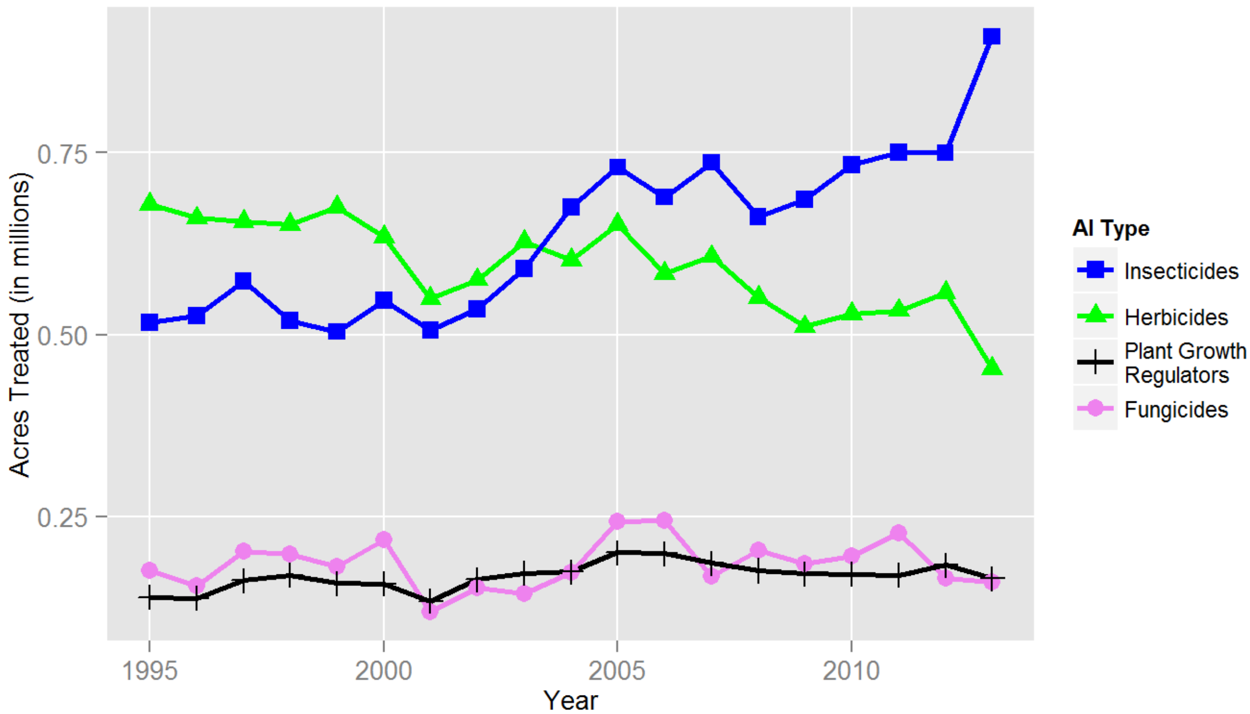

Figure 33: *Acres of orange treated by all AIs in the major types of pesticides from 1995 to 2013.*

The Asian citrus psyllid (ACP) has been the target of a considerable portion of the insecticides applied to citrus. It vectors Huanglongbing (citrus greening disease) and was first detected in California in Los Angeles in 2008. Since that time it has spread throughout southern California, up the Central Coast as far north as the Santa Barbara/San Luis Obispo county line, and to two locations in Tulare County in the San Joaquin Valley. The eradication protocol consists of two treatments: a foliar synthetic pyrethroid, such as beta-cyfluthrin, and a ground treatment with a systemic neonicotinoid, such as imidacloprid or thiamethoxam. However, despite eradication efforts, treatments have not prevented the spread of ACP. In most citrus growing regions where there are established populations, growers are advised to provide year-round control by applying a foliar application of an organophosphate (e.g., chlorpyrifos) in the fall, a foliar application of a synthetic pyrethroid in early spring, and a systemic neonicotinoid during the growing season. Additionally, growers are encouraged to treat for other pests using broad-spectrum pesticides that will kill ACP as well. Beginning in December 2012 growers could treat citrus closer to harvest so harvested fruit could be allowed out of restricted areas, which were established to prevent spread of ACP . This is much less expensive and favored by growers as they can get a better price than the packing line. Because imidacloprid is toxic to bees, applying it during bloom is discouraged. Areas treated with imidacloprid, chlorpyrifos, and thiamethoxam have increased.

Beginning in 2013 citrus that is exported to Korea must be treated to prevent transport of the Fuller rose beetle. The weevil does not cause economic damage in California, but it is hard to kill.

