Summary of Pesticide Use Report Data 2012

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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.

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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 1989-2012 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 2012) 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 of 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 while protecting people and the environment. 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 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 uses 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 food monitoring, 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 in DPR's reevaluation of currently registered pesticides. 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 pesticides 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 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 validating and relaying pesticide use reports electronically 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 enhanced the accuracy and integrity of the database.

Improving Accuracy

The use report data are checked for accuracy at several steps in the process. CalAgPermits checks for several kinds of errors when users enter data. For example, if the pesticide 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 in the permit. 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 of those products is often allowed while existing stocks remain with end-users. Records with suspected errors are flagged and returned electronically to the county for resolution.

In the late 1990s, DPR developed a statistical method to detect probable errors in the data fields for the acres treated and the pounds of pesticide used. This is one of the error checks done after data are sent to DPR. If a reported rate of use (pounds of pesticide per area treated) is so large it was probably an error, the rate is replaced with an estimated rate equal to the median rate of all 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 pounds 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 pounds 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 data base (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 statistics 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 to 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 and 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 pesticide use or treated acreage. 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, and 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.
- 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 applications 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 product reported 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 language. 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 language in the database called a crop by one name and the use report used another. For example, a grower may have reported a pesticide use on "almonds," but the actual label on the pesticide product coded into the database stated the pesticide was to be used on "nuts." A cross-reference table was created associating each crop with a more general crop name that could be used on a label. This cross-reference table also associated 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 rejections.

Plants and commodities grown in greenhouse and nursery operations represented a challenge in use reporting because of their diversity. Six commodity groupings were suggested by industry 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 to treat 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.

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.)

Acres Treated

The summary information in this annual report cannot be used to determine the total number of acres of a crop. However, it can be used to determine the cumulative acres treated. The problem is that the same field can be treated more than once in a year with the same active ingredient. A similar problem 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, in the summary tables, the three different active ingredients will each have recorded 20 acres treated. Adding these values results in a total of 60 acres as being treated instead of the 20 acres actually treated.

Number of Applications

The values for 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 given so they are no longer included in the totals. In the annual PUR reports before 1997, each monthly summary record was counted as one application. In the annual summary report 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. 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 2012 data submitted to DPR as of August 21, 2013. Total pounds may change slightly due to ongoing error correction. The revised numbers, when available, will more accurately reflect the total pounds applied.

Pesticide Use in California

In 2012, there were 186 million pounds of pesticide active ingredients reported 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 192 million pounds in 2011.

Such variances are and will continue to be a normal occurrence. 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, 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 2011 and 2012*

	2011 Pesticide Use		2012 Pesticide Use	
County	Pounds Applied	Rank	Pounds Applied	Rank
Alameda	352,925	37	289,411	39
Alpine	621	58	155	58
Amador	95,377	44	61,705	46
Butte	2,094,646	21	2,795,981	18
Calaveras	78,444	46	40,532	48
Colusa	2,523,891	18	2,540,002	19
Contra Costa	411,502	36	478,769	36
Del Norte	293,163	38	299,458	38
El Dorado	130,851	42	148,929	42
Fresno	36,742,956	1	33,238,182	1
Glenn	2,326,252	19	1,887,874	22
Humboldt	27,881	51	37,618	49
Imperial	5,222,679	11	5,845,189	12
Inyo	7,800	54	9,750	54
Kern	28,160,997	2	27,548,925	2
Kings	7,180,729	8	6,630,944	9
Lake	699,221	32	562,739	34
Lassen	80,165	45	65,995	45
Los Angeles	1,652,065	23	2,041,840	21
Madera	11,639,501	4	9,475,529	5
Marin	64,963	48	73,082	44
Mariposa	5,883	55	4,403	56
Mendocino	782,982	31	890,818	31
Merced	7,029,359	9	7,256,071	8
Modoc	116,185	43	115,026	43
Mono	9,745	53	5,489	55
Monterey	8,592,403	6	9,214,278	6
Napa	1,393,623	24	1,301,567	26
Nevada	30,363	50	46,748	47
Orange	959,407	28	1,024,479	28
Placer	267,146	40	325,694	37
Plumas	2,939	56	34,328	50
Riverside	2,117,956	20	2,815,462	17
Sacramento	3,562,310	13	3,265,064	14

Table 1: (continued) *Total pounds of pesticide active ingredients reported in each county and rank during 2011 and 2012*

	2011 Pesticide Use		2012 Pesticide Use	
County	Pounds Applied	Rank	Pounds Applied	Rank
San Benito	533,185	34	612,577	33
San Bernardino	509,146	35	520,269	35
San Diego	1,358,088	25	1,354,849	25
San Francisco	40,667	49	31,992	51
San Joaquin	10,862,797	5	9,556,521	4
San Luis Obispo	3,244,942	15	2,824,889	16
San Mateo	284,574	39	212,415	41
Santa Barbara	5,187,768	12	6,180,856	11
Santa Clara	892,257	29	899,928	30
Santa Cruz	1,682,416	22	1,693,000	24
Shasta	232,544	41	277,430	40
Sierra	718	57	3,307	57
Siskiyou	1,251,340	26	1,864,896	23
Solano	548,617	33	962,273	29
Sonoma	2,661,814	17	2,243,080	20
Stanislaus	6,391,740	10	6,463,110	10
Sutter	3,134,668	16	2,909,561	15
Tehama	879,269	30	680,068	32
Trinity	25,158	52	17,638	53
Tulare	15,273,797	3	14,164,763	3
Tuolumne	71,101	47	28,443	52
Ventura	7,528,413	7	7,653,583	7
Yolo	3,266,316	14	3,280,214	13
Yuba	1,203,499	27	1,133,656	27
Total	191,721,767		185,941,355	

Table 2: *Pounds of pesticide active ingredients, 1998 – 2012, by general use categories.*

Year	Production Agriculture	Post Harvest Fumigation	Structural Pest Control	Landscape Maintenance	All Others	Total Pounds
1998	207,927,441	1,760,324	5,931,519	1,408,227	6,874,496	223,902,007
1999	189,266,088	2,059,858	5,673,552	1,413,513	7,908,437	206,321,449
2000	175,720,759	2,167,778	5,187,129	1,416,991	6,855,212	191,347,868
2001	142,936,981	1,462,160	4,922,710	1,291,002	6,325,075	156,937,928
2002	159,183,713	1,852,668	5,469,448	1,450,458	6,834,752	174,791,040
2003	160,998,120	1,785,747	5,177,461	1,976,594	7,527,304	177,465,226
2004	165,872,033	1,874,210	5,120,277	1,613,244	6,995,543	181,475,307
2005	178,316,264	2,260,932	5,625,449	1,776,590	8,517,682	196,496,917
2006	168,594,038	2,216,042	5,273,684	2,287,478	10,340,442	188,711,684
2007	157,546,121	2,279,532	3,967,344	1,673,202	7,337,671	172,803,871
2008	150,964,696	2,540,189	3,224,588	1,589,888	7,173,158	165,492,519
2009	146,404,943	1,479,629	2,939,877	1,345,632	6,017,243	158,187,324
2010	159,817,371	2,164,749	3,734,020	1,735,295	8,020,581	175,472,016
2011	176,802,235	1,431,343	3,200,349	1,716,308	8,571,531	191,721,767
2012	170,574,727	1,244,780	3,524,498	1,572,048	9,025,302	185,941,355

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 619 million pounds of pesticide active ingredients 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 Use in Certain Pesticide Categories

Reported pesticide use in California in 2012 totaled 186 million pounds, a decrease of 5.8 million pounds (3.0 percent) from 2011. Production agriculture, the major category of use subject to reporting requirements, accounted for most of the decrease. Applications decreased by 6.2 million pounds for production agriculture, 186,000 pounds for post-harvest treatments, and 144,000 pounds for landscape maintenance. In contrast, there was a 324,000-pound increase for structural pest control and 453,000 pounds 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 as measured by pounds were sulfur, petroleum and mineral oils, 1,3-dichloropropene, glyphosate, and chloropicrin. The amount of sulfur accounted for 25 percent of all reported pesticide use in 2012.

This report discusses two different measures of pesticide use: amount of active ingredient (AI) applied in pounds and cumulative acres treated, which means that the area treated is added for each application even when the same field is treated more than once in a year. Because different AIs are used at very different rates, the picture of pesticide use looks quite different using these two measures.(For example, if one acre is treated three times in a season with an individual AI, it is counted as three acres treated in the tables and graphs in Sections IV and V of this report.) The data for pounds include both agricultural and nonagricultural applications; the data for area treated are primarily agricultural applications.

Reported pesticide use by cumulative area treated in 2012 was 84 million acres, a decrease of 1 million acres (1.2 percent) from 2011. By this measure the non-adjuvant pesticides with the greatest use in 2012 were glyphosate, sulfur, petroleum and mineral oils, abamectin, and copper-based pesticides. The most-used fumigant by area treated was aluminum phosphide.

DPR data analyses have shown that pesticide use varies from year to year depending upon pest problems, weather, acreage and types of crops planted, economics, and other factors. Use of most pesticide categories decreased from 2011 to 2012, except for increases in area treated by pesticides identified as reproductive toxins and fumigants and pounds of pesticides identified as carcinogens, air contaminants, and fumigants.

To provide an overview, pesticide use is summarized for eight different pesticide categories from 2004 to 2012 (Tables 3 – 18) and from 1995 to 2012 (Figures 1 – 8). These categories classify pesticides according to certain characteristics such as reproductive toxins, carcinogens, or reduced-risk characteristics. Some of the major changes from 2011 to 2012 include:

- Chemicals classified as reproductive toxins decreased in amount applied from 2011 to 2012 (2.6-million-pound decrease, 16 percent) while increasing in area treated (261,000-acres-treated increase, 7.7 percent). The decrease in pounds was mainly due to less use of the fumigant metam-sodium. In addition, there were also decreases in the fumigants methyl bromide and sodium tetrathiocarbonate and the miticide propargite. The increase in area was mostly from uses of the miticide/insecticide abamectin (also called avermectin). Pesticides in this category are ones listed on the State’s Proposition 65 list of chemicals “known to cause reproductive toxicity.”

- Amount applied of chemicals classified as carcinogens increased from 2011 to 2012 (1.0-million-pound increase, 3.0 percent), but area treated decreased (351,000-acre decrease, 8.4 percent). The increase in pounds was mainly due to higher use of the fumigants 1,3-dichloropropene and metam-potassium (potassium n-methyldithiocarbamate), and, to a lesser degree, increase in use of the fungicide mancozeb. However, the increase in use of metam-potassium was accompanied by a nearly identical decrease in use of the similar fumigant, metam-sodium. The decrease in area treated was mostly from decreases in acreage treated with the herbicide diuron and the fungicide iprodione. The pesticides in this category are ones listed by U.S. EPA as B2 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, decreased from the previous year (520,000-pound decrease, 11 percent; 429,000-acre decrease, 10 percent). Pesticides in this category have continued to decline for most years since 1995. The AIs with the greatest decreases were the insecticides chlorpyrifos, malathion, dimethoate, and oxamyl and the plant growth regulator ethephon. Note that ethephon, used mostly in cotton, 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 (176,000-pound decrease, 14 percent; 218,000-acre decrease, 20 percent). The decreases were from less use of the herbicides diuron, simazine, and bromacil.

- Chemicals categorized as toxic air contaminants increased in amount while decreasing in area treated (3.7-million-pound increase, 8 percent; 41,000-acre decrease, 1.6 percent). By pounds, most toxic air contaminants are fumigants which are used at high rates. The increase in amount was mainly from increased uses of the fumigants and metam-potassium, chloropicrin, and 1,3-dichloropropene. The decrease in area treated was mainly from the herbicide 2,4-D, dimethylamine salt.

- Use of fumigant chemicals applied increased in both amount and area treated (3.0-million-pound increase, 7.1 percent; 15,000-acre increase, 4.0 percent). The largest increases in amount were in metam-potassium, chloropicrin, and 1,3-dichloropropene, while amounts of metam sodium, sodium tetrathiocarbonate, and methyl bromide decreased. The increase in area treated was mostly from increases with aluminum phosphide and 1,3-dichloropropene.

- Use of oil pesticides decreased in both amount and area treated (3.5-million-pound decrease, 11 percent; 299,000-acre decrease, 10 percent). However, from 2001 the area treated with oils has increased in most years. Oils include many different chemicals, but the category used here includes only ones 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 highly toxic pesticides. Oils are also used by organic growers.

- Use of biopesticides decreased in both amount and area treated (241,000-pound decrease, 15 percent; 35,000-acre treated decrease, 1.2 percent). However, the use of most biopesticide AIs increased. The most-used biopesticide AIs by amount were *Bacillus thuringiensis* (Bt) (combining all subspecies), vegetable oil, and potassium bicarbonate. Vegetable oil and potassium bicarbonate accounted for most of the decrease in pounds while the amount of *Bacillus thuringiensis* used increased. Most of the decrease in area treated was due to vegetable oil. 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 1998 to 2012 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	2004	2005	2006	2007	2008	2009	2010	2011	2012
1080	<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4-DB ACID	5,486	11,722	9,733	9,185	11,416	13,523	4,570	55	5,826
ABAMECTIN	8,514	9,817	10,941	12,362	12,860	16,625	19,348	26,672	32,671
ABAMECTIN, OTHER RELATED	<1	<1	<1	<1	<1	<1	<1	<1	1
AMITRAZ	0	0	12	0	0	7	0	0	0
ARSENIC PENTOXIDE	12,705	180,505	474,517	7,805	7,433	400	16,144	8,034	9,240
ARSENIC TRIOXIDE	<1	<1	<1	<1	<1	<1	<1	<1	<1
BENOMYL	2,217	948	898	590	100	56	31	28	33
BROMACIL, LITHIUM SALT	1,801	1,059	2,529	1,172	1,851	896	1,835	1,486	1,422
BROMOXYNIL OCTANOATE	50,232	34,481	37,406	41,406	65,444	50,300	43,594	48,553	54,843
CARBARYL	240,068	190,633	156,997	142,010	126,860	135,301	113,238	74,833	114,200
CHLORSULFURON	9,967	3,242	3,488	3,675	3,886	5,048	3,386	4,377	3,282
CYANAZINE	8	7	0	0	0	0	0	1	<1
CYCLOATE	43,249	40,092	41,488	31,868	21,242	25,284	27,292	31,037	33,596
DICLOFOP-METHYL	5,988	1,413	174	157	0	15	0	7	0
DINOCAP	2	2	2	2	2	2	0	<1	0
DINOSEB	63	131	213	81	166	816	26	75	60
DIOCTYL PHTHALATE	397	708	1,016	610	340	186	453	248	262
DISODIUM CYANODITHIOIMIDO CARBONATE	0	0	0	0	0	0	0	0	53
EPTC	182,532	181,825	108,228	152,707	129,470	128,993	118,509	126,441	148,882
ETHYLENE GLYCOL MONOMETHYL ETHER	2,729	2,546	4,186	2,653	1,986	2,257	5,187	4,324	3,781
ETHYLENE OXIDE	0	0	0	2	3	7	0	0	8
FENOXAPROP-ETHYL	64	161	196	153	219	11	<1	8	0
FLUAZIFOP-BUTYL	34	41	26	5	3	21	11	8	5
FLUAZIFOP-P-BUTYL	10,298	11,638	11,104	10,192	11,408	7,903	9,542	9,073	10,392
HYDRAMETHYLNON	1,896	1,381	1,231	887	825	393	609	1,096	485
LINURON	69,289	72,093	59,164	58,592	60,693	51,265	48,424	54,489	56,652
METAM-SODIUM	14,698,228	12,991,279	11,422,382	9,929,803	10,227,094	9,027,455	11,153,177	10,868,495	8,423,824
METHYL BROMIDE	7,120,860	6,509,322	6,542,161	6,448,643	5,708,525	5,625,249	4,786,099	4,008,187	3,912,674
METIRAM	5	0	<1	0	0	0	0	15	34
MOLINATE	367,155	171,362	141,421	75,241	19,653	12,516	24	<1	3
MYCLOBUTANIL	74,963	84,102	74,365	68,403	61,565	59,057	65,598	65,360	64,068
NABAM	10,693	30,440	23,414	9,073	9,635	8,963	10,518	13,358	13,485
NICOTINE	4	2	<1	<1	<1	<1	<1	7	<1

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	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
NITRAPYRIN	12	171	0	9	0	84	211	0	<1
OXADIAZON	13,129	13,825	11,714	12,517	9,402	8,741	12,382	7,775	7,377
OXYDEMETON-METHYL	105,318	122,433	119,891	122,723	111,612	68,576	71,290	26,017	17,617
OXYTHIOQUINOX	27	8	90	166	170	45	6	<1	1
POTASSIUM DIMETHYL DITHIO CARBAMATE	293	0	0	0	0	<1	0	0	0
PROPARGITE	1,014,200	1,010,039	580,630	537,439	389,721	380,651	295,309	296,332	258,637
RESMETHRIN	245	958	676	452	269	211	206	122	46
SODIUM DIMETHYL DITHIO CARBAMATE	10,693	30,440	23,414	9,073	9,800	8,963	11,053	13,358	13,485
SODIUM TETRATHIOCARBONATE	259,542	330,886	171,204	391,303	355,373	249,580	233,949	168,761	49,713
STREPTOMYCIN SULFATE	4,740	7,862	7,598	5,809	4,394	3,233	4,040	4,650	4,061
TAU-FLUVALINATE	1,603	1,166	1,104	1,028	1,068	1,179	869	822	1,043
THIOPHANATE-METHYL	120,249	159,957	114,191	99,497	74,903	89,882	115,025	87,190	108,861
TRIADIMEFON	2,111	1,918	1,116	873	1,503	1,056	2,153	1,921	2,442
TRIBUTYLTIN METHACRYLATE	0	0	0	0	0	0	0	0	0
TRIFORINE	295	137	452	64	69	4	42	22	2
VINCLOZOLIN	14,863	3,574	402	390	512	476	217	328	456
WARFARIN	3	1	9	1	<1	<1	1	2	2
TOTAL	24,466,771	22,214,327	20,159,784	18,188,626	17,441,474	15,985,233	17,174,370	15,953,565	13,353,524

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
1080	<1	41	22	170	<1	67	176	127	<1
2,4-DB ACID	10,162	18,597	16,303	15,080	19,457	21,629	6,980	121	11,301
ABAMECTIN	1,001,281	1,076,948	1,131,758	1,257,542	1,226,819	1,274,963	1,552,536	1,979,078	2,209,384
ABAMECTIN, OTHER RELATED	<1	<1	<1	<1	<1	<1	<1	<1	<1
AMITRAZ	0	0	<1	0	0	74	0	0	0
ARSENIC PENTOXIDE	48	<1	<1	<1	<1	<1	<1	<1	<1
ARSENIC TRIOXIDE	<1	1	<1	<1	<1	<1	<1	<1	<1
BENOMYL	3,983	2,789	1,674	568	221	162	0	26	19
BROMACIL, LITHIUM SALT	<1	<1	<1	<1	<1	<1	<1	<1	<1
BROMOXYNIL OCTANOATE	162,572	120,175	134,283	136,831	186,214	146,301	125,836	141,014	148,292
CARBARYL	103,261	99,086	87,789	97,016	96,438	107,458	80,095	68,249	96,790
CHLORSULFURON	25,745	21,903	26,345	12,653	32,912	31,267	20,345	18,877	12,054
CYANAZINE	5	8	0	0	0	0	0	4	<1
CYCLOATE	20,699	19,319	19,886	15,601	10,581	12,058	13,799	14,895	17,623
DICLOFOP-METHYL	7,391	729	186	224	0	30	0	20	0
DINOCAP	47	7	9	8	7	7	0	1	0
DINOSEB	98	310	72	16	453	304	111	427	81
DIOCTYL PHTHALATE	6,249	13,858	13,231	13,258	3,582	4,928	7,921	4,741	5,311
DISODIUM CYANODITHIOIMIDO CARBONATE	0	0	0	0	0	0	0	0	157
EPTC	64,194	64,263	38,871	51,706	45,560	49,708	44,289	47,922	56,163
ETHYLENE GLYCOL MONOMETHYL ETHER	25,075	16,655	25,655	26,412	14,857	14,573	35,802	37,642	35,673
ETHYLENE OXIDE	0	0	0	<1	2	60	0	0	<1
FENOXAPROP-ETHYL	1,681	3,247	3,418	2,552	3,444	142	<1	61	0
FLUAZIFOP-BUTYL	<1	3	<1	<1	6	2	80	<1	<1
FLUAZIFOP-P-BUTYL	31,739	35,348	34,591	31,920	31,497	25,517	27,917	27,077	35,530
HYDRAMETHYLNON	1,314	1,990	657	931	1,138	1,280	4,689	1,554	6,799
LINURON	95,565	101,987	81,535	81,041	81,633	68,604	68,058	76,964	80,070
METAM-SODIUM	128,427	97,562	102,451	78,030	75,398	74,132	71,407	70,930	59,033
METHYL BROMIDE	57,385	45,700	50,677	45,675	35,761	39,619	32,095	46,741	28,774
METIRAM	2	0	1	0	0	0	0	<1	<1
MOLINATE	89,593	40,535	33,045	17,476	4,529	2,942	6	<1	<1
MYCLOBUTANIL	656,020	699,773	644,490	599,368	545,306	512,918	588,686	568,329	570,622
NABAM	<1	<1	<1	2	1	3	12	<1	4
NICOTINE	2	3	<1	<1	<1	<1	<1	<1	<1
NITRAPYRIN	42	143	0	35	0	88	111	0	<1
OXADIAZON	3,120	2,209	2,144	2,991	2,747	1,451	1,712	927	1,169

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	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
OXYDEMETON-METHYL	206,751	173,480	164,094	161,835	140,760	82,368	86,131	27,447	18,202
OXYTHIOQUINOX	137	14	10	9	5	4	4	1	1
POTASSIUM DIMETHYL DITHIO CARBAMATE	<1	0	0	0	0	<1	0	0	0
PROPARGITE	543,728	519,412	287,261	261,953	186,656	174,063	137,106	142,328	114,249
RESMETHRIN	209	1	1	18	3	11	<1	6	4
SODIUM DIMETHYL DITHIO CARBAMATE	<1	<1	<1	2	1	3	12	<1	4
SODIUM TETRATHIOCARBONATE	8,497	7,977	6,170	11,485	10,991	7,180	7,301	4,826	1,672
STREPTOMYCIN SULFATE	37,461	52,061	57,295	38,468	27,011	24,453	28,966	39,190	34,965
TAU-FLUVALINATE	7,313	5,879	5,438	4,777	5,708	5,015	4,583	4,994	4,788
THIOPHANATE-METHYL	112,501	135,296	108,408	100,011	71,867	92,429	122,563	85,694	122,916
TRIADIMEFON	6,752	8,585	2,949	1,806	2,043	1,007	1,172	2,425	1,290
TRIBUTYLTIN METHACRYLATE	0	0	0	0	0	0	0	0	0
TRIFORINE	61	181	102	373	11	10	22	3	<1
VINCLOZOLIN	18,207	3,899	440	258	212	85	86	100	26
WARFARIN	1,504	430	473	3,165	1,118	365	290	1,290	2,995
TOTAL	3,438,821	3,390,403	3,081,734	3,071,261	2,864,945	2,777,278	3,070,887	3,414,029	3,675,959

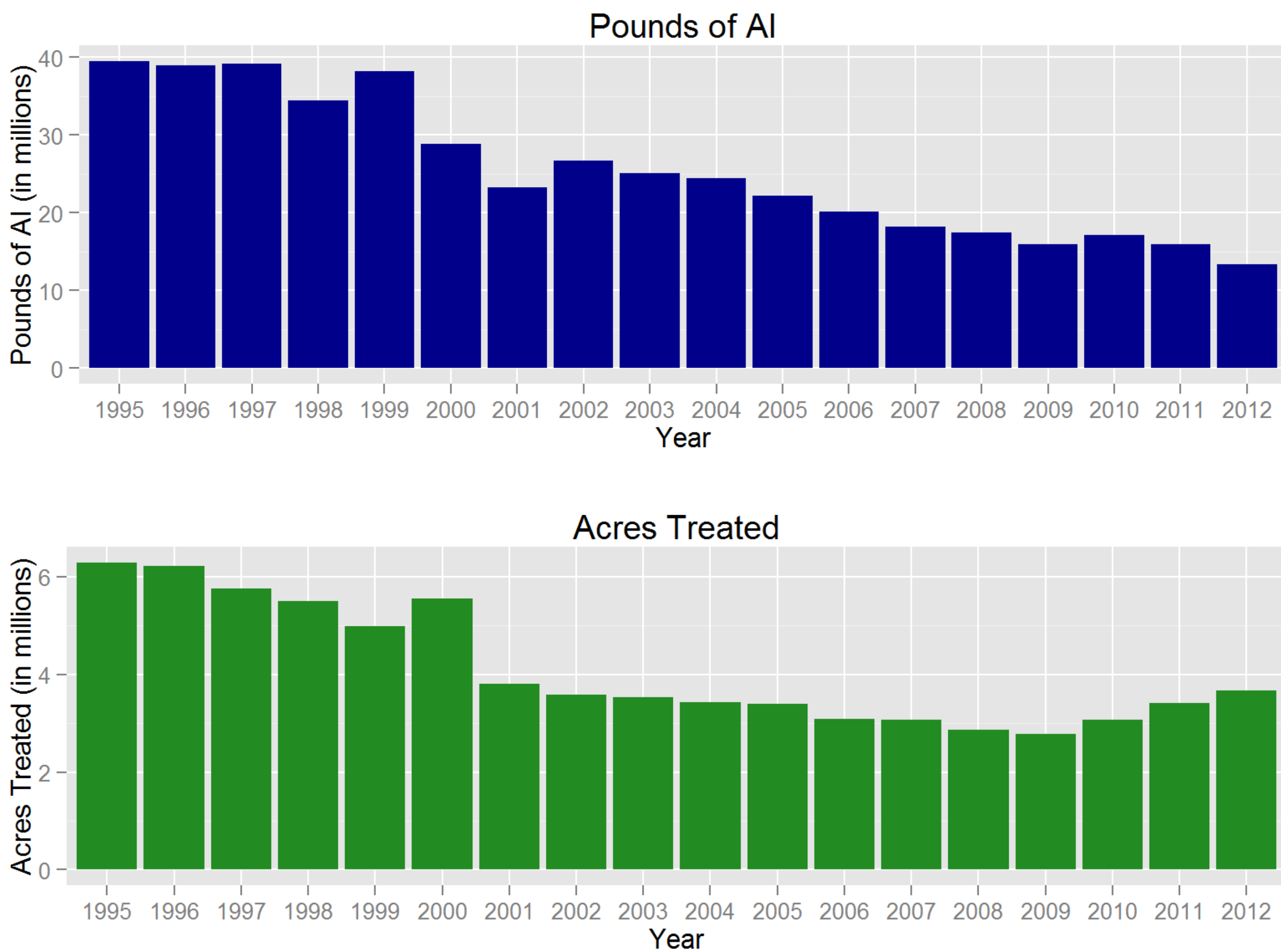

Figure 1: *Use trends of pesticides that are on the State's Proposition 65 list of chemicals that are "known to cause reproductive toxicity." Reported pounds of active ingredient (AI) applied include both agricultural and non-agricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are from the Department of Pesticide Regulation's Pesticide Use Reports.*

USE TRENDS OF PESTICIDES LISTED BY U.S. EPA AS B2 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 B2 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	2004	2005	2006	2007	2008	2009	2010	2011	2012
1,3-DICHLOROPROPENE	8,945,145	9,355,308	8,735,190	9,595,625	9,974,387	6,399,515	8,777,092	10,906,982	12,012,976
ACIFLUORFEN, SODIUM SALT	18	<1	0	0	0	0	<1	0	<1
ALACHLOR	27,229	21,052	13,740	3,911	4,343	6,362	9,936	9,294	7,928
ARSENIC ACID	223	68	3	0	0	0	0	17	0
ARSENIC PENTOXIDE	12,705	180,505	474,517	7,805	7,433	400	16,144	8,034	9,240
ARSENIC TRIOXIDE	<1	<1	<1	<1	<1	<1	<1	<1	<1
CACODYLIC ACID	115	131	20	41	43	<1	3	<1	<1
CAPTAN	374,607	472,744	510,661	456,475	362,757	329,747	450,225	375,944	387,816
CARBARYL	240,068	190,633	156,997	142,010	126,860	135,301	113,238	74,833	114,200
CHLOROTHALONIL	572,543	765,159	824,949	736,173	566,912	715,474	957,312	1,147,777	1,170,426
CHROMIC ACID	17,754	252,176	662,927	10,904	10,384	559	22,555	11,224	12,908
CREOSOTE	1,048	<1	0	3	<1	<1	0	0	0
DAMINOZIDE	9,635	8,882	7,812	7,192	7,094	6,570	9,361	8,402	7,996
DDVP	3,807	4,914	6,577	6,376	6,859	4,164	4,169	5,164	4,733
DIOCTYL PHTHALATE	397	708	1,016	610	340	186	453	248	262
DIPROPYL ISOCINCHOMERONATE	<1	<1	52	2	<1	<1	1	1	<1
DIURON	1,399,006	957,462	1,054,075	860,510	735,545	622,598	588,573	674,184	550,764
ETHOPROP	23,130	18,924	24,485	24,241	26,897	20,793	5,645	7,475	2,077
ETHYLENE OXIDE	0	0	0	2	3	7	0	0	8
FENOXYCARB	34	30	8	4	8	5	3	3	2
FOLPET	0	<1	<1	0	<1	0	<1	0	<1
FORMALDEHYDE	111,151	48,968	73,392	47,733	24,306	3,972	5,511	4,615	3,847
IMAZALIL	21,291	30,480	21,624	14,421	23,415	13,255	26,181	25,767	26,013
IPRODIONE	268,239	291,299	304,219	255,123	252,763	248,877	349,098	353,443	295,238
LINDANE	776	40	379	2	21	8	18	1	0
MANCOZEB	379,790	643,194	662,040	408,652	331,476	281,969	755,098	1,045,594	1,115,942
MANEB	963,204	1,135,698	1,181,738	1,061,028	861,006	656,648	370,333	53,870	6,276
METAM-SODIUM	14,698,228	12,991,279	11,422,382	9,929,803	10,227,094	9,027,455	11,153,177	10,868,495	8,423,824
METHYL IODIDE	0	0	0	0	0	0	0	1,157	21
METIRAM	5	0	<1	0	0	0	0	15	34
NITRAPYRIN	12	171	0	9	0	84	211	0	<1
ORTHO-PHENYLPHENOL	21,775	9,482	2,083	5,128	4,389	2,133	2,271	2,582	3,204
ORTHO-PHENYLPHENOL, SODIUM SALT	5,898	4,979	6,948	2,266	3,211	2,294	2,129	5,192	3,586
ORYZALIN	576,104	704,971	1,008,320	664,266	604,932	529,664	602,258	767,950	667,769
OXADIAZON	13,129	13,825	11,714	12,517	9,402	8,741	12,382	7,775	7,377

Table 5: (continued) *The reported pounds of pesticides used that are listed by U.S. EPA as B2 carcinogens or on the State's Proposition 65 list of chemicals that are "known to cause cancer."*

AI	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
OXYTHIOQUINOX	27	8	90	166	170	45	6	<1	1
PARA-DICHLOROBENZENE	10	139	0	15	1	17	0	<1	18
PENTACHLOROPHENOL	2	3	27	22	4	0	3	18	224
POLYACRYLAMIDE POLYMER	5,407	5,683	6,383	5,093	4,614	4,200	5,198	6,488	6,659
POTASSIUM DICHROMATE	71	40	0	0	0	0	0	0	0
POTASSIUM N-METHYLDITHIOCARBAMATE	894,186	1,994,072	3,202,884	3,785,436	5,791,671	4,102,412	4,832,615	5,673,371	8,315,873
PROPARGITE	1,014,200	1,010,039	580,630	537,439	389,721	380,651	295,309	296,332	258,637
PROPOXUR	223	220	212	191	188	202	298	808	361
PROPYLENE OXIDE	158,027	147,489	133,028	110,068	105,600	111,609	300,008	421,562	332,377
PROPYZAMIDE	119,191	116,967	121,711	114,882	104,086	73,811	51,345	49,649	47,271
SODIUM DICHROMATE	0	0	0	0	0	0	0	0	0
TERRAZOLE	1,100	750	946	872	1,534	1,140	1,500	642	479
THIODICARB	2,249	1,872	894	686	410	511	152	472	145
VINCLOZOLIN	14,863	3,574	402	390	512	476	217	328	456
TOTAL	30,896,624	31,383,941	31,215,071	28,808,096	30,570,389	23,691,856	29,720,030	32,815,707	33,796,967

Table 6: *The reported cumulative acres treated with pesticides that are listed by U.S. EPA as B2 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	2004	2005	2006	2007	2008	2009	2010	2011	2012
1,3-DICHLOROPROPENE	56,618	51,486	49,885	53,937	59,415	38,374	54,049	59,049	70,087
ACIFLUORFEN, SODIUM SALT	2	<1	0	0	0	0	<1	0	<1
ALACHLOR	9,888	7,935	5,192	1,500	1,635	2,261	3,276	3,385	3,041
ARSENIC ACID	<1	<1	<1	0	0	0	0	<1	0
ARSENIC PENTOXIDE	48	<1	<1	<1	<1	<1	<1	<1	<1
ARSENIC TRIOXIDE	<1	1	<1	<1	<1	<1	<1	<1	<1
CACODYLIC ACID	100	82	121	<1	<1	<1	<1	<1	<1
CAPTAN	211,028	252,040	262,936	215,864	198,262	173,133	245,464	209,556	204,672
CARBARYL	103,261	99,086	87,789	97,016	96,438	107,458	80,095	68,249	96,790
CHLOROTHALONIL	331,710	418,600	438,373	389,497	292,450	378,097	490,658	588,131	565,566
CHROMIC ACID	<1	<1	<1	<1	<1	<1	<1	<1	<1
CREOSOTE	<1	<1	0	1	1	2	0	0	0
DAMINOZIDE	2,667	2,376	2,220	2,291	2,471	2,111	4,357	2,427	2,915
DDVP	1,637	7,445	1,526	2,733	2,231	2,685	1,880	5,184	7,228
DIOCTYL PHTHALATE	6,249	13,858	13,231	13,258	3,582	4,928	7,921	4,741	5,311
DIPROPYL ISOCINCHOMERONATE	<1	1	18	<1	<1	<1	19	<1	<1
DIURON	971,628	894,073	886,032	702,939	519,050	405,583	517,619	691,013	552,515
ETHOPROP	4,917	4,296	4,815	4,283	4,159	4,293	1,348	1,892	541
ETHYLENE OXIDE	0	0	0	<1	2	60	0	0	<1
FENOXYCARB	1,011	1,398	828	210	489	353	100	106	110
FOLPET	0	<1	<1	0	<1	0	<1	0	<1
FORMALDEHYDE	23	2	265	57	67	5	1	6	4
IMAZALIL	476	<1	<1	<1	668	<1	26	2	<1
IPRODIONE	409,250	450,354	468,465	412,699	437,003	434,326	577,688	638,433	524,977
LINDANE	9,437	557	9	0	37	10	31	1	0
MANCOZEB	194,219	370,266	348,360	212,349	170,247	145,799	432,175	634,368	668,602
MANEB	601,360	730,254	675,941	655,235	558,506	471,395	290,266	40,464	4,567
METAM-SODIUM	128,427	97,562	102,451	78,030	75,398	74,132	71,407	70,930	59,033
METHYL IODIDE	0	0	0	0	0	0	0	278	37
METIRAM	2	0	1	0	0	0	0	<1	<1
NITRAPYRIN	42	143	0	35	0	88	111	0	<1
ORTHO-PHENYLPHENOL	272	429	65	149	22	49	58	117	94
ORTHO-PHENYLPHENOL, SODIUM SALT	<1	<1	<1	<1	<1	<1	<1	<1	<1
ORYZALIN	298,712	359,076	400,237	313,343	272,273	236,567	217,193	294,475	257,554
OXADIAZON	3,120	2,209	2,144	2,991	2,747	1,451	1,712	927	1,169
OXYTHIOQUINOX	137	14	10	9	5	4	4	1	1
PARA-DICHLOROBENZENE	<1	<1	0	<1	0	<1	<1	<1	<1

Table 6: (continued) *The reported cumulative acres treated with pesticides that are listed by U.S. EPA as B2 carcinogens or on the State's Proposition 65 list of chemicals that are "known to cause cancer."*

AI	2004	2005	2006	2007	2008	2009	2010	2011	2012
PENTACHLOROPHENOL	20	3	0	10	46	0	4	1	15
POLYACRYLAMIDE POLYMER	495,213	551,014	645,781	445,134	471,314	441,305	584,187	628,802	591,227
POTASSIUM DICHROMATE	<1	10	0	0	0	0	0	0	0
POTASSIUM N-METHYLDITHIOCARBAMATE	10,229	19,670	27,299	42,988	57,415	38,197	41,444	44,078	50,652
PROPARGITE	543,728	519,412	287,261	261,953	186,656	174,063	137,106	142,328	114,249
PROPOXUR	7	8	2	<1	10	356	<1	3	<1
PROPYLENE OXIDE	22	185	20	<1	12	<1	<1	<1	288
PROPYZAMIDE	147,631	148,376	153,045	148,399	133,444	102,176	69,303	60,994	57,619
SODIUM DICHROMATE	0	0	0	0	0	0	0	0	0
TERRAZOLE	253	495	884	879	1,419	711	5,107	443	575
THIODICARB	3,684	2,965	1,293	1,196	673	680	192	656	206
VINCLOZOLIN	18,207	3,899	440	258	212	85	86	100	26
TOTAL	4,555,834	5,009,021	4,866,938	4,059,245	3,548,357	3,240,740	3,834,886	4,191,142	3,839,670

