Summary of
Pesticide Use Report Data
2016

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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/docs/pur/purmain.htm>.
If you have questions concerning this report, contact <PUR.Inquiry@cdpr.ca.gov>.

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How to Access the Summary of Pesticide Use Report Data

The *Summary of Pesticide Use Report Data* issued by the California Department of Pesticide Regulation (DPR) for the years 1989-2016 can be found by clicking the "Access Annual Reports" link under the Pesticide Use Annual Summary Reports section at <www.cdpr.ca.gov/docs/pur/purmain.htm>. The tables in the Statewide Report and County Summary Reports list the pounds of active ingredient (AI) applied, the number of applications, and the number of acres or other unit treated. The data is available in two formats:

- *Indexed by chemical:* The report indexed by chemical shows all the commodities and sites in which a particular AI was applied.
- *Indexed by commodity:* The report indexed by commodity shows all the AIs that were applied to a particular commodity or site.

The following pesticide use report data can be downloaded from the Department's File Transfer Protocol (FTP) site at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur_archives/>.

- *Annual Report Data:* The raw data used in the *Pesticide Use Annual Summary Reports* for 1989 to 2016. The files are in text (comma-delimited) format and do not include updates that occur after the Pesticide Use Annual Summary was released. For more up-to-date data, use the online California Information Portal (CalPIP) at <http://calpip.cdpr.ca.gov/main.cfm> or contact DPR at <PUR.Inquiry@cdpr.ca.gov>
- *Early Pesticide Use Data 1974 - 1989:* Pesticide use data from 1974 to 1989 is available as text files.
- *Microfiche Pesticide Use Data 1970 - 1973:* Files of summarized pesticide use data from 1970 to 1973 are available as PDF scans of microfiche.

Starting in 2016, the data from each figure or table in the annual report can be found at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.

Please direct any questions regarding the *Summary of Pesticide Use Report Data* to the Department of Pesticide Regulation, Pest Management and Licensing Branch, P.O. Box 4015, Sacramento, California 95812-4015, or you may request copies of the data by contacting <PUR.Inquiry@cdpr.ca.gov>.

Year in Summary

Reported pesticide use for California in 2016 totaled 209 million pounds of applied active ingredients (AIs) and 101 million cumulative acres treated. Compared to 2015, pounds of AIs decreased by 3 million (1.4 percent) while the area treated increased by 4.3 million (4.4 percent). Biopesticides increased in both the pounds applied and the area treated since 2015. Pounds of pesticides considered to be reproductive toxins, carcinogens, cholinesterase inhibitors, ground water contaminants, toxic air contaminants, fumigants, and oils all decreased since 2015, although the area treated with carcinogens, ground water contaminants, and oils increased. The AIs with the highest total reported pounds were sulfur, petroleum and mineral oils, 1,3-dichloropropene, glyphosate, and metam-potassium (potassium N-methyldithiocarbamate) while the AIs with the highest reported cumulative area treated were glyphosate, sulfur, petroleum and mineral oils, abamectin, and copper.

1 Introduction

California's pesticide use reporting program is the most comprehensive in the world. California has reported pesticide use in some form since 1934. However the detailed reporting that occurs today did not begin until the 1990s. Until 1954, only statistics on aerial pesticide applications were recorded. In 1954, state regulators asked for reports on ground application acreage, without any detailed information about the pesticides used or commodities treated. In 1970, growers were required to report all applications of restricted materials and pest control operators were required to report all pesticides used. The Food Safety Act of 1989 (Chapter 1200, AB 2161) gave DPR statutory authority to require full reporting of agricultural pesticide use. In 1990, California became the first state requiring full reporting of agricultural pesticide use to better inform DPR's pesticide regulatory programs. Prior to full reporting, the regulatory program's estimates of pesticide use frequently relied on maximum rates and applications as listed on the label, overstating many risks. Over the years, these data have been used by a variety of individuals and groups, including government officials, scientists, growers, legislators, and public interest groups. Most pesticide use data required to be reported must be sent to the county agricultural commissioner (CAC), who then reports the data to DPR. On average, DPR collects around three million pesticide use records a year. Currently the PUR database contains over 77 million pesticide use records, going back to 1990. (A pesticide application record represents an individual pesticide product, even if it was applied simultaneously with other products in the field or if it contained more than one AI).

California's broad definition of "agricultural use" requires reporting pesticide applications in production agriculture, parks, golf courses, cemeteries, rangeland, pastures, and along roadside and railroad rights-of-way. Production agricultural pesticide use is a subset of agricultural use, defined as use of a pesticide for the "production for sale of an agricultural commodity" or "agricultural plant commodity." Each application of pesticide on crops (production agriculture) must include the site name given to a location or field by the CAC as well as the section (square mile) in which the application occurred. Most other uses are aggregated and reported by month with only the county identified. These other uses include rights-of-way applications, all postharvest pesticide treatments of agricultural commodities, structural applications by licensed applicators, all pesticide treatments in poultry and fish production, and some livestock applications. In addition, all applications made by licensed applicators and outdoor applications of pesticides that have the potential to pollute ground water must be reported. The primary exceptions to the reporting requirements are residential home and garden uses, veterinary uses, and most industrial and institutional uses.

In addition to requiring pesticide use reporting, California law (Food and Agricultural Code [FAC] section 12979) directs DPR to use the reports in setting priorities for monitoring food, enforcing pesticide laws, protecting the safety of farm workers, monitoring the environment for unanticipated residues, researching pest management practices, monitoring and researching public health issues, and similar activities. These activities help DPR continuously evaluate currently registered pesticides (FAC section 12824), another mandated activity. Information gathered during continuous evaluation is used to gauge the performance of DPR's regulatory programs and justify additional measures, including development of new regulations or reevaluation or cancellation of pesticide registrations. 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 increases 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 product applied. These data allow scientists and others to identify trends in pesticide use, compare use locations with other geographical information and data, and perform quantitative assessments and evaluations of risks pesticides may pose to human health and the environment.

DPR uses the PUR throughout its pesticide regulatory programs in ways that can be broadly grouped as temporal (time), geospatial (place), and quantitative (amount), often combining 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 acute and chronic risks to human health, 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. 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 contributions of smog-forming volatile organic compounds (VOCs) in the atmosphere from pesticide products using pesticide use data in combination with emissions potential data of products. DPR further refines the analyses to specific air basins that are particularly vulnerable to air pollution to 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 examine the proximity of pesticide use to endangered species habitat, resulting in the development of best use practices to protect these species. These analyses are invaluable 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 information provided in the PUR allows researchers to apply realistic assumptions when modeling pesticide exposure. PUR data have been used to model pesticide exposure of people who live near agricultural lands, workers in the field, handlers preparing and applying pesticides, and aquatic organisms inhabiting waterways that receive agricultural runoff. Analysis of the PUR enables well-informed and realistic assessments for risk management decisions.

It is frequently assumed that increases in the pounds, area treated, or number of applications of pesticides will correspond to higher risk to human health or the environment. However it is important to remember that risk is a function not only of the pesticide amount used, but also the toxicity of the AI to a non-targeted organism and the organism's exposure to the AI. For example, kaolin clay was a large contributor to the total pounds of pesticides used in California in 2016, ranking 10th in the top 100 pesticides used by pounds. Kaolin is a biopesticide and considered a minimum risk chemical. Increased use of lower risk chemicals do not heighten risk in the same way as increases in use of conventional chemicals, and may actually serve to reduce overall risk if they are used as alternatives to higher risk chemicals.

In contrast, some AIs with high toxicity are only needed in very small amounts to be effective pest control agents, and therefore have low total pounds. However if the toxicity, mode of action, and selectivity of the AI can cause unintended harm to a non-target organism, then a small amount of an AI with high toxicity could pose a greater risk than a large amount of an AI with a lower known toxicity.

In addition to toxicity, exposure plays a large role in determining potential human health or environmental risks. Minimizing exposure to an AI is generally thought to reduce risk of harm from the AI. Risk can therefore be mitigated through a number of tools and practices that minimize exposure, such as personal protective equipment (PPE), buffer zones, drift reduction practices and equipment, application timing with favorable environmental conditions, vegetative filter strips, tailwater ponds, and many other innovative techniques. In summary, when using PUR data to assess risk from an AI, consider the AI's toxicity and exposure potential as well.

The passage of the federal Food Quality Protection Act (FQPA) of 1996 launched the PUR into a more integral role as a tool for monitoring and achieving compliance with updated food safety regulations. 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. PUR data became increasingly important to commodity groups, University of California (UC) specialists, the United States Environmental Protection Agency (U.S. EPA), and other interested parties as they reassessed tolerances and calculated dietary risks from pesticides based on actual reported uses.

PUR information such as pesticide type, use rates, geographical locations, crops, and timing of applications help researchers understand how various pest management options are implemented in the field. Analyses of these data are the basis for grant projects that 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 state, regional, and local agencies, scientists, and public interest groups. The data are an invaluable tool for understanding pesticide use in order to protect human health and the environment while balancing the population's need for quality food, fiber, shelter, and surroundings.

Data Collection

Partial reporting of agricultural pesticide use has been in place in California since the 1930s, although much of this early data has been lost or is not available through DPR. In the early years, CACs required agricultural pest control operators to submit monthly reports. County requirements varied, but many reports included a statement for each application that showed the grower's name, the location and date of the application, the crop and the size of area treated, the target pest, and the type and amount of 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 discontinued requirements for detailed reporting of pesticides used and commodities treated. In 1970, DPR required growers to report all applications of restricted-use pesticides, and pest control operators to report all pesticides used, whether restricted or not. 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 within 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. DPR adopted regulations the same year and full-use reporting began in 1990. The first years of full-use reporting nearly overwhelmed DPR's capacity to process data. Use reports were on paper, and required staff to manually enter data from more than a million records each year. DPR began searching almost immediately for ways to automate reporting from pesticide users to the CAC, 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 CACs. Meanwhile, technological progress and increasing use of online resources by businesses fed expectations for more web-based functionality for pesticide use reporting.

CalAgPermits

In 2011, the counties implemented CalAgPermits, a standardized, web-based system that greatly enhanced the efficiency of data entry and transfer, and thus the accuracy and integrity of the PUR database. In addition to helping CACs issue restricted-materials permits, it allowed individuals and firms the option of reporting pesticide use electronically. CalAgPermits also greatly enhanced data quality assurance by adding another level of automated data validation and error checking of submitted pesticide use reports in addition to what occurs after transmission to DPR. The many improvements in the ability to share data electronically between DPR and CACs have greatly improved the efficiency and effectiveness of quality control for the PUR.

Improving Data Quality

DPR checks the quality of PUR data many times between the initial data entry and before it is made available to the public. CalAgPermits checks for data entry errors, such as whether the pesticide applicator has the correct permits for any restricted materials reported or whether the pesticide product is allowed on the reported application site. Once the data have been received by DPR they undergo more than 50 different validity checks such as verifying product registration numbers and confirming that products are registered for use on the reported site of application. The PUR database may include products that do not have an active registration since end-users are allowed to continue using stocks purchased prior to a product's registration becoming inactive. Records flagged for suspected errors are returned electronically to the county for resolution. Additional data checks are performed to identify errors and outliers in pesticide use amounts via an extensive statistical method developed by DPR in the late 1990s. If a reported use rate (amount of pesticide per area treated) greatly exceeds maximum label rates, it is flagged as an error and sent back to the CAC to confirm. If the county is unable to identify the correct rate, an estimated rate equal to the median rate of all other applications of the pesticide product on the same crop or site is used instead. Although less than one percent of the reports are flagged with this type of error, some errors are so large that if included, they would significantly affect the total cumulative amount of applied pesticides. For more information on errors and identifying outliers

in the PUR, see <www.cdpr.ca.gov/docs/pur/outlier.pdf> and
<www.cdpr.ca.gov/docs/pestmgt/pubs/pm9801.pdf>

Improving Access to the Data

There are several ways to access the PUR data. Annual reports serve as an accessible snapshot summary of the much larger PUR database. Before the late 1990s, summaries were available by request and were only hard copy. As use of online resources increased, DPR improved public access to the data and presented it in a more meaningful context, posting the summary annually on its website <www.cdpr.ca.gov/docs/pur/purmain.htm >. In addition, the PUR data used in each annual report from 1984 on can be downloaded from DPR's FTP website <ftp://pestreg.cdpr.ca.gov/pub/outgoing/pur_archives>. This data does not include any updates that may have occurred after the release of the annual report. Scans of the hard copy summaries from 1974 to 1989 are also available on the FTP site, although they are less a report and more of a tabular summary of pesticide use data by county. They differ greatly from the current type of detailed annual reports analyzing various pesticide use trends done today. Recently, PDF files of scanned summary pesticide use reports on microfiche from 1970 to 1973 were added to the FTP site for download.

Starting in 1996, DPR scientists began analyzing critical crops and their pest problems as well as trends in the pounds of pesticides used, and the number of applications and acres treated. Each year, the annual report charts pesticide use over several years in specific categories:

- Reproductive toxins
- Carcinogens
- organophosphorus and carbamate cholinesterase inhibitors
- Chemicals classified by DPR as ground water contaminants
- Chemicals listed by DPR as toxic air contaminants
- Fumigants
- Oil pesticides derived from petroleum distillation (many of which serve as alternatives to high-toxicity pesticides)
- Biopesticides (including microorganisms, naturally occurring compounds, or compounds similar to those in nature that are not toxic to the target pest, such as pheromones)
- Crops (DPR analyzes pesticide use trends for around a dozen crops with the highest amount of pesticide used or acreage treated)

Pesticide use trend analyses can help regulatory 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 to finding solutions.

In 2003, DPR launched the web-based California Pesticide Information Portal (CalPIP) database to increase public access to the PUR. CalPIP provides pesticide use information including date, site or crop treated, pounds used, acres treated, pesticide product name, AI name, application pattern (ground, air, or other), county, ZIP code, and location where the application was made to within a one-square-mile area. CalPIP annually updates the previous few years of data to account for any changes due to errors identified after the annual report has been released, so it is the most up-to-date source of pesticide information available via the website <http://www.cdpr.ca.gov/docs/pur/purmain.htm >.

Starting in 2016, text files of the data from all tables and figures in the annual reports can be accessed at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.

2 Comments and Clarifications of Data

When analyzing the data contained in this report, it is important to consider the following:

Terminology

- *Product versus active ingredient (AI):* A pesticide product contains both active and inert ingredients. An AI is a component of a pesticide product that controls target pests. There can be more than one AI in a product. Inert ingredients are all the other ingredients of the product which do not target the pest but may enhance product performance and application. Pesticide use of products is reported to DPR, where the associated AIs are identified and their use trends are analyzed.
- *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:* Total pounds of active ingredient summed over a given time period, geographic area, crop, or other category of interest. The pounds of AI in a single application is calculated by converting the product amount to pounds, then multiplying the pounds of product by the percent of the AI in the product.
- *Unit type:* The type of area treated with the pesticide:

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

- *Risk Analysis:* When using PUR data to analyze potential human health or environmental risks, consider the toxicity of the AI and the potential for exposure.

Agricultural and Nonagricultural Pesticide Use

Many pesticide licensing, sales, and use requirements are tied to California's definition of agricultural use. Pesticide labels differentiate between agricultural, industrial, or institutional uses. Some pesticide products are labeled for both agricultural and nonagricultural uses.

California law (FAC section 11408) identifies agricultural use as all use except the following categories specifically identified as nonagricultural use:

- *Home:* Use in or around the immediate environment of a household. Licensed, professional pesticide applications are reported as nonagricultural use (usually "structural pest control" or "landscape maintenance"). Unlicensed, non-professional, residential pesticide applications around a home or garden are not required to be reported.
- *Industrial:* Use in or on property necessary to operate factories, processing plants, packing houses, or similar buildings or use for a manufacturing, mining, or chemical process. Postharvest commodity fumigations for buildings or on trucks, vans, or rail cars are normally considered industrial use. Industrial pesticide uses are not required to be reported unless the pesticide is a restricted material, has the potential to pollute ground water, or was made by a licensed pest control operator. In California, industrial use does not include use on rights-of-way.
- *Institutional:* Use in or on property necessary to operate buildings such as hospitals, office buildings, libraries, auditoriums, or schools. Includes pesticide use on landscaping and around walkways, parking lots, and other areas bordering the institutional buildings. Institutional pesticide uses are not required to be reported unless the pesticide is a restricted material, has the potential to pollute ground water, or was made by a licensed pest control operator. Note that the Healthy Schools Act of 2000 requires additional pesticide use reporting by both unlicensed and licensed professionals if the pesticide application takes place at a school or childcare center. See the California School and Child Care Pesticide Use Report Summary for more information at <http://apps.cdpr.ca.gov/schoolipm/school_ipm_law/2015_pur_summary.pdf >.
- *Structural:* Use by licensed structural pest control operators within the scope of their licenses
- *Vector control:* Use by certain vector control (e.g., mosquito abatement) districts
- *Veterinary:* Use according to a written prescription of a licensed veterinarian. Veterinary prescription pesticide use is not reported to the State.

Agricultural use of pesticides includes:

- *Production agricultural use:* Any pesticide used to produce a plant or animal agricultural product (food, feed, fiber, ornamental, or forest) that will be distributed in the channels of trade (Some requirements—most notably those that address worker safety and use reporting—apply only to plant product production.)

- *Nonproduction agricultural use:* Any pesticide used on watersheds, rights-of-way, and landscaped areas (e.g., golf courses, parks, recreation areas, and cemeteries) not covered by the definitions of home and institutional uses

The following specific 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 (where livestock is defined in FAC section 18663 as "any cattle, sheep, swine, goat, or any horse, mule or other equine, whether live or dead")
- 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, including agricultural and structural applicators and maintenance gardeners

What must be reported. Growers must submit their production agricultural pesticide use reports to the CAC by the tenth day of the month following the month in which the work was performed, and pest control businesses must submit seven days after the application. Not all information submitted to the counties is transferred to DPR.

Production agricultural pesticide use reports include the following:

- Date and time of application
- Geographic location including the county, section, township, range, base, and meridian.
- Operator identification number (An operator identification number, sometimes called a "grower ID," is issued by CAC to property operators. The number is needed to report pesticide use and to purchase restricted-use pesticides. Pest control professionals are not required to obtain an operator ID number.)
- Operator name and address (this information is not submitted to DPR)

- Site identification number (A site identification code must be assigned to 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 obtains for the location. CalAgPermits has a map server feature that tracks locations of sites for county use.)
- Commodity, crop, or site treated
- Acres or units planted and treated
- Application method (e.g., by air, ground, or other means)
- Fumigation methods. Since 2008, fumigation applications in nonattainment areas that do not meet federal air quality standards for pesticide VOC emissions must be identified along with details on fumigation methods (for example, shallow shank injection with a tarp). This information allows DPR to estimate pesticide VOC emissions, which contribute to the formation of atmospheric ozone, an important air pollutant.
- Product name, U.S. EPA Registration Number (or the California Registration Number if the product is an adjuvant), and the amount of product applied

All other kinds of pesticide use (mostly nonagricultural) are reported as monthly summaries that include the following information:

- Pesticide product name
- Product registration number
- Amount used
- Number of applications
- Application site (e.g., roadside, structure)
- Month of application (rather than date and time)
- County (rather than square mile location)

Commodity Codes

DPR uses its product label database at <www.cdpr.ca.gov/docs/label/labelque.htm>to verify that products listed in pesticide use reports are registered for use on the reported commodity or site. The product label database uses a coding system consistent with U.S. EPA official label information. To minimize errors, DPR developed a cross-reference table to link the different commodity code naming systems of the U.S. EPA, DPR's product label database, and the PUR database.

Certain commodities or sites may have more than one site code associated with them if different production methods or uses of the commodity result in different pesticide use. For example, greenhouse and nursery operations are divided into six different site codes: 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 are also separated into further subcategories because of public and processor interest in differentiating pesticide use. Tomatoes are assigned codes to differentiate between fresh market and processing categories. Grapes are assigned separate codes to differentiate table grapes and raisins from wine grapes.

Unregistered Use

The PUR database may contain records of pesticide use on a commodity or site for which the pesticide is not currently registered. Unregistered uses that survive the error-checking process may be due to an error in the DPR product label database, where the product incorrectly lists a commodity or site as being registered. Other unregistered uses may be flagged as errors by the validation procedures, but left unchanged in the database. The error-checking process does not check whether the product was registered at the time of application. It is therefore possible that an application flagged as an error due to a recent change in registration may have been legally applied at the time of application. In addition, the law sometimes allows growers to use existing stocks of a pesticide product following its withdrawal from the market by the manufacturer, or suspension or cancellation by regulatory authorities since the safest way to dispose of small quantities of pesticides is to use them as they were intended. Finally, some pesticide products do not list specific sites or commodities on their labels as they are designed to target specific pests across all sites, such as some soil fumigants, certain pre-plant herbicides, and rodenticides. In these cases, reporting an application of one of these types of pesticides on a specific commodity or site can result in an error. In 2015, an option was added in CalAgPermits that allows the user to designate any application as “pre-plant” and enter the commodity or site without generating any error messages.

Adjuvants

Use data on spray adjuvants (e.g., emulsifiers, wetting agents, foam suppressants, and other efficacy enhancers) were not reported before full-use reporting was required. Adjuvants are exempt from federal registration requirements but must be registered as pesticides in California. Examples of adjuvants include many alkyl groups and some petroleum distillates. Adjuvant product formulations are considered proprietary and are therefore confidential, however pesticide use totals for adjuvant AIs are included in the annual report.

Cumulative Area Treated

The cumulative area treated is the sum of the area treated with an AI and is expressed in acres (applications reported in square feet are converted to acres). The cumulative area treated for a crop may be greater than the planted area of the crop since this measure accounts for a field being treated with the same AI more than once in a year. For example, if a 20-acre field is treated three times in a calendar year with an AI, the cumulative area treated would be reported as 60 acres while the area planted would be reported as 20 acres.

It is important, however, to be aware of the potential to over-count acreage when summing cumulative area for products that have more than one AI. If a 20-acre field is treated with a product that contains three different pesticide AIs, the PUR record will correctly show that the *product* was applied to 20 acres, but that 20 acre value will also be attributed to each of the three AIs in any chemical summary reports. Adding these values across the AIs results in a total of 60 acres treated instead of the 20 acres actually treated.

Number of Applications

The number of applications is only included in the Annual Summary Report for 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, required for all uses other than production agriculture, includes only monthly totals for all applications of pesticide product, site or commodity, and applicator.

The total number of applications in the monthly summary reports is not consistently reported, so they are no longer included in the annual totals. (In the annual PUR reports before 1997, each monthly summary record was counted as one application). On January 1, 2015, an amendment to section 8505.17 of the Business and Professions Code (BPC) brought about by the passage of Senate Bill 1244 (Chapter 560, Statutes of 2014), eliminated the requirement to report the number of applications made in monthly summary structural PURs.

Note that in the annual summary report arranged by commodity, the total number of agricultural applications for the site or commodity may not equal the sum of all applications of the listed AIs. Since the summary report is at the AI level rather than the product level, a single application of a product comprised of two AIs will result in the summary report assigning the single application to both AIs listed under the commodity heading. Summing the agricultural applications for these two AIs would result in an incorrect total of two applications. The total applications value at the bottom of each commodity section removes the possibility of over-counting applications for products with more than one AI, and is therefore a more accurate value.

3 Data Summary

This report is a summary of 2016 data submitted to DPR as of November 15, 2017. PUR data are continually updated and therefore may not match later data from CalPIP or internal queries that contain corrected records identified after November 15, 2017

Pesticide Use in California

In 2016, as in previous years, the region of greatest pesticide use was California's San Joaquin Valley (Table 1). The four counties in this region with the highest use were Fresno, Kern, Tulare, and San Joaquin. These counties were also among the leading producers of agricultural commodities.

Table 1: *Total pounds of pesticide active ingredients reported in each county and their rank during 2015 and 2016 Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2015 Pesticide Use		2016 Pesticide Use	
County	Pounds Applied	Rank	Pounds Applied	Rank
Alameda	356,325	38	360,559	38
Alpine	193	58	281	58
Amador	95,631	45	78,129	46
Butte	3,306,041	15	3,271,154	16
Calaveras	52,815	47	48,085	48
Colusa	2,595,276	20	3,138,962	17
Contra Costa	584,109	35	563,511	35
Del Norte	227,927	41	195,887	42
El Dorado	138,775	43	230,567	41
Fresno	37,581,795	1	35,567,669	1
Glenn	2,233,754	22	2,293,773	22
Humboldt	38,258	50	32,232	52
Imperial	4,976,019	11	5,124,263	12
Inyo	14,009	53	10,607	54
Kern	30,670,096	2	28,903,992	2
Kings	7,042,532	10	7,328,763	9
Lake	740,529	33	721,232	33
Lassen	56,676	46	100,520	43
Los Angeles	2,592,352	21	3,024,023	19
Madera	11,323,030	5	11,425,670	5
Marin	107,494	44	71,458	47
Mariposa	5,868	56	5,560	57
Mendocino	1,307,631	29	1,120,876	30

Table 1: (continued) *Total pounds of pesticide active ingredients reported in each county and their rank during 2015 and 2016*

	2015 Pesticide Use		2016 Pesticide Use	
County	Pounds Applied	Rank	Pounds Applied	Rank
Merced	10,160,010	6	10,119,227	6
Modoc	219,143	42	100,020	44
Mono	12,046	54	9,615	55
Monterey	8,905,055	7	9,284,537	7
Napa	1,581,698	25	1,299,485	27
Nevada	49,511	49	97,449	45
Orange	1,231,731	30	1,142,033	29
Placer	383,067	37	454,124	36
Plumas	20,971	52	38,440	50
Riverside	2,681,367	19	2,606,925	20
Sacramento	4,801,314	13	4,338,672	14
San Benito	589,269	34	637,849	34
San Bernardino	459,904	36	436,478	37
San Diego	1,458,461	27	1,569,683	23
San Francisco	28,935	51	35,023	51
San Joaquin	12,957,834	4	12,673,685	4
San Luis Obispo	3,184,087	16	3,091,363	18
San Mateo	251,756	40	271,027	40
Santa Barbara	4,968,188	12	5,532,928	11
Santa Clara	1,015,796	31	1,071,587	32
Santa Cruz	1,811,436	23	1,544,921	24
Shasta	295,022	39	329,075	39
Sierra	11,305	55	6,504	56
Siskiyou	1,427,377	28	1,478,211	25
Solano	1,462,366	26	1,346,221	26
Sonoma	2,861,105	18	2,494,712	21
Stanislaus	8,173,058	8	7,951,325	8
Sutter	3,147,643	17	3,369,985	15
Tehama	982,727	32	1,105,807	31
Trinity	4,944	57	19,992	53
Tulare	17,624,938	3	18,609,075	3
Tuolumne	50,298	48	46,618	49
Ventura	7,244,729	9	6,398,833	10
Yolo	4,185,401	14	4,560,736	13
Yuba	1,603,597	24	1,282,976	28
Total	211,893,222		208,972,917	

The reported pesticide use in California in 2016 totaled 209 million pounds, a decrease of 3 million pounds (1.4 percent) from 2015. However some categories of use increased, including postharvest treatments, structural pest control, and landscape maintenance. This increase was offset by the decrease in other categories including production agriculture. Production agriculture is a major category of pesticide use and accounted for the largest reduction, decreasing by 3.4 million pounds (1.7 percent). The remaining assortment of nonagricultural pesticide uses decreased as a whole. This group includes pesticide use for research purposes, vector control, pest and weed control on rights-of-way, and pest control through fumigation of non-food and non-feed materials such as lumber and furniture.

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

Table 2: *Pounds of pesticide active ingredients, 1997 – 2016, by general use categories. Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

Year	Production Agriculture	Post Harvest Treatment	Structural Pest Control	Landscape Maintenance	All Others	Total Pounds
1997	199,694,676	1,777,188	5,185,970	1,235,894	7,147,425	215,041,153
1998	207,992,472	1,760,530	5,931,495	1,407,583	6,874,185	223,966,266
1999	189,345,049	2,060,056	5,674,333	1,412,264	7,909,979	206,401,682
2000	175,767,355	2,168,039	5,187,138	1,414,911	6,854,993	191,392,435
2001	142,963,333	1,462,405	4,922,721	1,290,221	6,324,233	156,962,913
2002	159,214,706	1,852,840	5,469,442	1,449,922	6,834,210	174,821,120
2003	161,053,737	1,785,861	5,177,463	1,975,875	7,526,972	177,519,908
2004	165,915,813	1,874,372	5,120,256	1,612,079	6,996,641	181,519,160
2005	178,369,766	2,260,998	5,625,434	1,775,693	8,517,652	196,549,543
2006	168,668,283	2,216,081	5,273,696	2,286,811	10,269,493	188,714,363
2007	157,481,913	2,279,800	3,967,382	1,672,415	7,345,894	172,747,405
2008	149,461,898	2,540,234	3,202,934	1,589,069	7,236,696	164,030,831
2009	146,532,963	1,479,799	2,911,101	1,345,141	6,017,106	158,286,109
2010	159,970,741	2,160,685	3,699,144	1,734,479	8,022,669	175,587,718
2011	176,774,117	1,528,673	3,148,495	1,718,976	8,396,499	191,566,761
2012	172,058,414	1,241,628	3,465,077	1,555,818	9,330,694	187,651,631
2013	179,166,278	1,525,908	3,804,902	1,465,832	9,971,500	195,934,421
2014	174,874,059	1,333,815	3,736,006	1,618,823	8,899,479	190,462,182
2015	195,115,662	1,475,160	4,299,088	1,690,883	9,312,430	211,893,222
2016	191,738,176	1,650,838	4,622,736	1,747,464	9,213,702	208,972,917

4 Trends in Pesticide Use for Select Pesticide Categories

This report discusses three different measures of pesticide use: amount of AI applied in pounds, cumulative area treated in acres (for an explanation of cumulative area treated see page 12), and to a lesser degree, application counts. While most pesticides are applied at rates of one to two pounds per acre, some may be as low as a few ounces or as high as hundreds of pounds per acre. When comparing use among different AIs, pounds of use will emphasize pesticides used at high rates, such as sulfur, horticultural oils, and fumigants. In contrast, area treated lacks the bias toward pesticides with higher application rates, identifying the pesticides used over the widest area. However area treated is not always reported for non-production-agricultural pesticide use reports. Application counts can also be a useful measure of pesticide use, however it has been inconsistently reported for non-production-agricultural use and is no longer required for structural use reporting, so it is not included as often in the annual report.

The contrast between measuring pesticide use by pounds or by acres can be seen by looking at the use of different pesticide types (Figures 1 and 2). Figure 1, the amount applied by weight (pounds), shows that pesticides with both fungicidal and insecticidal properties (fungicide/insecticides) such as sulfur had the highest use, followed by insecticides and fumigants. By cumulative area (acres) treated in Figure 2, insecticides, herbicides, and fungicides had the highest use. The trends in use for a single AI will usually follow similar patterns of increases or decreases for both pounds and area treated measures of pesticide use. However, when looking at cumulative totals of many AIs over a period of time or a region, the trends may diverge depending on what measure of pesticide use is analyzed, with pounds increasing while area treated decreases, or vice versa.

There were 209 million pounds of pesticides used in 2016, a decrease of nearly 3 million pounds (1.4 percent) from 2015. The AIs with the highest total reported pounds were sulfur, petroleum and mineral oils, 1,3-dichloropropene, glyphosate, and metam-potassium (potassium N-methyldithiocarbamate). Sulfur accounted for 23 percent of all reported pesticide pounds in 2016.

Reported pesticide use by cumulative area treated in 2016 was 101 million acres, an increase of 4.3 million acres (4.4 percent) from 2015. The non-adjuvant pesticides applied to the greatest area in 2015 were glyphosate, sulfur, petroleum and mineral oils, abamectin, and copper (Figures 3, 4, and A-1). The top AIs for each pesticide type were petroleum and mineral oils (insecticides), copper (fungicides), sulfur (fungicide/insecticide combinations), glyphosate (herbicides) and aluminum phosphide (fumigants).

Since 1990, the reported pounds of pesticides applied and acres treated have fluctuated from year to year. These fluctuations can be attributed to a variety of factors, including changes in planted acreage, crop plantings, pest pressures, and weather conditions. An increase or decrease in use from one year to the next or in the span of a few years may not necessarily indicate a general

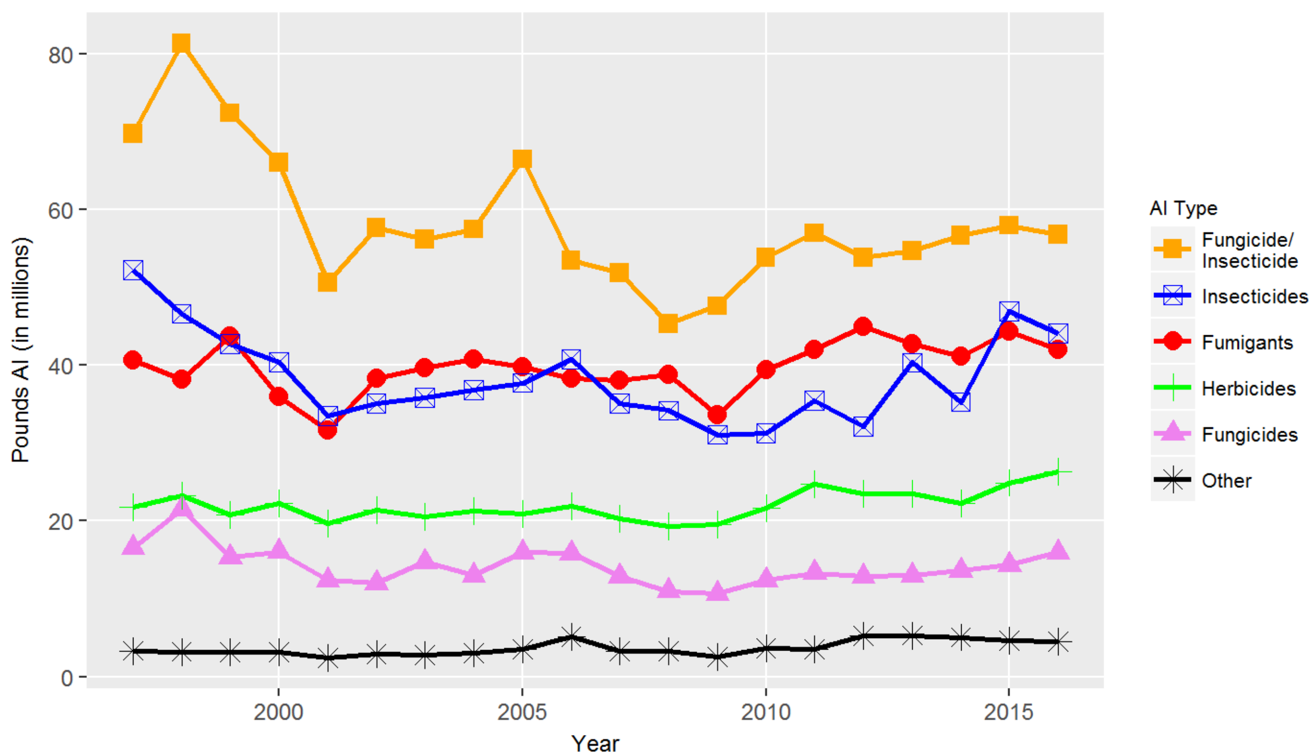


Figure 1: *Pounds of all AIs in the major types of pesticides from 1997 to 2016, where Other includes pesticides such as rodenticides, molluscicides, algaecides, repellents, antimicrobials, antifoulants, disinfectants, and biocides. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

trend in use, but rather variations related to changes in weather, pricing, supply of raw ingredients, or regulations. Regression analyses on use over the last twenty years do not indicate a significant trend of either increase or decrease in total pesticide use.

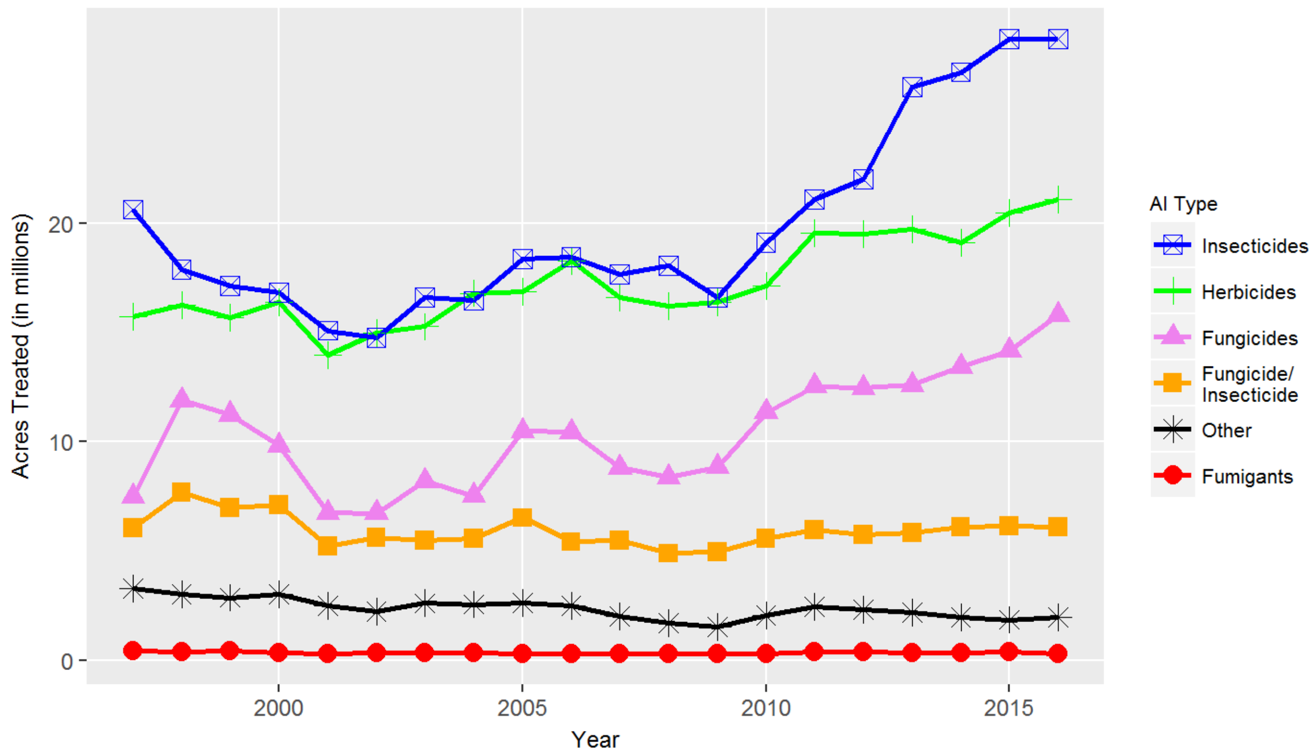


Figure 2: *Acres treated by all AIs in the major types of pesticides from 1997 to 2016, where Other includes pesticides such as rodenticides, molluscicides, algaecides, repellents, antimicrobials, antifoulants, disinfectants, and biocides. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

Pesticide use is summarized for eight different pesticide categories from 2007 to 2016 (Tables 3 – 18) and from 1997 to 2016 (Figures 5 – 12). These categories include reproductive toxicity, carcinogens, cholinesterase inhibitors, ground water contaminants, toxic air contaminants, fumigants, oils, and biopesticides. Changes from 2015 to 2016 are summarized as follows:

- *Reproductive toxins:* Chemicals classified as reproductive toxins decreased in amount applied from 2015 to 2016 (224 thousand-pound decrease, 2.9 percent) and area treated (135 thousand-acres treated decrease, 3.5 percent). The decrease in amount applied was mainly due to a decrease in use of the fumigant metam-sodium. The decrease in area mostly resulted from less use of the fungicides myclobutanil, the insecticide carbaryl, and the herbicide bromoxynil octanoate. Pesticides in this category are listed on the State's Proposition 65 list of chemicals known to cause reproductive toxicity. Propazine, simazine and atrazine were added to the Proposition 65 list in 2016 or 2017.

- *Carcinogens:* The amount of pesticides classified as carcinogens decreased by 2.3 million pounds from 2015 to 2016 (4.9 percent decrease), but the area treated increased by 165,000 acres (1.8 percent). The decrease in amount applied was largely due to less use of the

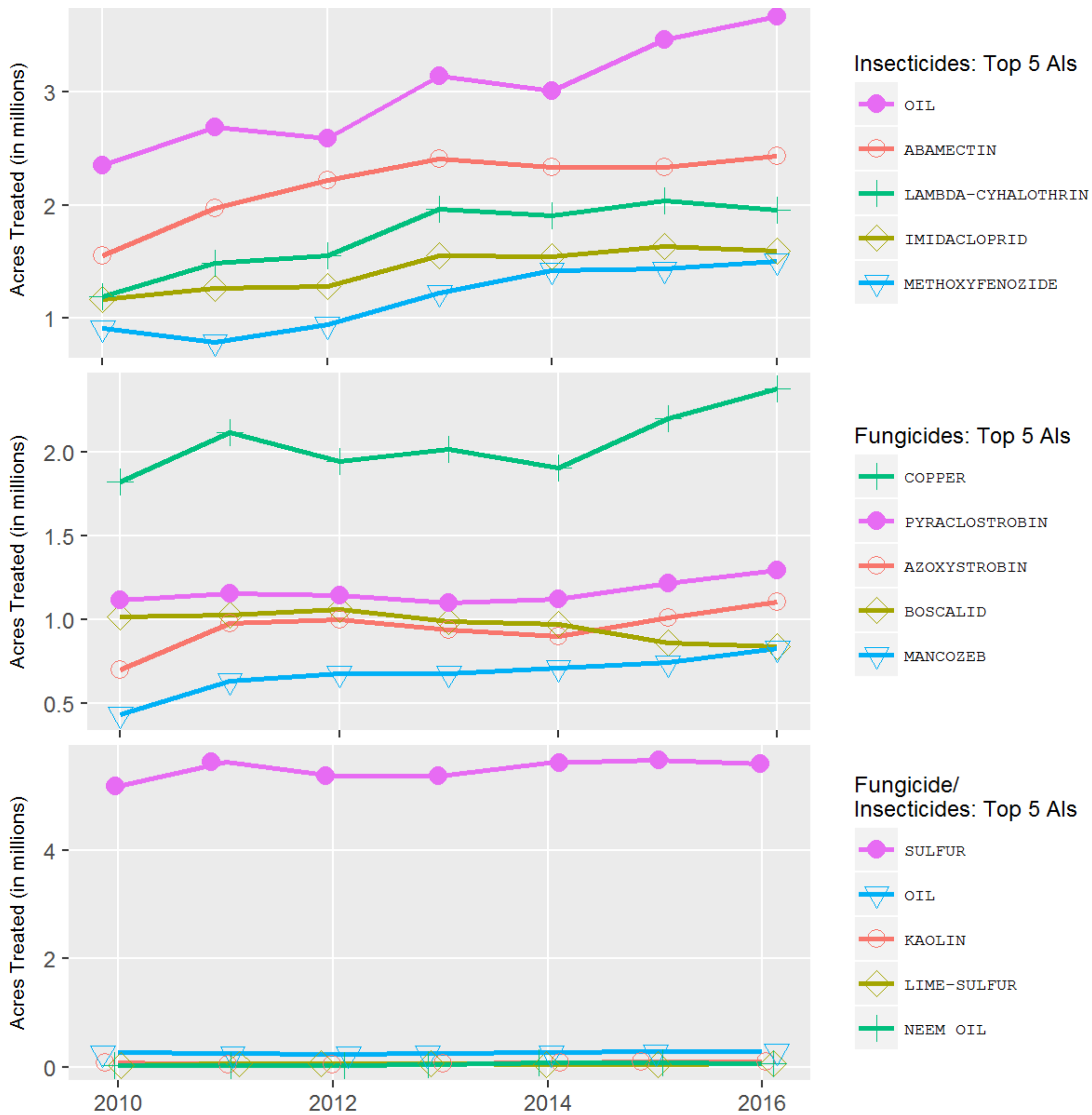


Figure 3: *Acres treated by the top 5 AIs in each of the major types of pesticides from 2010 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

fumigants 1,3-dichloropropene, metam-potassium, and metam-sodium. The increase in area treated was mostly due to greater use of the fungicides iprodione and mancozeb and the herbicide propyzamide. The pesticides in this category are listed by U.S. EPA as A or B carcinogens or on the State's Proposition 65 list of chemicals known to cause cancer. Glyphosate (and derivatives), malathion, parathion, sedaxane, and tetrachlorvinphos were added to the Proposition 65 or EPA lists in 2016 or 2017.

- *Cholinesterase inhibitors:* Use of organophosphorus and carbamate cholinesterase-inhibiting pesticides decreased from the previous year by 45,000 pounds (1.0 percent decrease) and by 231,000 acres treated (6.6 percent decrease). Most of the

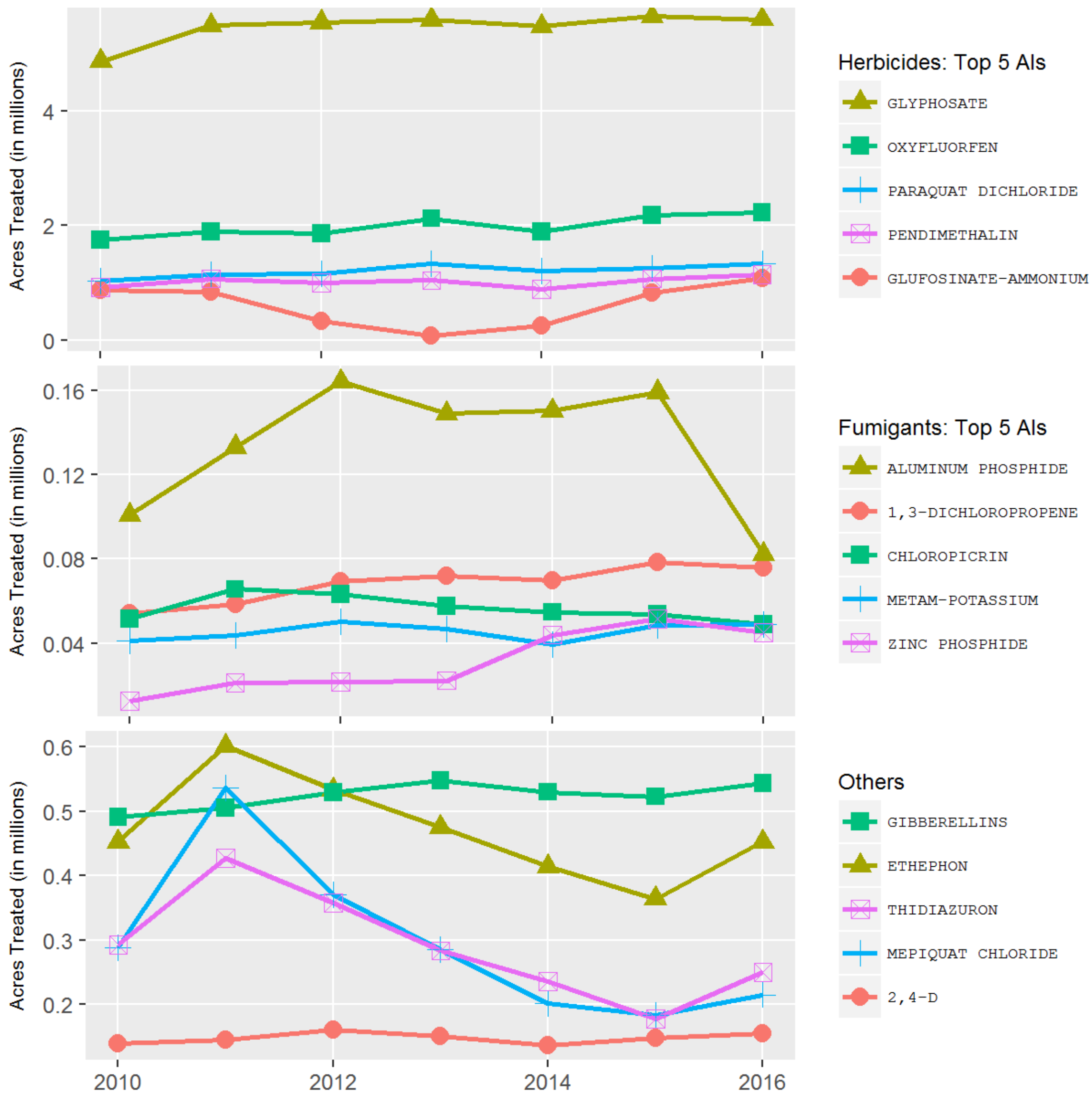


Figure 4: *Acres treated by the top 5 AIs in each of the major types of pesticides from 2010 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

decrease in amount applied and area treated resulted from a decrease in the use of the insecticide chlorpyrifos, which was designated as a restricted-use pesticide for agriculture in 2015. Other AIs with large decreases were malathion, bensulide, and dimethoate.

- *Ground water contaminants:* The use of AIs categorized as ground water contaminants decreased in amount applied by 101,000 pounds (17.2 percent decrease) but increased in area treated by 41,000 acres (9.3 percent increase), mainly from changes in the use of the herbicide diuron.

- *Toxic air contaminants:* The use of AIs categorized as toxic air contaminants decreased in amount applied by 2.2 million pounds (4.5 percent decrease) and decreased in area treated by 86,000 acres (3.4 percent decrease). Decreases in the pounds of metam-potassium, metam-sodium, and 1,3-dichloropropene accounted for much of the overall decrease in amount applied. The decrease in area treated was due to less acres treated with the herbicide trifluralin and the fumigant aluminum phosphide.

- *Fumigants:* The use of fumigant AIs decreased by 2.5 million pounds (5.5 percent decrease) and by 97,000 acres treated (24.2 percent decrease). Much of the decrease was due to less pounds applied of metam-potassium, metam-sodium, and 1,3-dichloropropene, and less area treated with aluminum phosphide.

- *Oils:* Use of oil pesticides decreased in amount by 3.3 million pounds (7.9 percent decrease), but increased in area treated by 329,000 acres (6.8 percent increase). Only oil AIs derived from petroleum distillation are included in these totals. Although some oils are listed on the State's Proposition 65 list of chemicals known to cause cancer, none of these carcinogenic oils are known to be used as pesticides in California. Most oil pesticides used in California serve as alternatives to highly toxic pesticides. Some highly refined petroleum-based oils are also used by organic growers.

- *Biopesticides:* Use of biopesticides and AIs considered to be lower risk to human health or the environment increased in amount by 792,000 pounds (11.5 percent increase) and by 522,000 acres (7.0 percent increase). Potassium phosphite and kaolin had the largest increases in pounds, while citric acid, vegetable oil, and potassium phosphite accounted for most of the increase by area treated. Kaolin is used both as a fungicide and insecticide, potassium phosphite is a fungicide, and citric acid and vegetable oil are adjuvants. In general, biopesticides are derived from or synthetically mimic natural materials such as animals, plants, bacteria, and minerals. Biopesticides fall into three major classes: microbial, plant-incorporated protectant, or naturally occurring substances.

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 2.)