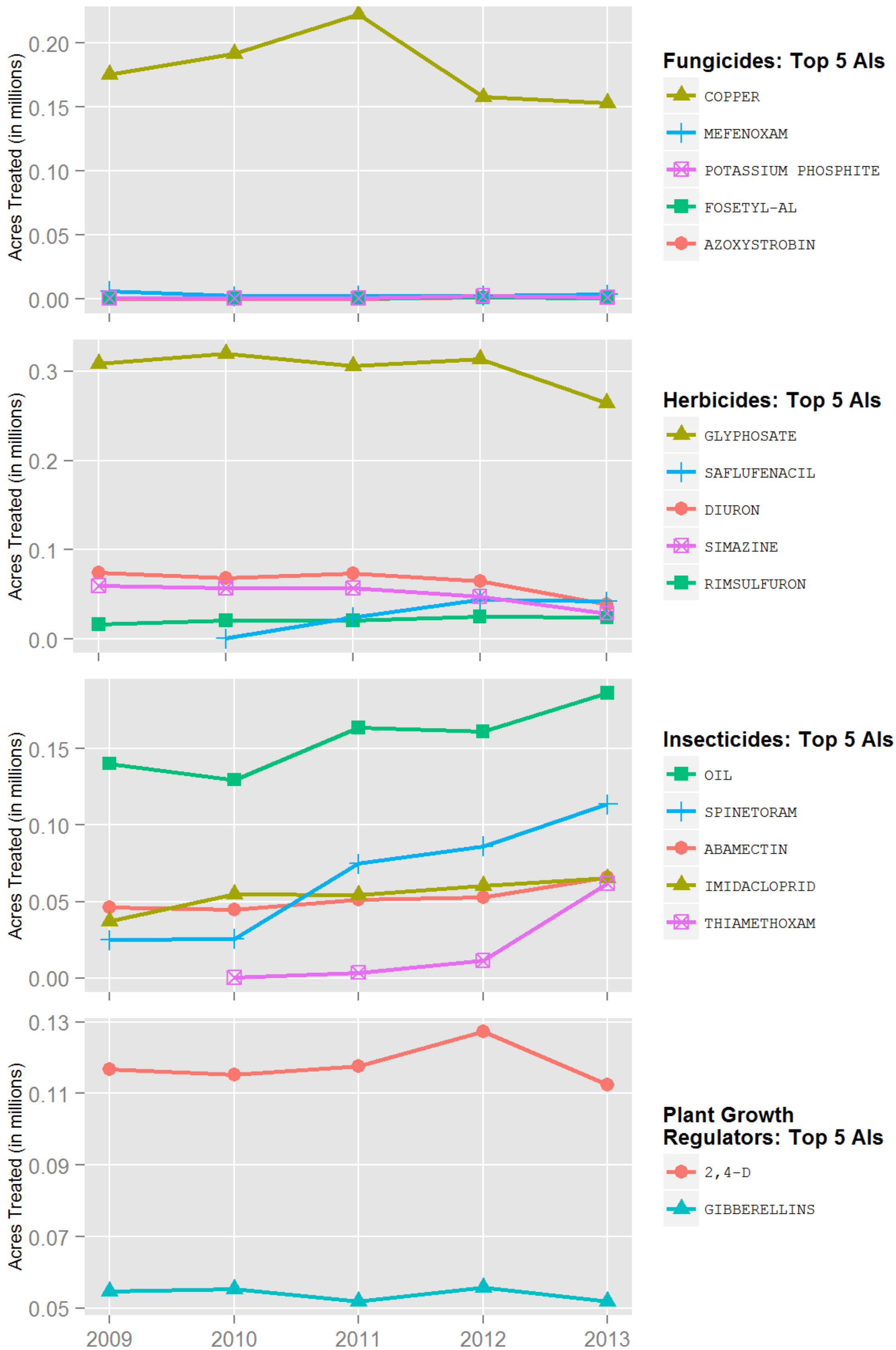

Figure 34: *Acres of orange treated by the top 5 AIs of each AI type from 2009 to 2013.*

To control it, the University of California Statewide IPM Program recommends two to four bifenthrin trunk sprays in June–September, followed by a foliar treatment of thiamethoxam in November. The area treated with thiamethoxam increased 447 percent in 2013.

Brown rot is caused by multiple fungal species when conditions are cool and wet. It occurs mostly on fruit growing near the ground that is splashed by spores from the soil. Fruit that is in the early stages of the disease can go unnoticed at harvest and infect other fruit during storage. In April China banned citrus imports from California because they found brown rot in a few loads of fruit shipped in February. Despite the fact that officials and shippers were confident the risk of other infection was very low because citrus regions had so little rain, the ban remained in effect through the end of the year.

Aside from its use for the ACP eradication program, chlorpyrifos is a broad-spectrum insecticide used primarily for citricola scale control. However, chlorpyrifos resistance in citricola scale populations has been documented, and imidacloprid is increasingly being used to help suppress these resistant populations. Its use has steadily increased since 2007, and it is used by many large operations that make pre-planned applications in the spring. It has the positive effect of a growth stimulant for orange trees, possibly because it suppresses nematodes. Imidacloprid is also used in the glassy-winged sharpshooter treatment program, and orange growers are required to treat for the pest to reduce the spread of Pierce's disease in grapes. Nevertheless, sharpshooter populations are increasing in some areas. Acetamiprid is also used in the sharpshooter treatment program, but its use has declined.

Spinosad and spinetoram are primarily used in citrus to manage citrus thrips. Both are very selective, allowing natural enemies to survive. They may eventually erode the market share of older insecticides. Of the two, spinetoram is more effective against citrus thrips populations that have developed resistance to carbamate insecticides, and its persistence and effectiveness has resulted in the reduced use of spinosad. The area treated with spinosad decreased 55 percent in 2013, while spinetoram use increased 32 percent. These two chemicals are in the same chemical category, and the overall acreage treated with one or the other in the last five years has been fairly similar.