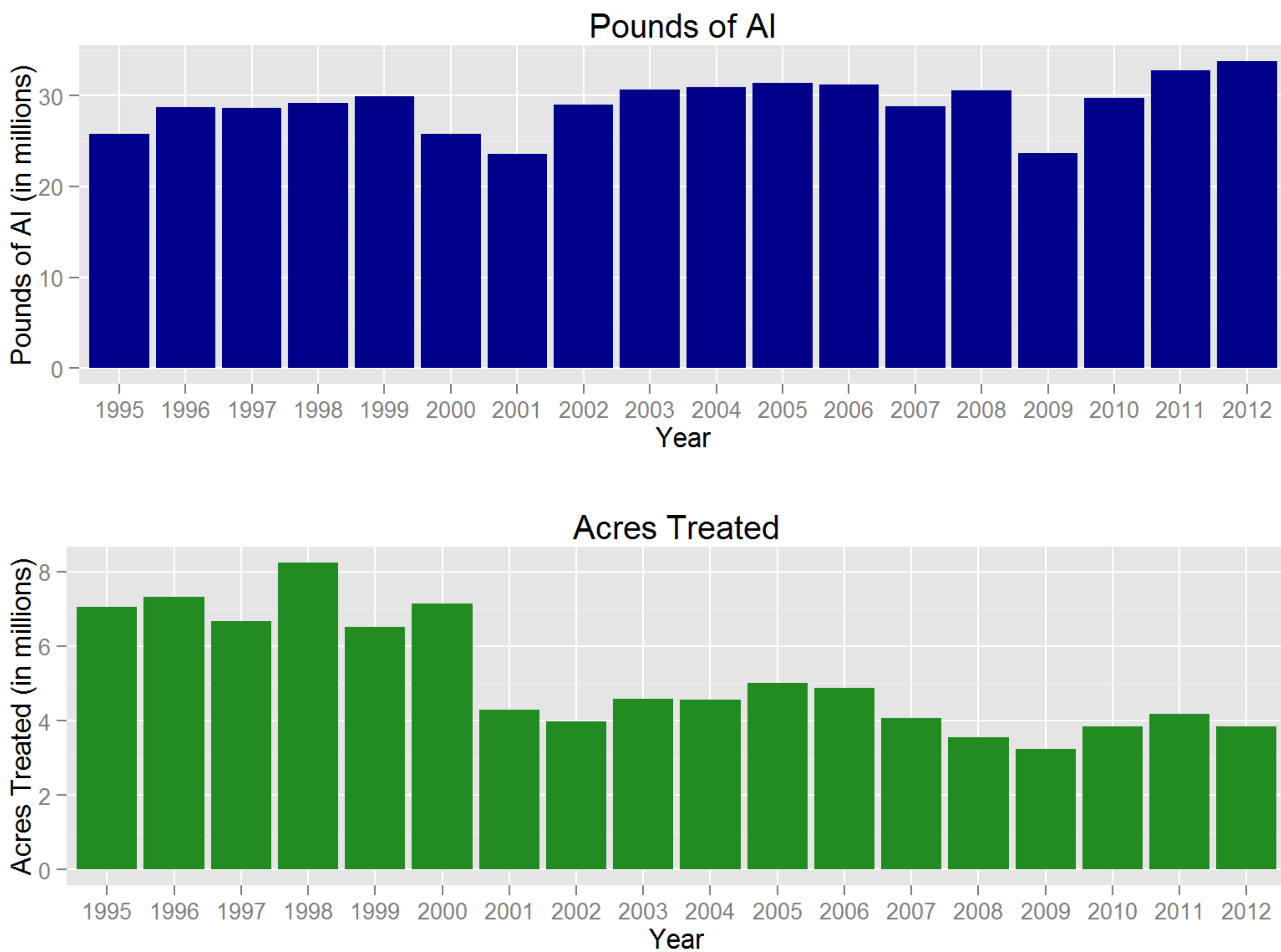

Figure 2: *Use trends of pesticides that are listed by U.S. EPA as B2 carcinogens or on the State's Proposition 65 list of chemicals that are "known to cause cancer." Reported pounds of active ingredient (AI) applied include both agricultural and non-agricultural applications. The reported cumulative 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	2004	2005	2006	2007	2008	2009	2010	2011	2012
3-IODO-2-PROPYNYL BUTYLCARBAMATE	0	0	0	0	0	<1	2,675	102	<1
ACEPHATE	205,428	195,704	167,705	143,073	152,342	112,562	134,993	152,545	129,999
ALDICARB	231,012	231,322	176,624	115,475	75,767	31,579	64,626	24,167	1,503
AZINPHOS-METHYL	50,578	55,183	38,775	25,418	17,037	13,045	1,619	1,582	1,232
BENDIOCARB	9	6	2	8	2	<1	1	3	3
BENSULIDE	237,293	247,767	288,048	259,548	244,526	247,733	271,835	288,558	267,262
BUTYLATE	20,323	9,923	2,671	945	27	0	299	0	0
CARBARYL	240,068	190,633	156,997	142,010	126,860	135,301	113,238	74,833	114,200
CARBOFURAN	30,354	28,093	25,790	25,467	16,389	10,117	4	1	0
CHLORPROPHAM	2,861	2,825	3,704	1,532	4,384	4,675	6,990	3,093	2,969
CHLORPYRIFOS	1,787,240	2,031,348	1,928,989	1,442,521	1,369,063	1,246,560	1,288,733	1,299,602	1,100,873
COUMAPHOS	63	1	3	<1	0	0	<1	3	3
CYCLOATE	43,249	40,092	41,488	31,868	21,242	25,284	27,292	31,037	33,596
DDVP	3,807	4,914	6,577	6,376	6,859	4,164	4,169	5,164	4,733
DEMETON	0	1	<1	1	0	2	0	0	0
DESMEDIPHAM	3,845	4,169	2,954	1,905	1,598	1,257	1,385	1,345	1,408
DIAZINON	493,748	403,996	386,244	353,098	258,544	142,061	126,804	86,661	76,907
DICROTOPHOS	0	2	6	0	0	0	0	0	0
DIMETHOATE	334,398	312,144	294,736	315,358	292,119	251,726	210,128	225,642	182,686
DISULFOTON	41,317	32,349	22,601	24,558	8,028	10,233	9,085	4,351	5,479
EPTC	182,532	181,825	108,228	152,707	129,470	128,993	118,509	126,441	148,882
ETHEPHON	640,139	643,450	587,954	430,522	298,031	207,788	373,574	548,842	483,676
ETHION	<1	261	13	0	2	28	72	1	44
ETHOPROP	23,130	18,924	24,485	24,241	26,897	20,793	5,645	7,475	2,077
FENAMIPHOS	58,691	46,336	33,511	39,677	17,482	11,493	8,978	2,964	5,254
FENTHION	36	15	2	4	4	9	4	<1	0
FONOFOS	30	15	0	0	1	0	<1	0	0
FORMETANATE HYDROCHLORIDE	30,651	30,761	33,738	34,127	44,704	32,670	30,313	20,952	20,362
MALATHION	497,263	426,416	411,505	468,614	484,322	532,321	560,117	511,397	403,576
METHAMIDOPHOS	31,332	37,865	30,570	18,867	24,224	17,934	9,664	6,037	<1
METHIDATHION	61,206	48,857	56,691	45,666	47,347	47,319	51,190	29,545	23,300
METHIOCARB	2,800	2,460	1,798	1,767	2,068	3,093	3,506	2,697	3,658
METHOMYL	264,226	349,785	318,089	307,169	251,382	221,248	231,690	219,731	273,285
METHYL PARATHION	71,573	79,000	84,785	75,385	34,110	25,770	21,427	22,970	25,392
MEVINPHOS	1	160	18	30	4	9	24	118	3
MEVINPHOS, OTHER RELATED	<1	107	12	20	3	6	16	79	2
MEXACARBATE	0	0	0	0	0	0	0	0	0

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

AI	2004	2005	2006	2007	2008	2009	2010	2011	2012
MOLINATE	367,155	171,362	141,421	75,241	19,653	12,516	24	<1	3
MONOCROTOPHOS	0	0	0	0	0	0	0	0	0
NALED	152,755	225,863	196,369	132,528	172,705	162,530	174,280	199,092	153,427
O,O-DIMETHYL O-(4-NITRO-M-TOLYL) PHOSPHOROTHIOATE	0	0	<1	0	0	0	0	0	0
OXAMYL	113,512	153,432	123,109	45,096	100,147	48,994	118,048	136,967	51,814
OXYDEMETON-METHYL	105,318	122,433	119,891	122,723	111,612	68,576	71,290	26,017	17,617
PARATHION	240	855	1,542	479	33	118	285	241	370
PEBULATE	10,118	1,154	210	441	68	0	0	0	0
PHENMEDIPHAM	4,579	5,419	4,046	2,841	2,305	2,516	2,448	2,087	1,985
PHORATE	60,247	48,981	38,066	33,776	32,408	17,686	14,775	46,061	58,965
PHOSALONE	0	0	0	0	0	0	0	0	0
PHOSMET	658,093	547,822	628,892	424,874	343,061	132,647	115,008	95,776	53,630
POTASSIUM DIMETHYL DITHIO CARBAMATE	293	0	0	0	0	<1	0	0	0
PROFENOFOS	15,620	23,924	20,885	3,638	216	0	1,552	0	58
PROPAMOCARB HYDROCHLORIDE	5	0	364	137,589	116,725	106,078	99,482	92,304	107,598
PROPETAMPHOS	315	148	207	136	116	352	213	139	171
PROPOXUR	223	220	212	191	188	202	298	808	361
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	179,690	100,225	78,084	45,757	16,335	8,161	18,427	30,745	21,960
SODIUM DIMETHYL DITHIO CARBAMATE	10,693	30,440	23,414	9,073	9,800	8,963	11,053	13,358	13,485
SULFOTEP	29	17	1	7	4	2	0	1	0
SULPROFOS	0	0	0	0	0	0	0	0	0
TEMEPHOS	356	1,102	803	1,173	684	83	99	33	17
TETRACHLORVINPHOS	722	788	1,203	667	1,012	1,306	1,086	912	689
THIOBENCARB	521,586	448,208	310,352	289,046	263,499	320,643	258,402	246,927	277,342
THIODICARB	2,249	1,872	894	686	410	511	152	472	145
TRIALLATE	6	0	0	0	0	0	879	2,671	819
TRICHLORFON	1,035	1,222	1,003	336	961	25	34	40	29
TOTAL	7,794,044	7,542,195	6,926,282	5,814,258	5,146,781	4,377,680	4,566,439	4,592,590	4,072,847

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
3-IODO-2-PROPYNYL BUTYLCARBAMATE	0	0	0	0	0	0	<1	<1	<1
ACEPHATE	211,892	198,982	172,119	148,887	147,950	115,063	144,134	150,202	131,868
ALDICARB	217,540	214,260	158,000	108,892	66,829	31,977	66,192	29,363	1,478
AZINPHOS-METHYL	38,622	37,622	25,534	16,636	10,272	7,849	1,724	1,809	1,639
BENDIOCARB	<1	1	<1	6	<1	<1	<1	<1	<1
BENSULIDE	70,367	70,625	82,280	76,748	75,695	73,306	78,736	84,205	79,152
BUTYLATE	3,940	1,954	610	236	6	0	60	0	0
CARBARYL	103,261	99,086	87,789	97,016	96,438	107,458	80,095	68,249	96,790
CARBOFURAN	50,138	55,488	43,417	39,795	24,651	7,331	15	30	0
CHLORPROPHAM	166	88	115	178	147	159	38	82	76
CHLORPYRIFOS	1,323,331	1,681,634	1,538,958	1,154,681	1,163,050	934,562	1,097,107	1,187,852	1,051,292
COUMAPHOS	49	<1	2	<1	0	0	<1	<1	<1
CYCLOATE	20,699	19,319	19,886	15,601	10,581	12,058	13,799	14,895	17,623
DDVP	1,637	7,445	1,526	2,733	2,231	2,685	1,880	5,184	7,228
DEMETON	0	35	<1	10	0	10	0	0	0
DESMEDIPHAM	37,152	35,795	30,883	24,780	16,787	16,073	19,264	19,349	16,691
DIAZINON	509,233	440,839	439,814	422,244	310,125	140,620	104,443	71,155	48,027
DICROTOPHOS	0	<1	110	0	0	0	0	0	0
DIMETHOATE	701,470	672,935	613,479	608,819	576,286	499,889	436,233	530,746	420,905
DISULFOTON	34,481	25,320	18,926	20,315	4,723	7,591	6,167	1,621	2,595
EPTC	64,194	64,263	38,871	51,706	45,560	49,708	44,289	47,922	56,163
ETHEPHON	660,356	679,253	640,720	490,361	365,752	261,211	452,404	602,803	532,933
ETHION	<1	66	32	0	6	15	184	81	332
ETHOPROP	4,917	4,296	4,815	4,283	4,159	4,293	1,348	1,892	541
FENAMIPHOS	34,142	29,314	18,918	22,618	10,730	7,537	5,873	2,127	2,690
FENTHION	18	<1	<1	<1	<1	<1	<1	<1	0
FONOFOS	20	15	0	0	<1	0	3	0	0
FORMETANATE HYDROCHLORIDE	33,167	31,775	35,293	35,383	45,715	32,678	30,898	22,038	21,733
MALATHION	249,319	226,729	218,196	250,823	288,852	277,706	433,352	280,421	269,797
METHAMIDOPHOS	38,874	45,835	37,585	23,022	27,532	20,408	10,731	6,464	<1
METHIDATHION	45,281	37,751	34,786	37,301	43,046	54,227	49,662	34,918	31,733
METHIOCARB	3,064	2,501	3,072	2,649	2,439	2,131	2,335	2,053	2,720
METHOMYL	437,673	612,989	529,347	502,384	406,030	377,954	410,186	395,172	472,789
METHYL PARATHION	48,640	49,771	51,184	45,173	21,574	15,198	13,046	13,343	15,556
MEVINPHOS	3	215	8	198	34	69	11	108	2
MEVINPHOS, OTHER RELATED	3	215	8	198	34	69	11	108	2
MEXACARBATE	0	0	0	0	0	0	0	0	0

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

AI	2004	2005	2006	2007	2008	2009	2010	2011	2012
MOLINATE	89,593	40,535	33,045	17,476	4,529	2,942	6	<1	<1
MONOCROTOPHOS	0	0	0	0	0	0	0	0	0
NALED	110,218	191,906	159,851	107,774	105,505	128,415	145,147	163,374	108,859
O,O-DIMETHYL O-(4-NITRO-M-TOLYL) PHOSPHOROTHIOATE	0	0	<1	0	0	0	0	0	0
OXAMYL	135,832	178,893	137,541	60,773	116,350	59,118	134,931	150,265	61,649
OXYDEMETON-METHYL	206,751	173,480	164,094	161,835	140,760	82,368	86,131	27,447	18,202
PARATHION	392	717	713	414	101	195	76	202	149
PEBULATE	4,319	297	35	163	151	0	0	0	0
PHENMEDIPHAM	38,964	38,675	33,208	26,762	18,198	18,837	21,366	20,767	17,920
PHORATE	47,488	35,938	27,676	23,557	10,933	10,236	8,719	32,555	45,886
PHOSALONE	0	0	0	0	0	0	0	0	0
PHOSMET	209,843	170,683	200,531	142,991	116,966	51,514	40,276	33,689	18,904
POTASSIUM DIMETHYL DITHIO CARBAMATE	<1	0	0	0	0	<1	0	0	0
PROFENOFOS	11,657	25,096	20,563	4,509	289	0	1,635	0	155
PROPAMOCARB HYDROCHLORIDE	10	0	187	144,949	123,699	109,027	103,734	95,929	112,418
PROPETAMPHOS	<1	<1	<1	<1	<1	<1	<1	<1	<1
PROPOXUR	7	8	2	<1	10	356	<1	3	<1
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	133,535	74,538	52,330	31,408	10,850	7,182	15,785	27,233	21,957
SODIUM DIMETHYL DITHIO CARBAMATE	<1	<1	<1	2	1	3	12	<1	4
SULFOTEP	8	9	<1	5	2	3	0	1	0
SULPROFOS	0	0	0	0	0	0	0	0	0
TEMEPHOS	<1	<1	<1	<1	<1	<1	<1	<1	<1
TETRACHLORVINPHOS	291	1,518	1	200	5	<1	5	5	8
THIOBENCARB	136,132	118,786	79,109	74,271	67,483	83,567	75,172	71,824	78,628
THIODICARB	3,684	2,965	1,293	1,196	673	680	192	656	206
TRIALLATE	<1	0	0	0	0	0	867	1,854	546
TRICHLORFON	<1	<1	<1	<1	<1	<1	<1	<1	<1
TOTAL	6,034,805	6,362,725	5,725,402	4,976,667	4,466,872	3,597,902	4,118,780	4,180,350	3,751,122

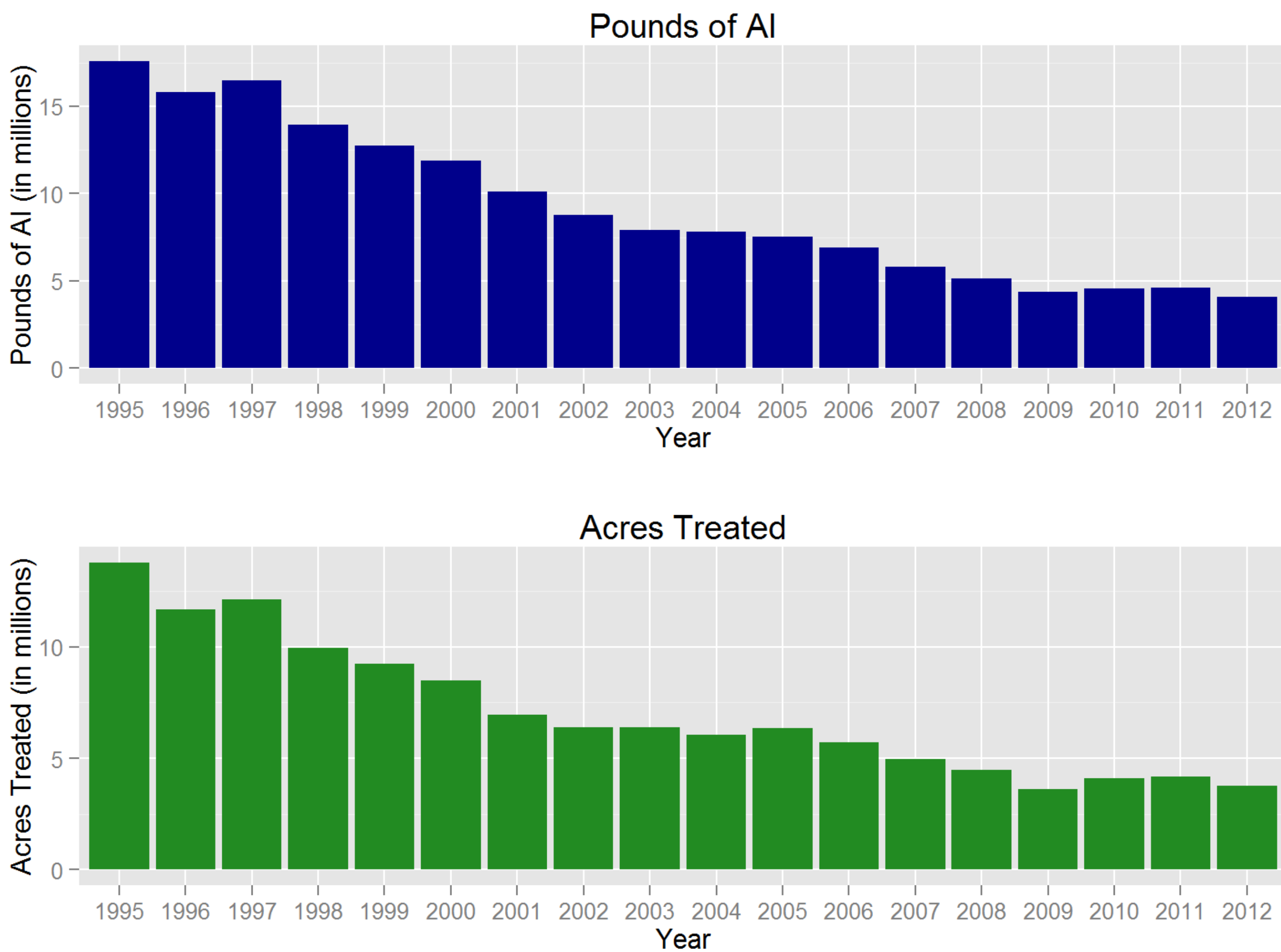

Figure 3: *Use trends of pesticides that are cholinesterase-inhibiting pesticides. These pesticides are organophosphate and carbamate active ingredients. Reported pounds of active ingredient (AI) applied include both agricultural and non-agricultural applications. The reported cumulative acres treated 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	2004	2005	2006	2007	2008	2009	2010	2011	2012
ATRAZINE	38,776	33,015	35,291	27,546	28,491	23,260	28,937	23,006	31,655
ATRAZINE, OTHER RELATED	812	695	732	571	600	482	607	483	665
BENTAZON, SODIUM SALT	1,370	2,272	2,633	4,858	8,075	9,589	7,447	5,800	7,111
BROMACIL	56,760	48,929	62,774	85,097	68,162	52,049	67,784	92,406	80,238
BROMACIL, LITHIUM SALT	1,801	1,059	2,529	1,172	1,851	896	1,835	1,486	1,422
DIURON	1,399,006	957,462	1,054,075	860,510	735,545	622,598	588,573	674,184	550,764
NORFLURAZON	140,143	94,082	107,826	78,150	58,590	44,762	43,686	30,572	41,703
PROMETON	20	3	8	3	3	1	6	3	8
SIMAZINE	732,677	628,561	637,691	541,296	438,952	419,423	378,373	425,373	363,058
TOTAL	2,371,364	1,766,079	1,903,558	1,599,204	1,340,270	1,173,061	1,117,248	1,253,313	1,076,623

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	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
ATRAZINE	26,989	24,085	21,834	17,382	16,766	15,767	19,990	17,514	23,358
ATRAZINE, OTHER RELATED	26,989	24,085	21,834	17,382	16,766	15,767	19,990	17,514	23,358
BENTAZON, SODIUM SALT	1,279	2,218	2,217	4,215	6,631	6,424	6,258	4,846	6,589
BROMACIL	26,204	21,886	19,132	20,455	21,471	24,420	28,757	32,168	28,746
BROMACIL, LITHIUM SALT	<1	<1	<1	<1	<1	<1	<1	<1	<1
DIURON	971,628	894,073	886,032	702,939	519,050	405,583	517,619	691,013	552,515
NORFLURAZON	125,802	81,589	91,035	74,085	58,866	44,503	45,638	30,601	31,569
PROMETON	171	6	168	4	35	2	20	<1	<1
SIMAZINE	588,016	463,244	480,142	411,719	320,992	339,117	289,038	324,309	236,430
TOTAL	1,716,706	1,466,859	1,483,320	1,212,529	923,696	812,543	879,390	1,068,916	850,855

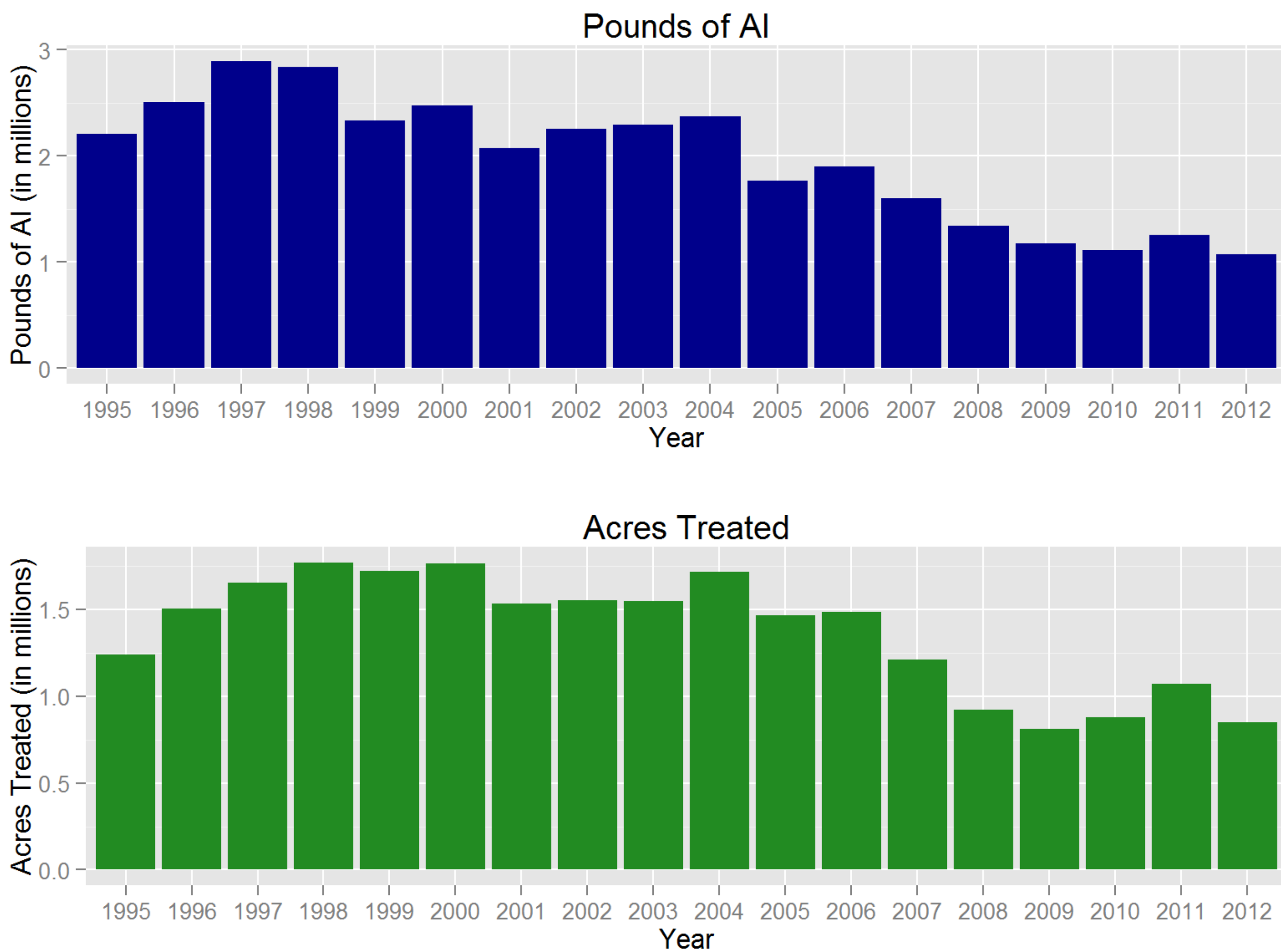

Figure 4: *Use trends of pesticides that are on the "a" part of DPR's groundwater protection list. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6800(a). Reported pounds of active ingredient (AI) 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	2004	2005	2006	2007	2008	2009	2010	2011	2012
1,3-DICHLOROPROPENE	8,945,145	9,355,308	8,735,190	9,595,625	9,974,387	6,399,515	8,777,092	10,906,982	12,012,976
2,4-D	1,797	1,552	1,735	2,755	11,619	10,788	12,526	5,400	4,253
2,4-D, 2-ETHYLHEXYL ESTER	21,130	26,641	21,062	15,029	20,464	15,113	74,398	25,746	27,623
2,4-D, ALKANOLAMINE SALTS (ETHANOL AND ISOPROPANOL AMINES)	624	458	16	29	25	131	516	1	16
2,4-D, BUTOXYETHANOL ESTER	4,782	8,190	1,720	843	1,775	2,751	1,368	1,757	1,807
2,4-D, BUTOXYPROPYL ESTER	0	0	<1	0	13	0	0	0	0
2,4-D, BUTYL ESTER	0	10	15	9	0	2	3	4	7
2,4-D, DIETHANOLAMINE SALT	5,024	3,961	2,947	4,025	5,533	4,913	6,872	3,164	2,696
2,4-D, DIMETHYLAMINE SALT	475,954	455,858	439,100	397,197	466,872	446,575	488,489	408,590	366,490
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	10,039	10,314	10,627	11,572	9,603	4,446	4,214	5,361	4,623
2,4-D, ISOPROPYL ESTER	10,992	11,220	10,863	10,578	10,671	13,123	11,682	19,605	12,471
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	472	404	398	212	141	99	57	0	0
2,4-D, TETRADECYLAMINE SALT	0	0	0	0	0	0	0	0	0
2,4-D, TRIETHYLAMINE SALT	391	203	1,614	383	332	472	2,829	106	5
2,4-D, TRIISOPROPANOLAMINE SALT	742	672	1,133	985	1,140	1,930	2,092	2,740	1,746
2,4-D, TRIISOPROPYLAMINE SALT	0	0	458	636	472	1,941	1,655	1,971	782
ACROLEIN	211,014	257,194	246,659	201,156	215,822	161,637	121,861	97,643	117,142
ALUMINUM PHOSPHIDE	131,864	137,969	151,037	105,169	132,296	108,084	108,406	155,187	140,010
ARSENIC ACID	223	68	3	0	0	0	0	17	0
ARSENIC PENTOXIDE	12,705	180,505	474,517	7,805	7,433	400	16,144	8,034	9,240
ARSENIC TRIOXIDE	<1	<1	<1	<1	<1	<1	<1	<1	<1
CAPTAN	374,607	472,744	510,661	456,475	362,757	329,747	450,225	375,944	387,816
CAPTAN, OTHER RELATED	7,766	9,982	11,217	10,131	8,031	7,374	10,002	8,380	8,557
CARBARYL	240,068	190,633	156,997	142,010	126,860	135,301	113,238	74,833	114,200
CHLORINE	516,546	613,837	730,986	857,144	1,278,580	585,673	1,011,383	762,464	1,437,637
CHLOROPICRIN	5,143,213	4,872,161	5,037,770	5,502,827	5,595,517	5,686,410	6,375,111	7,298,736	9,029,526
CHROMIC ACID	17,754	252,176	662,927	10,904	10,384	559	22,555	11,224	12,908
DAZOMET	58,567	48,263	34,310	37,537	40,272	65,725	60,539	59,245	38,593

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
DDVP	3,807	4,914	6,577	6,376	6,859	4,164	4,169	5,164	4,733
ENDOSULFAN	154,351	83,302	92,757	52,403	59,917	41,840	37,146	15,679	10,965
ETHYLENE OXIDE	0	0	0	2	3	7	0	0	8
FORMALDEHYDE	111,151	48,968	73,392	47,733	24,306	3,972	5,511	4,615	3,847
HYDROGEN CHLORIDE	2,529	14,755	2,464	1,470	4,318	3,976	2,240	504	336
LINDANE	776	40	379	2	21	8	18	1	0
MAGNESIUM PHOSPHIDE	2,621	3,156	3,931	5,132	10,507	8,009	12,233	12,700	12,514
MANCOZEB	379,790	643,194	662,040	408,652	331,476	281,969	755,098	1,045,594	1,115,942
MANEB	963,204	1,135,698	1,181,738	1,061,028	861,006	656,648	370,333	53,870	6,276
META-CRESOL	2	1	<1	<1	<1	<1	<1	1	2
METAM-SODIUM	14,698,228	12,991,279	11,422,382	9,929,803	10,227,094	9,027,455	11,153,177	10,868,495	8,423,824
METHANOL	0	0	0	0	0	0	0	0	0
METHIDATHION	61,206	48,857	56,691	45,666	47,347	47,319	51,190	29,545	23,300
METHOXYCHLOR	1	13	130	6	0	8	270	39	0
METHOXYCHLOR, OTHER RELATED	<1	<1	0	0	0	0	0	0	0
METHYL BROMIDE	7,120,860	6,509,322	6,542,161	6,448,643	5,708,525	5,625,249	4,786,099	4,008,187	3,912,674
METHYL ISOTHIOCYANATE	1,357	1,549	1,073	388	0	0	73	476	764
METHYL PARATHION	71,573	79,000	84,785	75,385	34,110	25,770	21,427	22,970	25,392
METHYL PARATHION, OTHER RELATED	3,766	4,155	4,447	3,960	1,792	1,355	1,127	1,195	1,333
NAPHTHALENE	0	<1	0	0	0	0	1	<1	0
PARA-DICHLOROBENZENE	10	139	0	15	1	17	0	<1	18
PARATHION	240	855	1,542	479	33	118	285	241	370
PCNB	34,216	38,038	32,786	30,689	29,188	24,637	37,378	11,629	17,350
PCP, OTHER RELATED	<1	<1	3	2	1	0	<1	3	32
PCP, SODIUM SALT	0	0	0	<1	0	0	0	<1	0
PCP, SODIUM SALT, OTHER RELATED	0	0	0	<1	0	0	0	0	0
PENTACHLOROPHENOL	2	3	27	22	4	0	3	18	224
PHENOL	9	71	<1	0	0	2	0	0	0
PHOSPHINE	1,690	2,699	3,491	5,286	48,243	29,527	11,291	118,089	49,604
PHOSPHORUS	1	<1	2	<1	<1	<1	1	0	4
POTASSIUM N-METHYLDITHIOCARBAMATE	894,186	1,994,072	3,202,884	3,785,436	5,791,671	4,102,412	4,832,615	5,673,371	8,315,873
POTASSIUM PERMANGANATE	0	0	0	0	0	109	0	0	0
PROPOXUR	223	220	212	191	188	202	298	808	361
PROPYLENE OXIDE	158,027	147,489	133,028	110,068	105,600	111,609	300,008	421,562	332,377
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	179,690	100,225	78,084	45,757	16,335	8,161	18,427	30,745	21,960
SODIUM CYANIDE	2,865	3,086	2,853	2,670	3,406	2,579	2,502	1,073	2,588
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	2004	2005	2006	2007	2008	2009	2010	2011	2012
SODIUM TETRATHIOCARBONATE	259,542	330,886	171,204	391,303	355,373	249,580	233,949	168,761	49,713
SULFURYL FLUORIDE	3,270,698	3,394,126	2,880,853	2,152,451	2,120,860	2,184,823	2,728,977	2,354,589	2,714,292
TRIFLURALIN	1,028,782	1,032,503	1,049,147	908,614	676,386	533,307	473,502	497,353	482,782
XYLENE	2,109	1,598	1,418	1,173	576	517	1,103	291	406
ZINC PHOSPHIDE	1,925	2,380	3,794	3,215	1,299	20,898	1,745	2,543	2,263
TOTAL	45,600,857	45,526,915	44,940,235	42,895,058	44,747,442	36,978,955	43,515,454	45,583,242	49,263,248

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
1,3-DICHLOROPROPENE	56,618	51,486	49,885	53,937	59,415	38,374	54,049	59,049	70,087
2,4-D	3,377	1,466	2,824	7,405	33,344	25,244	23,856	7,565	7,647
2,4-D, 2-ETHYLHEXYL ESTER	20,642	21,360	15,303	8,362	15,047	9,020	11,797	10,318	7,746
2,4-D, ALKANOLAMINE SALTS (ETHANOL AND ISOPROPANOL AMINES)	1,475	403	6	23	55	270	172	1	36
2,4-D, BUTOXYETHANOL ESTER	3,835	2,950	1,600	1,297	3,648	5,110	2,542	1,206	1,054
2,4-D, BUTOXYPROPYL ESTER	0	0	<1	0	<1	0	0	0	0
2,4-D, BUTYL ESTER	0	8	1	10	0	6	<1	<1	7
2,4-D, DIETHANOLAMINE SALT	22,729	18,739	13,826	13,339	19,085	18,931	27,009	11,075	7,106
2,4-D, DIMETHYLAMINE SALT	553,369	567,143	523,912	487,361	543,863	527,098	518,915	445,578	372,176
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	7,502	6,532	7,638	7,143	4,708	2,673	2,424	2,903	414
2,4-D, ISOPROPYL ESTER	117,870	144,377	146,090	137,055	135,797	132,302	138,826	145,519	160,911
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	8,680	5,261	5,660	3,348	1,955	1,750	895	0	0
2,4-D, TETRADECYLAMINE SALT	0	0	0	0	0	0	0	0	0
2,4-D, TRIETHYLAMINE SALT	677	243	815	473	679	740	165	117	3
2,4-D, TRIISOPROPANOLAMINE SALT	209	396	392	108	952	541	720	623	308
2,4-D, TRIISOPROPYLAMINE SALT	0	0	<1	204	<1	<1	<1	25	37
ACROLEIN	575	73	18	141	1,027	1,497	12	45	56
ALUMINUM PHOSPHIDE	74,762	63,289	79,951	84,963	81,029	112,063	100,859	133,283	160,332
ARSENIC ACID	<1	<1	<1	0	0	0	0	<1	0
ARSENIC PENTOXIDE	48	<1	<1	<1	<1	<1	<1	<1	<1
ARSENIC TRIOXIDE	<1	1	<1	<1	<1	<1	<1	<1	<1
CAPTAN	211,028	252,040	262,936	215,864	198,262	173,133	245,464	209,556	204,672
CAPTAN, OTHER RELATED	209,571	251,846	262,860	215,229	198,095	173,083	245,464	209,556	200,658
CARBARYL	103,261	99,086	87,789	97,016	96,438	107,458	80,095	68,249	96,790
CHLORINE	2,137	<1	431	1,201	14,414	24,644	88,144	24,253	24,097
CHLOROPICRIN	60,932	53,797	56,129	55,678	54,152	49,639	51,877	70,519	68,322
CHROMIC ACID	<1	<1	<1	<1	<1	<1	<1	<1	<1
DAZOMET	298	113	124	700	183	301	274	243	348
DDVP	1,637	7,445	1,526	2,733	2,231	2,685	1,880	5,184	7,228

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
ENDOSULFAN	180,387	97,745	111,338	56,627	64,695	48,639	47,147	19,812	10,985
ETHYLENE OXIDE	0	0	0	<1	2	60	0	0	<1
FORMALDEHYDE	23	2	265	57	67	5	1	6	4
HYDROGEN CHLORIDE	1	17	18	4	46	49	116	<1	2
LINDANE	9,437	557	9	0	37	10	31	1	0
MAGNESIUM PHOSPHIDE	1	23	29	6	143	32	145	80	29
MANCOZEB	194,219	370,266	348,360	212,349	170,247	145,799	432,175	634,368	668,602
MANEB	601,360	730,254	675,941	655,235	558,506	471,395	290,266	40,464	4,567
META-CRESOL	288	164	50	54	38	108	79	144	857
METAM-SODIUM	128,427	97,562	102,451	78,030	75,398	74,132	71,407	70,930	59,033
METHANOL	0	0	0	0	0	0	0	0	0
METHIDATHION	45,281	37,751	34,786	37,301	43,046	54,227	49,662	34,918	31,733
METHOXYCHLOR	44	26	395	43	0	75	90	58	0
METHOXYCHLOR, OTHER RELATED	<1	<1	0	0	0	0	0	0	0
METHYL BROMIDE	57,385	45,700	50,677	45,675	35,761	39,619	32,095	46,741	28,774
METHYL ISOTHIOCYANATE	<1	<1	<1	<1	0	0	<1	<1	<1
METHYL PARATHION	48,640	49,771	51,184	45,173	21,574	15,198	13,046	13,343	15,556
METHYL PARATHION, OTHER RELATED	48,609	49,644	50,762	45,165	21,331	15,053	13,029	13,326	15,342
NAPHTHALENE	0	2	0	0	0	0	3	<1	0
PARA-DICHLOROBENZENE	<1	<1	0	<1	0	<1	<1	<1	<1
PARATHION	392	717	713	414	101	195	76	202	149
PCNB	3,817	3,001	1,496	1,764	1,656	1,400	4,429	879	334
PCP, OTHER RELATED	20	3	0	10	46	0	4	1	15
PCP, SODIUM SALT	0	0	0	<1	0	0	0	47	0
PCP, SODIUM SALT, OTHER RELATED	0	0	0	<1	0	0	0	0	0
PENTACHLOROPHENOL	20	3	0	10	46	0	4	1	15
PHENOL	310	239	<1	0	0	15	0	0	0
PHOSPHINE	349	22	23	3	1,751	50	643	665	686
PHOSPHORUS	<1	23	<1	10	<1	<1	<1	0	74
POTASSIUM N-METHYLDITHIOCARBAMATE	10,229	19,670	27,299	42,988	57,415	38,197	41,444	44,078	50,652
POTASSIUM PERMANGANATE	0	0	0	0	0	5	0	0	0
PROPOXUR	7	8	2	<1	10	356	<1	3	<1
PROPYLENE OXIDE	22	185	20	<1	12	<1	<1	<1	288
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	133,535	74,538	52,330	31,408	10,850	7,182	15,785	27,233	21,957
SODIUM CYANIDE	<1	<1	<1	<1	<1	<1	<1	<1	<1
SODIUM DICHROMATE	0	0	0	0	0	0	0	0	0
SODIUM TETRATHIOCARBONATE	8,497	7,977	6,170	11,485	10,991	7,180	7,301	4,826	1,672

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	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
SULFURYL FLUORIDE	2	<1	78	9	57	361	130	537	532
TRIFLURALIN	920,545	886,258	901,629	772,753	556,306	492,498	438,784	466,933	464,458
XYLENE	3,375	2,722	1,824	2,021	1,418	1,387	609	747	1,074
ZINC PHOSPHIDE	14,150	9,038	15,284	9,301	11,478	14,512	12,751	21,417	21,610
TOTAL	3,522,709	3,661,116	3,571,082	3,116,678	2,815,873	2,578,286	2,733,484	2,550,000	2,508,923