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 nonagricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
1080	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4-DB ACID	9,185	11,416	13,523	4,570	55	5,826	10,807	10,547	9,104	19,023
ABAMECTIN	12,362	12,846	16,624	19,345	26,945	33,008	40,419	38,521	40,045	45,140
AMITRAZ	0	0	7	0	0	0	1,486	45	101	28
ARSENIC PENTOXIDE	7,805	7,433	400	16,144	8,034	9,240	8,480	16,719	22,190	10,508
ARSENIC TRIOXIDE	<1	<1	<1	<1	<1	<1	0	<1	<1	<1
ATRAZINE	27,546	28,491	23,260	28,937	22,654	32,173	23,763	20,896	17,912	21,282
BENOMYL	590	100	56	31	27	32	3	10	2	1
BROMACIL, LITHIUM SALT	1,172	1,851	896	1,835	1,486	1,422	1,145	2,472	2,891	2,504
BROMOXYNIL OCTANOATE	41,406	65,375	50,300	43,643	47,704	56,495	49,699	44,247	52,458	45,145
CARBARYL	141,971	126,678	135,264	113,066	74,690	113,900	117,252	131,744	155,525	220,860
CARBON DISULFIDE	36	393	<1	0	1	18	0	1	<1	<1
CHLORDECONE	<1	0	0	0	<1	<1	<1	<1	<1	<1
CYANAZINE	0	0	0	0	1	<1	0	1	3	<1
CYCLOATE	31,868	21,242	25,284	27,292	30,950	33,562	30,619	36,566	39,655	45,150
CYCLOHEXIMIDE	0	0	0	0	<1	0	0	0	0	0
DICHLOROPHEN	0	0	0	0	0	0	<1	0	0	0
DICLOFOP-METHYL	157	0	15	0	7	0	0	0	0	0
DINOCAP	2	2	2	0	<1	0	0	0	0	0
DINOSEB	81	166	816	26	75	60	22	374	7	581
DIOCTYL PHTHALATE	610	340	186	453	248	262	198	73	36	94
DISODIUM CYANODITHIOIMIDO CARBONATE	0	0	0	0	0	80	<1	0	101	280
ENDRIN	0	0	0	<1	0	0	0	0	0	0
EPTC	152,707	129,470	128,993	118,509	125,570	168,665	187,349	235,271	237,983	255,431
ETHYLENE DIBROMIDE	3	127	<1	0	0	6	0	0	<1	0
ETHYLENE GLYCOL MONOMETHYL ETHER	2,653	1,986	2,257	5,187	4,326	3,782	6,202	5,601	7,601	7,627
ETHYLENE OXIDE	2	3	7	0	0	8	0	<1	0	0
FENOXAPROP-ETHYL	153	219	11	<1	8	0	0	0	0	0
FLUAZIFOP-BUTYL	5	3	21	11	8	6	17	43	16	23
HEPTACHLOR	0	0	0	0	0	<1	0	0	0	0
HYDRAMETHYLNON	887	825	393	609	1,096	486	444	6,024	399	301
LINURON	58,592	60,247	51,265	48,424	54,339	57,637	52,529	54,158	50,395	52,249
METAM-SODIUM	9,930,337	9,497,562	9,028,103	11,153,272	10,837,368	8,428,425	4,846,428	4,297,539	3,606,650	3,297,827
METHANOL	0	0	0	0	0	0	0	0	0	2

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	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
METHYL BROMIDE	6,448,717	5,693,394	5,615,683	4,809,280	4,002,102	4,017,075	3,534,425	2,963,036	2,655,234	2,602,823
METIRAM	0	0	0	0	15	34	17	13	<1	4
MOLINATE	75,241	19,653	12,516	24	<1	3	<1	<1	<1	5
MYCLOBUTANIL	68,403	61,550	59,056	65,604	65,272	64,425	61,080	65,056	61,036	58,794
NABAM	9,073	9,635	8,963	10,518	13,358	13,485	22,187	16,535	9,357	18,414
NICOTINE	<1	<1	<1	<1	7	<1	0	0	<1	0
NITRAPYRIN	9	0	84	211	0	<1	2	0	5	2
OXADIAZON	12,517	9,402	8,741	12,382	7,781	7,272	6,759	4,960	12,139	5,009
OXYDEMETON-METHYL	122,723	111,612	68,576	71,290	26,013	17,562	10,656	8,407	6,610	3,764
OXYTETRACYCLINE HYDROCHLORIDE	2,433	80	147	1,356	208	81	266	15	45	7,223
OXYTHIOQUINOX	166	170	45	6	<1	1	<1	1	0	1
POTASSIUM DIMETHYL DITHIO CARBAMATE	0	0	<1	0	0	0	0	0	0	0
PROPARGITE	531,832	386,203	378,099	294,853	295,374	252,218	291,001	246,496	213,205	206,164
PROPAZINE	0	0	0	0	0	665	4	1	0	0
RESMETHRIN	452	269	211	206	122	46	19	188	4	146
SIMAZINE	541,296	438,952	419,423	378,363	421,905	368,621	300,394	242,895	179,321	163,332
SODIUM DIMETHYL DITHIO CARBAMATE	9,073	9,800	8,963	11,053	13,358	13,485	22,187	16,535	9,357	18,414
STREPTOMYCIN SULFATE	5,809	4,394	3,233	4,040	4,646	4,054	4,797	5,161	4,737	15,254
SULFUR DIOXIDE	162,856	187,804	127,394	191,393	228,612	188,459	247,117	227,965	247,898	279,789
TAU-FLUVALINATE	1,028	1,068	1,179	869	833	1,083	1,082	1,361	1,220	1,249
THIOPHANATE-METHYL	99,497	74,903	89,882	115,025	86,988	109,775	103,618	112,593	113,192	128,485
TRIADIMEFON	873	1,503	1,056	2,153	1,918	2,427	1,620	1,986	1,623	1,232
TRIBUTYLTIN METHACRYLATE	0	0	0	0	0	0	1	0	0	0
TRICHLORO ETHYLENE	0	0	0	0	1	0	<1	0	0	0
TRIFORINE	64	69	4	42	22	2	4	1	<1	<1
VINCLOZOLIN	392	512	476	217	328	470	151	219	149	125
WARFARIN	1	<1	<1	1	2	2	1	1	<1	<1
TOTAL	18,512,588	16,977,747	16,281,416	17,550,242	16,404,457	14,006,338	9,984,252	8,814,279	7,758,210	7,534,281

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 available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1080	170	<1	67	176	127	<1	111	4	<1	4
2,4-DB ACID	15,080	19,457	21,629	6,980	121	11,301	13,739	14,719	15,508	26,333
ABAMECTIN	1,257,542	1,225,216	1,274,898	1,552,360	1,972,337	2,222,666	2,406,516	2,335,421	2,338,023	2,430,329
AMITRAZ	0	0	74	0	0	0	351	316	88	450
ARSENIC PENTOXIDE	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
ARSENIC TRIOXIDE	<1	<1	<1	<1	<1	<1	0	<1	<1	<1
ATRAZINE	17,382	16,766	15,767	19,990	17,236	23,827	18,305	15,404	14,537	17,237
BENOMYL	568	221	162	0	24	19	1	<1	<1	<1
BROMACIL, LITHIUM SALT	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BROMOXYNIL OCTANOATE	136,831	186,026	146,301	125,926	139,293	153,503	132,256	118,306	133,826	119,809
CARBARYL	97,016	96,136	107,458	80,082	68,074	97,229	96,647	108,805	136,319	116,551
CARBON DISULFIDE	<1	1	<1	0	<1	<1	0	<1	<1	<1
CHLORDECONE	1	0	0	0	<1	<1	<1	<1	<1	<1
CYANAZINE	0	0	0	0	4	<1	0	<1	<1	<1
CYCLOATE	15,601	10,581	12,058	13,799	14,879	17,565	16,045	19,124	21,037	23,173
CYCLOHEXIMIDE	0	0	0	0	4	0	0	0	0	0
DICHLOROPHEN	0	0	0	0	0	0	<1	0	0	0
DICLOFOP-METHYL	224	0	30	0	20	0	0	0	0	0
DINOCAP	8	7	7	0	1	0	0	0	0	0
DINOSEB	16	453	304	111	427	81	55	450	67	<1
DIOCTYL PHTHALATE	13,258	3,582	4,928	7,921	4,741	5,311	3,188	1,885	626	76
DISODIUM CYANODITHIOIMIDO CARBONATE	0	0	0	0	0	235	<1	0	300	831
ENDRIN	0	0	0	<1	0	0	0	0	0	0
EPTC	51,706	45,560	49,708	44,289	47,645	56,872	69,989	89,126	91,512	100,884
ETHYLENE DIBROMIDE	<1	<1	<1	0	0	<1	0	0	<1	0
ETHYLENE GLYCOL MONOMETHYL ETHER	26,412	14,857	14,573	35,802	37,552	35,682	34,566	35,902	38,633	29,998
ETHYLENE OXIDE	<1	2	60	0	0	<1	0	<1	0	0
FENOXAPROP-ETHYL	2,552	3,444	142	<1	61	0	0	0	0	0
FLUAZIFOP-BUTYL	<1	6	2	80	<1	<1	40	3	180	<1
HEPTACHLOR	0	0	0	0	0	<1	0	0	0	0
HYDRAMETHYLNON	931	1,138	1,280	4,689	1,514	6,876	1,376	1,653	5,307	6,854
LINURON	81,041	81,244	68,604	68,058	76,828	81,958	73,493	76,353	70,944	74,469
METAM-SODIUM	78,030	71,815	74,132	71,407	70,794	58,998	28,145	24,422	24,254	19,437
METHANOL	0	0	0	0	0	0	0	0	0	23
METHYL BROMIDE	45,675	35,685	39,587	32,232	46,785	30,147	26,429	16,578	12,753	11,031
METIRAM	0	0	0	0	<1	<1	<1	<1	<1	<1

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
MOLINATE	17,476	4,529	2,942	6	<1	<1	3	<1	1	1
MYCLOBUTANIL	599,368	545,175	512,906	588,750	567,201	574,436	537,492	564,798	544,951	524,782
NABAM	2	1	3	12	<1	<1	<1	<1	<1	6
NICOTINE	<1	<1	<1	<1	<1	<1	0	0	<1	0
NITRAPYRIN	35	0	88	111	0	<1	1	0	<1	<1
OXADIAZON	2,991	2,747	1,451	1,712	927	1,148	1,511	1,239	1,777	1,067
OXYDEMETON-METHYL	161,835	140,760	82,368	86,131	27,438	18,204	12,163	9,096	7,355	7,883
OXYTETRACYCLINE HYDROCHLORIDE	24,825	473	815	8,644	1,125	364	1,417	1	<1	52,727
OXYTHIOQUINOX	9	5	4	4	1	1	<1	<1	0	7
POTASSIUM DIMETHYL DITHIO CARBAMATE	0	0	<1	0	0	0	0	0	0	0
PROPARGITE	261,953	186,581	174,063	137,106	141,890	114,213	121,952	104,758	87,943	87,222
PROPAZINE	0	0	0	0	0	<1	<1	<1	0	0
RESMETHRIN	18	3	11	<1	6	4	436	18	7	3
SIMAZINE	411,719	320,992	339,117	289,006	322,104	241,359	205,338	165,261	118,823	112,782
SODIUM DIMETHYL DITHIO CARBAMATE	2	1	3	12	<1	<1	<1	<1	<1	6
STREPTOMYCIN SULFATE	38,468	27,011	24,453	28,966	39,115	34,895	38,017	39,705	40,747	67,829
SULFUR DIOXIDE	71	19	2,503	256	45	1,323	218	535	777	400
TAU-FLUVALINATE	4,777	5,708	5,015	4,583	5,045	4,996	5,398	5,363	5,195	5,484
THIOPHANATE-METHYL	100,011	71,867	92,429	122,563	85,053	124,162	120,670	134,968	119,799	129,407
TRIADIMEFON	1,806	2,043	1,007	1,172	2,358	1,341	907	1,282	2,042	1,185
TRIBUTYLTIN METHACRYLATE	0	0	0	0	0	0	<1	0	0	0
TRICHLORO ETHYLENE	0	0	0	0	<1	0	<1	0	0	0
TRIFORINE	373	11	10	22	3	<1	<1	3	<1	<1
VINCLOZOLIN	258	212	85	86	99	34	11	5	10	6
WARFARIN	3,165	1,118	365	290	1,290	3,115	381	435	556	236
TOTAL	3,469,201	3,121,449	3,071,407	3,333,322	3,692,169	3,921,843	3,967,167	3,885,937	3,833,898	3,968,517

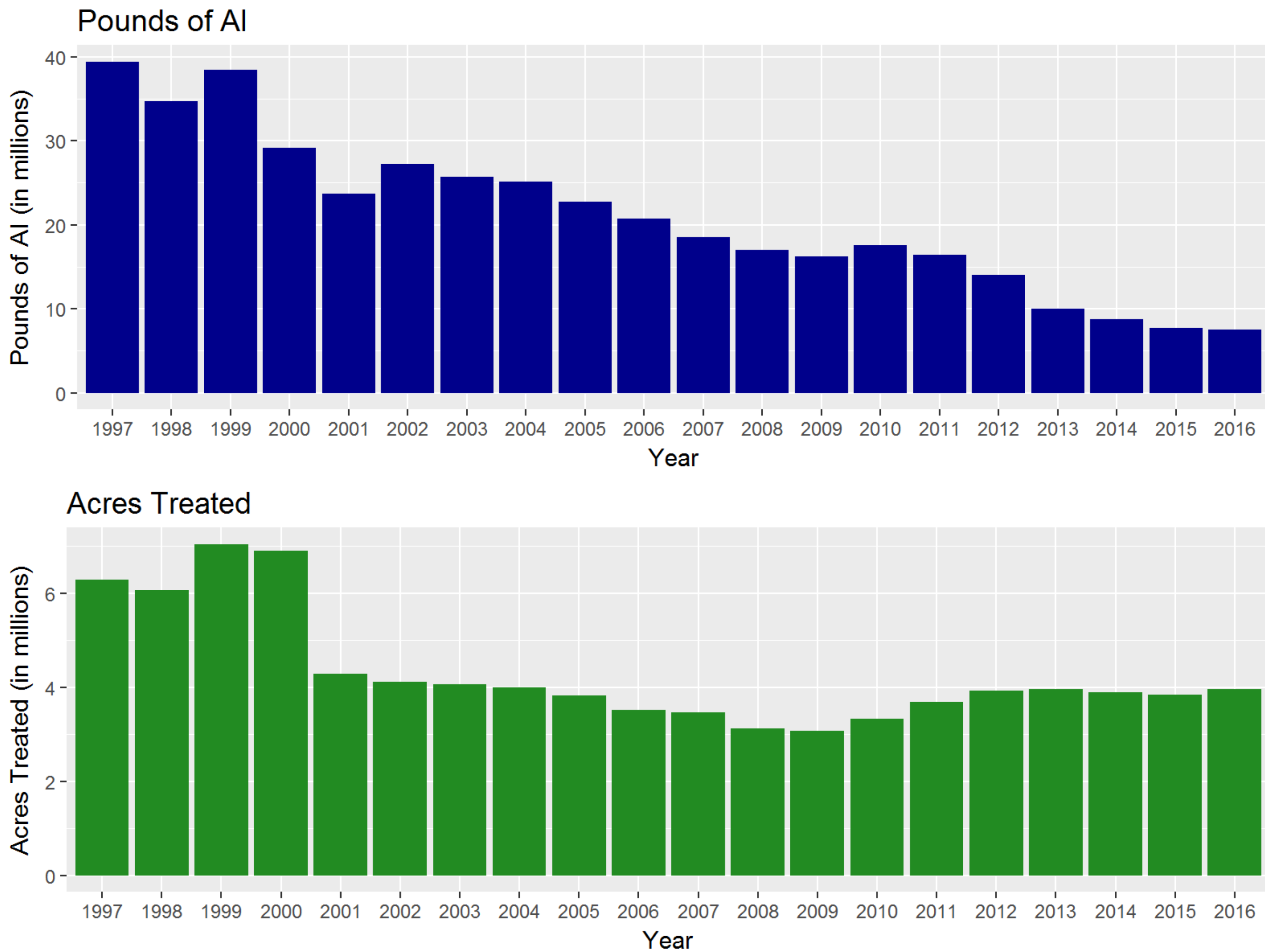


Figure 5: *Use trends of pesticides that are on the State's Proposition 65 list of chemicals that are "known to cause reproductive toxicity." Reported pounds of active ingredient (AI) applied include both agricultural and nonagricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

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

Table 5: *The reported pounds of pesticides used that are listed by U.S. EPA as A or B carcinogens or on the State's Proposition 65 list of chemicals that are "known to cause cancer." Use includes both agricultural and reportable nonagricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1,2-DICHLOROPROPANE, 1,3-DICHLOROPROPENE AND RELATED C3 COMPOUNDS	10,532	0	0	0	0	6	0	1	0	0
1,3-DICHLOROPROPENE	9,596,317	9,708,712	6,399,534	8,777,714	10,892,540	11,947,156	12,941,042	13,614,468	15,689,571	14,126,938
ACIFLUORFEN, SODIUM SALT	0	0	0	<1	0	<1	<1	<1	0	0
ALACHLOR	3,911	4,343	6,362	9,936	9,294	8,836	6,562	5,118	3,230	84
AMITROLE	7	3	5	4	4	6	0	0	0	2
ARSENIC ACID	0	0	0	0	17	0	0	0	0	0
ARSENIC PENTOXIDE	7,805	7,433	400	16,144	8,034	9,240	8,480	16,719	22,190	10,508
ARSENIC TRIOXIDE	<1	<1	<1	<1	<1	<1	0	<1	<1	<1
AURAMINE	0	0	<1	0	0	0	0	0	0	0
CACODYLIC ACID	41	43	<1	3	<1	<1	0	<1	0	<1
CAPTAN	456,475	362,757	329,747	450,225	376,278	403,428	349,430	370,136	511,017	638,194
CARBARYL	141,971	126,678	135,264	113,066	74,690	113,900	117,252	131,744	155,525	220,860
CARBON TETRACHLORIDE	180	1,980	<1	0	6	90	0	7	<1	<1
CHLORDANE	0	2	6	6	0	16	0	0	2	0
CHLORDECONE	<1	0	0	0	<1	<1	<1	<1	<1	<1
CHLOROTHALONIL	736,173	566,773	715,152	956,931	1,144,670	1,183,472	1,114,931	1,215,447	1,068,624	1,124,450
CHROMIC ACID	10,904	10,384	559	22,555	11,224	12,908	11,847	23,358	31,629	15,709
CREOSOTE	3	<1	<1	0	0	0	3	0	1	0
DAMINOZIDE	7,192	7,094	6,570	9,361	8,425	8,250	8,576	8,427	8,959	7,443
DDVP	6,376	6,859	4,164	4,169	5,253	4,888	4,619	4,032	4,078	3,977
DICLOFOP-METHYL	157	0	15	0	7	0	0	0	0	0
DIETHANOLAMINE	0	0	0	0	0	0	0	0	76	392
DIOCTYL PHTHALATE	610	340	186	453	248	262	198	73	36	94
DIPROPYL ISOCINCHOMERONATE	2	<1	<1	1	1	<1	<1	<1	1	<1
DIURON	860,510	734,757	622,598	588,574	669,486	554,618	413,291	325,345	317,328	248,007
ETHOPROP	24,241	26,897	20,793	5,495	7,475	2,077	2,502	3,076	1,820	2,023
ETHYL ACRYLATE	<1	<1	0	9	36	0	2	11	4	1
ETHYLENE DIBROMIDE	3	127	<1	0	0	6	0	0	<1	0
ETHYLENE DICHLORIDE	0	<1	0	0	0	0	0	0	0	0
ETHYLENE OXIDE	2	3	7	0	0	8	0	<1	0	0
FENOXYCARB	4	8	5	3	3	2	1	1	9	2
FOLPET	0	<1	0	<1	0	<1	<1	<1	<1	<1
FORMALDEHYDE	47,733	24,306	3,972	5,511	4,615	3,847	11,165	52,989	31,956	23,116
GLYPHOSATE	4,648	5,803	8,167	10,737	5,290	1,894	645	21	129	40

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GLYPHOSATE, DIAMMONIUM SALT	37,421	34,534	34,032	11,987	11,468	2,428	2,989	3,673	1,019	897
GLYPHOSATE, DIMETHYLAMINE SALT	0	0	13,801	29,788	127,348	123,817	92,504	128,942	139,644	156,425
GLYPHOSATE, ISOPROPYLAMINE SALT	4,451,947	4,156,738	4,735,453	5,569,940	5,883,987	4,985,836	5,009,812	4,877,739	4,857,445	5,312,363
GLYPHOSATE, MONOAMMONIUM SALT	69,014	65,103	31,567	24,675	22,691	11,921	36,553	21,965	12,390	18,612
GLYPHOSATE, POTASSIUM SALT	2,768,712	2,735,388	2,399,288	3,073,675	4,682,659	5,403,848	5,307,485	5,611,737	6,516,610	6,412,855
GLYPHOSATE-TRIMESIUM	7,663	2,972	2,153	535	574	144	41	310	0	0
HEPTACHLOR	0	0	0	0	0	<1	0	0	0	0
IMAZALIL	14,421	23,415	13,255	26,181	25,767	26,004	26,013	19,312	22,305	25,719
IPRODIONE	255,123	252,212	248,877	349,030	352,547	297,788	260,201	240,455	220,085	298,265
KRESOXIM-METHYL	14,646	8,243	27,338	32,107	38,494	26,276	26,213	28,346	23,912	22,895
LINDANE	2	21	8	18	1	0	2	0	6	0
MALATHION	468,614	484,322	531,966	560,117	511,327	405,353	446,890	502,997	443,128	354,955
MANCOZEB	408,652	330,238	281,639	754,844	1,042,475	1,131,008	1,149,329	1,282,132	1,273,675	1,432,250
MANEB	1,061,028	861,006	656,648	370,333	53,485	6,260	1,383	1,274	286	1,871
METAM-SODIUM	9,930,337	9,497,562	9,028,103	11,153,272	10,837,368	8,428,425	4,846,428	4,297,539	3,606,650	3,297,827
METHYL EUGENOL	0	0	0	0	5	0	9	0	0	126
METHYL IODIDE	0	0	0	0	1,157	21	0	0	0	0
METHYLENE CHLORIDE	55	48	32	31	24	61	53	76	35	39
METIRAM	0	0	0	0	15	34	17	13	<1	4
NAPHTHALENE	0	0	0	1	<1	0	<1	0	0	0
NITRAPYRIN	9	0	84	211	0	<1	2	0	5	2
NITROFEN	0	0	2	0	0	0	0	0	0	0
ORTHO-PHENYLPHENOL	5,128	4,389	2,133	2,271	2,306	2,964	1,713	1,777	1,313	1,038
ORTHO-PHENYLPHENOL, SODIUM SALT	2,266	3,211	2,294	2,129	5,192	3,586	4,375	3,611	4,815	2,261
ORYZALIN	664,266	604,932	529,735	602,291	766,483	686,207	584,258	582,736	510,611	314,812
OXADIAZON	12,517	9,402	8,741	12,382	7,781	7,272	6,759	4,960	12,139	5,009
OXYTHIOQUINOX	166	170	45	6	<1	1	<1	1	0	1
PARA-DICHLOROBENZENE	15	1	17	0	<1	18	<1	0	0	0
PARATHION	479	33	118	248	196	25	<1	1	836	41
PENTACHLOROPHENOL	22	4	0	3	18	224	274	11	25	1
PIRIMICARB	1	5	2	1	1	0	0	0	0	0
POTASSIUM DICHROMATE	0	0	0	0	0	0	<1	0	<1	0
POTASSIUM N-METHYLDITHIOCARBAMATE	3,785,436	5,524,647	4,102,412	4,832,615	5,672,183	8,320,255	9,484,467	7,798,703	10,252,596	9,343,192
PROPARGITE	531,832	386,203	378,099	294,853	295,374	252,218	291,001	246,496	213,205	206,164
PROPOXUR	191	188	202	298	808	359	373	251	100	48
PROPYLENE OXIDE	110,068	105,600	111,609	300,008	448,767	389,070	410,360	400,719	396,191	367,437
PROPYZAMIDE	114,882	104,077	73,811	51,384	49,651	47,404	42,022	42,662	41,902	93,849

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

AI	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
PYMETROZINE	6,499	4,833	2,905	3,820	2,832	3,195	3,719	4,123	2,992	4,201
RESMETHRIN	452	269	211	206	122	46	19	188	4	146
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	45,757	16,335	8,161	18,427	30,328	21,820	19,077	11,683	6,472	6,882
SEDAXANE	0	0	0	0	0	0	0	0	0	<1
SODIUM DICHROMATE	0	0	0	0	0	0	0	2	0	0
SPIRODICLOFEN	28,864	32,369	44,850	30,594	22,729	28,358	52,050	49,054	34,540	42,278
TERRAZOLE	872	1,534	1,140	1,500	638	503	393	473	452	400
TETRACHLOROETHYLENE	160	140	94	90	68	176	153	221	101	112
TETRACHLORVINPHOS	667	1,012	1,306	1,086	870	665	2,660	629	173	66
THIODICARB	686	410	511	152	472	145	156	0	0	0
TOXAPHENE	43	0	42	16	28	16	8	7	4	3
TRICHLORO ETHYLENE	0	0	0	0	1	0	<1	0	0	0
VINCLOZOLIN	392	512	476	217	328	470	151	219	149	125
TOTAL	36,715,109	36,847,379	31,526,666	39,082,239	44,116,162	44,869,131	43,100,458	41,936,010	46,442,004	44,145,010

Table 6: *The reported cumulative acres treated with pesticides that are listed by U.S. EPA as A or B carcinogens or on the State's Proposition 65 list of chemicals that are "known to cause cancer." Use includes primarily agricultural applications. The grand total for acres treated may be less than the sum of acres treated for all active ingredients because some products contain more than one active ingredient. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1,2-DICHLOROPROPANE, 1,3-DICHLOROPROPENE AND RELATED C3 COMPOUNDS	108	0	0	0	0	18	0	8	0	0
1,3-DICHLOROPROPENE	53,937	57,922	38,374	54,049	58,696	69,422	71,794	69,656	78,336	75,725
ACIFLUORFEN, SODIUM SALT	0	0	0	<1	0	<1	<1	4	0	0
ALACHLOR	1,500	1,635	2,261	3,276	3,385	3,284	2,670	2,033	1,497	70
AMITROLE	6	<1	<1	<1	<1	<1	0	0	0	70
ARSENIC ACID	0	0	0	0	<1	0	0	0	0	0
ARSENIC PENTOXIDE	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
ARSENIC TRIOXIDE	<1	<1	<1	<1	<1	<1	0	<1	<1	<1
AURAMINE	0	0	1	0	0	0	0	0	0	0
CACODYLIC ACID	<1	<1	<1	<1	<1	<1	0	<1	0	<1
CAPTAN	215,864	198,262	173,133	245,464	209,750	209,406	187,988	211,312	212,098	246,006
CARBARYL	97,016	96,136	107,458	80,082	68,074	97,229	96,647	108,805	136,319	116,551
CARBON TETRACHLORIDE	<1	161	<1	0	<1	<1	0	<1	<1	<1
CHLORDANE	0	<1	8	<1	0	<1	0	0	<1	0
CHLORDECONE	1	0	0	0	<1	<1	<1	<1	<1	<1
CHLOROTHALONIL	389,497	292,385	377,954	490,304	585,999	571,892	530,305	566,228	541,432	541,201
CHROMIC ACID	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CREOSOTE	1	1	2	0	0	0	<1	0	<1	0
DAMINOZIDE	2,291	2,471	2,111	4,357	2,414	2,981	2,549	2,443	2,408	2,060
DDVP	2,733	2,231	2,685	1,880	5,069	6,530	5,593	3,307	6,282	3,317
DICLOFOP-METHYL	224	0	30	0	20	0	0	0	0	0
DIETHANOLAMINE	0	0	0	0	0	0	0	0	4,872	16,766
DIOCTYL PHTHALATE	13,258	3,582	4,928	7,921	4,741	5,311	3,188	1,885	626	76
DIPROPYL ISOCINCHOMERONATE	<1	<1	<1	19	<1	<1	<1	<1	1	<1
DIURON	702,939	514,554	405,583	517,649	689,792	555,470	440,233	342,061	279,721	330,719
ETHOPROP	4,283	4,159	4,293	1,318	1,892	541	676	844	591	575
ETHYL ACRYLATE	<1	<1	0	72	88	0	24	222	<1	<1
ETHYLENE DIBROMIDE	<1	<1	<1	0	0	<1	0	0	<1	0
ETHYLENE DICHLORIDE	0	160	0	0	0	0	0	0	0	0
ETHYLENE OXIDE	<1	2	60	0	0	<1	0	<1	0	0
FENOXYCARB	210	489	353	100	106	110	37	58	15	33
FOLPET	0	<1	0	<1	0	<1	<1	<1	<1	<1
FORMALDEHYDE	57	67	5	1	6	4	52	2	30	<1
GLYPHOSATE	634	284	1,708	1,741	1,808	508	451	<1	24	2
GLYPHOSATE, DIAMMONIUM SALT	36,580	36,910	58,768	16,353	8,559	3,287	2,938	3,381	1,173	665
GLYPHOSATE, DIMETHYLAMINE SALT	0	0	897	3,847	6,196	9,406	9,707	25,463	34,323	36,305

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GLYPHOSATE, ISOPROPYLAMINE SALT	2,294,589	2,179,253	2,733,026	2,868,756	2,577,064	2,379,750	2,426,203	2,322,606	2,183,776	2,163,404
GLYPHOSATE, MONOAMMONIUM SALT	8,701	15,783	11,367	11,443	12,029	545	19,922	11,919	6,443	5,786
GLYPHOSATE, POTASSIUM SALT	2,139,810	2,041,770	1,632,400	1,961,734	2,884,487	3,151,434	3,130,848	3,110,436	3,426,425	3,391,775
GLYPHOSATE-TRIMESIUM	4,529	2,031	2,023	295	431	172	43	450	0	0
HEPTACHLOR	0	0	0	0	0	<1	0	0	0	0
IMAZALIL	<1	668	<1	26	2	<1	<1	32	1	50
IPRODIONE	412,699	436,226	434,326	577,544	636,372	529,986	479,154	459,124	407,066	519,285
KRESOXIM-METHYL	100,721	65,011	180,877	236,638	279,997	192,745	199,709	210,367	172,512	177,798
LINDANE	0	37	10	31	1	0	<1	0	28	0
MALATHION	250,823	288,852	277,523	433,352	280,719	271,627	289,865	285,266	266,825	218,241
MANCOZEB	212,349	169,422	145,616	431,911	631,192	678,932	675,961	711,016	740,579	828,335
MANEB	655,235	558,506	471,395	290,266	40,046	4,559	1,524	1,006	425	987
METAM-SODIUM	78,030	71,815	74,132	71,407	70,794	58,998	28,145	24,422	24,254	19,437
METHYL EUGENOL	0	0	0	0	<1	0	<1	0	0	<1
METHYL IODIDE	0	0	0	0	278	37	0	0	0	0
METHYLENE CHLORIDE	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
METIRAM	0	0	0	0	<1	<1	<1	<1	<1	<1
NAPHTHALENE	0	0	0	3	<1	0	<1	0	0	0
NITRAPYRIN	35	0	88	111	0	<1	1	0	<1	<1
NITROFEN	0	0	2	0	0	0	0	0	0	0
ORTHO-PHENYLPHENOL	149	22	49	58	117	85	130	104	329	264
ORTHO-PHENYLPHENOL, SODIUM SALT	<1	<1	<1	<1	<1	<1	<1	<1	<1	2
ORYZALIN	313,343	272,273	236,523	217,193	293,893	263,654	203,900	203,504	162,500	90,034
OXADIAZON	2,991	2,747	1,451	1,712	927	1,148	1,511	1,239	1,777	1,067
OXYTHIOQUINOX	9	5	4	4	1	1	<1	<1	0	7
PARA-DICHLOROBENZENE	<1	0	<1	<1	<1	<1	<1	0	0	0
PARATHION	414	101	195	51	68	15	<1	1	207	82
PENTACHLOROPHENOL	10	46	0	4	1	15	170	2	5	97
PIRIMICARB	<1	<1	<1	<1	<1	0	0	0	0	0
POTASSIUM DICHROMATE	0	0	0	0	0	0	<1	0	<1	0
POTASSIUM N-METHYLDITHIOCARBAMATE	42,988	56,009	38,197	41,444	44,046	50,361	46,861	39,708	48,504	49,022
PROPARGITE	261,953	186,581	174,063	137,106	141,890	114,213	121,952	104,758	87,943	87,222
PROPOXUR	<1	10	356	<1	3	<1	4	178	39	19
PROPYLENE OXIDE	<1	12	<1	<1	<1	288	9	<1	<1	<1
PROPYZAMIDE	148,399	133,426	102,176	69,328	60,991	57,625	51,921	51,307	49,022	110,588
PYMETROZINE	74,140	50,752	30,516	40,675	29,635	33,655	37,228	42,540	30,716	42,514
RESMETHRIN	18	3	11	<1	6	4	436	18	7	3

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

AI	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	31,408	10,850	7,182	15,785	27,139	21,894	22,774	15,139	7,582	7,725
SEDAXANE	0	0	0	0	0	0	0	0	0	<1
SODIUM DICHROMATE	0	0	0	0	0	0	0	<1	0	0
SPIRODICLOFEN	105,133	103,397	146,746	98,677	72,312	83,110	135,077	124,024	97,629	107,800
TERRAZOLE	879	1,419	711	5,107	443	579	414	660	255	175
TETRACHLOROETHYLENE	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TETRACHLORVINPHOS	200	5	<1	5	5	8	4	3	1,044	5
THIODICARB	1,196	673	680	192	656	206	247	0	0	0
TOXAPHENE	<1	0	45	12	1	<1	<1	<1	<1	<1
TRICHLORO ETHYLENE	0	0	0	0	<1	0	<1	0	0	0
VINCLOZOLIN	258	212	85	86	99	34	11	5	10	6
TOTAL	8,661,823	7,847,895	7,856,740	8,921,112	9,719,923	9,430,616	9,209,892	9,045,520	9,007,050	9,172,311

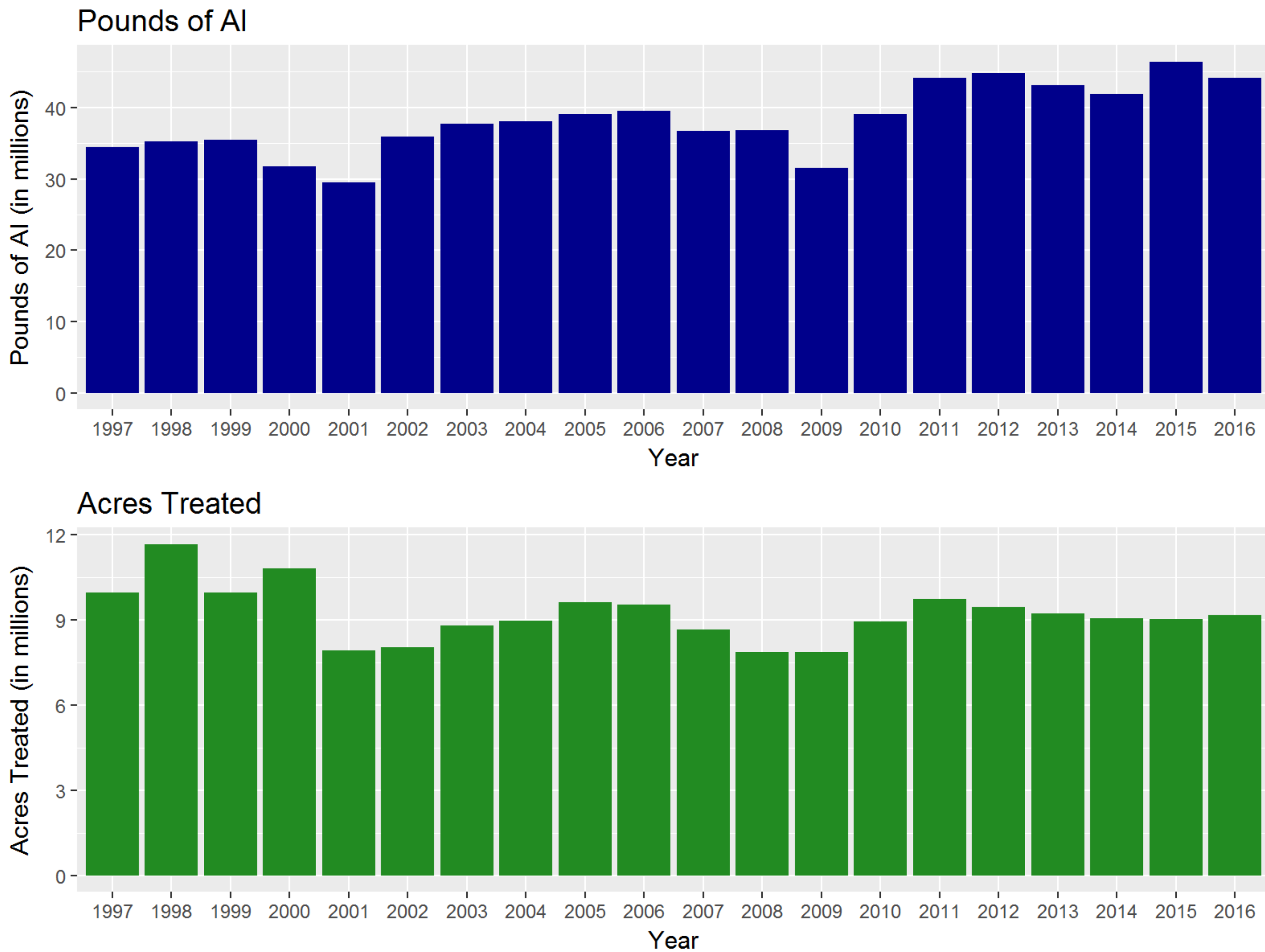


Figure 6: *Use trends of pesticides that are listed by U.S. EPA as A or B carcinogens or on the State's Proposition 65 list of chemicals that are "known to cause cancer." Reported pounds of active ingredient (AI) applied include both agricultural and nonagricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

USE TRENDS OF CHOLINESTERASE-INHIBITING PESTICIDES.

Table 7: *The reported pounds of pesticides used that are organophosphorus or carbamate cholinesterase-inhibiting pesticides. Use includes both agricultural and reportable nonagricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ACEPHATE	143,073	152,303	112,562	134,993	152,501	130,485	185,153	144,640	170,656	159,013
ALDICARB	115,475	75,767	31,579	64,626	24,167	1,489	1,487	126	0	0
AZINPHOS-METHYL	25,418	16,269	13,045	1,619	1,582	1,232	32	0	1	0
BENDIOCARB	8	2	<1	1	3	3	2	4	1	4
BENSULIDE	259,553	244,526	247,735	271,835	288,307	267,050	285,471	319,400	346,269	292,802
BUTYLATE	945	27	0	299	0	0	88	53	0	10
CARBARYL	141,971	126,678	135,264	113,066	74,690	113,900	117,252	131,744	155,525	220,860
CARBOFURAN	25,467	16,389	10,117	4	1	0	0	0	0	0
CARBOPHENOTHION	<1	0	4	51	4	1,204	0	0	0	0
CHLORPYRIFOS	1,442,521	1,368,568	1,246,560	1,288,100	1,298,885	1,106,479	1,469,298	1,312,361	1,106,608	902,575
COUMAPHOS	<1	0	0	<1	3	3	14	0	1	0
CROTOXYPHOS	<1	0	0	0	0	0	0	0	0	<1
CYCLOATE	31,868	21,242	25,284	27,292	30,950	33,562	30,619	36,566	39,655	45,150
DDVP	6,376	6,859	4,164	4,169	5,253	4,888	4,619	4,032	4,078	3,977
DDVP, OTHER RELATED	440	452	221	201	262	278	286	164	168	130
DEMETON	1	0	2	0	0	0	0	0	0	0
DIAZINON	353,098	258,544	142,061	126,804	86,625	78,524	61,224	61,126	52,833	48,991
DICROTOPHOS	0	0	0	0	0	0	0	5	<1	0
DIMETHOATE	315,358	292,119	251,726	210,128	226,116	183,201	270,182	334,563	288,376	243,686
DIOXATHION	0	0	<1	2	0	0	9	0	0	0
DIOXATHION, OTHER RELATED	0	0	<1	1	0	0	4	0	0	0
DISULFOTON	24,558	8,028	10,233	9,085	4,351	5,479	1,924	2,219	415	10
EPN	7	0	0	528	13	8	20	425	1	2
EPTC	152,707	129,470	128,993	118,509	125,570	168,665	187,349	235,271	237,983	255,431
ETHEPHON	430,522	296,421	207,788	373,581	547,439	484,377	397,059	348,544	319,312	399,036
ETHION	0	2	28	72	<1	44	0	<1	1	0
ETHOPROP	24,241	26,897	20,793	5,495	7,475	2,077	2,502	3,076	1,820	2,023
FENAMIPHOS	39,677	17,482	11,493	8,978	2,964	5,254	2,244	865	97	143
FENTHION	4	4	9	4	<1	0	0	<1	0	<1
FONOFOS	0	1	0	<1	0	0	0	0	0	0
FORMETANATE HYDROCHLORIDE	34,127	44,704	32,670	30,313	20,952	20,446	26,912	28,333	31,172	42,037
MALATHION	468,614	484,322	531,966	560,117	511,327	405,353	446,890	502,997	443,128	354,955
MERPHOS	0	0	0	4	0	0	0	0	0	0
MERPHOS, OTHER RELATED	0	0	0	<1	0	0	0	0	0	0
METHAMIDOPHOS	18,867	24,224	17,934	9,664	6,037	<1	55	0	0	0
METHIDATHION	45,666	47,203	47,319	51,190	29,502	23,396	6,375	3,614	245	146
METHIOCARB	1,767	2,068	3,093	3,506	2,705	3,786	3,679	3,722	3,371	2,799
METHOMYL	307,169	251,382	221,248	231,690	219,992	273,337	260,563	278,741	282,501	260,552

Table 7: (continued) *The reported pounds of pesticides used that are organophosphorus or carbamate cholinesterase-inhibiting pesticides.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
METHYL PARATHION	75,385	34,110	25,770	21,512	22,819	25,408	21,520	481	182	24
METHYL PARATHION, OTHER RELATED	3,960	1,792	1,355	1,132	1,187	1,334	1,131	<1	5	<1
MEVINPHOS	30	4	9	24	118	3	<1	8	9	4
MEVINPHOS, OTHER RELATED	20	3	6	16	79	2	0	5	6	3
MEXACARBATE	0	0	0	0	0	0	1	0	0	0
MOLINATE	75,241	19,653	12,516	24	<1	3	<1	<1	<1	5
NALED	132,528	172,632	162,530	174,280	199,123	153,116	218,690	225,285	288,473	316,894
OXAMYL	45,096	100,000	48,994	118,048	136,967	52,984	73,005	65,805	17,236	2,466
OXYDEMETON-METHYL	122,723	111,612	68,576	71,290	26,013	17,562	10,656	8,407	6,610	3,764
PARATHION	479	33	118	248	196	25	<1	1	836	41
PARATHION, OTHER RELATED	5	1	1	9	<1	<1	0	0	1	<1
PEBULATE	441	68	0	0	0	0	0	0	0	0
PHORATE	33,776	32,408	17,686	14,775	46,152	61,545	30,909	32,683	19,519	20,378
PHOSACETIN	0	0	0	0	0	0	<1	<1	<1	0
PHOSMET	424,874	341,422	132,647	115,008	95,781	53,587	60,903	44,344	19,278	28,909
PHOSPHAMIDON	2	0	0	24	0	0	0	0	0	6
PHOSPHAMIDON, OTHER RELATED	<1	0	0	1	0	0	0	0	0	<1
PIRIMICARB	1	5	2	1	1	0	0	0	0	0
POTASSIUM DIMETHYL DITHIO CARBAMATE	0	0	<1	0	0	0	0	0	0	0
PROFENOFOS	3,638	216	0	1,552	0	58	0	0	0	0
PROPETAMPHOS	136	116	352	213	139	171	127	3,047	5	2
PROPOXUR	191	188	202	298	808	359	373	251	100	48
RONNEL	<1	<1	0	0	1	0	1	1	112	16
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	45,757	16,335	8,161	18,427	30,328	21,820	19,077	11,683	6,472	6,882
SODIUM DIMETHYL DITHIO CARBAMATE	9,073	9,800	8,963	11,053	13,358	13,485	22,187	16,535	9,357	18,414
SULFOTEP	7	4	2	0	1	0	0	0	0	0
TEMEPHOS	1,173	684	83	99	34	17	8	10	5	3
TEPP	<1	0	0	1	0	0	0	0	0	0
TEPP, OTHER RELATED	<1	0	0	2	0	0	0	0	0	0
TETRACHLORVINPHOS	667	1,012	1,306	1,086	870	665	2,660	629	173	66
THIOBENCARB	289,046	263,499	320,643	258,402	246,927	280,678	289,946	373,930	523,582	698,671
THIODICARB	686	410	511	152	472	145	156	0	0	0
TRIALLATE	0	0	0	879	2,671	3,752	4,530	5,886	4,830	5,217
TRICHLORFON	1,346	3,846	100	135	161	115	99	46	2	1
TOTAL	5,675,783	5,021,806	4,264,421	4,454,616	4,491,884	4,001,355	4,517,296	4,541,625	4,381,011	4,336,145

Table 8: *The reported cumulative acres treated with pesticides that are organophosphorus or carbamate cholinesterase-inhibiting pesticides. 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 available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ACEPHATE	148,887	147,910	115,063	144,134	150,213	132,424	183,260	122,703	163,014	172,372
ALDICARB	108,892	66,829	31,977	66,192	29,363	1,451	1,882	166	0	0
AZINPHOS-METHYL	16,636	9,888	7,849	1,724	1,739	1,639	24	0	1	0
BENDIOCARB	6	<1	<1	<1	<1	<1	<1	<1	<1	<1
BENSULIDE	76,748	75,695	73,306	78,736	84,169	79,195	84,384	85,657	94,170	79,237
BUTYLATE	236	6	0	60	0	0	20	12	0	8
CARBARYL	97,016	96,136	107,458	80,082	68,074	97,229	96,647	108,805	136,319	116,551
CARBOFURAN	39,795	24,651	7,331	15	30	0	0	0	0	0
CARBOPHENOTHION	2	0	15	107	12	31	0	0	0	0
CHLORPYRIFOS	1,154,681	1,162,654	934,562	1,097,001	1,186,878	1,056,026	1,297,159	1,108,317	828,896	640,709
COUMAPHOS	<1	0	0	<1	<1	<1	1	0	62	0
CROTOXYPHOS	<1	0	0	0	0	0	0	0	0	<1
CYCLOATE	15,601	10,581	12,058	13,799	14,879	17,565	16,045	19,124	21,037	23,173
DDVP	2,733	2,231	2,685	1,880	5,069	6,530	5,593	3,307	6,282	3,317
DDVP, OTHER RELATED	2,733	1,930	2,017	410	1,830	5,447	5,537	3,301	5,149	3,287
DEMETON	10	0	10	0	0	0	0	0	0	0
DIAZINON	422,244	310,125	140,620	104,443	71,086	48,594	35,069	32,862	27,089	24,352
DICROTOPHOS	0	0	0	0	0	0	0	23	<1	0
DIMETHOATE	608,819	576,286	499,889	436,233	532,214	422,176	594,441	725,268	626,623	531,106
DIOXATHION	0	0	36	<1	0	0	78	0	0	0
DIOXATHION, OTHER RELATED	0	0	36	<1	0	0	78	0	0	0
DISULFOTON	20,315	4,723	7,591	6,167	1,621	2,595	1,042	1,157	204	16
EPN	54	0	0	135	<1	<1	2	<1	<1	2
EPTC	51,706	45,560	49,708	44,289	47,645	56,872	69,989	89,126	91,512	100,884
ETHEPHON	490,361	362,926	261,211	452,394	601,787	533,731	475,399	414,134	363,740	452,865
ETHION	0	6	15	184	36	332	0	<1	306	0
ETHOPROP	4,283	4,159	4,293	1,318	1,892	541	676	844	591	575
FENAMIPHOS	22,618	10,730	7,537	5,873	2,127	2,690	1,437	465	<1	<1
FENTHION	<1	<1	<1	<1	<1	0	0	<1	0	60
FONOFOS	0	<1	0	3	0	0	0	0	0	0
FORMETANATE HYDROCHLORIDE	35,383	45,715	32,678	30,898	22,038	21,821	27,894	28,234	31,515	41,115
MALATHION	250,823	288,852	277,523	433,352	280,719	271,627	289,865	285,266	266,825	218,241
MERPHOS	0	0	0	<1	0	0	0	0	0	0
MERPHOS, OTHER RELATED	0	0	0	<1	0	0	0	0	0	0
METHAMIDOPHOS	23,022	27,532	20,408	10,731	6,464	<1	69	0	0	0
METHIDATHION	37,301	43,010	54,227	49,662	34,833	31,741	9,046	3,564	453	198
METHIOCARB	2,649	2,439	2,131	2,335	2,056	2,800	3,378	2,409	2,444	1,760
METHOMYL	502,384	406,030	377,954	410,186	396,230	473,037	439,709	450,025	453,825	431,614

Table 8: (continued) *The reported cumulative acres treated with pesticides that are organophosphorus or carbamate cholinesterase-inhibiting pesticides.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
METHYL PARATHION	45,173	21,574	15,198	13,046	13,243	15,551	12,486	<1	298	60
METHYL PARATHION, OTHER RELATED	45,165	21,331	15,053	13,029	13,226	15,337	12,440	<1	36	18
MEVINPHOS	198	34	69	11	108	2	<1	51	51	23
MEVINPHOS, OTHER RELATED	198	34	69	11	108	2	0	51	51	23
MEXACARBATE	0	0	0	0	0	0	<1	0	0	0
MOLINATE	17,476	4,529	2,942	6	<1	<1	3	<1	1	1
NALED	107,774	105,505	128,415	145,147	163,388	109,008	160,907	139,823	164,576	175,205
OXAMYL	60,773	116,202	59,118	134,931	150,265	61,931	83,585	75,330	21,033	3,301
OXYDEMETON-METHYL	161,835	140,760	82,368	86,131	27,438	18,204	12,163	9,096	7,355	7,883
PARATHION	414	101	195	51	68	15	<1	1	207	82
PARATHION, OTHER RELATED	231	25	49	48	<1	10	0	0	10	4
PEBULATE	163	151	0	0	0	0	0	0	0	0
PHORATE	23,557	10,933	10,236	8,719	32,650	47,176	22,469	25,700	14,682	16,300
PHOSACETIN	0	0	0	0	0	0	<1	<1	<1	0
PHOSMET	142,991	116,516	51,514	40,276	33,692	18,923	23,726	21,122	10,336	11,265
PHOSPHAMIDON	<1	0	0	72	0	0	0	0	0	35
PHOSPHAMIDON, OTHER RELATED	<1	0	0	72	0	0	0	0	0	35
PIRIMICARB	<1	<1	<1	<1	<1	0	0	0	0	0
POTASSIUM DIMETHYL DITHIO CARBAMATE	0	0	<1	0	0	0	0	0	0	0
PROFENOFOS	4,509	289	0	1,635	0	155	0	0	0	0
PROPETAMPHOS	<1	<1	<1	<1	<1	<1	<1	3,621	<1	<1
PROPOXUR	<1	10	356	<1	3	<1	4	178	39	19
RONNEL	<1	<1	0	0	<1	0	11	<1	<1	<1
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	31,408	10,850	7,182	15,785	27,139	21,894	22,774	15,139	7,582	7,725
SODIUM DIMETHYL DITHIO CARBAMATE	2	1	3	12	<1	<1	<1	<1	<1	6
SULFOTEP	5	2	3	0	1	0	0	0	0	0
TEMEPHOS	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TEPP	<1	0	0	3	0	0	0	0	0	0
TEPP, OTHER RELATED	<1	0	0	3	0	0	0	0	0	0
TETRACHLORVINPHOS	200	5	<1	5	5	8	4	3	1,044	5
THIOBENCARB	74,271	67,483	83,567	75,172	71,824	79,689	84,726	107,636	148,349	197,774
THIODICARB	1,196	673	680	192	656	206	247	0	0	0
TRIALLATE	0	0	0	867	1,854	2,715	2,998	3,918	3,221	3,665
TRICHLORFON	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TOTAL	4,804,833	4,320,245	3,469,710	3,993,775	4,063,323	3,636,105	4,059,164	3,882,982	3,492,273	3,261,474

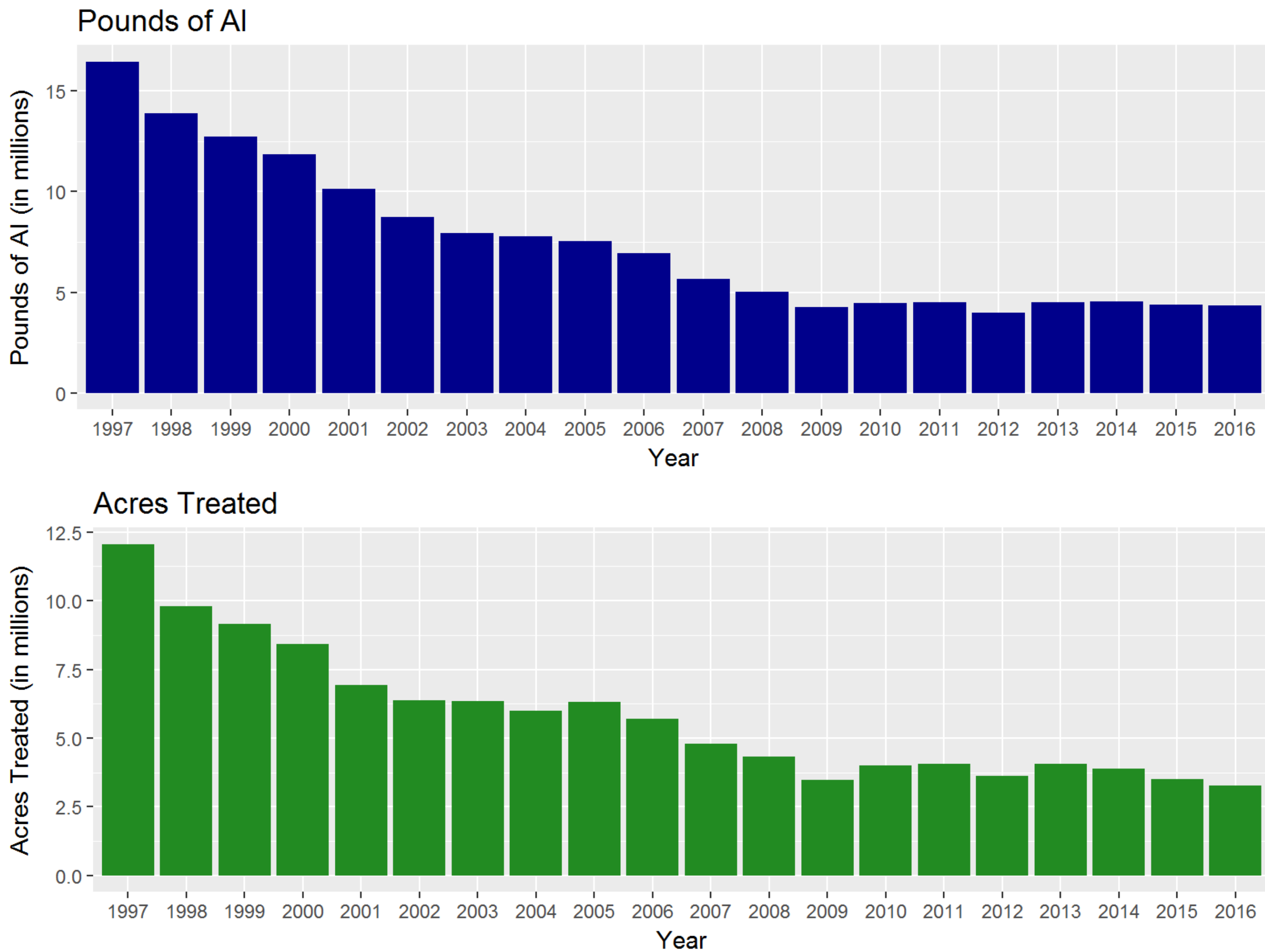


Figure 7: *Use trends of pesticides that are organophosphorus or carbamate cholinesterase-inhibiting pesticides. Reported pounds of active ingredient (AI) applied include both agricultural and nonagricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

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 ground water 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 nonagricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ATRAZINE	27,546	28,491	23,260	28,937	22,654	32,173	23,763	20,896	17,912	21,282
ATRAZINE, OTHER RELATED	571	600	482	607	475	676	488	434	375	445
BENTAZON, SODIUM SALT	4,858	8,075	9,589	7,447	5,800	7,060	8,250	8,506	8,322	8,671
BROMACIL	85,097	68,162	52,049	67,784	92,204	82,485	68,294	61,793	37,484	29,992
BROMACIL, LITHIUM SALT	1,172	1,851	896	1,835	1,486	1,422	1,145	2,472	2,891	2,504
DIURON	860,510	734,757	622,598	588,574	669,486	554,618	413,291	325,345	317,328	248,007
NORFLURAZON	78,150	58,590	44,762	43,686	30,653	42,045	29,946	30,226	22,562	11,320
PROMETON	3	3	1	6	3	8	34	1	59	<1
SIMAZINE	541,296	438,952	419,423	378,363	421,905	368,621	300,394	242,895	179,321	163,332
TOTAL	1,599,204	1,339,482	1,173,061	1,117,239	1,244,667	1,089,108	845,605	692,569	586,253	485,553

Table 10: *The reported cumulative acres treated with pesticides that are on the "a" part of DPR's ground water 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 available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ATRAZINE	17,382	16,766	15,767	19,990	17,236	23,827	18,305	15,404	14,537	17,237
ATRAZINE, OTHER RELATED	17,382	16,766	15,767	19,990	17,236	23,827	18,305	15,404	14,537	17,237
BENTAZON, SODIUM SALT	4,215	6,631	6,424	6,258	4,846	6,539	7,466	7,956	6,823	7,320
BROMACIL	20,455	21,471	24,420	28,757	32,104	28,746	16,607	12,628	5,942	6,936
BROMACIL, LITHIUM SALT	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
DIURON	702,939	514,554	405,583	517,649	689,792	555,470	440,233	342,061	279,721	330,719
NORFLURAZON	74,085	58,866	44,503	45,638	30,585	31,693	23,306	25,112	17,343	9,790
PROMETON	4	35	2	20	<1	<1	234	<1	18	38
SIMAZINE	411,719	320,992	339,117	289,006	322,104	241,359	205,338	165,261	118,823	112,782
TOTAL	1,212,529	919,200	812,543	879,389	1,065,195	859,283	695,196	556,157	437,858	478,372

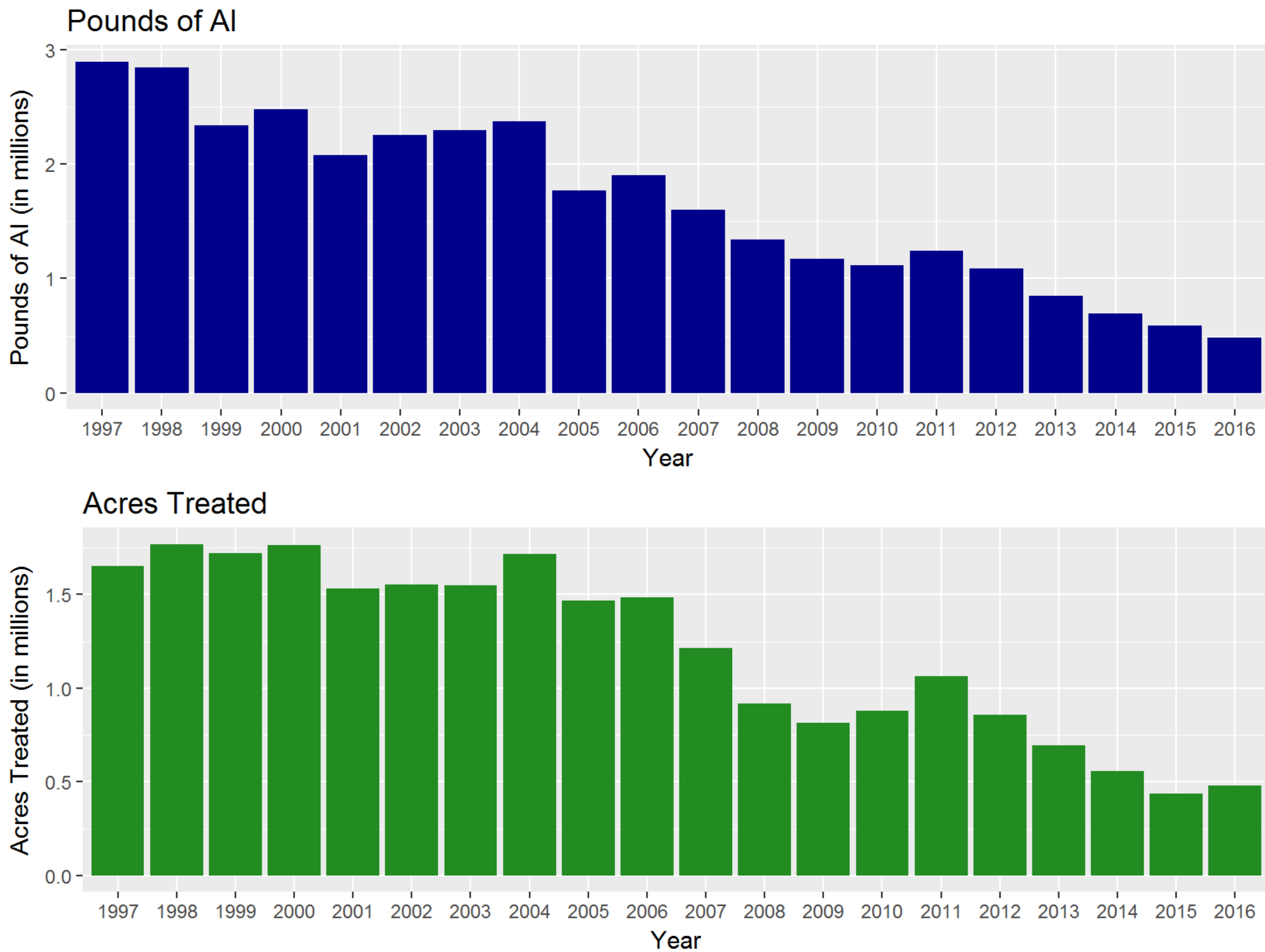


Figure 8: *Use trends of pesticides that are on the "a" part of DPR's ground water protection list. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6800(a). Reported pounds of active ingredient (AI) applied include both agricultural and nonagricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

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 nonagricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1,3-DICHLOROPROPENE	9,596,317	9,708,712	6,399,534	8,777,714	10,892,540	11,947,156	12,941,042	13,614,468	15,689,571	14,126,938
2,4-D	2,755	11,619	10,788	12,526	5,392	4,281	5,965	6,384	7,869	9,667
2,4-D, 2-ETHYLHEXYL ESTER	15,029	20,464	15,113	74,398	25,782	27,639	25,647	21,656	26,991	31,887
2,4-D, ALKANOLAMINE SALTS (ETHANOL AND ISOPROPANOL AMINES)	29	25	131	516	1	16	18	<1	201	21
2,4-D, BUTOXYETHANOL ESTER	843	1,775	2,751	1,368	1,757	1,807	3,016	2,318	1,791	893
2,4-D, BUTOXYPROPYL ESTER	0	13	0	0	0	0	0	0	0	0
2,4-D, BUTYL ESTER	9	0	2	3	4	7	26	0	129	0
2,4-D, DIETHANOLAMINE SALT	4,025	5,533	4,913	6,872	3,165	2,649	2,880	4,081	3,628	3,227
2,4-D, DIMETHYLAMINE SALT	397,197	466,872	446,575	488,565	406,834	371,743	352,140	329,058	361,024	364,379
2,4-D, DODECYLAMINE SALT	0	0	0	0	0	0	0	0	0	10
2,4-D, ISOOCTYL ESTER	11,572	9,603	4,446	4,214	5,172	4,623	2,156	779	1,026	876
2,4-D, ISOPROPYL ESTER	10,578	10,671	13,123	11,615	18,874	13,527	11,766	10,440	11,488	14,936
2,4-D, PROPYL ESTER	212	141	99	57	0	0	6	0	0	0
2,4-D, TETRADECYLAMINE SALT	0	0	0	0	0	0	0	0	0	2
2,4-D, TRIETHYLAMINE SALT	383	332	472	2,829	106	5	<1	23	10	137
2,4-D, TRIISOPROPANOLAMINE SALT	985	1,140	1,930	2,092	2,741	1,746	1,588	2,439	1,945	1,675
2,4-D, TRIISOPROPYLAMINE SALT	636	472	1,941	1,655	1,971	770	1,263	1,871	1,372	1,139
ACROLEIN	201,156	215,822	161,637	123,660	97,579	114,130	101,817	84,220	56,830	48,108
ALUMINUM PHOSPHIDE	105,169	132,296	108,084	108,406	156,363	148,904	142,903	113,910	90,264	160,799
ARSENIC ACID	0	0	0	0	17	0	0	0	0	0
ARSENIC PENTOXIDE	7,805	7,433	400	16,144	8,034	9,240	8,480	16,719	22,190	10,508
ARSENIC TRIOXIDE	<1	<1	<1	<1	<1	<1	0	<1	<1	<1
CAPTAN	456,475	362,757	329,747	450,225	376,278	403,428	349,430	370,136	511,017	638,194
CAPTAN, OTHER RELATED	10,131	8,031	7,374	10,002	8,387	8,909	5,967	4,717	4,026	4,835
CARBARYL	141,971	126,678	135,264	113,066	74,690	113,900	117,252	131,744	155,525	220,860
CHLORINE	857,144	1,278,580	585,673	1,011,383	738,584	1,437,637	1,323,645	800,013	603,519	624,396
CHLOROPICRIN	5,505,912	5,590,285	5,687,571	6,391,407	7,272,563	8,931,248	8,220,328	8,994,608	8,514,720	8,641,552
CHROMIC ACID	10,904	10,384	559	22,555	11,224	12,908	11,847	23,358	31,629	15,709
DAZOMET	37,537	40,272	65,725	60,539	59,245	39,229	63,920	58,652	83,058	51,588
DDVP	6,376	6,859	4,164	4,169	5,253	4,888	4,619	4,032	4,078	3,977
ENDOSULFAN	52,403	59,917	41,840	37,146	15,679	11,113	1,833	8,136	6,420	576
ETHYLENE OXIDE	2	3	7	0	0	8	0	<1	0	0
FORMALDEHYDE	47,733	24,306	3,972	5,511	4,615	3,847	11,165	52,989	31,956	23,116
HYDROGEN CHLORIDE	1,470	4,318	3,976	2,240	504	336	395	412	553	589