Fenpropathrin is used to control red mites, citrus thrips, Asian citrus psyllid, katydids, and other miscellaneous pests. The area treated with fenpropathrin decreased 11 percent. The insecticidal activity of fenpropathrin is largely interchangeable with that of beta-cyfluthrin. The area treated with beta-cyfluthrin decreased 51 percent whereas the area treated with cyfluthrin increased 414 percent in 2013.

Abamectin is used for thrips, mites, and citrus leafminer, and it is preferred because it is inexpensive and has broad-spectrum and long residual activity, low worker risk, and a short pre-harvest interval. With the exception of a slight drop in 2007, its use has steadily increased since 2004. The area where it was used increased 24 percent in 2013 over use in 2012.

Dimethoate is used for a variety of pests such as scales and thrips. Its declining use is likely due to the growing popularity of replacement insecticides such as spinetoram and the neonicotinoids imidacloprid and acetamiprid. The area treated with dimethoate increased 111 percent from 2012, but its use is still following a downward trend in the last ten years. The use of pyriproxyfen, which is used almost exclusively for California red scale control, reversed a declining trend. The area treated with pyriproxyfen increased 56 percent in 2013 and attained the second highest area in 20 years. In the San Joaquin Valley, populations of armored scale have been found to be resistant to chlorpyrifos, methidathion, and carbaryl, and growers are encouraged to release parasitic wasps and use buprofezin, oil, pyriproxyfen and spirotetramat.

Fungicide use decreased both by area treated and by amount applied in 2013. The area treated decreased 3 percent to the fewest number of acres treated with fungicides since 2003. This decrease is attributable to a substantial decrease in the use of copper-based fungicides, which are the most widely used fungicides in oranges. They are used to prevent Phytophthora gummosis, Phytophthora root rot, and fruit diseases such as brown rot and Septoria spot. Copper-based pesticides are also used for the brown garden snail. These diseases and pests are exacerbated by wet, cool weather during harvest, but the spring of 2013 was dominated by warm, dry weather. Copper-based pesticide treatments are required for citrus exported to Korea to control Septoria spot fungus. Similarly, imazalil is used as a post-harvest treatment to control storage decay.

Weed control is important in citrus groves to prevent weeds from affecting tree growth and yields or impeding production and harvesting operations. A combination of pre- and post-emergence herbicides is used, as well as mechanical removal. The area treated with herbicides decreased 19 percent between 2012 and 2013, and the amount applied decreased 23 percent. This was the lowest area treated and amount used in over 20 years. Decreases in area treated were observed in the use of glyphosate, saflufenacil, diuron, simazine, rimsulfuron, bromacil, and pendimethalin. Glyphosate, a post-emergence herbicide, was the most-used herbicide, but the amount of glyphosate applied decreased after its high use in 2012. Saflufenacil is a post-emergence, burn-down herbicide that was first used in 2010. The area treated decreased 5 percent in 2012. There is a growing problem with resistance of horseweed and fleabane to glyphosate, and saflufenacil is a contact herbicide that is a good replacement.

Use of pendimethalin (a pre-emergence herbicide) has steadily declined since 2007, when it had its highest use on California citrus. Simazine is also a pre-emergence herbicide, as are oryzalin and diuron; use of all these herbicides decreased. However, indaziflam, also a pre-emergence pesticide, increased 30 percent in area used. Decreased use of pre-emergence herbicides was probably due to the relatively dry conditions in 2013 and reduced weed growth. Decreased use of some herbicides may also be partially due to regulations aimed at protecting ground water quality, particularly the regulations that affect the use of simazine and diuron, which are classified as ground water contaminants and regulated accordingly. Trifluralin and oryzalin are probably replacing diuron as a pre-emergence herbicide.

The area treated with diphacinone, a ground squirrel control agent, decreased 24 percent between 2012 and 2013, following an increase in 2011 and 2012. Between 2000 and 2011, there had been a steady decrease in the area treated. The area where strychnine was used also decreased 18 percent.

The area treated with metaldehyde decreased 11 percent. Metaldehyde is used to control snails and slugs, and the warm, dry spring inhibited outbreaks of these pests.

Peach and nectarine

California grew 73 percent of all U.S. peaches, including 44 percent of fresh market peaches and 96 percent of processed peaches, and 93 percent of nectarines in 2013. Most freestone peaches and nectarines are produced in Fresno, Tulare, and Kings counties in the central San Joaquin Valley and sold on the fresh market. Clingstone peach, largely grown in the Sacramento Valley, is used exclusively for canning and processing into products such as baby food, fruit salad, and juice. Peach and nectarine are discussed together because pest management issues for the two crops are similar.

The California stone fruit industry appears to be turning a corner after several years of oversupply, financial hardship, and consolidation. During that period some growers switched to grapes or nut crops, which have lower labor requirements and higher profit margins. More than 10 percent of clingstone peach acreage was pulled out after the 2012 harvest, and the 2013 crop was the third smallest in over 50 years. In spite of a second consecutive year of declining peach and nectarine production, overall crop value per ton decreased by 8 percent (Table 31). Currently the industry is attempting to re-establish a satisfactory balance between supply and demand and between crop value and production costs. Some positive signs of unmet demand and higher crop values appeared in 2013. There were supply shortfalls for USDA purchases of canned and frozen peaches for schools and other feeding programs. Processors set a clingstone peach price per ton that met grower needs for sustainability, followed by a significantly higher 2014 price. The price per ton of freestone peaches sold for freezing also rose.