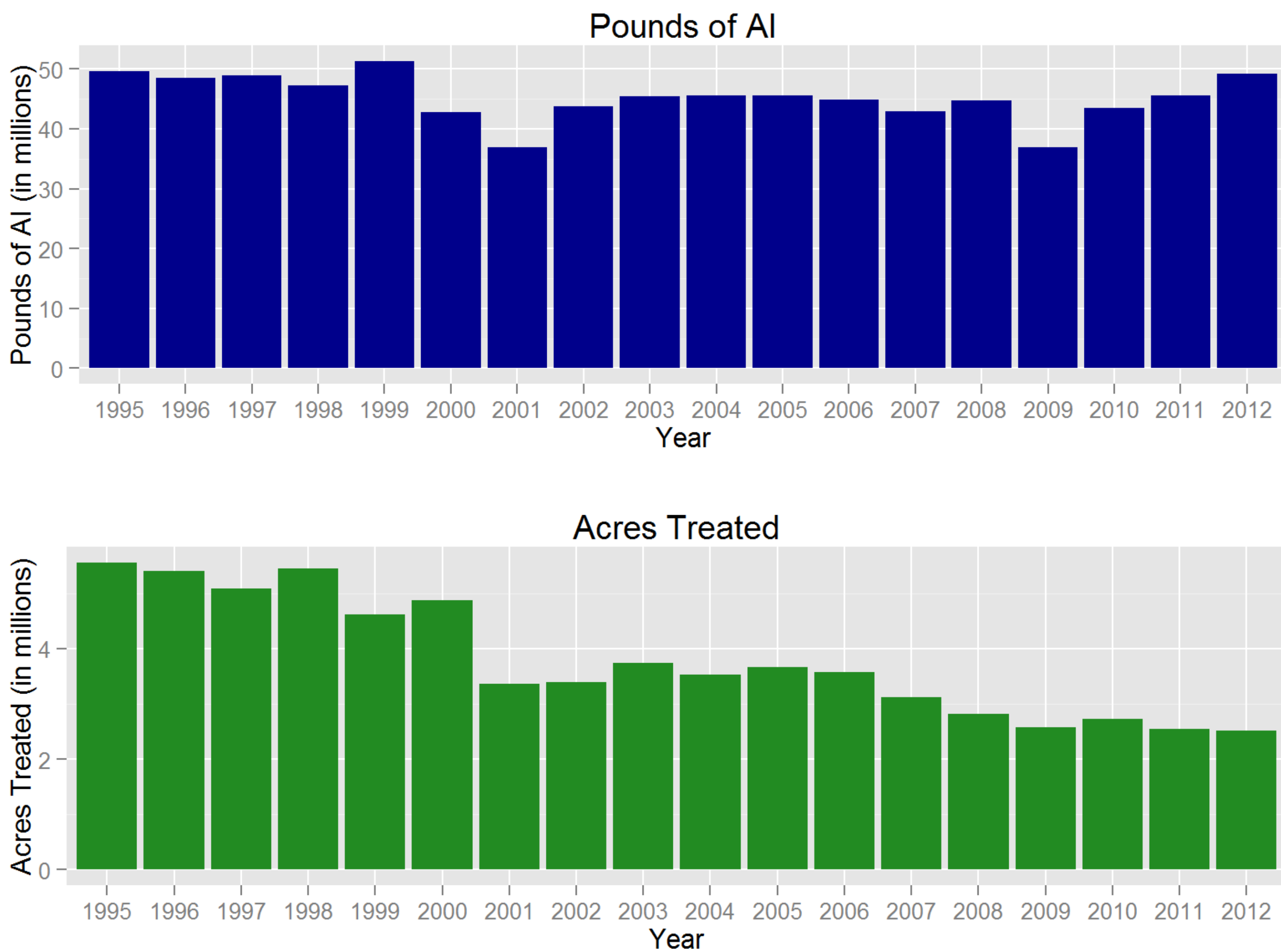

Figure 5: *Use trends of pesticides that are on DPR's toxic air contaminants list applied in California. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6860. Reported pounds of active ingredient (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	2004	2005	2006	2007	2008	2009	2010	2011	2012
1,2-DICHLOROPROPANE, 1,3-DICHLOROPROPENE AND RELATED C3 COMPOUNDS	22	0	182	10,532	0	0	0	0	6
1,3-DICHLOROPROPENE	8,945,145	9,355,308	8,735,190	9,595,625	9,974,387	6,399,515	8,777,092	10,906,982	12,012,976
ALUMINUM PHOSPHIDE	131,864	137,969	151,037	105,169	132,296	108,084	108,406	155,187	140,010
CARBON TETRACHLORIDE	<1	0	0	180	1,980	<1	0	6	90
CHLOROPICRIN	5,143,213	4,872,161	5,037,770	5,502,827	5,595,517	5,686,410	6,375,111	7,298,736	9,029,526
DAZOMET	58,567	48,263	34,310	37,537	40,272	65,725	60,539	59,245	38,593
ETHYLENE DIBROMIDE	3	0	0	3	127	<1	0	0	6
ETHYLENE DICHLORIDE	1	0	0	0	<1	0	0	0	0
ETHYLENE OXIDE	0	0	0	2	3	7	0	0	8
MAGNESIUM PHOSPHIDE	2,621	3,156	3,931	5,132	10,507	8,009	12,233	12,700	12,514
METAM-SODIUM	14,698,228	12,991,279	11,422,382	9,929,803	10,227,094	9,027,455	11,153,177	10,868,495	8,423,824
METHYL BROMIDE	7,120,860	6,509,322	6,542,161	6,448,643	5,708,525	5,625,249	4,786,099	4,008,187	3,912,674
METHYL IODIDE	0	0	0	0	0	0	0	1,157	21
PHOSPHINE	1,690	2,699	3,491	5,286	48,243	29,527	11,291	118,089	49,604
POTASSIUM N-METHYLDITHIOCARBAMATE	894,186	1,994,072	3,202,884	3,785,436	5,791,671	4,102,412	4,832,615	5,673,371	8,315,873
PROPYLENE OXIDE	158,027	147,489	133,028	110,068	105,600	111,609	300,008	421,562	332,377
SODIUM TETRATHIOCARBONATE	259,542	330,886	171,204	391,303	355,373	249,580	233,949	168,761	49,713
SULFURYL FLUORIDE	3,270,698	3,394,126	2,880,853	2,152,451	2,120,860	2,184,823	2,728,977	2,354,589	2,714,292
ZINC PHOSPHIDE	1,925	2,380	3,794	3,215	1,299	20,898	1,745	2,543	2,263
TOTAL	40,686,593	39,789,111	38,322,216	38,083,212	40,113,755	33,619,302	39,381,244	42,049,609	45,034,369

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	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
1,2-DICHLOROPROPANE, 1,3-DICHLOROPROPENE AND RELATED C3 COMPOUNDS	9	0	32	108	0	0	0	0	18
1,3-DICHLOROPROPENE	56,618	51,486	49,885	53,937	59,415	38,374	54,049	59,049	70,087
ALUMINUM PHOSPHIDE	74,762	63,289	79,951	84,963	81,029	112,063	100,859	133,283	160,332
CARBON TETRACHLORIDE	<1	0	0	<1	161	<1	0	<1	<1
CHLOROPICRIN	60,932	53,797	56,129	55,678	54,152	49,639	51,877	70,519	68,322
DAZOMET	298	113	124	700	183	301	274	243	348
ETHYLENE DIBROMIDE	<1	0	0	<1	<1	<1	0	0	<1
ETHYLENE DICHLORIDE	<1	0	0	0	160	0	0	0	0
ETHYLENE OXIDE	0	0	0	<1	2	60	0	0	<1
MAGNESIUM PHOSPHIDE	1	23	29	6	143	32	145	80	29
METAM-SODIUM	128,427	97,562	102,451	78,030	75,398	74,132	71,407	70,930	59,033
METHYL BROMIDE	57,385	45,700	50,677	45,675	35,761	39,619	32,095	46,741	28,774
METHYL IODIDE	0	0	0	0	0	0	0	278	37
PHOSPHINE	349	22	23	3	1,751	50	643	665	686
POTASSIUM N-METHYLDITHIOCARBAMATE	10,229	19,670	27,299	42,988	57,415	38,197	41,444	44,078	50,652
PROPYLENE OXIDE	22	185	20	<1	12	<1	<1	<1	288
SODIUM TETRATHIOCARBONATE	8,497	7,977	6,170	11,485	10,991	7,180	7,301	4,826	1,672
SULFURYL FLUORIDE	2	<1	78	9	57	361	130	537	532
ZINC PHOSPHIDE	14,150	9,038	15,284	9,301	11,478	14,512	12,751	21,417	21,610
TOTAL	356,814	300,847	337,084	333,549	340,330	331,284	328,742	391,245	406,747

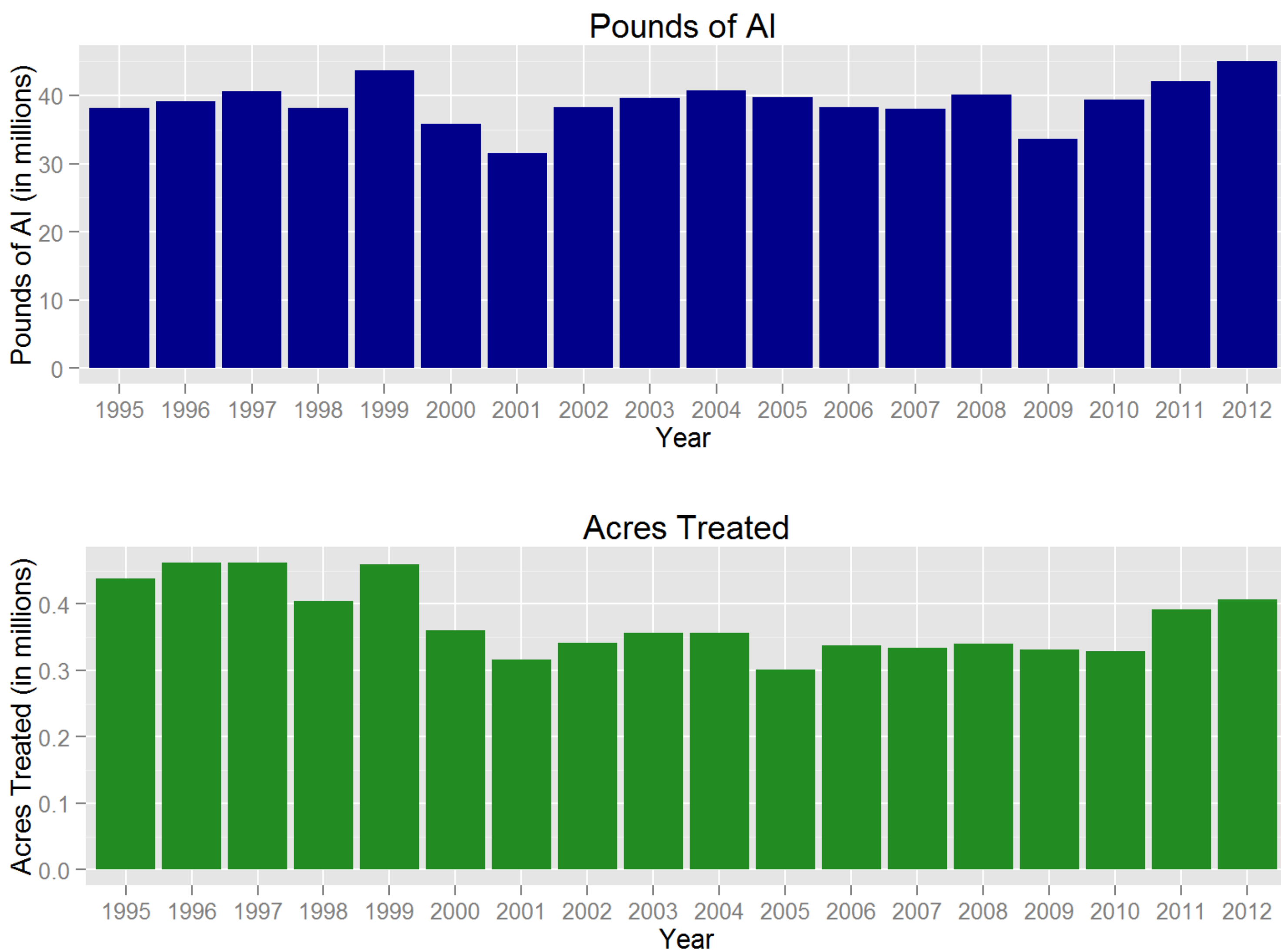

Figure 6: *Use trends of pesticides that are fumigants. Reported pounds of active ingredient (AI) applied include both agricultural and non-agricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are from the Department of Pesticide Regulation's 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 B2 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	2004	2005	2006	2007	2008	2009	2010	2011	2012
COAL TAR HYDROCARBONS	0	0	0	0	0	0	0	0	0
HYDROTREATED PARAFFINIC SOLVENT	334,196	244,817	254,213	300,501	247,676	248,774	224,458	239,377	153,941
ISOPARAFFINIC HYDROCARBONS	30,166	31,183	18,997	16,859	11,250	13,007	6,628	13,823	9,510
KEROSENE	14,266	8,023	11,387	12,431	22,272	148,479	95,973	34,659	20,347
MINERAL OIL	9,975,877	10,617,874	12,414,370	12,859,559	12,286,611	11,635,255	11,419,335	10,298,846	11,379,029
MINERAL OIL, PETROLEUM DISTILLATES, SOLVENT REFINED LIGHT	0	0	169	139	219	124	401	11	0
NAPHTHA, HEAVY AROMATIC	53	0	0	0	0	0	0	0	0
PETROLEUM DERIVATIVE RESIN	1	4	5	0	0	1	0	<1	0
PETROLEUM DISTILLATES	715,611	609,966	297,335	343,123	504,035	548,178	341,843	279,083	247,315
PETROLEUM DISTILLATES, ALIPHATIC	40,238	34,182	34,017	18,323	16,390	10,493	15,627	8,987	6,641
PETROLEUM DISTILLATES, AROMATIC	5,486	2,092	2,136	1,160	367	103	247	12	100
PETROLEUM DISTILLATES, REFINED	1,025,718	781,411	1,206,463	1,240,305	1,487,043	1,222,830	2,005,527	1,982,349	1,817,471
PETROLEUM HYDROCARBONS	642	956	1,574	1,407	184	138	177	177	27
PETROLEUM NAPHTHENIC OILS	27	48	158	240	249	254	888	1,048	552
PETROLEUM OIL, PARAFFIN BASED	443,264	414,094	563,646	511,255	506,841	1,048,157	618,281	748,994	974,420
PETROLEUM OIL, UNCLASSIFIED	15,936,714	16,232,621	18,241,640	13,419,141	13,629,907	12,246,849	12,490,234	17,835,068	13,285,490
PETROLEUM SULFONATES	0	0	<1	<1	<1	0	0	<1	0
TOTAL	28,522,260	28,977,272	33,046,110	28,724,444	28,713,046	27,122,642	27,219,619	31,442,432	27,894,845

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 B2 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	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
COAL TAR HYDROCARBONS	0	0	0	0	0	0	0	0	0
HYDROTREATED PARAFFINIC SOLVENT	327,022	252,863	270,421	261,415	226,988	232,299	227,415	254,703	180,502
ISOPARAFFINIC HYDROCARBONS	67,795	55,920	39,757	27,903	19,228	22,913	13,709	19,129	14,683
KEROSENE	264,266	314,821	348,522	254,279	284,703	303,567	316,705	319,353	286,018
MINERAL OIL	417,559	488,458	607,575	823,491	872,331	996,953	1,182,216	1,262,492	1,365,781
MINERAL OIL, PETROLEUM DISTILLATES, SOLVENT REFINED LIGHT	0	0	959	522	1,010	850	1,255	60	0
NAPHTHA, HEAVY AROMATIC	<1	0	0	0	0	0	0	0	0
PETROLEUM DERIVATIVE RESIN	<1	10	<1	0	0	<1	0	<1	0
PETROLEUM DISTILLATES	244,673	171,158	180,495	280,747	422,253	277,893	238,831	215,595	175,738
PETROLEUM DISTILLATES, ALIPHATIC	25,904	22,723	34,136	31,441	28,312	30,905	58,342	75,134	32,428
PETROLEUM DISTILLATES, AROMATIC	519	385	658	383	107	225	445	12	170
PETROLEUM DISTILLATES, REFINED	79,589	117,570	200,933	231,860	288,363	258,026	273,923	254,728	241,273
PETROLEUM HYDROCARBONS	108	430	260	546	334	309	159	35	5
PETROLEUM NAPHTHENIC OILS	2,484	358	11,125	17,950	18,246	22,435	44,879	65,431	27,369
PETROLEUM OIL, PARAFFIN BASED	555,670	605,289	724,671	738,037	658,728	631,263	673,415	712,408	712,722
PETROLEUM OIL, UNCLASSIFIED	653,743	717,903	807,931	674,659	706,768	693,360	762,026	1,041,623	847,112
PETROLEUM SULFONATES	0	0	<1	<1	<1	0	0	<1	0
TOTAL	2,632,389	2,744,767	3,213,555	3,323,231	3,506,793	3,445,584	3,748,162	4,155,217	3,856,272

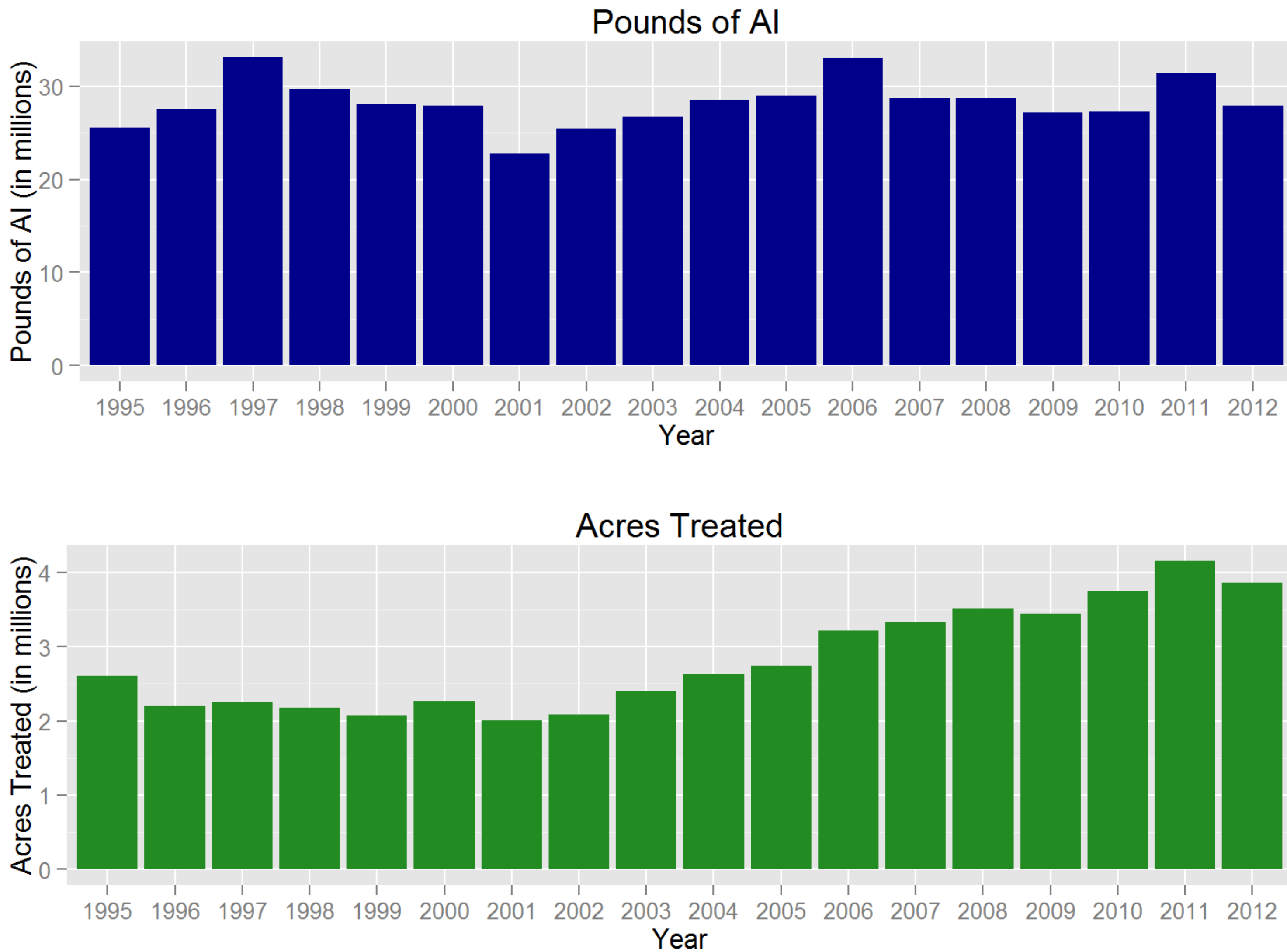

Figure 7: *Use trends of pesticides that are oils. As a broad group, oil pesticides and other petroleum distillates are on U.S. EPA's list of B2 carcinogens or the State's Proposition 65 list of chemicals "known to cause cancer." However, these classifications do not distinguish among oil pesticides 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	2004	2005	2006	2007	2008	2009	2010	2011	2012
(3S, 6R)-3-METHYL-6-ISOPROPENYL-9-DECEN-1-YL ACETATE	<1	<1	<1	0	0	<1	0	0	<1
(3S, 6S)-3-METHYL-6-ISOPROPENYL-9-DECEN-1-YL ACETATE	<1	<1	<1	0	0	<1	0	0	<1
(E)-4-TRIDECEN-1-YL-ACETATE	131	68	103	113	176	80	94	0	0
(E)-5-DECEN-1-OL	0	0	0	0	0	0	0	0	<1
(E)-5-DECENOL	5	<1	4	2	2	1	1	<1	2
(E)-5-DECENYL ACETATE	23	<1	17	7	8	4	5	2	10
(E,E)-9, 11-TETRADECADIEN-1-YL ACETATE	0	0	0	39	28	11	2	6	3
(E,Z)-7,9-DODECADIEN-1-YL ACETATE	0	0	0	0	0	0	50	249	269
(R,Z)-5-(1-DECENYL) DIHYDRO-2-(3H)-FURANONE	<1	<1	0	0	0	0	0	0	0
(S)-KINOPRENE	359	289	201	238	252	276	277	191	297
(S)-VERBENONE	0	0	0	0	0	0	0	0	55
(Z)-11-HEXADECEN-1-YL ACETATE	10	5	6	2	0	681	0	1	0
(Z)-11-HEXADECENAL	10	5	6	2	0	0	0	0	0
(Z)-4-TRIDECEN-1-YL-ACETATE	4	2	3	4	6	3	3	0	0
(Z)-9-DODECENYL ACETATE	0	<1	<1	1	<1	<1	<1	<1	<1
(Z,E)-7,11-HEXADECADIEN-1-YL ACETATE	0	0	0	0	<1	3	2	0	0
(Z,Z)-11,13-HEXADECADIENAL	0	0	0	<1	<1	0	<1	569	270
(Z,Z)-7,11-HEXADECADIEN-1-YL ACETATE	0	0	0	0	0	3	3	0	0
1,7-DIOXASPIRO-(5,5)-UNDECANE	0	<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	113	55	30	49	55	32	25	20	20
3,13 OCTADECADIEN-1-YL ACETATE	0	0	0	0	44	0	1	12	0
3,7-DIMETHYL-6-OCTEN-1-OL	0	0	0	0	1	5	23	12	28
ACETIC ACID	<1	<1	0	1	21	79	1,732	73	601
AGROBACTERIUM RADIOBACTER	183	27	291	577	32	142	124	97	28
AGROBACTERIUM RADIOBACTER, STRAIN K1026	<1	<1	6	<1	<1	1	<1	<1	<1

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	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
ALLYL ISOTHIOCYANATE	<1	<1	<1	0	0	0	0	0	<1
ALMOND, BITTER	0	0	<1	<1	<1	<1	<1	<1	<1
AMINO ETHOXY VINYL GLYCINE HYDROCHLORIDE	0	24	703	963	1,073	543	1,024	1,194	1,354
AMMONIUM BICARBONATE	0	<1	2	7	2	<1	9	14	7
AMPELOMYCES QUISQUALIS	<1	<1	<1	<1	0	<1	<1	0	0
ANIMAL GLAND EXTRACTS	0	0	0	0	0	0	0	0	0
ASPERGILLUS FLAVUS STRAIN AF36	0	<1	0	0	0	0	0	<1	4
AZADIRACHTIN	2,933	1,350	2,408	2,235	2,248	2,500	1,885	2,005	2,700
BACILLUS PUMILUS, STRAIN QST 2808	2	3,567	5,646	7,062	8,138	6,987	6,783	7,537	6,700
BACILLUS SPHAERICUS, SEROTYPE H-5A5B, STRAIN 2362	14,187	34,154	45,430	20,192	21,441	18,178	13,013	10,572	9,046
BACILLUS SUBTILIS GB03	7	15	14	6	1	<1	<1	<1	1
BACILLUS SUBTILIS MBI600	0	0	0	0	0	0	0	0	<1
BACILLUS SUBTILIS VAR. AMYLOLIQUEFACIENS STRAIN FZB24	0	0	0	0	0	0	0	0	3
BACILLUS THURINGIENSIS (BERLINER)	12	16	35	27	16	4	6	26	18
BACILLUS THURINGIENSIS (BERLINER), SUBSP. AIZAWAI, GC-91 PROTEIN	4,088	11,255	9,377	20,474	20,569	27,539	20,397	11,666	17,084
BACILLUS THURINGIENSIS (BERLINER), SUBSP. AIZAWAI, SEROTYPE H-7	3,015	2,336	1,752	2,877	2,373	894	814	812	716
BACILLUS THURINGIENSIS (BERLINER), SUBSP. ISRAELENSIS, SEROTYPE H-14	9,254	11,869	14,310	8,267	9,433	17,202	11,401	22,620	12,797
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI STRAIN SA-12	16,576	16,580	16,042	22,702	12,325	12,128	7,424	4,689	9,736
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A,3B	3,987	1,932	2,272	987	460	402	150	244	234
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN EG 2348	107	211	281	147	369	118	66	478	44
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN EG2371	2	5	1	0	0	0	<1	<1	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	2004	2005	2006	2007	2008	2009	2010	2011	2012
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN SA-11	20,547	53,895	54,236	63,866	66,651	80,565	75,036	58,196	52,325
BACILLUS THURINGIENSIS (BERLINER), SUBSP. SAN DIEGO	1	<1	2	2	0	<1	<1	0	0
BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI STRAIN BMP 123	10	1	3	0	764	118	14	0	0
BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI, GENETICALLY ENGINEERED STRAIN EG7841 LEPIDOPTERAN ACTIVE TOXIN	344	338	3,872	632	277	42	1	75	298
BACILLUS THURINGIENSIS VAR. KURSTAKI STRAIN M-200	0	0	0	<1	0	<1	0	0	0
BACILLUS THURINGIENSIS VAR. KURSTAKI, GENETICALLY ENGINEERED STRAIN EG7826	930	1,919	1,384	154	442	95	0	0	528
BACILLUS THURINGIENSIS, SUBSP. AIZAWAI, STRAIN ABTS-1857	27,075	33,336	28,905	32,529	41,824	31,043	26,250	24,515	30,462
BACILLUS THURINGIENSIS, SUBSP. AIZAWAI, STRAIN SD-1372, LEPIDOPTERAN ACTIVE TOXIN(S)	532	315	432	563	256	243	130	88	1
BACILLUS THURINGIENSIS, SUBSP. ISRAELENSIS, STRAIN AM 65-52	23,001	41,734	59,019	40,376	52,969	53,778	71,050	52,817	170,566
BACILLUS THURINGIENSIS, SUBSP. KURSTAKI, STRAIN ABTS-351, FERMENTATION SOLIDS AND SOLUBLES	46,762	57,987	53,351	71,755	79,539	69,545	96,988	82,936	94,895
BACILLUS THURINGIENSIS, SUBSP. KURSTAKI, STRAIN HD-1	4,731	3,185	6,139	2,262	2,076	3,747	3,579	2,611	3,169
BACILLUS THURINGIENSIS, VAR. KURSTAKI DELTA ENDOTOXINS CRY 1A(C) AND CRY 1C (GENETICALLY ENGINEERED) ENCAPSULATED IN PSEUDOMONAS FLUORESCENS (KILLED)	5	3	<1	1	26	28	<1	<1	4

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	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
BACTERIOPHAGE ACTIVE AGAINST XANTHOMONAS CAMPESTRIS PV. VESICATORIA AND PSEUDOMONAS SYRINGAE PV. TOMATO	0	0	0	0	0	0	0	<1	<1
BALSAM FIR OIL	0	0	0	0	0	0	<1	0	<1
BEAUVERIA BASSIANA STRAIN GHA	863	824	571	711	569	378	357	574	920
BUFFALO GOURD ROOT POWDER	0	0	0	137	279	1	11	0	1
CANDIDA OLEOPHILA ISOLATE I-182	0	0	0	0	0	0	0	0	0
CANOLA OIL	4	1	4	29	25	17	131	26	15
CAPSICUM OLEORESIN	49	2	2	10	5	2	4	4	12
CASTOR OIL	363	79	37	4	4	21	7	<1	2
CHENOPODIUM AMBROSIODES NEAR AMBROSIODES	0	0	0	0	0	20,330	10,336	7,897	10,319
CHITOSAN	<1	0	0	0	0	0	0	0	0
CINNAMALDEHYDE	326	34	12	3	354	0	0	1	0
CLARIFIED HYDROPHOBIC EXTRACT OF NEEM OIL	86,776	117,205	96,537	110,881	104,956	106,271	115,931	70,555	75,968
CODLING MOTH GRANULOSIS VIRUS	0	0	<1	<1	<1	<1	<1	<1	<1
CONIOTHYRIUM MINITANS STRAIN CON/M/91-08	198	6	11	6	0	127	80	176	229
CORN GLUTEN MEAL	18	2	1	0	<1	0	0	0	0
CORN SYRUP	0	0	0	81	1,893	2,891	3,026	4,368	4,739
COYOTE URINE	0	0	0	0	0	0	<1	1	2
CYTOKININ	0	0	0	0	0	0	0	<1	<1
DIHYDRO-5-HEPTYL-2(3H)-FURANONE	<1	<1	<1	<1	<1	<1	<1	<1	<1
DIHYDRO-5-PENTYL-2(3H)-FURANONE	<1	<1	<1	<1	<1	<1	<1	0	0
E,E-8,10-DODECADIEN-1-OL	1,170	2,388	2,278	2,273	2,037	4,978	1,942	1,376	1,894
E-11-TETRADECEN-1-YL ACETATE	91	79	99	2,399	744	312	100	172	132
E-8-DODECENYL ACETATE	135	118	229	236	265	607	898	188	266
ENCAPSULATED DELTA ENDOTOXIN OF BACILLUS THURINGIENSIS VAR. KURSTAKI IN KILLED PSEUDOMONAS FLUORESCENS	114	7	6	32	18	18	0	1	<1
ENCAPSULATED DELTA ENDOTOXIN OF BACILLUS THURINGIENSIS VAR. SAN DIEGO IN KILLED PSEUDOMONAS FLUORESCENS	2	1	0	0	0	0	0	0	0
ESSENTIAL OILS	1	<1	4	<1	0	<1	<1	<1	1
ETHYLENE	32	0	0	0	0	0	97	1,030	941
EUCALYPTUS OIL	0	50	<1	0	0	0	22	<1	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	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
EUGENOL	3	<1	<1	0	0	0	0	0	1
FARNESOL	7	10	4	2	2	3	10	5	11
FENUGREEK	0	0	5	31	6	17	1	5	8
FISH OIL	0	0	0	0	0	0	0	1,657	5,466
FORMIC ACID	0	0	1	1,509	499	280	223	241	634
FOX URINE	0	0	0	0	0	0	<1	<1	2
GAMMA AMINOBUTYRIC ACID	8,664	8,679	4,213	1,936	944	177	118	40	133
GARLIC	174	203	89	142	212	36	423	29	1,883
GERANIOL	0	0	<1	0	1	5	23	12	28
GERMAN COCKROACH PHEROMONE	<1	<1	<1	<1	<1	<1	<1	<1	<1
GIBBERELLINS	22,984	26,516	24,688	25,083	23,517	22,916	21,378	21,258	22,518
GIBBERELLINS, POTASSIUM SALT	1	<1	15	<1	<1	0	<1	<1	5
GLIOCLADIUM VIRENS GL-21 (SPORES)	30	19	1	152	945	356	945	650	1,957
GLUTAMIC ACID	8,664	8,679	4,213	1,936	944	177	118	40	133
HARPIN PROTEIN	170	127	60	32	16	14	13	11	1
HEPTYL BUTYRATE	0	0	0	0	0	0	<1	<1	<1
HYDROGEN PEROXIDE	2,822	5,553	17,526	11,860	20,740	21,750	69,179	59,233	36,112
HYDROPRENE	1,309	2,910	11,970	2,282	2,383	1,664	6,381	11,265	3,959
IBA	27	11	31	20	11	6	7	9	12
IRON PHOSPHATE	1,256	1,645	1,484	1,634	1,916	1,435	2,351	2,862	2,278
LACTOSE	3,923	7,903	10,667	9,019	11,365	9,160	7,967	9,280	6,541
LAGENIDIUM GIGANTEUM (CALIFORNIA STRAIN)	58	<1	0	<1	<1	0	0	0	5
LAURYL ALCOHOL	317	876	472	503	830	432	736	497	753
LAVANDULYL SENECIOATE	0	0	0	0	140	462	437	6,120	586
LIMONENE	14,392	45,890	32,845	68,949	45,536	56,495	56,406	62,815	73,179
LINALOOL	174	176	170	113	63	62	1,104	95	137
MARGOSA OIL	0	0	0	0	0	0	579	7,701	9,217
MENTHOL	0	93	<1	0	0	0	5	<1	0
METARHIZIUM ANISOPLIAE STRAIN F52	0	0	0	0	0	0	0	0	115
METARHIZIUM ANISOPLIAE, VAR. ANISOPLIAE, STRAIN ESF1	<1	<1	<1	<1	<1	0	<1	<1	0
METHOPRENE	8,874	9,900	6,941	3,357	2,620	1,568	1,492	1,801	1,310
METHYL ANTHRANILATE	534	151	449	152	118	312	343	448	301
METHYL EUGENOL	0	0	0	0	0	0	0	5	0
METHYL SALICYLATE	0	0	<1	<1	0	<1	0	0	0
MONTOK PEPPER	0	0	0	0	0	0	0	0	0
MUSCALURE	10	14	15	22	19	20	15	15	16

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
MYRISTYL ALCOHOL	65	178	96	102	169	88	150	102	154
MYROTHECIUM VERRUCARIA, DRIED FERMENTATION SOLIDS & SOLUBLES, STRAIN AARC-0255	39,888	27,977	25,039	29,990	23,867	23,273	22,813	27,757	25,556
N6-BENZYL ADENINE	174	124	446	198	153	168	217	128	168
NAA	13	12	9	4	31	3	5	4	9
NAA, AMMONIUM SALT	1,356	1,543	1,100	1,253	1,193	1,203	976	839	1,294
NAA, ETHYL ESTER	1	3	1	2	8	3	6	23	4
NAA, SODIUM SALT	10	8	3	3	1	2	0	0	0
NEROLIDOL	6	8	3	2	2	6	24	12	28
NITROGEN, LIQUIFIED	79,369	82,298	57,121	15,741	11,945	2,181	135	216	74
NONANOIC ACID	7,224	8,845	11,203	10,949	11,093	9,063	17,322	17,938	18,210
NONANOIC ACID, OTHER RELATED	380	466	590	576	584	477	912	944	958
NOSEMA LOCUSTAE SPORES	<1	<1	<1	<1	<1	<1	<1	<1	1
OIL OF ANISE	<1	<1	<1	<1	<1	0	0	<1	<1
OIL OF BERGAMOT	0	0	<1	0	0	0	0	0	0
OIL OF CEDARWOOD	0	0	0	0	0	0	<1	0	0
OIL OF CITRONELLA	0	<1	<1	<1	3	0	5	46	0
OIL OF CITRUS	0	<1	0	0	0	0	0	0	0
OIL OF GERANIUM	0	0	0	0	0	0	<1	0	0
OIL OF JOJOBA	3,031	3,540	9,572	7,240	12,070	3,418	4,176	1,202	507
OIL OF LEMON EUCALYPTUS	0	0	0	0	0	0	0	<1	3
OIL OF LEMONGRASS	0	<1	<1	0	0	0	0	0	0
OIL OF MUSTARD	0	0	0	0	0	0	0	0	0
OIL OF PEPPERMINT	<1	<1	0	<1	<1	0	<1	0	0
OXYPURINOL	0	<1	0	<1	0	0	0	0	0
PAECILOMYCES FUMOSOROSEUS APOPKA STRAIN 97	0	0	0	0	0	0	0	0	507
PAECILOMYCES LILACINUS STRAIN 251	0	0	0	0	0	0	252	515	840
PANTOEA AGGLOMERANS STRAIN E325, NRRL B-21856	0	0	0	0	0	33	4	1	1
PERFUME	<1	0	0	0	0	0	0	0	0
POLYHEDRAL OCCLUSION BODIES (OB'S) OF THE NUCLEAR POLYHEDROSIS VIRUS OF HELICOVERPA ZEA (CORN EARWORM)	1	0	0	0	<1	1	1	51	6
POTASSIUM BICARBONATE	160,569	390,806	163,083	114,163	109,171	180,858	275,648	358,002	224,160
PROPYLENE GLYCOL	46,580	48,956	42,641	28,505	24,132	25,792	54,215	47,897	58,046

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
PSEUDOMONAS FLUORESCENS, STRAIN A506	872	896	1,004	614	390	328	217	274	59
PSEUDOMONAS SYRINGAE STRAIN ESC-11	20	<1	<1	0	0	0	0	0	0
PSEUDOMONAS SYRINGAE, STRAIN ESC-10	0	0	<1	0	0	0	<1	0	0
PUTRESCENT WHOLE EGG SOLIDS	110	60	69	20	1	143	3	1	1
PYTHIUM OLIGANDRUM DV74	0	0	0	0	0	0	0	<1	<1
QST 713 STRAIN OF DRIED BACILLUS SUBTILIS	16,737	14,040	17,139	17,337	16,889	16,175	21,307	23,721	22,757
QUILLAJA	0	0	83	276	1,183	410	682	1,060	783
REYNOUTRIA SACHALINENSIS	0	0	0	0	0	179	8,996	14,807	14,654
S-ABSCISIC ACID	0	0	0	0	7	66	864	1,852	2,651
S-METHOPRENE	530	1,138	1,391	1,726	3,520	3,284	3,921	2,313	2,173
SAWDUST	1	<1	2	<1	1	<1	1	0	4
SESAME OIL	0	0	35	883	529	851	1,309	1,334	15
SILVER NITRATE	0	0	0	0	0	0	<1	<1	<1
SODIUM BICARBONATE	126	0	0	0	67	27	3	515	145
SODIUM LAURYL SULFATE	3	15	274	400	340	146	96	458	879
SOYBEAN OIL	50,301	46,199	70,398	14,747	12,201	28,359	23,805	23,957	22,208
STREPTOMYCES GRISEOVIRIDIS STRAIN K61	<1	<1	1	<1	<1	<1	<1	<1	<1
STREPTOMYCES LYDICUS WYEC 108	0	0	<1	<1	<1	1	2	1	2
SUCROSE OCTANOATE	0	0	2	0	1,685	4,003	1,128	230	55
THYME	0	0	171	485	593	775	1,311	662	845
TRICHODERMA HARZIANUM RIFAI STRAIN KRL-AG2	37	16	24	38	20	11	504	129	156
TRICHODERMA ICC 012 ASPERELLUM	0	0	0	0	0	0	0	13	18
TRICHODERMA ICC 080 GAMSII	0	0	0	0	0	0	0	13	18
VANILLIN	0	0	1	5	1	3	<1	1	1
VEGETABLE OIL	248,684	208,860	256,605	154,128	270,375	196,078	323,250	514,438	276,278
XANTHINE	0	<1	0	<1	0	0	0	0	0
XANTHOMONAS CAMPESTRIS PV. POANNUA	0	0	<1	0	0	0	0	0	0
YEAST	1,085	1,106	1,159	1,030	999	926	470	1,165	818
YUCCA SCHIDIGERA	0	0	0	0	7	169	634	1,649	7,086
Z,E-9,12-TETRADECADIEN-1-YL ACETATE	0	0	0	1	0	6,149	1	7	6
Z-11-TETRADECEN-1-YL ACETATE	14	12	14	228	9	9	9	4	8
Z-8-DODECENOL	24	21	41	41	47	106	157	33	45