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	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
LINDANE	2	21	8	18	1	0	2	0	6	0
MAGNESIUM PHOSPHIDE	5,132	10,507	8,009	12,233	12,594	11,497	12,372	7,562	22,316	14,765
MANCOZEB	408,652	330,238	281,639	754,844	1,042,475	1,131,008	1,149,329	1,282,132	1,273,675	1,432,250
MANEB	1,061,028	861,006	656,648	370,333	53,485	6,260	1,383	1,274	286	1,871
META-CRESOL	<1	<1	<1	<1	1	2	7	<1	<1	1
METAM-SODIUM	9,930,337	9,497,562	9,028,103	11,153,272	10,837,368	8,428,425	4,846,428	4,297,539	3,606,650	3,297,827
METHANOL	0	0	0	0	0	0	0	0	0	2
METHIDATHION	45,666	47,203	47,319	51,190	29,502	23,396	6,375	3,614	245	146
METHOXYCHLOR	6	0	8	270	39	0	<1	0	<1	<1
METHOXYCHLOR, OTHER RELATED	0	0	0	0	0	0	0	0	0	<1
METHYL BROMIDE	6,448,717	5,693,394	5,615,683	4,809,280	4,002,102	4,017,075	3,534,425	2,963,036	2,655,234	2,602,823
METHYL IODIDE	0	0	0	0	1,157	21	0	0	0	0
METHYL ISOTHIOCYANATE	388	0	0	73	476	764	0	92	63	77
METHYL PARATHION	75,385	34,110	25,770	21,512	22,819	25,408	21,520	481	182	24
METHYL PARATHION, OTHER RELATED	3,960	1,792	1,355	1,132	1,187	1,334	1,131	<1	5	<1
NAPHTHALENE	0	0	0	1	<1	0	<1	0	0	0
PARA-DICHLOROBENZENE	15	1	17	0	<1	18	<1	0	0	0
PARATHION	479	33	118	248	196	25	<1	1	836	41
PCNB	30,689	29,188	24,637	37,378	11,836	17,418	26,131	23,431	20,306	53,271
PCP, OTHER RELATED	2	1	0	<1	3	32	39	2	3	<1
PCP, SODIUM SALT	<1	0	0	0	0	0	0	<1	0	0
PCP, SODIUM SALT, OTHER RELATED	<1	0	0	0	0	0	0	0	0	0
PENTACHLOROPHENOL	22	4	0	3	18	224	274	11	25	1
PHENOL	0	0	2	0	0	0	5	3	1	41
PHENOL, FERROUS SALT	0	0	0	0	0	0	0	<1	0	0
PHOSPHINE	5,286	48,243	29,527	11,291	125,033	51,259	20,855	11,399	28,397	19,164
PHOSPHORUS	<1	<1	<1	1	0	4	3	0	0	0
POTASSIUM N-METHYLDITHIOCARBAMATE	3,785,436	5,524,647	4,102,412	4,832,615	5,672,183	8,320,255	9,484,467	7,798,703	10,252,596	9,343,192
POTASSIUM PERMANGANATE	0	0	109	0	0	0	0	0	0	113
PROPOXUR	191	188	202	298	808	359	373	251	100	48
PROPYLENE OXIDE	110,068	105,600	111,609	300,008	448,767	389,070	410,360	400,719	396,191	367,437
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	45,757	16,335	8,161	18,427	30,328	21,820	19,077	11,683	6,472	6,882
SODIUM CYANIDE	2,670	3,406	2,579	2,502	1,073	2,588	2,593	2,611	3,108	2,869
SODIUM DICHROMATE	0	0	0	0	0	0	0	2	0	0
SODIUM TETRATHIOCARBONATE	391,303	354,294	249,580	233,949	168,761	49,713	<1	120	0	0
SULFURYL FLUORIDE	2,152,451	2,120,860	2,184,823	2,728,977	2,358,706	2,664,125	3,062,343	2,805,366	3,042,512	3,296,298
TRIFLURALIN	908,614	676,386	533,307	473,395	493,249	505,585	509,788	513,766	471,538	387,724

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	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
XYLENE	1,173	576	517	1,060	282	372	1,181	1,712	668	556
ZINC PHOSPHIDE	3,215	1,299	20,898	1,745	2,542	2,249	2,287	3,598	4,002	3,656
TOTAL	42,899,403	43,462,206	36,970,850	43,556,933	45,510,343	49,286,000	46,823,864	44,786,270	48,008,246	45,831,673

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 available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1,3-DICHLOROPROPENE	53,937	57,922	38,374	54,049	58,696	69,422	71,794	69,656	78,336	75,725
2,4-D	7,405	33,344	25,244	23,856	7,553	7,764	11,445	11,041	13,603	15,186
2,4-D, 2-ETHYLHEXYL ESTER	8,362	15,047	9,020	11,797	10,386	7,703	11,634	8,541	11,354	15,719
2,4-D, ALKANOLAMINE SALTS (ETHANOL AND ISOPROPANOL AMINES)	23	55	270	172	1	36	26	<1	<1	2
2,4-D, BUTOXYETHANOL ESTER	1,297	3,648	5,110	2,542	1,206	1,054	1,661	1,775	813	1,000
2,4-D, BUTOXYPROPYL ESTER	0	<1	0	0	0	0	0	0	0	0
2,4-D, BUTYL ESTER	10	0	6	<1	<1	7	<1	0	33	0
2,4-D, DIETHANOLAMINE SALT	13,339	19,085	18,931	27,009	11,075	7,033	8,859	7,547	6,581	8,176
2,4-D, DIMETHYLAMINE SALT	487,361	543,863	527,098	519,005	443,618	378,234	351,899	311,534	328,966	328,354
2,4-D, DODECYLAMINE SALT	0	0	0	0	0	0	0	0	0	<1
2,4-D, ISOOCTYL ESTER	7,143	4,708	2,673	2,424	2,763	414	1,409	30	97	288
2,4-D, ISOPROPYL ESTER	137,055	135,797	132,302	137,862	144,937	161,007	149,908	136,530	147,250	155,476
2,4-D, PROPYL ESTER	3,348	1,955	1,750	895	0	0	128	0	0	0
2,4-D, TETRADECYLAMINE SALT	0	0	0	0	0	0	0	0	0	<1
2,4-D, TRIETHYLAMINE SALT	473	679	740	165	117	3	<1	10	45	<1
2,4-D, TRIISOPROPANOLAMINE SALT	108	952	541	720	623	308	524	936	861	209
2,4-D, TRIISOPROPYLAMINE SALT	204	<1	<1	<1	25	37	653	585	238	<1
ACROLEIN	141	1,027	1,497	12	41	56	68	306	432	78
ALUMINUM PHOSPHIDE	84,963	80,989	112,063	100,859	133,062	164,083	148,962	150,088	159,012	82,160
ARSENIC ACID	0	0	0	0	<1	0	0	0	0	0
ARSENIC PENTOXIDE	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
ARSENIC TRIOXIDE	<1	<1	<1	<1	<1	<1	0	<1	<1	<1
CAPTAN	215,864	198,262	173,133	245,464	209,750	209,406	187,988	211,312	212,098	246,006
CAPTAN, OTHER RELATED	215,229	198,095	173,083	245,464	209,750	205,402	144,375	119,113	98,444	105,733
CARBARYL	97,016	96,136	107,458	80,082	68,074	97,229	96,647	108,805	136,319	116,551
CHLORINE	1,201	14,414	24,644	88,144	24,253	24,097	<1	38,381	6,258	2,275
CHLOROPICRIN	55,490	53,408	49,089	51,665	65,717	63,433	57,655	54,872	53,770	49,149
CHROMIC ACID	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
DAZOMET	700	183	301	274	243	594	768	152	368	18
DDVP	2,733	2,231	2,685	1,880	5,069	6,530	5,593	3,307	6,282	3,317
ENDOSULFAN	56,627	64,695	48,639	47,147	19,810	11,134	1,856	8,331	6,561	644
ETHYLENE OXIDE	<1	2	60	0	0	<1	0	<1	0	0
FORMALDEHYDE	57	67	5	1	6	4	52	2	30	<1
HYDROGEN CHLORIDE	4	46	49	116	<1	5	0	155	100	<1
LINDANE	0	37	10	31	1	0	<1	0	28	0

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	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
MAGNESIUM PHOSPHIDE	6	143	32	145	80	29	19	14	131	9
MANCOZEB	212,349	169,422	145,616	431,911	631,192	678,932	675,961	711,016	740,579	828,335
MANEB	655,235	558,506	471,395	290,266	40,046	4,559	1,524	1,006	425	987
META-CRESOL	54	38	108	79	144	857	614	6	128	690
METAM-SODIUM	78,030	71,815	74,132	71,407	70,794	58,998	28,145	24,422	24,254	19,437
METHANOL	0	0	0	0	0	0	0	0	0	23
METHIDATHION	37,301	43,010	54,227	49,662	34,833	31,741	9,046	3,564	453	198
METHOXYCHLOR	43	0	75	90	58	0	<1	0	<1	8
METHOXYCHLOR, OTHER RELATED	0	0	0	0	0	0	0	0	0	8
METHYL BROMIDE	45,675	35,685	39,587	32,232	46,785	30,147	26,429	16,578	12,753	11,031
METHYL IODIDE	0	0	0	0	278	37	0	0	0	0
METHYL ISOTHIOCYANATE	<1	0	0	<1	<1	<1	0	<1	<1	<1
METHYL PARATHION	45,173	21,574	15,198	13,046	13,243	15,551	12,486	<1	298	60
METHYL PARATHION, OTHER RELATED	45,165	21,331	15,053	13,029	13,226	15,337	12,440	<1	36	18
NAPHTHALENE	0	0	0	3	<1	0	<1	0	0	0
PARA-DICHLOROBENZENE	<1	0	<1	<1	<1	<1	<1	0	0	0
PARATHION	414	101	195	51	68	15	<1	1	207	82
PCNB	1,764	1,656	1,400	4,429	856	331	605	1,365	811	2,084
PCP, OTHER RELATED	10	46	0	4	1	15	170	2	5	97
PCP, SODIUM SALT	<1	0	0	0	0	0	0	1	0	0
PCP, SODIUM SALT, OTHER RELATED	<1	0	0	0	0	0	0	0	0	0
PENTACHLOROPHENOL	10	46	0	4	1	15	170	2	5	97
PHENOL	0	0	15	0	0	0	114	315	170	556
PHENOL, FERROUS SALT	0	0	0	0	0	0	0	2	0	0
PHOSPHINE	3	1,751	50	643	665	687	110	2	25	3
PHOSPHORUS	10	<1	<1	<1	0	74	108	0	0	0
POTASSIUM N-METHYLDITHIOCARBAMATE	42,988	56,009	38,197	41,444	44,046	50,361	46,861	39,708	48,504	49,022
POTASSIUM PERMANGANATE	0	0	5	0	0	0	0	0	0	<1
PROPOXUR	<1	10	356	<1	3	<1	4	178	39	19
PROPYLENE OXIDE	<1	12	<1	<1	<1	288	9	<1	<1	<1
S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	31,408	10,850	7,182	15,785	27,139	21,894	22,774	15,139	7,582	7,725
SODIUM CYANIDE	<1	<1	<1	<1	<1	<1	<1	<1	18	<1
SODIUM DICHROMATE	0	0	0	0	0	0	0	<1	0	0
SODIUM TETRATHIOCARBONATE	11,485	10,725	7,180	7,301	4,826	1,672	<1	4	0	0
SULFURYL FLUORIDE	9	57	361	130	537	532	63	585	153	<1
TRIFLURALIN	772,753	556,306	492,498	438,635	461,203	466,421	478,269	531,635	480,734	387,903
XYLENE	2,021	1,418	1,387	584	633	1,010	2,157	1,778	1,225	671

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	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
ZINC PHOSPHIDE	9,301	11,478	14,512	12,751	21,417	21,685	22,425	44,037	51,789	45,168
TOTAL	3,116,678	2,807,846	2,578,071	2,732,296	2,536,813	2,536,122	2,381,711	2,470,547	2,501,914	2,416,086

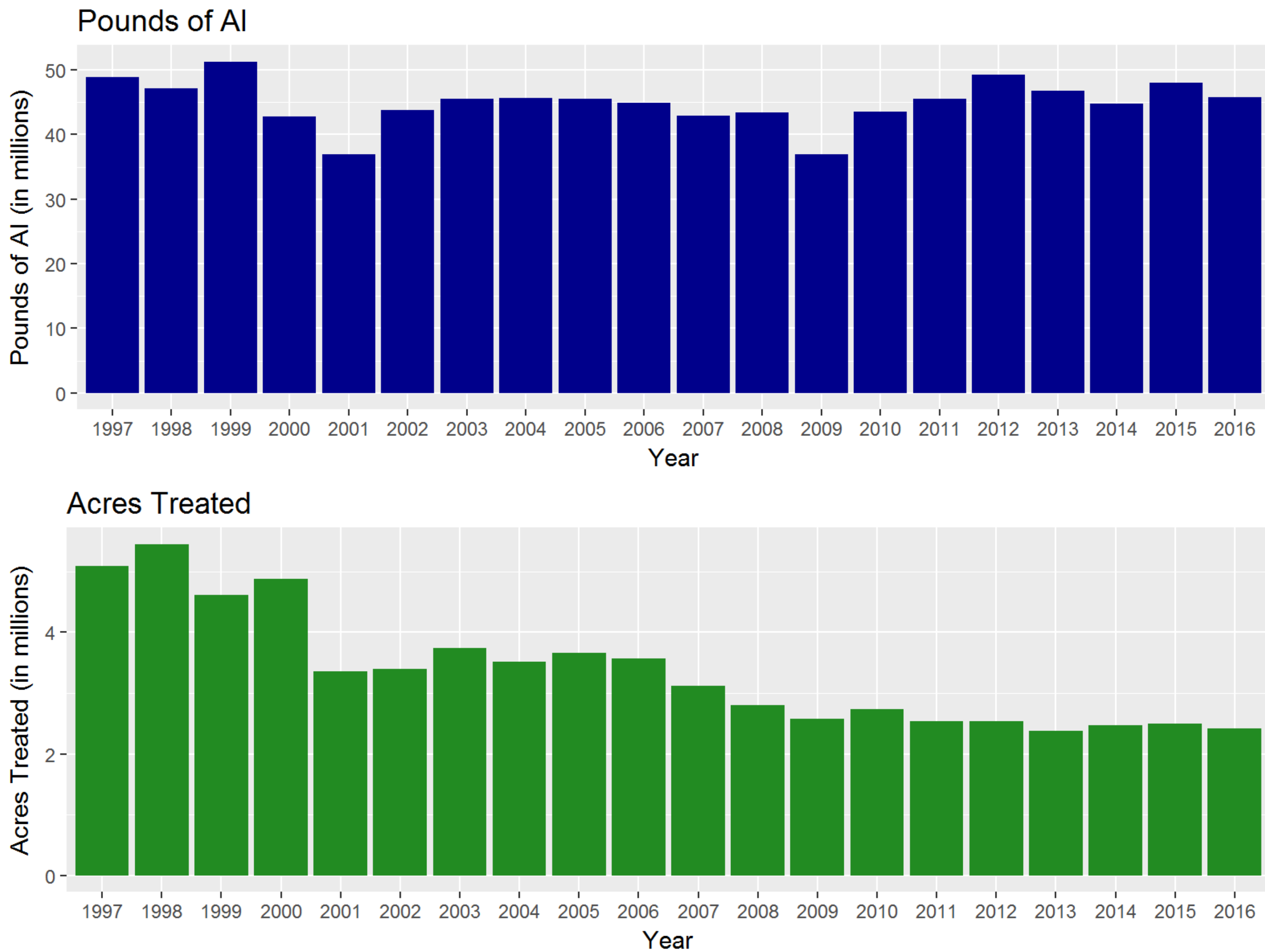


Figure 9: *Use trends of pesticides that are on DPR's toxic air contaminants list applied in California. These pesticides are the active ingredients listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6860. Reported pounds of active ingredient (AI) applied include both agricultural and nonagricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

USE TRENDS OF PESTICIDES THAT ARE FUMIGANTS.

Table 13: *The reported pounds of pesticides used that are fumigants. Use includes both agricultural and reportable nonagricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1,2-DICHLOROPROPANE, 1,3-DICHLOROPROPENE AND RELATED C3 COMPOUNDS	10,532	0	0	0	0	6	0	1	0	0
1,3-DICHLOROPROPENE	9,596,317	9,708,712	6,399,534	8,777,714	10,892,540	11,947,156	12,941,042	13,614,468	15,689,571	14,126,938
ALUMINUM PHOSPHIDE	105,169	132,296	108,084	108,406	156,363	148,904	142,903	113,910	90,264	160,799
CARBON TETRACHLORIDE	180	1,980	<1	0	6	90	0	7	<1	<1
CHLOROPICRIN	5,505,912	5,590,285	5,687,571	6,391,407	7,272,563	8,931,248	8,220,328	8,994,608	8,514,720	8,641,552
DAZOMET	37,537	40,272	65,725	60,539	59,245	39,229	63,920	58,652	83,058	51,588
ETHYLENE DIBROMIDE	3	127	<1	0	0	6	0	0	<1	0
ETHYLENE DICHLORIDE	0	<1	0	0	0	0	0	0	0	0
ETHYLENE OXIDE	2	3	7	0	0	8	0	<1	0	0
MAGNESIUM PHOSPHIDE	5,132	10,507	8,009	12,233	12,594	11,497	12,372	7,562	22,316	14,765
METAM-SODIUM	9,930,337	9,497,562	9,028,103	11,153,272	10,837,368	8,428,425	4,846,428	4,297,539	3,606,650	3,297,827
METHYL BROMIDE	6,448,717	5,693,394	5,615,683	4,809,280	4,002,102	4,017,075	3,534,425	2,963,036	2,655,234	2,602,823
METHYL IODIDE	0	0	0	0	1,157	21	0	0	0	0
PHOSPHINE	5,286	48,243	29,527	11,291	125,033	51,259	20,855	11,399	28,397	19,164
POTASSIUM N-METHYLDITHIOCARBAMATE	3,785,436	5,524,647	4,102,412	4,832,615	5,672,183	8,320,255	9,484,467	7,798,703	10,252,596	9,343,192
PROPYLENE OXIDE	110,068	105,600	111,609	300,008	448,767	389,070	410,360	400,719	396,191	367,437
SODIUM TETRATHIOCARBONATE	391,303	354,294	249,580	233,949	168,761	49,713	<1	120	0	0
SULFURYL FLUORIDE	2,152,451	2,120,860	2,184,823	2,728,977	2,358,706	2,664,125	3,062,343	2,805,366	3,042,512	3,296,298
ZINC PHOSPHIDE	3,215	1,299	20,898	1,745	2,542	2,249	2,287	3,598	4,002	3,656
TOTAL	38,087,596	38,830,083	33,611,563	39,421,436	42,009,930	45,000,335	42,741,732	41,069,687	44,385,510	41,926,039

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 available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
1,2-DICHLOROPROPANE, 1,3-DICHLOROPROPENE AND RELATED C3 COMPOUNDS	108	0	0	0	0	18	0	8	0	0
1,3-DICHLOROPROPENE	53,937	57,922	38,374	54,049	58,696	69,422	71,794	69,656	78,336	75,725
ALUMINUM PHOSPHIDE	84,963	80,989	112,063	100,859	133,062	164,083	148,962	150,088	159,012	82,160
CARBON TETRACHLORIDE	<1	161	<1	0	<1	<1	0	<1	<1	<1
CHLOROPICRIN	55,490	53,408	49,089	51,665	65,717	63,433	57,655	54,872	53,770	49,149
DAZOMET	700	183	301	274	243	594	768	152	368	18
ETHYLENE DIBROMIDE	<1	<1	<1	0	0	<1	0	0	<1	0
ETHYLENE DICHLORIDE	0	160	0	0	0	0	0	0	0	0
ETHYLENE OXIDE	<1	2	60	0	0	<1	0	<1	0	0
MAGNESIUM PHOSPHIDE	6	143	32	145	80	29	19	14	131	9
METAM-SODIUM	78,030	71,815	74,132	71,407	70,794	58,998	28,145	24,422	24,254	19,437
METHYL BROMIDE	45,675	35,685	39,587	32,232	46,785	30,147	26,429	16,578	12,753	11,031
METHYL IODIDE	0	0	0	0	278	37	0	0	0	0
PHOSPHINE	3	1,751	50	643	665	687	110	2	25	3
POTASSIUM N-METHYLDITHIOCARBAMATE	42,988	56,009	38,197	41,444	44,046	50,361	46,861	39,708	48,504	49,022
PROPYLENE OXIDE	<1	12	<1	<1	<1	288	9	<1	<1	<1
SODIUM TETRATHIOCARBONATE	11,485	10,725	7,180	7,301	4,826	1,672	<1	4	0	0
SULFURYL FLUORIDE	9	57	361	130	537	532	63	585	153	<1
ZINC PHOSPHIDE	9,301	11,478	14,512	12,751	21,417	21,685	22,425	44,037	51,789	45,168
TOTAL	333,549	333,467	331,252	328,879	390,595	410,951	358,345	364,792	399,388	302,605

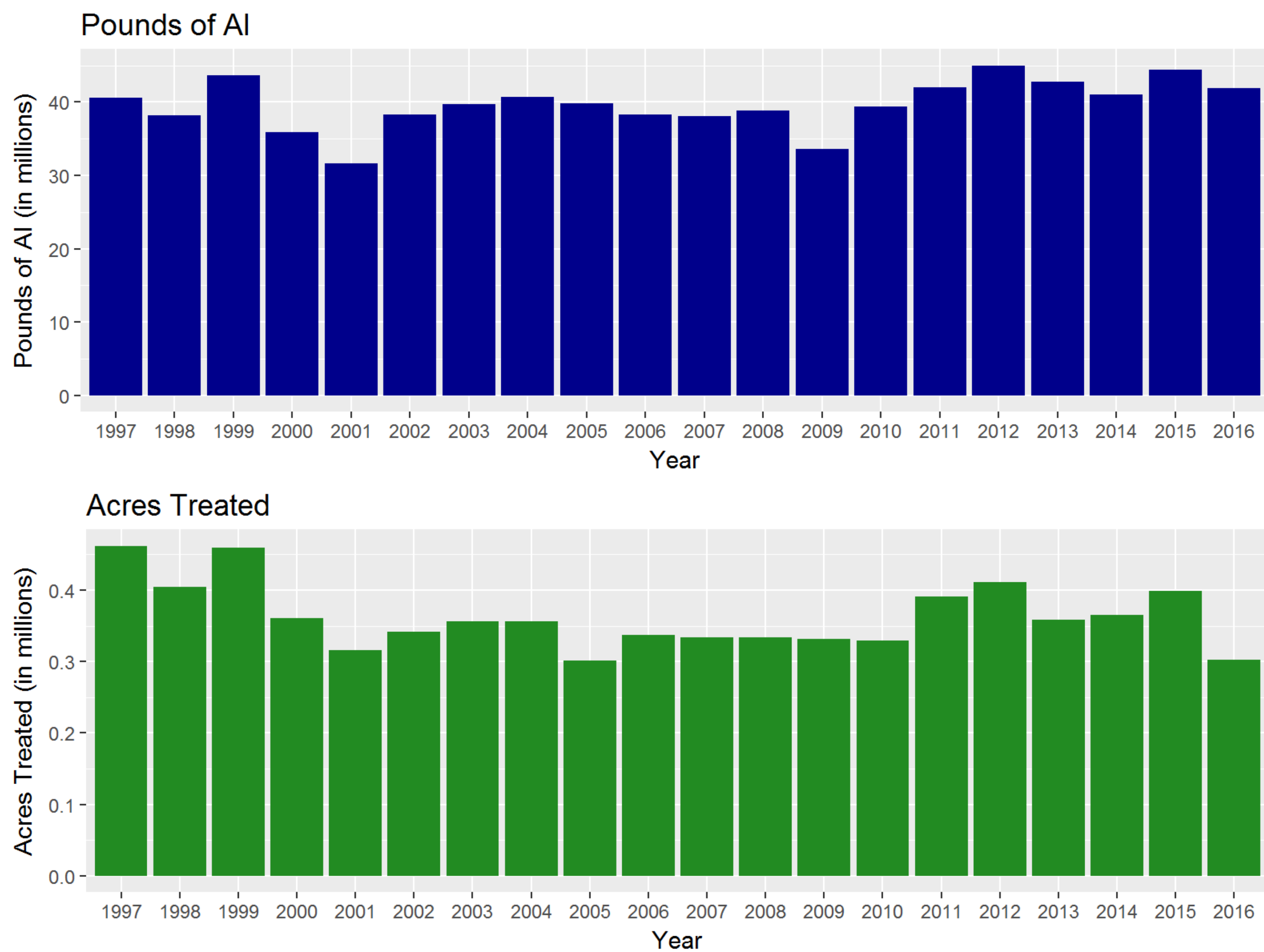


Figure 10: *Use trends of pesticides that are fumigants. Reported pounds of active ingredient (AI) applied include both agricultural and nonagricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

USE TRENDS OF OIL PESTICIDES.

Table 15: *The reported pounds of pesticides used that are oils. Although some oils and other petroleum distillates are on U.S. EPA's list of A or B carcinogens or the State's Proposition 65 list of chemicals "known to cause cancer," these carcinogenic oils are not known to be used in California as pesticides. Many oil pesticides used in California serve as alternatives to chemicals with higher toxicity. Use includes both agricultural and reportable nonagricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
HYDROTREATED PARAFFINIC SOLVENT	300,501	247,676	248,774	224,458	247,998	240,650	229,203	264,564	260,487	265,447
ISOPARAFFINIC HYDROCARBONS	16,859	11,250	13,007	6,628	13,823	9,822	7,290	2,191	11,426	20,769
KEROSENE	12,431	22,269	148,478	95,971	34,580	20,819	7,151	13,930	4,788	4,946
LOW MOLECULAR WEIGHT PARAFFINIC OIL	0	0	0	0	376	1,032	1,588	2,583	264	122
MINERAL OIL	14,755,482	14,590,054	13,740,353	12,984,118	12,367,333	12,630,030	18,249,404	17,077,483	27,884,833	25,035,200
MINERAL OIL, PETROLEUM DISTILLATES, SOLVENT REFINED LIGHT	139	219	124	401	11	0	0	0	0	0
NAPHTHA, HEAVY AROMATIC	0	0	0	0	0	0	<1	0	31	0
ORCHEX 796 OIL	138,145	92,289	54,864	44,624	41,328	61,963	121,278	75,668	26,462	12,485
PETROLEUM DERIVATIVE RESIN	0	0	1	0	<1	0	6	0	0	<1
PETROLEUM DISTILLATES	343,107	504,022	548,175	341,825	279,898	247,352	207,188	158,681	139,448	155,544
PETROLEUM DISTILLATES, ALIPHATIC	18,323	16,390	10,493	15,480	8,981	6,638	7,680	15,233	10,861	6,104
PETROLEUM DISTILLATES, AROMATIC	42,168	44,188	119,480	127,358	135,291	148,867	146,904	119,993	129,363	172,427
PETROLEUM DISTILLATES, REFINED	1,237,891	1,487,043	1,222,830	2,005,527	1,979,551	1,909,225	1,905,974	1,737,545	2,027,694	1,984,415
PETROLEUM HYDROCARBONS	1,407	184	138	177	177	27	77	33	692	809
PETROLEUM NAPHTHENIC OILS	240	248	254	884	1,072	518	349	842	574	1,103
PETROLEUM OIL, PARAFFIN BASED	511,255	506,839	1,048,107	617,316	749,139	899,673	1,188,762	976,615	995,001	542,349
PETROLEUM OIL, UNCLASSIFIED	11,525,656	11,335,303	10,163,009	10,932,995	15,746,265	12,356,333	13,855,917	9,825,513	10,150,353	10,154,182
PETROLEUM SULFONATES	<1	<1	0	0	<1	0	0	0	0	0
TOTAL	28,903,604	28,857,973	27,318,088	27,397,763	31,605,822	28,532,949	35,928,771	30,270,873	41,642,278	38,355,903

Table 16: *The reported cumulative acres treated with pesticides that are oils. Although some oils and other petroleum distillates are on U.S. EPA's list of A or B carcinogens or the State's Proposition 65 list of chemicals "known to cause cancer," these carcinogenic oils are not known to be used in California as pesticides. Many oil pesticides used in California serve as alternatives to chemicals with higher 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 available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
HYDROTREATED PARAFFINIC SOLVENT	261,415	226,988	232,299	227,415	259,990	247,830	236,841	275,904	286,906	434,724
ISOPARAFFINIC HYDROCARBONS	27,903	19,228	22,913	13,709	19,129	15,023	8,637	4,657	23,216	39,060
KEROSENE	254,279	284,440	303,497	316,673	318,822	288,599	286,883	267,821	191,023	183,214
LOW MOLECULAR WEIGHT PARAFFINIC OIL	0	0	0	0	2,064	5,872	9,499	16,631	1,791	465
MINERAL OIL	912,870	980,477	1,119,869	1,287,638	1,379,342	1,445,669	1,922,481	2,013,535	2,488,605	2,539,413
MINERAL OIL, PETROLEUM DISTILLATES, SOLVENT REFINED LIGHT	522	1,010	850	1,255	60	0	0	0	0	0
NAPHTHA, HEAVY AROMATIC	0	0	0	0	0	0	<1	0	<1	0
ORCHEX 796 OIL	170,606	105,399	75,571	54,255	54,434	62,455	84,529	61,815	24,565	10,100
PETROLEUM DERIVATIVE RESIN	0	0	<1	0	<1	0	<1	0	0	<1
PETROLEUM DISTILLATES	280,747	422,253	277,893	238,831	218,970	175,514	175,473	131,336	115,976	132,422
PETROLEUM DISTILLATES, ALIPHATIC	31,441	28,159	30,905	57,764	74,947	32,428	36,156	34,352	44,341	51,513
PETROLEUM DISTILLATES, AROMATIC	33,195	44,567	141,479	161,326	157,970	178,941	163,753	141,533	170,395	204,131
PETROLEUM DISTILLATES, REFINED	231,860	288,363	258,026	273,923	254,839	244,541	258,843	274,439	289,769	298,776
PETROLEUM HYDROCARBONS	546	334	309	159	35	5	75	80	173	156
PETROLEUM NAPHTHENIC OILS	17,950	18,093	22,435	44,459	65,252	27,369	30,539	21,280	35,826	46,936
PETROLEUM OIL, PARAFFIN BASED	738,037	658,709	631,120	672,867	703,458	651,743	608,111	645,825	540,810	505,923
PETROLEUM OIL, UNCLASSIFIED	585,289	597,767	583,325	666,808	930,529	793,498	882,228	724,288	688,602	795,055
PETROLEUM SULFONATES	<1	<1	0	0	<1	0	0	0	0	0
TOTAL	3,498,751	3,636,135	3,652,164	3,958,636	4,355,404	4,126,932	4,664,841	4,587,519	4,864,115	5,192,924

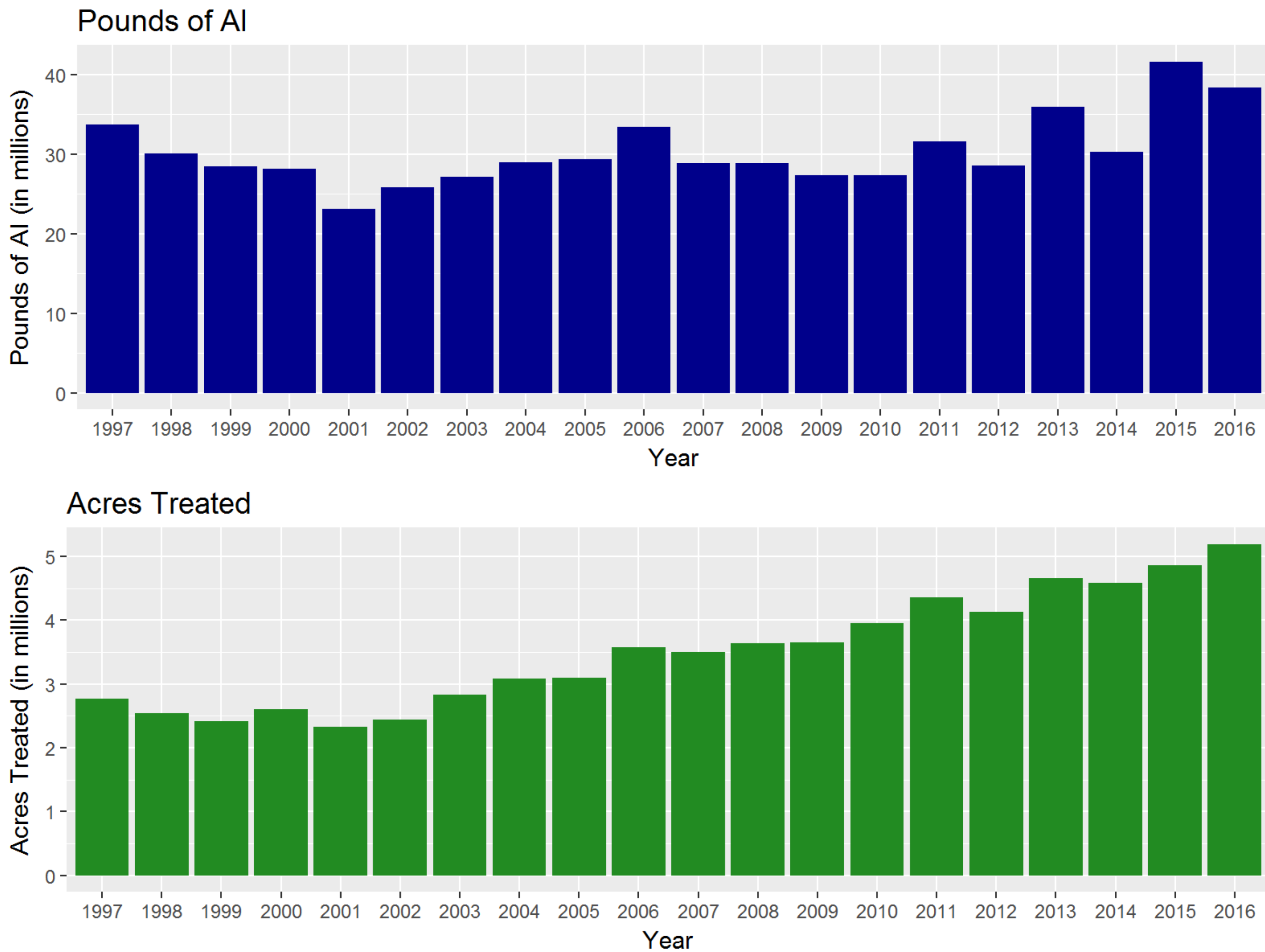


Figure 11: *Use trends of pesticides that are oils. Although some oils and other petroleum distillates are on U.S. EPA's list of A or B carcinogens or the State's Proposition 65 list of chemicals "known to cause cancer," these carcinogenic oils are not known to be used in California as pesticides. Many oil pesticides used in California serve as alternatives to chemicals with higher toxicity. Reported pounds of active ingredient (AI) applied include both agricultural and nonagricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

USE TRENDS OF BIOPESTICIDES.

Table 17: *The reported pounds of pesticides used that are biopesticides or AIs considered to be lower risk to human health or the environment. Biopesticides include microorganisms and naturally occurring compounds, or compounds similar to those found in nature that are not toxic to the target pest (such as pheromones). Use includes both agricultural and reportable nonagricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
(3S, 6R)-3-METHYL-6-ISOPROPENYL-9-DECEN-1-YL ACETATE	0	0	<1	0	0	<1	0	<1	0	<1
(3S, 6S)-3-METHYL-6-ISOPROPENYL-9-DECEN-1-YL ACETATE	0	0	<1	0	0	<1	0	<1	0	<1
(E)-4-TRIDECEN-1-YL-ACETATE	113	176	80	94	0	0	0	23	0	0
(E)-5-DECEN-1-OL	0	0	0	0	0	<1	<1	<1	1	8
(E)-5-DECENOL	2	2	1	1	<1	2	3	1	28	8
(E)-5-DECENYL ACETATE	7	8	4	5	2	10	7	4	23	133
(E,E)-9, 11-TETRADECADIEN-1-YL ACETATE	39	28	11	2	6	3	4	3	3	1
(E,Z)-7,9-DODECADIEN-1-YL ACETATE	0	0	0	50	249	270	24	24	0	0
(S)-KINOPRENE	238	252	276	277	190	300	285	311	429	322
(S)-VERBENONE	0	0	0	0	0	55	0	0	781	633
(Z)-11-HEXADECEN-1-YL ACETATE	2	0	681	0	1	0	0	0	0	<1
(Z)-11-HEXADECENAL	2	0	0	0	0	0	0	0	1	1
(Z)-4-TRIDECEN-1-YL-ACETATE	4	6	3	3	0	0	0	1	0	0
(Z)-9-DODECENYL ACETATE	1	<1	<1	<1	<1	<1	<1	<1	<1	0
(Z,E)-7,11-HEXADECADIEN-1-YL ACETATE	0	<1	3	2	0	0	0	0	0	0
(Z,Z)-11,13-HEXADECADIENAL	<1	<1	0	<1	571	271	321	619	969	1,072
(Z,Z)-7,11-HEXADECADIEN-1-YL ACETATE	0	0	3	3	0	0	0	0	0	0
1,4-DIMETHYLNAPHTHALENE	18	837	1,544	1,152	544	893	2,225	1,085	891	660
1,7-DIOXASPIRO-(5,5)-UNDECANE	<1	<1	<1	<1	<1	<1	1	<1	1	0
1-METHYLCYCLOPROPENE	<1	<1	<1	<1	<1	1	1	<1	1	1
1-NAPHTHALENEACETAMIDE	49	55	32	25	20	20	19	22	18	14
1-OCTEN-3-OL	0	0	0	0	0	0	0	<1	<1	0
2,4-DECADIENOIC ACID, ETHYL ESTER, (2E,4Z)-	0	0	0	0	0	0	0	<1	4	3
2-METHYL-1-BUTANOL	0	0	0	0	0	0	<1	<1	<1	<1
3,13 OCTADECADIEN-1-YL ACETATE	0	44	0	1	12	0	<1	0	<1	142
3,7-DIMETHYL-6-OCTEN-1-OL	0	1	5	23	12	28	54	42	49	72
ACETIC ACID	1	21	79	1,732	73	601	43	62	20,806	9,111
AGROBACTERIUM RADIOBACTER	577	32	142	124	95	28	236	271	137	2,560

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
AGROBACTERIUM RADIOBACTER, STRAIN K1026	<1	<1	1	<1	<1	<1	34	<1	<1	<1
ALLYL ISOTHIOCYANATE	0	0	0	0	0	<1	0	0	0	<1
ALMOND, BITTER	<1	<1	<1	<1	<1	<1	<1	<1	<1	0
AMINO ETHOXY VINYL GLYCINE HYDROCHLORIDE	963	1,073	543	1,024	1,194	1,368	1,444	1,757	2,011	1,371
AMMONIUM BICARBONATE	7	2	<1	9	14	7	51	34	42	0
AMMONIUM NITRATE	35,119	48,460	52,922	55,872	74,916	90,858	125,016	121,744	120,053	114,715
AMMONIUM NONANOATE	0	0	0	0	0	0	1,937	3,131	3,399	21,728
AMPELOMYCES QUISQUALIS	<1	0	<1	<1	0	0	0	0	0	0
ASPERGILLUS FLAVUS STRAIN AF36	0	0	0	0	<1	4	4	8	9	14
AUREOBASIDIUM PULLULANS STRAIN DSM 14940	0	0	0	0	0	0	81	458	356	1,095
AUREOBASIDIUM PULLULANS STRAIN DSM 14941	0	0	0	0	0	0	81	458	356	1,095
AZADIRACHTIN	2,235	2,246	2,500	1,880	2,006	3,417	3,387	4,325	5,108	4,751
BACILLUS AMYLOLIQUEFACIENS STRAIN D747	0	0	0	0	0	869	84,957	177,589	131,295	209,619
BACILLUS FIRMUS (STRAIN I-1582)	0	0	0	0	0	0	0	42	190	170
BACILLUS POPILLIAE	0	0	0	0	0	0	<1	<1	<1	<1
BACILLUS PUMILUS, STRAIN QST 2808	7,062	8,138	6,987	6,783	7,546	6,752	6,245	7,957	8,118	7,878
BACILLUS SPHAERICUS, SEROTYPE H-5A5B, STRAIN 2362	20,192	21,441	18,178	13,013	10,337	9,123	10,500	10,499	12,357	13,104
BACILLUS SUBTILIS GB03	6	1	<1	<1	<1	1	1	2	3	3
BACILLUS SUBTILIS MBI600	0	0	0	0	0	<1	<1	0	0	14
BACILLUS SUBTILIS VAR. AMYLOLIQUEFACIENS STRAIN FZB24	0	0	0	0	0	2	94	119	178	6
BACILLUS THURINGIENSIS (BERLINER)	27	16	4	6	26	18	11	4	29	21
BACILLUS THURINGIENSIS (BERLINER), SUBSP. AIZAWAI, GC-91 PROTEIN	20,474	20,484	27,539	20,397	11,666	17,042	13,265	18,776	16,771	18,882
BACILLUS THURINGIENSIS (BERLINER), SUBSP. AIZAWAI, SEROTYPE H-7	2,877	2,373	894	814	814	714	359	333	184	47
BACILLUS THURINGIENSIS (BERLINER), SUBSP. ISRAELENSIS, SEROTYPE H-14	8,267	9,433	17,202	11,401	22,110	12,632	9,269	11,779	15,761	15,728

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

AI	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI STRAIN SA-12	22,702	12,325	12,128	7,424	4,679	10,361	8,246	7,971	8,473	9,799
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A,3B	987	460	402	150	244	234	53	41	18	34
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN EG 2348	147	369	118	66	478	44	500	514	344	645
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN EG2371	0	0	0	<1	<1	0	0	0	0	0
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN SA-11	63,866	66,612	80,565	75,036	115,662	52,421	77,932	80,401	80,953	74,957
BACILLUS THURINGIENSIS (BERLINER), SUBSP. SAN DIEGO	2	0	<1	<1	0	0	0	0	0	0
BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI STRAIN BMP 123	0	764	118	14	0	0	0	0	0	0
BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI, GENETICALLY ENGINEERED STRAIN EG7841 LEPIDOPTERAN ACTIVE TOXIN	632	277	42	1	75	298	116	65	3	43
BACILLUS THURINGIENSIS VAR. KURSTAKI STRAIN M-200	<1	0	<1	0	0	0	0	0	<1	0
BACILLUS THURINGIENSIS VAR. KURSTAKI, GENETICALLY ENGINEERED STRAIN EG7826	154	442	95	0	0	528	0	0	0	7
BACILLUS THURINGIENSIS, SUBSP. AIZAWAI, STRAIN ABTS-1857	32,529	39,464	31,043	26,250	24,264	30,648	29,863	49,186	55,901	72,261
BACILLUS THURINGIENSIS, SUBSP. AIZAWAI, STRAIN SD-1372, LEPIDOPTERAN ACTIVE TOXIN(S)	563	256	243	130	88	1	18	6	43	13
BACILLUS THURINGIENSIS, SUBSP. ISRAELENSIS, STRAIN AM 65-52	40,376	52,969	53,778	71,050	52,777	173,153	49,687	42,766	46,598	68,995

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BACILLUS THURINGIENSIS, SUBSP. KURSTAKI, STRAIN ABTS-351, FERMENTATION SOLIDS AND SOLUBLES	71,755	78,527	69,545	96,988	82,850	95,294	83,418	111,388	95,431	117,564
BACILLUS THURINGIENSIS, SUBSP. KURSTAKI, STRAIN HD-1	2,262	2,068	3,747	3,579	2,525	3,187	2,323	1,928	1,916	441
BACILLUS THURINGIENSIS, VAR. KURSTAKI DELTA ENDOTOXINS CRY 1A(C) AND CRY 1C (GENETICALLY ENGINEERED) ENCAPSULATED IN PSEUDOMONAS FLUORESCENS (KILLED)	1	26	28	<1	<1	4	0	<1	0	<1
BACTERIOPHAGE ACTIVE AGAINST XANTHOMONAS CAMPESTRIS PV. VESICATORIA AND PSEUDOMONAS SYRINGAE PV. TOMATO	0	0	0	0	<1	<1	<1	<1	0	0
BALSAM FIR OIL	0	0	0	<1	0	<1	<1	<1	1	<1
BEAUVERIA BASSIANA HF 23	0	0	0	0	0	0	0	0	0	37
BEAUVERIA BASSIANA STRAIN GHA	711	569	378	357	608	1,220	1,796	2,749	3,511	2,839
BETA-CONGLUTIN	0	0	0	0	0	0	0	0	6,762	6,099
BUFFALO GOURD ROOT POWDER	137	279	1	11	0	1	25	5	6	8
BURKHOLDERIA SP STRAIN A396 CELLS AND FERMENTATION MEDIA	0	0	0	0	0	0	0	2,829	58,593	53,655
BUTYL MERCAPTAN	0	0	0	0	0	<1	0	0	0	0
CANOLA OIL	29	25	17	131	26	15	28	57	97	246
CAPSICUM OLEORESIN	10	5	2	4	4	12	10	27	92	125
CARBON DIOXIDE	32,010	44,315	7,727	17,550	21,239	30,826	15,739	18,297	17,675	25,366
CASTOR OIL	4	4	21	7	<1	2	<1	8	<1	4
CHENOPODIUM AMBROSIODES NEAR AMBROSIODES	0	0	20,330	10,336	7,897	10,231	20,261	17,504	12,828	10,207
CHROMOBACTERIUM SUBTSUGAE STRAIN PRAA4-1	0	0	0	0	0	1,169	30,262	46,419	45,894	31,438
CINNAMALDEHYDE	3	354	0	0	1	0	0	0	0	0
CITRIC ACID	41,249	57,279	56,086	74,634	82,831	95,653	130,231	115,972	127,401	143,557
CLARIFIED HYDROPHOBIC EXTRACT OF NEEM OIL	110,881	104,822	106,271	115,931	70,234	77,254	119,298	197,351	222,602	166,005
CODLING MOTH GRANULOSIS VIRUS	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CONIOTHYRIUM MINITANS STRAIN CON/M/91-08	6	0	127	80	176	245	611	641	786	657
CORN GLUTEN MEAL	0	<1	0	0	0	0	0	0	0	0

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
CORN SYRUP	81	1,893	2,891	3,026	4,377	4,766	3,216	3,344	4,342	4,850
COTTONSEED OIL	178,546	138,841	79,250	152,118	318,700	114,610	105,083	132,464	87,451	55,082
COYOTE URINE	0	0	0	<1	1	2	3	9	6	3
CYTOKININ	0	0	0	0	<1	<1	<1	<1	<1	<1
DIALLYL DISULFIDE	0	0	0	0	0	0	0	0	0	103
DIHYDRO-5-HEPTYL-2(3H)-FURANONE	<1	<1	<1	<1	0	0	0	0	0	0
DIHYDRO-5-PENTYL-2(3H)-FURANONE	<1	<1	<1	<1	0	0	0	0	0	0
E,E-8,10-DODECADIEN-1-OL	2,273	2,037	4,978	1,942	1,376	1,995	2,276	1,395	1,445	1,076
E-11-TETRADECEN-1-YL ACETATE	2,399	744	312	100	172	133	142	61	73	32
E-8-DODECENYL ACETATE	236	265	606	898	195	283	273	224	683	389
ENCAPSULATED DELTA ENDOTOXIN OF BACILLUS THURINGIENSIS VAR. KURSTAKI IN KILLED PSEUDOMONAS FLUORESCENS	32	18	18	0	1	<1	0	0	0	0
ESSENTIAL OILS	<1	0	<1	<1	<1	1	<1	15	12	20
ETHYLENE	0	0	0	97	1,018	954	1,359	1,333	1,651	1,182
EUCALYPTUS OIL	0	0	0	22	<1	0	0	0	0	0
EUGENOL	0	0	0	0	0	1	<1	1	<1	1
FARNESOL	2	2	3	10	5	11	21	17	20	29
FENUGREEK	31	6	17	1	5	8	2	1	7	0
FERRIC SODIUM EDTA	0	0	0	0	1,979	6,351	5,855	6,790	8,000	12,449
FISH OIL	0	0	0	0	1,657	5,466	4,114	0	0	1,078
FORMIC ACID	1,509	499	280	223	241	634	66	337	2,606	1,243
FOX URINE	0	0	0	<1	<1	2	1	4	3	1
GAMMA AMINOBUTYRIC ACID	1,936	944	177	118	40	133	28	15	15	0
GARLIC	142	212	36	423	29	1,905	2,832	1,392	667	849
GERANIOL	0	1	5	23	12	28	54	42	49	72
GERMAN COCKROACH PHEROMONE	<1	<1	<1	<1	<1	<1	<1	<1	0	<1
GIBBERELLINS	25,094	23,516	22,916	21,310	21,271	23,214	41,103	27,422	27,408	23,116
GIBBERELLINS, POTASSIUM SALT	<1	<1	0	<1	<1	5	0	0	0	0
GLIOCLADIUM VIRENS GL-21 (SPORES)	152	945	356	945	649	1,957	3,538	2,989	4,586	4,395
GLUTAMIC ACID	1,936	944	177	118	40	133	28	15	15	0
GS-OMEGA/KAPPA-HXTX-HV1A (VERSITUDE PEPTIDE)	0	0	0	0	0	0	0	0	0	<1
HARPIN PROTEIN	32	16	14	13	11	1	1	<1	0	<1
HEPTYL BUTYRATE	0	0	0	<1	<1	<1	14	6	4	3
HYDROGEN PEROXIDE	11,860	20,740	21,750	69,179	58,928	36,302	47,236	49,936	74,419	129,523
HYDROPRENE	2,282	2,383	1,664	6,382	11,261	3,948	7,352	5,734	6,456	3,793
IBA	20	11	6	7	9	12	15	14	13	10

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
INDOLE	0	0	0	0	0	0	<1	0	<1	<1
IRON HEDTA	0	0	0	0	0	43	92	120	91	170
IRON PHOSPHATE	1,634	1,901	1,435	2,351	2,871	2,327	2,119	2,007	2,071	2,247
KAOLIN	1,681,292	1,460,552	2,371,254	3,040,482	1,686,870	2,007,204	2,473,768	2,854,542	3,411,278	3,590,641
KINOPRENE	18	23	3	3	9	3	8	33	17	10
LACTIC ACID	0	0	0	0	0	0	0	0	2	1
LACTOSE	9,019	11,341	9,160	7,967	9,192	6,554	7,143	6,616	7,855	8,501
LAGENIDIUM GIGANTEUM (CALIFORNIA STRAIN)	<1	<1	0	0	0	5	0	0	0	0
LAURYL ALCOHOL	503	830	432	736	497	755	449	293	501	317
LAVANDULYL SENECIOATE	0	140	462	437	6,120	586	477	3,166	507	1,029
LIMONENE	68,949	45,536	56,495	56,406	62,921	74,369	61,293	68,134	72,906	67,546
LINALOOL	113	63	62	1,104	95	137	72	62	93	15
MARGOSA OIL	0	0	0	579	7,886	9,106	12,189	22,585	26,019	32,493
MENTHOL	0	0	0	5	<1	0	20	0	0	0
METARHIZIUM ANISOPLIAE STRAIN F52	0	0	0	0	0	116	89	121	20	54
METARHIZIUM ANISOPLIAE, VAR. ANISOPLIAE, STRAIN ESF1	<1	<1	0	<1	<1	0	0	0	0	0
METHOPRENE	3,357	2,620	1,568	1,492	1,763	1,304	1,350	3,556	1,390	1,236
METHYL ANTHRANILATE	152	118	312	343	448	300	1,237	634	672	789
METHYL EUGENOL	0	0	0	0	5	0	9	0	0	126
METHYL NONYL KETONE	<1	<1	<1	<1	0	0	<1	<1	<1	<1
METHYL SALICYLATE	<1	0	<1	0	0	0	0	0	0	0
MUSCALURE	22	19	20	15	15	16	13	17	23	29
MYRISTYL ALCOHOL	102	169	88	150	102	155	91	60	102	64
MYROTHECIUM VERRUCARIA, DRIED FERMENTATION SOLIDS & SOLUBLES, STRAIN AARC-0255	29,990	23,867	23,273	22,813	27,694	25,556	26,005	17,675	30,810	26,033
N6-BENZYL ADENINE	198	153	168	217	128	168	183	184	230	221
NAA	4	31	3	5	4	9	15	12	18	11
NAA, AMMONIUM SALT	1,253	1,193	1,203	976	839	1,400	1,056	945	996	125
NAA, ETHYL ESTER	2	8	3	6	23	4	3	5	3	38
NAA, POTASSIUM SALT	11	0	0	0	0	0	53	15	2	934
NAA, SODIUM SALT	3	1	2	0	0	0	2	1	<1	<1
NATAMYCIN	0	0	0	0	0	0	<1	1	1	1
NEROLIDOL	2	2	6	24	12	28	54	42	49	72
NITROGEN, LIQUIFIED	15,741	11,945	2,181	135	216	74	594	6	0	0
NONANOIC ACID	10,949	11,093	9,063	17,322	17,891	18,200	21,545	17,530	14,482	13,298
NONANOIC ACID, OTHER RELATED	576	584	477	912	941	958	1,134	923	762	700

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
NOSEMA LOCUSTAE SPORES	<1	<1	<1	<1	<1	1	<1	<1	<1	1
OIL OF ANISE	<1	<1	0	0	<1	<1	<1	<1	<1	<1
OIL OF BLACK PEPPER	<1	<1	1	<1	<1	<1	1	1	<1	<1
OIL OF CEDARWOOD	0	0	0	<1	0	0	0	0	<1	<1
OIL OF CITRONELLA	<1	3	0	5	5	0	0	1	5	<1
OIL OF GERANIUM	0	0	0	<1	0	0	0	0	0	0
OIL OF JOJOBA	7,240	12,070	3,418	4,176	1,232	507	135	376	44	19
OIL OF LEMON EUCALYPTUS	0	0	0	0	<1	3	0	0	0	0
OIL OF LEMONGRASS	0	0	0	<1	0	0	0	0	0	0
OIL OF ORANGE	0	0	0	0	0	0	0	0	198	386
OIL OF PEPPERMINT	<1	<1	0	<1	0	0	0	0	0	0
OXYPURINOL	<1	0	0	0	0	0	0	<1	0	0
PAECILOMYCES FUMOSOROSEUS APOPKA STRAIN 97	0	0	0	0	0	507	3,302	5,950	5,624	8,947
PANTOEA AGGLOMERANS STRAIN E325, NRRL B-21856	0	0	33	4	1	1	1	0	0	0
PHENYLETHYL PROPIONATE	326	502	500	822	423	535	701	712	185	96
PHOSPHORIC ACID, MONOPOTASSIUM SALT	0	0	12	6,984	9,079	3,927	1,918	374	9,585	15,002
PIPERINE	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
POLYHEDRAL OCCLUSION BODIES (OB'S) OF THE NUCLEAR POLYHEDROSIS VIRUS OF HELICOVERPA ZEA (CORN EARWORM)	0	<1	1	1	51	6	1	2	4	20
POLYOXIN D, ZINC SALT	234	331	397	1,296	3,492	4,738	6,731	7,412	8,613	10,296
POTASSIUM BICARBONATE	114,163	109,171	180,858	275,648	357,282	228,900	239,695	223,547	318,099	462,158
POTASSIUM PHOSPHITE	189,512	182,376	141,395	287,730	279,746	281,601	390,300	708,946	666,561	950,741
POTASSIUM SILICATE	76	119	231	39	1,412	988	5,407	23,582	36,525	25,901
POTASSIUM SORBATE	743	0	<1	65	0	0	0	0	0	0
PROPYLENE GLYCOL	28,505	24,132	25,792	54,215	47,878	58,461	86,331	90,353	87,134	89,547
PROPYLENEGLYCOL MONOLAURATE	0	0	7	12	0	0	203	44	0	0
PSEUDOMONAS FLUORESCENS, STRAIN A506	614	390	328	217	274	59	92	270	87	123
PSEUDOMONAS SYRINGAE, STRAIN ESC-10	0	0	0	<1	0	0	3	0	0	0
PURPUREOCILIUM LILACIUNUM STRAIN 251	0	0	0	252	515	840	4,073	5,031	6,408	6,273
PUTRESCENT WHOLE EGG SOLIDS	20	1	143	3	1	1	1	1	1	6
PYTHIUM OLIGANDRUM DV74	0	0	0	0	<1	<1	<1	0	0	0