Table 31: *Total reported pounds of all active ingredients (AI), acres treated, acres bearing, and prices for peach and nectarine each year from 2009 to 2013. Bearing acres from 2009 to 2013 are from USDA, August 2014; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	5,034,574	4,466,805	4,558,446	4,015,660	3,724,657
Acres Treated	1,383,046	1,341,707	1,338,146	1,370,690	1,349,966
Acres Bearing	81,500	78,000	74,000	72,000	64,000
Price/ton	$ 483.04	$ 427.95	$ 451.35	$ 572.68	$ 527.72

Peach and nectarine acreage treated with the major categories of pesticides has fluctuated from year to year since 1995. The area treated with sulfur shows a gently decreasing trend (Figure 35). Pesticide use per acre increased in 2013. The 7 percent reduction in total amount of pesticide AI applied and 2 percent reduction in area treated did not keep pace with an 11 percent reduction in bearing acres (Table 31). The area treated with insecticides increased while areas treated with fungicides, herbicides, and sulfur declined (Figure 35).

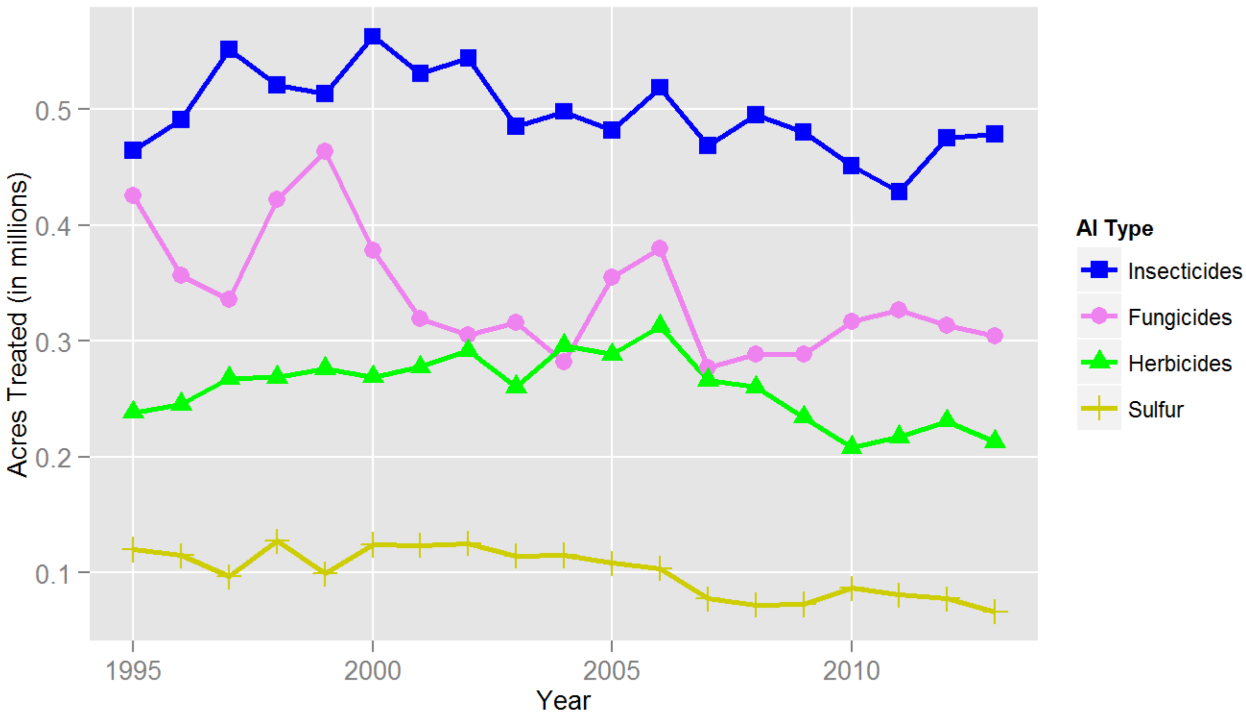

Figure 35: *Acres of peach and nectarine treated by all AIs in the major types of pesticides from 1995 to 2013.*

Winter 2012/13 ushered in a second consecutive year of drought. Heavy rainfall in November and December was followed by months of sparse precipitation. Stone fruit growers started irrigating in February. Freestone peach and nectarine growing areas received 40-50 percent of normal rainfall, while rainfall in clingstone peach production areas ranged from 50-86 percent of normal. Winter chilling hours were more than sufficient and produced a well-defined bloom period. Strong winds did damage in some orchards in mid-April and a June heat wave caused early harvest clingstone peaches to be undersized, but otherwise growing conditions were favorable. The warm, dry weather was perfect for ripening, and fruit quality was good. Total clingstone peach production was only slightly reduced from 2012, but freestone peach and nectarine production declined by 16 and 17 percent, respectively.