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
Z-8-DODECENYL ACETATE	2,081	1,818	3,454	3,646	4,050	9,261	13,964	2,890	3,739
Z-9-TETRADECEN-1-OL	0	0	0	0	0	0	0	0	0
TOTAL	1,002,777	1,355,579	1,184,708	948,993	1,055,212	1,094,349	1,421,055	1,603,992	1,362,946

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
(3S, 6R)-3-METHYL-6-ISOPROPENYL-9-DECEN-1-YL ACETATE	86	1,604	1,484	0	0	3	0	0	7
(3S, 6S)-3-METHYL-6-ISOPROPENYL-9-DECEN-1-YL ACETATE	86	1,604	1,484	0	0	3	0	0	7
(E)-4-TRIDECEN-1-YL-ACETATE	5,555	3,226	4,870	5,193	7,672	3,942	3,905	0	0
(E)-5-DECEN-1-OL	0	0	0	0	0	0	0	0	53
(E)-5-DECENOL	809	70	385	737	262	118	249	166	502
(E)-5-DECENYL ACETATE	809	70	385	737	262	118	249	166	555
(E,E)-9, 11-TETRADECADIEN-1-YL ACETATE	0	0	0	22	956	3	474	759	585
(E,Z)-7,9-DODECADIEN-1-YL ACETATE	0	0	0	0	0	0	5,168	18,098	22,774
(R,Z)-5-(1-DECENYL) DIHYDRO-2-(3H)-FURANONE	15	<1	0	0	0	0	0	0	0
(S)-KINOPRENE	1,864	494	440	453	575	510	490	346	481
(S)-VERBENONE	0	0	0	0	0	0	0	0	100
(Z)-11-HEXADECEN-1-YL ACETATE	365	164	183	116	0	1,622	0	49	0
(Z)-11-HEXADECENAL	365	164	423	72	0	0	0	0	0
(Z)-4-TRIDECEN-1-YL-ACETATE	5,555	3,226	4,870	5,193	7,672	3,942	3,905	0	0
(Z)-9-DODECENYL ACETATE	0	570	96	5,342	1,304	123	74	1,814	392
(Z,E)-7,11-HEXADECADIEN-1-YL ACETATE	0	0	0	0	1	93	1	0	0
(Z,Z)-11,13-HEXADECADIENAL	0	0	0	200	109	0	763	11,336	17,283
(Z,Z)-7,11-HEXADECADIEN-1-YL ACETATE	0	0	0	0	0	93	1	0	0
1,7-DIOXASPIRO-(5,5)-UNDECANE	0	49	4	55	<1	6	<1	<1	30
1-DECANOL	0	0	0	0	0	0	0	0	0
1-METHYLCYCLOPROPENE	4	8	2	6	13	61	3	1	17
1-NAPHTHALENEACETAMIDE	2,201	1,100	666	927	870	607	408	315	393
3,13 OCTADECADIEN-1-YL ACETATE	0	0	0	0	85	0	50	131	0
3,7-DIMETHYL-6-OCTEN-1-OL	0	0	0	0	67	349	1,531	788	2,220
ACETIC ACID	290	60	0	10	2	226	110	162	3,173
AGROBACTERIUM RADIOBACTER	493	306	698	555	217	215	362	325	852
AGROBACTERIUM RADIOBACTER, STRAIN K1026	524	292	335	366	1,935	5,086	81	19	4,947
ALLYL ISOTHIOCYANATE	<1	20	<1	0	0	0	0	0	<1

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
ALMOND, BITTER	0	0	328	2,068	87	471	74	412	271
AMINO ETHOXY VINYL GLYCINE HYDROCHLORIDE	0	229	6,453	9,238	10,253	5,611	10,179	11,108	14,752
AMMONIUM BICARBONATE	0	49	4	55	<1	6	<1	<1	30
AMPELOMYCES QUISQUALIS	696	247	10	14	0	22	2	0	0
ANIMAL GLAND EXTRACTS	0	0	0	0	0	0	0	0	0
ASPERGILLUS FLAVUS STRAIN AF36	0	258	0	0	0	0	0	260	48,833
AZADIRACHTIN	64,488	55,657	68,244	91,385	86,950	82,652	71,707	70,007	97,649
BACILLUS PUMILUS, STRAIN QST 2808	4	34,748	64,333	79,795	91,795	75,509	72,518	84,080	75,674
BACILLUS SPHAERICUS, SEROTYPE H-5A5B, STRAIN 2362	<1	<1	<1	<1	<1	<1	9	<1	231
BACILLUS SUBTILIS GB03	379	23	3	2	5	2	<1	6	<1
BACILLUS SUBTILIS MBI600	0	0	0	0	0	0	0	0	2
BACILLUS SUBTILIS VAR. AMYLOLIQUEFACIENS STRAIN FZB24	0	0	0	0	0	0	0	0	384
BACILLUS THURINGIENSIS (BERLINER)	441	100	2,939	1,129	41	82	127	875	292
BACILLUS THURINGIENSIS (BERLINER), SUBSP. AIZAWAI, GC-91 PROTEIN	63,504	62,244	39,077	53,040	40,553	48,842	40,395	18,657	25,317
BACILLUS THURINGIENSIS (BERLINER), SUBSP. AIZAWAI, SEROTYPE H-7	24,160	19,190	15,784	24,379	20,510	7,888	6,847	7,745	6,079
BACILLUS THURINGIENSIS (BERLINER), SUBSP. ISRAELENSIS, SEROTYPE H-14	1,048	3,480	543	833	4,719	501	1,873	337	650
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI STRAIN SA-12	28,485	34,533	29,505	35,513	21,008	19,700	10,721	8,222	14,643
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A,3B	69,454	31,406	42,279	16,522	8,671	7,807	2,269	3,063	1,972
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN EG 2348	737	1,625	2,913	1,271	2,147	1,302	688	3,428	644
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN EG2371	18	54	7	0	0	0	<1	<1	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	2004	2005	2006	2007	2008	2009	2010	2011	2012
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN SA-11	123,796	156,026	125,390	119,055	100,718	101,522	111,686	84,076	81,158
BACILLUS THURINGIENSIS (BERLINER), SUBSP. SAN DIEGO	1	<1	<1	<1	0	<1	<1	0	0
BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI STRAIN BMP 123	268	20	93	0	1,898	310	73	0	0
BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI, GENETICALLY ENGINEERED STRAIN EG7841 LEPIDOPTERAN ACTIVE TOXIN	1,766	1,160	6,684	1,225	451	62	3	200	373
BACILLUS THURINGIENSIS VAR. KURSTAKI STRAIN M-200	0	0	0	<1	0	<1	0	0	0
BACILLUS THURINGIENSIS VAR. KURSTAKI, GENETICALLY ENGINEERED STRAIN EG7826	6,456	8,724	3,021	479	1,298	250	0	0	1,320
BACILLUS THURINGIENSIS, SUBSP. AIZAWAI, STRAIN ABTS-1857	38,718	47,071	41,546	43,209	50,665	41,724	37,209	35,252	41,432
BACILLUS THURINGIENSIS, SUBSP. AIZAWAI, STRAIN SD-1372, LEPIDOPTERAN ACTIVE TOXIN(S)	3,465	3,025	4,235	4,766	2,343	2,136	1,057	640	4
BACILLUS THURINGIENSIS, SUBSP. ISRAELENSIS, STRAIN AM 65-52	3	313	4,809	25	2,497	270	758	824	1,301
BACILLUS THURINGIENSIS, SUBSP. KURSTAKI, STRAIN ABTS-351, FERMENTATION SOLIDS AND SOLUBLES	94,559	109,681	100,697	133,297	135,227	120,661	162,444	152,302	164,266
BACILLUS THURINGIENSIS, SUBSP. KURSTAKI, STRAIN HD-1	44,536	29,129	23,346	20,045	15,249	20,295	18,369	16,390	15,058
BACILLUS THURINGIENSIS, VAR. KURSTAKI DELTA ENDOTOXINS CRY 1A(C) AND CRY 1C (GENETICALLY ENGINEERED) ENCAPSULATED IN PSEUDOMONAS FLUORESCENS (KILLED)	7	<1	<1	<1	25	52	2	<1	10

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	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
BACTERIOPHAGE ACTIVE AGAINST XANTHOMONAS CAMPESTRIS PV. VESICATORIA AND PSEUDOMONAS SYRINGAE PV. TOMATO	0	0	0	0	0	0	0	11	25
BALSAM FIR OIL	0	0	0	0	0	0	<1	0	<1
BEAUVERIA BASSIANA STRAIN GHA	4,019	3,531	2,743	2,481	2,091	2,188	1,686	2,573	3,521
BUFFALO GOURD ROOT POWDER	0	0	0	1,694	3,227	8	138	0	25
CANDIDA OLEOPHILA ISOLATE I-182	0	0	0	0	0	0	0	0	0
CANOLA OIL	<1	2	5	33	1,388	1,541	4,786	3,872	2,329
CAPSICUM OLEORESIN	379	71	247	277	528	325	388	238	557
CASTOR OIL	<1	<1	2	<1	4	12	<1	<1	<1
CHENOPODIUM AMBROSIODES NEAR AMBROSIODES	0	0	0	0	0	6,355	9,265	6,868	13,617
CHITOSAN	<1	0	0	0	0	0	0	0	0
CINNAMALDEHYDE	137	18	10	2	556	0	0	<1	0
CLARIFIED HYDROPHOBIC EXTRACT OF NEEM OIL	51,009	69,051	73,386	71,278	64,429	47,422	42,281	40,802	42,090
CODLING MOTH GRANULOSIS VIRUS	0	0	1,479	2,141	1,487	1,139	984	3,468	3,416
CONIOTHYRIUM MINITANS STRAIN CON/M/91-08	1,781	26	62	120	0	1,204	395	1,107	1,546
CORN GLUTEN MEAL	<1	<1	<1	0	3	0	0	0	0
CORN SYRUP	0	0	0	1,132	7,991	14,316	12,877	27,648	27,398
COYOTE URINE	0	0	0	0	0	0	<1	12	<1
CYTOKININ	0	0	0	0	0	0	0	199	2,409
DIHYDRO-5-HEPTYL-2(3H)-FURANONE	<1	<1	<1	<1	<1	<1	<1	<1	<1
DIHYDRO-5-PENTYL-2(3H)-FURANONE	<1	<1	<1	<1	<1	<1	<1	0	0
E,E-8,10-DODECADIEN-1-OL	17,383	21,896	20,728	27,784	21,585	15,309	15,283	17,872	15,815
E-11-TETRADECEN-1-YL ACETATE	8,836	7,351	6,637	6,189	5,996	5,592	5,405	1,701	4,463
E-8-DODECENYL ACETATE	41,752	33,419	37,412	49,086	54,242	46,757	49,591	45,650	49,024
ENCAPSULATED DELTA ENDOTOXIN OF BACILLUS THURINGIENSIS VAR. KURSTAKI IN KILLED PSEUDOMONAS FLUORESCENS	143	33	9	35	91	37	0	<1	<1
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	<1	<1	1	0	<1	4	<1	<1
ETHYLENE	7	0	0	0	0	0	4	70	49
EUCALYPTUS OIL	0	150	<1	0	0	0	2	<1	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	2004	2005	2006	2007	2008	2009	2010	2011	2012
EUGENOL	15	<1	<1	0	0	0	0	0	<1
FARNESOL	4,294	4,369	1,246	652	422	503	1,597	826	2,227
FENUGREEK	0	0	328	2,068	87	471	74	412	271
FISH OIL	0	0	0	0	0	0	0	<1	382
FORMIC ACID	0	0	<1	1	51	10	60	1	368
FOX URINE	0	0	0	0	0	0	<1	12	<1
GAMMA AMINOBUTYRIC ACID	117,477	114,189	58,586	24,697	12,905	1,786	835	542	1,811
GARLIC	259	513	363	346	288	374	1,123	1,369	12,222
GERANIOL	0	0	<1	0	67	349	1,531	788	2,220
GERMAN COCKROACH PHEROMONE	<1	6	<1	<1	<1	<1	<1	<1	<1
GIBBERELLINS	414,093	462,231	458,764	455,130	490,970	513,398	492,342	509,698	526,309
GIBBERELLINS, POTASSIUM SALT	170	65	348	32	8	0	34	150	795
GLIOCLADIUM VIRENS GL-21 (SPORES)	<1	18	<1	5	1,090	716	1,401	1,077	3,172
GLUTAMIC ACID	117,477	114,189	58,586	24,697	12,905	1,786	835	542	1,811
HARPIN PROTEIN	17,949	12,232	6,089	3,721	1,998	1,562	1,631	1,582	115
HEPTYL BUTYRATE	0	0	0	0	0	0	<1	<1	<1
HYDROGEN PEROXIDE	1,057	985	9,952	7,744	9,361	14,521	23,208	39,181	21,749
HYDROPRENE	<1	<1	7	2	200	82	<1	<1	1
IBA	1,566	79	27,670	44,093	3,862	150	227	1,155	1,264
IRON PHOSPHATE	2,148	3,910	4,197	7,145	6,649	4,561	6,345	5,477	6,340
LACTOSE	45,293	79,734	95,549	80,366	101,586	77,363	80,387	91,887	68,215
LAGENIDIUM GIGANTEUM (CALIFORNIA STRAIN)	24	2	0	<1	<1	0	0	0	2
LAURYL ALCOHOL	6,009	6,719	5,488	9,358	7,782	4,705	5,495	6,443	6,578
LAVANDULYL SENECIOATE	0	0	0	0	4,316	2,375	7,025	11,754	6,669
LIMONENE	49,320	62,359	75,333	79,012	64,151	55,465	29,621	15,289	71,439
LINALOOL	<1	<1	<1	<1	7	1	<1	<1	<1
MARGOSA OIL	0	0	0	0	0	0	40	4,110	7,979
MENTHOL	0	150	<1	0	0	0	2	<1	0
METARHIZIUM ANISOPLIAE STRAIN F52	0	0	0	0	0	0	0	0	202
METARHIZIUM ANISOPLIAE, VAR. ANISOPLIAE, STRAIN ESF1	<1	<1	<1	<1	<1	0	<1	<1	0
METHOPRENE	1	<1	157	51	42	211	4	896	<1
METHYL ANTHRANILATE	1,458	448	1,557	298	219	550	380	2,043	215
METHYL EUGENOL	0	0	0	0	0	0	0	<1	0
METHYL SALICYLATE	0	0	<1	1	0	<1	0	0	0
MONTOK PEPPER	0	0	0	0	0	0	0	0	0
MUSCALURE	307	2,715	476	1,179	<1	739	300	68	40

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
MYRISTYL ALCOHOL	6,009	6,719	5,488	9,358	7,782	4,705	5,495	6,443	6,578
MYROTHECIUM VERRUCARIA, DRIED FERMENTATION SOLIDS & SOLUBLES, STRAIN AARC-0255	8,348	4,680	4,478	5,097	5,257	5,331	4,840	5,136	4,274
N6-BENZYL ADENINE	4,544	1,552	7,711	2,628	1,775	2,072	3,352	1,691	1,667
NAA	1,096	49	26,799	43,507	3,331	47	38	220	635
NAA, AMMONIUM SALT	12,889	12,569	11,174	11,709	10,445	9,024	9,140	9,075	11,579
NAA, ETHYL ESTER	<1	<1	<1	<1	73	1	23	396	374
NAA, SODIUM SALT	642	858	452	340	37	257	0	0	0
NEROLIDOL	4,294	4,369	1,246	652	422	503	1,597	826	2,227
NITROGEN, LIQUIFIED	<1	<1	<1	<1	<1	<1	<1	<1	<1
NONANOIC ACID	1,075	675	883	1,275	498	703	412	828	457
NONANOIC ACID, OTHER RELATED	1,075	675	877	1,275	498	701	412	828	457
NOSEMA LOCUSTAE SPORES	37	1	<1	254	30	132	12	12	1,598
OIL OF ANISE	<1	<1	<1	<1	<1	0	0	<1	<1
OIL OF BERGAMOT	0	0	<1	0	0	0	0	0	0
OIL OF CEDARWOOD	0	0	0	0	0	0	15	0	0
OIL OF CITRONELLA	0	<1	<1	<1	2	0	34	48	0
OIL OF CITRUS	0	<1	0	0	0	0	0	0	0
OIL OF GERANIUM	0	0	0	0	0	0	15	0	0
OIL OF JOJOBA	1,259	4,705	9,029	7,846	11,566	7,203	8,255	1,760	1,075
OIL OF LEMON EUCALYPTUS	0	0	0	0	0	0	0	<1	<1
OIL OF LEMONGRASS	0	20	<1	0	0	0	0	0	0
OIL OF MUSTARD	0	0	0	0	0	0	0	0	0
OIL OF PEPPERMINT	<1	<1	0	<1	<1	0	15	0	0
OXYPURINOL	0	<1	0	1	0	0	0	0	0
PAECILOMYCES FUMOSOROSEUS APOPKA STRAIN 97	0	0	0	0	0	0	0	0	2,106
PAECILOMYCES LILACINUS STRAIN 251	0	0	0	0	0	0	1,115	2,330	3,531
PANTOEA AGGLOMERANS STRAIN E325, NRRL B-21856	0	0	0	0	0	698	55	25	50
PERFUME	<1	0	0	0	0	0	0	0	0
POLYHEDRAL OCCLUSION BODIES (OB'S) OF THE NUCLEAR POLYHEDROSIS VIRUS OF HELICOVERPA ZEA (CORN EARWORM)	742	0	0	0	98	254	302	14,752	1,297
POTASSIUM BICARBONATE	64,994	143,968	61,465	47,299	41,899	69,155	101,283	118,565	73,801
PROPYLENE GLYCOL	778,321	754,665	738,448	520,537	420,161	381,957	591,117	661,113	670,507

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
PSEUDOMONAS FLUORESCENS, STRAIN A506	6,559	7,176	11,929	4,801	1,943	2,463	1,472	1,281	372
PSEUDOMONAS SYRINGAE STRAIN ESC-11	<1	<1	<1	0	0	0	0	0	0
PSEUDOMONAS SYRINGAE, STRAIN ESC-10	0	0	<1	0	0	0	3	0	0
PUTRESCENT WHOLE EGG SOLIDS	<1	<1	<1	<1	<1	33	2	<1	<1
PYTHIUM OLIGANDRUM DV74	0	0	0	0	0	0	0	2	2
QST 713 STRAIN OF DRIED BACILLUS SUBTILIS	58,871	56,342	64,606	67,563	76,784	81,252	99,317	116,467	121,517
QUILLAJA	0	0	3,591	18,584	27,814	22,595	22,916	29,853	21,803
REYNOUTRIA SACHALINENSIS	0	0	0	0	0	1,297	70,363	90,509	93,331
S-ABSCISIC ACID	0	0	0	0	34	502	5,197	9,528	14,974
S-METHOPRENE	49	2,395	9,552	30,635	47,284	47,190	65,114	62,668	87,369
SAWDUST	<1	23	<1	10	19	<1	<1	0	74
SESAME OIL	0	0	<1	888	846	1,448	1,912	1,945	39
SILVER NITRATE	0	0	0	0	0	0	<1	<1	5
SODIUM BICARBONATE	100	0	0	0	17	57	1	967	1,008
SODIUM LAURYL SULFATE	<1	<1	<1	<1	14	<1	<1	<1	<1
SOYBEAN OIL	9,870	6,344	3,675	3,277	2,900	3,792	6,160	3,636	3,271
STREPTOMYCES GRISEOVIRIDIS STRAIN K61	5	20	29	12	<1	<1	<1	1	<1
STREPTOMYCES LYDICUS WYEC 108	0	0	50	96	1,910	4,009	6,998	6,403	10,058
SUCROSE OCTANOATE	0	0	4	0	448	930	1,172	148	1
THYME	0	0	<1	<1	<1	68	<1	<1	<1
TRICHODERMA HARZIANUM RIFAI STRAIN KRL-AG2	833	406	286	311	201	320	7,253	873	1,086
TRICHODERMA ICC 012 ASPERELLUM	0	0	0	0	0	0	0	86	668
TRICHODERMA ICC 080 GAMSII	0	0	0	0	0	0	0	86	668
VANILLIN	0	0	328	2,068	87	471	74	412	271
VEGETABLE OIL	214,183	211,388	275,541	144,591	231,954	211,586	292,218	458,210	266,226
XANTHINE	0	<1	0	1	0	0	0	0	0
XANTHOMONAS CAMPESTRIS PV. POANNUA	0	0	14	0	0	0	0	0	0
YEAST	4,630	4,835	5,262	4,694	4,560	3,957	1,306	5,261	3,729
YUCCA SCHIDIGERA	0	0	0	0	18	598	2,316	4,907	15,914
Z,E-9,12-TETRADECADIEN-1-YL ACETATE	0	0	0	44	0	1,622	<1	49	<1
Z-11-TETRADECEN-1-YL ACETATE	8,836	7,351	6,637	6,166	5,040	5,589	4,931	942	3,877
Z-8-DODECENOL	41,752	33,419	37,412	49,086	54,242	46,757	49,591	45,650	49,024

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	2004	2005	2006	2007	2008	2009	2010	2011	2012
Z-8-DODECENYL ACETATE	41,752	33,419	37,412	49,086	54,242	46,757	49,591	45,650	49,024
Z-9-TETRADECEN-1-OL	0	0	0	0	0	0	0	0	0
TOTAL	2,526,848	2,698,117	2,681,867	2,386,180	2,358,040	2,221,245	2,647,051	2,967,008	2,932,027

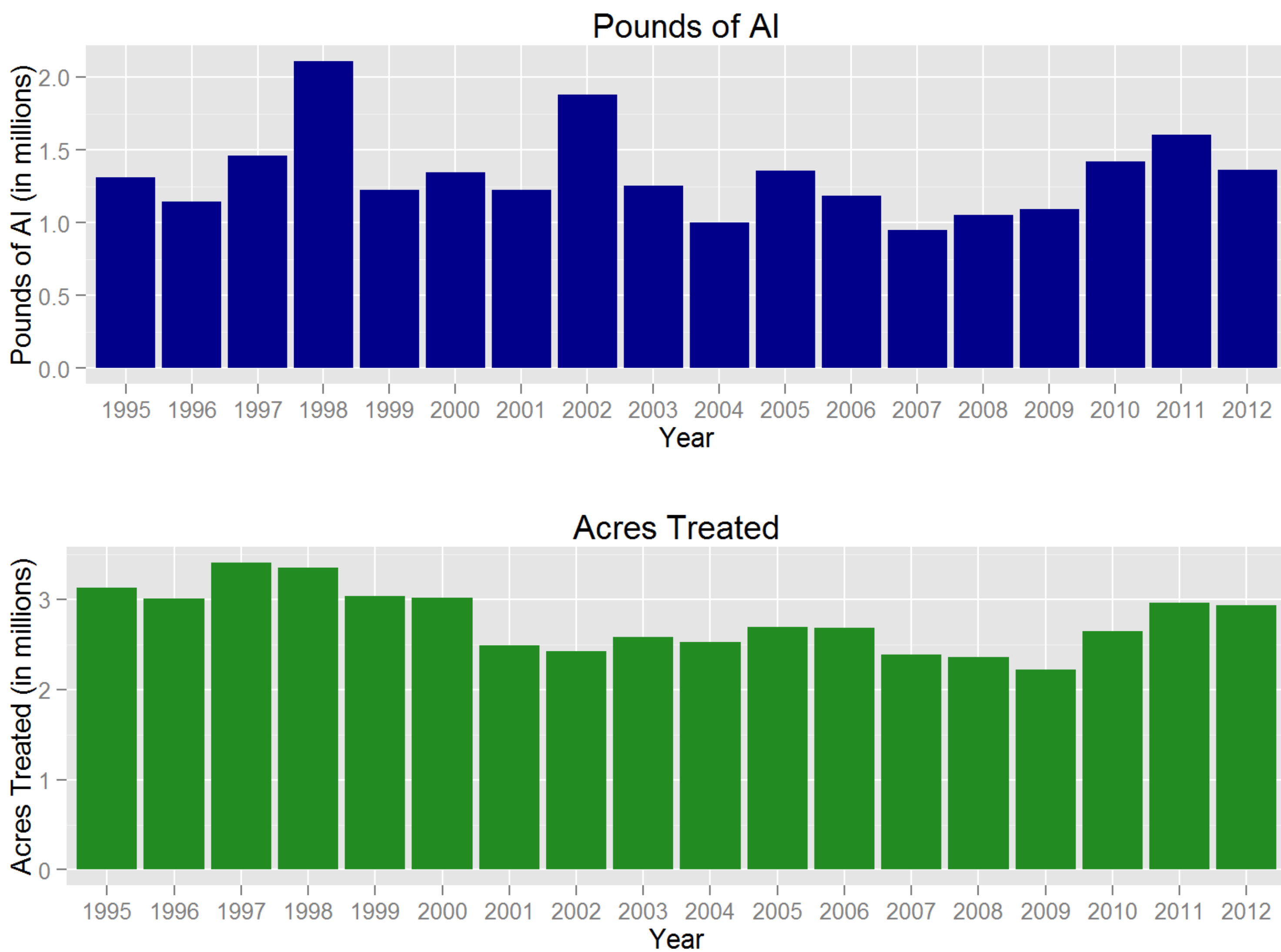

Figure 8: *Use trends of pesticides that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds essentially identical to naturally occurring compounds that are not toxic to the target pest (such as pheromones). Reported pounds of active ingredient (AI) 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 2011 to 2012 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 reportedly used (77 percent of total used on agricultural fields) and 72 percent of the area treated in 2012.

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 and cumulative area treated. The latter can be described as the sum total of the area treated with an AI and integrates situations where the same field may be treated with the same AI more than once in a year. For example, if the same acre is treated three times in a calendar year with an AI, the AI would have been applied to three acres. Thus the total area treated could be more than the area planted for a crop. 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 9 and 10). 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.

Reported pesticide use in California in 2012 totaled 186 million pounds, a decrease of 5.8 million pounds (3.0 percent) from 2011. The AIs with the largest use amounts were sulfur, petroleum and mineral oils, 1,3-dichloropropene, glyphosate, and chloropicrin.

Reported pesticide use by cumulative area treated in 2012 was 84 million acres, a decrease of 1 million acres (1.2 percent) from 2011. By this measure the non-adjuvant pesticides with the greatest use in 2012 were glyphosate, sulfur, petroleum and mineral oils, abamectin, and

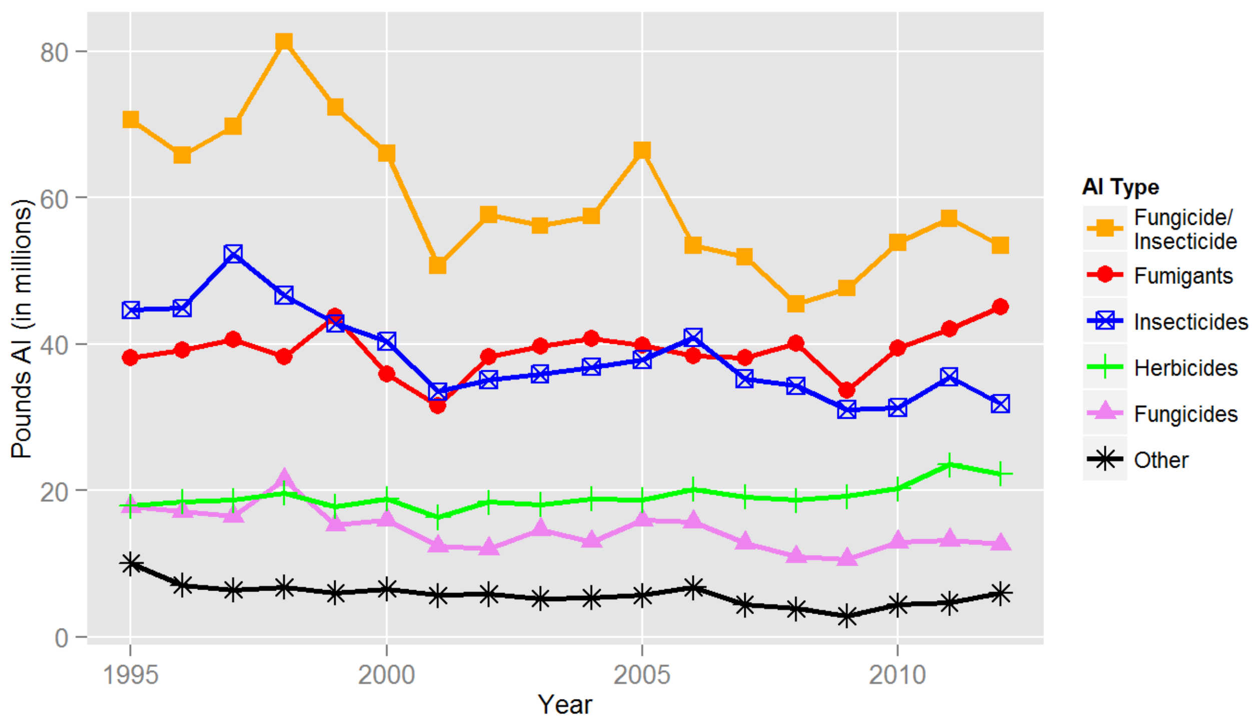

Figure 9: *Pounds of all AIs in the major types of pesticides from 1995 to 2012.*

copper-based pesticides (Figures 11 and 12). The most-used fumigant by area treated was aluminum phosphide.

Although total use declined from 2011 to 2012, the amount of fumigants used and the area treated increased, and insecticide area treated increased (Figures 9 and 10). Among the most-used pesticides by amount, the fumigant metam-potassium had the greatest percentage increase in use. Also increasing were the fumigants chloropicrin and 1,3-dichloropropene. Among the most-used pesticides by area treated, the insecticide abamectin had the greatest percentage increase in use. The use of most insecticides increased, especially some low-risk pesticides such as spinetoram, methoxyfenozide, and chlorantraniliprole. Notable decreases in use included sulfur, oils, metam-sodium, and chlorpyrifos.

The amount of sulfur accounted for 25 percent of all reported pesticide use in 2012. 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, wine grape, lemon, and peach. 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, cotton, and wine grape. Chloropicrin is a fumigant used mostly for strawberry. In production agriculture, fumigants are usually applied to the soil before planting a crop.

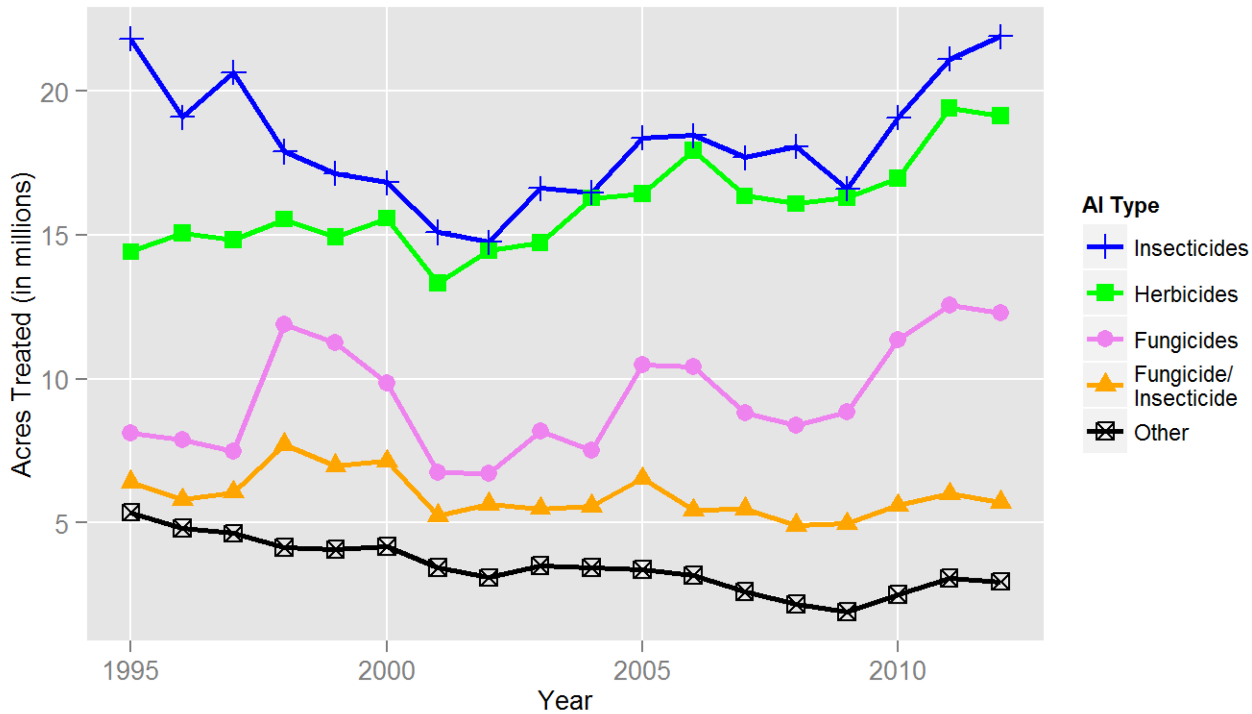

Figure 10: *Acres treated by all AIs in the major types of pesticides from 1995 to 2012.*

Metam-potassium use increased primarily because metam-potassium is replacing the similar fumigant, metam-sodium. Metam-potassium may be preferred because in addition to controlling pests, it adds potassium as a nutrient to the soil. Most of its use and most of the increase in use was in carrot, followed by processing tomato, the next most commonly crop treated with metam-potassium.

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 2012 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 cotton, wine grape, and walnut. Spinetoram is a recently developed insecticide; the AI was discovered using artificial intelligence to find the most effective insecticide among many related compounds produced by a particular soil microorganism during fermentation. Spinetoram is used mostly in orange orchards to control citrus thrips and to a lesser degree on lettuce and table and raisin grape. However, it is used on many crops and its use has increased dramatically since its introduction in 2007. 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 wine grape, table and raisin grape, and pistachio. Chlorantraniliprole is another new insecticide that interrupts muscle contraction in caterpillars and in some beetles and flies. Most

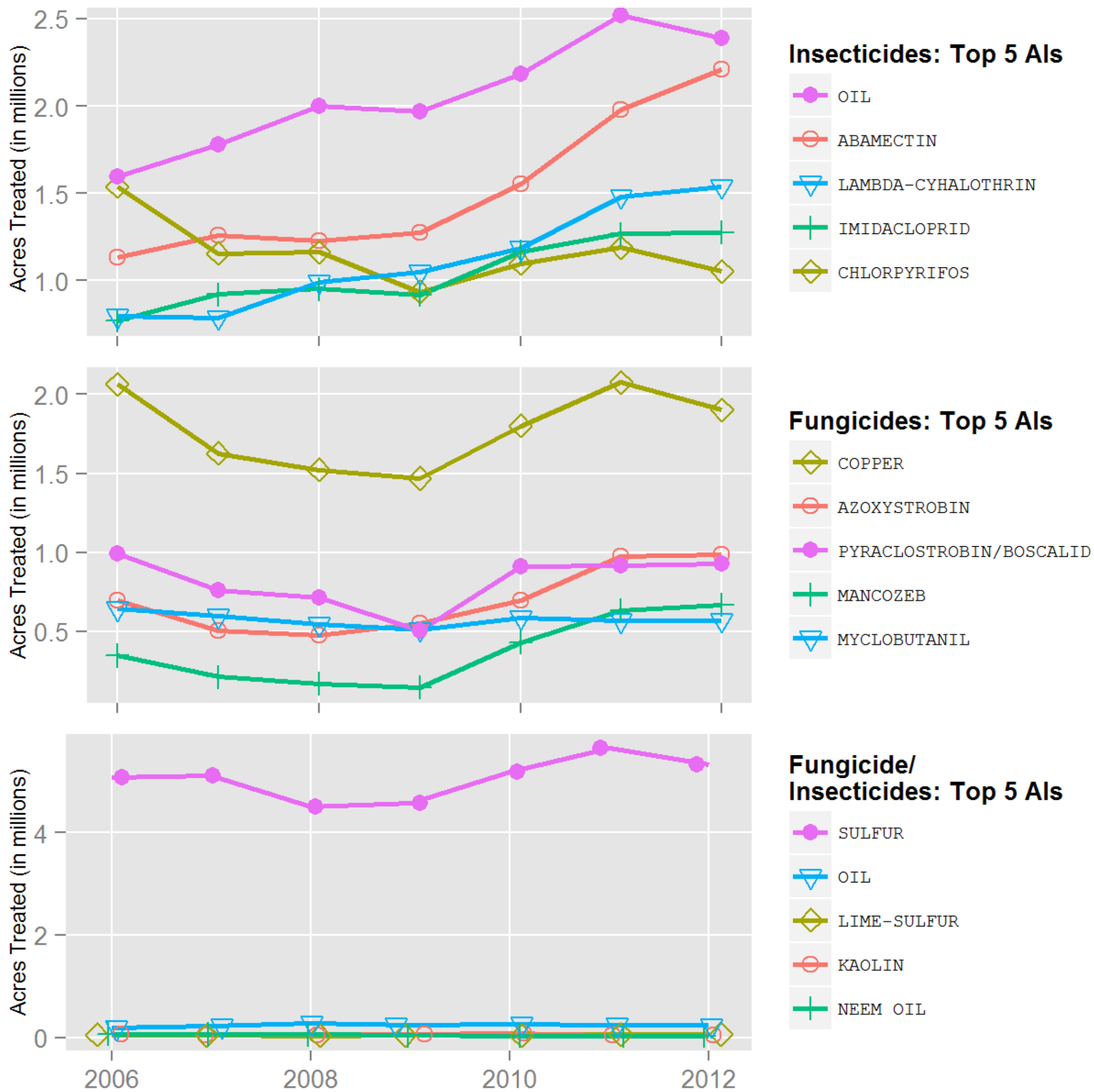

Figure 11: *Acres treated by the top 5 AIs in each of the major types of pesticides from 2006 to 2012.*

chlorantraniliprole is used in almond, structural pest control, and walnut. Use on all three sites has increased dramatically since its first use in 2008.