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
QST 713 STRAIN OF DRIED BACILLUS SUBTILIS	17,337	16,703	16,175	21,307	23,942	23,504	24,590	20,969	20,901	21,029
QUILLAJA	276	1,183	410	682	1,081	785	1,040	775	829	1,027
REYNOUTRIA SACHALINENSIS	0	0	179	8,996	14,821	14,803	15,354	16,105	18,358	23,437
S-ABSCISIC ACID	0	7	66	864	1,850	2,651	2,131	2,382	2,114	2,192
S-METHOPRENE	1,726	3,520	3,284	3,921	2,305	2,324	2,331	2,524	2,781	3,219
SAWDUST	<1	1	<1	1	0	4	4	0	0	1
SESAME OIL	883	529	851	1,309	1,327	15	<1	0	0	0
SILVER NITRATE	0	0	0	<1	<1	<1	0	0	0	<1
SODIUM BICARBONATE	0	67	27	3	515	146	44	479	420	13,604
SODIUM CARBONATE PEROXYHYDRATE	11,902	39,470	114,653	101,714	293,876	300,693	295,762	463,448	244,233	261,347
SODIUM CHLORIDE	715	4	3	2	131	112	119	211	216	128
SODIUM LAURYL SULFATE	400	340	146	96	458	884	431	570	1,749	507
SORBITOL OCTANOATE	0	0	2,007	0	35	0	0	0	0	0
SOYBEAN OIL	14,747	12,005	28,359	23,805	24,109	22,022	45,973	59,297	69,771	84,295
STREPTOMYCES GRISEOVIRIDIS STRAIN K61	<1	<1	<1	<1	<1	<1	10	11	18	5
STREPTOMYCES LYDICUS WYEC 108	<1	<1	1	2	1	2	3	3	3	4
SUCROSE OCTANOATE	0	1,685	4,003	1,128	230	55	188	98	203	29
SUGAR	4,180	1,103	993	1,122	448	1,240	51	16	60	667
THYME	485	593	775	1,311	665	844	1,135	1,150	257	122
THYME OIL	0	0	0	0	0	0	0	0	1	3
THYMOL	289	523	1,675	1,539	265	181	398	314	278	534
TRICHODERMA HARZIANUM RIFAI STRAIN KRL-AG2	38	20	11	504	129	158	186	86	65	112
TRICHODERMA ICC 012 ASPERELLUM	0	0	0	0	13	19	43	2	2	9
TRICHODERMA ICC 080 GAMSII	0	0	0	0	13	19	43	2	2	9
TRIMETHYLAMINE	0	0	0	0	0	0	<1	0	<1	<1
ULOCLADIUM OUDEMANSII (U3 STRAIN)	0	0	0	0	0	0	29	792	516	155
VANILLIN	5	1	3	<1	1	1	<1	<1	1	0
VEGETABLE OIL	154,128	270,375	196,078	323,250	513,650	276,278	315,218	267,446	485,628	517,738
XANTHINE	<1	0	0	0	0	0	0	<1	0	0
YEAST	1,030	999	926	470	1,165	818	80	32	86	14
YUCCA SCHIDIGERA	0	7	169	634	1,649	7,147	12,327	5,652	2,565	3,130
Z,E-9,12-TETRADECADIEN-1-YL ACETATE	1	0	6,149	1	7	6	14	122	20	10
Z-11-TETRADECEN-1-YL ACETATE	228	9	9	9	4	8	8	<1	<1	<1
Z-8-DODECENOL	41	46	106	157	34	48	44	38	89	60

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

AI	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Z-8-DODECENYL ACETATE	3,647	4,051	9,262	13,964	3,007	4,005	3,467	3,248	4,320	4,298
TOTAL	3,125,244	3,025,887	3,925,010	5,164,119	4,434,697	4,320,169	5,125,973	6,202,830	6,911,672	7,703,193

Table 18: *The reported cumulative acres treated with pesticides that are biopesticides or AIs considered to be lower risk to human health or the environment. Biopesticides include microorganisms and naturally occurring compounds, or compounds similar to those found in nature 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 available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
(3S, 6R)-3-METHYL-6-ISOPROPENYL-9-DECEN-1-YL ACETATE	0	0	3	0	0	7	0	24	0	10
(3S, 6S)-3-METHYL-6-ISOPROPENYL-9-DECEN-1-YL ACETATE	0	0	3	0	0	7	0	24	0	10
(E)-4-TRIDECEN-1-YL-ACETATE	5,193	7,672	3,942	3,905	0	0	0	1,074	0	0
(E)-5-DECEN-1-OL	0	0	0	0	0	53	83	20	166	354
(E)-5-DECENOL	737	262	118	249	166	502	837	639	348	352
(E)-5-DECENYL ACETATE	737	262	118	249	166	555	920	659	514	705
(E,E)-9, 11-TETRADECADIEN-1-YL ACETATE	22	956	3	474	759	608	985	466	645	349
(E,Z)-7,9-DODECADIEN-1-YL ACETATE	0	0	0	5,168	18,104	22,856	2,479	1,623	0	0
(S)-KINOPRENE	453	575	510	490	344	506	675	750	990	689
(S)-VERBENONE	0	0	0	0	0	100	0	0	<1	<1
(Z)-11-HEXADECEN-1-YL ACETATE	116	0	1,622	0	49	0	0	0	0	26
(Z)-11-HEXADECENAL	72	0	0	0	0	0	0	0	74	145
(Z)-4-TRIDECEN-1-YL-ACETATE	5,193	7,672	3,942	3,905	0	0	0	1,074	0	0
(Z)-9-DODECENYL ACETATE	5,342	1,304	123	74	1,814	392	555	1,966	950	0
(Z,E)-7,11-HEXADECADIEN-1-YL ACETATE	0	1	93	1	0	0	0	0	0	0
(Z,Z)-11,13-HEXADECADIENAL	200	109	0	763	11,336	17,283	20,591	38,681	61,037	66,068
(Z,Z)-7,11-HEXADECADIEN-1-YL ACETATE	0	0	93	1	0	0	0	0	0	0
1,4-DIMETHYLNAPHTHALENE	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,7-DIOXASPIRO-(5,5)-UNDECANE	55	<1	6	<1	<1	30	43	25	32	0
1-METHYLCYCLOPROPENE	6	13	61	3	1	17	21	14	10	6
1-NAPHTHALENEACETAMIDE	927	870	607	408	315	393	343	394	257	338
1-OCTEN-3-OL	0	0	0	0	0	0	0	<1	<1	0
2,4-DECADIENOIC ACID, ETHYL ESTER, (2E,4Z)-	0	0	0	0	0	0	0	179	3,246	1,308
2-METHYL-1-BUTANOL	0	0	0	0	0	0	<1	<1	<1	<1
3,13 OCTADECADIEN-1-YL ACETATE	0	85	0	50	131	0	<1	0	10	25
3,7-DIMETHYL-6-OCTEN-1-OL	0	67	349	1,531	788	2,220	3,939	3,545	3,111	4,331
ACETIC ACID	10	2	226	110	162	3,165	3,114	10,301	15,775	10,437
AGROBACTERIUM RADIOBACTER	555	217	215	362	324	852	624	664	806	604

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
AGROBACTERIUM RADIOBACTER, STRAIN K1026	366	1,935	5,086	81	19	4,947	9,016	754	745	<1
ALLYL ISOTHIOCYANATE	0	0	0	0	0	<1	0	0	0	<1
ALMOND, BITTER	2,068	87	471	74	412	271	88	68	73	0
AMINO ETHOXY VINYL GLYCINE HYDROCHLORIDE	9,238	10,253	5,611	10,179	11,108	14,991	16,371	17,666	20,248	14,174
AMMONIUM BICARBONATE	55	<1	6	<1	<1	30	43	25	32	0
AMMONIUM NITRATE	503,230	643,869	679,675	726,836	815,380	867,336	1,085,578	953,175	987,263	882,120
AMMONIUM NONANOATE	0	0	0	0	0	0	239	284	452	443
AMPELOMYCES QUISQUALIS	14	0	22	2	0	0	0	0	0	0
ASPERGILLUS FLAVUS STRAIN AF36	0	0	0	0	260	48,833	89,337	147,011	159,586	183,128
AUREOBASIDIUM PULLULANS STRAIN DSM 14940	0	0	0	0	0	0	254	2,823	1,569	5,376
AUREOBASIDIUM PULLULANS STRAIN DSM 14941	0	0	0	0	0	0	254	2,823	1,569	5,376
AZADIRACHTIN	91,385	86,813	82,652	71,628	69,621	98,803	113,976	159,397	193,929	174,750
BACILLUS AMYLOLIQUEFACIENS STRAIN D747	0	0	0	0	0	2,337	29,684	41,678	38,545	57,340
BACILLUS FIRMUS (STRAIN I-1582)	0	0	0	0	0	0	0	12	45	41
BACILLUS POPILLIAE	0	0	0	0	0	0	<1	<1	<1	<1
BACILLUS PUMILUS, STRAIN QST 2808	79,795	91,795	75,509	72,582	84,138	76,229	68,102	83,406	89,435	83,149
BACILLUS SPHAERICUS, SEROTYPE H-5A5B, STRAIN 2362	<1	<1	<1	9	<1	231	38	110	118	233
BACILLUS SUBTILIS GB03	2	5	2	<1	6	<1	20	302	467	613
BACILLUS SUBTILIS MBI600	0	0	0	0	0	2	<1	0	0	165
BACILLUS SUBTILIS VAR. AMYLOLIQUEFACIENS STRAIN FZB24	0	0	0	0	0	406	1,702	3,516	4,328	152
BACILLUS THURINGIENSIS (BERLINER)	1,129	41	82	127	877	292	258	91	249	250
BACILLUS THURINGIENSIS (BERLINER), SUBSP. AIZAWAI, GC-91 PROTEIN	53,040	40,440	48,842	40,395	18,657	25,262	22,511	28,611	26,155	25,221
BACILLUS THURINGIENSIS (BERLINER), SUBSP. AIZAWAI, SEROTYPE H-7	24,379	20,510	7,888	6,847	7,766	6,064	3,296	2,941	1,360	421
BACILLUS THURINGIENSIS (BERLINER), SUBSP. ISRAELENSIS, SEROTYPE H-14	833	4,719	501	1,873	337	773	1,110	1,254	1,713	334

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI STRAIN SA-12	35,513	21,008	19,700	10,721	8,197	15,379	9,855	10,751	10,850	13,664
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, SEROTYPE 3A,3B	16,522	8,671	7,807	2,269	3,063	1,973	818	453	145	274
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN EG 2348	1,271	2,147	1,302	688	3,428	644	3,580	4,038	2,502	4,480
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN EG2371	0	0	0	<1	<1	0	0	0	0	0
BACILLUS THURINGIENSIS (BERLINER), SUBSP. KURSTAKI, STRAIN SA-11	119,055	100,581	101,522	111,686	83,989	81,574	95,890	111,648	108,411	95,615
BACILLUS THURINGIENSIS (BERLINER), SUBSP. SAN DIEGO	<1	0	<1	<1	0	0	0	0	0	0
BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI STRAIN BMP 123	0	1,898	310	73	0	0	0	0	0	0
BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI, GENETICALLY ENGINEERED STRAIN EG7841 LEPIDOPTERAN ACTIVE TOXIN	1,225	451	62	3	200	373	5	99	116	473
BACILLUS THURINGIENSIS VAR. KURSTAKI STRAIN M-200	<1	0	<1	0	0	0	0	0	<1	0
BACILLUS THURINGIENSIS VAR. KURSTAKI, GENETICALLY ENGINEERED STRAIN EG7826	479	1,298	250	0	0	1,320	0	0	0	9
BACILLUS THURINGIENSIS, SUBSP. AIZAWAI, STRAIN ABTS-1857	43,209	49,890	41,724	37,209	35,200	41,720	36,837	68,895	70,570	86,966
BACILLUS THURINGIENSIS, SUBSP. AIZAWAI, STRAIN SD-1372, LEPIDOPTERAN ACTIVE TOXIN(S)	4,766	2,343	2,136	1,057	638	4	112	47	306	120
BACILLUS THURINGIENSIS, SUBSP. ISRAELENSIS, STRAIN AM 65-52	25	2,497	270	758	1,050	1,305	794	2,544	2,009	1,419

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BACILLUS THURINGIENSIS, SUBSP. KURSTAKI, STRAIN ABTS-351, FERMENTATION SOLIDS AND SOLUBLES	133,297	134,290	120,661	162,444	152,206	164,936	147,823	192,454	152,721	192,843
BACILLUS THURINGIENSIS, SUBSP. KURSTAKI, STRAIN HD-1	20,045	15,173	20,295	18,369	15,662	15,228	10,138	7,887	11,007	2,241
BACILLUS THURINGIENSIS, VAR. KURSTAKI DELTA ENDOTOXINS CRY 1A(C) AND CRY 1C (GENETICALLY ENGINEERED) ENCAPSULATED IN PSEUDOMONAS FLUORESCENS (KILLED)	<1	25	52	2	<1	10	0	<1	0	<1
BACTERIOPHAGE ACTIVE AGAINST XANTHOMONAS CAMPESTRIS PV. VESICATORIA AND PSEUDOMONAS SYRINGAE PV. TOMATO	0	0	0	0	11	25	21	12	0	0
BALSAM FIR OIL	0	0	0	<1	0	<1	<1	<1	<1	<1
BEAUVERIA BASSIANA HF 23	0	0	0	0	0	0	0	0	0	32
BEAUVERIA BASSIANA STRAIN GHA	2,481	2,091	2,188	1,686	2,702	4,011	6,857	10,900	14,356	11,103
BETA-CONGLUTIN	0	0	0	0	0	0	0	0	9,032	12,422
BUFFALO GOURD ROOT POWDER	1,694	3,227	8	138	0	25	161	200	224	114
BURKHOLDERIA SP STRAIN A396 CELLS AND FERMENTATION MEDIA	0	0	0	0	0	0	0	196	5,531	6,816
BUTYL MERCAPTAN	0	0	0	0	0	<1	0	0	0	0
CANOLA OIL	33	1,388	1,541	4,786	3,872	2,329	5,791	4,272	7,455	20,332
CAPSICUM OLEORESIN	277	528	325	388	238	576	546	1,541	1,997	2,084
CARBON DIOXIDE	<1	<1	<1	<1	26	917	5	20	19	2
CASTOR OIL	<1	4	12	<1	<1	<1	<1	<1	<1	<1
CHENOPODIUM AMBROSIODES NEAR AMBROSIODES	0	0	6,355	9,265	6,868	13,401	22,552	25,820	19,072	15,804
CHROMOBACTERIUM SUBTSUGAE STRAIN PRAA4-1	0	0	0	0	0	1,424	38,138	61,191	62,467	43,340
CINNAMALDEHYDE	2	556	0	0	<1	0	0	0	0	0
CITRIC ACID	815,766	919,736	903,198	1,203,850	1,318,991	1,389,801	1,542,598	1,686,332	1,922,437	2,199,842
CLARIFIED HYDROPHOBIC EXTRACT OF NEEM OIL	71,278	64,156	47,422	42,281	40,303	42,613	60,211	85,369	87,905	65,647
CODLING MOTH GRANULOSIS VIRUS	2,141	1,487	1,139	984	3,450	3,431	4,339	4,530	3,683	2,938
CONIOTHYRIUM MINITANS STRAIN CON/M/91-08	120	0	1,204	395	1,107	1,697	4,286	4,886	6,194	4,104
CORN GLUTEN MEAL	0	3	0	0	0	0	0	0	0	0

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
CORN SYRUP	1,132	7,991	14,316	12,877	27,721	27,760	15,992	14,206	18,817	18,940
COTTONSEED OIL	228,343	157,432	74,386	127,730	177,622	95,344	98,797	78,736	67,349	41,034
COYOTE URINE	0	0	0	<1	12	<1	<1	<1	<1	<1
CYTOKININ	0	0	0	0	199	2,409	352	3,290	1,966	1,910
DIALLYL DISULFIDE	0	0	0	0	0	0	0	0	0	225
DIHYDRO-5-HEPTYL-2(3H)-FURANONE	<1	<1	<1	<1	0	0	0	0	0	0
DIHYDRO-5-PENTYL-2(3H)-FURANONE	<1	<1	<1	<1	0	0	0	0	0	0
E,E-8,10-DODECADIEN-1-OL	27,784	21,585	15,300	15,283	17,872	15,879	18,241	16,548	10,772	12,874
E-11-TETRADECEN-1-YL ACETATE	6,189	5,996	5,592	5,405	1,701	4,485	4,396	489	696	369
E-8-DODECENYL ACETATE	49,086	54,242	46,757	49,591	45,656	49,300	47,640	41,405	42,615	39,608
ENCAPSULATED DELTA ENDOTOXIN OF BACILLUS THURINGIENSIS VAR. KURSTAKI IN KILLED PSEUDOMONAS FLUORESCENS	35	91	37	0	<1	<1	0	0	0	0
ESSENTIAL OILS	1	0	<1	4	<1	<1	<1	<1	<1	181
ETHYLENE	0	0	0	4	70	49	36	21	28	77
EUCALYPTUS OIL	0	0	0	2	<1	0	0	0	0	0
EUGENOL	0	0	0	0	0	<1	<1	<1	<1	<1
FARNESOL	652	422	503	1,597	826	2,227	3,940	3,547	3,121	4,331
FENUGREEK	2,068	87	471	74	412	271	88	68	73	0
FERRIC SODIUM EDTA	0	0	0	0	3,049	8,428	8,038	10,540	12,522	13,115
FISH OIL	0	0	0	0	<1	382	252	0	0	66
FORMIC ACID	1	51	10	60	1	368	5	178	1,203	60
FOX URINE	0	0	0	<1	12	<1	<1	<1	<1	<1
GAMMA AMINOBUTYRIC ACID	24,697	12,905	1,786	835	542	1,811	384	314	287	0
GARLIC	346	288	374	1,123	1,369	12,410	14,485	8,509	4,767	7,185
GERANIOL	0	67	349	1,531	788	2,220	3,939	3,545	3,111	4,331
GERMAN COCKROACH PHEROMONE	<1	<1	<1	<1	<1	<1	<1	<1	0	<1
GIBBERELLINS	455,130	490,530	513,398	491,246	504,987	529,744	548,205	530,086	522,928	543,927
GIBBERELLINS, POTASSIUM SALT	32	8	0	34	150	795	0	0	0	0
GLIOCLADIUM VIRENS GL-21 (SPORES)	5	1,090	716	1,401	1,076	3,172	5,444	5,187	7,439	7,140
GLUTAMIC ACID	24,697	12,905	1,786	835	542	1,811	384	314	287	0
GS-OMEGA/KAPPA-HXTX-HV1A (VERSITUDE PEPTIDE)	0	0	0	0	0	0	0	0	0	1
HARPIN PROTEIN	3,721	1,998	1,562	1,631	1,582	115	95	0	0	112
HEPTYL BUTYRATE	0	0	0	<1	<1	<1	<1	<1	<1	<1
HYDROGEN PEROXIDE	7,744	9,361	14,521	23,208	38,110	21,863	22,955	28,040	32,676	68,987
HYDROPRENE	2	200	82	<1	<1	2	4	<1	<1	7
IBA	44,093	3,862	150	227	1,155	1,283	962	940	489	808

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

AI	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
INDOLE	0	0	0	0	0	0	<1	0	<1	<1
IRON HEDTA	0	0	0	0	0	<1	2	<1	<1	<1
IRON PHOSPHATE	7,145	6,569	4,561	6,345	5,477	6,519	6,286	8,109	8,618	13,313
KAOLIN	56,911	47,438	66,781	82,636	51,099	57,755	80,075	88,044	101,628	115,411
KINOPRENE	29	20	3	4	9	3	6	25	7	3
LACTIC ACID	0	0	0	0	0	0	0	0	38	59
LACTOSE	80,366	99,526	77,363	80,273	91,507	68,442	80,242	61,764	81,390	77,746
LAGENIDIUM GIGANTEUM (CALIFORNIA STRAIN)	<1	<1	0	0	0	2	0	0	0	0
LAURYL ALCOHOL	9,358	7,782	4,705	5,495	6,443	6,652	7,807	5,681	5,725	4,674
LAVANDULYL SENECIOATE	0	4,316	2,375	7,025	11,754	6,666	5,869	6,294	8,424	18,076
LIMONENE	79,012	64,151	55,465	29,621	15,514	73,605	29,552	32,924	45,208	40,214
LINALOOL	<1	7	1	<1	<1	<1	<1	2	<1	<1
MARGOSA OIL	0	0	0	40	4,260	7,977	9,546	19,013	19,917	25,809
MENTHOL	0	0	0	2	<1	0	20	0	0	0
METARHIZIUM ANISOPLIAE STRAIN F52	0	0	0	0	0	202	133	634	122	55
METARHIZIUM ANISOPLIAE, VAR. ANISOPLIAE, STRAIN ESF1	<1	<1	0	<1	<1	0	0	0	0	0
METHOPRENE	51	42	211	4	896	<1	<1	<1	<1	42
METHYL ANTHRANILATE	298	219	550	380	2,043	215	1,092	808	895	1,463
METHYL EUGENOL	0	0	0	0	<1	0	<1	0	0	<1
METHYL NONYL KETONE	<1	<1	1	<1	0	0	<1	<1	<1	<1
METHYL SALICYLATE	1	0	<1	0	0	0	0	0	0	0
MUSCALURE	1,179	<1	739	300	68	40	50	139	41	19
MYRISTYL ALCOHOL	9,358	7,782	4,705	5,495	6,443	6,652	7,807	5,681	5,725	4,674
MYROTHECIUM VERRUCARIA, DRIED FERMENTATION SOLIDS & SOLUBLES, STRAIN AARC-0255	5,097	5,257	5,331	4,840	5,123	4,274	4,456	3,637	8,775	6,473
N6-BENZYL ADENINE	2,628	1,775	2,072	3,352	1,690	1,666	2,954	2,630	2,592	2,996
NAA	43,507	3,331	47	38	219	655	293	109	210	84
NAA, AMMONIUM SALT	11,709	10,445	9,024	9,140	9,075	11,922	10,611	9,703	9,966	778
NAA, ETHYL ESTER	<1	73	1	23	396	384	113	189	37	44
NAA, POTASSIUM SALT	41	0	0	0	0	0	6	110	35	8,819
NAA, SODIUM SALT	340	37	257	0	0	0	153	85	55	11
NATAMYCIN	0	0	0	0	0	0	7	32	35	24
NEROLIDOL	652	422	503	1,597	826	2,227	3,940	3,547	3,121	4,331
NITROGEN, LIQUIFIED	<1	<1	<1	<1	<1	<1	<1	5	0	0
NONANOIC ACID	1,275	498	703	412	828	480	2,166	2,074	1,040	648
NONANOIC ACID, OTHER RELATED	1,275	498	701	412	828	460	2,166	2,074	1,040	648

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
NOSEMA LOCUSTAE SPORES	254	30	132	12	12	1,612	1,206	910	750	50
OIL OF ANISE	<1	<1	0	0	<1	<1	<1	<1	<1	<1
OIL OF BLACK PEPPER	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
OIL OF CEDARWOOD	0	0	0	15	0	0	0	0	<1	<1
OIL OF CITRONELLA	<1	2	0	34	<1	0	0	<1	<1	<1
OIL OF GERANIUM	0	0	0	15	0	0	0	0	0	0
OIL OF JOJOBA	7,846	11,566	7,203	8,255	1,762	1,077	316	323	83	16
OIL OF LEMON EUCALYPTUS	0	0	0	0	<1	<1	0	0	0	0
OIL OF LEMONGRASS	0	0	0	15	0	0	0	0	0	0
OIL OF ORANGE	0	0	0	0	0	0	0	0	21,472	37,651
OIL OF PEPPERMINT	<1	<1	0	15	0	0	0	0	0	0
OXYPURINOL	1	0	0	0	0	0	0	6	0	0
PAECILOMYCES FUMOSOROSEUS APOPKA STRAIN 97	0	0	0	0	0	2,109	12,822	18,483	19,076	31,000
PANTOEA AGGLOMERANS STRAIN E325, NRRL B-21856	0	0	698	55	25	50	50	0	0	0
PHENYLETHYL PROPIONATE	<1	<1	94	<1	<1	<1	<1	<1	<1	<1
PHOSPHORIC ACID, MONOPOTASSIUM SALT	0	0	<1	1,021	1,275	561	219	<1	1,837	3,142
PIPERINE	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
POLYHEDRAL OCCLUSION BODIES (OB'S) OF THE NUCLEAR POLYHEDROSIS VIRUS OF HELICOVERPA ZEA (CORN EARWORM)	0	98	254	302	14,752	1,297	337	518	1,011	4,902
POLYOXIN D, ZINC SALT	3	1,067	1,299	19,082	69,191	95,645	143,483	165,601	191,654	231,465
POTASSIUM BICARBONATE	47,299	41,899	69,155	101,283	118,285	75,356	85,879	85,701	112,047	156,199
POTASSIUM PHOSPHITE	52,370	49,951	36,665	92,671	82,205	115,741	131,552	214,918	199,571	299,081
POTASSIUM SILICATE	49	68	274	48	808	537	3,524	12,973	13,499	12,133
POTASSIUM SORBATE	230	0	2	105	0	0	0	0	0	0
PROPYLENE GLYCOL	520,537	420,161	381,957	591,117	658,896	676,470	974,892	1,069,976	1,107,471	1,119,249
PROPYLENEGLYCOL MONOLAURATE	0	0	3	12	0	0	159	76	0	0
PSEUDOMONAS FLUORESCENS, STRAIN A506	4,801	1,943	2,463	1,472	1,281	372	431	1,178	376	601
PSEUDOMONAS SYRINGAE, STRAIN ESC-10	0	0	0	3	0	0	<1	0	0	0
PURPUREOCILIUM LILACIUNUM STRAIN 251	0	0	0	1,115	2,330	3,531	20,039	25,826	32,089	26,924
PUTRESCENT WHOLE EGG SOLIDS	<1	<1	33	2	<1	<1	<1	<1	<1	<1
PYTHIUM OLIGANDRUM DV74	0	0	0	0	2	2	63	0	0	0

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

AI	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
QST 713 STRAIN OF DRIED BACILLUS SUBTILIS	67,563	75,619	81,252	99,317	117,865	124,702	141,246	138,006	140,713	129,968
QUILLAJA	18,584	27,814	22,595	22,949	30,225	22,907	28,538	30,232	31,107	53,330
REYNOUTRIA SACHALINENSIS	0	0	1,297	70,363	90,515	94,114	96,188	95,988	105,532	127,702
S-ABSCISIC ACID	0	34	502	5,195	9,498	14,974	11,645	12,761	11,202	11,471
S-METHOPRENE	30,635	47,284	47,190	65,114	61,532	87,637	49,491	53,371	102,129	76,961
SAWDUST	10	19	<1	<1	0	74	108	0	0	160
SESAME OIL	888	846	1,448	1,912	1,938	39	1	0	0	0
SILVER NITRATE	0	0	0	<1	<1	5	0	0	0	<1
SODIUM BICARBONATE	0	17	57	1	967	1,026	291	544	706	796
SODIUM CARBONATE PEROXYHYDRATE	531	219	1,453	3,666	6,554	13,797	11,764	17,035	8,051	10,137
SODIUM CHLORIDE	<1	<1	<1	<1	2	164	207	135	66	134
SODIUM LAURYL SULFATE	<1	14	<1	<1	<1	<1	<1	<1	<1	<1
SORBITOL OCTANOATE	0	0	268	0	42	0	0	0	0	0
SOYBEAN OIL	3,277	2,460	3,792	6,160	3,636	3,302	4,524	6,275	5,476	7,018
STREPTOMYCES GRISEOVIRIDIS STRAIN K61	12	<1	<1	<1	1	<1	5	10	18	5
STREPTOMYCES LYDICUS WYEC 108	96	1,910	4,009	6,998	6,399	10,367	16,071	14,050	16,546	20,474
SUCROSE OCTANOATE	0	448	930	1,172	148	1	5	10	2	12
SUGAR	7,175	4,717	4,507	1,526	5,807	4,843	1,062	1,427	452	504
THYME	<1	<1	68	<1	<1	<1	<1	<1	<1	<1
THYME OIL	0	0	0	0	0	0	0	0	<1	<1
THYMOL	52	60	50	422	10	18	1	1	1,267	485
TRICHODERMA HARZIANUM RIFAI STRAIN KRL-AG2	311	201	320	7,253	869	1,088	994	2,517	2,346	2,185
TRICHODERMA ICC 012 ASPERELLUM	0	0	0	0	86	704	604	35	251	159
TRICHODERMA ICC 080 GAMSII	0	0	0	0	86	704	604	35	251	159
TRIMETHYLAMINE	0	0	0	0	0	0	<1	0	<1	<1
ULOCLADIUM OUDEMANSII (U3 STRAIN)	0	0	0	0	0	0	19	707	406	150
VANILLIN	2,068	87	471	74	412	271	88	68	73	0
VEGETABLE OIL	144,591	231,954	211,586	292,218	457,698	266,226	350,771	243,680	311,693	405,225
XANTHINE	1	0	0	0	0	0	0	6	0	0
YEAST	4,694	4,560	3,957	1,306	5,261	3,729	325	142	220	25
YUCCA SCHIDIGERA	0	18	598	2,316	4,907	16,093	19,524	11,285	7,347	9,376
Z,E-9,12-TETRADECADIEN-1-YL ACETATE	44	0	1,622	<1	49	<1	<1	<1	<1	<1
Z-11-TETRADECEN-1-YL ACETATE	6,166	5,040	5,589	4,931	942	3,877	3,411	23	51	20
Z-8-DODECENOL	49,086	54,242	46,757	49,591	45,656	49,300	47,640	41,405	42,615	39,608

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

AI	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Z-8-DODECENYL ACETATE	49,086	54,242	46,757	49,591	45,656	49,300	47,640	41,405	42,615	39,608
TOTAL	4,039,404	4,166,774	3,980,553	4,901,362	5,471,994	5,585,538	6,548,518	6,925,400	7,485,717	8,007,672

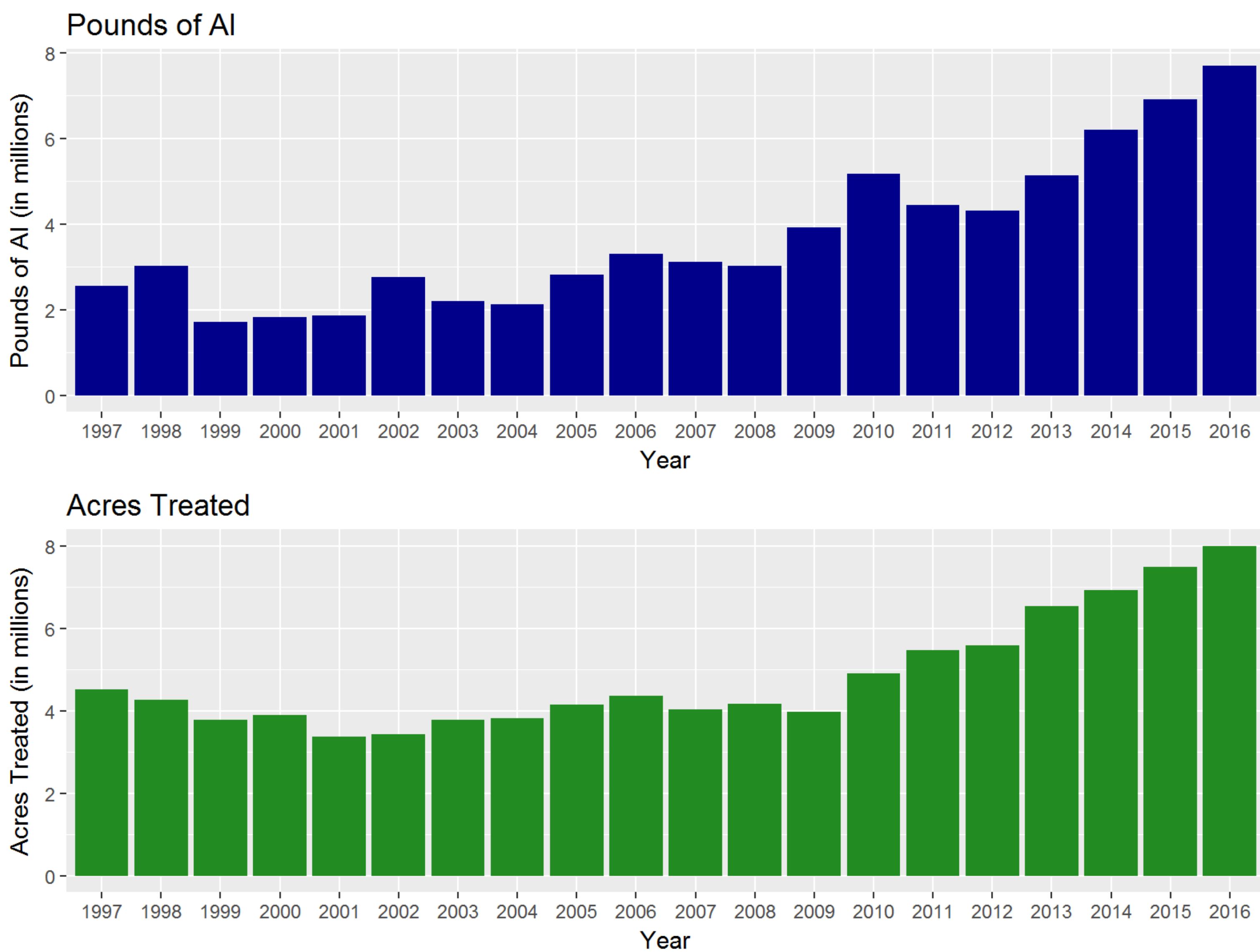


Figure 12: *Use trends of pesticides that are biopesticides. Biopesticides include microorganisms and naturally occurring compounds, or compounds similar to those found in nature that are not toxic to the target pest (such as pheromones). Reported pounds of active ingredient (AI) applied include both agricultural and nonagricultural applications. The reported cumulative acres treated include primarily agricultural applications. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

5 Trends in Pesticide Use for Select Commodities

A grower's or applicator's decision to apply pesticides depends on many factors, such as the presence of biological control agents (e.g., predatory insects and other natural enemies), current pest levels, cost of pesticides and labor, value of the crop, pesticide resistance and effectiveness, other available management practices, and potential pesticide risk to the environment or farm workers. Pest populations are determined by 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.

Crops treated with the greatest total pounds of pesticides in 2016 were almond, wine grape, table and raisin grape, processing tomato, and strawberry. Crops or sites with the greatest *increase* in the pounds applied from 2015 to 2016 include orange, rice, grape, tangerine, and tomato. Crops or sites with the greatest *decrease* in the pounds applied include pistachio, soil fumigation/preplant, wine grape, processing tomato, and potato (Table 19).

Table 19: *The change in pounds of AI applied and acres planted or harvested and the percent change from 2015 to 2016 for the crops or sites with the greatest increase and decrease in pounds applied. Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

	Change in Use 2015–2016		Percent Change 2015–2016	
Crop Treated	Pounds	Acres	Pounds	Acres
ORANGE	1,152,889	-6,000	12	-4
RICE	1,025,606	118,000	23	28
GRAPE	945,350	-15,000	6	-5
TANGERINE	564,554	0	24	0
TOMATO	482,374	Not Available	37	Not Available
POTATO	-534,182	-1,500	-28	-4
TOMATO, PROCESSING	-1,165,861	-37,000	-8	-12
GRAPE, WINE	-1,812,421	-6,000	-6	-1
SOIL FUMIGATION/PREPLANT	-2,584,549	Not Available	-33	Not Available
PISTACHIO	-2,638,670	6,000	-34	3

Thirteen commodities were chosen for in-depth analyses of the possible reasons for changes in pesticide use from 2015 to 2016: alfalfa, almond, carrot, cotton, orange, peach and nectarine, pistachio, processing tomato, rice, strawberry, table and raisin grape, walnut, and wine grape. ('Peach and nectarine' and 'table and raisin grapes' were grouped together for the purposes of the annual report due to similar pesticide use). They were selected because each commodity was treated with more than 4 million pounds of AIs or treated on more than 3 million acres, cumulatively. Collectively, these commodities represent 72 percent of the total amount used in 2016 (78 percent of total used on agricultural fields) and 73 percent of the area treated in 2016 (74 percent of total agricultural acres treated).

For these 13 commodities, the non-adjuvant AIs applied to the most area were sulfur and glyphosate. Sulfur, used on all 13 commodities except rice, was applied mostly on table and raisin grape, wine grape and processing tomato. Sulfur is a natural fungicide favored by both conventional and organic farmers and is used mostly to manage powdery mildew on grape and processing tomato. It can also be used on some crops to suppress mites. Glyphosate is a broad-spectrum herbicide and crop desiccant. Glyphosate was used on all 13 commodities although nearly 40 percent was on almond. Although not used on every one of the 13 commodities, the following AIs were used on over one million cumulative acres: the insecticides (and miticides) abamectin, lambda-cyhalothrin, bifenthrin, methoxyfenozide, imidacloprid, chlorantraniliprole, and petroleum and mineral oils; the herbicides oxyfluorfen and paraquat dichloride; and the fungicides copper and pyraclostrobin.

Petroleum and mineral oils were second to sulfur in amount of pounds of non-adjuvant pesticides used on all 13 commodities. Almond, wine grape, orange, and peach and nectarine had the highest use of oils out of the 13 commodities. Oils are mostly used as insecticides, but can also be used as fungicides and adjuvants. The fumigants 1,3-dichloropropene, chloropicrin, metam-potassium, and metam-sodium also ranked high in pounds of pesticide used on the 13 commodities, with the exception of rice. In production agriculture, these fumigants are usually applied to the soil before planting a crop to control various soil-borne diseases, nematodes, and other problematic pests. In orchards, fumigation may be used to spot-treat a small area following tree removal before a replacement tree is planted.

Information used to develop the trend analyses for each of the thirteen crops in this chapter was drawn from several publications and from the expertise of pest control advisors, growers, University of California Cooperative Extension farm advisors and specialists, researchers, and commodity association representatives. DPR scientists analyzed the information, using their knowledge of pesticides, California agriculture, pests, and pest management practices. As a result, the explanations for changes in pesticide use are largely based on the subjective opinions of experts as opposed to rigorous statistical analyses. Additional figures of pesticide distribution maps and graphs associated with each crop can be found in the Appendix of this document (Appendix figures are referenced by an “A” preceding the figure number). Note that graphs and tables of this section are based on statewide totals which may not accurately reflect regional differences in environmental conditions, pest pressure, and pesticide use patterns of crops grown in multiple, geographically-distinct areas of California.

Alfalfa

Alfalfa is grown primarily as a forage crop, providing protein and high energy for dairy cows and other livestock. California is the leading alfalfa hay-producing state in the United States. There are six alfalfa growing regions in California, encompassing a range of climatic conditions: Inter-mountain, Sacramento Valley, San Joaquin Valley, Coastal, High Desert, and Low Desert

(Figure A-3). The price received per ton of hay decreased in 2016 after having reached one of its highest values in 2014 (Table 20). In addition, the number of acres harvested was at its lowest since the 1940s. These two factors may account for some of the observed trends in pesticide use in alfalfa in 2016 (Figures 14, A-4, and A-5).

Table 20: *Total reported pounds of all active ingredients (AI), acres treated, acres harvested, and prices for alfalfa each year from 2012 to 2016. Harvested acres are from USDA(a) 2013 - 2017; marketing year average prices are from USDA(c), 2015 - 2017; Acres treated means cumulative acres treated (see explanation p. 12). Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	3,543,581	3,750,809	3,737,208	3,506,371	3,167,307
Acres Treated	5,207,906	6,207,370	6,651,166	5,686,474	5,349,047
Acres Harvested	950,000	900,000	875,000	790,000	720,000
Price/ton	$ 210	$ 206	$ 244	$ 181	$ 153

Use of all the major insecticides decreased in 2016 (Figure 13). This decrease can be tied to lower prices received for hay as well as a reduced number of acres planted. The alternative practice of early cutting is commonly used when the price of hay is low to reduce insect and disease problems and thus avoid the cost of pesticides. Dimethoate use decreased 93,788 acres, a 32 percent decline from 2015, suggesting a link to reduced pest pressure from blue alfalfa aphid. In addition to the organophosphates chlorpyrifos and dimethoate, the pyrethroid lambda-cyhalothrin was also used less (Figure 14). Pyrethroid use decreased in 2016 for a second year, which continued to reverse an increasing trend that began in 2009.

The area treated with pyrethroids, carbamates, and organophosphates decreased by 341,869 acres in 2016. Chlorantraniliprole, a broad-spectrum, anthranilic diamide insecticide, increased in area treated by 108 percent for a total of 57,544 acres treated. The use of *Bacillus thuringiensis* increased 251 percent, with a total of 20,353 acres treated in 2016, which is the largest acreage treated since 2008.

The inter-mountain region experienced pyrethroid resistance for the treatment of the alfalfa weevil. One expert source reported that in some instances, untreated areas yielded a better crop compared to treated areas, implying that resistance was extreme enough to render the pyrethroid applications ineffective. Indoxacarb use increased by 62 percent which can be attributed to weevil control and its use as an alternative to chlorpyrifos. Chlorpyrifos became a restricted material in July 2015 and its use in alfalfa has declined by 38 percent with 82,682 fewer acres treated. Flubendiamide was the only other top five AI to increase, with 33 percent increased use. In 2016, flubendiamide registration was canceled nationally. In the U.S. EPA's Flubendiamide; Notice of Intent to Cancel Pesticide Registration (Vol.81, No. 43, March 4, 2016, Notices), they concluded that continued use of the insecticide will result in unreasonable adverse effects to aquatic invertebrates, an important part of the aquatic food chain, particularly for fish.

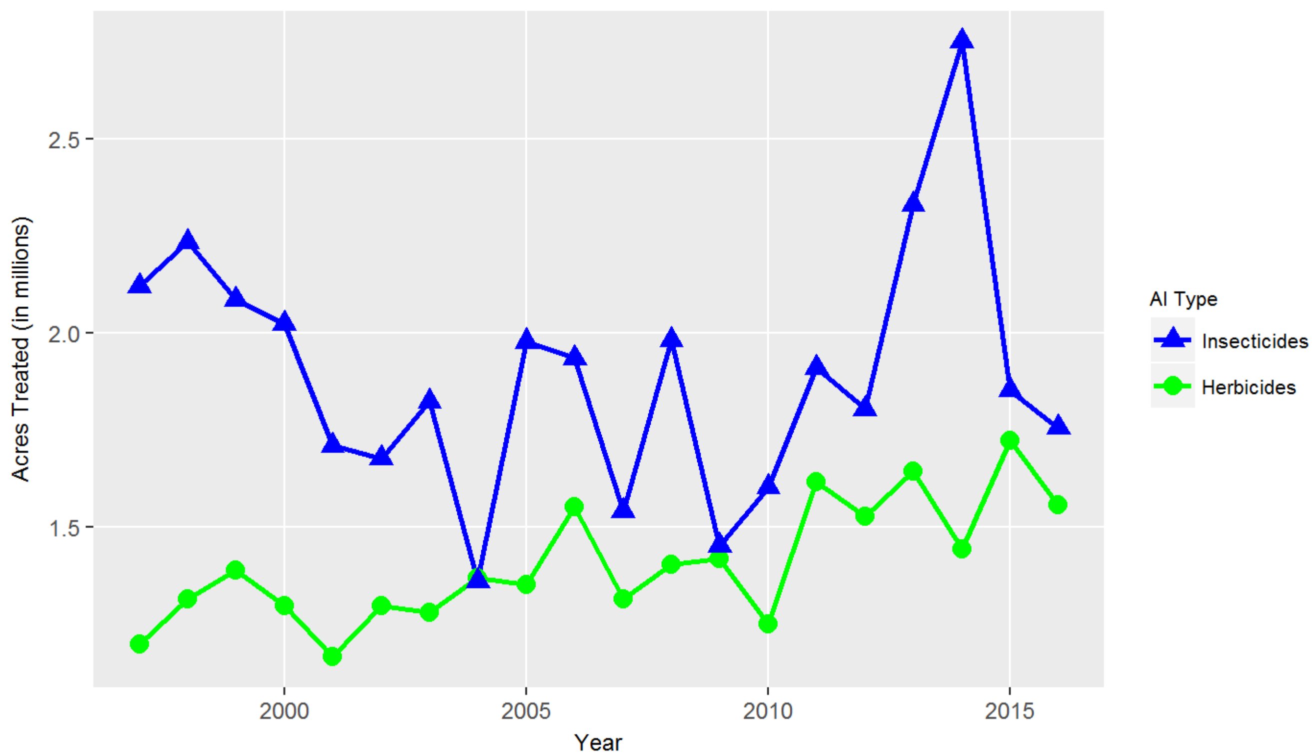


Figure 13: *Acres of alfalfa treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Herbicide use decreased for all of the top five AIs (Figure 13). The largest top five AI decreases were found in paraquat dichloride, pendimethalin, and trifluralin (Figure 14). Flumioxazin use decreased by 48 percent, with 39,820 fewer acres treated. Although the area treated with glyphosate in 2016 (257,966 acres) was four times that in 2011 (64,592 acres), the use of glyphosate decreased by 7 percent in 2016. This decrease ended a consistently increasing trend in use over the last five years which may be explained by the deregulation of genetically glyphosate resistant alfalfa seeds in 2011. An expert source reported that an estimated 50 to 60 percent of alfalfa was grown using genetically modified seeds resistant to glyphosate. Weed control for alfalfa is important during establishment. Glyphosate resistant alfalfa plants can be treated with glyphosate at a point in the plants life cycle when alfalfa is more susceptible to competition from weeds. Weed growth exerts a large effect on the quality of hay, and mature alfalfa plants out compete a greater percentage of weeds than immature plants.

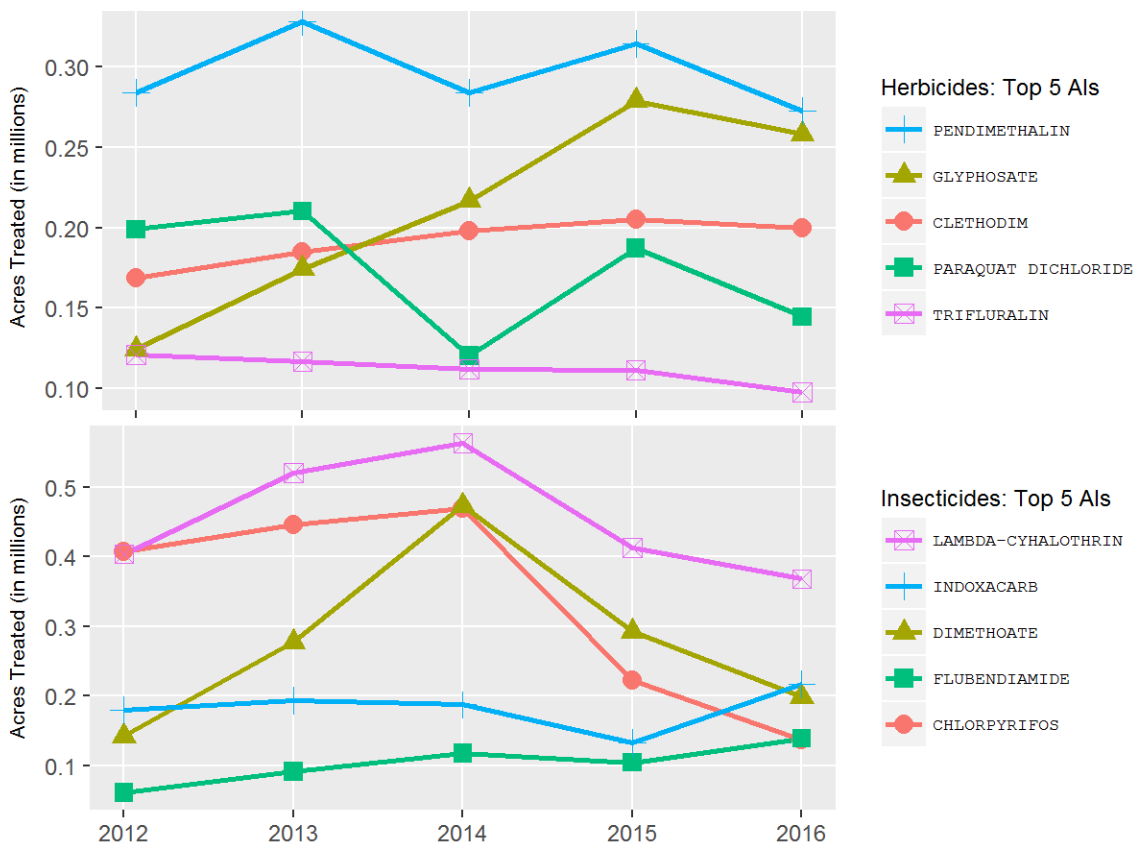


Figure 14: *Acres of alfalfa treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Botanical, microbial, oil and soap pesticides are generally regarded as having a lower risk of adverse effects to non-target species. The area treated with microbial and soap pesticides increased in 2016 to 20,774 and 13,094 total acres treated, respectively.

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

Domestic dairies are the primary U.S. market for alfalfa. Low profits in dairy drove alfalfa hay prices to the lowest level in many years. Exports were reported at a record high in 2016, to Middle Eastern markets, Japan, China, and other Asian countries. Because of Saudi Arabia's program to conserve water resources, they were the top importing country for U.S. grown alfalfa. Increased growth in alfalfa exports coincides with the USDA National Agriculture Statistics Service forecast for an increase in acres planted in 2017.

Almond

California produces over 80 percent of the worlds almond supply. There are approximately 1.1 million almond acres, located over a 400-mile stretch from northern Tehama County to southern Kern County in the Central Valley (Figure A-6).Total acres planted increased by 7 percent while total bearing acreage increased by 2 percent in 2016 (Table 21).

Table 21: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for almond each year from 2012 to 2016. Planted acres are from CDFA(a), 2014 - 2017; marketing year average prices are from USDA(d), 2015 - 2017; Acres treated means cumulative acres treated (see explanation p. 12).Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	23,222,357	29,958,040	25,925,406	35,620,665	35,357,726
Acres Treated	14,803,755	16,974,381	18,042,893	20,582,102	21,764,838
Acres Planted	930,000	970,000	1,050,000	1,160,000	1,240,000
Price/lb	$ 2.58	$ 3.21	$ 4.00	$ 3.13	$ 2.44

Almond acreage treated with insecticides and miticides decreased by 3 percent in 2016. Oil was the most used insecticide in 2016, with very little change in area treated since 2015. Major insect pests for almond include navel orangeworm, peach twig borer, web-spinning spider mites, leaffooted bug, San Jose scale, and ants. There were some notable changes in the months insecticides were used, indicating a fluctuation in pest pressures. Less acreage was treated with miticides in spring and more acreage was treated in the summer months (June and July), suggesting an outbreak of web-spinning spider mites later in the season. Abamectin use increased by 5 percent and etoxazole use decreased by 9 percent. Cyflumetofen, a relatively new miticide with a novel mode of action, started being used on almond acreage in 2015 and its use more than doubled in 2016. The resistance of mites to abamectin has led to the use of other miticides, such as cyflumetofen. Bifenthrin, a pyrethroid used to control leaffooted bug, was used on 13 percent less acreage in 2016. (Figures 15, 16, A-7, and A-8).

The winter of 2015-2016 had below average temperatures and rainfall, resulting in a large over-wintering population of navel orangeworm and leaffooted bug. Almond acreage planted in

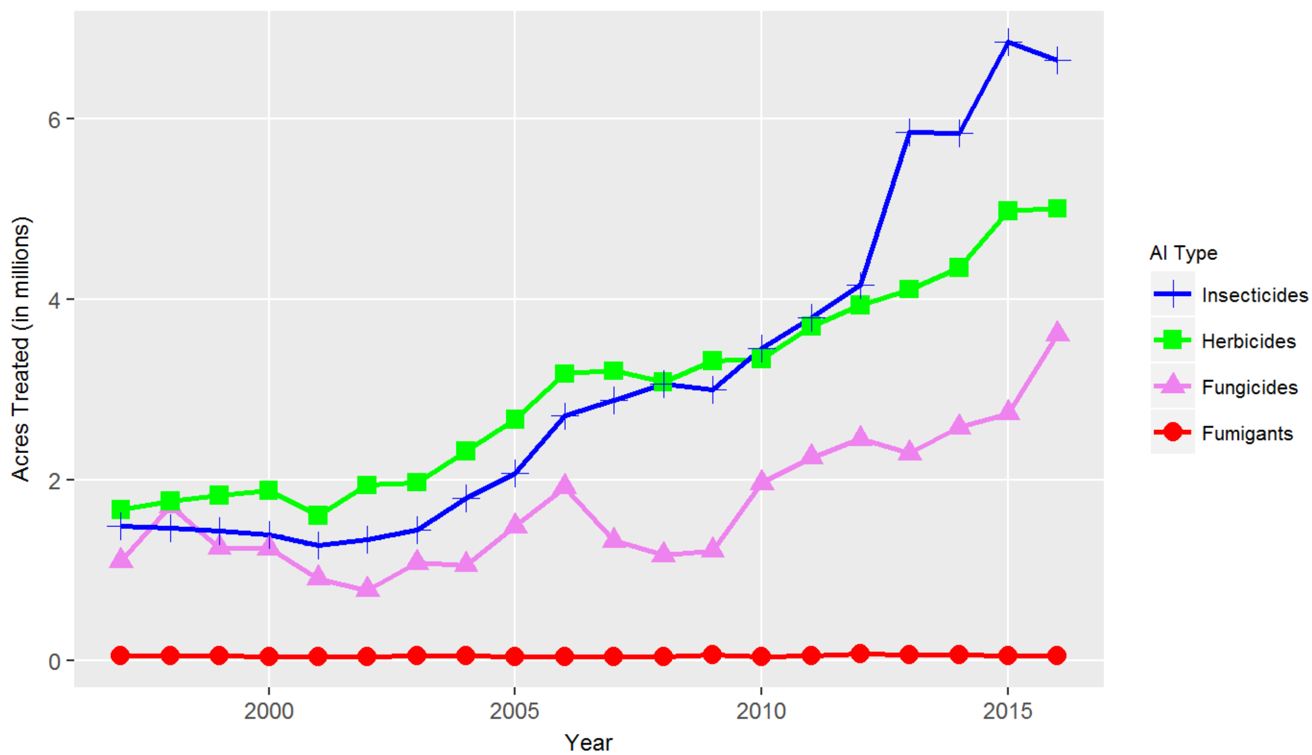


Figure 15: *Acres of almond treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

close proximity to an overwintering crop, such as pomegranates, has a higher chance of leaffooted bug damage early in the season. Navel orangeworm is the chief pest associated with almond production. Not only does navel orangeworm cause direct yield losses to growers, but also market issues for the handlers since damage can lead to aflatoxin contamination, a major food safety concern. Methoxyfenozide is the main insecticide used to control navel orangeworm and its use stayed the same in 2016. However, the use of (z,z)-11,13-hexadecadienal, a relatively new synthetic compound, increased by 23 percent. This insecticide mimics the pheromone of the female navel orangeworm moth to disrupt mating. It has very low environmental or human health risks and has shown to be effective in controlling the navel orangeworm.

Herbicide use only increased by 1 percent which is in line with the increase in acreage for 2016. The area treated with glyphosate declined by 8 percent while paraquat dichloride and glufosinate-ammonium use increased by 24 and 50 percent respectively. Paraquat dichloride and glufosinate-ammonium are non-selective post-emergence herbicides that kill existing weeds on contact. Herbicide resistance to glyphosate has been increasing in recent years. Glufosinate-ammonium use has increased due to its ability to control glyphosate resistant weed species as well as increased availability of the AI for purchase on the west coast. Weed control is important, especially during a drought, since weeds can increase water use by 10 to 30 percent.

Acreage treated with fungicides during 2016 increased by 32 percent and a 2 percent increase in bearing acreage suggests that there was significant disease pressure from Alternaria leaf spot, brown rot blossom blight, shot hole, and anthracnose. Rainfall, during and after bloom, is the key predictor of diseases such as brown rot blossom blight and Alternaria leaf spot. Metconazole was used on the most acreage in 2016 and its use increased by 57 percent. Pyraclostrobin and iprodione use also increased by 13 and 45 percent respectively. Metconazole and fluopyram are fungicides used to control many diseases, such as powdery mildew and brown rot blossom blight. A recent increase in resistance to the demethylation inhibitor (DMI) fungicide propiconazole has resulted in an increase in the use of other DMI fungicides such as metconazole. Copper-based fungicides are used to combat scab and their use decreased by 5 percent.

Overall, fumigant use decreased by 3 percent in 2016. Fumigants have multiple functions in almond production: post-harvest insect control during storage, pest control to meet phytosanitary and food safety standards, pre-plant soil fumigation to control soil borne diseases and nematodes, and finally, to some extent, rodent control. Use of pre-plant soil fumigants remained relatively low over the last five years, with little fluctuation.