Warm dry winter weather can favor survival and reproduction of insect pests and mites that attack orchard trees. Cumulative peach and nectarine acreage treated with insecticides and miticides

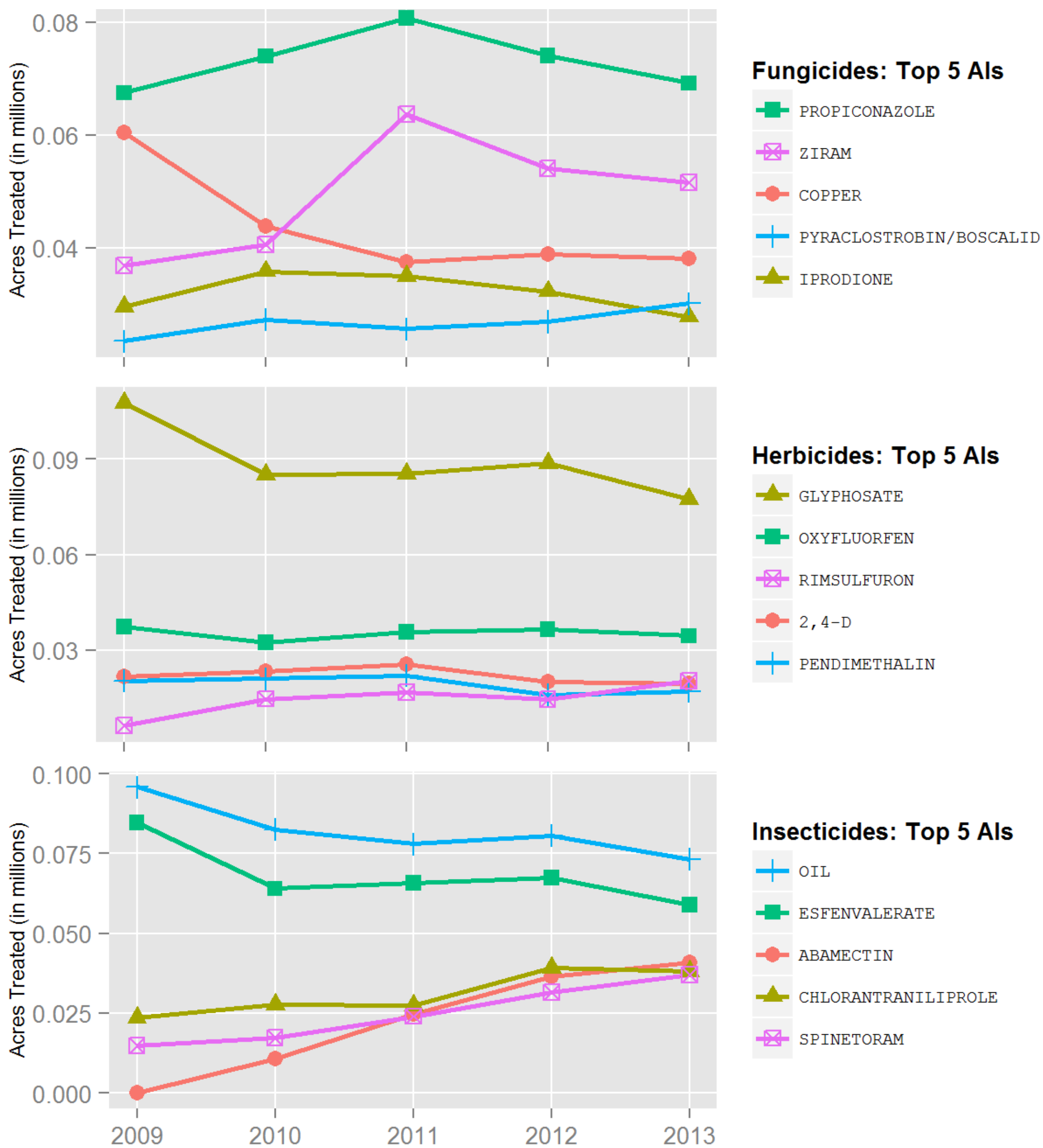

Figure 36: *Acres of peach and nectarine treated by the top 5 AIs of each AI type from 2009 to 2013.*

increased slightly in 2013 in spite of the decrease in bearing acreage (Figure 35). Target pests, price, and efficacy affect choices of pesticide products. The data and reports from the field indicate that the larvae of moths such as the Oriental fruit moth (OFM), peach twig borer, and leafrollers, mites, aphids, and perhaps katydids in the San Joaquin Valley were significant problems. Figure 36 shows the most-used active ingredients (AIs) by area treated. Oils are applied during the dormant season and/or during the growing season to prevent outbreaks of scales, mites, and moth pests. Esfenvalerate is a relatively inexpensive broad-spectrum chemical used during tree dormancy or during the growing season to control aphids and as an alternative to OFM mating-disruption pheromones. Abamectin is a miticide; the areas treated with abamectin and the miticides spirodiclofen and hexythiazox increased by 12, 25, and 104 percent, respectively. Chlorantraniliprole and spinetoram are applied to control moth larvae and katydids; spinetoram is used for thrips as well. Areas treated with indoxacarb and phosmet, also used to control moth larvae and katydids, increased by 42 and 49 percent, respectively.

Cumulative acreage of peach and nectarine orchards treated with fungicides and sulfur during 2013 declined by 1 and 14 percent, respectively (Figure 35). Fungicide use decreased far less than bearing acreage, suggesting that pressure of diseases such as brown rot and powdery mildew increased despite dry weather. Sulfur is the standard treatment for preventing powdery mildew infection, but its use has been declining gradually over the years. It has no curative effect, unlike propiconazole and the reduced-risk AIs pyraclostrobin and boscalid, all of which control powdery mildew and brown rot reliably (Figure 36). Many growers also use propiconazole to control sour rot, especially in fruit ripening mid- to late-season. Ziram provides excellent control of leaf curl and is also effective against shot hole and scab diseases. Copper-based fungicides, which have become expensive, are applied to control leaf curl and shot hole diseases. Iprodione is reliable for brown rot control. Areas treated for brown rot or powdery mildew with the new AI difenoconazole jumped from 110 to 1,317 acres during its second year on the market.