Crops treated with the greatest amount of pesticides in 2012 were wine grape, almond, table and raisin grape, strawberry, and processing tomato. Major crops or sites with an increase in amount applied from 2011 to 2012 include strawberry, industrial water, soil fumigation, sweet potato, and water area (Table 19). Crops or sites with a decrease in amount applied include almond, wine grape, table and raisin grape, cotton, and orange. For some crops, the increase in pesticide use was larger than the increase in area planted, especially sweet potato, which had a 131 percent increase in amount of pesticide but a 1 percent decrease in area planted. All crops with a decrease

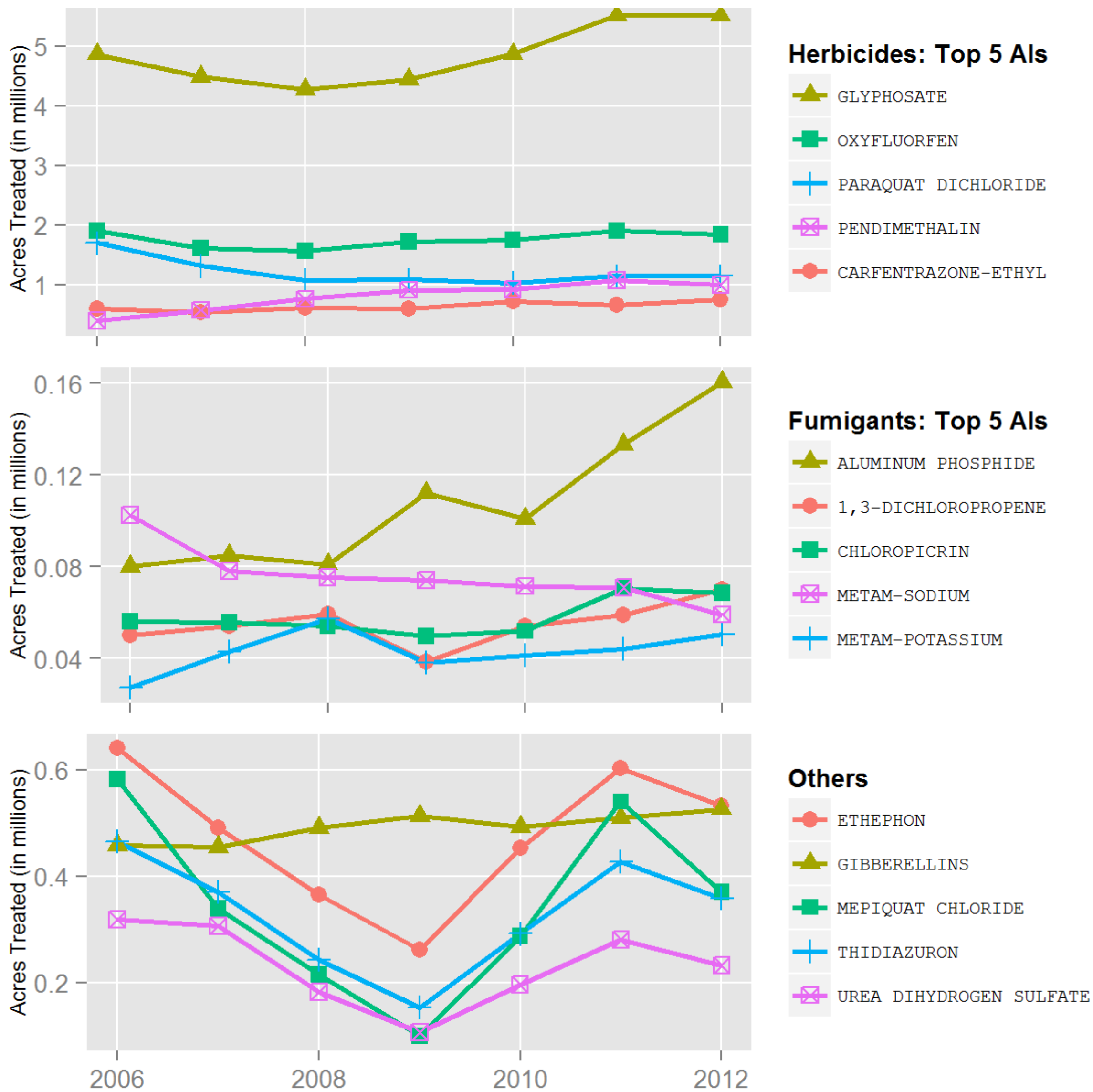

Figure 12: *Acres treated by the top 5 AIs in each of the major types of pesticides from 2006 to 2012.*

in use had a smaller percent decrease in area planted or even an increase in area planted.

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

Table 19: *The change in pounds of AI applied and acres planted or harvested and the percent change from 2011 to 2012 for the crops or sites with the greatest increase and decrease in pounds applied.*

	Change in Use 2011–2012		Percent Change 2011–2012	
Crop Treated	Pounds	Acres	Pounds	Acres
STRAWBERRY	1,961,231	500	16	1
WATER (INDUSTRLIAL)	995,716		89	
SOIL FUMIGATION/PREPLANT	993,643		26	
SWEET POTATO	686,737	-500	131	-3
WATER AREA	576,251		109	
ORANGE	-1,210,551	-3,000	-12	-2
COTTON	-1,532,467	-89,000	-30	-20
GRAPE	-1,660,361	-4,000	-10	-1
GRAPE, WINE	-2,731,254	3,000	-9	1
ALMOND	-3,192,935	35,000	-12	4

winter of 2012 was relatively dry and mild, conditions that reduced levels of many weeds and diseases, but helped overwintering survival of many insect pests. However, there was a very cold spell in January, and some insect populations suffered. Insect pest populations were low in cotton and alfalfa in 2012, but high in peach and nectarine, processing tomato, and walnut. Spring was rainy, promoting disease problems in some crops. High summer temperatures, such as those seen in July 2012, seemed to favor 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 are California's largest nut crop economically and have the highest export value of any specialty crop in the United States. Almond acreage has been consistently increasing over the last 15 years and was up 4 percent from 835,000 acres in 2011 to 870,000 acres in 2012 (Table 20). Of the total acreage for 2012, 790,000 acres were bearing and 80,000 acres were non-bearing. There are three distinct almond growing regions in California: Sacramento Valley, central San Joaquin Valley, and southern San Joaquin Valley. The total production of almonds increased 3 percent to about 1.89 billion pounds of nutmeat.

The 2012 California almond production season began with a warm and dry February that created favorable bloom conditions. The 2012 bloom period was shorter than in the previous year, but the excellent weather favored honeybee activity and pollination. Chilling hours were plentiful.

Table 20: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for almond each year from 2008 to 2012. Planted acres from 2008 to 2012 are from CDFA, April 2013; marketing year average prices from 2008 to 2012 are from USDA, August 2013. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	19,569,674	18,887,758	20,416,487	25,841,205	22,647,959
Acres Treated	10,187,072	10,511,318	12,410,536	13,715,695	14,633,587
Acres Planted	795,000	810,000	825,000	835,000	870,000
Price/lb	$ 1.45	$ 1.65	$ 1.79	$ 1.99	$ 2.20

Weather conditions and pest pressure varied greatly between the northern and southern regions. Consequently, pesticide product preferences and use rates varied from region to region.

A frost in early March resulted in some spotty damage to crops in the southern San Joaquin Valley, and a hailstorm in April affected orchards in Merced County. Weather in the Sacramento Valley was near ideal. A heavier than normal nut drop was reported in the San Joaquin Valley. Across the state, lower limb death was higher than in 2011. The total amount of pesticides used in almonds decreased 12 percent, mostly from a decreased amount of insecticides. However, the total area treated increased 7 percent. The area treated with herbicides in 2012 increased 5 percent, insecticide use increased 8 percent, and fungicide use increased 5 percent (Figure 13).

The most prominent insecticides used in 2012, based on area treated, were abamectin, oils, bifenthrin, methoxyfenozide, and esfenvalerate (Figure 14). The use of insecticides for controlling larval lepidopterans continued to shift away from organophosphates and toward alternatives that include pyrethroids, such as bifenthrin and esfenvalerate; insect growth regulators, such as methoxyfenozide; and diamides, such as chlorantraniliprole. This shift to alternative products may be an indication of their effectiveness and growers' intolerance for insect damage, considering crop prices increased in 2012. Growers tend to use more insecticides and fungicides to protect a crop from damage and yield loss as crop prices increase, which is probably a reason why use of bifenthrin and methoxyfenozide, insecticides that are primarily used for navel orangeworm (NOW), increased. Pyrethroid insecticides are often linked with outbreaks of spider mites, so their increased use in 2012 may help explain the increased use of the acaricides hexythiazox and abamectin. The decreased use of oils may have been the result of relatively low overwintering pest populations in 2012 or of a shift to employing other control measures at other times of the year. Red imported fire ant, an invasive species, was a problem in the southern San Joaquin Valley; most growers bait for ants with insect growth regulators.

Key pests in almonds are NOW, San Jose scale (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 habitat for overwintering NOW larvae. Almonds can be treated with oils alone in the winter dormant season to control low

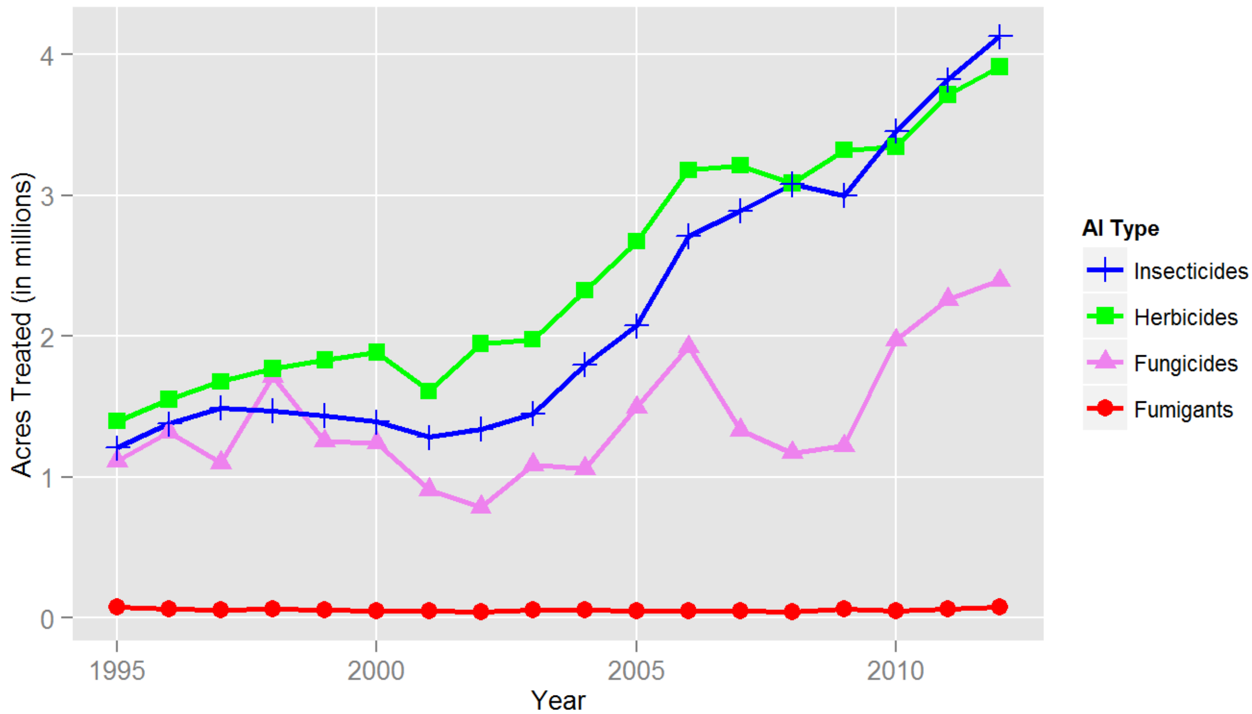

Figure 13: *Acres of almond treated by all AIs in the major types of pesticides from 1995 to 2012.*

to moderate populations of SJS and brown and European red mites. In situations where overwintering populations of SJS and PTB are relatively high, other insecticides may be added to oils. Because pesticide users are not required to report target pests, it is difficult to determine what products are used for what pest. However, by examining the month the product is applied as reported in the PUR, one can infer a target pest. For example, applications of insecticide products to almond in the dormant season or during bloom probably target SJS and PTB; treatments in July and August, probably target NOW; and treatments in May may target any of these. However, most May applications north of Fresno target PTB and south of Fresno, NOW.

The area treated with fungicides increased 5 percent from 2011 to 2012. The main fungicides, as determined by area treated, were pyraclostrobin, in combination with boscalid; iprodione; propiconazole; metconazole; and azoxystrobin (Figure 14). The shift in use of fungicide AIs from 2011 to 2012 may indicate that diseases are developing resistance to various fungicides or that growers are practicing resistance management and rotating the use of different classes of fungicides. The rest of the top fungicides used in 2012 were relatively new in the market. Fungicide use is often dictated by local climatic conditions: warm, late winters favor disease growth, and hot summers reduce disease growth.

In 2012, herbicide use increased slightly due to the warmer spring weather. The main herbicides as measured by area treated were glyphosate, oxyfluorfen, saflufenacil, paraquat dichloride, and

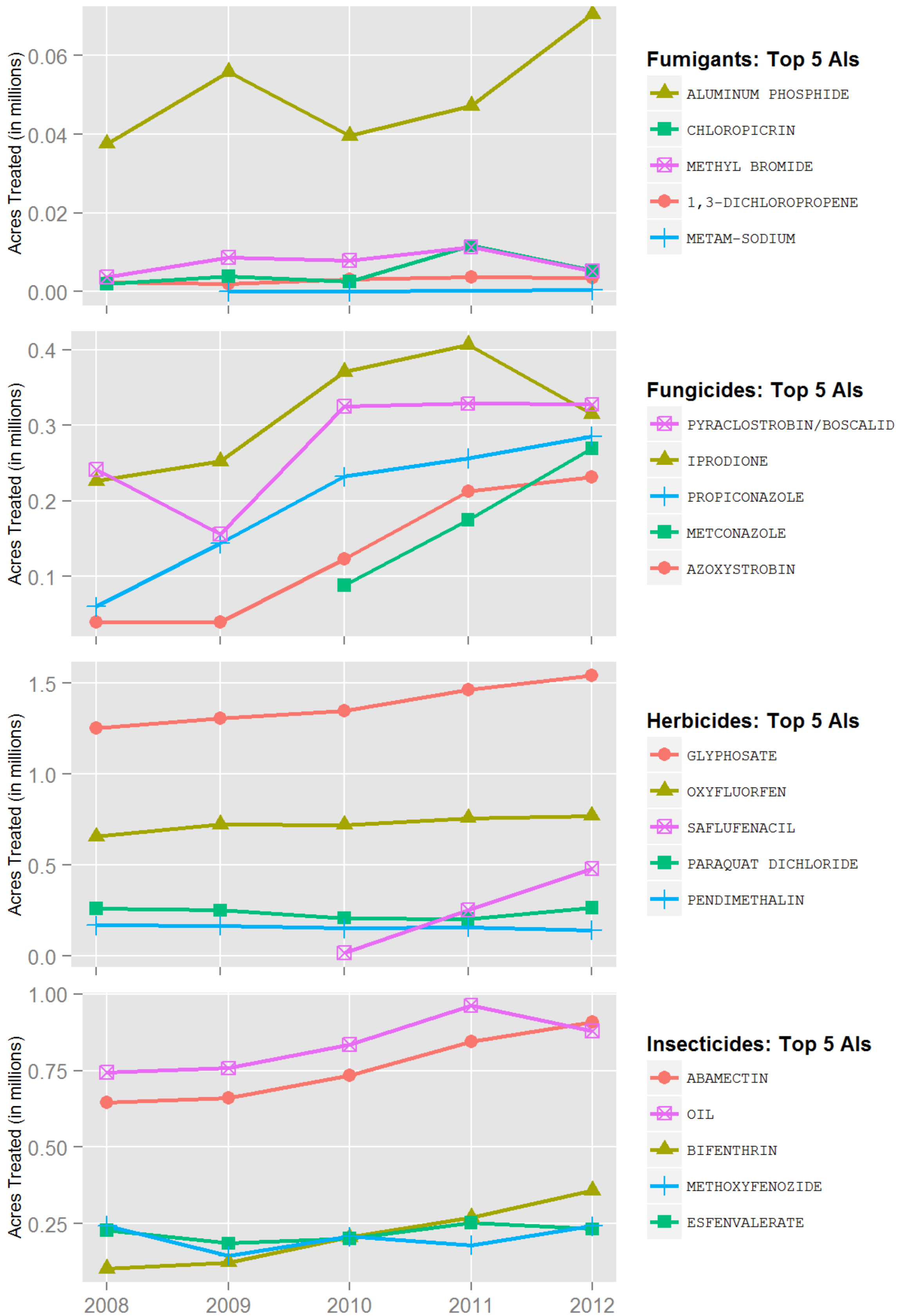

Figure 14: *Acres of almond treated by the top 5 AIs of each AI type from 2008 to 2012.*

pendimethalin (Figure 14). In the past, glufosinate-ammonium use increased as concerns with glyphosate resistant weeds increased, but use in 2012 decreased 72 percent. The decrease in 2012 is most likely due to supply-chain issues, with growers of large-scale production of crops like corn, soybean, canola, and cotton buying up most of the glufosinate-ammonium as fast as the manufacturer produced it. Increased glyphosate use may reflect increased bearing acreage of almonds. Saflufenacil and indaziflam are relatively new in the market and are efficacious, which may explain the increased use of the two products. There was no significant regional difference observed in the use of herbicides in 2012.

Wine grape

In 2012, wine grape acreage in California increased marginally from approximately 543,000 to 546,000 acres and accounts for roughly 64 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 2008 to 2012. Planted acres in 2012 are from CDFA, March 2013; planted acres from 2008 to 2011 are from USDA, October 2012; marketing year average prices from 2008 to 2011 are from USDA, October 2012. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	21,297,620	22,101,212	26,274,352	29,442,693	26,627,634
Acres Treated	7,173,352	7,740,909	8,901,928	9,702,396	9,233,495
Acres Planted	526,000	531,000	535,000	543,000	546,000
Price/ton	$ 609	$ 613	$ 576	$ 638	NA

Changes in pesticide use on wine grapes 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, 2012 was an exceptional year for wine grape growers, with low levels of pressure from pests and disease. As a result, the total amount of pesticide AIs applied to wine grapes and the cumulative area treated declined in 2012, although the levels still remained higher than what was seen from 2008 to 2010 (Table 21).

Vine mealybug continued to be a concern for growers, appearing in locations in Santa Barbara County where it had not been found before. 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, and trap catches decreased (from >100,000 in 2010, to 146 in 2011, to only 77 in 2012). Growers in Napa County were still advised to spray for this pest, however.

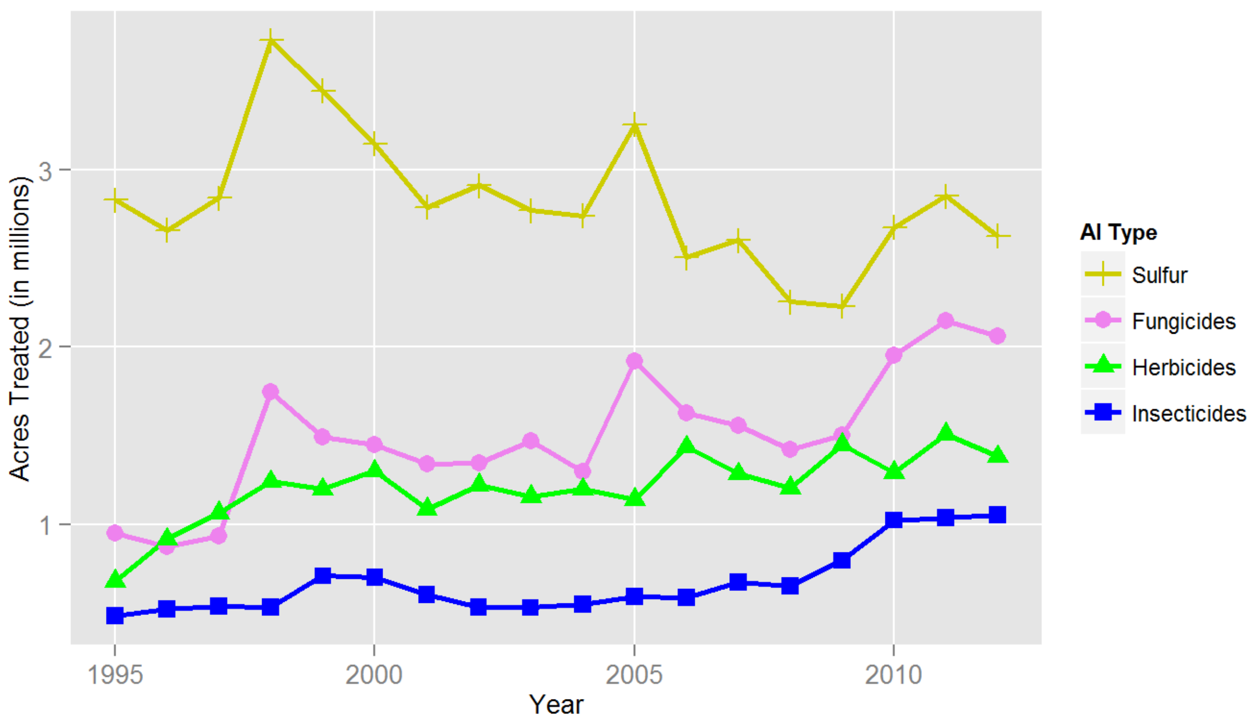

Figure 15: *Acres of wine grape treated by all AIs in the major types of pesticides from 1995 to 2012.*

Overall, the amount of insecticide applied to wine grapes decreased in 2012 to a level lower than that of the previous two years, though the area treated increased marginally (Figure 15). The insecticides applied to the greatest acreage in 2012 were imidacloprid, abamectin, methoxyfenozide, spirotetramat, and oils (Figure 16). Chlorantraniliprole, etoxazole, and bifenazate were relatively widely used; acres treated with these insecticides ranged from about 35,000 (bifenazate) to 54,000 (chlorantraniliprole). Spirotetramat provides good control of mealybugs and continued to increase in popularity. Grape prices were high in 2012, which may have made an expensive but effective product like spirotetramat affordable. There was a substantial decrease in use of oils and a small decrease in use of imidacloprid (Figure 16). Oils have many attractive, broad spectrum properties and are relatively low risk to public health and the environment. Increasingly mixed with fungicides, oils can replace a surfactant and eradicate

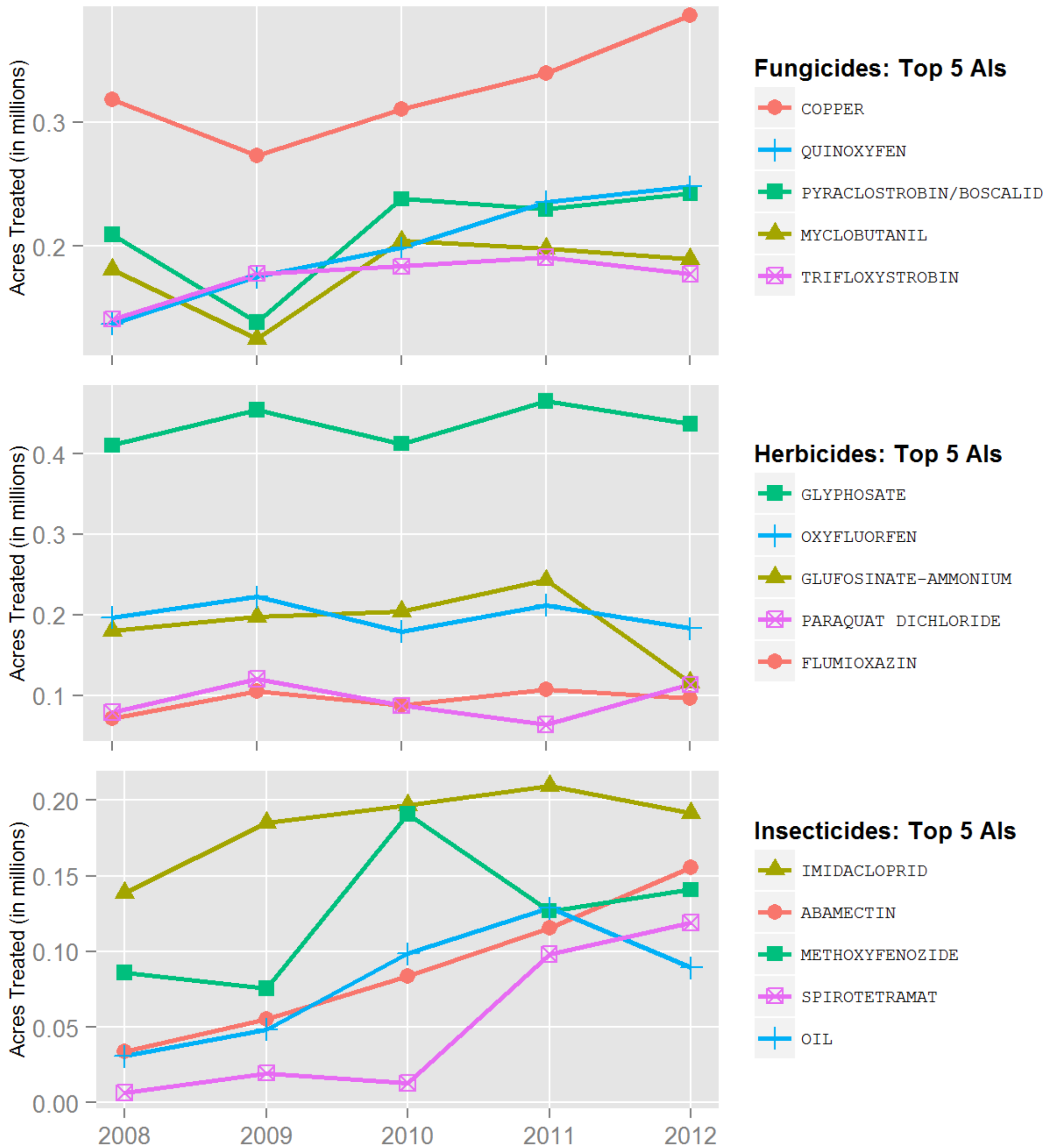

Figure 16: *Acres of wine grape treated by the top 5 AIs of each AI type from 2008 to 2012.*

mildew growth, as well as suppress mites and insects such as grape leafhoppers. Imidacloprid may not be effective where heavy clay soils exist due to poor plant uptake; this likely explains less use of this insecticide in the North Coast, where heavy clay soils are common. Use of the low-risk insecticide *Bacillus thuringiensis* (Bt) decreased 34 percent. In contrast, there was a large increase in use of chlorpyrifos (88 percent). The 28,360 acres treated with chlorpyrifos was still lower than in any of the previous 8 years, except 2011. Chlorpyrifos was used for post-harvest applications and as a delayed dormant application for control of mealybugs and ants. Imidacloprid was used during warmer weather between budbreak and harvest to control mealybug infestations. The area treated with chlorantraniliprole, first registered in 2008, increased 32 percent in 2012. Chlorantraniliprole is relatively selective and methoxyfenozide is highly selective for lepidopteran pests. Both AIs are used in the control of the European grapevine moth. The area treated with indoxacarb, also used for the control of lepidopteran pests, decreased 30 percent in 2012.

In general, fungal pathogens were not as big a problem as in the previous two years, and thanks to a dry year, the incidence of powdery mildew in particular was much lower in most areas in 2012. Nevertheless, fungicide use only decreased marginally and the area treated with sulfur declined for the first time since 2008 (Figure 15). With the exception of copper-based pesticides, use of other fungicides was similar to the previous two years. 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 area treated with tebuconazole decreased by nearly 50,000 acres. The area treated with cyprodinil decreased slightly, as growers shifted to the newer chemicals difenoconazole and metrafenone. The latter increased in use nearly threefold. Growers are cognizant of the need to rotate AIs to delay the evolution of resistance.

Glyphosate-resistant weeds, such as marestail and fleabane, continue to be a problem in vineyards. Marestail is also host to the glassy-winged sharpshooter, which has become less of a threat over the past few years. The area treated with herbicides decreased 11 percent in 2012 (Figure 15). Glyphosate resistance issues and a reduced supply of glufosinate-ammonium due to global demand may help to explain some of the observed trends in herbicide use. The herbicides applied to the greatest area in wine grapes were glyphosate, oxyfluorfen, glufosinate-ammonium, paraquat dichloride, flumioxazin, and carfentrazone-ethyl. With the exceptions of paraquat dichloride and carfentrazone-ethyl, use of all these herbicides decreased in 2012. Use reductions ranged from 6 percent (glyphosate) to 52 percent (glufosinate-ammonium) (Figure 16). The area treated with paraquat dichloride had decreased in the previous two years; increased use may reflect the unavailability of glufosinate-ammonium. Carfentrazone-ethyl was applied to 26,000 more acres in 2012. Its use has increased every year since 2005, when two new products containing this AI were first registered.

Largely due to a perceived shortage of grapes over the past two years, as well as the age of vineyards planted during the planting boom of the early 1990s, planting increased in 2012. The planting of new vineyards is reflected in an increase in use of fumigants in preparing for planting. Though the total area treated is small, there were relatively large increases in use of 1,3-dichloropropene (from 1,625 to 2,649 acres) and sodium tetrathiocarbonate (from 367 to 1,318 acres). In addition, though used on an even smaller number of acres, there was a substantial increase in area treated with metam-potassium and chloropicrin. The majority of pre-plant fumigations occurred in the southern San Joaquin Valley and the Central Coast, though increases occurred in the other two major grape growing regions as well. The largest use of a fumigant in wine grapes in 2012, as in years past, was aluminum phosphide, used to control rodents. Aluminum phosphide use was especially pronounced in Monterey County (82 percent of all applications).

Gibberellins are applied in early spring in order to lengthen and loosen grape clusters, which reduces vulnerability to berry splitting and bunch rot. They continue to be by far the most common plant growth regulator (PGR) used in wine grapes, accounting for 89 percent of PGR use. Overall area treated with PGRs increased marginally in 2012 (4 percent).

Table and raisin grape

Total acreage planted to table and raisin grapes decreased slightly from 305,000 to 301,000 acres, continuing a trend that reflects the increasing attraction of planting almonds in the southern San Joaquin Valley region (Table 22). This comprised approximately 36 percent of California's total grape acreage in 2012, the rest being wine grapes. The southern San Joaquin Valley region accounts for more than 90 percent of California's raisin and table grape production. In 2012, raisin acreage decreased nearly 3 percent while table grape acreage increased by slightly more than 2 percent. These values tend to shift yearly depending on market conditions, since some grape varieties can be used for more than one purpose. Thompson Seedless was the leading raisin grape variety, while Flame Seedless was again the leading table grape variety. California produced 1,951,000 tons of raisin grapes and 987,000 tons of table grapes in 2012. Statewide raisin grape tonnage decreased 16 percent and table grape tonnage decreased 4.5 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 2008 to 2012. Planted acres in 2012 are from CDFA, March 2013; planted acres from 2008 to 2011 are from USDA, October 2012; marketing year average prices from 2008 to 2011 are from USDA, October 2012. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	13,880,609	12,832,640	14,041,039	16,361,154	14,781,992
Acres Treated	5,536,969	5,501,176	5,880,474	6,786,534	6,784,949
Acres Planted	318,000	312,000	307,000	305,000	301,000
Price/ton	$ 305.94	$ 341.57	$ 354.94	$ 524.94	NA

Changes in pesticide use on table and raisin grapes are, like wine grapes, influenced by a number of factors, including weather, topography, pest pressure, evolution of resistance, competition from newer pesticide products, commodity prices, application restrictions, and effort by growers to reduce costs. Pest and disease pressure was relatively low in 2012. As might be expected, the total amount of AI applied declined in 2012, though the area treated remained relatively stable (Table 22).

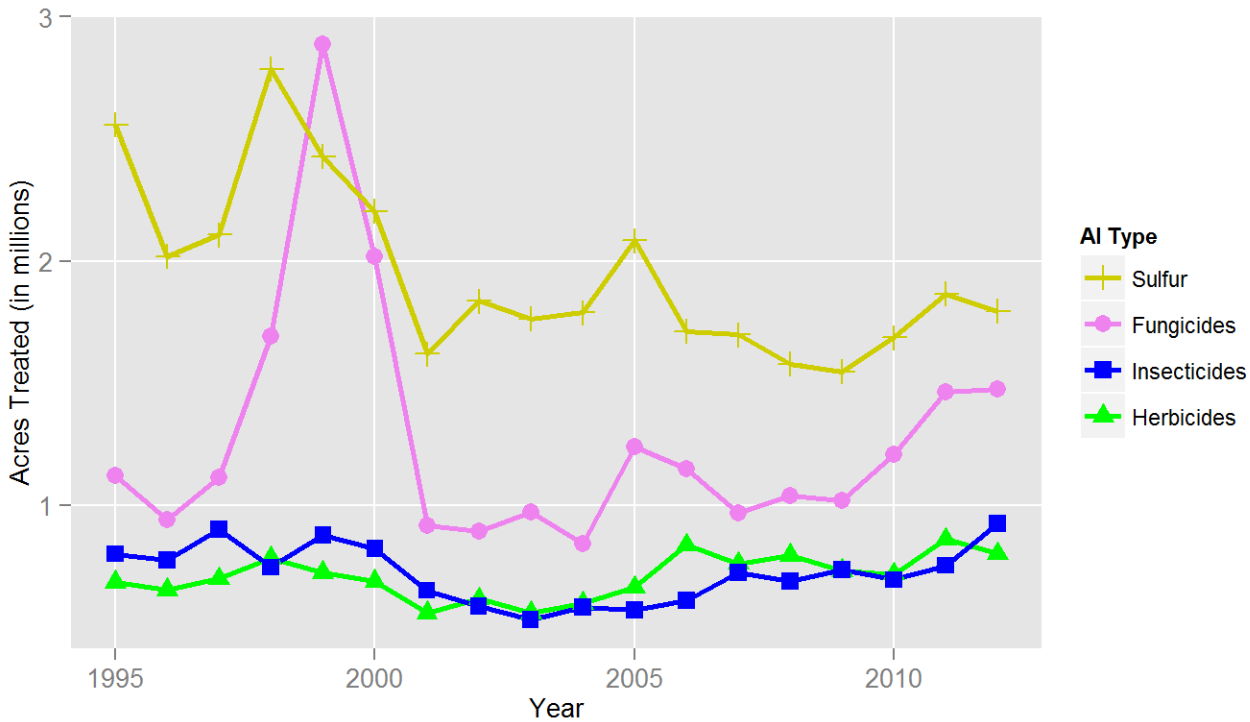

Figure 17: *Acres of table and raisin grape treated by all AIs in the major types of pesticides from 1995 to 2012.*

The cumulative area treated with insecticides increased in 2012, reaching the highest level recorded in nearly two decades (Figure 17). Although the amount of insecticide applied increased, this value was still less than in most recent years and substantially less than in the 1990s. 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 newer insecticides.

The insecticides applied to the greatest area in 2012 were imidacloprid, spirotetramat, abamectin, methoxyfenozide, spinetoram, and *Bacillus thuringiensis* (Bt), the last of which was applied to nearly as many acres as spinetoram (Figure 18). Imidacloprid and buprofezin are used during warm weather between budbreak and harvest to control mealybug infestations. Spirotetramat also provides control of mealybugs. It has steadily increased in use since its registration in 2008. Abamectin is used to treat for mites, which were a concern for growers due to above average temperatures early in the growing season. Other widely applied insecticides were cryolite,

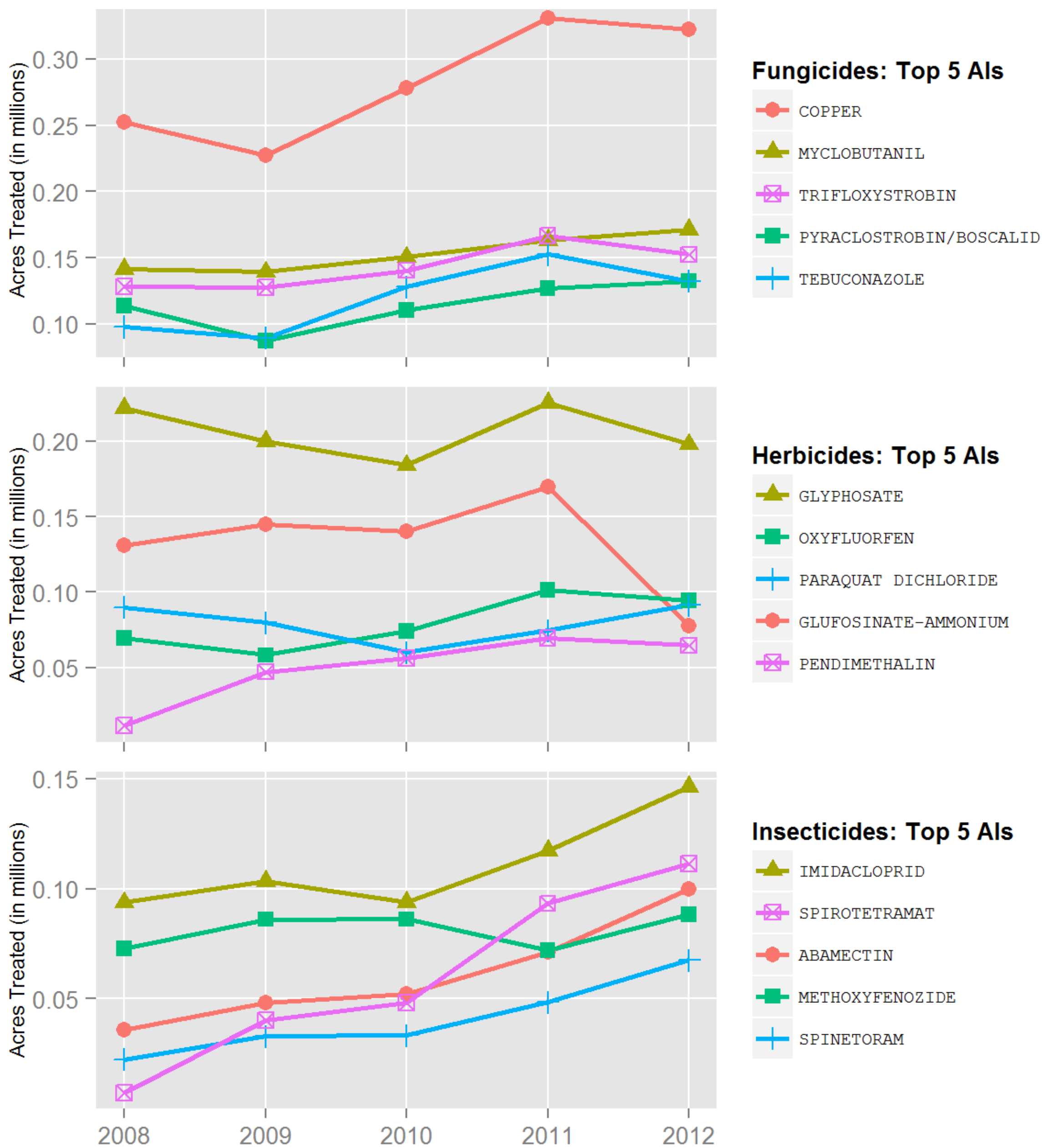

Figure 18: *Acres of table and raisin grape treated by the top 5 AIs of each AI type from 2008 to 2012.*

buprofezin, spinosad, chlorantraniliprole, and chlorpyrifos. Cryolite use decreased in 2012, 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. Buprofezin use increased in 2012, but the area treated was still lower than in any of the years from 2007-2010. Use of spinosad decreased in 2012, while chlorpyrifos use increased. Chlorpyrifos was used as a delayed dormant spray or post-harvest application to prevent spring build-up of vine mealybug populations. Chlorantraniliprole treatments had increased slightly in 2011 but increased 65 percent in 2012; 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 2011 and 2012 than in 2010, 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 decreased slightly, while the area treated with all other fungicides was nearly the same as in 2011 (Figure 17). Spring rains caused growers to spray for powdery mildew early in the season but treatments decreased later in the year. Fungicides with the greatest area treated included sulfur, copper-based pesticides, myclobutanil, trifloxystrobin, boscalid, pyraclostrobin (boscalid and pyraclostrobin are used as a mix), and tebuconazole (Figure 18). Other commonly used fungicides were quinoxyfen and cyprodinil. The area treated with lime sulfur against overwintering disease inoculum in early 2012 increased, with close to 7,000 more acres being treated in 2012. Use of the recently registered fungicides metrafenone, fludioxonil, and difenoconazole has been increasing (nearly threefold for metrafenone and nearly twofold for fludioxonil), as growers seek to rotate AIs to delay the evolution of resistance.

Winter of 2012 was relatively dry, which may have inhibited weed growth. The area treated with herbicides decreased in 2012 (Figure 17). The herbicides applied to the greatest area were glyphosate, oxyfluorfen, paraquat dichloride, glufosinate-ammonium, and pendimethalin (Figure 18). Glyphosate use decreased, likely the result of growing concerns over weed resistance to this AI. Glufosinate-ammonium is an attractive alternative to glyphosate. Corn and soybean varieties genetically engineered for resistance to glufosinate-ammonium have been planted in the Midwest, causing a high demand for the herbicide. Stocks of glufosinate-ammonium were subsequently low in California, causing a steep reduction in its use. The unavailability of glufosinate-ammonium perhaps explains the increased use of paraquat dichloride and other herbicides such as rimsulfuron, flumioxazin, oryzalin, and carfentrazone-ethyl. Use increases of these herbicides ranged from 18 percent (flumioxazin) to 36 percent (carfentrazone-ethyl).