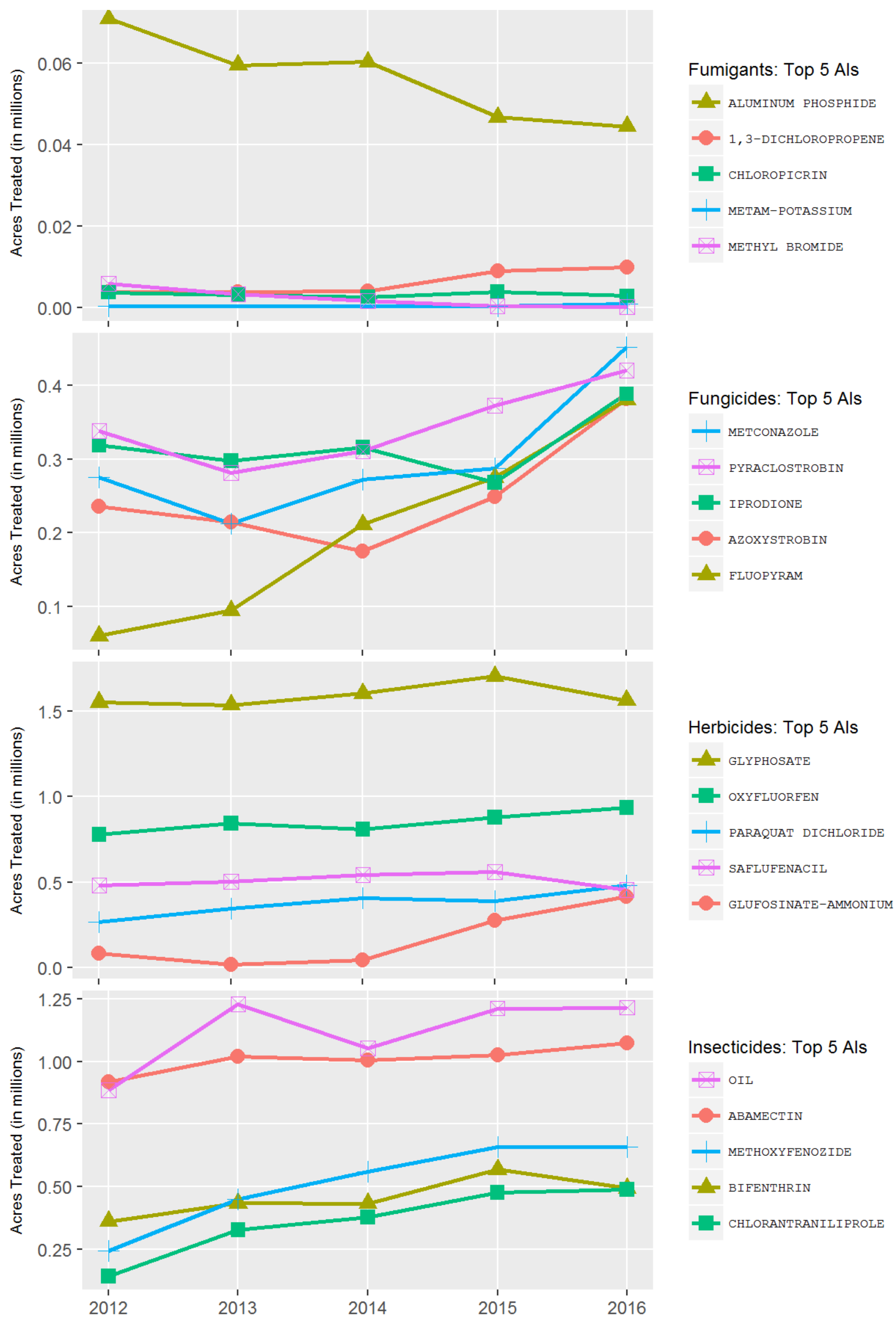


Figure 16: *Acres of almond treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Carrot

California is the largest producer of fresh market carrots in the United States, accounting for 72 percent of the 2016 U.S. production of 3 billion pounds. 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)(Figure A-9). The San Joaquin Valley accounts for more than half the state's acreage.

In 2016, 67,500 acres of carrots were planted in California, an increase of nearly one percent from 2015. The area treated with fungicides and insecticides decreased while the area treated with fumigants and herbicides increased (Figure 17). Nematodes, leaf blights, weeds, cavity spot, and rots remain the major pest concerns.

Table 22: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for carrot each year from 2012 to 2016. Planted acres are from USDA(e), 2015-2017; marketing year average prices are from USDA(e), 2015-2016. Acres treated means cumulative acres treated (see explanation p. 12). Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	7,235,652	6,430,217	5,498,534	5,597,574	5,943,983
Acres Treated	507,562	526,661	605,551	533,508	490,635
Acres Planted	62,000	63,000	66,000	67,000	67,500
Price/cwt	$ 26.9	$ 29.6	$ 28.2	$ 32.7	$ 32.1

The most-applied fungicides by area in 2016 were sulfur, mefenoxam, and copper, followed by pyraclostrobin and azoxystrobin. The patterns of fungicide use in carrots have remained stable with the exception of 2014, when the use of copper was less and the use of sulfur was greater than usual. All five fungicides decreased in both area treated and amount used since 2015 (Figures 18, A-10, and A-11).

As was the case in 2015, the most applied herbicides in carrot production by area treated in 2016 were linuron, pendimethalin, fluazifop-p-butyl, and trifluralin. Use of clethodim, which replaced EPTC for the fifth most used herbicide by area in 2015, continued to increase (Figure 18). Linuron, which was applied to the largest number of acres, is a post-emergence herbicide used to control broadleaf weeds and small grasses.

The insecticides most used for the carrot crop in 2016 by area treated remained the same as the previous year: esfenvalerate, *Purpureocillium lilaciunum* Strain 251 (formerly *Paecilomyces lilacinus*), imidacloprid, methoxyfenozide, and s-cypermethrin (Figure 18). Use of imidacloprid increased by area treated and pounds applied, driven mostly by an increase in use of a systemic

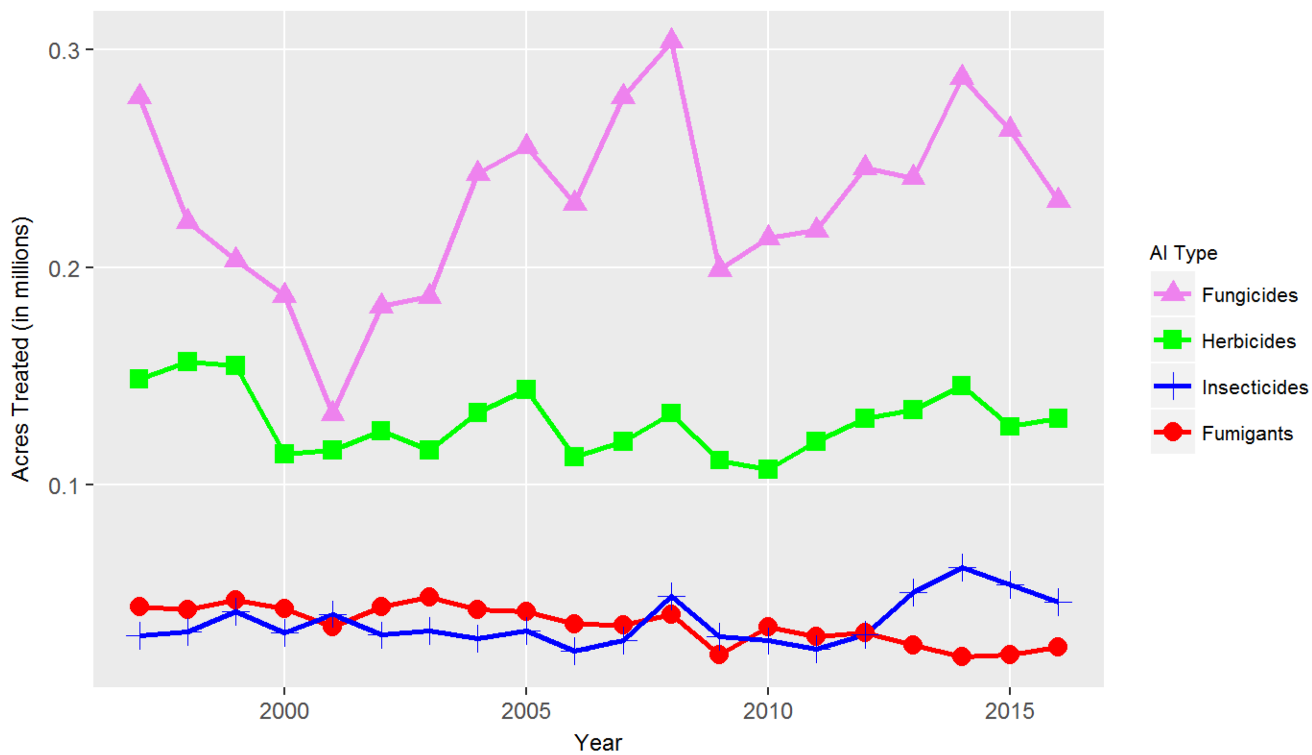


Figure 17: *Acres of carrot treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

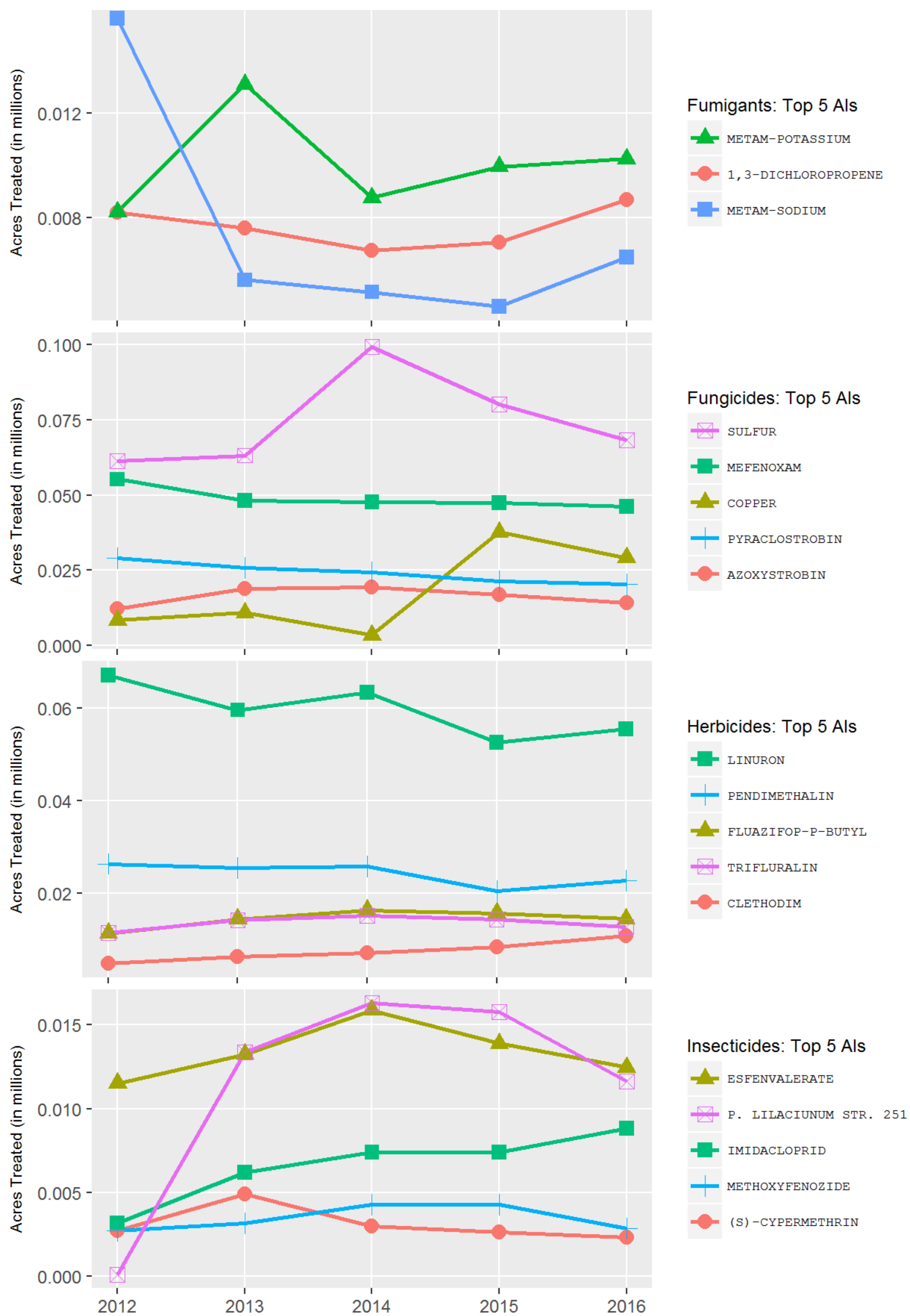


Figure 18: *Acres of carrot treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

insecticide product in Los Angeles, Fresno, and San Luis Obispo counties that was already commonly used in Kern and Santa Barbara counties. The four other most commonly applied insecticides decreased in area treated. Use of *Purpureocillium lilaciunum* Strain 251, a naturally occurring fungus with nematicidal properties, decreased more than the use of esfenvalerate, which is applied to kill pests such as whitefly, leafhoppers, and cutworms. Use of carbamate and organophosphate insecticides decreased by area treated.

Fumigants in carrot production are primarily used to manage nematodes and also control weeds and soil-borne diseases. Metam-potassium (potassium N-methyldithiocarbamate), 1,3-dichloropropene, and metam-sodium were again the three most used fumigants for carrots. Fumigant use increased both for the area treated and for the total pounds applied across all active ingredients. However, fumigant use remains lower overall when compared with years prior to 2013. The increase in the use of fumigants was the primary factor that led to the 6 percent increase from 2015 in total pounds of active ingredients used in carrot production.

Cotton

Total planted cotton acreage continued to decrease in 2016 (Table 23), largely due to the drought and conversion to more lucrative crops, especially almonds. The value of the cotton crop declined by 44 percent with acreage down by 33 percent. Cotton planting was delayed in 2016 due to cool weather but a warm summer hastened growth and maturity with some farmers reporting high yields. Cotton is grown for its fiber, and cottonseed can be used to produce cottonseed oil and cottonseed meal for dairy feed. Most cotton is grown in the southern San Joaquin Valley, with smaller acreages grown in Imperial and Riverside counties and a few counties in the Sacramento Valley (Figure A-12).

Table 23: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for cotton each year from 2012 to 2016. Planted acres are from USDA(a), 2013-2016; marketing year average prices from 2012 to 2016 are from CDFA(c), 2016. Acres treated means cumulative acres treated (see explanation p. 12). Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	3,524,596	3,007,945	2,437,017	2,147,998	2,605,288
Acres Treated	6,550,710	6,254,124	4,594,373	4,405,343	5,658,708
Acres Planted	367,000	280,000	212,000	164,000	218,000
Price/lb	$ 1.10	$ 1.43	$ 1.36	$ 1.11	$ NA

Pounds of insecticides decreased by three percent in 2016 (Figure 19). It was a modest year for lygus bugs but whiteflies required late season insecticide applications into August and September

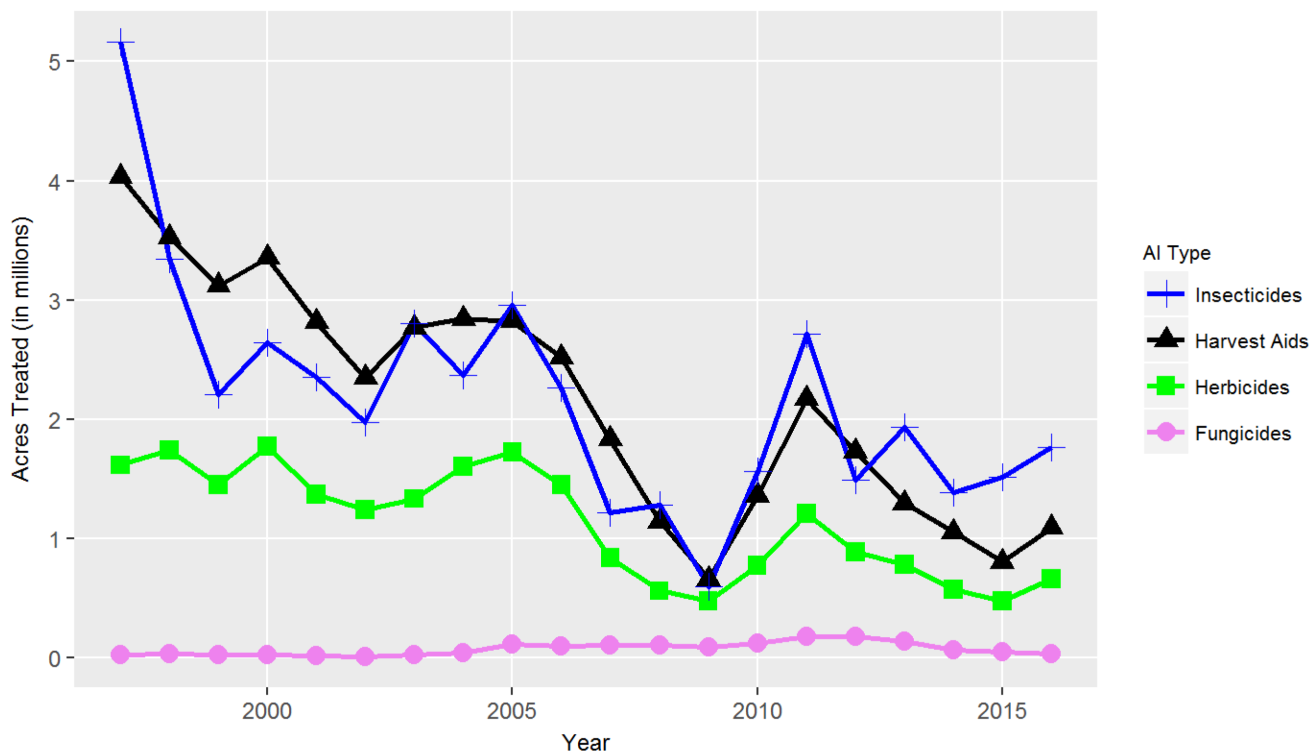


Figure 19: *Acres of cotton treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

(Figure A-14). Sweet potato whitefly (strain B) became a major pest in 2013 and still remains an issue. Late season aphids and whiteflies are a serious concern because they produce sugary excretions which drop onto the cotton lint creating a condition called sticky cotton. When ginned, sticky cotton produces a lower quality cotton lint, thus reducing the price growers receive. The California drought is partly responsible for larger whitefly populations in recent years. The systemic carbamate insecticide aldicarb has not been used on cotton since 2014. Acephate (used primarily to treat aphids) was down by more than half of the pounds of the previous year. Malathion use was down nearly 10-fold, likely replaced by more effective whitefly insecticides.

Despite declining cotton acreage, the use of nearly all major herbicides increased, resulting in a 38 percent increase in total pounds of herbicides applied (Figure 19). The area treated with glyphosate increased by 44 percent. Pounds used of pendimethalin more than doubled over the prior year. Some AIs, such as paraquat dichloride, are used both as an herbicide and as a harvest aid to defoliate or desiccate cotton plants before harvest. It is assumed that if an herbicide is applied from August through November, it is used as a harvest aid, otherwise as an herbicide. The use of harvest aides increased in both pounds and area treated in spite of declining cotton acreage. Among pre-emergent herbicides, pounds of trifluralin used decreased by approximately two-thirds while pounds used of diuron and pendimethalin increased by 50 percent and 118 percent, respectively. (Figures 20, A-13, and A-14).

Pounds of fungicides used decreased by 30 percent to the lowest level in a decade. Delayed plantings due to a wet spring followed by hot weather likely reduced the risk of seedling fungal diseases (e.g. *Rhizoctonia solani*). Sulfur use increased nearly three-fold. Sulfur is used to suppress mites and certain diseases.

Fumigant use was the lowest it has been in a decade. Fumigants are used to treat the soil before planting for a range of soil pathogens, nematodes, and weeds, in addition to treating stored products. *Fusarium oxysporum* f. sp. *vasinfectum* race 4, more commonly known as FOV race 4, is spreading throughout the San Joaquin Valley and is an ongoing concern. Some experts consider this pathogen to be one of the biggest challenges California cotton growers have faced in many years. Once a field is infected, it is impossible to achieve profitable yields of many cotton varieties. Although the pathogen cannot be completely eradicated by pesticides, some research has shown that metam-sodium treatments can knock down inoculum populations. Growers have adapted their cotton production to this challenging disease by avoiding planting in heavily infested areas and by using resistant varieties. Fusarium is worse in fields that are also impacted by nematodes. Less cotton was planted on lighter (sandy) soils in 2016 due to nematode pressure and higher water usage.

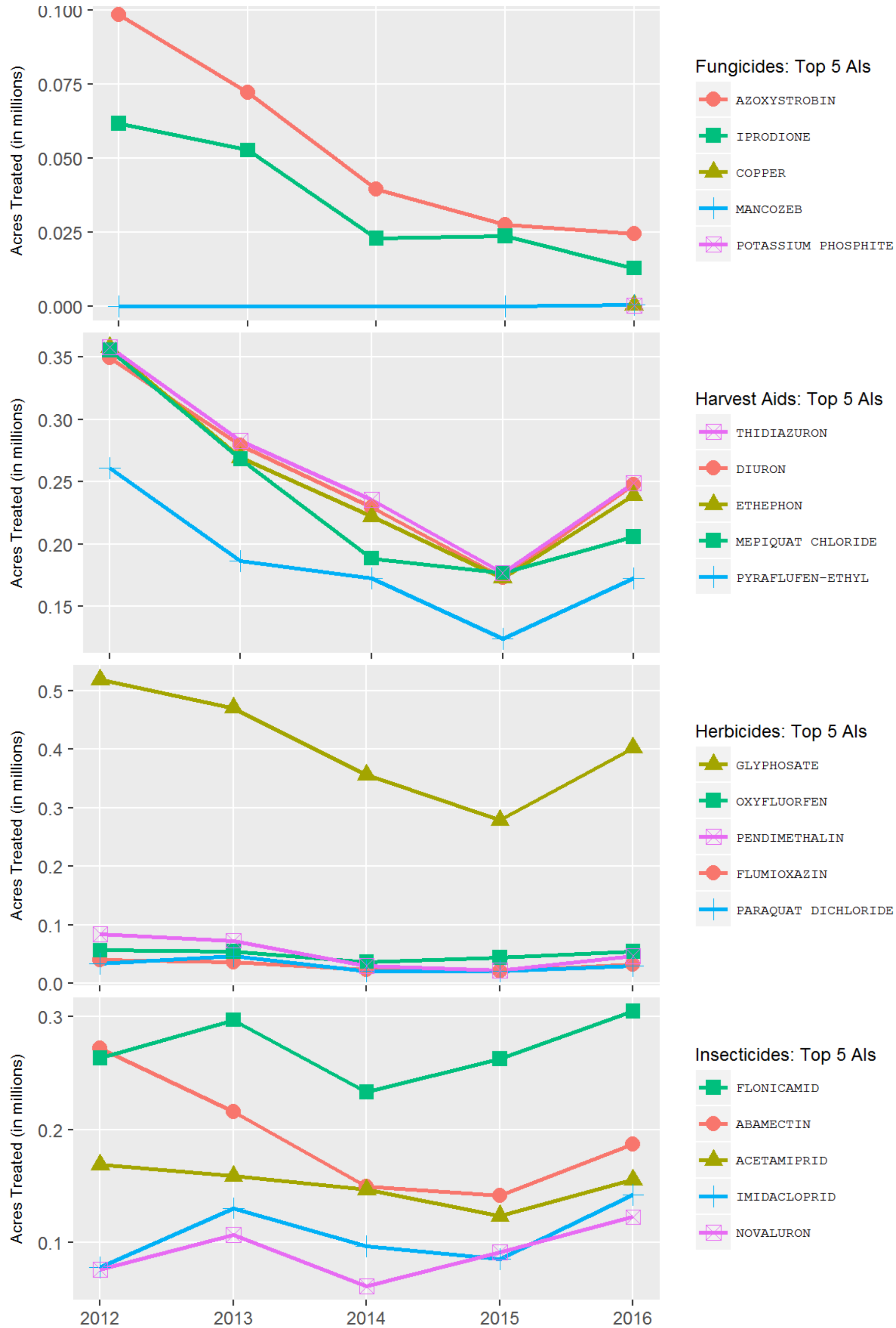


Figure 20: *Acres of cotton treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Orange

California has the highest valued citrus industry in the United States. 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 extends from Santa Barbara County south to the San Diego County-Mexican border and has a mild climate influenced by marine air. The Desert Region includes the Coachella and Imperial valleys where temperatures fluctuate wildly (Figure A-15).

Table 24: *Total reported pounds of all active ingredients (AI), acres treated, acres bearing, and prices for orange each year from 2012 to 2016. Bearing acres are from USDA(b), 2014-2017; marketing year average prices are from USDA(b), 2014-2017. Acres treated means cumulative acres treated (see explanation p. 12). Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	8,937,067	8,975,224	8,490,004	9,951,309	11,104,198
Acres Treated	2,344,856	2,370,856	2,386,049	2,538,941	2,643,066
Acres Bearing	177,000	171,000	166,000	163,000	157,000
Price/box	$ 13.19	$ 13.05	$ 19.03	$ 16.04	$ 14.12

Total bearing acres decreased in 2016 by four percent (Table 24), continuing a five-year decline due in part to a reduction in available irrigation water. The price per box decreased 12 percent in 2016, and was similar to prices from 2012 and 2013.

Insecticide use increased in 2016 (Figure 21). It has increased 50 percent in the last 5 years. Oils are the most widely used insecticide on oranges and their use increased in 2016, continuing a trend since 2008 (Figure 22). Oil insecticides kill soft-bodied pests such as aphids, immature whiteflies, immature scales, psyllids, immature true bugs, thrips, mites, and some insect eggs. Oils are also used to manage powdery milder and other fungi, and as an adjuvant for many insecticide treatments in citrus.

The Asian citrus psyllid (ACP), which vectors a bacterium that causes Huanglongbing or Citrus greening disease, was first detected in California in Los Angeles in 2008. Since that time, ACP has spread throughout Southern California, up the Central Coast, and into the San Joaquin Valley. Attempts are being made in the San Joaquin Valley to eradicate ACP using a combination of foliar pyrethroids to kill all stages, and the neonicotinoid imidacloprid which is distributed systemically throughout the tree and causes death when consumed by the insect. Some pesticides show better efficacy against one stage or another. Area-wide treatments using abamectin, beta-cyfluthrin, cyfluthrin, thiamethoxam, and spirotetramat, as well as many other insecticides,

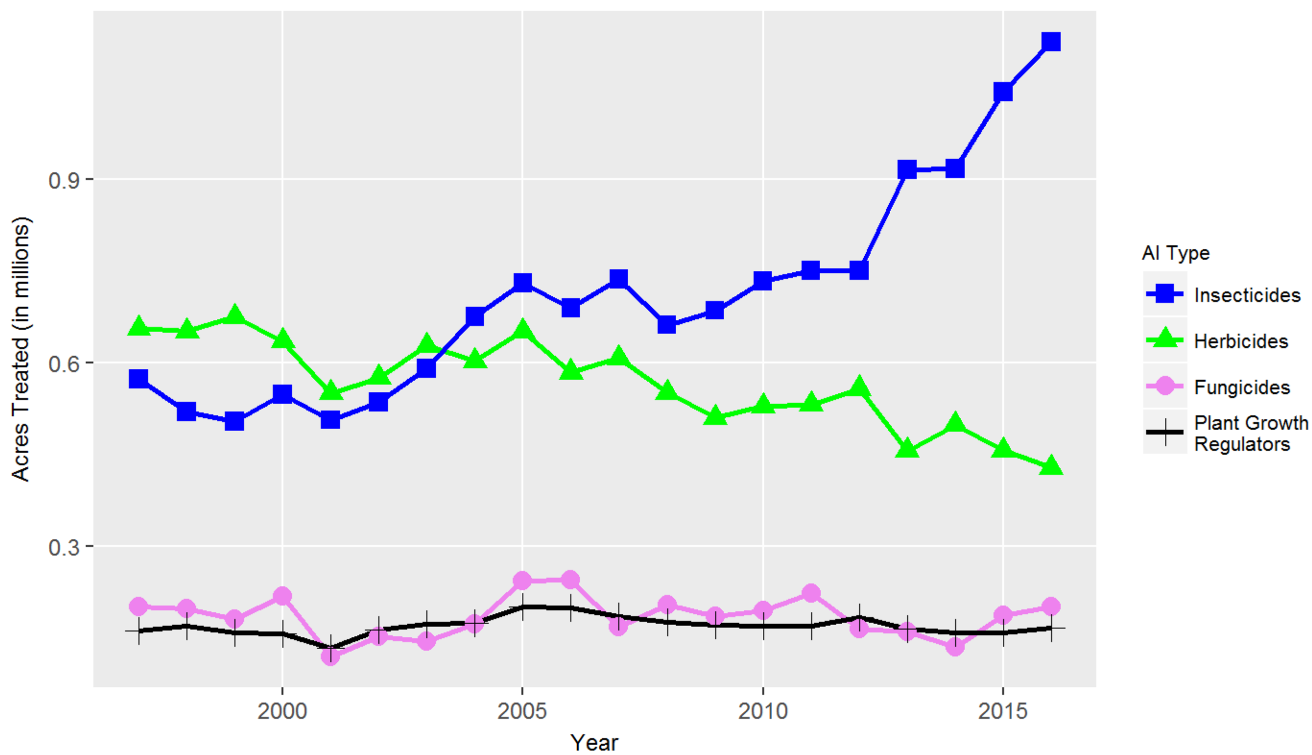


Figure 21: *Acres of orange treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

are being conducted in Southern California where the insect is established. Use of many of these chemicals has increased since 2013. Despite eradication efforts, treatments have not prevented the spread of ACP and it remains a major concern.

Chlorpyrifos is a broad-spectrum insecticide used primarily for citricola scale management. However, chlorpyrifos resistance in citricola scale has been documented and imidacloprid is increasingly being used to suppress these resistant populations. Imidacloprid is also used in the required treatment of glassy-winged sharpshooter (Figure A-17).

Korea is a major California naval export market and they are planning to discontinue the use of methyl bromide to disinfest citrus pests. Fuller's rose weevil is a quarantine pest in South Korea and orchards exporting to South Korea must have low levels of this pest and acceptable management practices in place. South Korea has required treatment for Fuller rose beetle since 2013. The weevil does not cause economic damage in California, but it is hard to kill. California growers are required to apply two insecticide treatments and thiamethoxam is most commonly used. Thiamethoxam use has been increasing since 2010, with a 36 percent increase in pounds applied since 2015.

Spinosad and spinetoram are relatively new insecticides and are primarily used in citrus to manage citrus thrips (Figure 22). Both are very selective, allowing natural enemies to survive and may eventually take over the market share of older insecticides. Of the two, spinetoram is more effective against citrus thrips populations that have developed resistance to carbamate insecticides. Spinetoram's persistence and effectiveness has resulted in the reduced use of spinosad.

The relatively warm, dry winters and hot summers of 2015 and 2016 produced higher populations of California red scale. Spirotetramat is used on the younger instar of California red scale and it is also effective for citrus red mite, citrus leafminer, and citrus thrips. Pyriproxyfen is used almost exclusively for California red scale.

Fenpropathrin is used to manage red mites, citrus thrips, Asian citrus psyllid, katydids, and other miscellaneous pests. The insecticidal activity of fenpropathrin is similar to that of beta-cyfluthrin. Abamectin is used for thrips, mites, and citrus leafminer, and is preferred because it is inexpensive and has broad-spectrum and long residual activity, low worker risk, and a short pre-harvest interval. Dimethoate is used for a variety of pests such as scales and thrips. Its declining use is likely due to the growing popularity of replacement insecticides such as spinetoram and the neonicotinoids imidacloprid and acetamiprid. Pyriproxyfen is used almost exclusively for California red scale. In the San Joaquin Valley, populations of armored scale show resistance to chlorpyrifos, methidathion, and carbaryl, and growers are encouraged to release parasitic wasps and use buprofezin, oil, pyriproxyfen, and spirotetramat.

Two new insecticides, flupyradifurone and cyantraniliprole, were first used in 2015. It usually takes some time for growers to regularly use a new pesticide but these two insecticides showed an

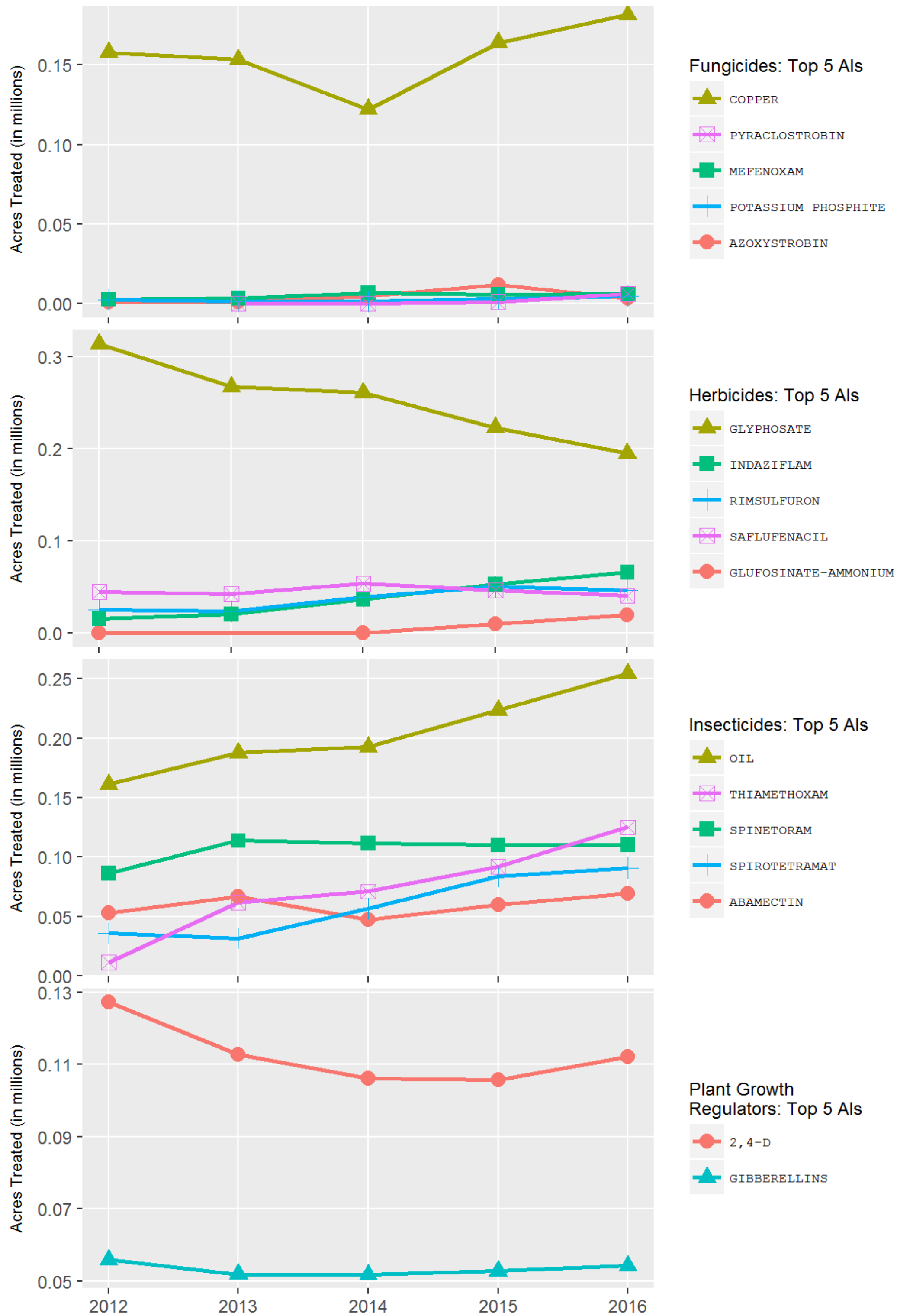


Figure 22: *Acres of orange treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

increase in pounds used in 2016.

Fungicides are used to prevent Phytophthora gummosis, Phytophthora root rot, and fruit diseases such as brown rot and Septoria spot. These diseases are exacerbated by wet, cool weather during harvest. There was an increase in fungicide use in 2016, largely due to a substantial increase in the use of copper-based fungicides, the most widely used fungicides in oranges (Figures 21, 22, and A-16).

Weed management is important in citrus groves to prevent competition for nutrients and water, which affects tree growth and reduces yield. Excessive weed growth also impedes production and harvesting operations. Both pre-emergence and post-emergence herbicides, as well as mechanical removal, are used to control weeds. Herbicide use decreased in 2015. Glyphosate, a post-emergence herbicide, was the most-used herbicide. Simazine is widely used for pre- and post- emergence weed management. Saflufenacil is a post-emergence, burn-down herbicide that was first used in 2010 and now replaces glyphosate for use on horseweed and fleabane due to resistance. Indaziflam is a pre-emergence herbicide, and its use has increased every year since it was first registered in California in 2011 (Figures 21, 22, and A-16).

Peach and nectarine

California grew 72 percent of all U.S. peaches (including 42 percent of fresh market peaches and 93 percent of processed peaches) and 94 percent of nectarines in 2016. Most freestone peaches and nectarines are grown 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 exclusively canned and processed into products such as baby food, fruit salad, and juice (Figure A-18). Peach and nectarine are discussed together because pest management issues for the two crops are similar.

Table 25: *Total reported pounds of all active ingredients (AI), acres treated, acres bearing, and prices for peach and nectarine each year from 2012 to 2016. Bearing acres in 2012 are from USDA(d), 2015-2017; marketing year average prices are from USDA(d), 2015-2017. Acres treated means cumulative acres treated (see explanation p. 12). Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	4,018,906	3,739,863	3,619,092	4,378,765	4,635,890
Acres Treated	1,370,963	1,351,003	1,397,748	1,466,831	1,565,103
Acres Bearing	72,000	64,000	65,000	63,000	59,200
Price/ton	$ 572.68	$ 527.72	$ 670.95	$ 674.06	$ 697.20

The price per pound in Table 25 is an average of the prices of peach and nectarine, weighted by their respective acreages. Due to the wide variation in individual prices, it is best to consult USDA and CDFA for specific prices.

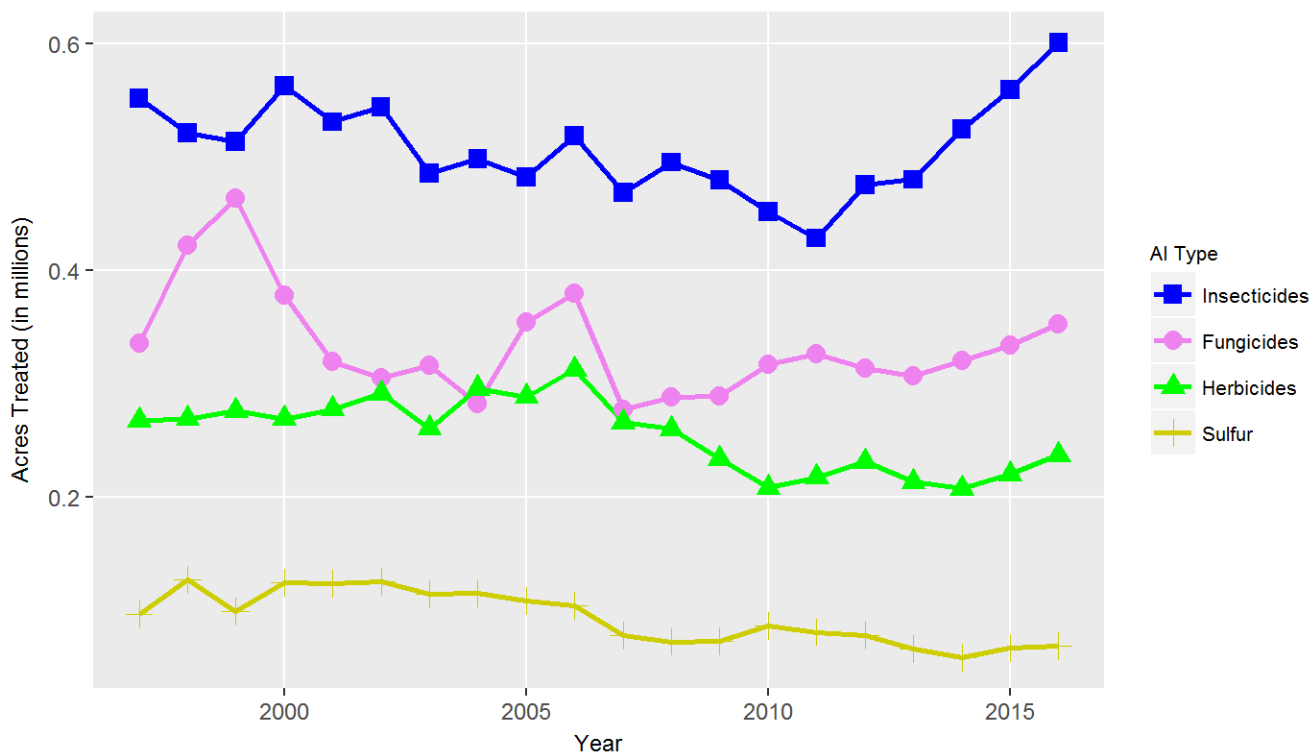


Figure 23: *Acres of peach and nectarine treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Cumulative peach and nectarine acreage treated with insecticides and miticides increased 7 percent in 2016 despite the decrease in bearing acreage (Figure 23). The data suggests that mites, peach twig borer, leafrollers, ants, and moth larvae were all major pests in 2016. Oil was used on the most acreage in 2016 and its use increased 35 percent. Oils are applied during the dormant season and/or during the growing season to prevent outbreaks of scales, mites, and moth species (Figure A-20). Spinetoram decreased in acreage by 8 percent while indoxacarb increased by 19 percent. Spinetoram and indoxacarb are applied to control moths and katydids; spinetoram is used for thrips as well. Chlorpyrifos, an organophosphate used on relatively fewer acres, increased in 2016.

Although herbicides were applied to 8 percent more cumulative area in peach and nectarine orchards, the bearing acreage declined 6 percent (Figure 23). The area treated with glyphosate declined by 4 percent. Pendimethalin and rimsulfuron were applied to less area while indaziflam was applied to more than double the acreage from 2015 (Figures 24 and A-19). Pre-emergence herbicides such as oxyfluorfen, pendimethalin, rimsulfuron, and indaziflam are applied to soil before the growing season to prevent weed sprouting. Post-emergence herbicides such as

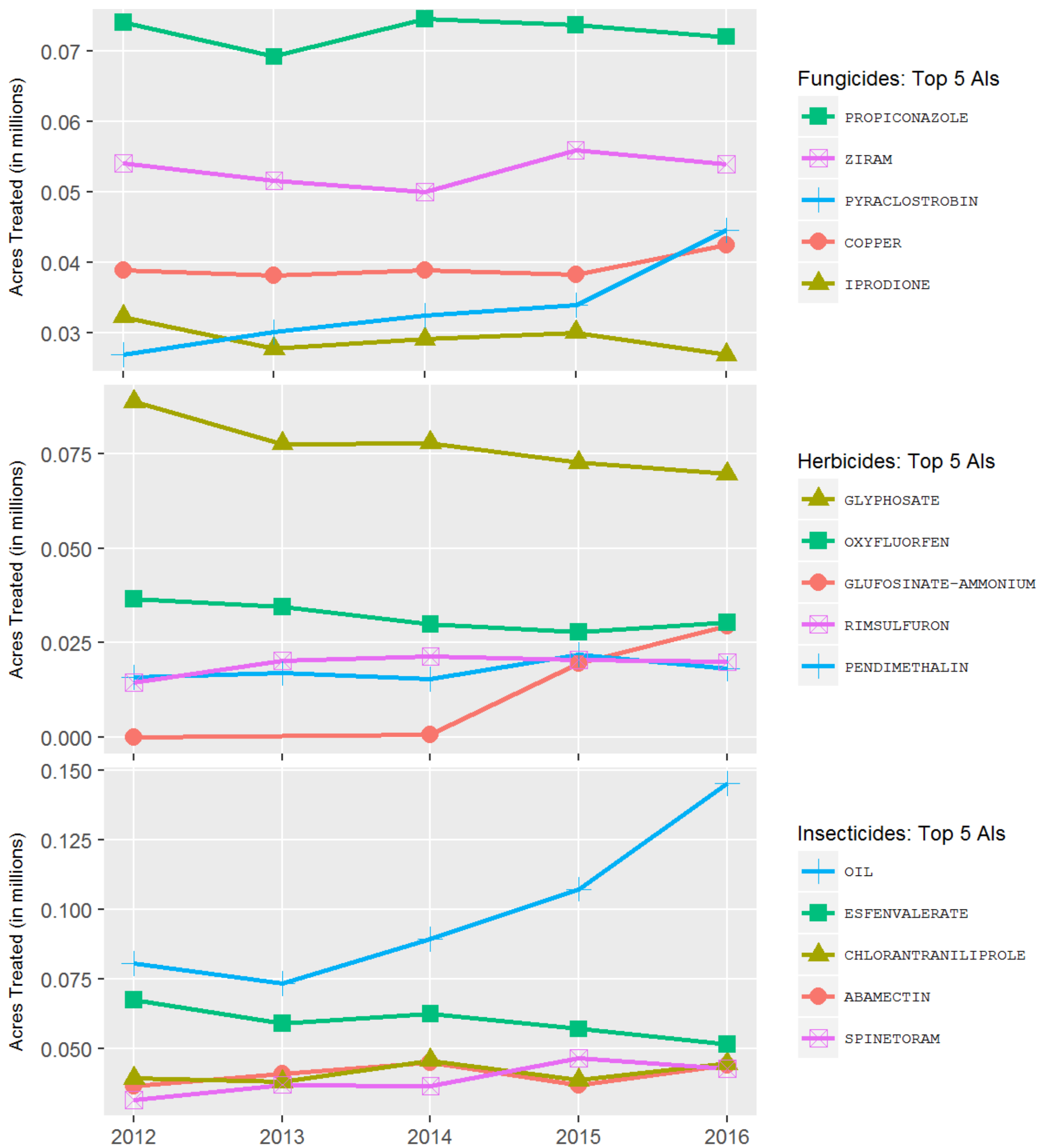


Figure 24: *Acres of peach and nectarine treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

glyphosate, 2,4-D, pyraflufen-ethyl, and paraquat kill existing weeds on contact. Glufosinate-ammonium was not used much in past years due to limited supply on the west coast, but its use increased dramatically in 2015 and by as much as 50 percent in 2016. Glufosinate-ammonium is a broad spectrum herbicide that has gained popularity in recent years because of its ability to control glyphosate-resistant weed species.

Cumulative acreage of peach and nectarine orchards treated with fungicides and sulfur during 2016 increased by 5 and 4 percent, respectively (Figure 23). Brown rot, powdery mildew, scab, and rust are the top diseases for peach and nectarine. Sulfur is customarily used to prevent powdery mildew but it does not treat the infection. Metconazole, a fungicide used to control powdery mildew and brown rot, was used on a much larger scale beginning in 2015 and increased by 39 percent in 2016. Resistance of other demethylation inhibitors or (DMI) fungicides, such as propiconazole, has been a contributing factor to the increase in metconazole use. 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.

Fumigant use increased by 2 percent in 2016 (Figure 23). Fumigants are used in peach and nectarine orchards for rodent control and for pre-plant soil treatments against arthropod pests, nematodes, pathogens, and weeds. Only 154 acres of rodent burrows were treated with aluminum phosphide, perhaps in part because of the drought. Aluminum phosphide requires, and works best in, moist soils. Area treated with the most widely-used pre-plant soil fumigant 1,3-D, increased by 2 percent and chloropicrin application decreased by 4 percent, indicating a reduction in replanting compared to last year. Agricultural use of methyl bromide in the field is being phased out and has not been used since 2013. Changing relationships between nematode infestations, pathogen infections, rootstock choices, and application patterns also affect fumigant selection and use from year to year.

A cumulative total of 1,411 acres of peaches and nectarines were treated with plant growth regulators (PGRs) in 2016. Gibberellins, plant hormones that regulate growth and development, were applied to 916 acres, a 17 percent decrease from 2015. However, applications of amino ethoxy vinyl glycine hydrochloride, an ethylene synthesis inhibitor applied during bloom, increased by 126 percent from 219 to 495 acres in 2016. Both chemicals can enhance the firmness, size, and durability 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; there is less, and in some cases, no need for hand thinning 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 an increasing scarcity of field labor has motivated some growers to experiment with PGRs for that purpose.

Pistachio

In 2016, California accounted for 239,000 bearing acres of pistachio, or about 98 percent of the U.S. crop (Table 26). The crop suffered in 2015 due to weather conditions, but rebounded in 2016, showing a 231 percent yield increase, from 271,000 pounds in 2015 to 896,000 pounds in 2016. Bearing acres increased 3 percent from 2015 to 2016. In 2016, the U.S. regained its spot as top pistachio producer (57 percent), compared to Turkey (22 percent), and Iran (21 percent).

Table 26: *Total reported pounds of all active ingredients (AI), acres treated, acres bearing, and prices for pistachio each year from 2012 to 2016. Bearing acres are from USDA(d), 2015-2017; marketing year average prices are from USDA(d), 2015-2017. Acres treated means cumulative acres treated (see explanation p. 12). Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	3,971,975	4,757,595	4,856,096	7,817,193	5,178,467
Acres Treated	2,779,239	3,369,690	3,767,178	4,310,423	4,903,886
Acres Bearing	182,000	203,000	221,000	233,000	239,000
Price/lb	$ 2.61	$ 3.48	$ 3.57	$ 2.48	$ 1.68

Pistachio acreage will continue to increase during the next few years due to a surge in planting around 2005. Pistachio is grown in 22 counties, from San Bernardino County in the south to Tehama County in the north, with most grown in the San Joaquin Valley counties of Kern, Madera, Fresno, and Tulare (Figure A-21). Pistachio trees generally alternate between high and low production each year and 2016 was projected to be a heavier harvest. Despite drought conditions in the San Joaquin Valley, rainfall was close to normal during the winter leading up to the growing season. The 2015 crop was threatened from the start with inadequate chilling hours, which interfered with nut development and resulted in a dismally low crop. In contrast, the 2016 crop had plenty of chilling hours that resulted in synchronized blooming and pollination.

In 2016, important arthropod pests of pistachio included mites, leaffooted plant bugs, false chinch bug, stink bugs, and navel orangeworm.

Acres treated with insecticide increased 9 percent from 2015 to 2016, primarily due to additional bearing acres and threats by leaffooted plant bugs, stink bugs, and navel orangeworm (Figures 25, A-22, and A-23). Feeding by leaffooted plant bugs (a complex of three *Leptoglossus* species) 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 reappear just before harvest in August and September. Stink bugs can also be late-season pests, causing kernel necrosis during July and August. Often growers preemptively apply insecticides, primarily lambda-cyhalothrin and permethrin, before the bugs can do much damage. Use of both of these insecticides peaked during spring.

Navel orangeworm attack nuts beginning in July, but insecticide sprays target the third generation that coincides with the beginning of the nut harvest. Use of bifenthrin, which peaked in August, increased 50 percent. As the larvae feed, they leave behind frass (or excrement), a substrate for the fungi *Aspergillus flavus* and *A. parasiticus*. In 2016, navel orangeworm damage to the harvested crop set a record at 2 percent.

Navel orangeworm larvae overwinter in mummy nuts on the ground. During dry winters, they survive the fungal diseases that would normally kill them under wet conditions. The use of mating-disruption pheromone puffers that contain the active ingredient (Z,Z)-11, 13-hexadecadienal have generally increased since 2011. Use of mating disruption puffers during the first egg-laying period in late April and May remained steady in 2016, but fell off during the second egg-laying period in June and July. Overall, use of puffers in 2016 decreased 7 percent.

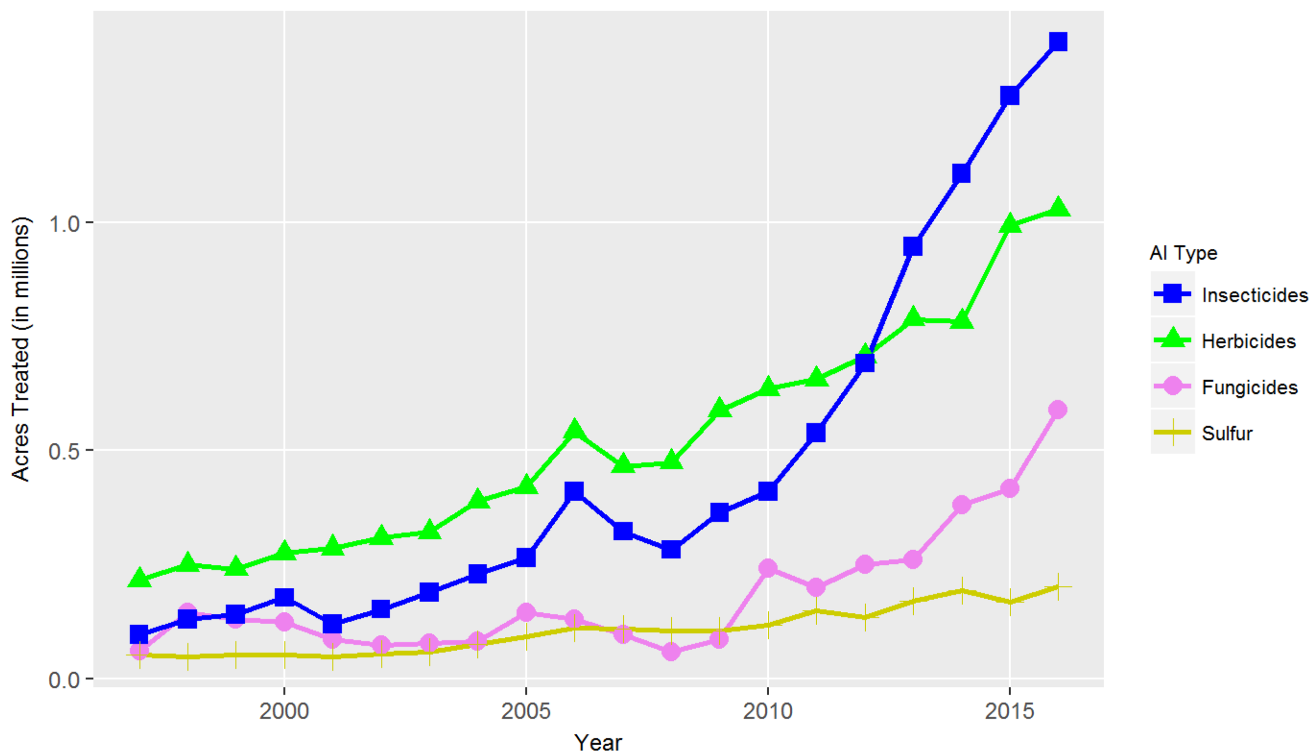


Figure 25: *Acres of pistachio treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Use of the main fungicides increased (Figure 26). *Aspergillus flavus* strain AF36 is included in the fungicide group, but is actually a fungal inoculant acceptable for use on organically grown produce that acts as a biological control agent and prevents contamination of nuts by aflatoxins. The aflatoxin-producing fungi, a complex of *Aspergillus flavus* and *A. parasiticus*, grow on pest-damaged nuts. Aflatoxins 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. In 2016, use of AF36 increased 17 percent.

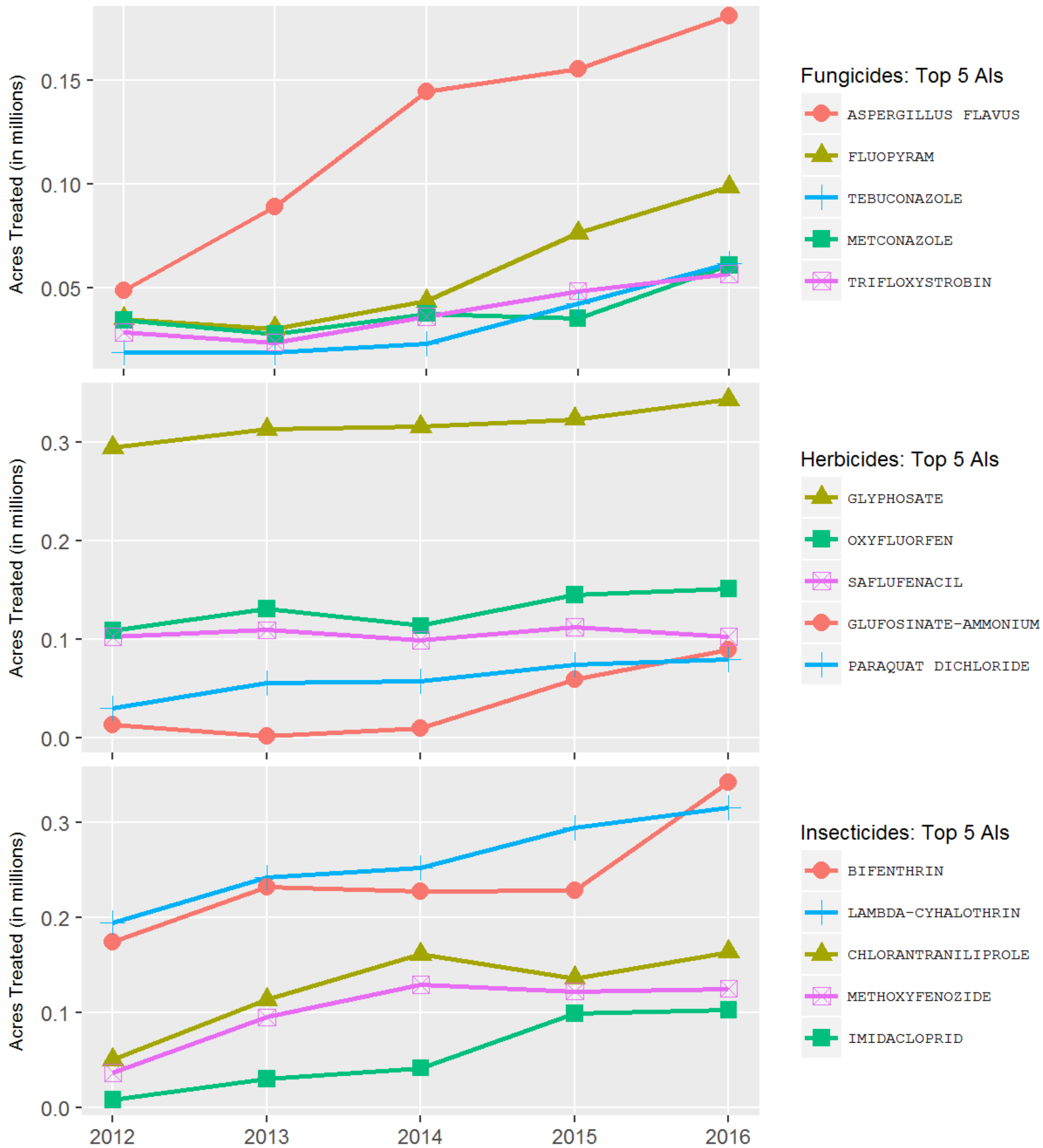


Figure 26: *Acres of pistachio treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Sulfur, used as a low-risk miticide, is applied at several pounds per acre, and is used to manage citrus flat mite. The mites feed 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 2016, growers began applying sulfur for mites in April and applied higher-than-average amounts during August and September, with an average increase from 2015 of 19 percent. (Figure A-23).