Rainfall during the growing season affects the volume of fresh peaches and nectarines treated with fungicides after harvest to prevent spoilage by rots and molds. Brown rot is the chief cause of postharvest fruit decay, but gray mold (known as Botrytis bunch rot when it infects grapes), Rhizopus rot (aka black bread mold), and sour rot can also pose significant problems. Fludioxonil and fenhexamid generally dominate postharvest fungicide applications. Propiconazole is the most effective fungicide for sour rot control. They allow fruit to be shipped over longer periods to distant export markets or displayed within the marketplace at shelf temperatures without decay developing.

The second consecutive dry year did not reduce herbicide use on a per acre basis. Herbicides were applied to 8 percent less cumulative area in peach and nectarine orchards but planted acreage declined 11 percent (Figure 35). Although crop value decreased, increasing problems with glyphosate-resistant weeds may have caused some growers to spend more on herbicides. The area treated with glyphosate declined by 13 percent (Figure 36). In contrast, rimsulfuron was applied to 39 percent more area. It is a pre-emergence AI with some post-emergence effectiveness, controls a relatively broad spectrum of weed species, and has been inexpensive since going off-patent in 2010. The area treated with indaziflam, a new, relatively long-lasting pre-emergence AI that tank mixes well and controls glyphosate-resistant weeds such as hairy fleabane and mare's tail (also called horseweed), grew by 45 percent. Pre-emergence herbicides such as oxyfluorfen, pendimethalin, rimsulfuron, and indaziflam are applied to soil before the growing season to prevent weed sprouting. Post-emergence herbicides such as glyphosate, 2,4-D, pyraflufen-ethyl, and paraquat kill existing weeds on contact.

Fumigants are used in peach and nectarine orchards for rodent control and for pre-plant soil treatments against arthropod pests, nematodes, pathogens, and weeds. The area having rodent burrows fumigated with aluminum phosphide was small for a second year: 221 acres, perhaps in part because lack of rainfall reduced food and shelter, and rodent populations were low. Moreover, aluminum phosphide works best in moist soils. Area treated with the most widely used pre-plant soil fumigant, 1,3-D, increased by 58 percent, and chloropicrin application increased as well, indicating an uptick in orchard replanting. The number of small cling peach trees sold by nurseries increased 90 percent from the record low of 2012. Newly planted cling peach acreage reportedly increased by 68 percent. In recent years only a relatively small area has been treated with the soil fumigant methyl bromide before planting. Field agricultural use of methyl bromide is being phased out and it has become expensive. Changing relationships between nematode infestations, pathogen infections, rootstock choices, and application patterns also affect fumigant selection and use from year to year.

A total of 1,821 cumulative acres of peaches and nectarines were treated with plant growth regulators (PGRs) in 2013. Gibberellins, which are plant hormones that regulate growth and development, were applied to 1,593 acres, an increase of 60 percent. Amino ethoxy vinyl glycine hydrochloride, an ethylene synthesis inhibitor, was applied to 228 acres. Both chemicals can enhance the firmness, size, and storability of fruit. In many cultivars, gibberellins applied from May through July can reduce the percentage of buds that produce flowers the following year. As a result, fruit numbers are reduced, the need for hand thinning is reduced and in some cases eliminated, and fruit quality is better. There are risks associated with "chemical thinning" because it is impossible to predict weather conditions during bloom and fruit set, but a worsening scarcity of field labor may have motivated some growers to experiment with PGRs for that purpose.

Carrot

California is the largest producer of fresh market carrots in the United States, accounting for 82 percent of the U.S. production of 2.3 billion pounds in 2013. California has four main production regions for carrots: the San Joaquin Valley (Kern County), the Central Coast in San Luis Obispo and Santa Barbara counties (Cuyama Valley) and Monterey County, the low desert (Imperial and Riverside counties), and the high desert (Los Angeles County). The San Joaquin Valley accounts for more than half the state's acreage.

In 2013, 63,000 acres of carrots were planted in California, an increase of about 2 percent from

Table 32: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for carrot each year from 2009 to 2013. Planted acres from 2009 to 2013 are from USDA, August 2014; marketing year average prices from 2009 to 2013 are from USDA, August 2014. Acres treated means cumulative acres treated (see explanation p. 10).*

	2009	2010	2011	2012	2013
Pounds AI	5,527,956	8,107,077	6,620,271	7,229,722	6,407,218
Acres Treated	439,491	445,301	457,754	507,486	524,004
Acres Planted	63,500	57,000	65,000	62,000	63,000
Price/cwt	\$ 25.7	\$ 27.6	\$ 34.2	\$ 26.9	\$ 29.6

2012 (Table 32). The amount of AI applied to carrots decreased 11 percent (7.2 million pounds in 2012 to 6.4 million pounds in 2013), and the area treated increased 3 percent (Table 32). The cumulative area of carrot treated with insecticides increased 63 percent (Figure 37), while the amount of insecticide applied increased 60 percent. Reported use of fumigants decreased 18 percent in terms of area treated (Figure 37), while the overall amount decreased 14 percent. Fungicide use increased 5 percent, while the area of carrot treated with fungicides decreased 3 percent. Herbicide use increased 17 percent, while area of carrot treated with herbicide increased 2 percent.