Fumigant use dropped dramatically in 2012; only 2,938 acres were treated in 2012, 25 percent of the acreage treated in 2011. This is the smallest area treated with fumigants in table and raisin grapes in nearly 20 years.

The area treated with plant growth regulators (PGRs) changed little in 2012. The most commonly used PGRs were gibberellins (78 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 decreased slightly in 2012. Ethephon was the next most commonly applied PGR, though it was applied on 16 percent fewer acres in 2012. Ethephon is applied at onset of ripening to improve berry color.

Cotton

Cotton is an unusual crop in that it is grown for fiber, oil, and animal feed. It is primarily grown for its fiber, but cottonseed, which is removed from the fibers during ginning, is processed into oil and is also used as a supplement for dairy feed. Total planted acreage in 2012 was 367,000, a 20 percent decrease from 2011 (Table 23). The decrease results partly from lower cotton prices, but a more probable explanation is that growers were concerned about the availability of irrigation water. Competing with cotton for water are higher value orchards and vineyards. Because of the lower cotton acreage, the cotton that was planted was grown on the best available land, which with the ideal weather conditions in 2012, led to some of the highest yields ever: 1,604 pounds per acre. Two main kinds of cotton are grown: upland and Pima. About 60 percent of the cotton acreage was Pima. Most cotton varieties have also been genetically modified to be tolerant to the herbicide glyphosate. Most cotton is grown in the southern San Joaquin Valley, though a small percentage is 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 2008 to 2012. Planted acres from 2008 to 2012 are from USDA, August 2013; marketing year average prices from 2008 to 2012 are from USDA, August 2013. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	2,448,264	1,445,785	3,072,021	5,047,214	3,514,860
Acres Treated	4,979,626	2,887,709	6,107,494	9,882,606	6,540,322
Acres Planted	275,000	190,000	306,000	456,000	367,000
Price/lb	$ 0.82	$ 1.00	$ 1.50	$ 1.29	$ 1.11

Total amount of pesticides used on cotton decreased 30 percent from 5.1 million to 3.5 million pounds from 2011 to 2012 (Table 23); use per acre planted also decreased. Use in every cotton-growing county decreased, except in Riverside and San Joaquin counties. Use of nearly all major AIs decreased. The use of all AI types decreased more than the decrease in planted acreage, except for the use of fungicides, which decreased 15 percent in amount of AI (Figure 19). The largest decrease was in use of insecticides.

The low insecticide use in 2012 may be due to low pest pressures. The major arthropod pests in cotton in 2012 were lygus bugs, spider mites, cotton aphids, silverleaf whitefly, thrips, beet armyworms, and stink bugs. 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

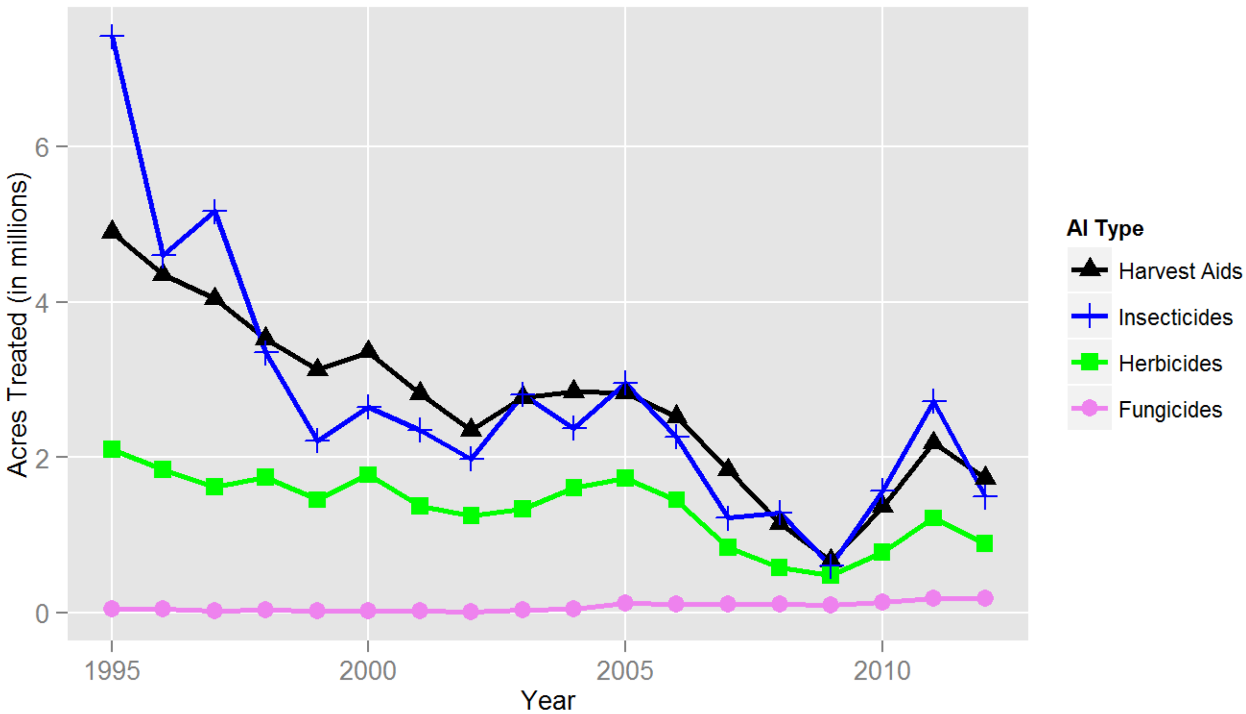

Figure 19: *Acres of cotton treated by all AIs in the major types of pesticides from 1995 to 2012.*

spring rainfall patterns resulted in less than ideal vegetative habitat for lygus. Although use of most major insecticides decreased (Figure 20), use of phorate, the third highest used insecticide by amount, increased. Phorate is applied at planting as an alternative to aldicarb for nematode control. Aldicarb, once one of the most-used insecticides, has decreased dramatically because the producer/registrant, Bayer, will voluntarily phase out its production by December 31, 2014, due to health and environmental concerns and has already reduced its supply.

Abamectin, flonicamid, novaluron, imidacloprid, and bifenthrin were all applied from June through August, mostly for lygus bugs. Acetamiprid, chlorpyrifos, and naled were applied in August and September to manage aphids and whiteflies. Abamectin, etoxazole, and spiromesifin are used mostly for mites. Use of indoxacarb decreased because growers are using newer products, such as flubendiamide, for caterpillar control and because caterpillars were not much of a problem in 2012.

Use of nearly all major herbicides decreased even though use per area planted remained nearly the same (Figure 20). As had been the case for the last several years, glyphosate was by far the most-used herbicide by amount, accounting for 74 percent of all herbicide use. The high use of glyphosate was 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 and herbicides. It is assumed if use occurred between August and November it was

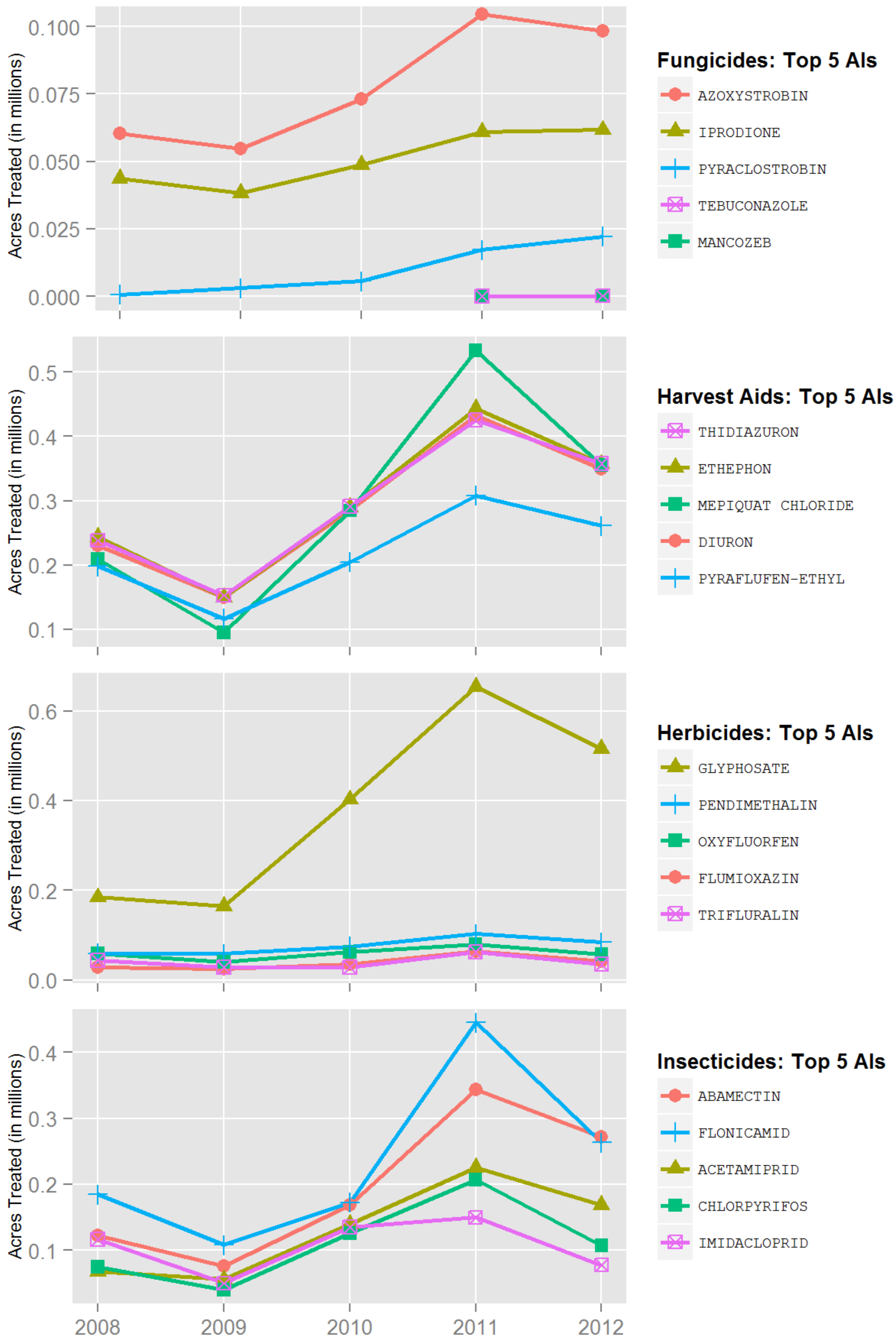

Figure 20: *Acres of cotton treated by the top 5 AIs of each AI type from 2008 to 2012.*

used as a harvest aid, otherwise as an herbicide. The largest decreases in herbicide use, as measured by amount used, were in paraquat dichloride and trifluralin use. The decrease in trifluralin use was relative: use in 2011 was unusually high.

Use of harvest aids, chemicals used to defoliate or desiccate cotton plants before harvest, decreased 19 percent as measured by amount of AI and 21 percent by area treated, which is nearly the same as the decrease in area planted (Figure 20). The main exception was use of mepiquat chloride, which decreased 37 percent in amount applied, and sodium chlorate, which decreased 7 percent. Mepiquat chloride is included among the harvest aids, but it is actually a growth regulator and typically used mid-season. The decrease in mepiquat chloride use was in relation to its particularly high use in 2011; the use in 2012 was close to normal.

The amount of fungicides used decreased 15 percent, but the area treated decreased only 1 percent (Figure 20). Fungicides are not widely used in cotton, but use has been increasing in recent years because of increased incidence of seedling diseases, especially the disease caused by *Rhizoctonia solani*. The most-used fungicides are azoxystrobin, iprodione, and pyraclostrobin. Azoxystrobin and iprodione are applied to cotton fields at planting in April to control seedling diseases; pyraclostrobin is applied mostly in June and July. Most of the other fungicides are used as seed treatments, so the area treated is not reported.

Fumigants are little used in cotton fields and account for only 0.01 percent of all acreage treated with pesticides. The amount of fumigants applied decreased 62 percent in 2012, although fumigant use was still more than in years before 2011. The main fumigants were metam-sodium and metam-potassium. 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 facing California cotton growers in many years. Once a field is infected, it is impossible to achieve economic yields with many cotton varieties. The pathogen cannot be controlled by pesticides, but some research has shown that metam-sodium treatments can knock down inoculum populations. However, they will not eradicate the disease.

Alfalfa

Alfalfa is grown primarily as a forage crop, providing protein and high energy feed primarily for dairy cows and other livestock as well. California is the leading alfalfa hay-producing state in the United States. More than half of California's alfalfa production in 2012 was in Fresno, Kern, Imperial, Merced, and Tulare counties. The price received per ton of hay remains historically high although it decreased 12 percent from a peak in 2011. The decreased price for hay may be due to increased harvested tonnage, a downturn in the dairy industry and 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. From 2011 to 2012, the acres harvested increased 8 percent, but alfalfa acreage treated with pesticides decreased 7 percent (Table 24). The total amount of pesticide AI applied to California alfalfa was unchanged.

Table 24: *Total reported pounds of all active ingredients (AI), acres treated, acres harvested, and prices for alfalfa each year from 2008 to 2012. Harvested acres from 2008 to 2012 are from USDA, August 2013; marketing year average prices from 2008 to 2012 are from USDA, August 2013. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	3,231,235	3,364,459	2,727,502	3,522,167	3,513,798
Acres Treated	5,350,863	4,415,891	4,558,137	5,538,759	5,169,582
Acres Harvested	1,030,000	1,000,000	930,000	880,000	950,000
Price/ton	$ 204	$ 107	$ 133	$ 239	$ 211

Insecticides and herbicides continued to be the most commonly used pesticide classes in California alfalfa production (Figure 21). The area treated with insecticides decreased 6 percent but the amount AI applied increased 6 percent. From 2011 to 2012, use of herbicides decreased 7 percent as measured by area treated and 2 percent by amount AI applied. The decreased use resulted primarily from growers' management practices and intensity of pest infestations.

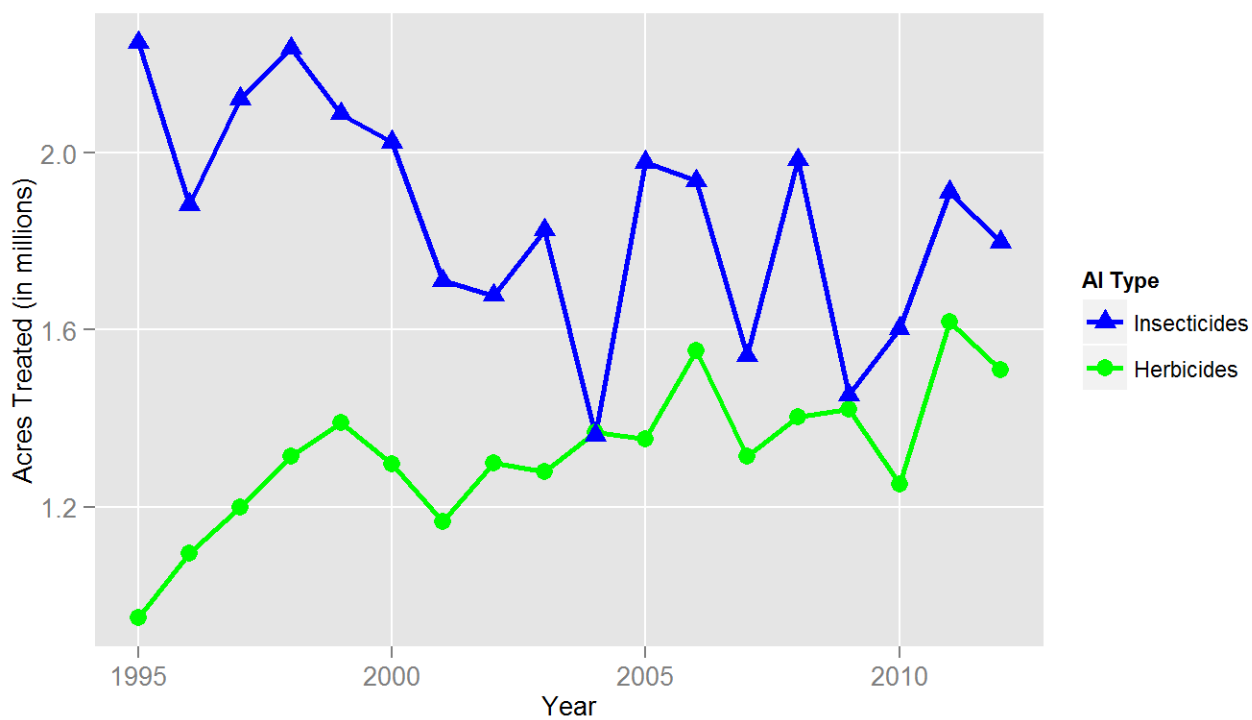

Figure 21: *Acres of alfalfa treated by all AIs in the major types of pesticides from 1995 to 2012.*

The decrease in area treated with insecticides resulted from reduced insect pest infestations and a lower price received for hay. The reason the area treated decreased but the amount of AI applied

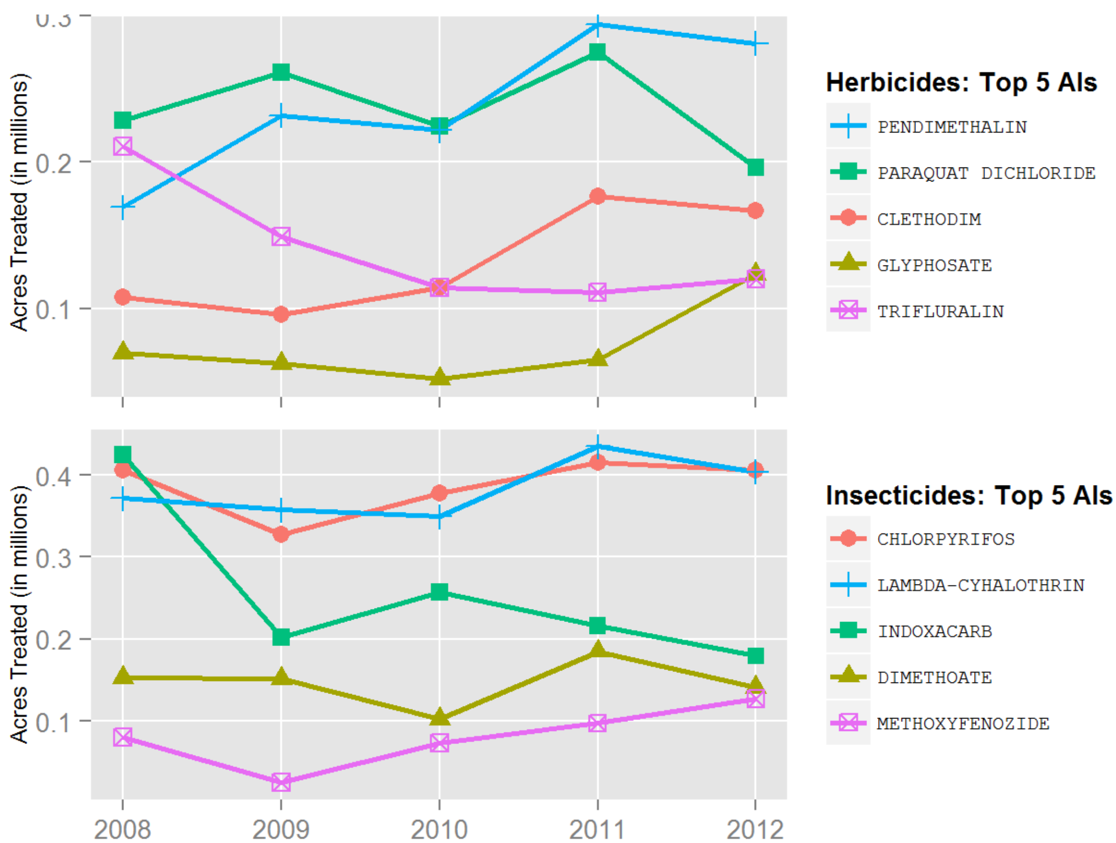

Figure 22: *Acres of alfalfa treated by the top 5 AIs of each AI type from 2008 to 2012.*

increased was that use of chlorantaniliprole and other recently registered insecticides, which are applied at lower rates per unit area than the older products, declined. Growers generally deal with three major insect pest groups in alfalfa production: a weevil complex in late winter to spring, an aphid complex in late fall through spring and continuing throughout summer, and a larval lepidopteran complex in the summer. In 2012, weevil problems seemed less due to the warm, relatively dry winter and spring, which affected emergence and development of weevil pests. This situation resulted in less use of some pyrethroids like lambda-cyhalothrin and beta-cyfluthrin. Aphid problems were not very severe in the summer of 2012, especially in the San Joaquin Valley, resulting in decreased use of chlorpyrifos, which growers most prefer. Populations of the summer lepidopteran complex were lower in 2012 than in recent years and accounted for the decreased use of indoxacarb and chlorantraniliprole. The uncertainty surrounding hay prices, water availability, and shipments from other states affected management practices for insect pests in 2012.

From 2011 to 2012, statewide herbicide use, as measured by amount used and area treated, decreased 2 and 7 percent, respectively. The reduction may be a result of less weed pressure and reduced hay prices. The area treated with the most-used herbicides decreased except that treated with glyphosate and trifluralin. Glyphosate is replacing pendimethalin because of increased planting of Roundup Ready alfalfa, which is resistant to glyphosate. Use of diquat dibromide increased, possibly because the use of paraquat dichloride, which is applied as an alternative pre-harvest desiccant in alfalfa seed production, declined. The decrease in herbicide use occurred mainly in the San Joaquin and Sacramento valleys, whereas most of the increased application of herbicides occurred in the Imperial 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 that of insecticides and herbicides.

Processing tomato

In 2012, processing tomato growers planted 260,000 acres, which yielded 12.6 million tons, a 6 percent yield increase over 2011's yield. About 95 percent of U.S. processing tomatoes are grown in California. The U.S. is the world's top producer of processing tomatoes (34 percent of the world's total), followed by the European Union and China. California processing tomatoes, valued at $950 million in 2012, are primarily grown in the Sacramento and San Joaquin valleys. Fresno County leads the state in acreage with 38 percent (99,000 acres) of the statewide total, followed by Yolo (35,000 acres), Kings (29,000 acres), and San Joaquin (22,000 acres) counties. Significant production also occurs in Merced, Colusa, Kern, Stanislaus, and Solano counties.

Overall, use of all pesticide AIs decreased 4 percent, from 14 million pounds in 2011 to 13.5 million pounds in 2012 (Table 25). Total cumulative treated area of processing tomatoes decreased 4 percent. Insecticides was the most-used category as measured by area treated, which increased 22 percent from 2011 to 2012 (Figure 23). The most-used category as measured by amount AI applied was fungicide/insecticide (mostly sulfur and kaolin); use in this category

Table 25: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for processing tomato each year from 2008 to 2012. Planted acres from 2008 to 2012 are from USDA, August 2013; marketing year average prices from 2008 to 2012 are from USDA, August 2013. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	11,576,987	14,540,732	13,808,650	14,029,414	13,471,268
Acres Treated	2,667,762	3,269,116	3,214,722	3,119,124	2,996,126
Acres Planted	281,000	312,000	271,000	255,000	260,000
Price/ton	$ 78.60	$ 86.10	$ 71.40	$ 74.30	$ 75.00

decreased 2 percent. The overall decrease in pesticide use may have been in response to an especially dry growing season which reduced the incidence of weeds and diseases.

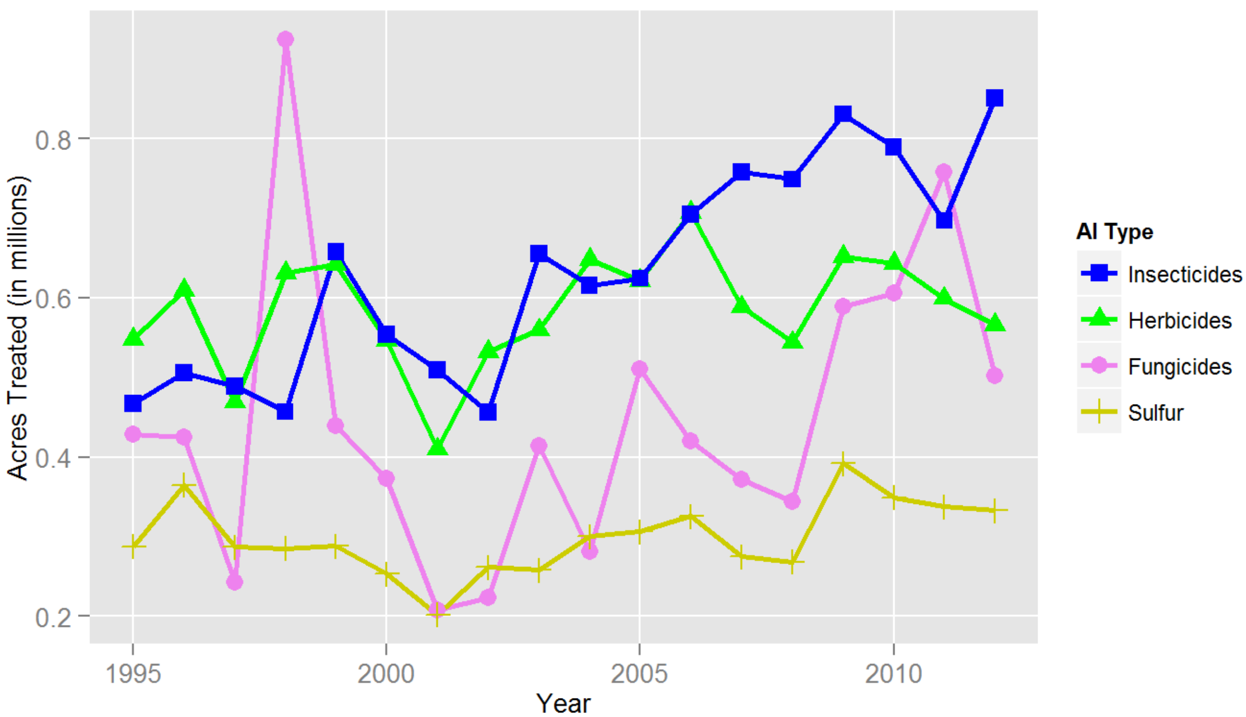

Figure 23: *Acres of processing tomato treated by all AIs in the major types of pesticides from 1995 to 2012.*

Overall fungicide use, expressed as cumulative area treated, decreased 34 percent and the amount of AI decreased 30 percent. The decrease in fungicide use may be attributed to a drier 2012 growing season, resulting in fewer early spring diseases and reduced mildew pressure. Although not a fungal disease, bacterial speck was almost a non-existent problem in 2012, especially compared to the previous year. The top fungicides used in terms of area treated in 2012 were chlorothalonil, azoxystrobin, difenoconazole, copper-based pesticides, and pyraclostrobin

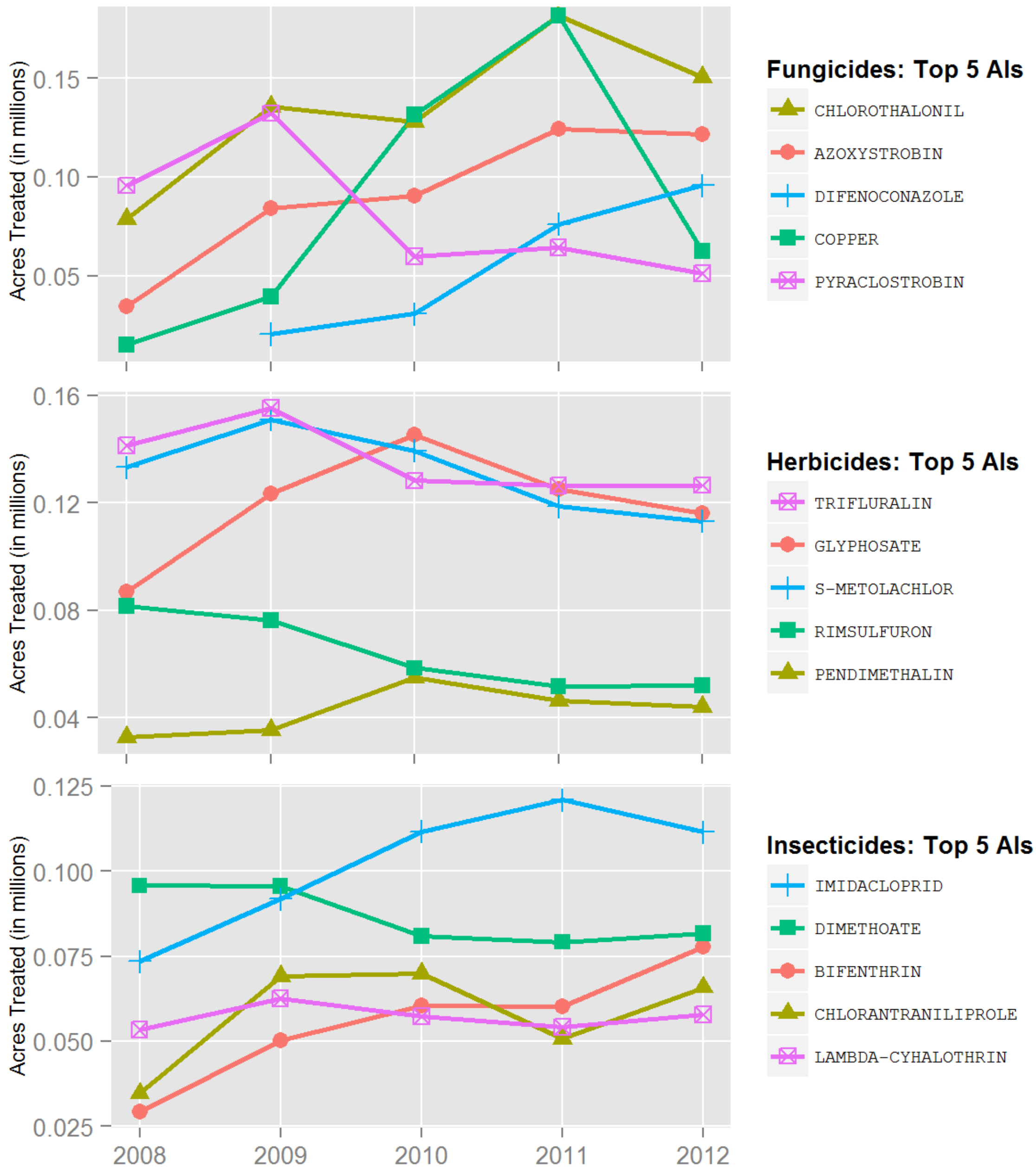

Figure 24: *Acres of processing tomato treated by the top 5 AIs of each AI type from 2008 to 2012.*

(Figure 24). Although overall fungicide use decreased, the amount of difenoconazole and azoxystrobin applied increased 133 percent and 69 percent, respectively. These preventive fungicides are often applied in combination products to treat black mold and powdery mildew. Since 2009, use of difenoconazole and azoxystrobin has 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. The area treated with chlorothalonil decreased 17 percent. This may have been due in part to increased use of products containing both difenoconazole and azoxystrobin and increased use restrictions for chlorothalonil. Although the overall use of sulfur decreased, use in parts of the northern Sacramento Valley increased because of high local incidence of powdery mildew.

Since many growers are installing drip lines for multi-year use, they tend to rotate out of tomatoes less frequently, which increases the bank of soilborne pests, such as *Phytophthora* spp. Additionally, growers are moving toward pesticides that can be effectively applied via drip. For example, the amount of mefenoxam used increased 3 percent, perhaps in response to the increased incidence of Phytophthora root rot.

The acreage treated with herbicides decreased 6 percent from 2011 to 2012 (Figure 23); the amount used increased 8 percent. Primary weeds of concern for processing tomatoes are nightshades and bindweed. Since 2012 was a relatively dry year, there were fewer post-emergence herbicide applications. The most-applied herbicides in 2012 were trifluralin, glyphosate, s-metolachlor, rimsulfuron, and pendimethalin (Figure 24). Trifluralin and pendimethalin are used to control bindweed and are often used in combination with s-metolachlor. The area treated with pendimethalin decreased 5 percent, trifluralin use was unchanged, s-metolachlor use decreased 5 percent, and metolachlor use increased 49 percent (Figure 24). Recent episodes of phytotoxicity involving trifluralin and 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. This may account for its increased use and the decrease in s-metolachlor use in 2012; this was also the case in 2011. Glyphosate is commonly used for preplant treatments in late winter and early spring; the amount used increased 17 percent. Flumioxazin is a relatively new product used on fallowed tomato fields. Because of reduced water availability in some growing areas, there was more fallowed ground in 2012 than in 2011.

In 2012, 867,000 cumulative acres were treated with insecticides, a 22 percent increase from 2011 (Figure 23). This overall increase was likely to due to population explosions 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, practices that effectively reduce the incidence of tomato spotted wilt disease. Dimethoate, methomyl, spinetoram, and flonicamid are available for thrips control; the area treated by the first three of these AIs increased in 2012. These insecticides, as well as imidacloprid, endosulfan, and methoxyfenozide, are rotated to prevent resistance from developing in thrips populations. Spinetoram is the most effective pesticide used for thrips management in processing tomato, and the area treated with spinetoram increased 28 percent. Dimethoate is a broad spectrum insecticide; its use increased 3 percent. However, its use early in the season can affect biological control organisms and cause population explosions of other insect pests, such as leafminers, later in the season. Secondary pest outbreaks due to the use of broad spectrum insecticides to control thrips may account for the 9 percent increase in spinosad use, the 20 percent increase in abamectin use, and the 30 percent increase in use of methoxyfenozide, an insect growth regulator used against lepidopteran pests. Methomyl use increased 7 percent, even though growers have begun switching to pyrethroids because they pose fewer hazards to workers. Bifenthrin, use of which increased 29 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 7 percent. The use of flonicamid and imidacloprid, the most-used insecticide, both decreased 8 percent from the previous year. This may account for the increased use of other insecticides to threat thrips.

Carbaryl and diazinon, the use of which increased 67 percent and 7 percent, respectively, are also used to control seedling pests, such as cutworms and flea beetles, at planting. Carbaryl, primarily applied in bait form, is applied prophylactically before planting to avoid loss of new transplants, which are very attractive to pests. Carbaryl and diazinon use may have increased in response to higher levels of soilborne pests that often occur in second year crops. Many of these pests are becoming more prevalent because growers are not rotating from tomatoes to other crops as frequently. Although lepidopteran pest pressures were relatively low in 2012, there was a 79 percent increase in the use of indoxacarb. Chlorantraniliprole, the use of which increased 30 percent, is used midseason, and because it is easily applied through drip irrigation, growers may have begun to use the pesticide more frequently. Use of flubendiamide, another relatively new product that controls lepidopterous pests, significantly increased from 11,000 acres in 2011 to 52,000 acres in 2012. Acres treated with emamectin benzoate, used to control russet mites, increased 76 percent.

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. There was a 22 percent increase in the use of endosulfan to treat stink bugs. Although not a highly used insecticide, clothianidin use more than doubled in 2012, 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 2012, the amount of fumigant applied decreased 9 percent, but accounted for about 25 percent of the total amount of pesticide AIs applied. In terms of area treated, fumigant use decreased 4 percent. The overall decrease in fumigant use, particularly metam-sodium and metam-potassium use, may be attributed to increasingly stringent regulations that make these products less attractive for growers to use. About 95 percent of processing tomatoes are grown from transplants, which have reduced the need for preplant treatments of metam to control weeds. Additionally, metam is being used prophylactically more frequently to manage diseases and is being injected into drip irrigation lines, which reduces application rates.

The increase in 1,3-dichloropropene use is likely due to increased incidence of resistance-breaking nematodes in nematode-resistant tomato cultivars. Populations of these nematodes are limited but 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 irrigation, which produces higher crop yields. The transition to buried drip irrigation, however, has enhanced conditions for nematode infestations, and nematode damage in tomatoes has increased. The shift to buried drip also correlated to an increase in the use of aluminum phosphide, from 645 acres in 2011 to 4,080 acres in 2012, to control gopher populations that damage drip tape. In 2012, approximately 90–95 percent of processing tomato acreage in San Joaquin Valley has been converted to drip irrigation, about 70–45 percent in the Sacramento Valley.

Rice

California is the second most productive rice-growing state in the United States, producing more than 2 million tons of rice each year and contributing over $1.3 billion to the state's economy. Six counties in the Sacramento Valley (Colusa, Sutter, Glenn, Butte, Yuba, and Yolo) together grow 95 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 2011 to 2012, rice acreage decreased 4 percent and the price dropped 8 percent. Pesticide use, measured by pounds of AI, increased 9 percent, and area treated was unchanged at 3 million acres (Table 26).

Table 26: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for rice each year from 2008 to 2012. Planted acres from 2008 to 2012 are from USDA, August 2013; marketing year average prices from 2008 to 2012 are from USDA, August 2013. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	4,731,653	5,634,595	4,668,693	4,864,232	5,310,356
Acres Treated	2,468,221	2,805,673	2,635,836	2,961,290	2,958,780
Acres Planted	519,000	561,000	558,000	585,000	561,000
Price/cwt	$ 27.50	$ 19.60	$ 21.00	$ 18.60	$ 17.10

Herbicides was the most-used pesticide class in 2012 (Figure 25) and accounted for 72 percent of the area treated and 70 percent of the total amount of AIs applied. The area treated with propanil, penoxsulam, and triclopyr (triethylamine salt) decreased 4, 6, and 4 percent, respectively, reflecting the reduced rice acreage, while the area treated with bispyribac-sodium and clomazone

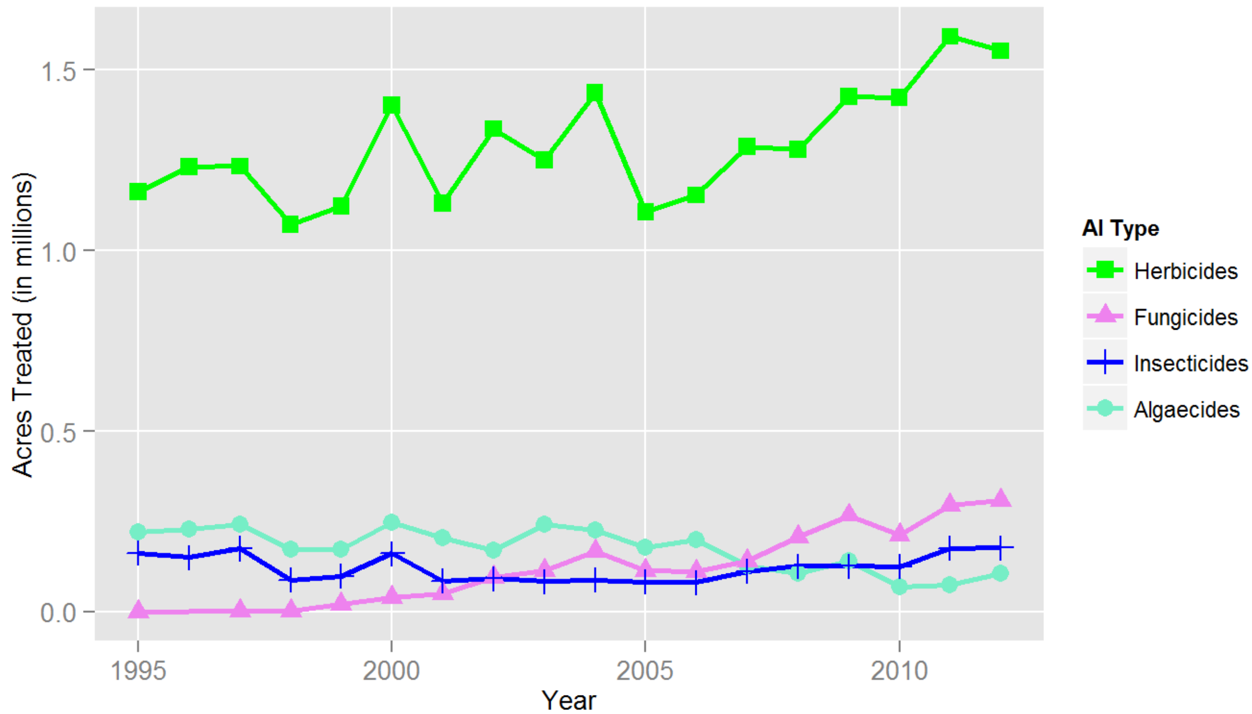

Figure 25: *Acres of rice treated by all AIs in the major types of pesticides from 1995 to 2012.*

increased 22 and 2 percent, respectively (Figure 26). Thiobencarb use increased, probably because growers were seeing less resistance of sprangletop (a troublesome grassy weed) to it than was forecast. This would help explain why clomazone use increased and propanil use decreased. Both herbicides are alternatives to thiobencarb for sprangletop control. Penoxsulam use dropped, perhaps because growers rotated use to other herbicide classes as a means to manage resistance. Although penoxsulam is an acetolactate synthase (ALS)-inhibiting herbicide, resistance among sedges and broadleaf weeds to penoxsulam is not as widespread as it is to other ALS-inhibiting herbicides. Bensulfuron methyl use decreased because several sedges and broadleaf weeds are resistant to it.