Use of herbicides increased 4 percent, corresponding to increased bearing acreage (Figure 26). Additionally, nonbearing trees, which lack shade to deter weed growth, often require more herbicide than bearing trees. The post-emergence herbicide glyphosate is applied year-round, but mostly during the summer months to manage weeds such as field bindweed and cheeseweed. Even under drought conditions, herbicides, both pre-emergence and post-emergence, are needed to limit weed growth. Reducing competition from weeds extends limited supplies of irrigation water and protects young trees from the false chinch bug, which builds up on weeds next to the orchards.

Processing tomato

In 2016, processing tomato growers planted 262,000 acres, yielding 12.6 million tons, an 11 percent yield decrease from 2015. About 95 percent of U.S. processing tomatoes are grown in California. At 34 percent, the U.S. is the worlds top producer of processing tomatoes followed by the European Union and China. California processing tomatoes, valued at $1.03 billion in 2016, are primarily grown in the Sacramento and San Joaquin Valleys (Figure A-24). Fresno County leads the state in acreage with 31 percent (90,000 acres) of the statewide total, followed by Yolo County (38,000 acres), Kings County (26,000 acres), and San Joaquin County (34,000 acres). Significant production also occurs in Merced, Colusa, Kern, Stanislaus, and Solano counties.

Table 27: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for processing tomato each year from 2012 to 2016. Planted acres are from USDA(e), 2015-2016 and USDA(f), 2017; marketing year average prices are from USDA(e), 2015-2017. Acres treated means cumulative acres treated (see explanation p. 12). Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	13,462,728	13,894,733	15,006,443	15,163,977	13,998,117
Acres Treated	2,991,155	3,431,718	3,701,418	4,047,258	3,523,046
Acres Planted	260,000	263,000	292,000	299,000	262,000
Price/ton	$ 75.0	$ 88.8	$ 98.6	$ 96.4	$ 81.6

Total cumulative treated area of processing tomatoes decreased 13 percent in 2016 (Table 27). Sulfur, kaolin, 1,3-dichloropropene, and potassium N-methyldithiocarbamate (metam-potassium) accounted for 88 percent of the total pounds of pesticide AIs applied, while sulfur, chlorothalonil, trifluralin, glyphosate, copper, and imidacloprid were applied to the most acreage. The most-used pesticide type as measured by area treated was insecticides, which decreased 22 percent(Figure 27). The most-used category as measured by amount AI applied was fungicide/insecticide (mostly sulfur and kaolin); use in this category decreased 11 percent.

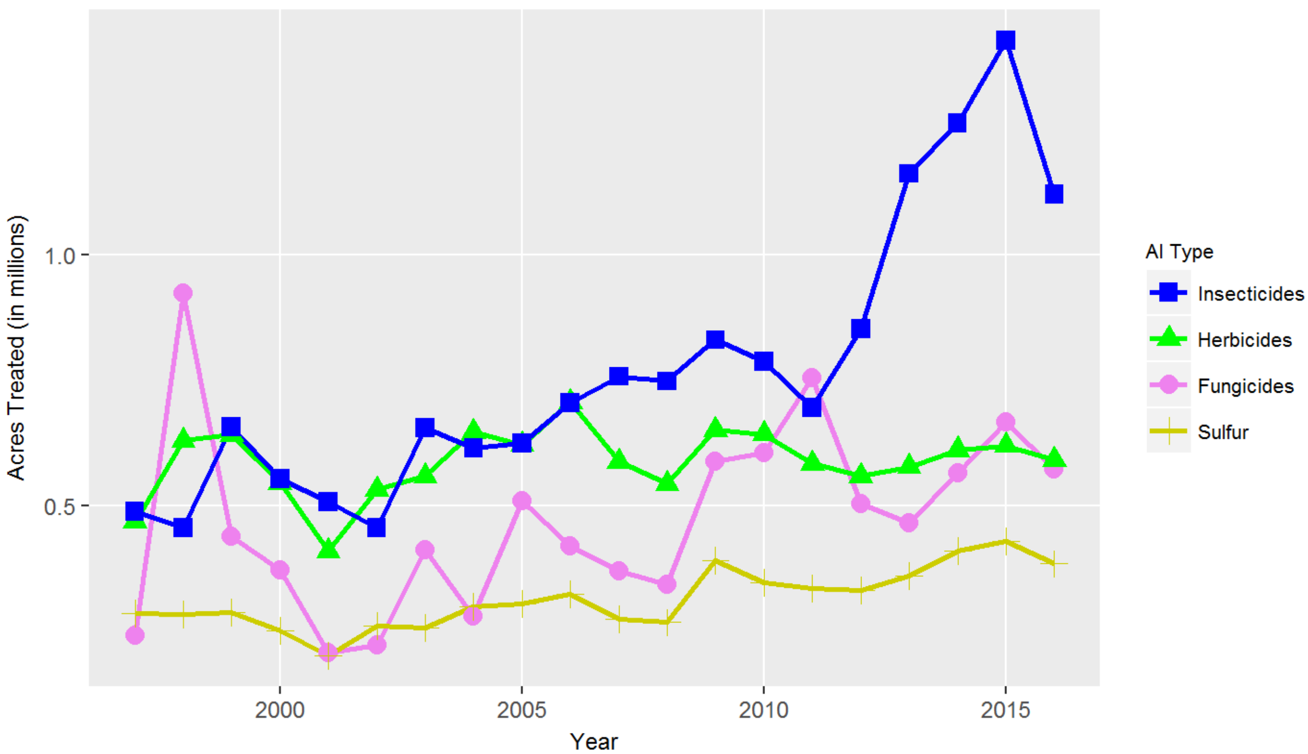


Figure 27: *Acres of processing tomato treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ ≥.*

Overall fungicide use, expressed as cumulative area treated, decreased 14 percent; pounds of AI decreased 13 percent. Difenoconazole and azoxystrobin ended a seven year trend of increasing use in 2016, with a little over 40 percent decrease in area treated. 2016 was a relatively light year for powdery mildew, but bacterial diseases were more problematic. Copper use increased 92 percent, while mancozeb use increased 39 percent; mancozeb increases the efficacy of copper when they are applied together for bacterial disease control. Lower-risk fungicide use increased substantially in 2016: use of the biopesticide,*Bacillus amyloliquifaciens*, increased over 1,000 percent (going from 143 acres treated in 2015 to 1,666 acres treated in 2016), while hydrogen peroxide use increased by 360 percent.

The area treated with herbicides decreased 5 percent (Figure 27); the amount used decreased 2 percent. Primary weeds of concern for processing tomatoes are nightshades and bindweed. Trifluralin and pendimethalin are used to control bindweed and are often used in combination with metolachlor. The use of pendimethalin decreased 13 percent, while trifluralin use decreased 15 percent (Figures 28 and A-25). Glyphosate is commonly used for preplant treatments in late winter and early spring; its use increased 21 percent. (Figure A-26).

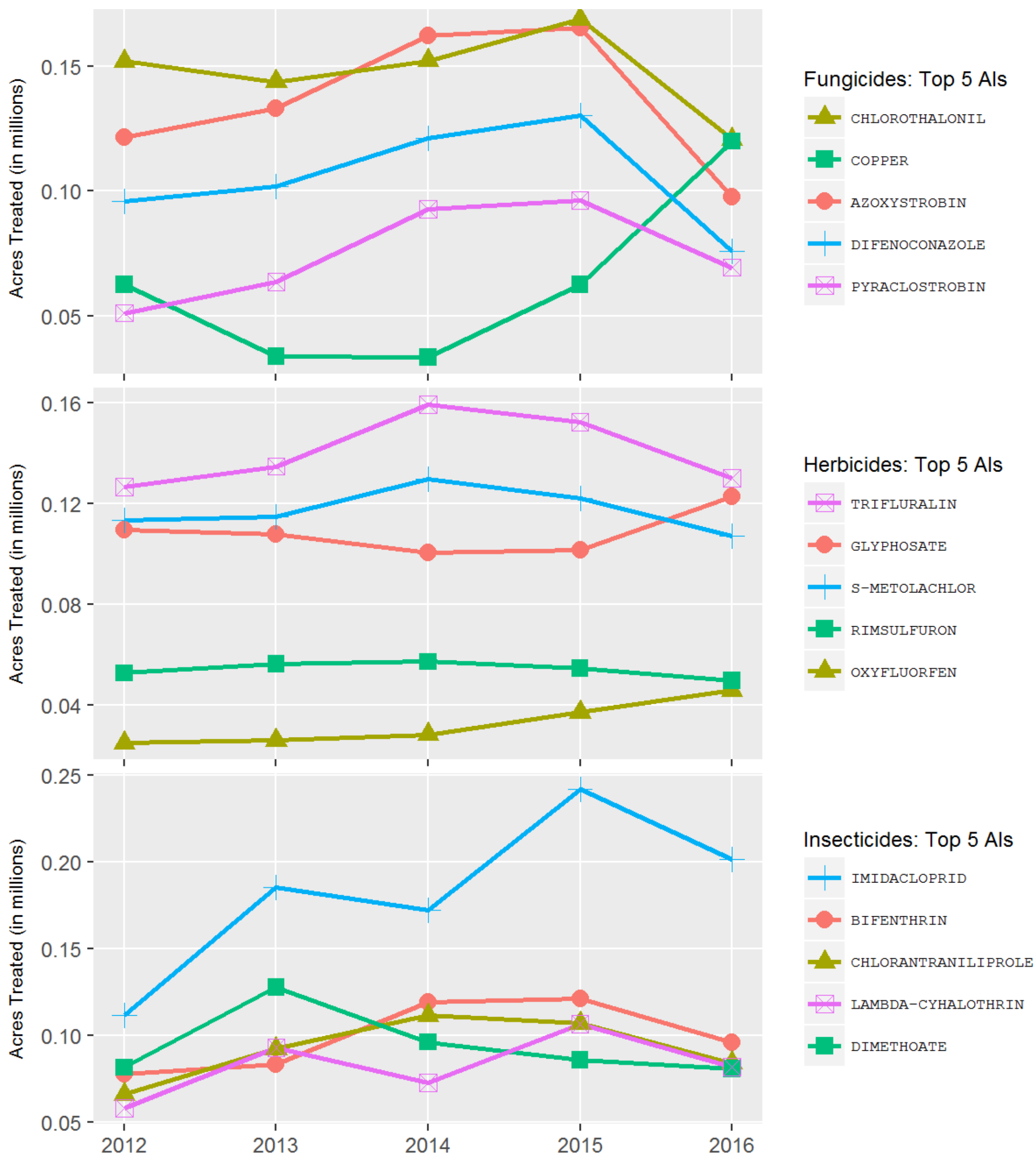


Figure 28: *Acres of processing tomato treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ ≥.*

Processing tomato growers primarily use three fumigants—metam-potassium (potassium n-methyldithiocarbamate), metam-sodium, and 1,3-dichloropropene—to manage root-knot nematodes and weeds, particularly those of the nightshade family. In 2016, the pounds of fumigants used increased 4 percent and accounted for about 21 percent of the total amount of pesticide AIs applied. In terms of area treated, fumigant use increased 9 percent. The increase in fumigated acres is mostly due to a 25 percent increase in acres treated with metam-potassium.

In 2016, 1,120,364 cumulative acres were treated with insecticides, a 22 percent decrease from 2015 (Figure 27). Imidacloprid, the most-used insecticide, is used to control whiteflies; its use decreased 17 percent from the previous year. Dimethoate, which decreased 6 percent, is a broad spectrum insecticide used for thrips control. However, its use early in the season can disrupt natural predation and cause population explosions of other insect pests, such as leafminers, later in the season (Figure A-26). Methomyl use decreased 48 percent, as growers have begun switching to pyrethroids such as bifenthrin because of worker safety concerns. Bifenthrin, which decreased 21 percent, is a broad spectrum pyrethroid often used in rotation with spinosad for thrips control. Bifenthrin is also used to manage mites and stinkbugs.

Rice

California is the largest producer of short and medium grain ('Calrose') Japonica rice in the United States and the second largest rice-growing state in the nation. Ninety-five percent of the rice in California is grown in six counties in the Sacramento Valley (Colusa, Sutter, Glenn, Butte, Yuba, and Yolo, Figure A-27). The drought had marked effects on rice growers, and water cutbacks caused reduction in rice plantings in 2014 and 2015. Relaxed water restrictions in Northern California in 2016 allowed farmers to grow more rice; the acres planted with rice increased 28 percent, similar to the number of acres planted in prior years. (Table 28).

Table 28: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for rice each year from 2012 to 2016. Planted acres are from USDA(a), 2013-2017; marketing year average prices are from USDA(c), 2015-2017. Acres treated means cumulative acres treated (see explanation p. 12). Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	5,376,404	5,330,948	4,924,779	4,372,501	5,398,107
Acres Treated	2,992,418	3,091,660	2,657,101	2,605,766	3,148,708
Acres Planted	561,000	566,000	434,000	423,000	541,000
Price/cwt	$ 18.6	$ 20.9	$ 19.3	$ 18.4	$ 13.7

Rice planting was delayed in the spring due to late spring rains and water deliveries to support salmon in the upper Sacramento River. Late planting meant late harvest in the fall of 2016 with some fields left unharvested late into October and even mid-November. Additionally, the fall rains came earlier and were far heavier than normal years creating muddy conditions which were a problem during harvest.

Herbicides were the most-used type of pesticides on rice in 2016 in terms of area treated. Much of California's rice is grown repeatedly in the same fields and growers are heavily dependent on herbicides for effective weed management. Many weed species are difficult to manage and if allowed to grow unimpeded, will severely compete with the rice crop for resources. Several species of broadleaf, grass, and sedge weeds that grow along with rice have developed resistance to herbicides.

Propanil, a post-emergence herbicide, was the most used rice herbicide in California. Collaborative water monitoring efforts between the California Rice Commission and registrants have been ongoing since 2006. The pounds applied increased 32 percent from 2015 which had been a 10-year low (Figures 30 and A-28). The 33 percent increase in both pounds used and acres applied of thiobencarb in 2016 was probably due to the progressive resistance of sprangletop to clomazone and cyhalofop-butyl. The continuing decrease of bensulfuron methyl may have resulted from a 2013 introduction of a product that combined thiobencarb and imazosulfuron for bensulfuron methyl-resistant sedges. More acres of weedy rice (red rice) were reported in 2016 than in the previous two decades. The origin and spread are not well understood and the guidelines for treatment will be refined as more knowledge is gained. For larger infestations, glyphosate is used as a burn down herbicide. The pounds of glyphosate applied in 2016 increased 120 percent.

The area treated with fungicides increased 6 percent (Figure 29) and the pounds applied increased 4 percent in 2016. Sodium carbonate peroxyhydrate, an organic fungicide, was the most-used fungicide on rice in terms of pounds applied. Azoxystrobin was used on the greatest number of acres, accounting for 87 percent of the acres where fungicide was applied. Azoxystrobin, propiconazole, and trifloxystrobin are reduced-risk fungicides often used as preventive treatments.

Copper sulfate is the key algaecide registered for rice in California. It is used primarily for algal management in rice fields and also to manage tadpole shrimp in both conventional and organic production. Copper sulfate can bind to organic matter such as straw residue and potentially reduce the algaecide efficacy. Sodium carbonate peroxyhydrate was registered as an alternative to copper sulfate to manage algae. However, it has yet to displace copper sulfate as the most used algaecide (Figure A-28).

Usually there is little insect pressure on California rice and insecticides are used on relatively few acres (Figure 29).Use of insecticides decreased in 2016. However, armyworm pressure was high for a second consecutive year. Armyworms have a naturally occurring level of tolerance to insecticides. In 2015, no registered insecticide was effective in managing the significant outbreak. Multiple applications of different pesticides, predominantly pyrethroids and carbaryl, had little

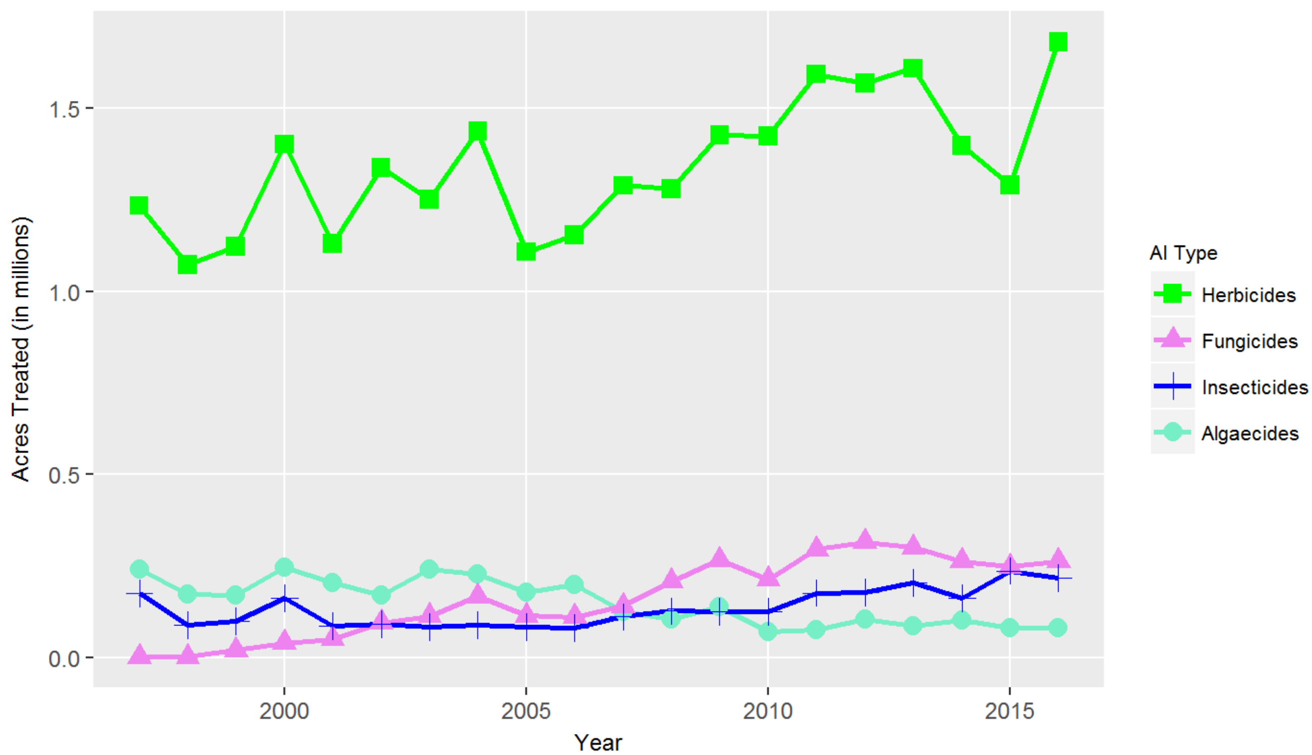


Figure 29: *Acres of rice treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

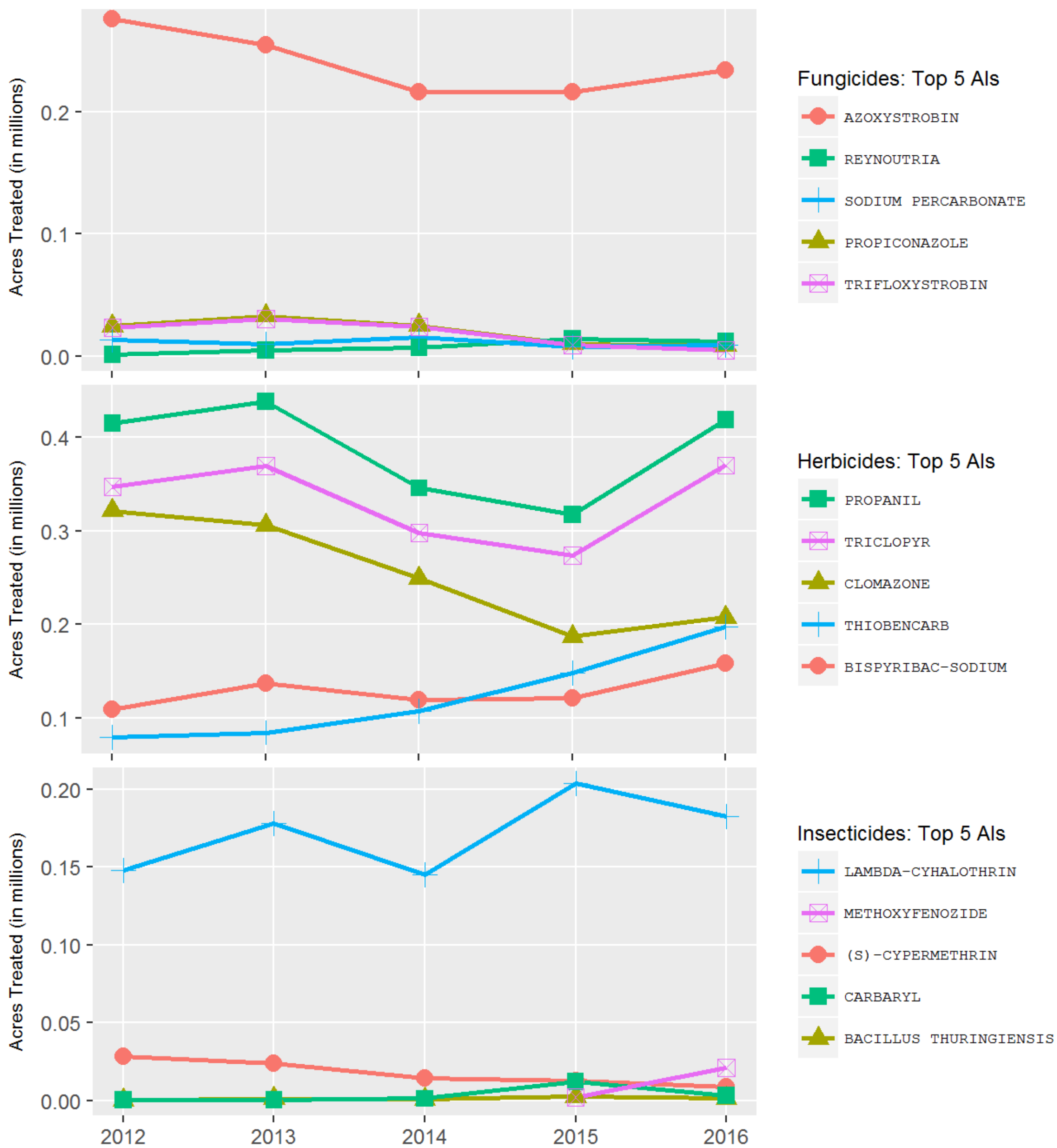


Figure 30: *Acres of rice treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

effect on the pest. An emergency exemption was issued for a methoxyfenozide-containing product in 2015 and 2016. Rice water weevil is the major insect pest on California rice, but tadpole shrimp are becoming more problematic, and in some areas they are the main pest of rice during the seedling stage. Growers often rely on lambda-cyhalothrin, copper sulfate pentahydrate, and carbaryl, applied soon after flooding, to manage tadpole shrimp. Pyrethroids have been used intensively over the last 15 years for rice water weevil and they are managing this pest less effectively (Figures 30 and A-29).

Strawberry

In 2016 California produced 2.87 billion pounds of strawberries valued at more than $1.8 billion. Market prices determine how much of the crop goes to fresh market and how much is processed, and in 2016, about 79 percent of the crop went to fresh market. About 38,500 acres of strawberry were planted and harvested in 2016, primarily along the central and southern coast, with smaller but significant production occurring in the Central Valley (Figure A-30 and Table 29).

Table 29: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for strawberry each year from 2012 to 2016. Planted acres are from USDA(d), 2015-2017; marketing year average prices are from USDA(d), 2015-2017. Acres treated means cumulative acres treated (see explanation p. 12). Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	13,847,539	12,039,414	12,282,762	11,810,136	11,345,895
Acres Treated	2,208,349	2,564,713	2,820,816	2,686,575	2,511,864
Acres Planted	39,000	41,500	41,500	40,500	38,500
Price/cwt	$ 77.1	$ 79.8	$ 88.4	$ 67.7	$ 63.8

The major insect pests of strawberry are lygus bugs and worms (various moth and beetle larvae), especially in the Central and South Coast growing areas. Until recently, lygus bugs were not considered a problem in the South Coast, but lygus has become a serious threat probably due to warmer, drier winters and increased diversity in the regional crop complex that supports this pest. Flonicamid and acetamiprid, insecticides used to control lygus, were applied to 19 and 26 percent fewer acres in 2016, respectively. Overall insecticide use was down 16 percent in 2016, with 25 to 35 percent decreases in neonicotinoid, organochlorine, organophosphate, and pyrethroid insecticides. Use of organophosphates and carbamates decreased by 29 percent. (Figures 32, A-31, and A-32).

Herbicide use in 2016 decreased 4 percent. The primary contributors to this decrease were a 5 percent decrease in oxyfluorfen use and a 19 percent decrease in flumioxazin.

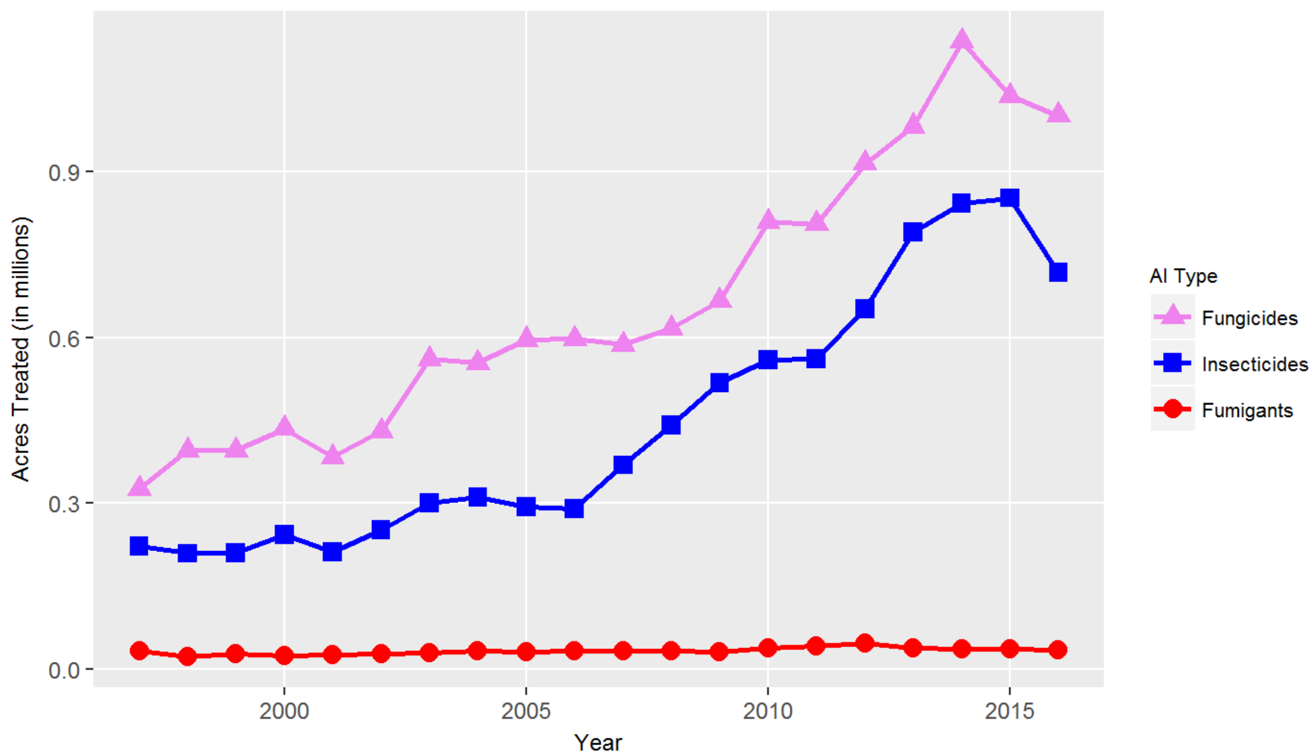


Figure 31: *Acres of strawberry treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Fungicides continued to be the most-used pesticides in 2016, as measured by area treated. Overall, fungicide use decreased by 3 percent in 2016, with most fungicides showing a slight decrease in use. (Figure 31).

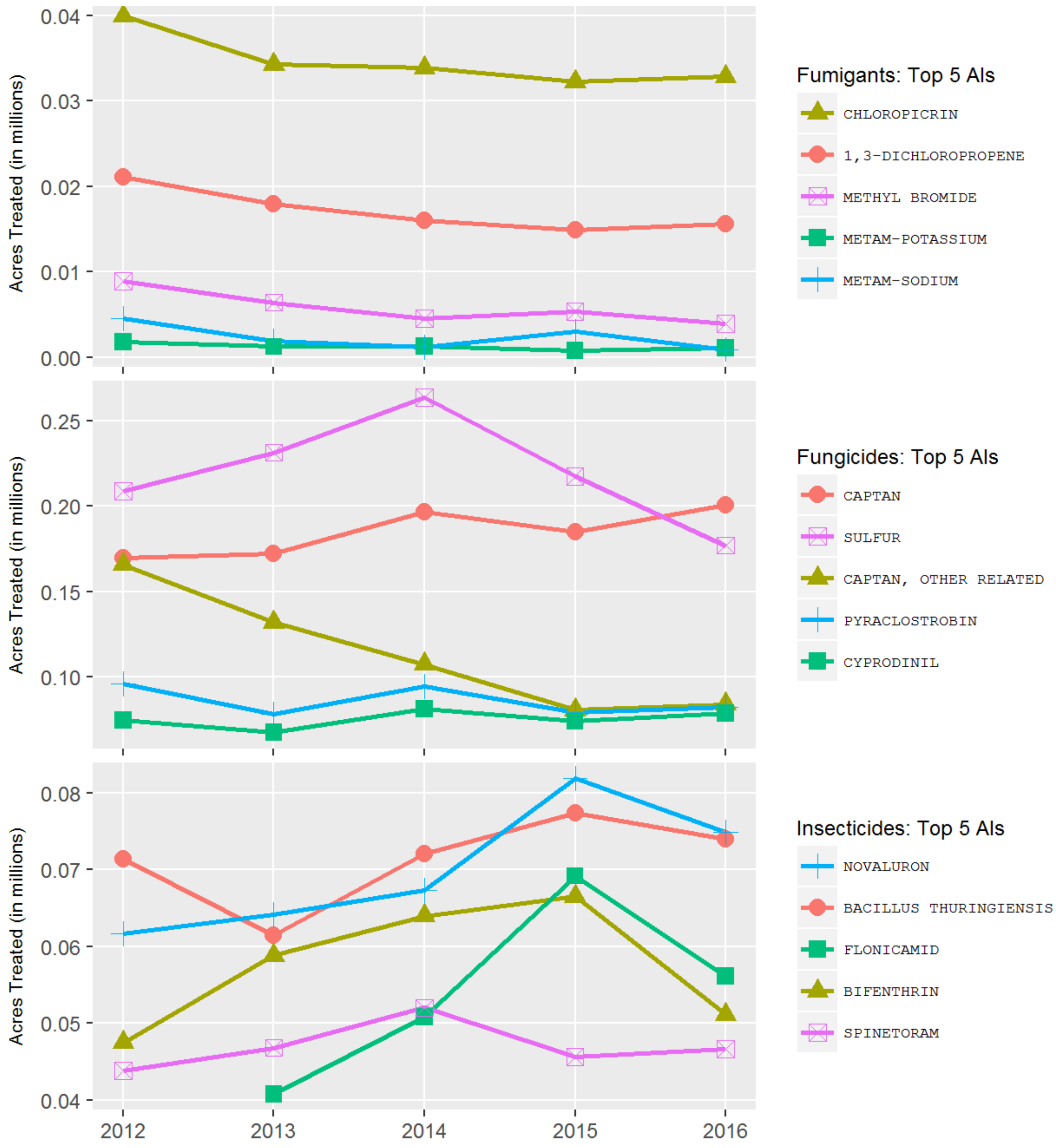


Figure 32: *Acres of strawberry treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Strawberry production relies on several fumigants. Fumigants accounted for about 81 percent (as measured by pounds applied) of all pesticide AIs applied to strawberries in 2016. The area treated with fumigants in 2016 decreased 3 percent.(Figures 32 and A-31). Methyl bromide use decreased by 26 percent, metam-sodium use decreased by 69 percent, and 1,3-dichloropropene use increased by 5 percent. Chloropicrin use increased by roughly 2 percent. Methyl bromide is used primarily to control pathogens and nutsedge. Metam-sodium is generally more effective in controlling weeds, but less effective than 1,3-dichloropropene or 1,3-dichloropropene plus chloropicrin against soilborne diseases and nematodes. Fumigants usually are applied at higher rates than other pesticide types, such as fungicides and insecticides, in part because they treat a volume of space rather than a surface such as leaves and stems of plants. Thus, the amounts applied are large relative to other pesticide types even though the number of applications or number of acres treated may be relatively small.

Table and raisin grape

The southern San Joaquin Valley region accounts for more than 90 percent of California's raisin and table grape production (Figure A-33). Total acreage planted in table and raisin grapes decreased by an estimated 15,000 acres in 2016, continuing a trend that reflects a decrease primarily in raisin production. Average prices decreased as well, after increases in 2014 and 2015 (Table 30). The California Grape Acreage survey for 2016 found that Thompson Seedless was again the leading raisin grape variety, while Flame Seedless was again the leading table grape variety.

Table 30: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for table and raisin grape each year from 2012 to 2016. Planted acres are from CDFA(b), 2015-2016; marketing year average prices are from USDA(d), 2015-2017. Acres treated means cumulative acres treated (see explanation p. 12). Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	14,925,655	14,646,527	15,110,450	14,770,370	15,741,273
Acres Treated	6,833,753	7,146,654	7,115,540	6,867,068	6,957,470
Acres Planted	321,000	323,000	313,000	310,000	295,000
Price/ton	$ 737	$ 697	$ 756	$ 821	$ 707

The price per ton in Table 30 is an average of the prices of table and raisin grapes, weighted by their respective acreages. Due to the wide variation in individual prices depending on type and use of the grape, it is best to consult USDA and CDFA for specific prices.

Patterns in pesticide use on table and raisin 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, and efforts by growers to reduce costs.

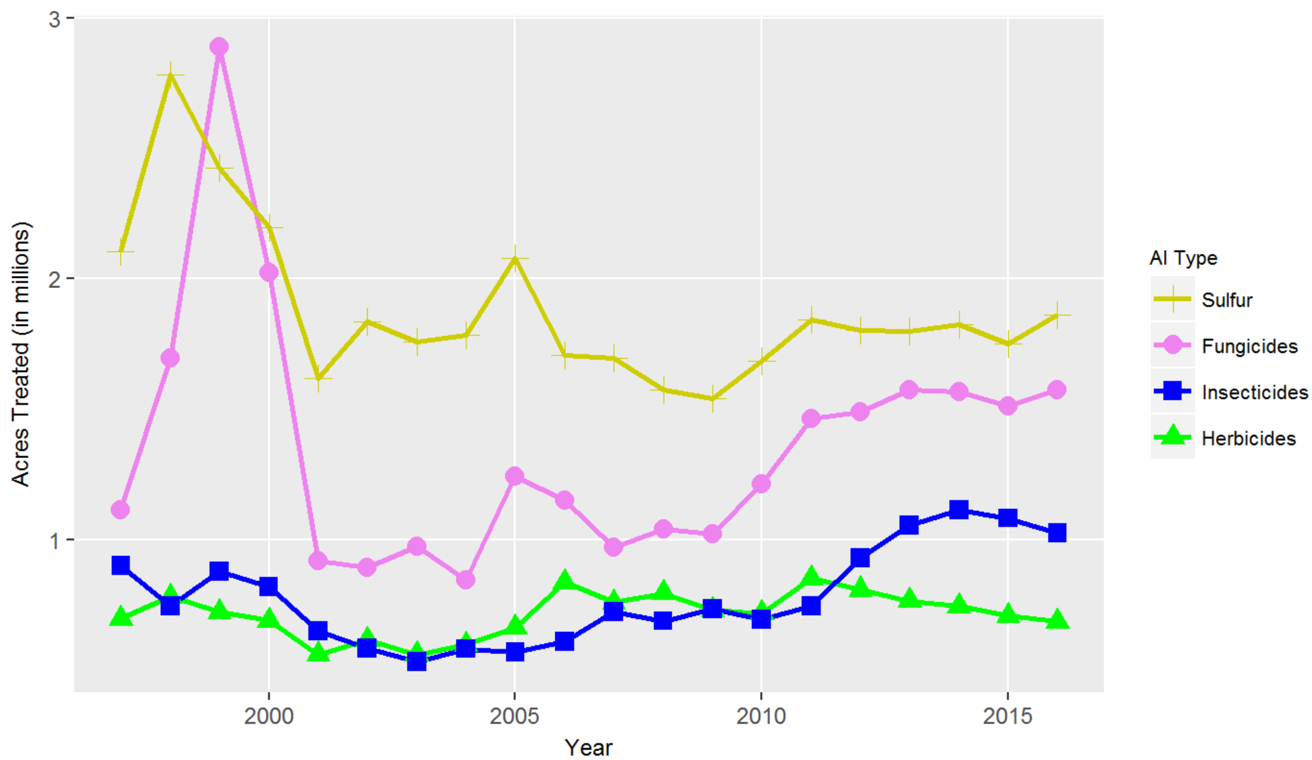


Figure 33: *Acres of table and raisin grape treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Area treated with sulfur and fungicides increased, while area treated with insecticides and herbicides decreased in 2016. Herbicide use has trended downward for five years, and after an upward trend from 2010, insecticide use has decreased since 2014 (Figure 33).

The major arthropod pests in table and raisin grapes continue to be the vine mealybug, leafhoppers, western grape leaf skeletonizer and other Lepidoptera, and spider mites.

The area treated with the top five insecticide AIs changed little from 2015 (Figure 34). With the exception of methoxyfenozide (used for control of Lepidoptera), area treated with all these AIs had generally been increasing over the last decade until 2014, when use of imidacloprid, spirotetramat, and abamectin either leveled off or began to decrease. Spinetoram use has generally continued an increasing trend over the last decade. For the last decade, approximately 81,000 acres were treated with methoxyfenozide each year, though this amount has decreased by around 6,000 acres during each of the last two years. The reduction in overall insecticide use may be attributed in part to a decline in grape acreage as vineyards are replaced by almond and pistachio orchards, as well as a reduction in pest pressure. Growers may have shifted to other AIs to some extent but overall insecticide use decreased. Beta-cyfluthrin, a pyrethroid, and clothianidin, a neonicotinoid, were used on a larger number of acres in 2016 but they were not used extensively (22,000-25,000 acres in total) compared to other AIs. The newly registered miticide, cyflumetofen, and fenproximate, also a miticide, were used on a substantially greater area in 2016 compared to 2015, with increases of 219 and 56 percent, respectively.

The areas treated with sulfur and other fungicides increased marginally (Figure 33). The top five fungicides with the greatest area treated were mostly the same as in 2015, with the addition of tebuconazole in place of pyraclostrobin/boscalid combination fungicides (Figure 34and A-34). The area treated with quinoxyfen trended upward from 2008 to 2015, but decreased slightly in 2016. Notable increases in area treated were observed for cyflufenamid and potassium bicarbonate. Flutriafol increased from less than 1,000 acres in 2015 to nearly 14 thousand acres in 2016. Substantial decreases in area treated were observed for triflumizole and fenhexamid. Cyflufenamid was first registered in 2012 and flutriafol in 2014 so increases in use would be expected as growers test new AIs and use them in rotation with other AIs. Much of the pattern of fungicide use across years can be explained by rotation of AIs as part of a resistance management program. Most applications were in spring to early summer, likely for powdery mildew (Figure A-35). There were some late season applications of copper, cyprodinil, fludioxonil and fenhexamid.

Though drought conditions were abating in 2016, weed pressure was still light and the area treated with herbicides decreased again, a trend that has continued since drought began in 2011 (Figure 33). Very little change occurred in the area treated with the top herbicides, except for pendimethalin which was used on 48 percent more area (Figure 34). There were reductions in area treated with most other herbicides, except flazasulfuron and capric acid, which were applied to a relatively small number of acres (around 8,000 acres each). Flazasulfuron was registered in

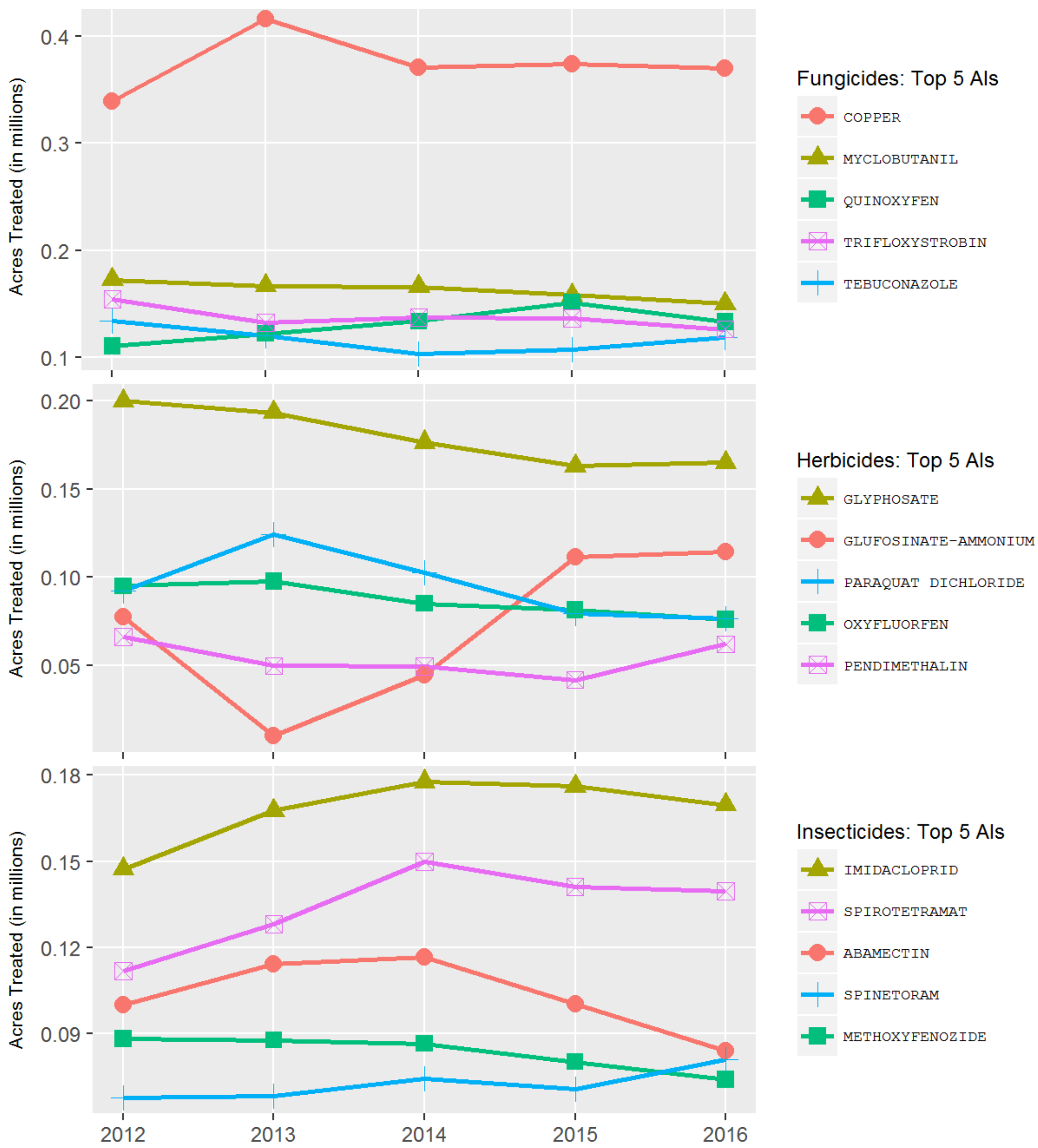


Figure 34: *Acres of table and raisin grape treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

2012 so its use might be expected to increase as more applicators become aware of it. Capric acid is an AI of an Organic Materials Review Institute (OMRI) approved organic product and was registered for grapes in 2015.

The area treated with fumigants was nearly unchanged from 2015, with a three percent increase of 85 acres treated. 1,3-dichloropropene decreased by 14 percent, while metam-sodium and metam-potassium (potassium n-methyldithiocarbamate) increased.

The area treated with plant growth regulators (PGRs) increased by two percent in 2016. Gibberellins were again used more than other PGRs. Ethephon and hydrogen cyanamide were the next most widely applied PGRs. Gibberellins are applied in early spring to lengthen and loosen grape clusters and increase berry size. Ethephon releases ethylene and is used to enhance fruit ripening in raisin grapes and fruit color in table grapes. Hydrogen cyanamide is applied after pruning to promote bud break. More area was treated with forchlorfenuron in 2016 (by 3,080 acres). Forchlorfenuron is a synthetic cytokinin, applied after fruit set to increase the size and firmness of table grapes.

Walnut

California produces 99 percent of the walnuts grown in the United States. The California walnut industry is comprised of over 4,000 growers who farmed 315,000 bearing acres in 2016 (Table 31 and Figure A-36). According to the 2016 Walnut Objective Measurement Report, the season had satisfactory chilling hours and rain, although spring rains increased the probability of blight, and high temperatures in August resulted in an earlier harvest. Walnut production was estimated at 670,000 tons in 2016, an increase of about 11 percent from the previous year. The price increased by 8 percent while bearing acreage increased by 5 percent. The amount of applied pesticides increased by 5 percent and the area treated increased by 3 percent (Figure 35).

Table 31: *Total reported pounds of all active ingredients (AI), acres treated, acres bearing, and prices for walnut each year from 2012 to 2016. Bearing acres are from USDA(d), 2015-2017; marketing year average prices are from USDA(d), 2015-2017. Acres treated means cumulative acres treated (see explanation p. 12). Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	4,302,214	5,048,801	5,709,138	6,973,178	7,331,322
Acres Treated	2,981,995	3,496,941	4,031,563	4,835,115	4,962,213
Acres Bearing	270,000	280,000	290,000	300,000	315,000
Price/ton	$ 3,030	$ 3,710	$ 3,340	$ 1,670	$ 1,810

The area treated with insecticides, which includes miticides, increased by 1 percent (Figure 35). Important pests for walnuts include codling moth, walnut husk fly, navel orangeworm, aphids and webspinning spider mites. The top five insecticides by area treated did not change much from 2015, consisting of abamectin, bifenthrin, chlorantraniliprole, acetamiprid, and methoxyfenozide. Abamectin, a miticide, remained the most-used insecticide because of its low cost and continued efficacy. Pheromone-treated acreage jumped by 35 percent while area treated with organophosphate insecticides continued to decline, showing an 11 percent reduction in 2016. This reduction was largely due to decreased use of chlorpyrifos which became a restricted use material in 2015 (Figures 36 and A-37).

The area treated with herbicides decreased by 2 percent (Figure 35). Similar to 2015, glyphosate, oxyfluorfen, glufosinate-ammonium, paraquat dichloride, and saflufenacil were the top five herbicides by area treated. However, in 2016, the area treated with glufosinate-ammonium increased above that of paraquat dichloride and saflufenacil. Lack of availability of glufosinate-ammonium on the west coast in 2014 and 2015 resulted in low use that did not really reflect its high demand at the time. Recently, glufosinate-ammonium went off patent, increasing the number of available herbicide products and likely reducing costs as a result of product competition. Glyphosate remained the herbicide with the most use, probably due to its effectiveness at controlling a wide variety of weeds and its relatively low cost. However, reports of glyphosate-resistant weeds continue to surface, causing growers to take measures to delay or prevent resistance. The Sacramento Valley is dominated by glyphosate-resistant ryegrass whereas in the San Joaquin Valley, glyphosate-resistant fleabane and horseweed are more prevalent. In both areas, glyphosate-resistant summer grasses such as junglerice are becoming increasingly important problems. Glufosinate-ammonium and paraquat dichloride are non-selective herbicides recommended for use with a protoporphyrinogen oxidase (PPO) inhibitor such as saflufenacil or oxyfluorfen as an alternative to glyphosate to slow or prevent glyphosate resistance. Saflufenacil is less expensive than glufosinate-ammonium and controls broadleaf weeds like fleabane and horseweed, but is not effective on grass weeds (Figures 36, A-37 and A-38).

The area treated with fungicides increased 10 percent (Figure 35). Copper and mancozeb, used for blight control, had the highest use, increasing in area treated by 14 and 16 percent respectively. Propiconazole, tebuconazole, and pyraclostrobin were also in the top five fungicides for 2016, with tebuconazole showing a 78 percent increase in area treated (Figures A-37, and A-38). These increases were likely due to more occurrences of Botryosphaeria canker (Bot), a fungus that can infect branches, nuts, spurs, and shoots of walnut trees resulting in severe crop loss. Area treated with microbial fungicides which are generally thought to be lower risk increased by 56 percent. Sulfur, a fungicide/insecticide, decreased by 67 percent while kaolin clay increased by 4 percent.

The area treated with fumigants decreased by 40 percent. Aluminum phosphide, a fumigant used for vertebrate control, decreased by 29 percent. Similarly, fumigants applied to the soil before planting such as 1,3-dichloropropene, chloropicrin, and methyl bromide saw significant decreases in area treated by 20, 53, and 67 percent respectively. Given the cost and tighter regulations of

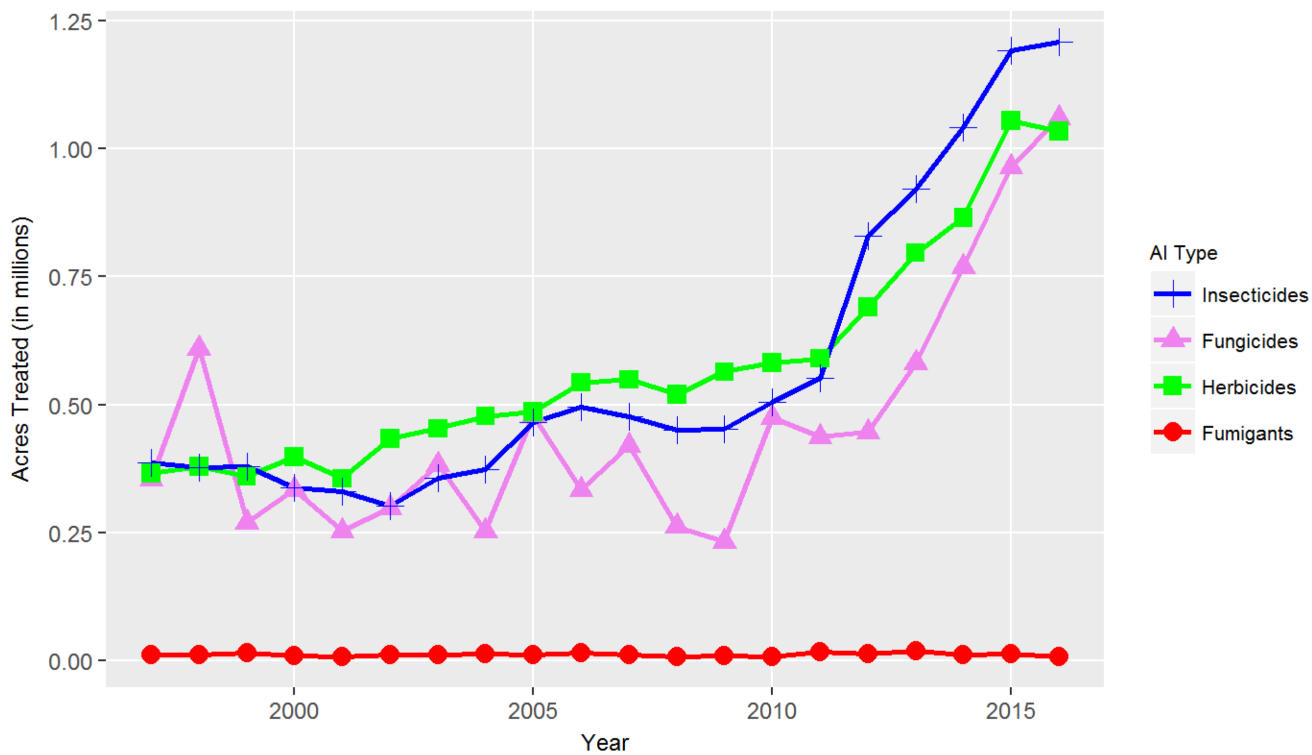


Figure 35: *Acres of walnut treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

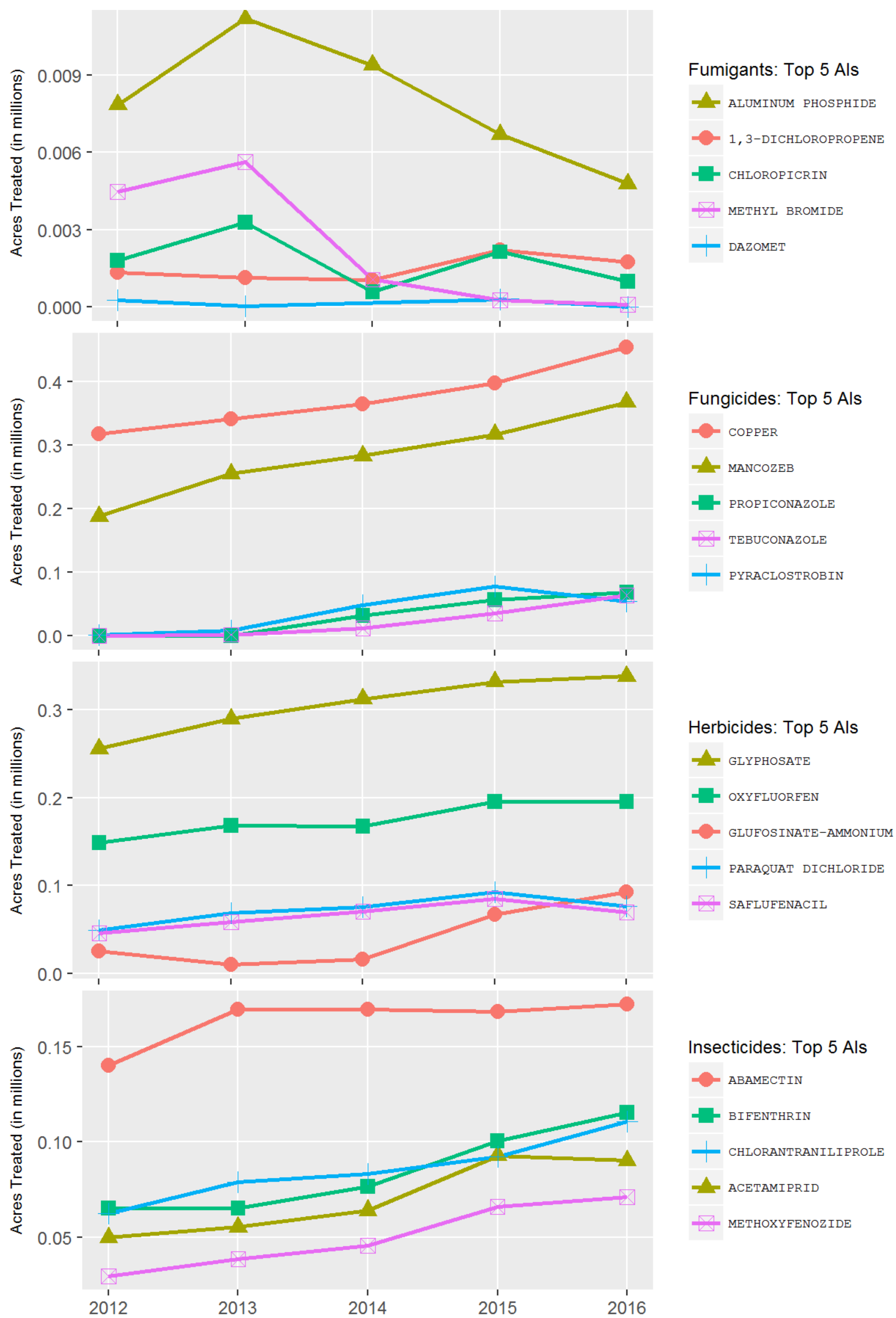


Figure 36: *Acres of walnut treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

fumigants, some growers are using alternatives such as fallowing or cover-cropping for a year prior to replanting orchards with new trees.

Wine grape

There are four major wine grape production regions: North Coast (Lake, Mendocino, Napa, Sonoma, and Solano counties); Central Coast (Alameda, Monterey, San Luis Obispo, Santa Barbara, San Benito, Santa Cruz, and Santa Clara counties); northern San Joaquin Valley (San Joaquin, Calaveras, Amador, Sacramento, Merced, Stanislaus, and Yolo counties); and southern San Joaquin Valley (Fresno, Kings, Tulare, Kern, and Madera counties). (Figure A-39). 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.

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

Table 32: *Total reported pounds of all active ingredients (AI), acres treated, acres planted, and prices for wine grape each year from 2012 to 2016. Planted acres are from CDFA(b), 2015-2017; marketing year average prices are from USDA(d), 2015-2017. Acres treated means cumulative acres treated (see explanation p. 12). Text files of data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*

	2012	2013	2014	2015	2016
Pounds AI	26,868,522	26,774,581	26,811,883	29,549,428	27,711,454
Acres Treated	9,332,099	10,259,868	10,104,231	10,768,333	10,533,479
Acres Planted	588,000	610,000	615,000	608,000	602,000
Price/ton	$ 773	$ 753	$ 759	$ 781	$ 904

The total amount of pesticides applied and the cumulative area treated in 2016 decreased (Table 32).The area treated with sulfur and herbicides decreased, and the area treated with fungicides and insecticides increased in 2016. The long term trend over the last two decades is an increasing area treated for all pesticide types except for sulfur which has tended to fluctuate more annually (Figure 37).