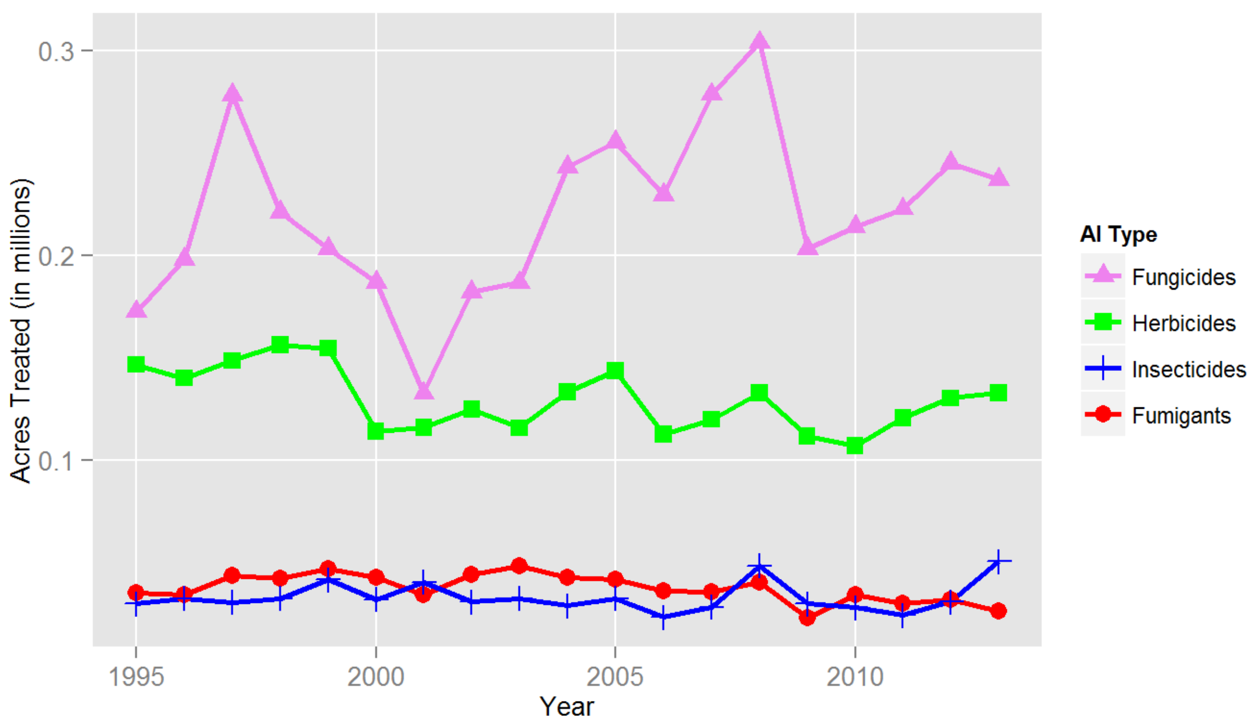

Figure 37: *Acres of carrot treated by all AIs in the major types of pesticides from 1995 to 2013.*

The most-applied fungicides in 2013 by area treated were sulfur, mefenoxam, pyraclostrobin,