The area treated with fungicides increased 4 percent, continuing a trend that started in the late 1990s. Azoxystrobin was the major fungicide used on rice in California, accounting for 81 percent of all the area treated with fungicides. In 2012, the area treated with azoxystrobin increased marginally (1 percent), even as the total amount applied increased 2 percent. The area treated with propiconazole and trifloxystrobin both increased 12 percent. Azoxystrobin, propiconazole, and trifloxystrobin are reduced-risk fungicides often used for preventive treatments. In 2010, there was an unexpected increase in the incidence of rice blast disease, so in 2011 and 2012, growers responded by treating fields where high levels of disease were previously documented. Use of the three major fungicides increased due to their effectiveness in increasing yields when used in preventive applications.

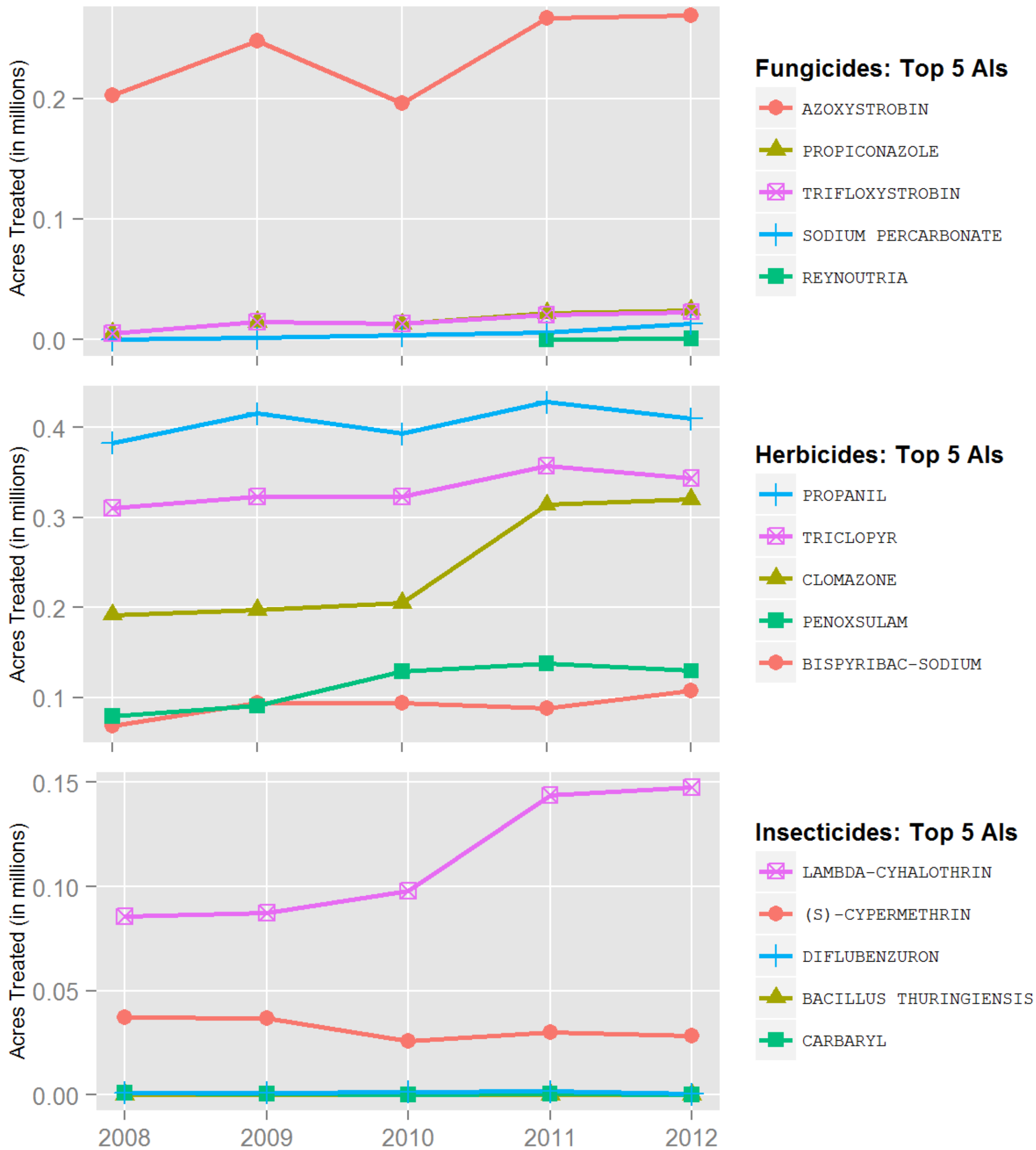

Figure 26: *Acres of rice treated by the top 5 AIs of each AI type from 2008 to 2012.*

Copper sulfate is the key algaecide used in California rice and is acceptable for organic production. Copper sulfate use has fluctuated from 2004 through 2012; in 2012 the cumulative area treated with copper sulfate increased 40 percent over the area treated in 2011. Copper sulfate is used primary for algae control, but also doubles as a control for tadpole shrimp in both conventional and organic production. Some of the increase may be associated with increasing organic rice production.

In 2012, the total area treated with insecticides increased marginally (1 percent) but the amount used decreased 21 percent. Only one insecticide, lambda-cyhalothrin, was among the 15 pesticides with the largest change in area treated; its use increased 3 percent. The other commonly used insecticide on rice is (s)-cypermethrin, and the area treated with it decreased 6 percent. Decreased use of both insecticides, even with substantial drops in their prices in recent years, may be due to decreased rice acreage. Lambda-cyhalothrin and (s)-cypermethrin are used to control primarily rice water weevil and secondarily armyworm and tadpole shrimp. Rice water weevil is the major arthropod pest on California rice. Growers have limited options among insecticides and often rely on the two pyrethroids, applied soon after planting for weevil and tadpole shrimp. Insect pressures are usually low on California rice and insecticides are used on relatively few acres.

Walnut

California produces 99 percent of the walnuts grown in the United States and around 78 percent grown in the world. The California walnut industry is comprised of over 4,000 growers, who farmed approximately 245,000 bearing acres in 2012 (Table 27). Weather in 2012 was favorable for walnut pollination and growth, although there were some reports of abnormal nut drop in June and July due to blight. Walnut production was estimated at 497,000 tons in 2012, an increase of 8 percent from the previous year. Although the total bearing acreage remained the same as in 2011, the area treated with pesticides increased 24 percent, and the amount of applied AIs increased 6 percent.

Table 27: *Total reported pounds of all active ingredients (AI), acres treated, acres bearing, and prices for walnut each year from 2008 to 2012. Bearing acres from 2008 to 2012 are from USDA, August 2013; marketing year average prices from 2008 to 2011 are from USDA, August 2013. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	3,381,725	3,273,681	3,992,294	3,951,869	4,200,788
Acres Treated	1,781,229	1,856,395	2,316,586	2,348,478	2,922,455
Acres Bearing	223,000	227,000	237,000	245,000	245,000
Price/ton	$ 1,280	$ 1,710	$ 2,040	$ 2,900	NA

The Sacramento and San Joaquin Valleys accounted for 99 percent of total walnut pesticide use in 2012, both in terms of amount of AIs applied and area treated. Total pesticide use was split nearly equally between the two valleys, with the Sacramento Valley contributing a slightly higher amount. Overall, use of insecticides, herbicides, and plant growth regulators increased in 2012, while use of fungicides and fumigants decreased (Figure 27).

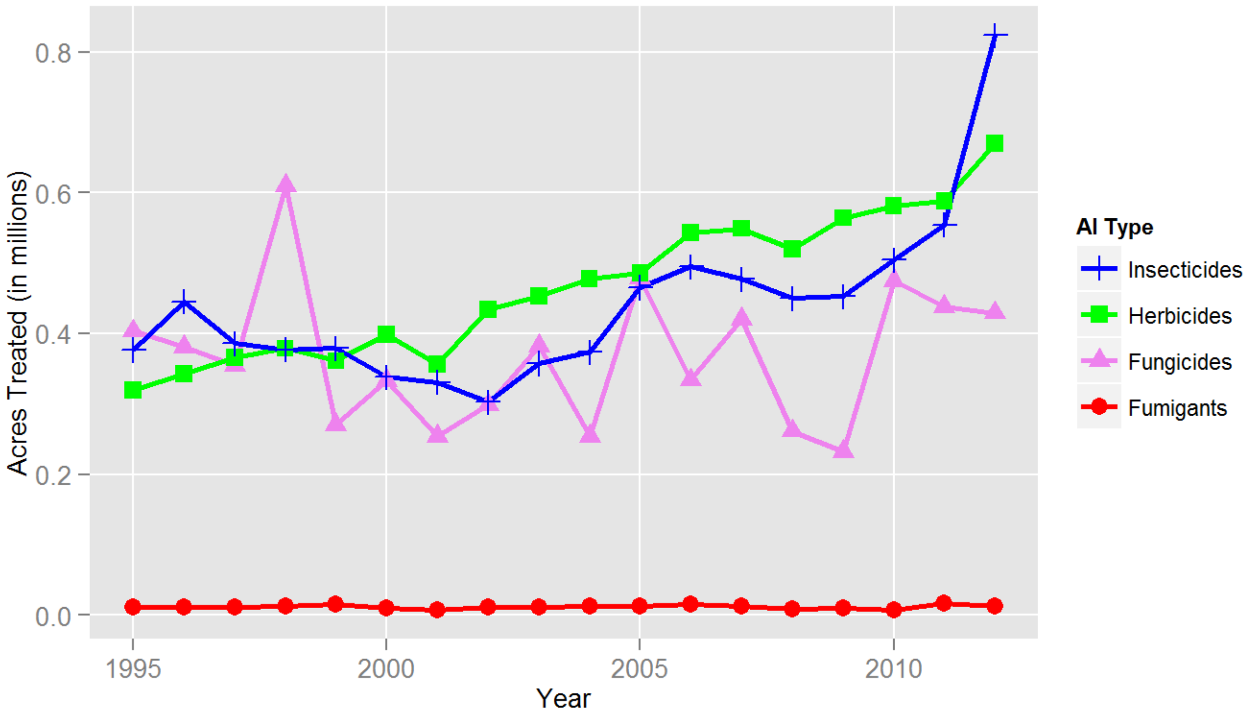

Figure 27: *Acres of walnut treated by all AIs in the major types of pesticides from 1995 to 2012.*

The area treated with insecticides, including miticides, increased 49 percent in 2012, replacing herbicides as the pesticide type with the highest use (Figure 27). Important pests in walnuts include codling moth, walnut husk fly, navel orangeworm, aphids, and webspinning spider mites. The insecticide applied to the largest area in 2012 was the miticide abamectin: It is relatively low cost, and the periodic flares of hot weather favored build-ups of webspinning spider mites populations. Other insecticides with high use in 2012 included chlorpyrifos, bifenthrin, chlorantraniliprole, and lambda-cyhalothrin (Figure 28). With the exception of chlorantraniliprole, which was mainly used in the San Joaquin Valley to control codling moth, these pesticides had approximately equal use in the San Joaquin and Sacramento valleys and were capable of controlling a broad spectrum of pests, including the most important walnut pests. Notably, although the area treated with insecticides rose considerably in 2012, the use of insecticides with relatively low risks to human health and the environment also rose, largely due to a higher use of oils.

The area treated with herbicides increased 14 percent in 2012 (Figure 27). 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

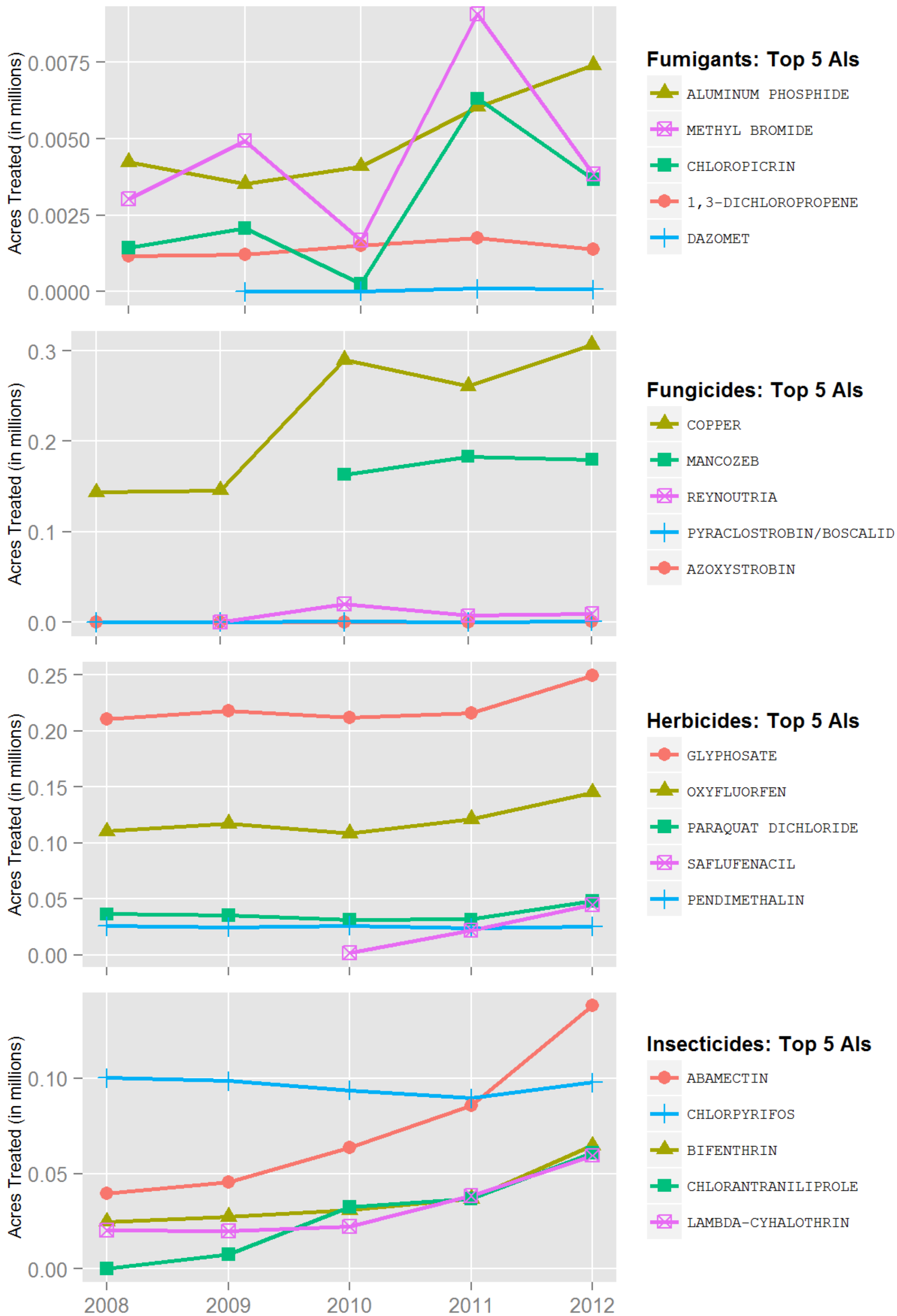

Figure 28: *Acres of walnut treated by the top 5 AIs of each AI type from 2008 to 2012.*

surface, causing growers to take measures to delay or prevent resistance. Glyphosate-resistant populations of ryegrass are evident in the Sacramento Valley, while resistant populations of hairy fleabane and horseweed are evident in the San Joaquin Valley. The herbicides applied to the greatest area in 2012 included glyphosate, oxyfluorfen, paraquat dichloride, saflufenacil, pendimethalin, and glufosinate-ammonium (Figure 28). All increased in use except glufosinate-ammonium (not shown in Figure 28) which decreased 61 percent due to a global supply shortage. While both valleys had similar use of oxyfluorfen, the Sacramento Valley tended toward higher use of glyphosate and glufosinate-ammonium, while the San Joaquin Valley had higher use of paraquat dichloride, saflufenacil, and pendimethalin. Glufosinate-ammonium and paraquat dichloride are nonselective herbicides which are recommended for use in combination with a protoporphyrinogen (PPO) oxidase inhibitor, such as saflufenacil or oxyfluorfen, to slow or prevent glyphosate resistance. Saflufenacil is less expensive than glufosinate-ammonium, but it does not control grasses. Pendimethalin is a selective herbicide used to control most annual grasses and certain broadleaf weeds. A popular new formulation of pendimethalin may be applied to bearing acreage, whereas use of previously registered products was limited to orchards with nonbearing dormant trees.

The area treated with the plant growth regulator ethephon increased 28 percent in 2012. Ethephon hastens hull cracking and shell separation, which can advance harvest 4 to 7 days. It allows growers to spread out the harvest and thus optimize use of existing harvesting, hulling, and drying equipment. In addition, ethephon allows growers to harvest earlier in the year, potentially avoiding the onset of fall rains, which can cause economic loss if they occur at harvest time.

Fungicide use, as measured by area treated, decreased 2 percent in 2012 (Figure 27). Use of copper-based fungicides and mancozeb predominated, and over 70 percent of their total use occurred in the Sacramento Valley for walnut blight control. They were often applied as tank mixes because there has been documented resistance of the causal bacterium to copper-based fungicides used alone. Mancozeb disrupts bacterial cell membranes and prevents copper-resistant bacteria from removing copper ions that had penetrated cells.

The area treated with fumigants decreased 25 percent from the relatively high usage in 2011 to a level approaching the ten-year average (Figure 27). Most of this decrease can be attributed to a 67 percent reduction in the area treated with methyl bromide and a 41 percent reduction in the area treated with chloropicrin (Figure 28). Methyl bromide use continues to decline under the terms of an international agreement aimed at reducing applications of methyl bromide, a potent depleter of stratospheric ozone. Other fumigants applied to large areas in 2012 included 1,3-dichloropropene and dazomet; both had slight decreases in use since 2011. In contrast, use of aluminum phosphide, a fumigant used for burrowing rodents, increased in use 21 percent. Post-harvest fumigation only accounted for 7 percent of the total amount of fumigants used.

Pistachio

In 2012, California accounted for more than 178,000 bearing acres of pistachio, or almost 99 percent of the U.S. crop (Table 28). Worldwide, U.S. pistachio production in 2012 ranked second to that of Iran. In California, pistachios are grown in 22 counties, from San Bernardino County in the south to Tehama County in the north. In 2012, 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 2012, the counties with the highest number of bearing acres were Kern, Fresno, and Madera, which had 41, 17, and 16 percent, respectively, of the state's production.

Table 28: *Total reported pounds of all active ingredients (AI), acres treated, acres bearing, and prices for pistachio each year from 2008 to 2012. Bearing acres from 2008 to 2012 are from USDA, August 2013; marketing year average prices from 2008 to 2012 are from USDA, August 2013. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	2,416,673	3,016,942	2,829,109	4,033,552	3,941,622
Acres Treated	1,402,050	1,767,435	2,167,513	2,363,983	2,769,755
Acres Bearing	118,000	126,000	137,000	153,000	178,000
Price/lb	$ 2.05	$ 1.67	$ 2.22	$ 1.98	$ 2.02

Pistachio trees alternate between high and low production each year. Projected as a good year for most trees, 2012 saw the highest total pistachio production and yield ever recorded in California at 551 million pounds. The dry, cool spring and mild summer of 2012 resulted in normal growth. During early 2012, ample winter chilling encouraged adequate bloom and pollination. From 2011 to 2012, the number of bearing acres increased 16 percent (Table 28). This increase will continue over the next few years due to a surge in planting around 2005.

Pesticide use on pistachio fluctuated from 2008 through 2012 (Table 28). Combined use of insecticides, fungicides, and herbicides, as measured by area treated, increased 17 percent from 2011 to 2012, reflecting the 16 percent rise in bearing acres (Table 28). Use of sulfur, a miticide, decreased 11 percent.

During 2012, the top insecticides used as measured by area treated were lambda-cyhalothrin, bifenthrin, permethrin, beta-cyfluthrin, and chlorantraniliprole (Figure 30). Sulfur was the dominant miticide used. The main fungicides used were pyraclostrobin, boscalid, fluopyram, metconazole, pyrimethanil, and trifloxystrobin. *Aspergillus flavus* strain AF36, widely used in 2012, 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. Three herbicides dominated:

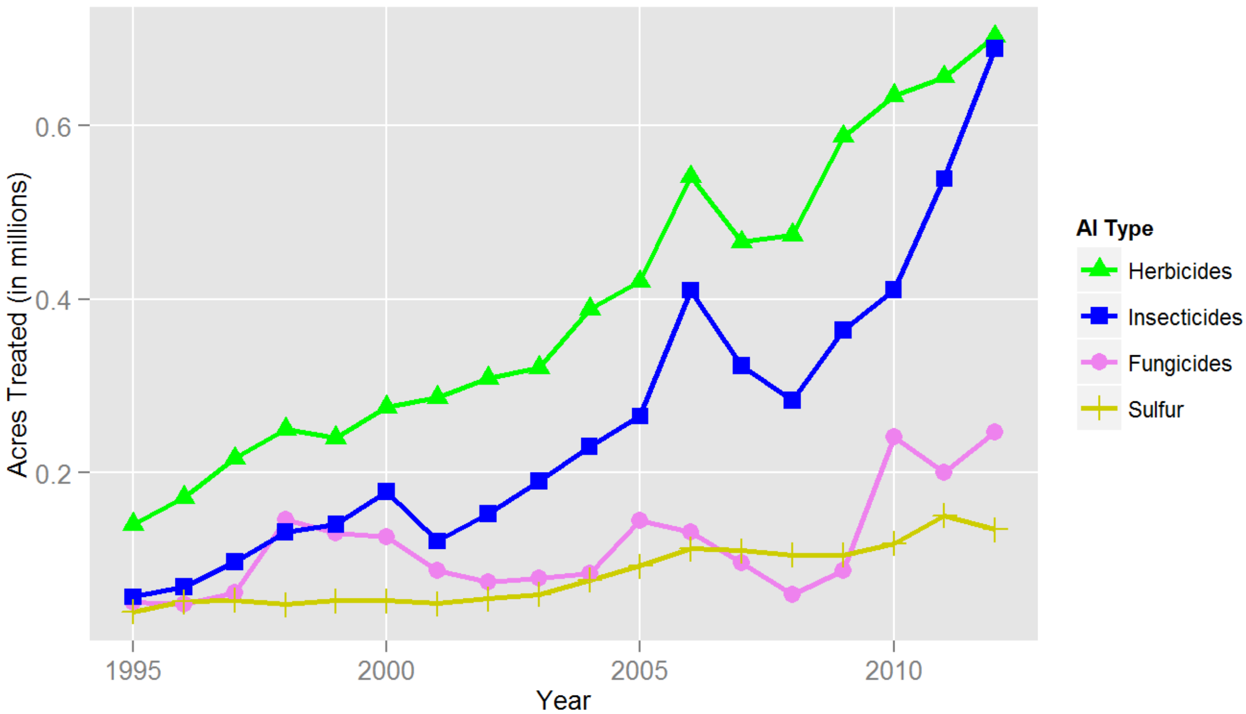

Figure 29: *Acres of pistachio treated by all AIs in the major types of pesticides from 1995 to 2012.*

glyphosate, oxyfluorfen, and saflufenacil. Aluminum phosphide, which is used for burrowing rodents, was the main fumigant.

Insecticide use, as measured by pounds, increased 4 percent from 2011 to 2012, primarily due to additional bearing acres and higher pest pressure. During 2012, early-season populations of true bugs were much higher than they had been in 2011. 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—permethrin, lambda-cyhalothrin, and beta-cyfluthrin—preemptively for all of the bugs before the bugs can do much damage. Use of permethrin peaked during May, although its use that month was 39 percent lower compared with 2011. From 2011 to 2012, area treated with permethrin increased 27 percent and use of lambda-cyhalothrin increased 19 percent. Beta-cyfluthrin use peaked during May and its overall use decreased 19 percent from 2011 to 2012.

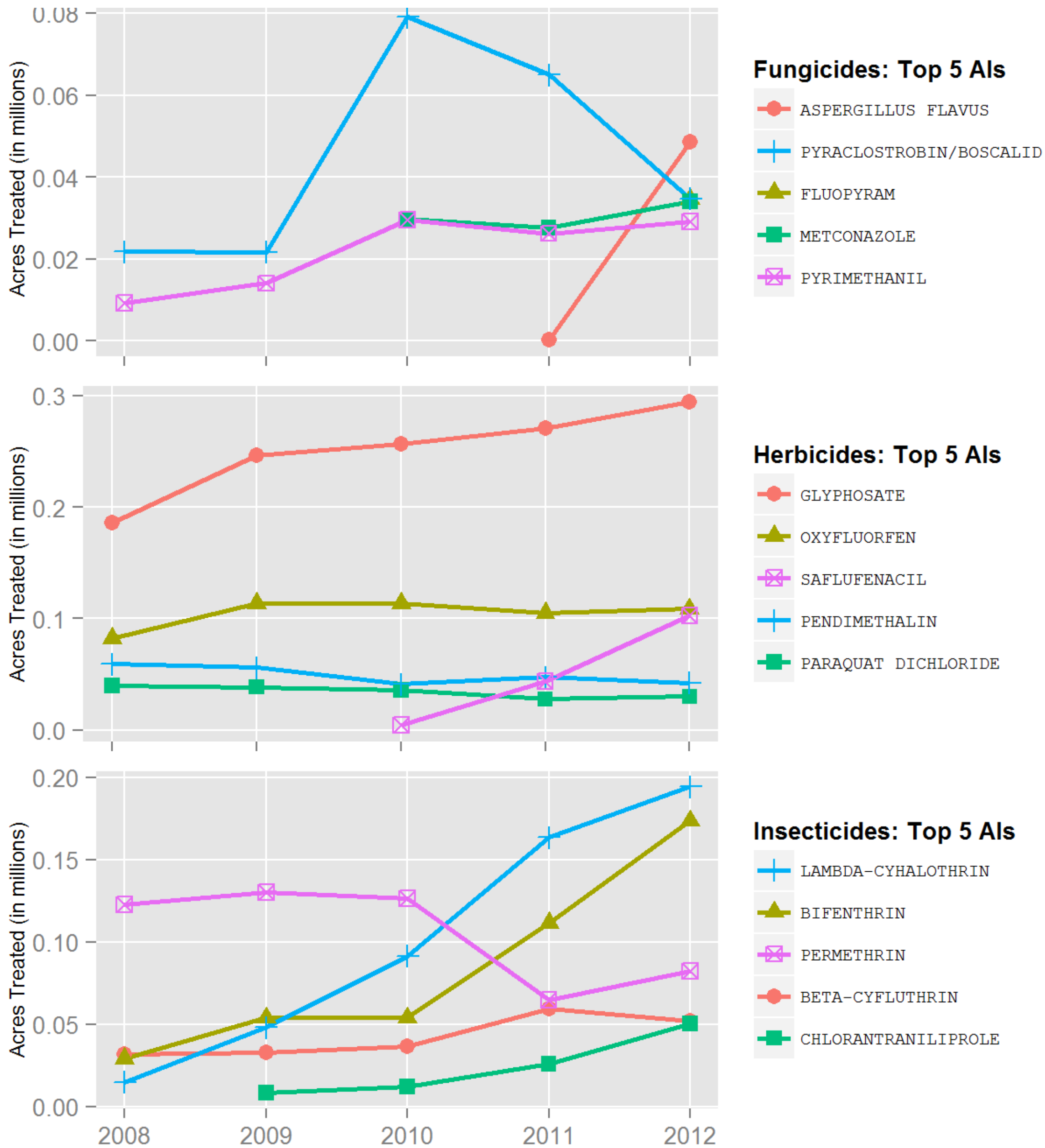

Figure 30: *Acres of pistachio treated by the top 5 AIs of each AI type from 2008 to 2012.*

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. NOW attacks nuts beginning in July, but insecticide sprays target the third generation that coincides with the beginning of the nut harvest. NOW pressure was higher in 2012 than in 2011, and according to several observations, was at the highest level since 2007. The harvest in 2012 was later than average, although not as late as in 2011. Still, growers applied 56 percent more bifenthrin, as measured by area treated, and 95 percent more chlorantraniliprole than they did in 2011. The latter is also used for OBLR. During September and October, use of permethrin tripled over the amount used in 2011. Since 2011, the target pest of permethrin applications shifted from true bugs to late-season NOW.

Oils comprise 90 percent of insecticide use and 35 percent of total pesticides used by pounds. From 2011 to 2012, amount of oils increased 1 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 92 percent of the oils used throughout the growing season in February.

Use of buprofezin for Gill's mealybug climbed 14 percent from 2011 to 2012. Most applications were made in June and targeted immature crawlers moving into the clusters.

Sulfur use decreased 11 percent from 2011 to 2012, as measured by area treated (Figure 29). 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 2012, growers began applying sulfur for mites in April, applied most in May and August, and continued applications through September.

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 atoxigenic—that 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 2011 to 2012, AF36 use rose from 260 acres to almost 49,000 acres.

From 2011 to 2012, fungicide use decreased 3 percent as measured by pounds. The spring was warmer and drier than in 2011 and growers in the San Joaquin Valley made fewer fungicide applications. During 2012, fungicide applications peaked in April with additional applications during June for Botryosphaeria of a product containing pyraclostrobin and boscalid and another product containing metconazole. Use of the pyraclostrobin-boscalid product fell 46 percent because pyraclostrobin lacks efficacy against Alternaria, and fungal resistance to boscalid is becoming more widespread. During 2012, the new fungicide fluopyram was used on over 34,000 acres. 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 increased 7 percent from 2011 to 2012 (Figure 29). 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 2011 to 2012, use of glyphosate increased 9 percent. Use of the pre-emergence herbicide oxyfluorfen increased 3 percent from 2011 to 2012, while that of pendimethalin, a pre-emergence herbicide for cool-weather weeds, decreased 10 percent. 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 2011 to 2012 increased 134 percent. Use of flumioxazin, another pre-emergence herbicide used mostly during winter, decreased 43 percent. Flumioxazin provides long residual pre-emergence control of annual grasses, hairy fleabane, and other annual broadleaf weeds. Use of oryzalin, a cool-weather pre-emergence herbicide that controls annual grasses, decreased 57 percent.

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. In 2012 oranges ranked the 18th highest-valued commodity in California. 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, 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 includes Riverside and San Bernardino counties, and inland portions of San Diego, Orange, and Los Angeles counties and is marginally affected by the coastal climate. 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 wildly.

California accounted for 177,000 bearing acres of oranges in 2012, a decline of 2 percent from 2011 (Table 29), and orange production was 5 percent lower. The price per box increased 25 percent from 2011 and was the highest in five years.

Table 29: *Total reported pounds of all active ingredients (AI), acres treated, acres bearing, and prices for orange each year from 2008 to 2012. Bearing acres from 2008 to 2012 are from USDA, August 2013; marketing year average prices from 2008 to 2012 are from USDA, August 2013. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	9,581,427	8,495,167	8,803,065	10,038,578	8,840,795
Acres Treated	2,334,103	2,253,339	2,416,705	2,444,725	2,337,478
Acres Bearing	188,000	186,000	183,000	180,000	177,000
Price/box	$ 9.82	$ 12.91	$ 12.54	$ 10.50	$ 13.15

The dry winter conditions reduced overall fruit size, and then record low freezing temperatures in January in the San Joaquin Valley resulted in lower naval orange production. Spring was predominately dry and mild, but at times temperatures were below normal. Above normal temperatures persisted through summer with a heat wave in July. Late summer and fall were warm and windy with a number of thunderstorms. Santa Ana winds brought warm winds and low humidity to the San Joaquin Valley, where temperatures were very high in October. Temperatures remained relatively warm through the end of the year.

Pesticide use on oranges has fluctuated from 2008 through 2012 (Table 29). The cumulative area treated with pesticides decreased 4 percent from 2011 to 2012. The area treated in 2012 differed from the 5-year average only 0.8 percent, and the bearing acreage decreased nearly 6 percent from the high in 2008.

The area treated with insecticides decreased 2 percent between 2011 and 2012; however, the amount of insecticides used increased 6 percent. During 2012, the insecticides oils, spinetoram, beta-cyfluthrin, imidacloprid, and abamectin were used on the greatest acreage (Figure 31). The area treated with oils decreased in 2012 and, except for an increase in 2011 and 2012, its use had been declining since 2005. However, the amount of oils applied in 2012 increased 8 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. The decrease in area treated was mostly tied to a reduction in the use of chlorpyrifos and spinosad. The area treated with a number of pesticides, including spirotetramat, pyridaben, and spinetoram increased.

The Asian citrus psyllid (ACP), which vectors Huanglongbing (citrus greening disease), 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. Areas treated with beta-cyfluthrin, imidacloprid, and thiamethoxam have all increased. However, despite eradication

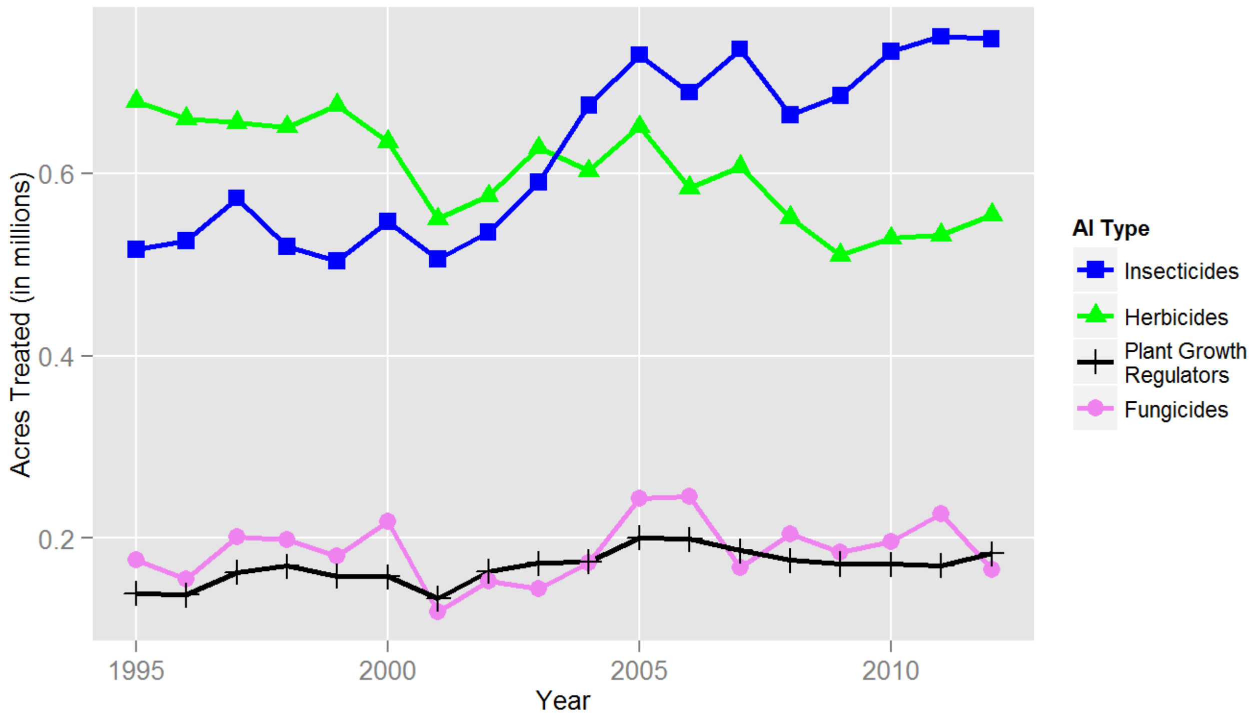

Figure 31: *Acres of orange treated by all AIs in the major types of pesticides from 1995 to 2012.*

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. Because imidacloprid is toxic to bees, applying it during bloom is discouraged.

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 2005, 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 relatively new insecticides and are primarily used in citrus to

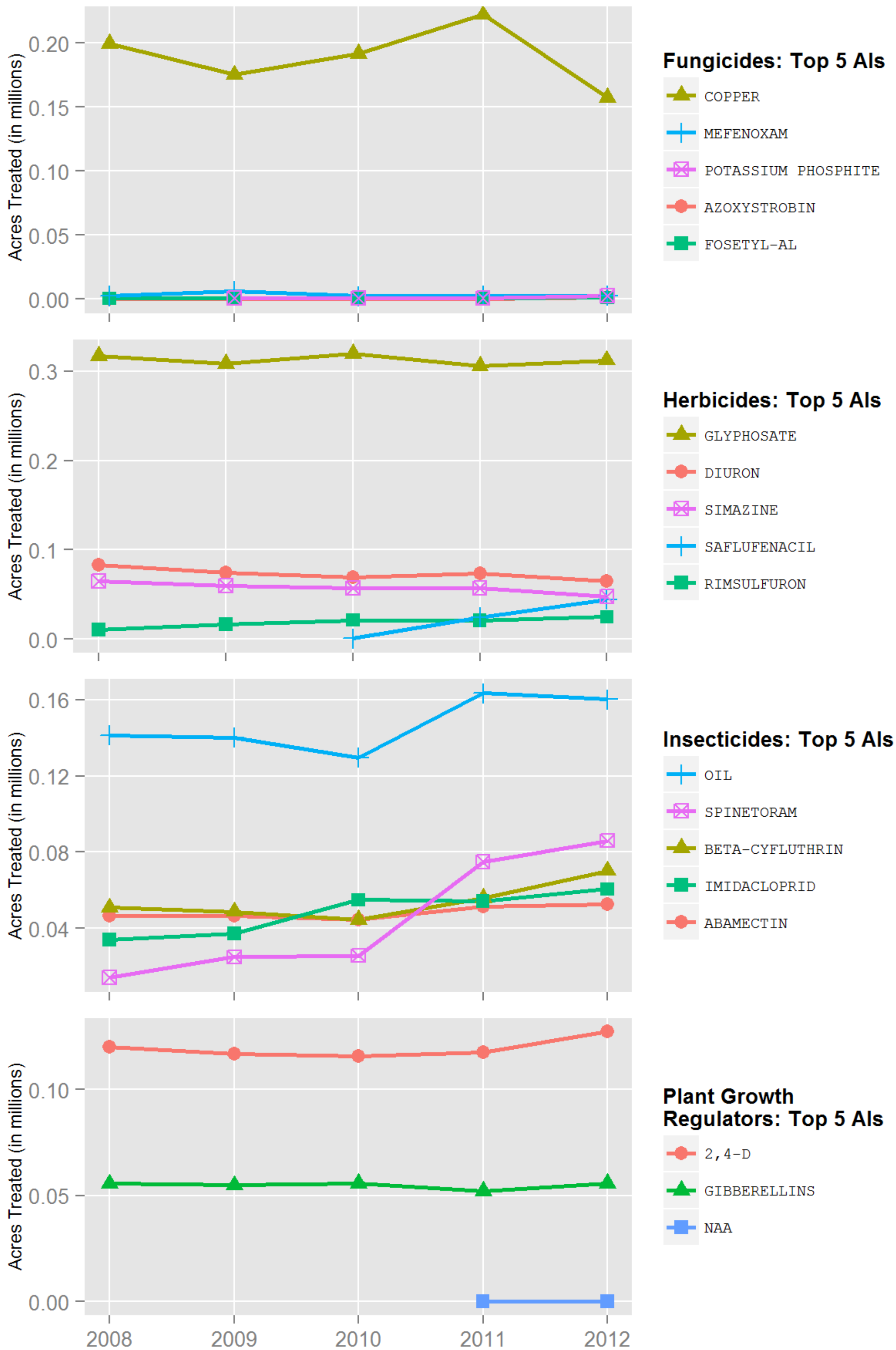

Figure 32: *Acres of orange treated by the top 5 AIs of each AI type from 2008 to 2012.*

manage citrus thrips. Both are very selective, allowing natural enemies to survive. They may eventually erode the market share of older insecticides and miticides. 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 56 percent in 2012, while spinetoram use increased 15 percent. These two chemicals are in the same chemical category, and the overall acreage treated with one or the other in the last four years has been similar.