Vine mealybug continued to be a concern for growers. It has now been found throughout most of the grape growing regions of California. The warm winters since 2012 have allowed vine mealybug populations to build up early in the season. In the North Coast region, the Virginia creeper leafhopper, a recent pest, continued to cause substantial damage in some locations, as did the western grape leafhopper. While there is effective biological control for western grape leafhopper, Virginia creeper leafhopper infestations require insecticide applications. In this region, these leafhoppers have generally been treated with organic materials (botanical pyrethrins and oils) as well as imidacloprid.

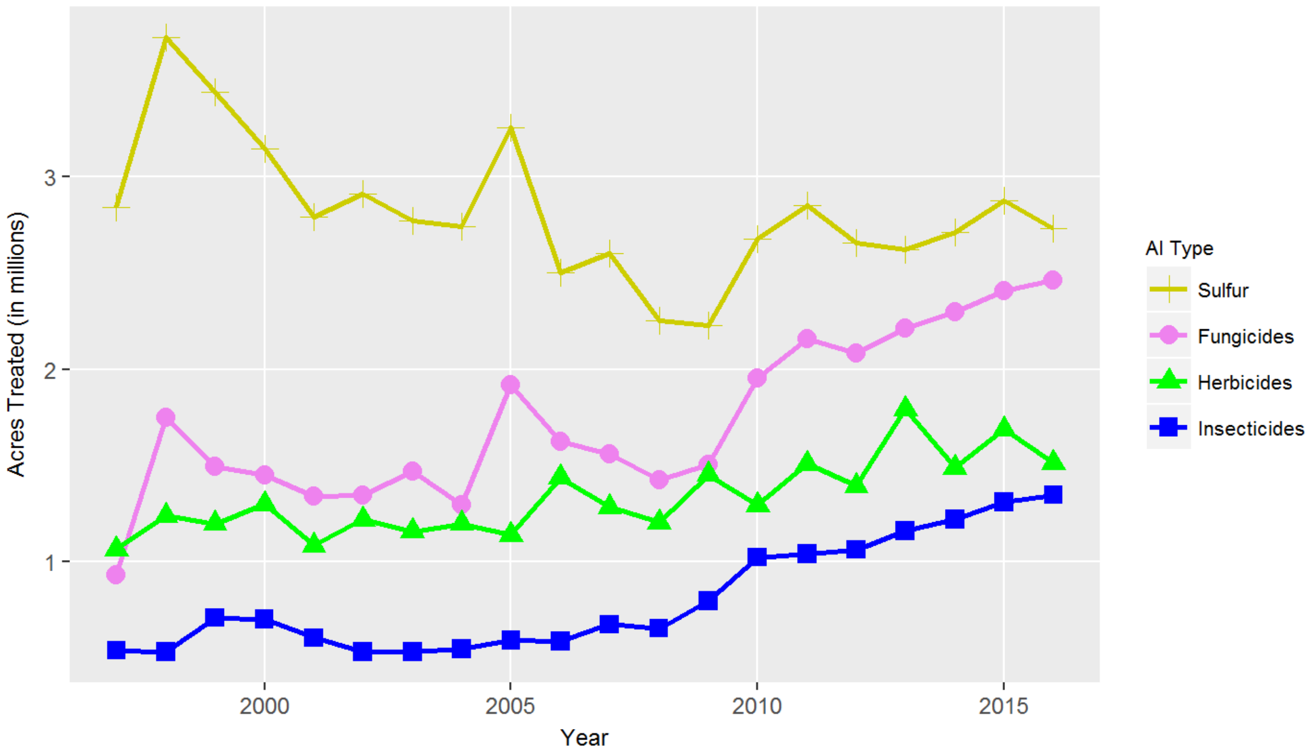


Figure 37: *Acres of wine grape treated by all AIs in the major types of pesticides from 1996 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

There has been a generally increasing use of relatively lower risk insecticides (oil, spirotetramat, buprofezin) over the past five years. Over this same period, use of the neonicotinoid insecticides such as imidacloprid, thiamethoxam and clothianidin, have tended to increase, though area treated with imidacloprid decreased in 2014 and 2016 (Figure 38). These insecticides are used to control mealybugs, leafhoppers and sharpshooters. Use of chlorpyrifos dropped off sharply in 2011 and has remained relatively low ever since. Chlorpyrifos was made a restricted material in 2015. Large vine mealybug populations in 2015 and 2016 have kept this AI as an important tool for growers however. Chlorpyrifos is used as postharvest or delayed dormant treatments to prevent spring buildup of vine mealybug populations (Figure A-41). Some AIs used for mite control (abamectin, etoxazole, fenpyroximate) remained about the same or decreased in area treated in 2016 while the newly registered cyflumetofen, and hexythiazox, were used on greater area. Methoxyfenozide has continued to be used on a substantial area for the treatment of Lepidoptera.

Overall, fungicide use has been increasing for two decades (Figure 37), though area treated with the major AIs changed little over the past five years, except for an increased use of tebuconazole from 2012-2014 (Figure 38). Although the dry conditions of the drought generally do not favor fungal reproduction, the winter of 2015-2016 was wetter in most parts of the state than the previous winters during the drought. While there were small increases in area treated with some fungicides (copper, boscalid/pyraclostrobin combination fungicides, cyprodinil, potassium bicarbonate), the decreases in others led to little net change. It is likely that growers were rotating AIs to slow the evolution of resistance. The top five fungicides applied to the largest cumulative treated area changed little from 2015, with myclobutanil replacing trifloxystrobin for fifth largest in area treated (Figure 38).

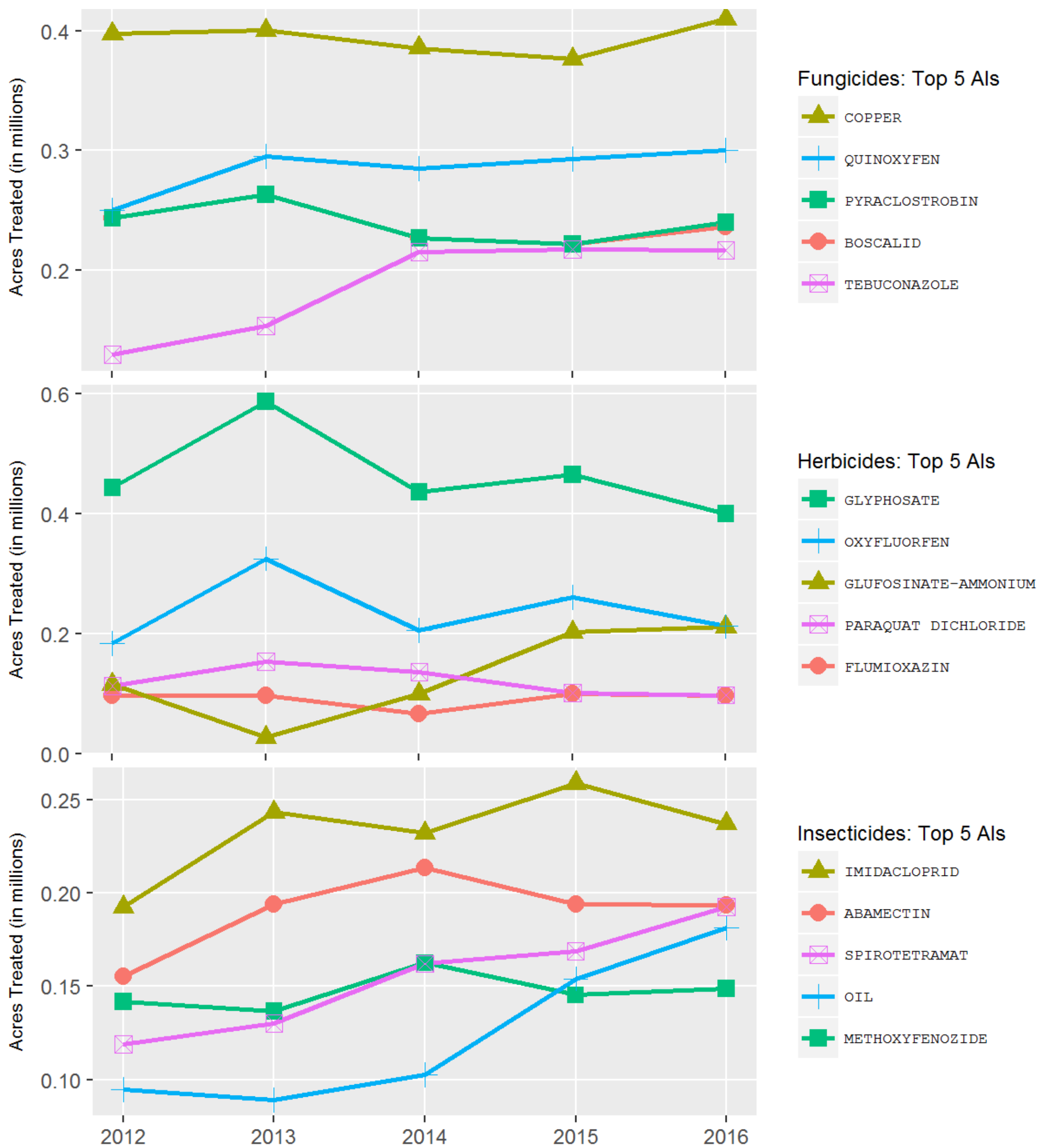


Figure 38: *Acres of wine grape treated by the top 5 AIs of each AI type from 2012 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Weed pressure was light in 2016, perhaps accounting for a slight decrease in area treated with herbicides (Figure 37). The top five herbicides in area treated were the same as in 2015 (Figure 38). There were no notable increases in area treated with any herbicide, while substantial decreases in area treated with glyphosate, oxyfluorfen, indaziflam, oryzalin, and flazasulfuron can account for the overall decrease observed.

Fumigant use continued a decreasing trend that has been observed over the past five years (Figure A-41). All fumigant AIs were used less in 2016. This likely reflects a decrease in the number of acres planted in 2016, a move away from soil fumigation by growers, and a decrease in the use of aluminum phosphide for rodent control.

Gibberellins were by far the most commonly applied plant growth regulator (PGR). Forchlorfenuron was used on three times as many acres in 2016. Forchlorfenuron is a synthetic cytokinin, which is applied after fruit set to increase the size and firmness of table grapes. Since most applications were in May, wine grape growers may have used it at bloom to increase fruit set. Use of other PGRs was negligible in 2016.

Sources of Information

Adaskaveg, J., D. Gubler and T. Michailides. 2013. Fungicides, bactericides, and biologicals for deciduous tree fruit, nut, strawberry, and vine crops. UC Davis Dept. of Plant Pathology, UC Kearney Agricultural Center, UC Statewide IPM Program. 53 pp. <http://www.ipm.ucdavis.edu/PDF/PMG/fungicideefficacytiming.pdf>

Adaskaveg, J. E., H. Forster, D. Thompson, D. Felts and K. Day. 2012. Epidemiology and Management of Pre- and Post-Harvest Diseases of Fresh Market Stone Fruits. Annual research report submitted to the California Tree Fruit Agreement for 2010. 22 pp. <http://ucce.ucdavis.edu/files/repositoryfiles/CTFA2010_22.pdf-92530.pdf>

CDFA(a). 2016. California Department of Food and Agriculture - National Agricultural Statistics Service. 2016 California Almond Acreage Report. April 26, 2017. 8 pp. <www.nass.usda.gov/Statistics_by_State/California/Publications/Specialty_and_Other_Releases/Almond/index.php>

CDFA(a). 2016. California Department of Food and Agriculture - National Agricultural Statistics Service. 2015 California Almond Acreage Report. April 27, 2016. 8 pp. <www.nass.usda.gov/Statistics_by_State/California/Publications/Specialty_and_Other_Releases/Almond/index.php>

CDFA(a). 2015. California Department of Food and Agriculture - National Agricultural Statistics Service. 2014 California Almond Acreage Report. May 4, 2015. 8 pp. <www.nass.usda.gov/Statistics_by_State/California/Publications/Specialty_and_Other_Releases/Almond/index.php>

CDFA(a). 2014. California Department of Food and Agriculture - National Agricultural Statistics Service. 2013 California Almond Acreage Report. April 24, 2014. 8 pp. <www.nass.usda.gov/Statistics_by_State/California/Publications/Specialty_and_Other_Releases/Almond/index.php>

CDFA(a). 2013. California Department of Food and Agriculture - National Agricultural Statistics Service. 2012 California Almond Acreage Report. April 25, 2013. 8 pp. <www.nass.usda.gov/Statistics_by_State/California/Publications/Specialty_and_Other_Releases/Almond/index.php>

CDFA(b). 2017. California Department of Food and Agriculture - National Agricultural Statistics Service. California Grape Acreage Report 2016 Crop. April 20, 2017. 79 pp. <www.nass.usda.gov/Statistics_by_State/California/Publications/Acreage/index.php>

CDFA(b). 2016. California Department of Food and Agriculture - National Agricultural Statistics Service. California Grape Acreage Report 2016 Summary April 20, 2017. 6 pp. <www.nass.usda.gov/Statistics_by_State/California/Publications/Specialty_and_Other_Releases/Grapes/>

CDFA(b). 2015. California Department of Food and Agriculture - National Agricultural Statistics Service. California Grape Acreage Report 2016 Summary April 20, 2017. 6 pp. <www.nass.usda.gov/Statistics_by_State/California/Publications/Specialty_and_Other_Releases/Grapes/>

CDFA(b). 2014. California Department of Food and Agriculture - National Agricultural Statistics Service. California Grape Acreage Report 2015 Summary April 12, 2016. 6 pp. <www.nass.usda.gov/Statistics_by_State/California/Publications/Specialty_and_Other_Releases/Grapes/>

CDFA(c). 2016. California Department of Food and Agriculture. California Agricultural Statistics Review, 2015-2016. 126 pp. <www.cdfa.ca.gov/Statistics/PDFs/2016Report.pdf >

California Farm Bureau. Ag Alert. Various issues. <http://www.agalert.com/>

Ogawa, J.M. and H. English. 1991. Diseases of Temperate Zone Tree Fruit and Nut Crops. UC ANR, Oakland, Calif. Pub. 3345. 461 pp.

University of California Agricultural and Natural Resources Field Notes.

University of California Integrated Pest Management (UC IPM). Pest Management Guidelines. <http://ipm.ucanr.edu/>.

USDA. United States Department of Agriculture - National Agricultural Statistics Service. Crop Progress and Condition Reports. California Crop Weather. (weekly bulletins) <www.nass.usda.gov/Statistics_by_State/California/Publications/Crop_Progress_&_Condition/>.

USDA. United States Department of Agriculture - National Agricultural Statistics Service (USDA). Quick Stats. <http://quickstats.nass.usda.gov>.

USDA(a). 2017. United States Department of Agriculture - National Agricultural Statistics Service. Acreage. June 30, 2017. 47 pp. <http://usda.mannlib.cornell.edu/usda/nass/Acre//2010s/2017/Acre-06-30-2017.pdf>

USDA(a). 2016. United States Department of Agriculture - National Agricultural Statistics Service. Acreage. June 30, 2016. 47 pp. <http://usda.mannlib.cornell.edu/usda/nass/Acre//2010s/2016/Acre-06-30-2016.pdf>

USDA(a). 2015. United States Department of Agriculture - National Agricultural Statistics Service. Acreage. June 30, 2015. 42 pp. <http://usda.mannlib.cornell.edu/usda/nass/Acre//2010s/2015/Acre-06-30-2015.pdf>

USDA(a). 2014. United States Department of Agriculture - National Agricultural Statistics Service. Acreage. June 30, 2014. 42 pp. <http://usda.mannlib.cornell.edu/usda/nass/Acre//2010s/2014/Acre-06-30-2014.pdf>

USDA(a). 2013. United States Department of Agriculture - National Agricultural Statistics Service. Acreage. June 28, 2013. 42 pp.

<http://usda.mannlib.cornell.edu/usda/nass/Acre//2010s/2013/Acre-06-28-2013.pdf>

USDA(a). 2012. United States Department of Agriculture - National Agricultural Statistics Service. Acreage. June 29, 2012. 42 pp. <http://usda.mannlib.cornell.edu/usda/nass/Acre//2010s/2012/Acre-06-29-2012.pdf>

USDA(b). 2017. United States Department of Agriculture - National Agricultural Statistics Service. Citrus Fruits 2017 Summary. August 31, 2017. 36 pp. <http://usda.mannlib.cornell.edu/usda/nass/CitrFrui//2010s/2017/CitrFrui-08-31-2017.pdf>

USDA(b). 2016. United States Department of Agriculture - National Agricultural Statistics Service. Citrus Fruits 2016 Summary. September 12, 2016. 36 pp. <http://usda.mannlib.cornell.edu/usda/nass/CitrFrui//2010s/2016/CitrFrui-09-12-2016.pdf>

USDA(b). 2015. United States Department of Agriculture - National Agricultural Statistics Service. Citrus Fruits 2015 Summary. September 17, 2015. 34 pp. <http://usda.mannlib.cornell.edu/usda/nass/CitrFrui//2010s/2015/CitrFrui-09-17-2015.pdf>

USDA(b). 2014. United States Department of Agriculture - National Agricultural Statistics Service. Citrus Fruits 2014 Summary. September 18, 2014. 36 pp. <http://usda.mannlib.cornell.edu/usda/nass/CitrFrui//2010s/2014/CitrFrui-09-18-2014.pdf>

USDA(b). 2013. United States Department of Agriculture - National Agricultural Statistics Service. Citrus Fruits 2013 Summary. September 19, 2013. 36 pp. <http://usda.mannlib.cornell.edu/usda/nass/CitrFrui//2010s/2013/CitrFrui-09-19-2013.pdf>

USDA(c). 2017. United States Department of Agriculture - National Agricultural Statistics Service. Crop Values 2016 Summary. February 24, 2017. 50 pp. <http://usda.mannlib.cornell.edu/usda/nass/CropValuSu//2010s/2017/CropValuSu-02-24-2017.pdf>

USDA(c). 2016. United States Department of Agriculture - National Agricultural Statistics Service. Crop Values 2015 Summary. February 24, 2016. 49 pp. <http://usda.mannlib.cornell.edu/usda/nass/CropValuSu//2010s/2016/CropValuSu-02-24-2016.pdf>

USDA(c). 2015. United States Department of Agriculture - National Agricultural Statistics Service. Crop Values 2014 Summary. February 24, 2015. 49 pp. <http://usda.mannlib.cornell.edu/usda/nass/CropValuSu//2010s/2015/CropValuSu-02-24-2015_correction.pdf>

USDA(c). 2014. United States Department of Agriculture - National Agricultural Statistics Service. Crop Values 2013 Summary. February 14, 2014. 49 pp.

<http://usda.mannlib.cornell.edu/usda/nass/CropValuSu//2010s/2014/CropValuSu-02-14-2014.pdf>

USDA(d). 2017. United States Department of Agriculture - National Agricultural Statistics Service. Noncitrus Fruits and Nuts 2016 Summary. June 27, 2017. 121 pp. <http://usda.mannlib.cornell.edu/usda/nass/NoncFruiNu//2010s/2017/NoncFruiNu-06-27-2017.pdf>

USDA(d). 2016. United States Department of Agriculture - National Agricultural Statistics Service. Noncitrus Fruits and Nuts 2015 Summary. July 6, 2016. 107 pp. <http://usda.mannlib.cornell.edu/usda/nass/NoncFruiNu//2010s/2016/NoncFruiNu-07-06-2016.pdf>

USDA(d). 2015. United States Department of Agriculture - National Agricultural Statistics Service. Noncitrus Fruits and Nuts 2014 Summary. July 17, 2015. 98 pp. <http://usda.mannlib.cornell.edu/usda/nass/NoncFruiNu//2010s/2015/NoncFruiNu-07-17-2015.pdf>

USDA(d). 2014.United States Department of Agriculture - National Agricultural Statistics Service. Noncitrus Fruits and Nuts 2013 Summary. July 17, 2014. 79 pp. <http://usda.mannlib.cornell.edu/usda/nass/NoncFruiNu//2010s/2014/NoncFruiNu-07-17-2014_revision.pdf>

USDA(e). 2017. United States Department of Agriculture - National Agricultural Statistics Service. Vegetables 2016 Summary. February 22, 2017. 111 pp. <http://usda.mannlib.cornell.edu/usda/nass/VegeSumm//2010s/2017/VegeSumm-02-22-2017_revision.pdf>

USDA(e). 2016. United States Department of Agriculture - National Agricultural Statistics Service. Vegetables 2015 Summary. February 4, 2016. 75 pp. <http://usda.mannlib.cornell.edu/usda/nass/VegeSumm//2010s/2016/VegeSumm-02-04-2016.pdf>

USDA(e). 2015. United States Department of Agriculture - National Agricultural Statistics Service. Vegetables 2014 Summary. January 29, 2015. 83 pp. <http://usda.mannlib.cornell.edu/usda/nass/VegeSumm//2010s/2015/VegeSumm-01-29-2015.pdf>

USDA(e). 2014. United States Department of Agriculture - National Agricultural Statistics Service. Vegetables 2013 Summary. March 27, 2014. 83 pp. <http://usda.mannlib.cornell.edu/usda/nass/VegeSumm//2010s/2014/VegeSumm-03-27-2014.pdf>

USDA(f). 2017. United States Department of Agriculture - National Agricultural Statistics

Service. 2017 California Processing Tomato Report (May no longer be available online) <https://www.nass.usda.gov/Statistics_by_State/California/Publications/Vegetables/Processing_Tomato/>

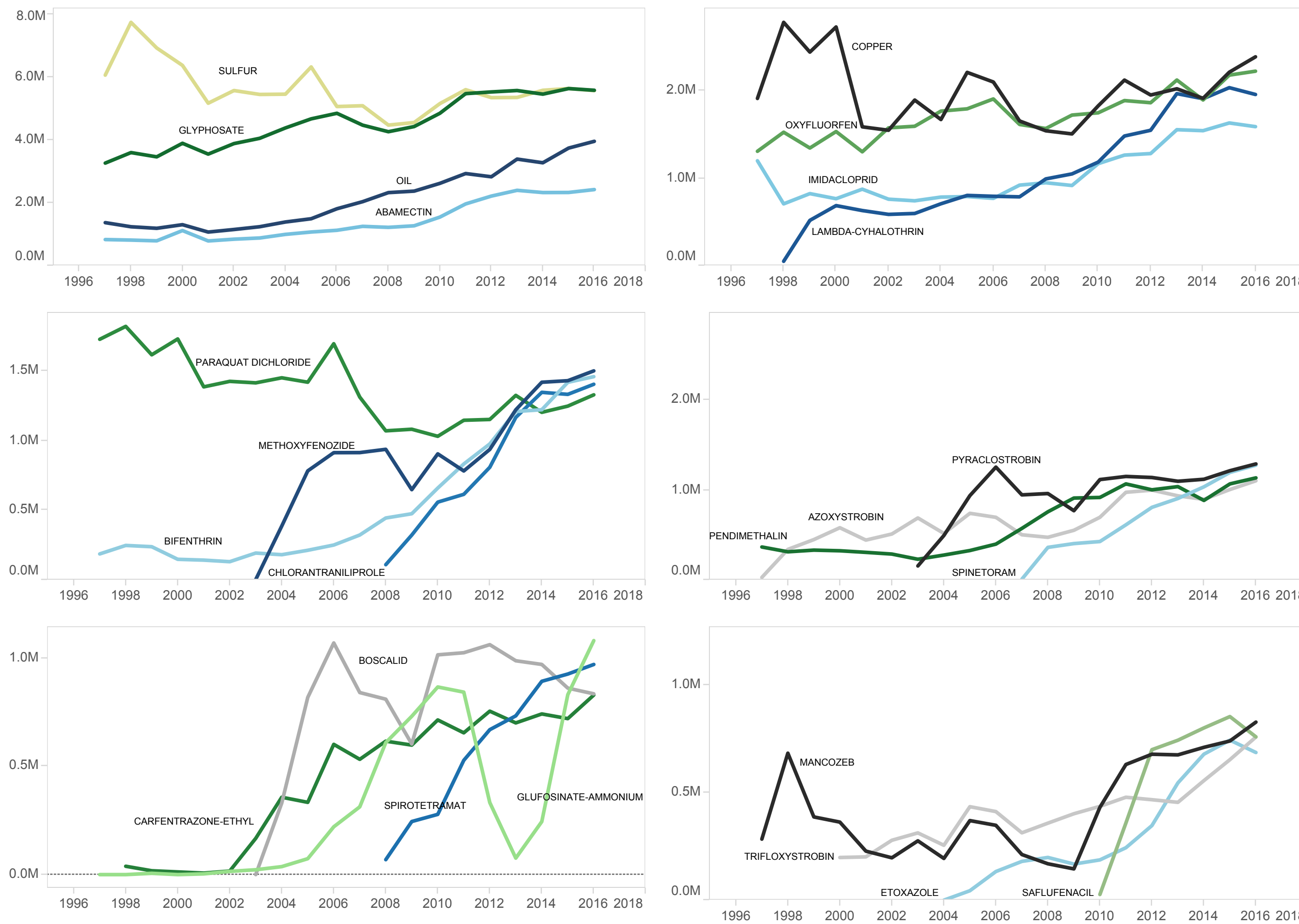
Varela, Lucia G.; Rhonda J. Smith; and Glenn T. McGourty. 2013. Sonoma County Farm News, July.

Weksler, A., A. Dagar, H. Friedman and S. Lurie. 2009. The effect of gibberellin on firmness and storage potential of peaches and nectarines. Proceedings of the VII International Peach Symposium. International Society for Horticultural Science Acta Horticulturae 962. <http://www.actahort.org/books/962/962_80.htm>

Western Farm Press. Various issues. <http://www.westernfarmpress.com/>

And many thanks to all the contributions and expertise from County Agricultural Commissioners, growers, University of California Cooperative Extension Area Integrated Pest Management Advisors and Farm Advisors, pest control advisors, commodity marketing boards, and University of California researchers.

Appendix



Total acres treated by the major AIs from 1997 to 2016. The graphs are ordered by their acres treated in 2016 starting with the graph in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, yellow insecticide/fungicides (mostly sulfur), orange defoliants, and others as purple.

Figure A-1: *Acres treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

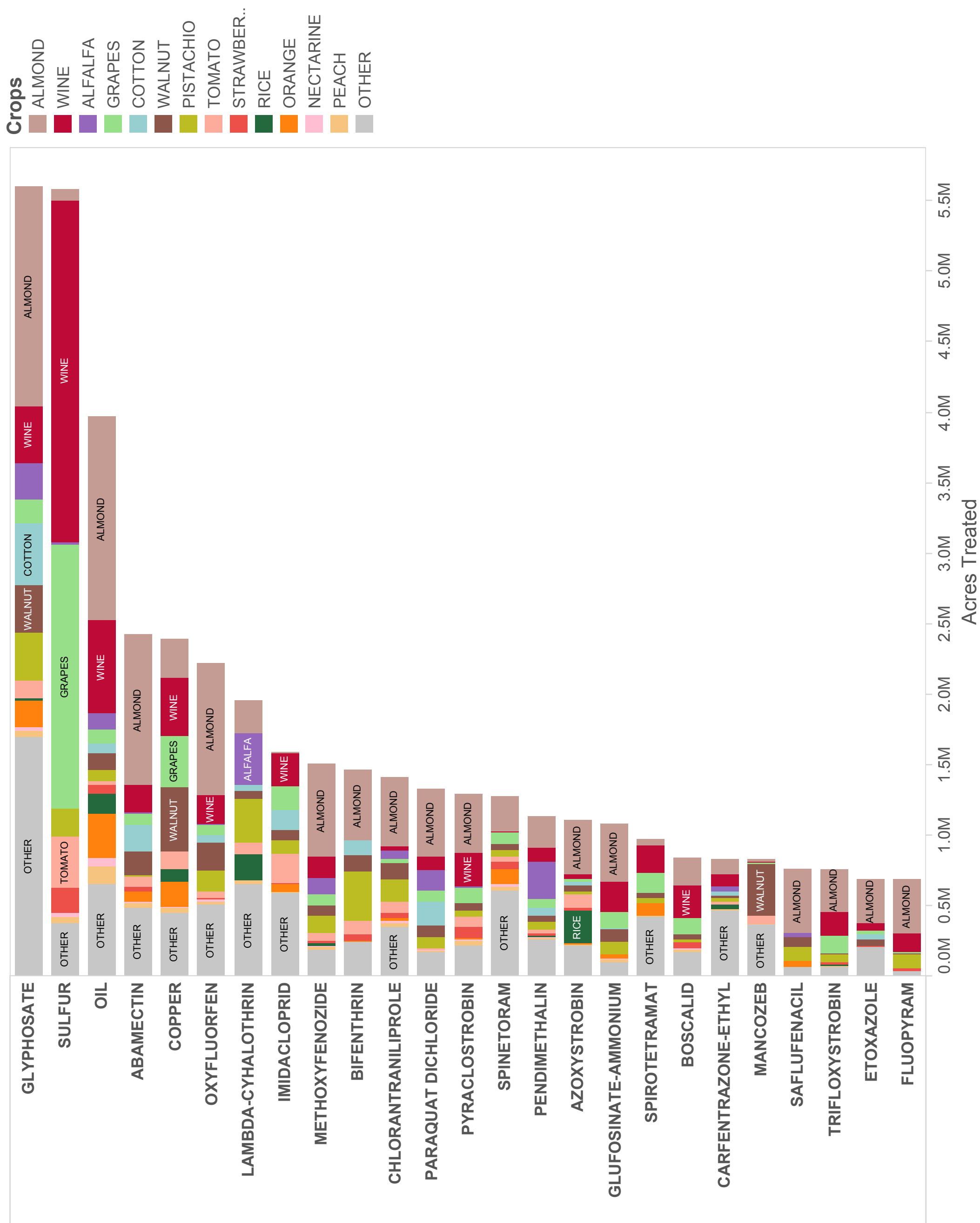


Figure A-2: *Acres treated by the major AIs and crops in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

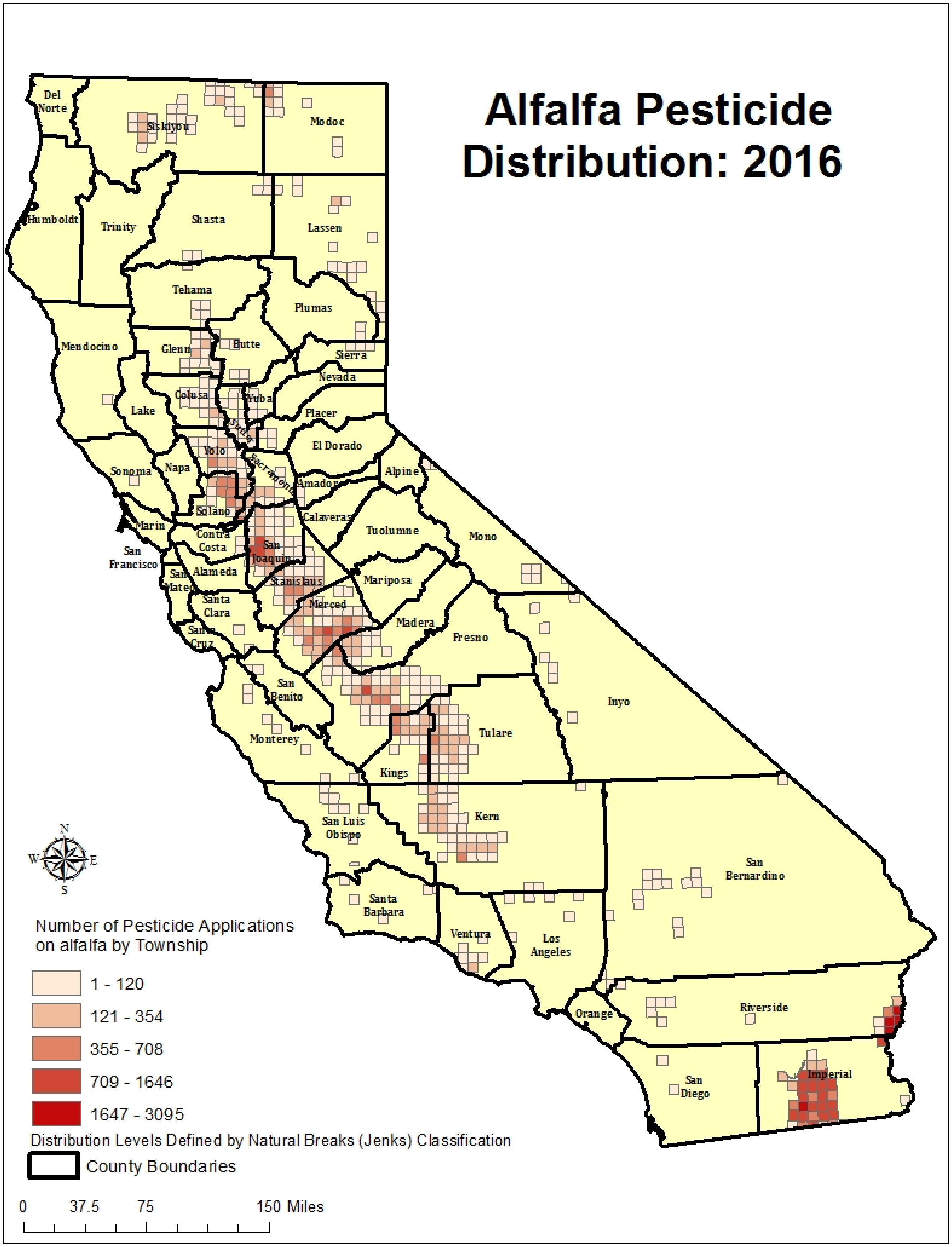
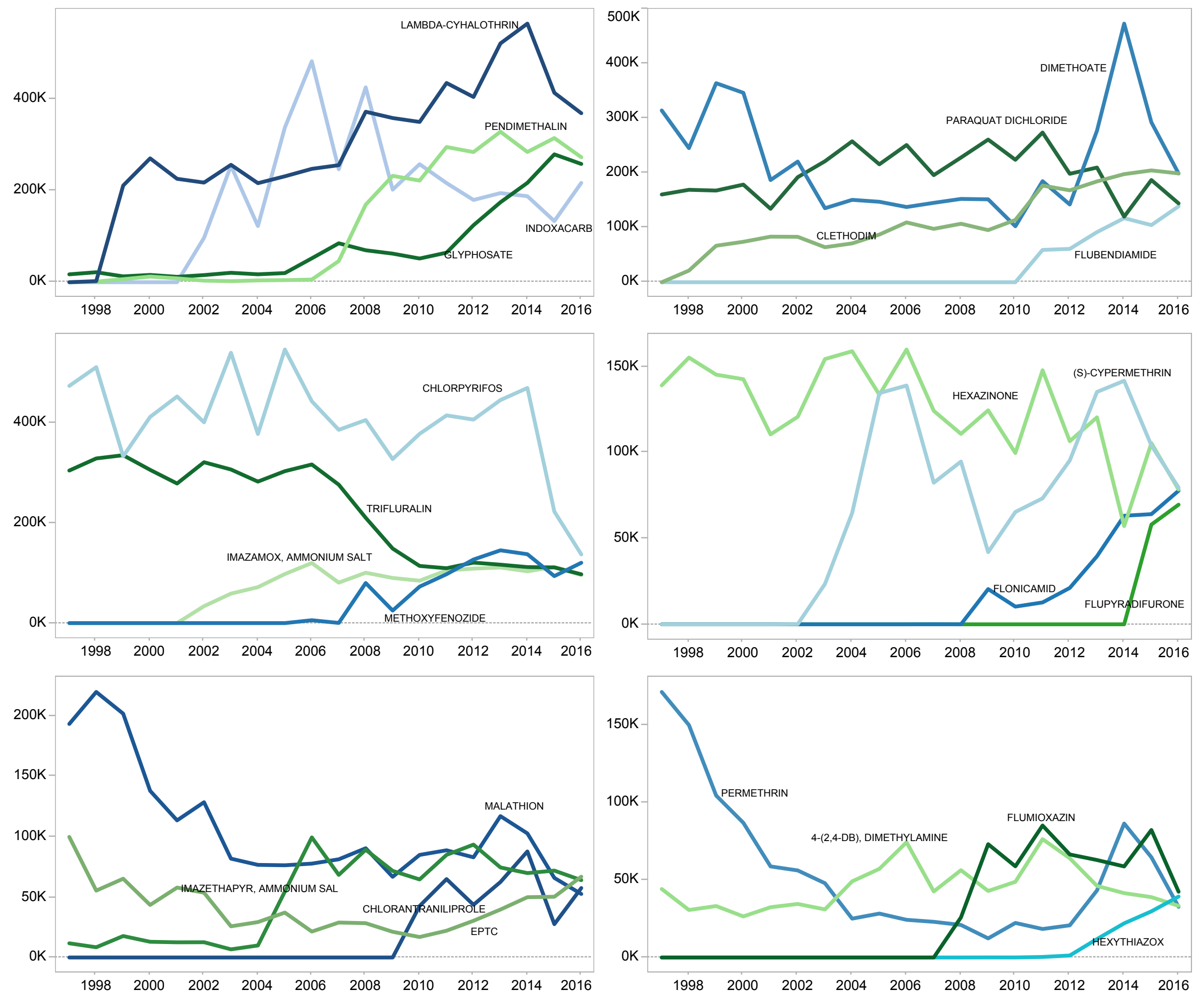


Figure A-3: *Number of pesticide applications in alfalfa by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Figure A-4: *Acres of alfalfa treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*



Alfalfa acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities

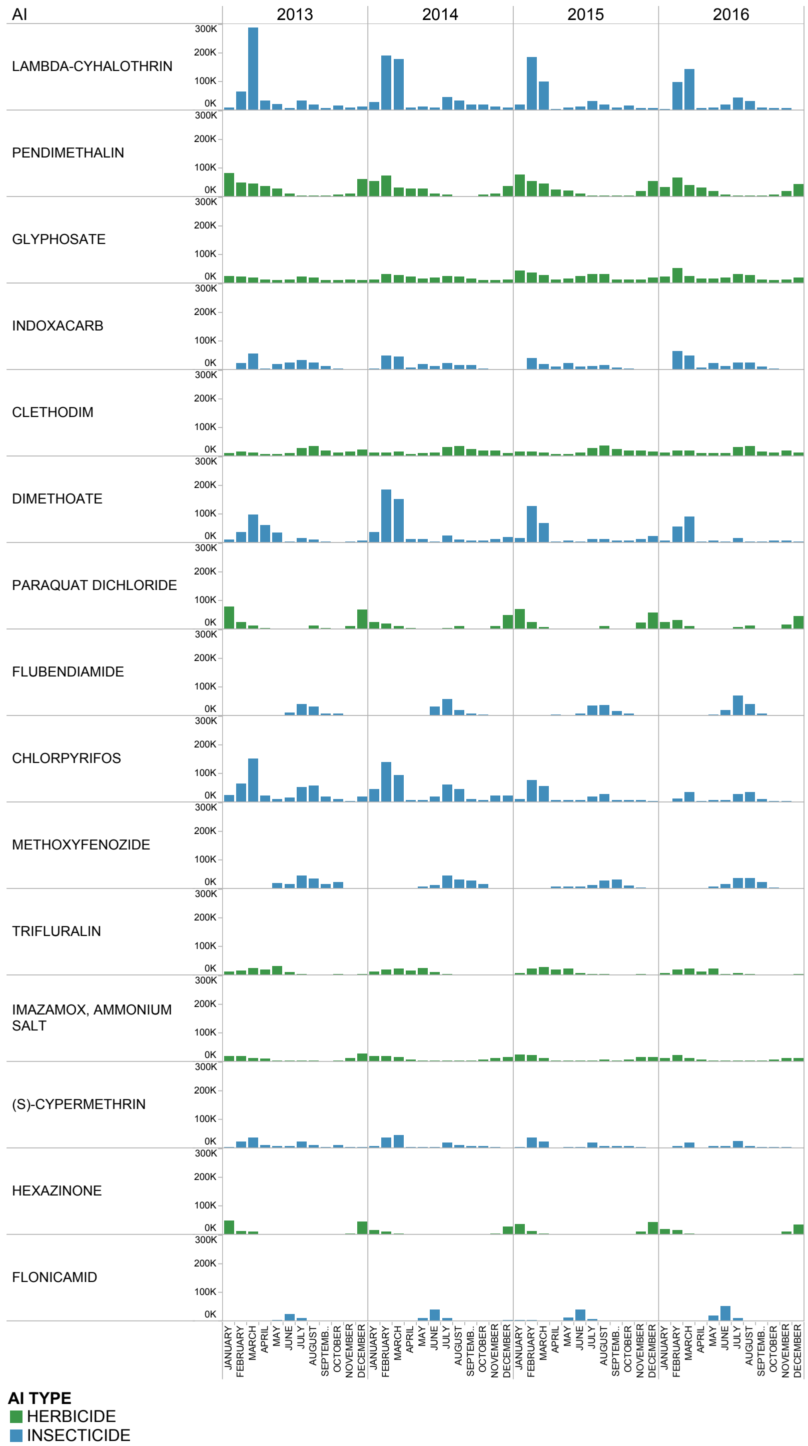


Figure A-5: *Acres of alfalfa treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

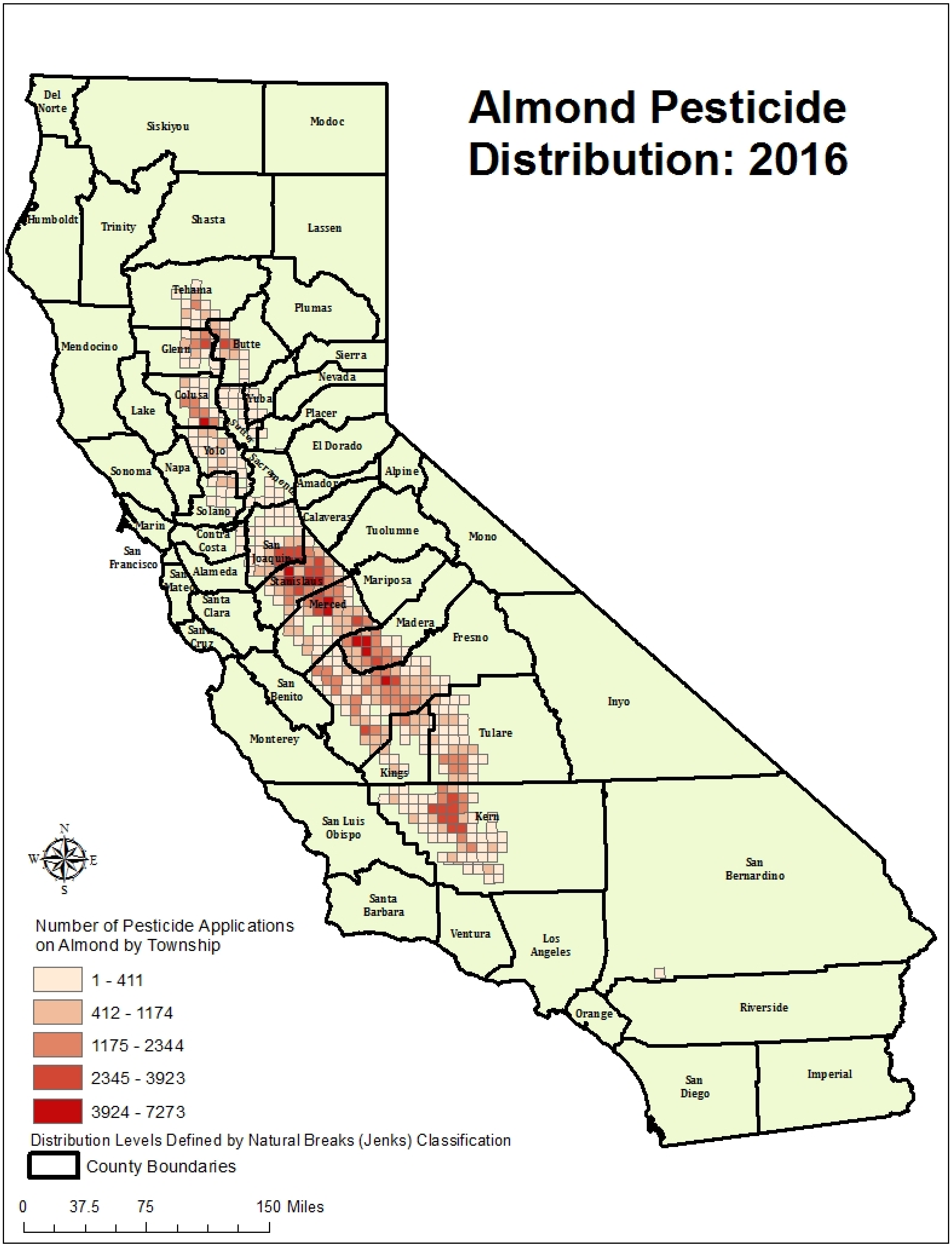
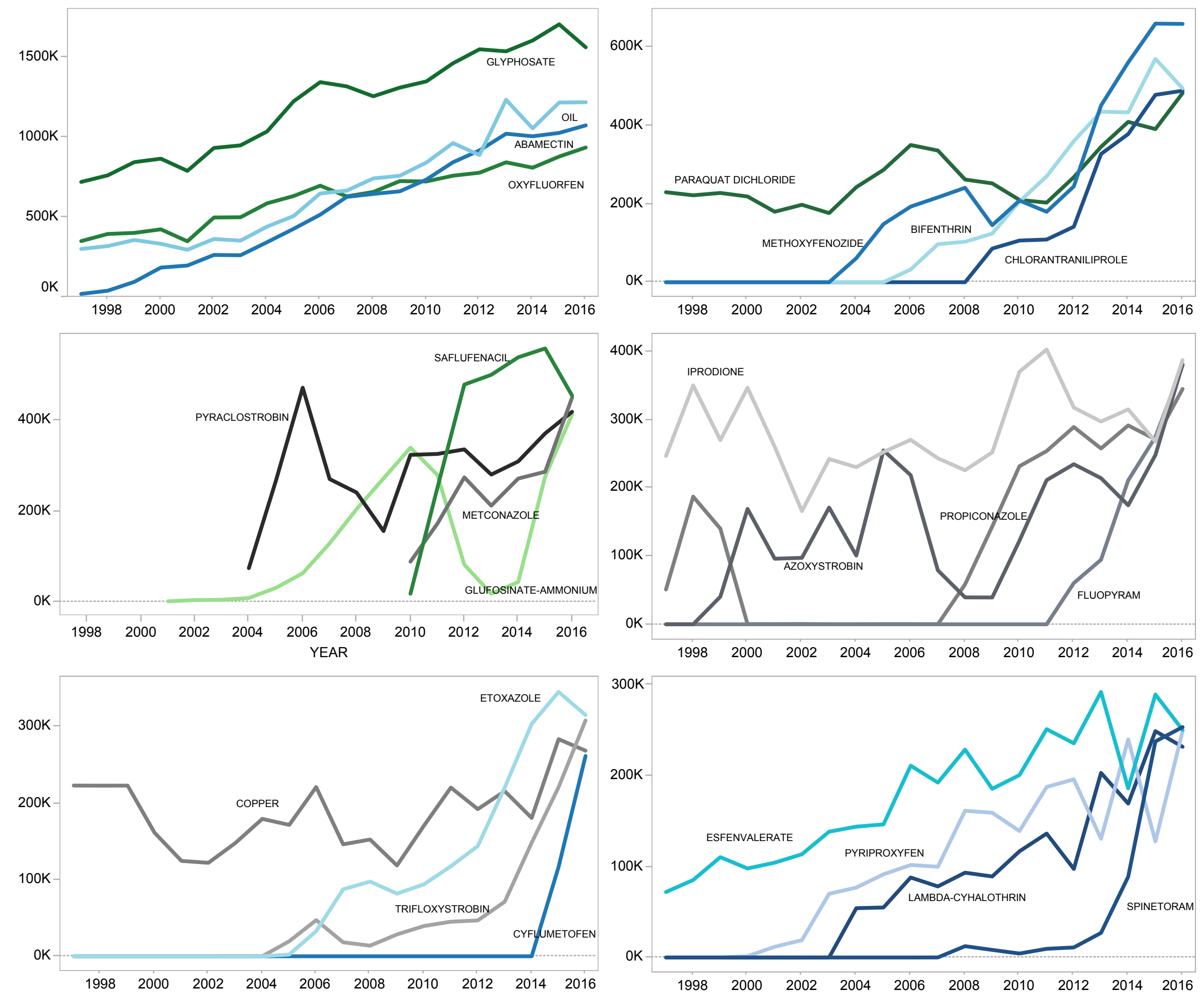


Figure A-6: *Number of pesticide applications in almond by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Figure A-7: *Acres of almond treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*



Almond acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities.

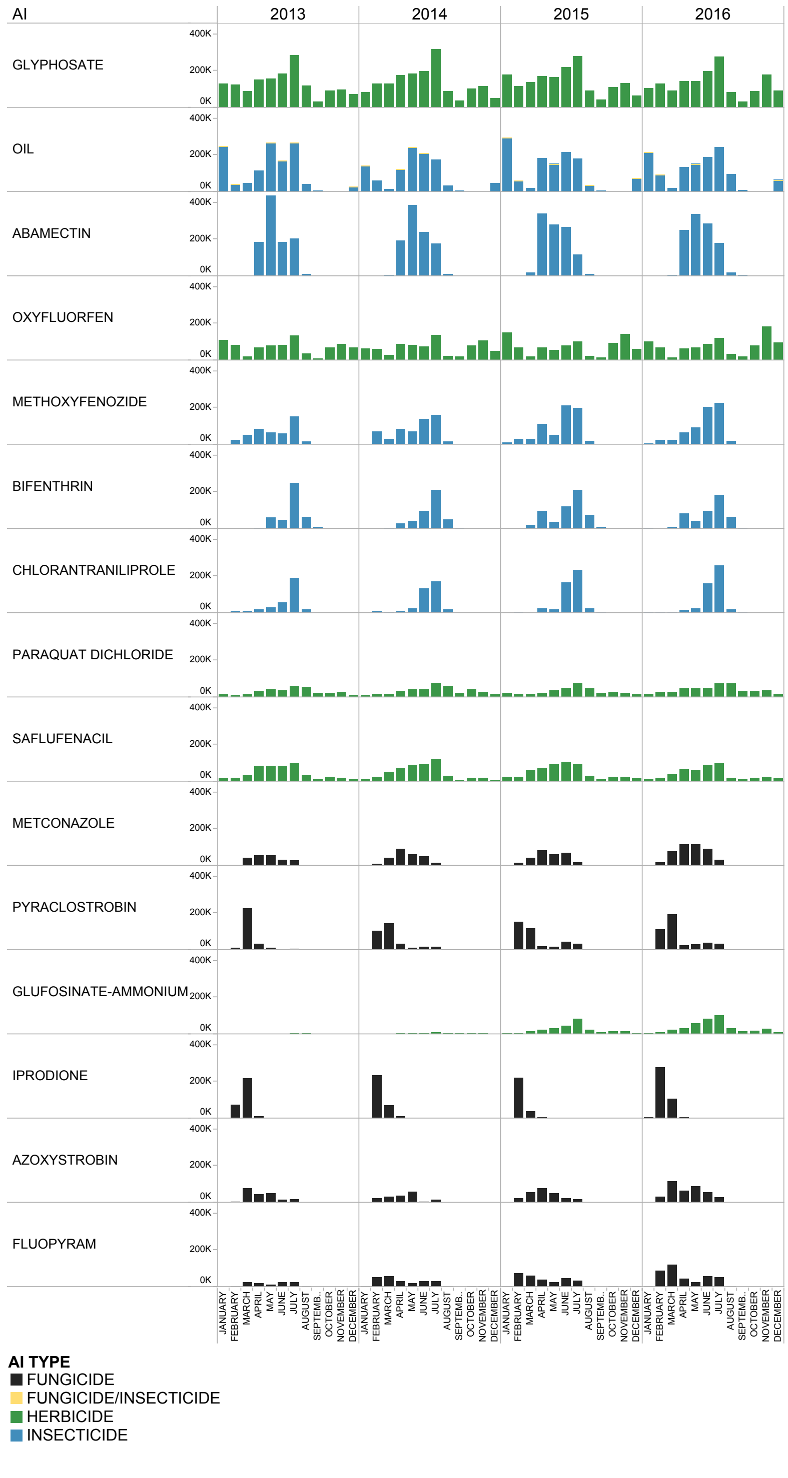


Figure A-8: *Acres of almond treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

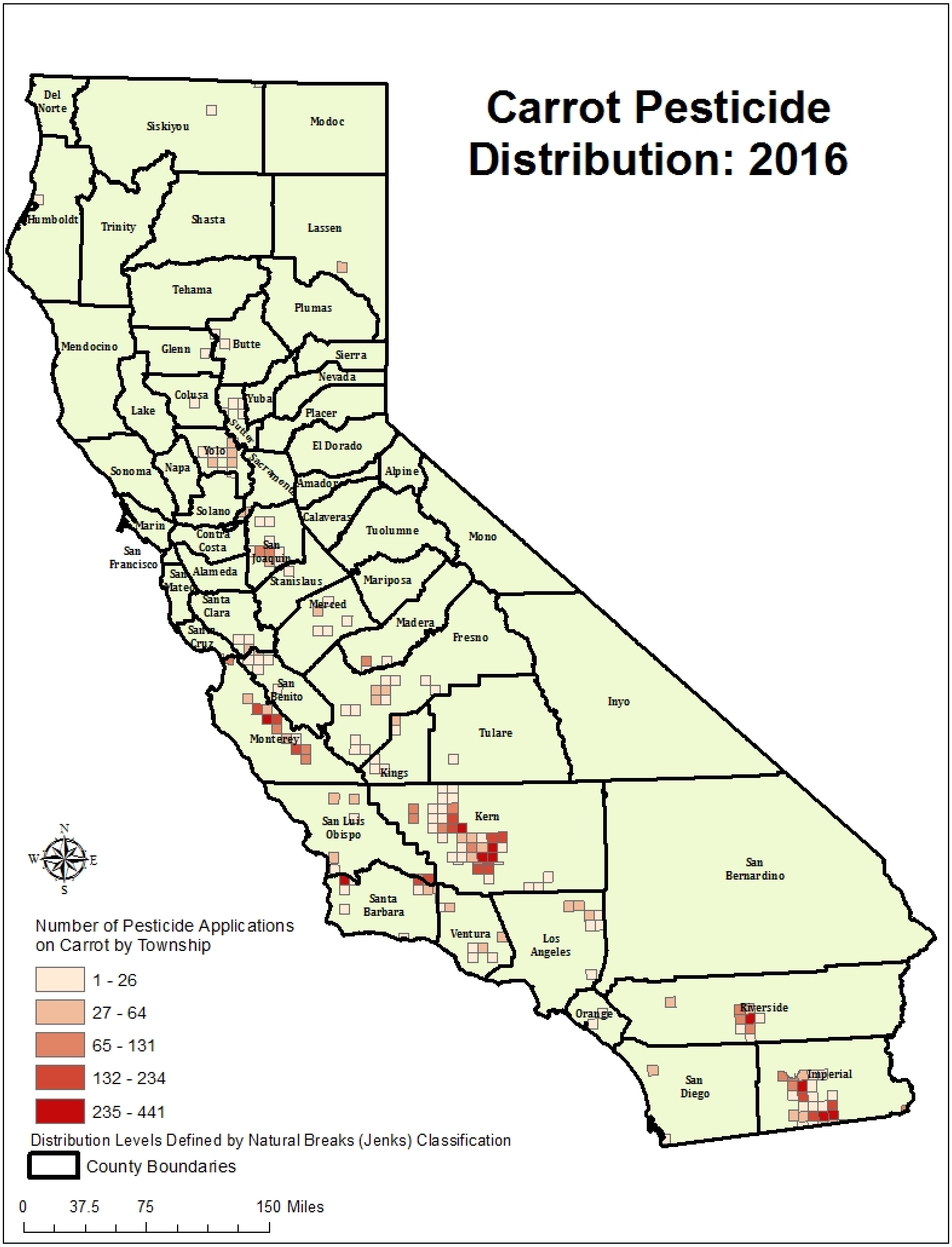
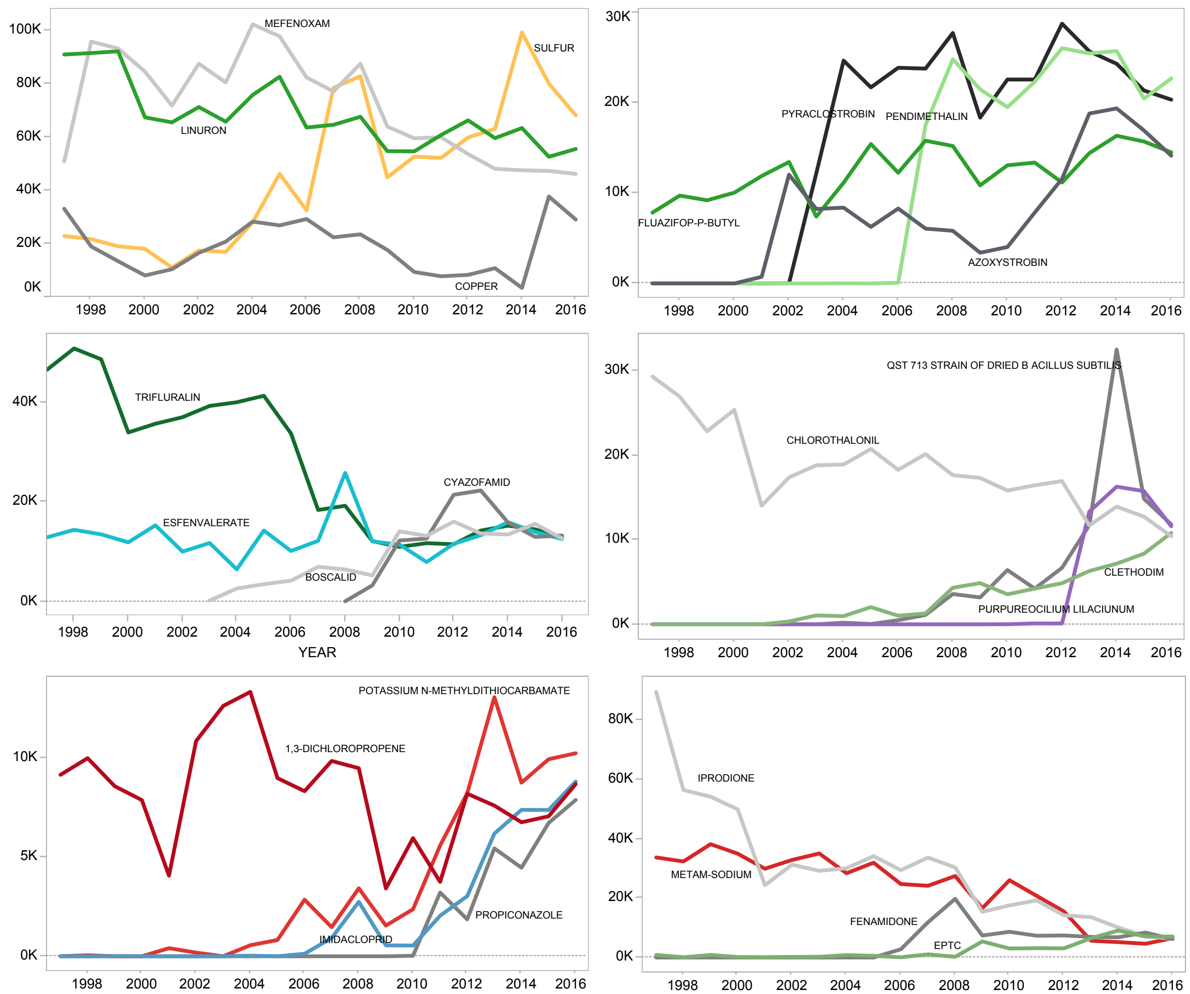


Figure A-9: *Number of pesticide applications in carrot by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*



Carrot acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities.