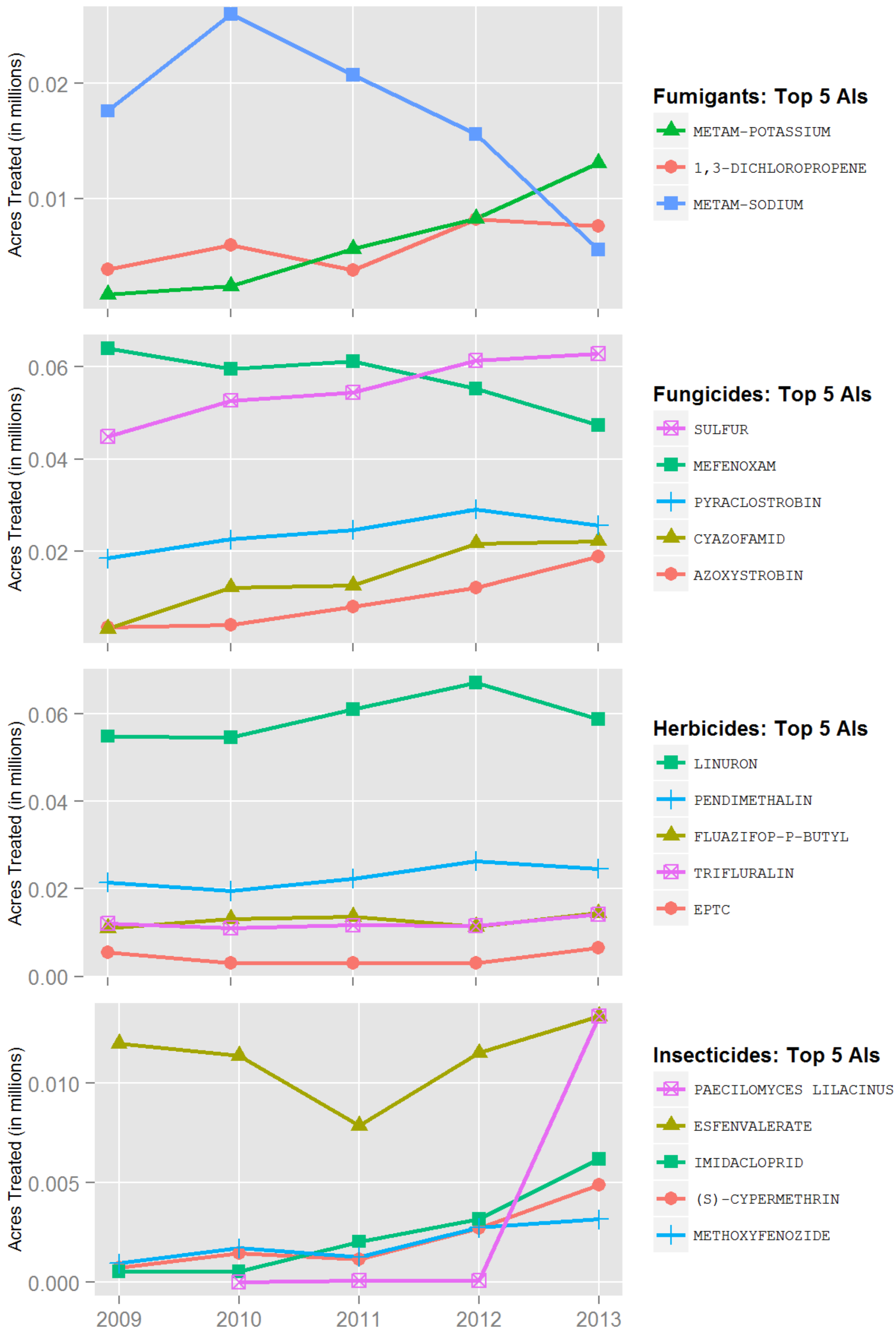

Figure 38: *Acres of carrot treated by the top 5 AIs of each AI type from 2009 to 2013.*

cyazofamid, and azoxystrobin. This was similar to the previous year, though azoxystrobin use increased 55 percent (Figure 38). Sulfur and cyazofamid saw a slight increase in area treated, while mefenoxam and pyraclostrobin use both decreased about 13 percent (Figure 38). Cyazofamid, often used in rotation with mefenoxam, continues to provide good cavity spot control. Cavity spot is a major soilborne fungal disease that is also controlled with fenamidone or the soil fumigants metam-sodium and metam-potassium. The use of QST 713 strain of dried *Bacillus subtilis* to control soil borne diseases increased 76 percent, after rising 54 percent the previous year. Alternaria leaf blight, a foliar disease, is generally controlled with iprodione, chlorothalonil, pyraclostrobin, all of which saw decreased use, and azoxystrobin, which saw a considerable increase. Sulfur, an inexpensive and popular choice for controlling powdery mildew, remains the most commonly used fungicide in both area treated and amount applied. (Figure 38). Copper-based pesticides, also used for powdery mildew, increased 39 percent over the previous year.

The most prominent herbicides used in carrot production by area treated in 2013 were linuron, pendimethalin, fluazifop-p-butyl, trifluralin, and EPTC (Figure 38). Linuron, a post-emergence herbicide that provides good control of broadleaf weeds and small grasses, showed a 12 percent decrease in use (Figure 38). Trifluralin is a pre-emergence herbicide that complements linuron for weed management; its use increased 23 percent. Pendimethalin, another selective herbicide, saw a 6 percent decrease in use. use of fluazifop-p-butyl, a selective post-emergence phenoxy herbicide used for control of annual and perennial grasses, increased 27 percent. EPTC is a selective pre-emergence herbicide that increased 110 percent in use.

The most prominent insecticides used in 2013 by area treated included *Paecilomyces lilacinus* Strain 251, esfenvalerate, imidacloprid, s-cypermethrin, and methoxyfenozide (Figure 38). After promising research results, the biopesticide *Paecilomyces lilacinus* Strain 251 (a naturally occurring fungus with nematicidal properties) was used to treat just over 13,000 acres of carrot in 2013. Part of this increase may also be due to the fact that metam was not allowed in the Imperial Valley. The area treated with the insecticide esfenvalerate, used against a range of insect pests such as whitefly, leafhoppers, and cutworms, increased 16 percent. The use of imidacloprid, effective against aphids and whiteflies, increased 94 percent. Use of methoxyfenozide, a selective insecticide that controls lepidopterous pests such as cutworms, increased 16 percent, while use of the pyrethroid s-cypermethrin increased 80 percent. Flea beetles, which have been identified as a new pest of carrots in California, may be driving the increase use of some of these insecticides. Use of diazinon, used to control aphids and other insects, continued to decline, down 71 percent. The use of the biological insecticide spinosad decreased 25 percent, while *Bacillus thuringiensis* increased 90 percent. Fumigants in carrot production are primarily used to manage nematodes and also provide control of weeds and soil-borne diseases. Fumigants accounted for 87 percent of all pesticide AIs applied to carrot acreage by amount applied, and 5 percent of AIs by area treated in 2013. Continuing the trend from 2012, the area treated with metam-sodium decreased (64 percent), while metam-potassium use increased 59 percent. The fumigant 1,3-dichloropropene saw a 7 percent decrease in 2013. No chloropicrin use was reported in carrot production in 2013.

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