Mite populations have increased in recent years, and there has been a concomitant increase in miticide use. This is possibly due to the increased use of imidacloprid, which reduces populations of natural enemies and predatory mites. Fenpropathrin is used to control red mites, citrus thrips, Asian citrus psyllid, katydids, and other miscellaneous pests. The insecticidal activity of fenpropathrin is largely interchangeable with that of beta-cyfluthrin, and use of both insecticides increased in 2012, possible as ACP treatments.

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.

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 neonicotinoids (imidacloprid and acetamiprid) and spinetoram. The area treated with dimethoate declined 64 percent, following a downward trend seen in the last ten years. The use of pyriproxyfen, which is used almost exclusively for California red scale control, has also been declining. The area treated with pyriproxyfen increased slightly (4 percent) in 2012, but has been steadily declining since 2009.

Citrus that is exported to Korea must be treated to prevent transport of Fuller rose beetle. The weevil does not cause economic damage in California, but it is hard to kill. To control it, the University of California Statewide IPM Program recommends 2-4 bifenthrin trunk sprays in June-September, followed by a foliar treatment of thiamethoxam in November. Additional postharvest fumigation with methyl bromide, phosphine, or ethyl formate is also necessary.

Fungicide use decreased both by acreage treated and by amount applied in 2012. The area treated decreased 27 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 2012 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. Total elimination of all weeds is not necessary. A combination of pre- and post-emergence herbicides are used, as well as mechanical removal. The area treated with herbicides increased 4 percent between 2011 and 2012, and the amount applied was similar to that in 2011. Increases in area treated were observed in the use of glyphosate, saflufenacil, rimsulfuron, and indaziflam; decreases were seen in the use of simazine and diuron. Glyphosate, a post-emergence herbicide, was the most-used herbicide, and the amount of glyphosate applied was the highest in over 9 years. Saflufenacil is a post-emergence, burn-down herbicide that was first used in 2010. The area treated increased 82 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 in California oranges. Simazine is also a pre-emergence herbicide, as are oryzalin and diuron; use of all these herbicides decreased. Decreased use of pre-emergence herbicides was probably due to the relatively dry conditions in 2012 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, increased 38 percent between 2011 and 2012, following an increase in 2011. Prior to 2011, there had been a steady decrease in the area it was used on since 2001. In 2012, diphacinone was applied to the highest number of acres since 2006.

The area treated with metaldehyde decreased 18 percent. Metaldehyde is used to control snails and slugs, and the warm, dry spring inhibited outbreaks of these pests.

Strawberry

In 2012 California produced 2.76 billion pounds of strawberries—over 90 percent of the total U.S. production—valued at more than $1.94 billion. Market prices determine how much of the crop goes to fresh market and how much is processed, and in 2011, about 93 percent of the crop went to fresh market. About 38,500 acres of strawberries were planted and harvested in 2012, primarily along the central and southern coast, with smaller but significant production occurring in the Central Valley.

Total acreage treated with pesticides increased 12 percent from 2011 to 2012 as harvested acreage increased 1 percent (Table 30). Amounts of pesticide applied increased 16 percent from 2011 to 2012. Fungicides, followed by insecticides, account for the largest proportion of pesticides applied on a per acre basis (Figure 33). The total area treated with fungicides increased 12 percent, while use of insecticides increased 17 percent. Area treated with fumigants increased 11

Table 30: *Total reported pounds of all active ingredients (AI), acres treated, acres harvested, and prices for strawberry each year from 2008 to 2012. Harvested acres from 2008 to 2012 are from USDA, August 2013; marketing year average prices from 2008 to 2012 are from USDA, August 2013. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	9,920,980	10,046,019	11,038,419	12,089,497	14,050,729
Acres Treated	1,515,882	1,661,396	2,000,497	1,970,651	2,204,754
Acres Harvested	37,600	39,800	38,600	38,000	38,500
Price/cwt	$ 69.60	$ 69.40	$ 69.60	$ 75.70	$ 76.80

percent, and area treated with herbicides increased 21 percent. The major pesticides with greatest increase in area treated from 2011 to 2012 were sulfur, boscalid, pyraclostrobin, cyprodinil, and fludioxanil; each of these active ingredients are fungicides. The major pesticides with decreased use were dimethylpolysiloxane, captan, and lecithin.

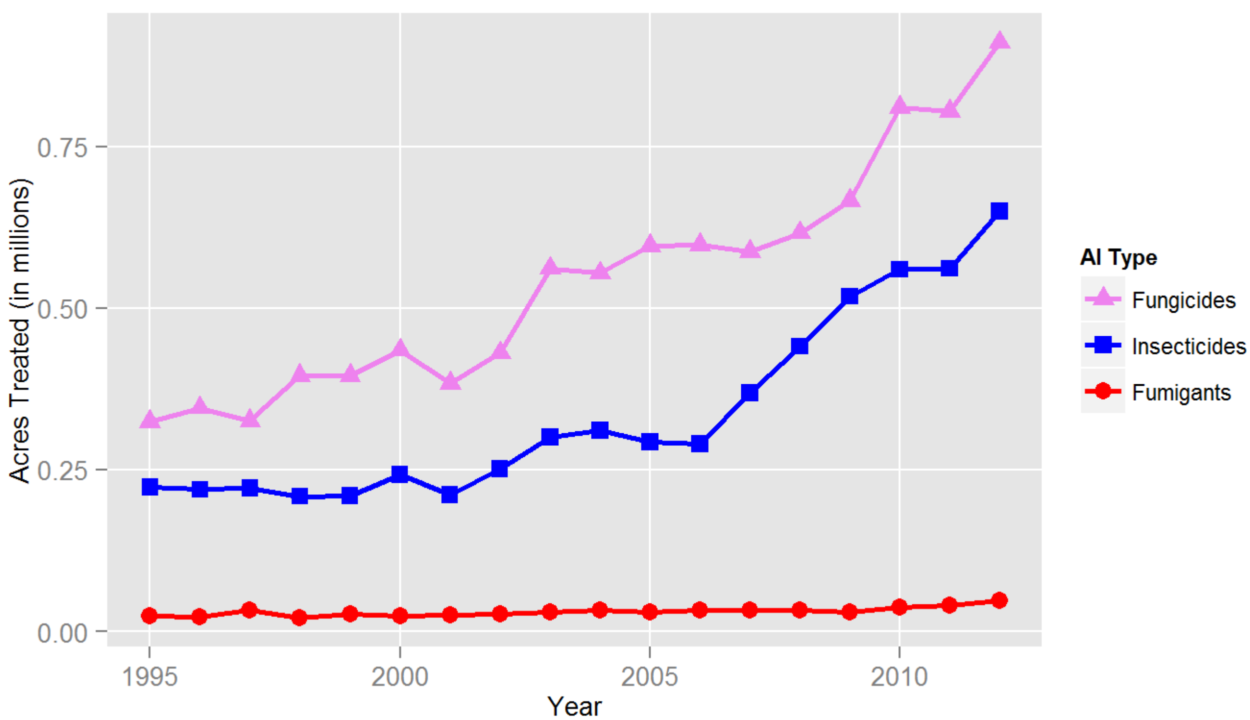

Figure 33: *Acres of strawberry treated by all AIs in the major types of pesticides from 1995 to 2012.*

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, dryer winters and increased diversity in the regional crop complex that supports this pest.

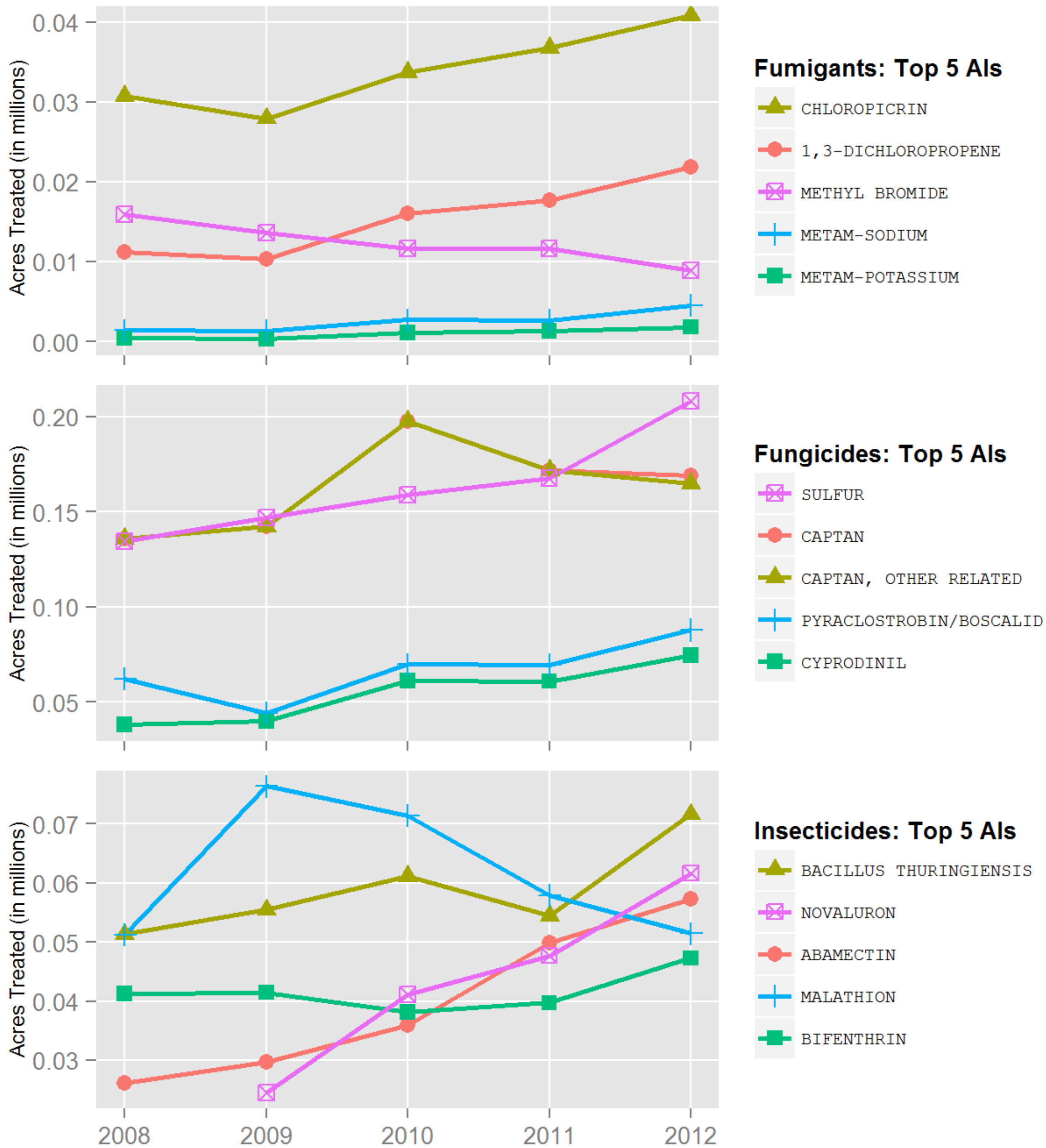

Figure 34: *Acres of strawberry treated by the top 5 AIs of each AI type from 2008 to 2012.*

Insecticides with the greatest increase in area treated from 2011 to 2012 were *Bacillus thuringiensis* (32 percent), bifenthrin (19 percent), abamectin (15 percent), novaluron (29 percent), acetamiprid (62 percent), and chlorantraniliprole (90 percent). With the exceptions of *Bacillus thuringiensis* and chlorantraniliprole, all of these active ingredients are used to control lygus bugs. Insecticides with decreased use include azadirachtin (36 percent), fenpropathrin (6 percent), and malathion (11 percent). Fenpropathrin and malathion are used primarily to control whitefly populations.

The increase in herbicide use in 2012 was due to increases in the area treated with two herbicides: oxyfluorfen (54 percent increase) and pendimethalin (98 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. Area treated with glyphosate decreased by 53 percent in 2012.

Fungicides continue to be the most-used pesticides, as measured by area treated. Fungal pressure was higher in 2012 compared to 2011, which is reflected in the overall increase in area treated. Fungicides with significant increases in area treated in 2012 include sulfur (24 percent), pyraclostrobin (18 percent), boscalid (26 percent), quinoxyfen (48 percent), trifloxystrobin (86 percent), and *Reynoutria sachalinensis* extract (175 percent). Pyraclostrobin is frequently used in combination with boscalid. For these two fungicides, both area treated and amount of active ingredient applied increased in 2012 despite concerns about their declining efficacy. *Reynoutria* extract is a relatively new product that is obtained from the giant knotweed plant. This reduced-risk botanical product works by systemically inducing an increased resistance to certain fungi, such as powdery mildew, in the treated plant.

Strawberry production relies on several fumigants. Fumigants accounted for about 87 percent (as measured by pounds applied) of all pesticide AIs applied to strawberries in 2012, but only two percent of the planted acreage was treated. The area treated with fumigants in 2012 increased 16 percent. This increase is attributable to increases in the use of three fumigant active ingredients: chloropicrin (11 percent), 1,3-dichloropropene (24 percent), and metam-sodium (72 percent). Area treated with methyl bromide dropped by 23 percent in 2012. 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.

Peach and nectarine

California grew 74 percent of all U.S. peaches (including 58 percent of fresh market peaches and 100 percent of processed peaches) and 95 percent of nectarines in 2012. 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 processing into canned and frozen products including baby food and juice. Peach and nectarine are discussed together because pest management issues for the two crops are similar.

Bearing acreage of peach and nectarine continued to decline in 2012, decreasing 3 percent (Table 31). Low production helped raise the overall price per ton 27 percent compared to 2011, perhaps signaling that the California stone fruit industry is turning a corner after several years of financial hardship and consolidation. During that period some growers switched to grapes or nut crops, which have lower labor requirements and higher profit margins. Other factors contributing to higher prices in 2012 included losses due to bad weather, an increase in canned peach exports while imports declined (especially from China, California's main competitor), and growing consumer demand for fresh peaches and nectarines coupled with a reduction in competing production in other U.S. states due to adverse weather conditions.

Table 31: *Total reported pounds of all active ingredients (AI), acres treated, acres bearing, and prices for peach and nectarine each year from 2008 to 2012. Bearing acres from 2008 to 2012 are from USDA, August 2013; marketing year average prices from 2008 to 2012 are from USDA, August 2013. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	5,387,748	5,033,843	4,469,213	4,562,657	3,950,860
Acres Treated	1,439,445	1,382,214	1,341,690	1,337,310	1,352,509
Acres Bearing	87,000	81,500	78,000	74,000	72,000
Price/ton	$ 350.84	$ 483.04	$ 427.95	$ 451.35	$ 572.68

Peach and nectarine acreage treated with the major categories of pesticides has fluctuated from year to year since 1994. Data for most types of pesticide use do not show substantial increasing or decreasing trends (Figure 35). The total amount of pesticide AI applied decreased 13 percent but the number of cumulative acres treated remained almost unchanged (Table 31). The area treated with insecticides and herbicides increased while the area treated with fungicides and sulfur declined (Figure 35).

Rainfall in California during winter 2011/12 was sparse, with many Central Valley peach and nectarine growing areas reporting 30–80 percent of normal. Ample chilling hours produced a good bloom. Full bloom came earlier than in 2011 and was followed by severe frost and hail damage. A series of mid-April hailstorms shredded leaves, knocked fruit off of trees, and slashed developing fruit. Labor costs increased after the storms because thinning had to be more selective. Some growers suffered massive crop losses and damage totaled tens of millions of dollars. A July hot spell that slowed growth plus a lack of thinning labor caused clingstone peaches to be small- to average-sized, but freestone peach and nectarine quality was good. Reduced per acre yields contributed to 6, 9, and 17 percent decreases in production for clingstone peaches, freestone peaches, and nectarines, respectively, compared to 2011.

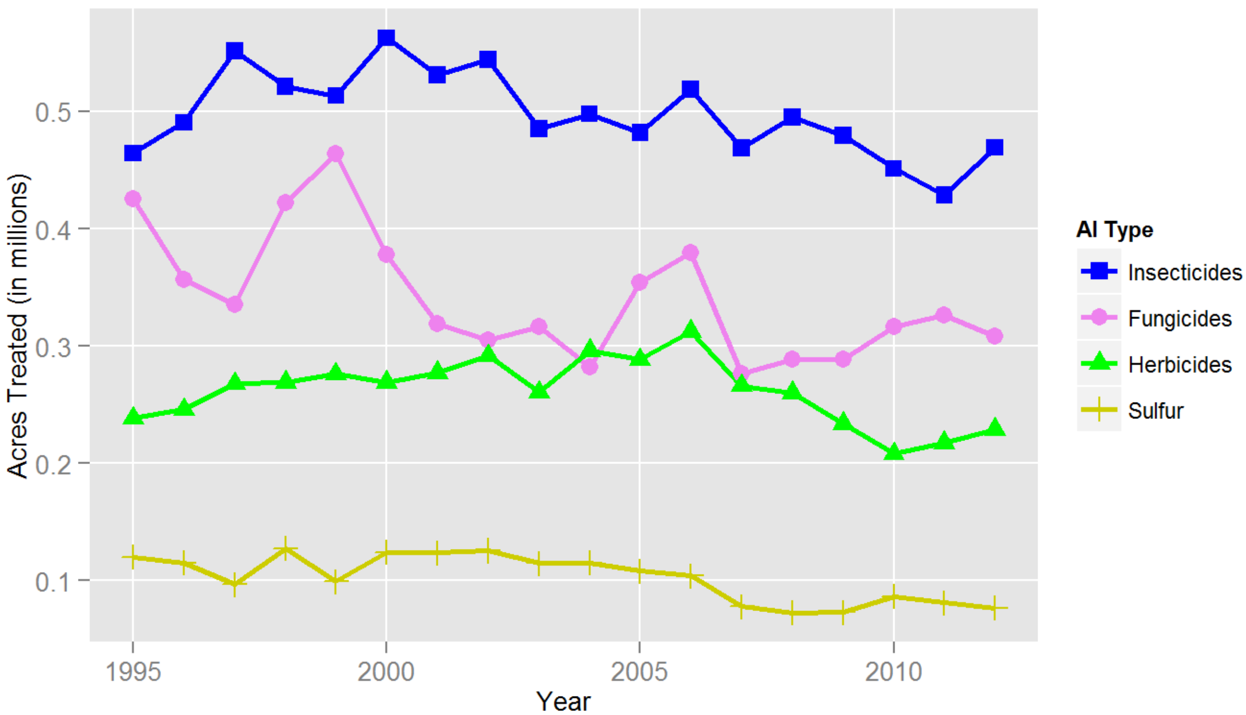

Figure 35: *Acres of peach and nectarine treated by all AIs in the major types of pesticides from 1995 to 2012.*

Warm dry weather can favor survival and reproduction of insect pests and mites that attack orchard trees. Total cumulative peach and nectarine acreage treated with insecticides and miticides increased 9 percent in 2012 in spite of the decrease in bearing acreage. Price and efficacy also affect choices of pesticide products. Figure 36 shows the most-used insecticide AIs as measured by area treated. Oils are applied during the dormant season or the growing season or both to prevent outbreaks of scales, mites, and larval moth pests. Esfenvalerate is a broad-spectrum chemical used during tree dormancy or the growing season or both and offers an alternative to the oriental fruit moth (OFM) mating disruption pheromones E-8-dodecenyl acetate, Z-8-dodecenyl acetate, and Z-8-dodecenol. The striking increases in area treated with chlorantraniliprole (42 percent) and abamectin (47 percent) suggest that growers were responding to problems caused by mites, thrips, possibly katydids in the San Joaquin Valley, and the larvae of moths such as OFM, peach twig borer, and leafrollers. Spinetoram, an AI that controls thrips, moth larvae, and katydids, was applied to 31 percent more acres than in 2011. Area treated with the broad-spectrum synthetic pyrethroid beta-cyfluthrin, which is very inexpensive, soared 79 percent. Growers also applied insect growth regulators (IGRs) to more acres: The use of pyriproxyfen, which controls sucking insects including San Jose scale, and methoxyfenozide, which affects moth larvae, was up 76 and 26 percent, respectively. IGRs are comparatively slow

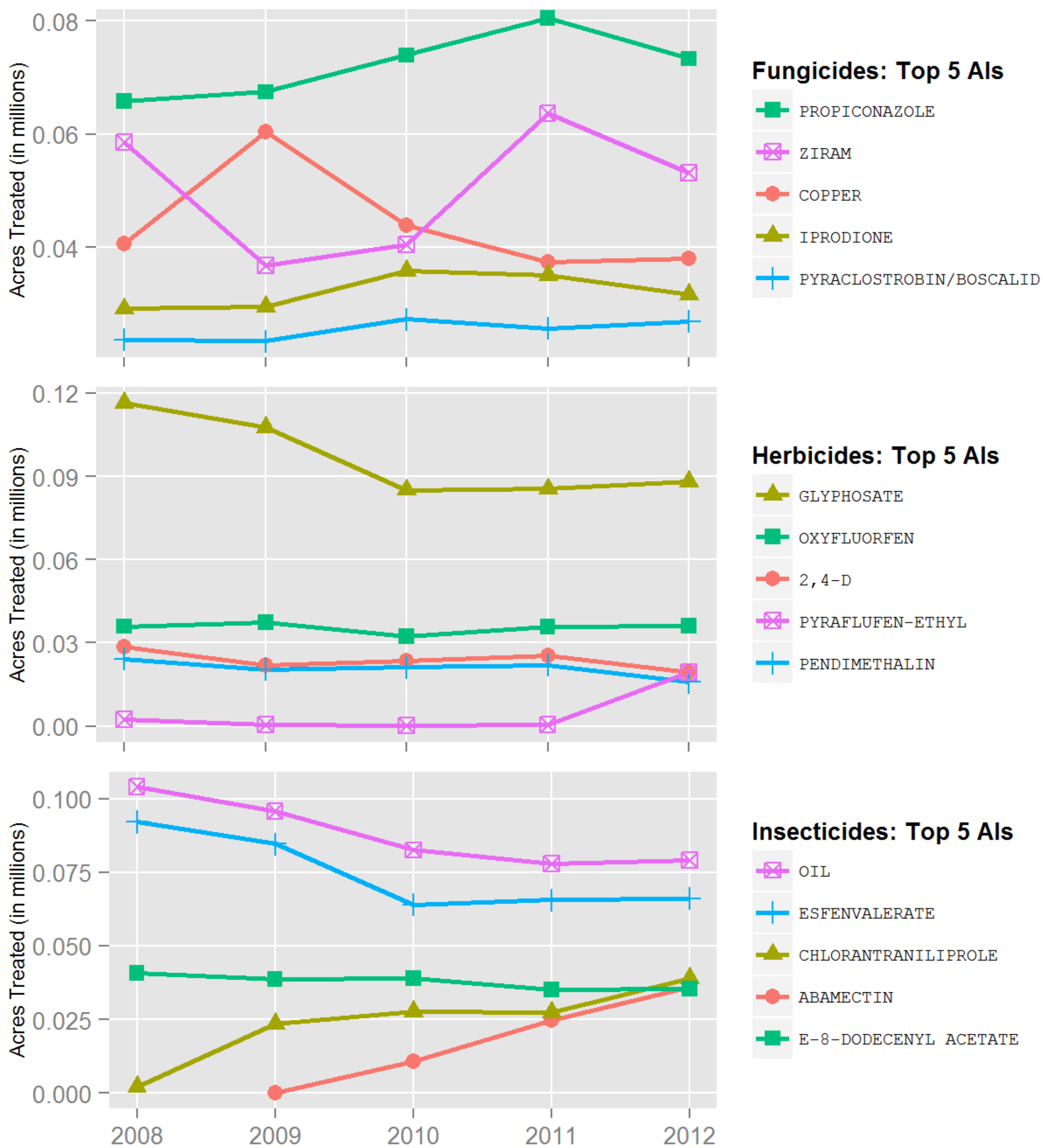

Figure 36: *Acres of peach and nectarine treated by the top 5 AIs of each AI type from 2008 to 2012.*

to take effect and applications must be well timed, but Farm Advisors have been recommending them as relatively “soft” management tools and part of AI rotations that prevent the development of resistance to other insecticides. Contrary to the general upward trend in insecticide use, phosmet was applied to 38 percent fewer acres in 2012. The continuing decrease in phosmet use may reflect pesticide residue concerns, reduced-risk cannery guidelines for growers, and declining effectiveness for moth control.

Cumulative total acres of peach and nectarine orchards treated with fungicides and sulfur during 2012 declined 4 and 5 percent, respectively—only slightly more than the decline in bearing acres (Figure 35). This suggests that crop disease pressure was similar to that in 2011. Sulfur is the standard treatment for preventing powdery mildew infection (Figure 36). 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 during 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. Tebuconazole controls brown rot and is also effective against powdery mildew and rust.

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 preventing post-harvest sour rot. These fungicides allow fruit to be shipped over longer periods to distant export markets or displayed within the marketplace at shelf temperatures without decay developing.

In spite of the dry winter, herbicides were applied to 5 percent more cumulative acres of peach and nectarine orchards in 2012 (Figure 35). Increasing problems with glyphosate-resistant weeds and significantly higher crop prices may have lessened some growers’ inclination to save money by cutting back on weed control. The area treated with pyraflufen-ethyl (Figure 36) and indaziflam soared 3,705 and 784 percent, respectively. Pyraflufen-ethyl became cheaper because its patent expired. It works well against hard-to-control weeds such as *Malva*, bindweed, and hairy fleabane and is excellent against catchweed bedstraw, an increasingly problematic weed with clinging seeds that are easily spread by animals and are annoying to orchard laborers. Indaziflam is a new AI that mixes well with other herbicides and controls glyphosate-resistant weeds such as hairy fleabane and Italian ryegrass. Oxyfluorfen, pendimethalin, rimsulfuron, and indaziflam are pre-emergence herbicides that are applied to soil before the growing season to prevent weed sprouting. Post-emergence herbicides such as glyphosate, 2,4-D, paraquat dichloride, and pyraflufen-ethyl 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. Areas with rodent burrows fumigated with aluminum phosphide dropped 87 percent, perhaps in part because lack of rainfall reduced food and shelter for rodent pests. Moreover, aluminum phosphide requires and works best in moist soils. The area treated with the most widely-used pre-plant soil fumigants, 1,3-dichloropropene and chloropicrin, decreased in 2012 73 and 88 percent, respectively. This is generally associated with decreased replanting. Indeed, in 2012 over 2,400 acres of clingstone peach trees were pulled out while only 400 acres were planted; nursery sales of small cling peach trees sank 66 percent to the lowest figure in over 20 years. In recent years relatively few acres—57 in 2012—have 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 interactions between nematode infestations, pathogen infections, rootstock choices, and application patterns also affect fumigant selection and use from year to year.

Depending on the importing country, growers who export fresh fruit may need to follow protocols that require carefully documented pre-harvest pest trapping, monitoring, and pesticide treatments or a post-harvest quarantine pesticide treatment. Methyl bromide is currently the only post-harvest fumigant used to treat fresh peach and nectarine to prevent transport of potentially invasive species within or outside the state. In 2012, a total of 3,118 pounds of methyl bromide was applied post-harvest to peach and nectarine, a decrease of approximately 9 percent.

A cumulative total of 1,096 acres of peaches and nectarines were treated with plant growth regulators (PGRs) in 2012. Gibberellins, which are plant hormones that regulate growth and development, were applied to 924 acres. Amino ethoxy vinyl glycine hydrochloride, an ethylene synthesis inhibitor, was applied to 171 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 81 percent of the U.S. production of 2.3 billion pounds in 2012. 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 2012, 62,000 acres of carrots were planted, a decrease of 5 percent from 2011 (Table 32). The amount of AI applied to carrots increased 9 percent (6.6 million in 2011 to 7.2 million in 2012),

Table 32: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for carrot each year from 2008 to 2012. Planted acres from 2008 to 2012 are from USDA, August 2013; marketing year average prices from 2008 to 2012 are from USDA, August 2013. Acres treated means cumulative acres treated (see explanation p. 10).*

	2008	2009	2010	2011	2012
Pounds AI	10,025,381	5,238,641	8,107,134	6,615,370	7,186,253
Acres Treated	622,276	427,434	445,375	457,584	499,755
Acres Planted	63,500	63,500	57,000	65,000	62,000
Price/cwt	$ 25.20	$ 25.70	$ 27.60	$ 34.20	$ 26.60

and the area treated increased 9 percent (Table 32). Reported use of herbicides and fumigants both increased 6 percent in terms of area treated, while use of fungicides increased 8 percent (Figure 37). Cumulative area of carrot treated with insecticides increased 26 percent, while the amount of insecticide applied decreased 26 percent.

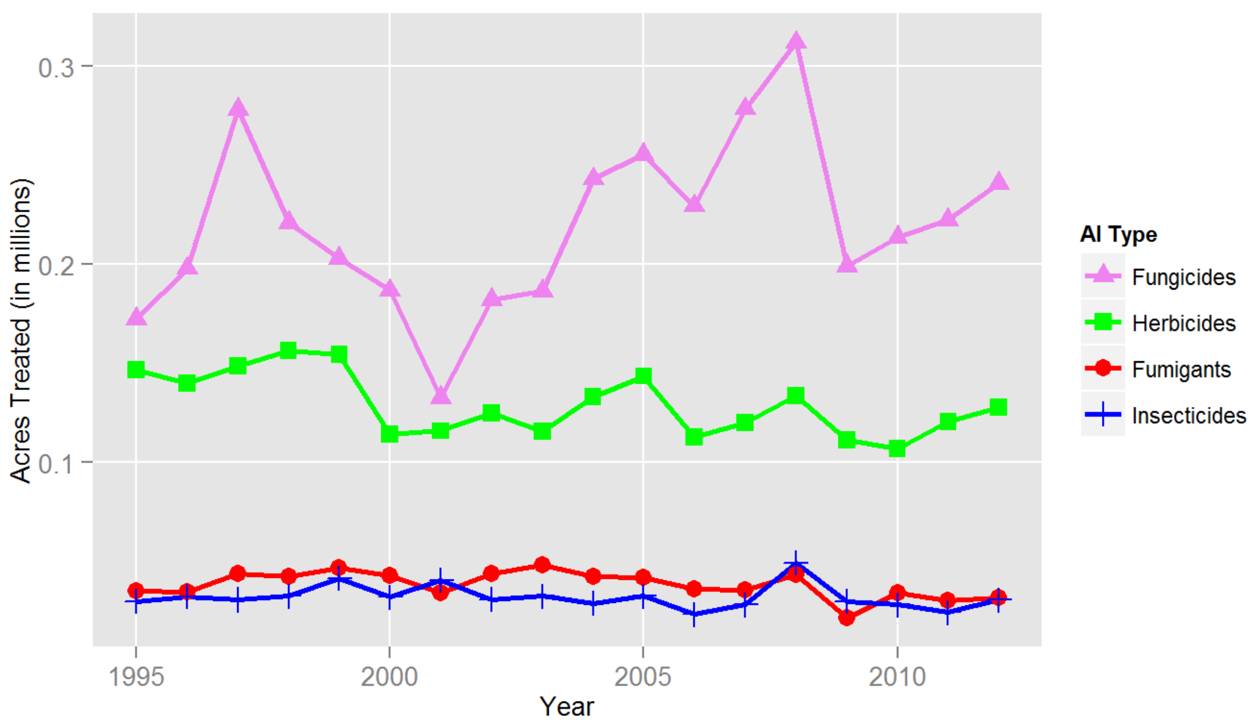

Figure 37: *Acres of carrot treated by all AIs in the major types of pesticides from 1995 to 2012.*

The most-applied fungicides in 2012, as measured by cumulative acres treated, were sulfur, mefenoxam, pyraclostrobin, and cyazofamid. The trend in fungicide use in 2012 was similar to the previous year, though mefenoxam use decreased and cyazofamid use increased (Figure 38). Cyazofamid is a relatively new fungicide for cavity spot control and is often used in rotation with mefenoxam (Figure 38). Cavity spot is a major soilborne fungal disease that is also controlled by

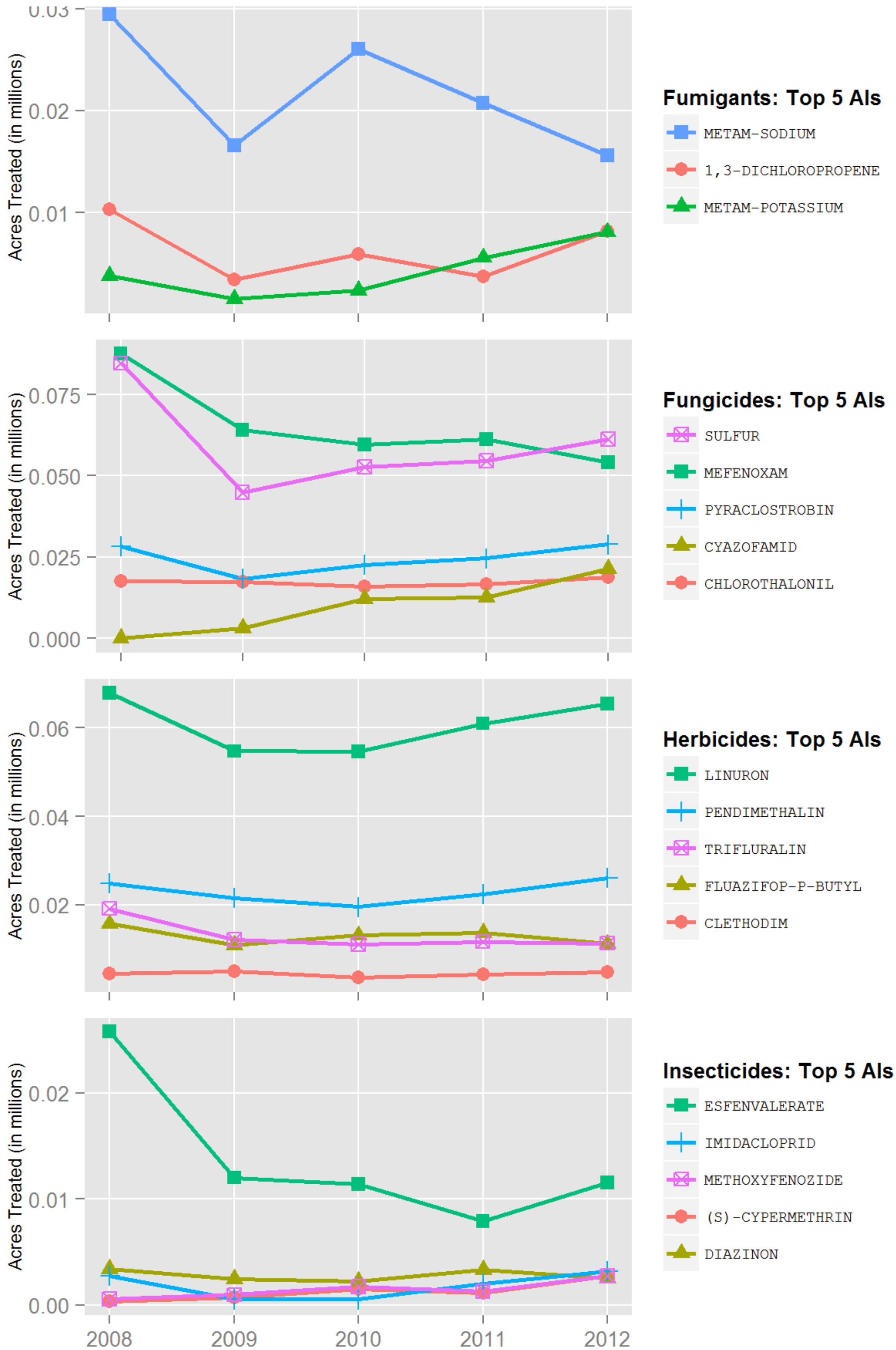

Figure 38: *Acres of carrot treated by the top 5 AIs of each AI type from 2008 to 2012.*

fenamidone or the soil fumigants metam-sodium and metam-potassium. In addition, the use of QST 713 strain of dried *Bacillus subtilis* to control soil borne diseases increased 54 percent, due in part to positive research results. Alternaria leaf blight, a foliar disease, is generally controlled with iprodione, chlorothalonil, pyraclostrobin, and azoxystrobin. Sulfur, an inexpensive and popular choice for controlling powdery mildew, saw a 12 percent increase in use (Figure 38). Copper-based pesticides, also used for powdery mildew, increased 6 percent over the previous year. Boscalid, used to control cottony soft rot, saw a 20 percent increase.

The main herbicides used in carrot production in terms of area treated in 2012 were linuron, pendimethalin, trifluralin, fluazifop-p-butyl, and clethodim (Figure 38). Linuron, a post-emergence herbicide that provides good control of broadleaf weeds and small grasses, showed a 7 percent increase in use (Figure 38). Trifluralin is a pre-emergence herbicide that complements linuron for weed management; its use decreased 3 percent. Pendimethalin, another selective herbicide, saw a 16 percent increase in use. Fluazifop-p-butyl, a selective post-emergence phenoxy herbicide used for control of annual and perennial grasses, decreased 18 percent.

The major insecticides used in 2012 in terms of area treated included esfenvalerate, imidacloprid, methoxyfenozide, s-cypermethrin, and diazinon (Figure 38). The area treated with the insecticide esfenvalerate, used against a range of insect pests such as whitefly, flea beetles, leafhoppers, and cutworms, increased 46 percent. The use of imidacloprid, effective against aphids and whiteflies, increased 60 percent, which may be attributed to its low cost and the broad-spectrum activity. Use of methoxyfenozide, a selective insecticide that controls lepidopterous pests, such as cutworms and leafhoppers, increased 113 percent, while use of the pyrethroid s-cypermethrin increased 137 percent. Use of diazinon, used to control aphids and flea beetles, decreased 26 percent, and use of methomyl, a carbamate pesticide that is effective against cutworms, leafhoppers, and whiteflies, decreased 16 percent. The use of the biological insecticide spinosad increased 224 percent after a 60 percent decline between 2010 and 2011. Growers are moving away from older broad-spectrum pesticides to those with relatively new chemistries that have fewer potential problems with target pest resistance. Concern about meeting maximum residue limits may also be contributing to growers' changing preferences.

Fumigants in carrot production are primarily used to manage nematodes and also provide control of weeds and soil-borne diseases. In terms of pounds applied, fumigants accounted for 90 percent of all pesticide AIs applied to carrot acreage. The area treated with metam-sodium decreased 25 percent, while metam-potassium use increased 45 percent. The move from metam-sodium to metam-potassium may be due to a marketing push by manufacturers and because metam-potassium adds the nutrient potassium. As metam is generally required to be applied by soil shank, which is a less effective application method, growers have also been switching to 1,3-dichloropropene, which saw a 119 percent increase in area treated. No chloropicrin use was reported in carrot production in 2012.

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