Figure A-10: *Acres of carrot treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

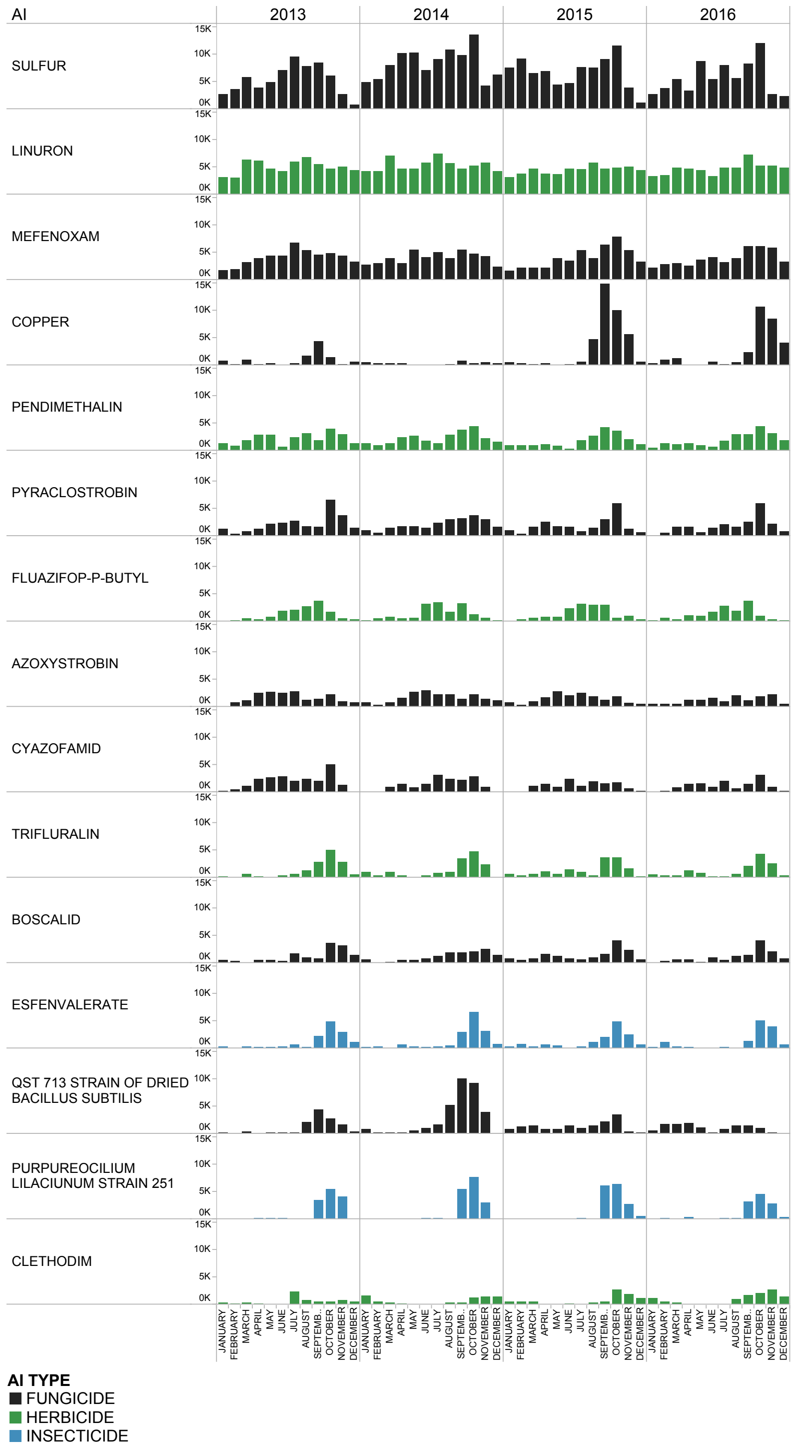


Figure A-11: *Acres of carrot treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

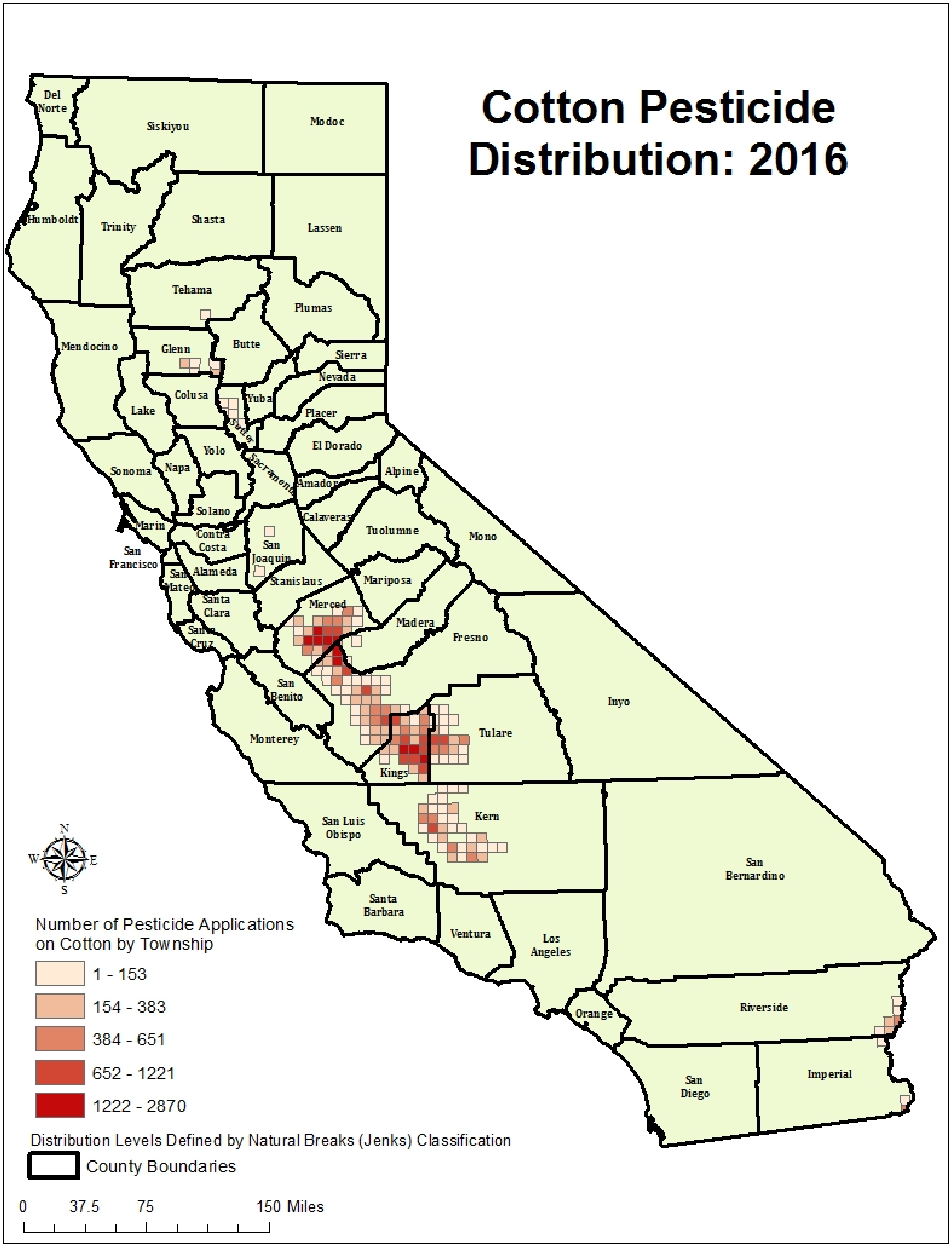
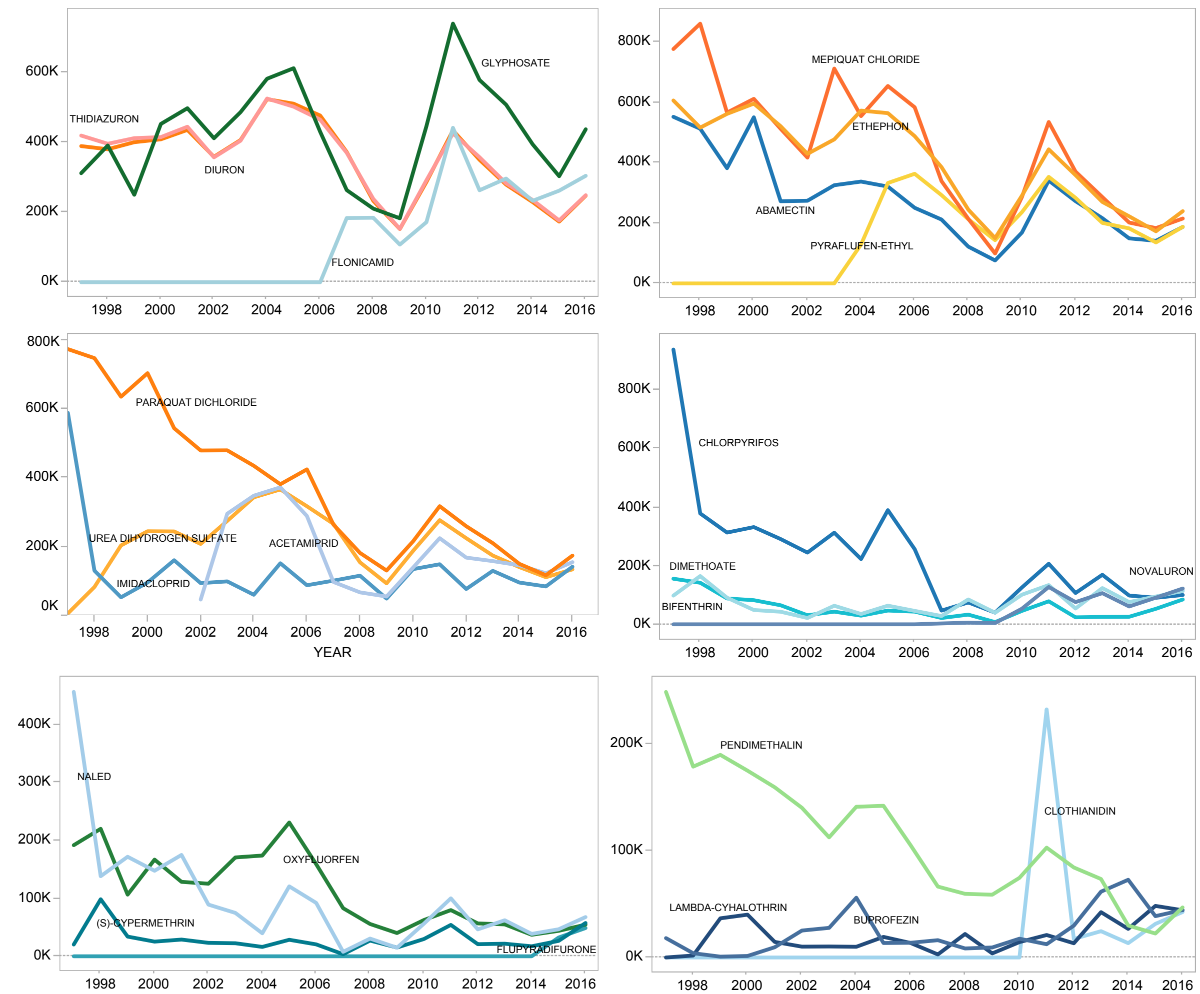


Figure A-12: *Number of pesticide applications in cotton by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Figure A-13: *Acres of cotton treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*



Cotton acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities.

Figure A-14: *Acres of cotton treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

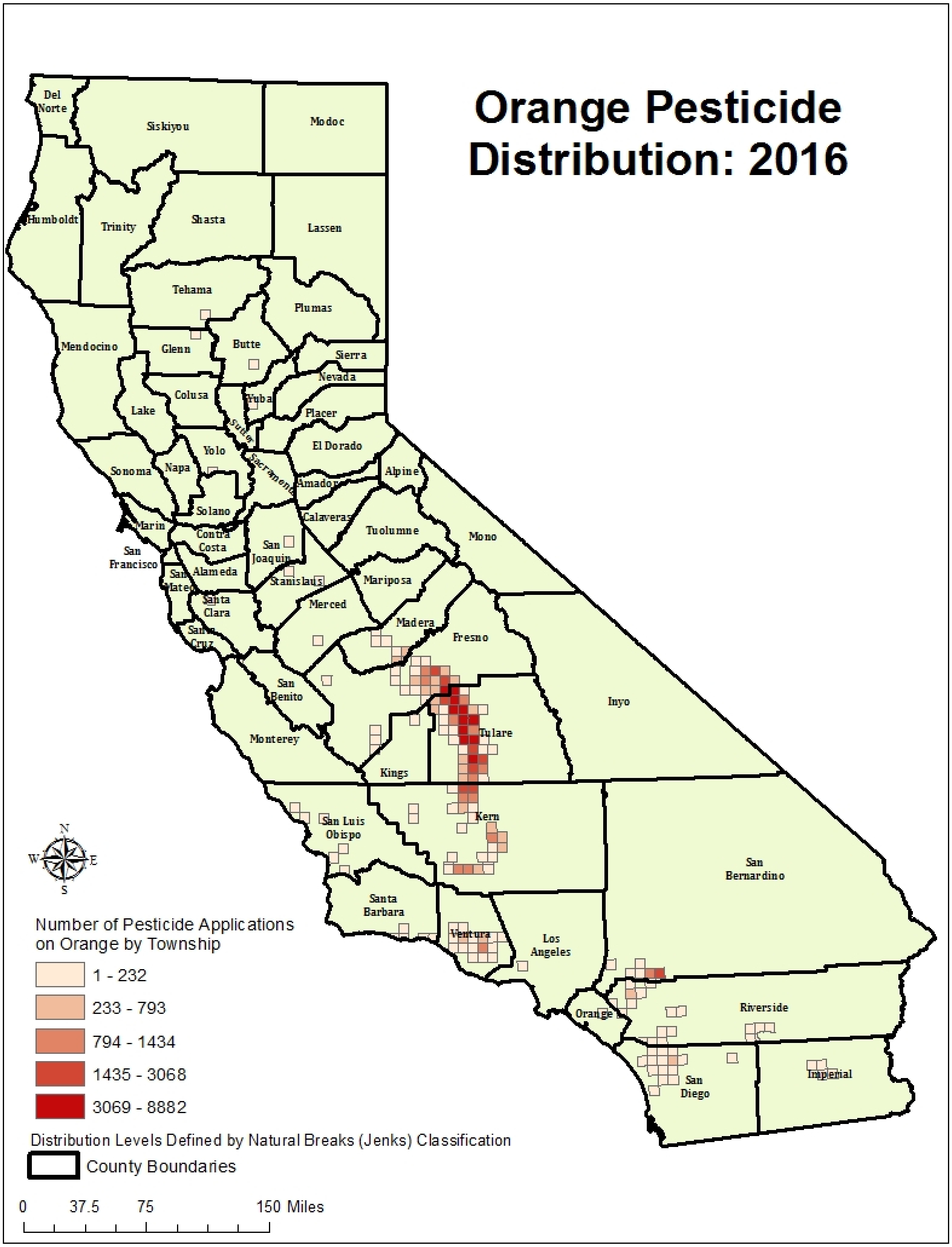
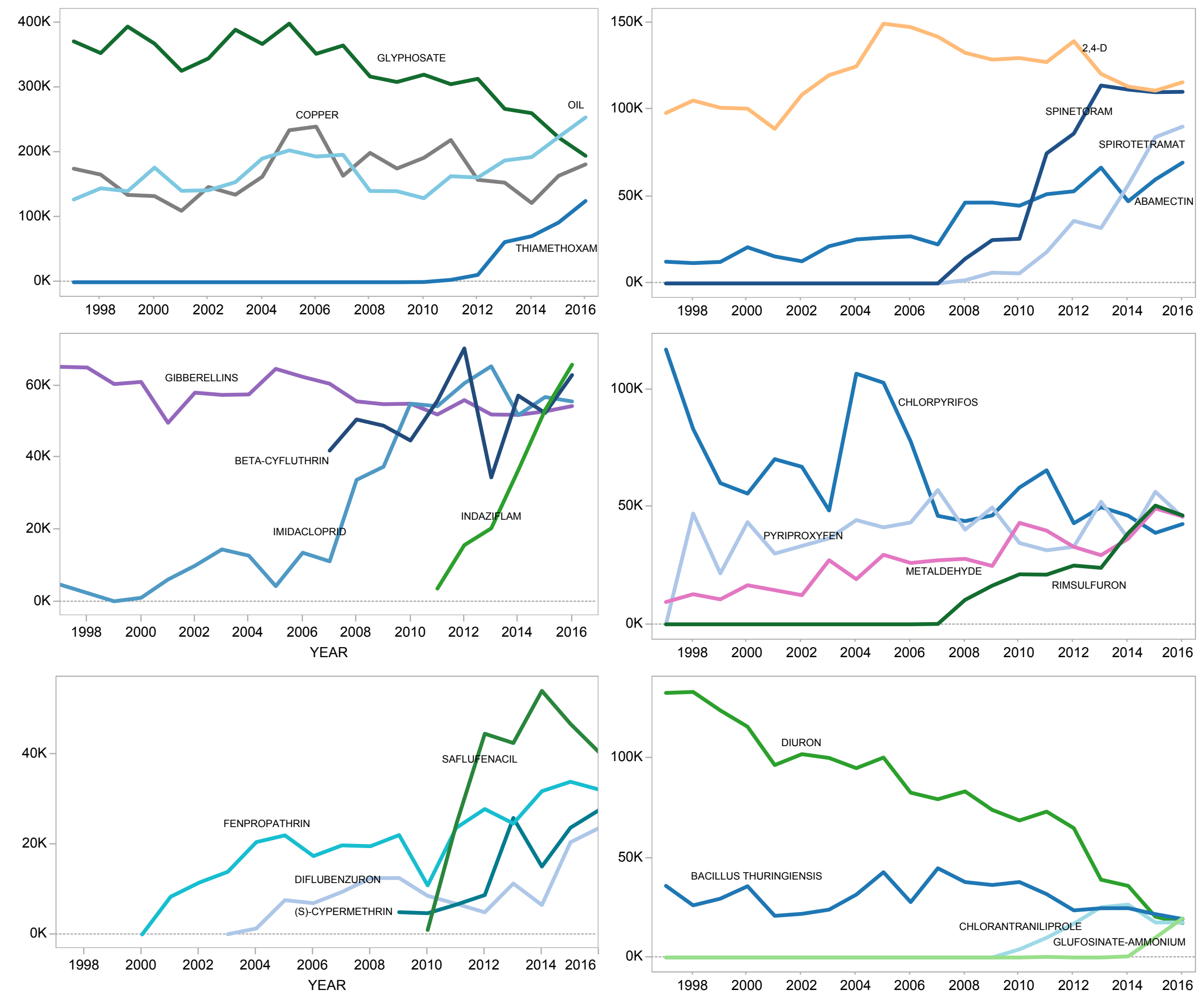


Figure A-15: *Number of pesticide applications in orange by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*



Orange acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities.

Figure A-16: *Acres of orange treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

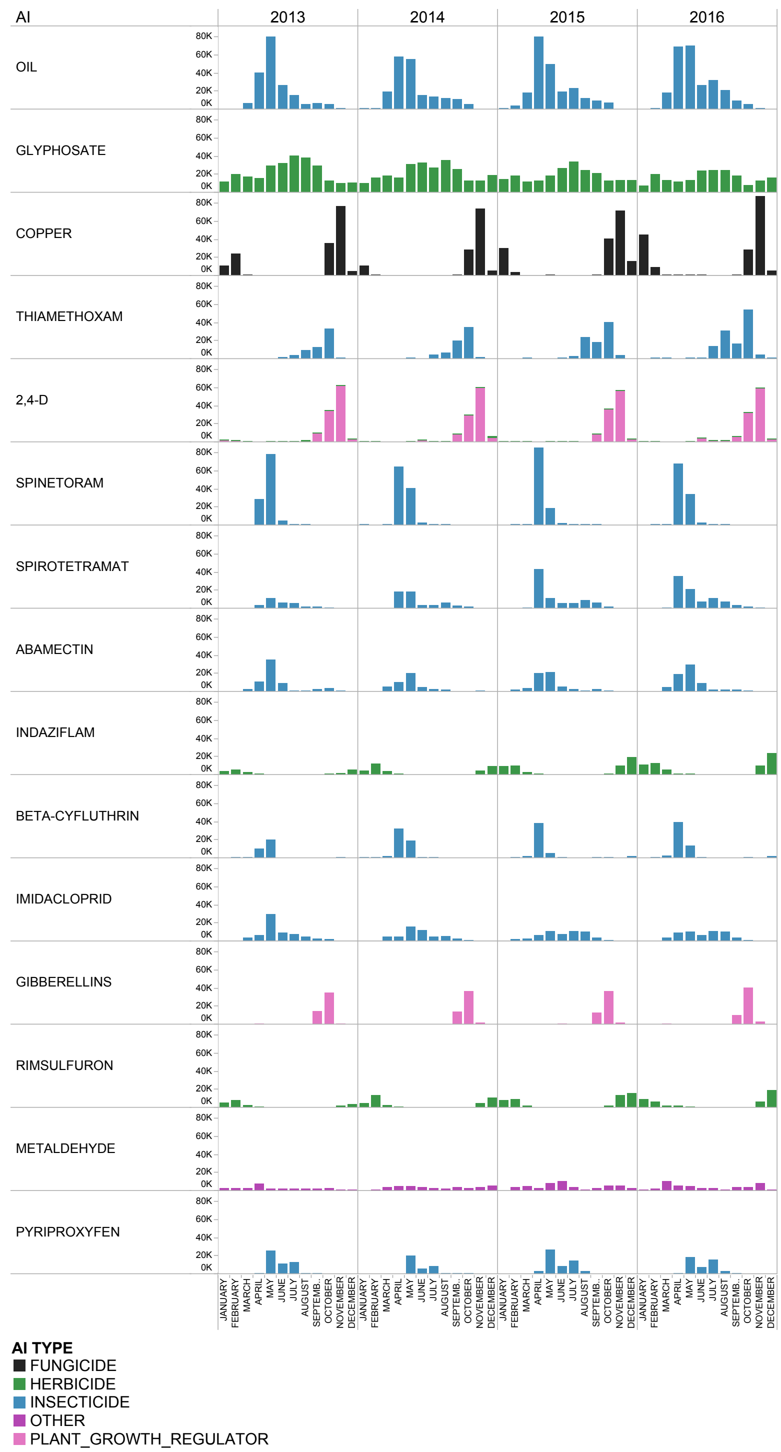


Figure A-17: *Acres of orange treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

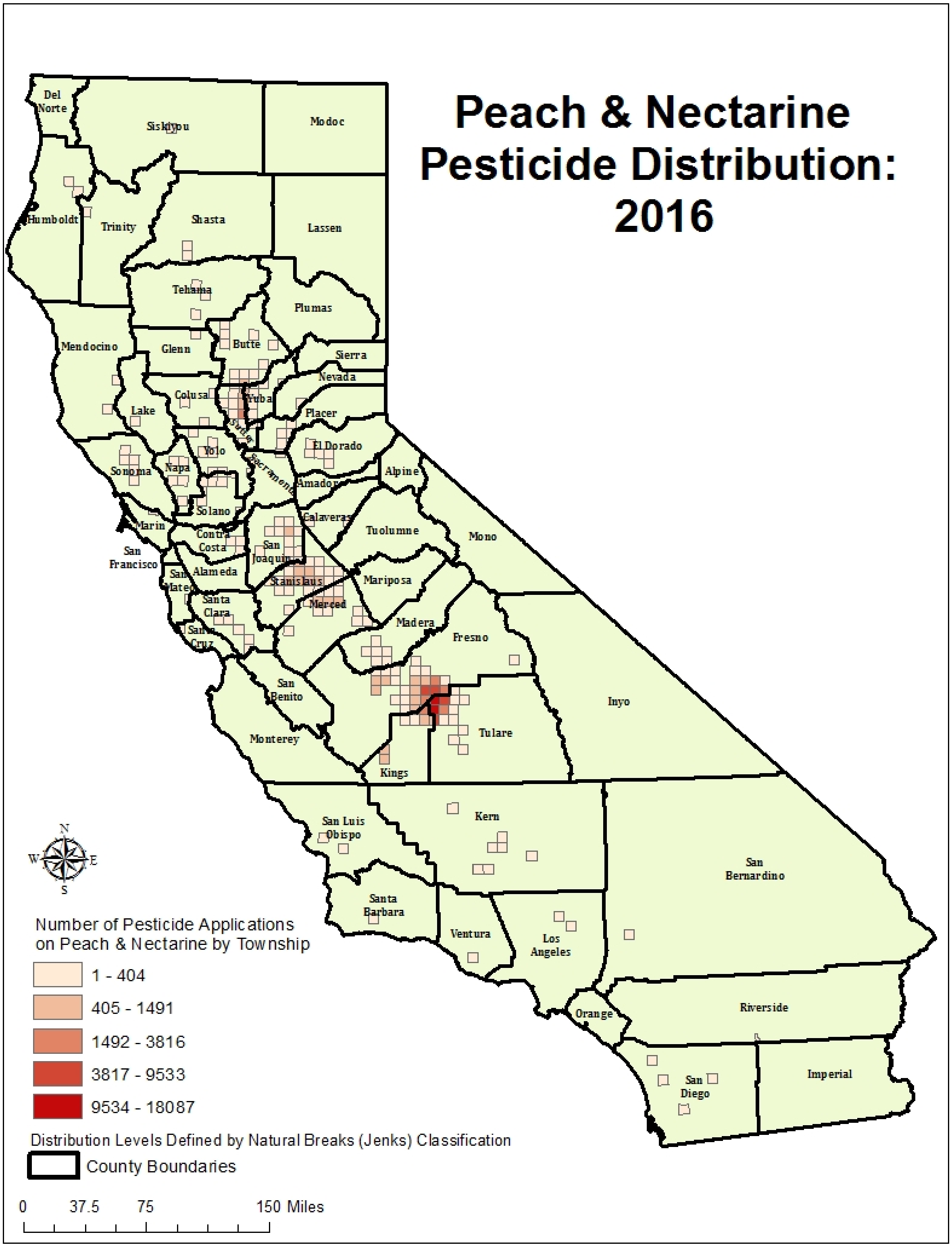
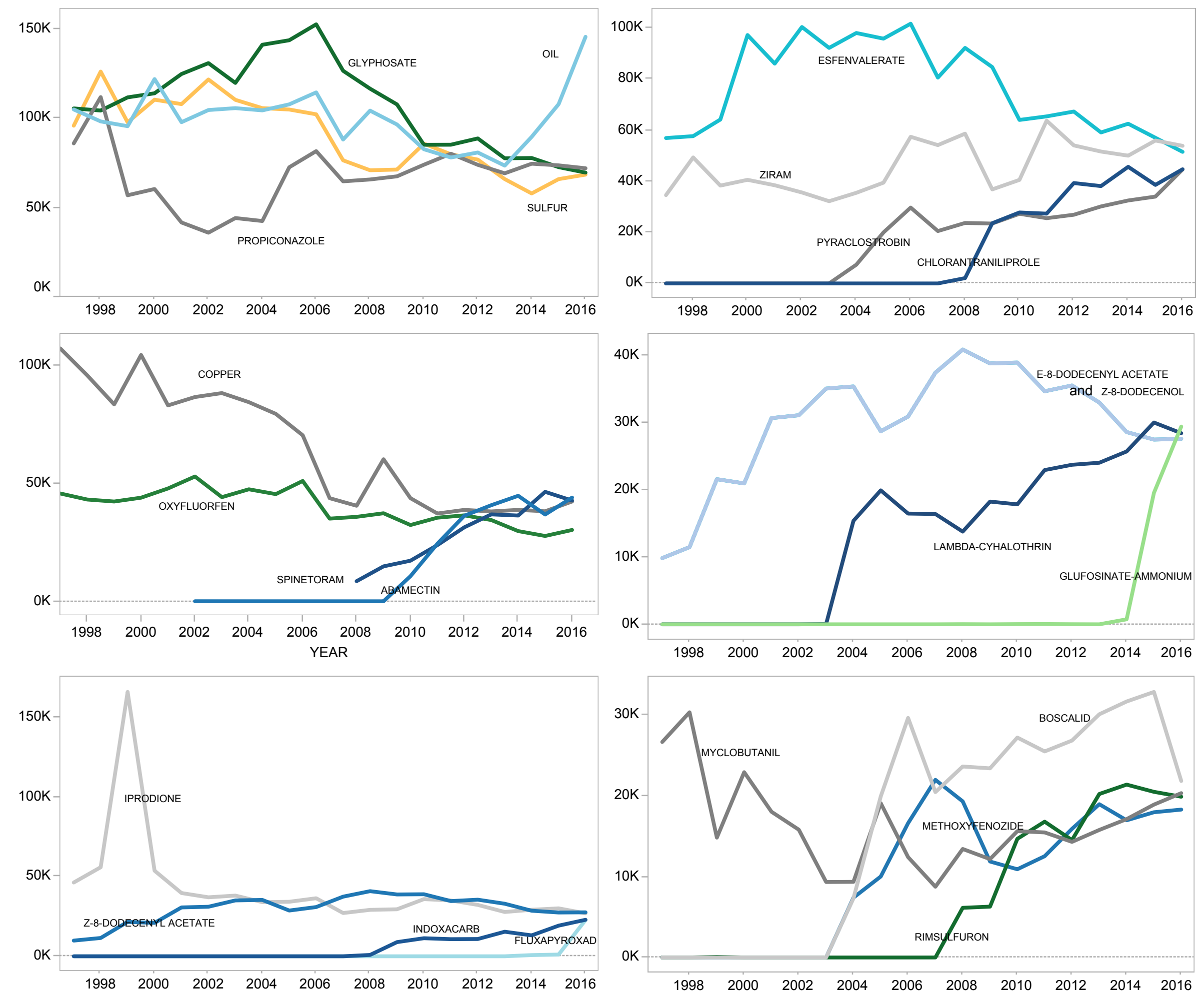


Figure A-18: *Number of pesticide applications in peach and nectarine by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Figure A-19: *Acres of peach and nectarine treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer:cdpr.ca.gov/pub/outgoing/pur/data/ >.*



Peach and nectarine acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities.

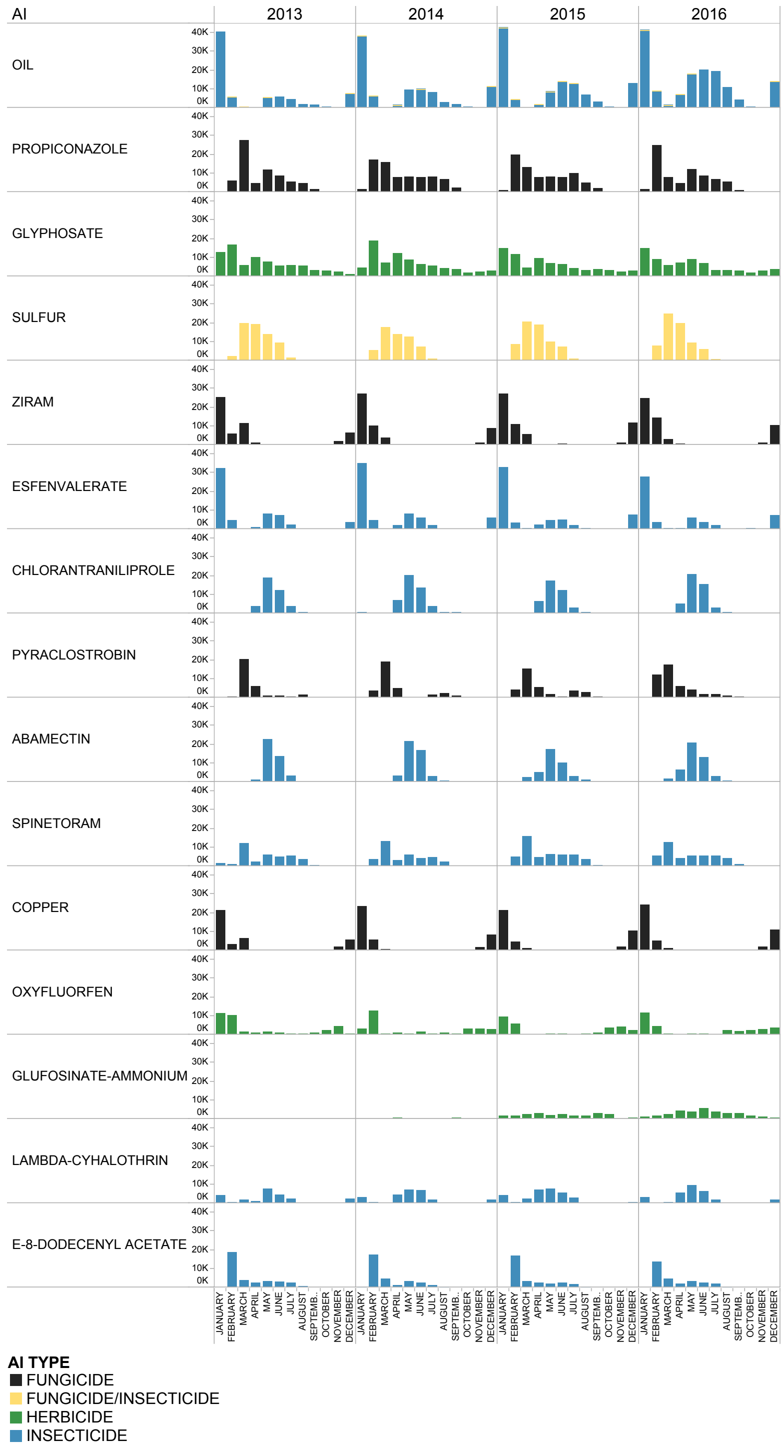


Figure A-20: *Acres of peach and nectarine treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

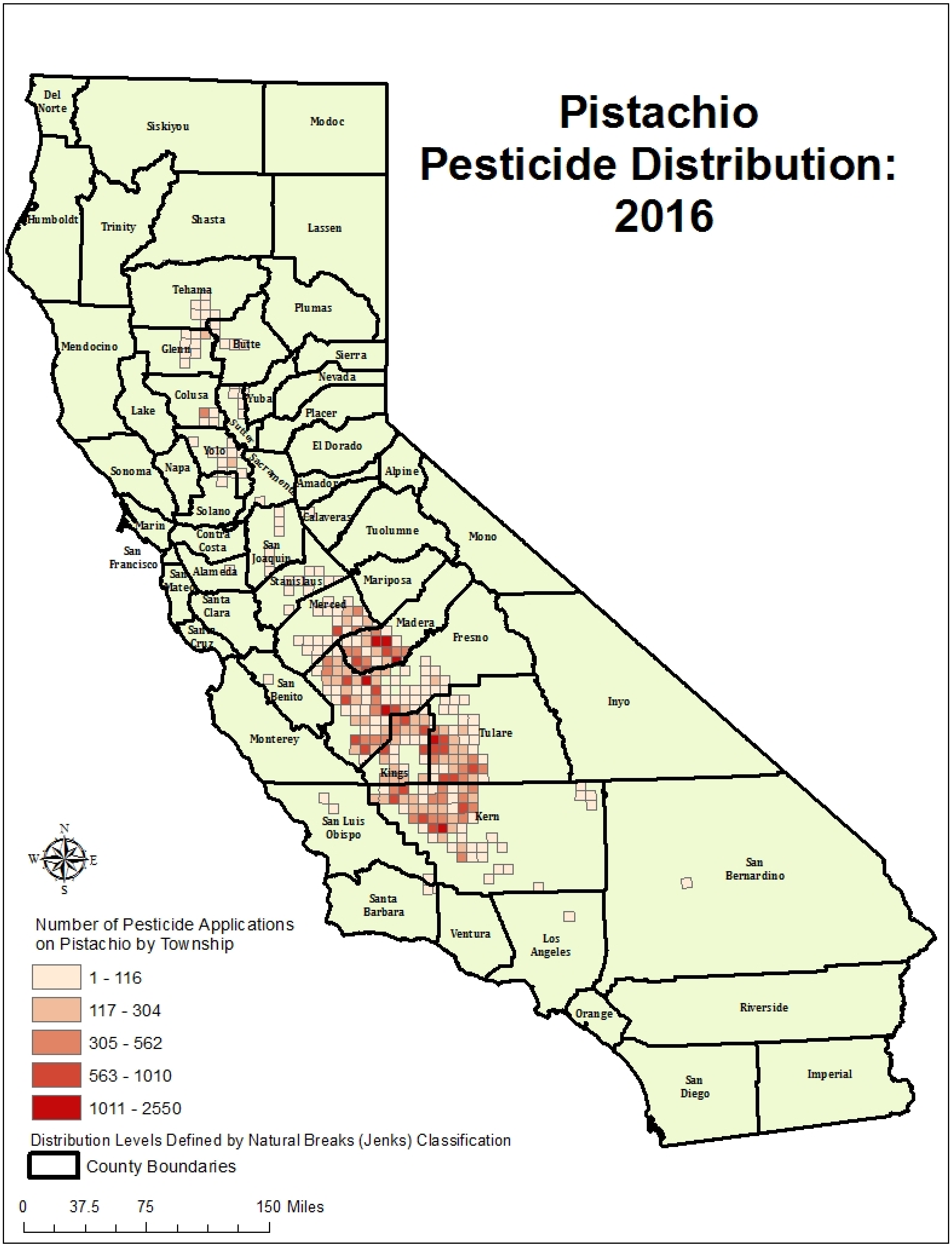
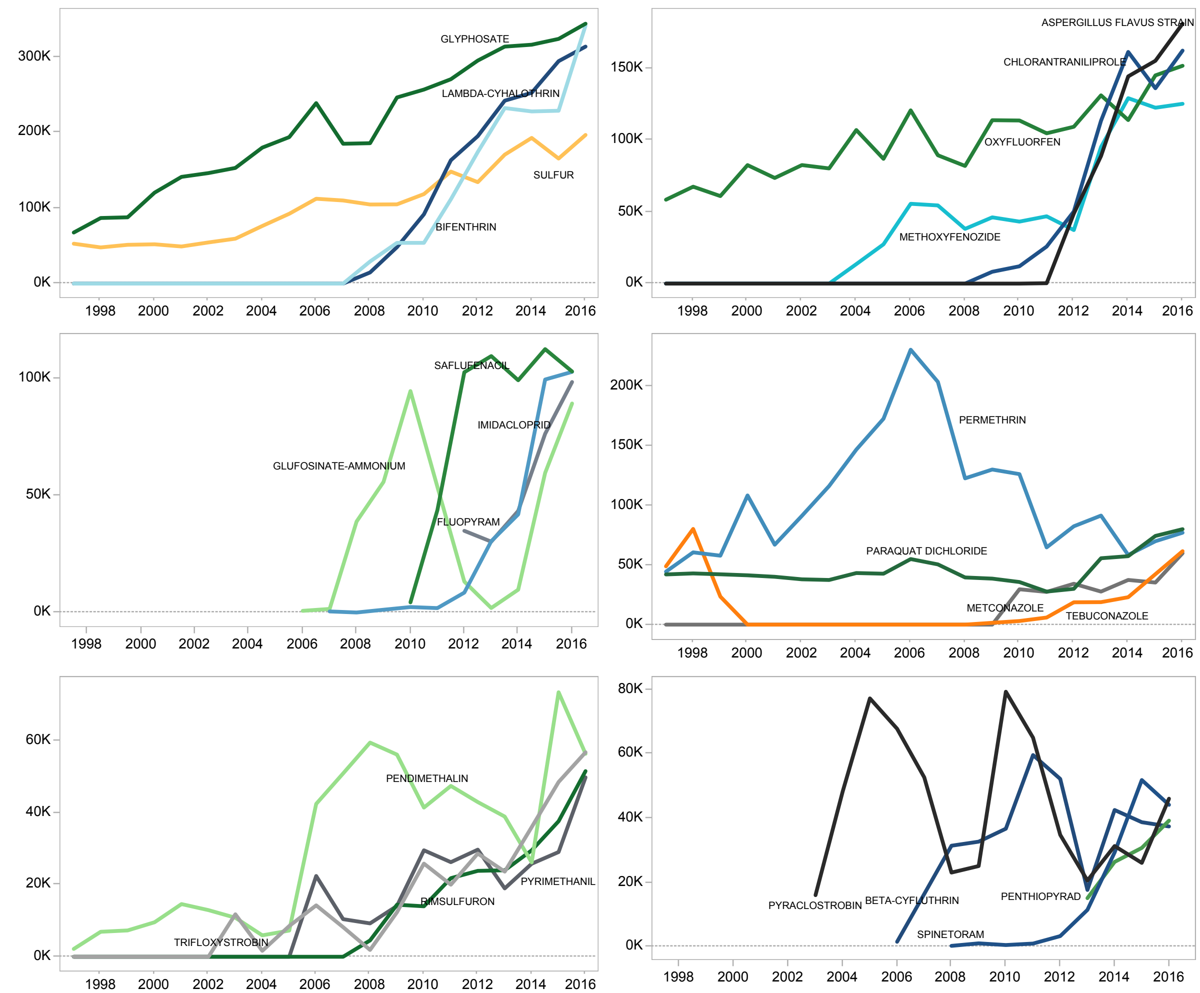


Figure A-21: *Number of pesticide applications in pistachio by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Figure A-22: *Acres of pistachio treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*



Pistachio acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities.

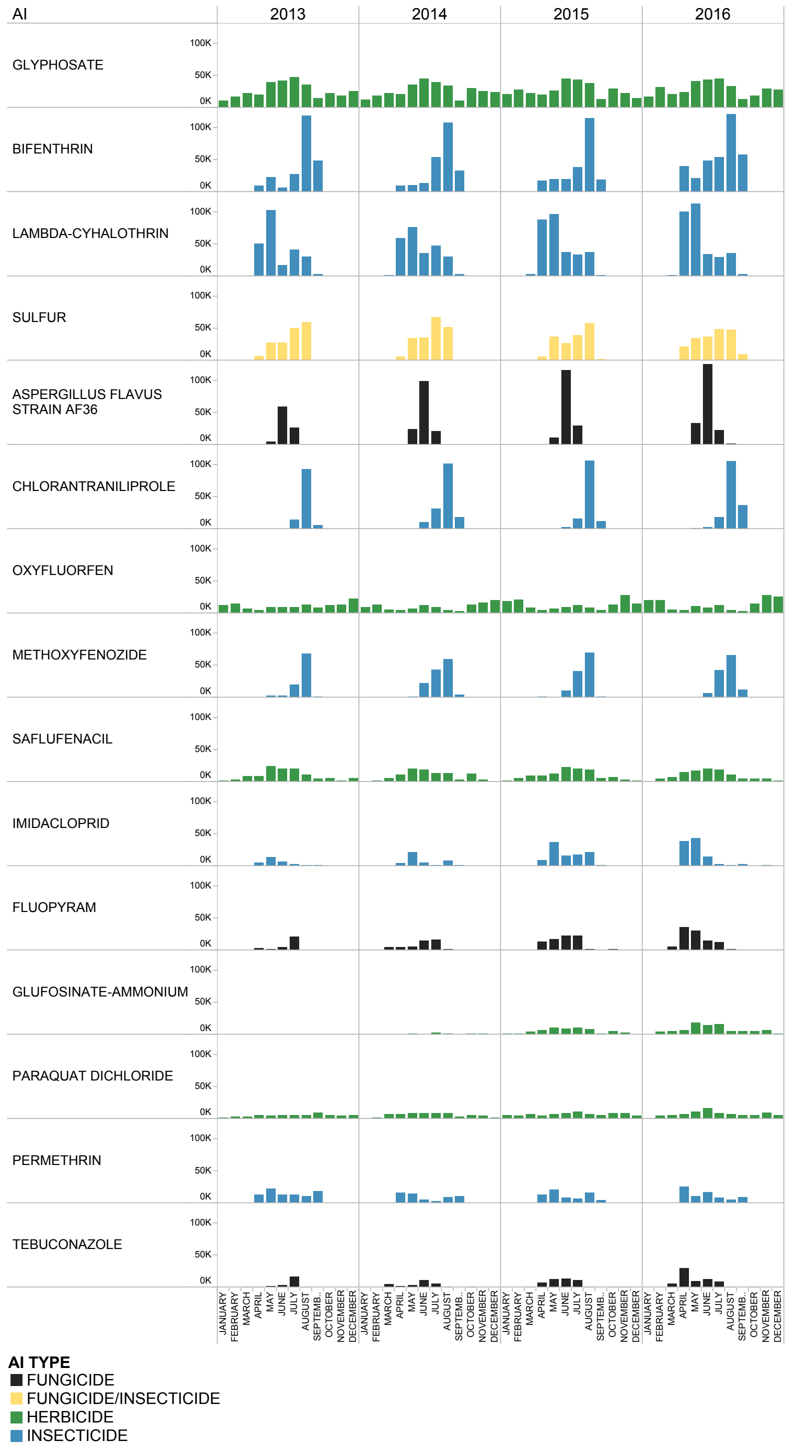


Figure A-23: *Acres of pistachio treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

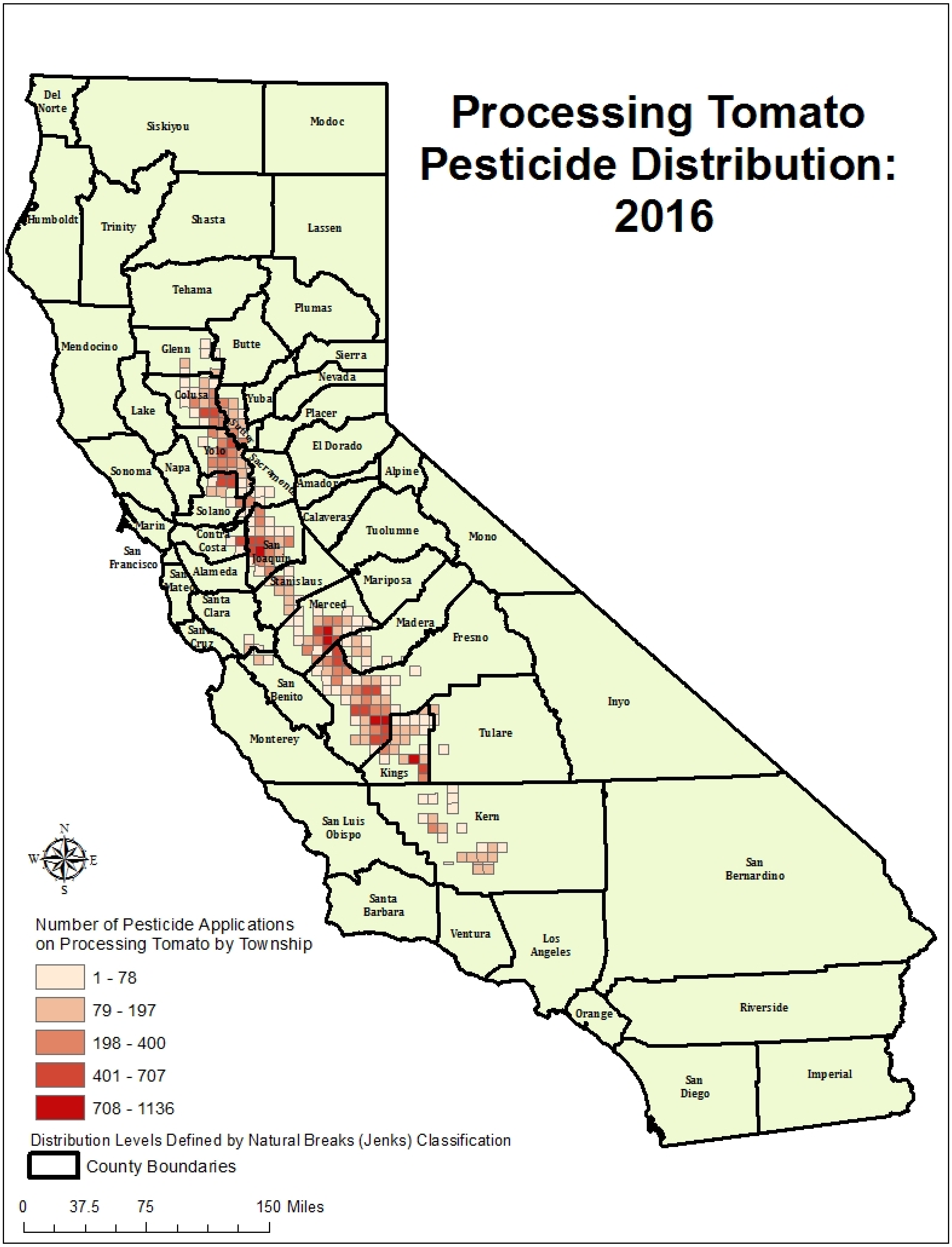
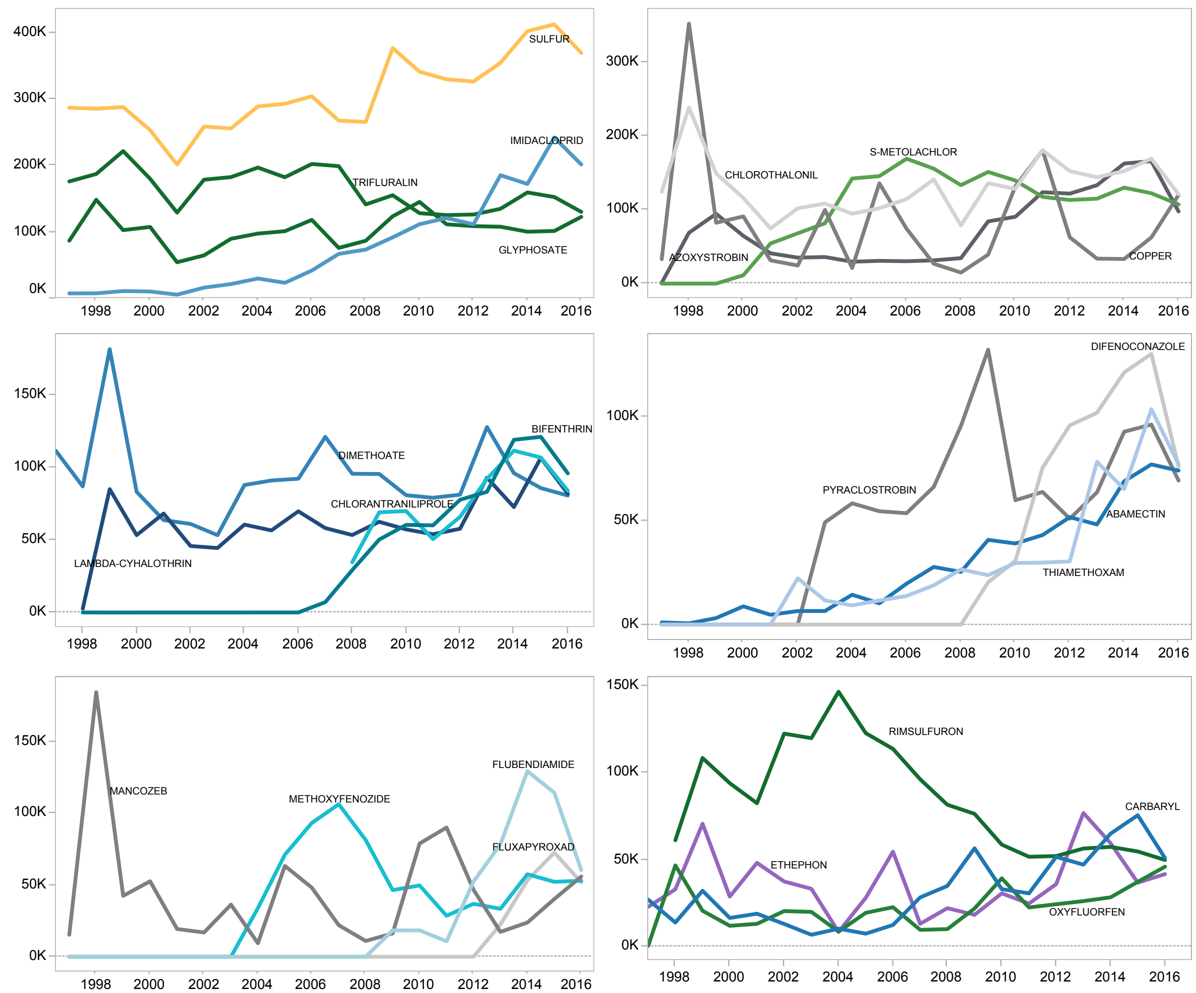


Figure A-24: *Number of pesticide applications in processing tomato by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*



Processing tomato acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities.

Figure A-25: *Acres of processing tomato treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

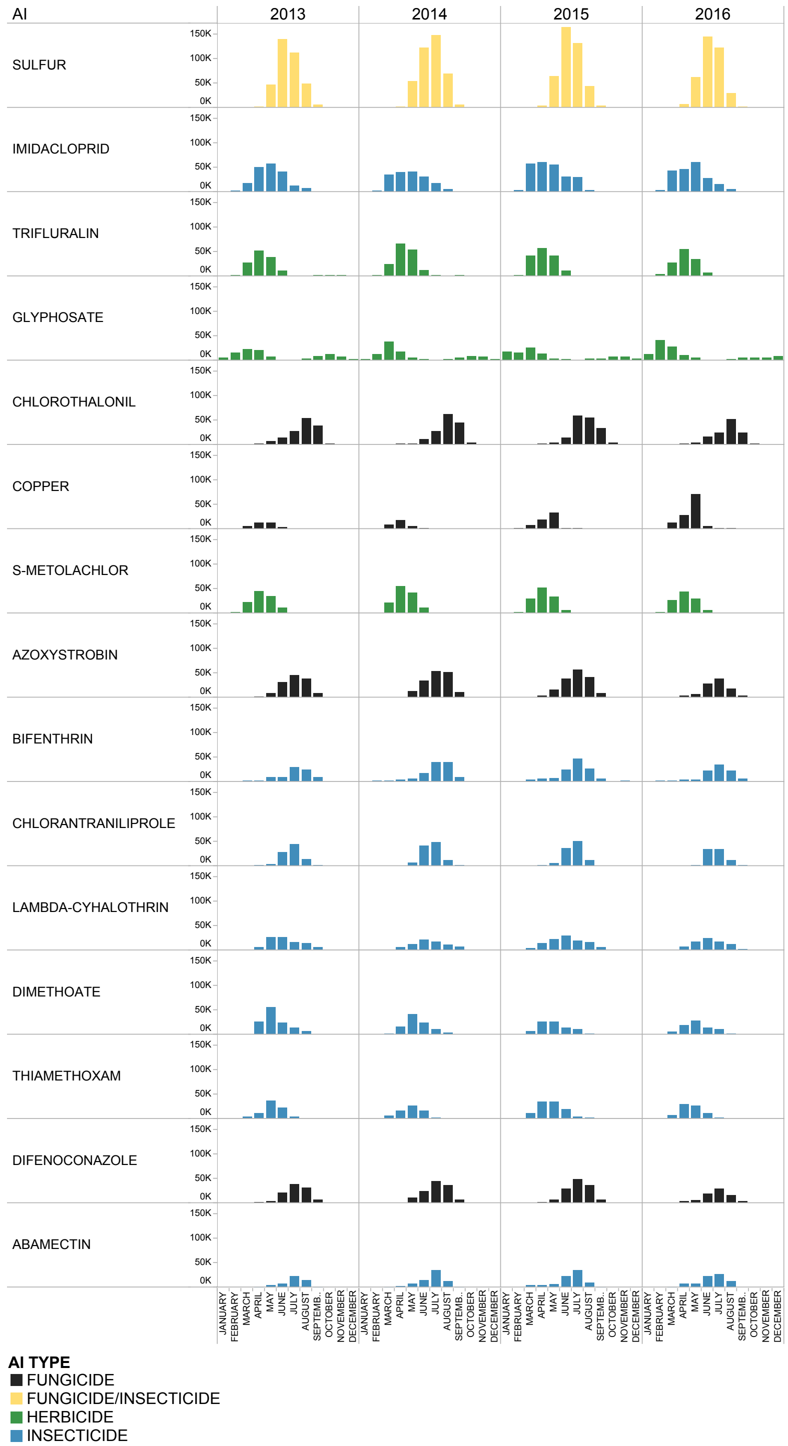


Figure A-26: *Acres of processing tomato treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

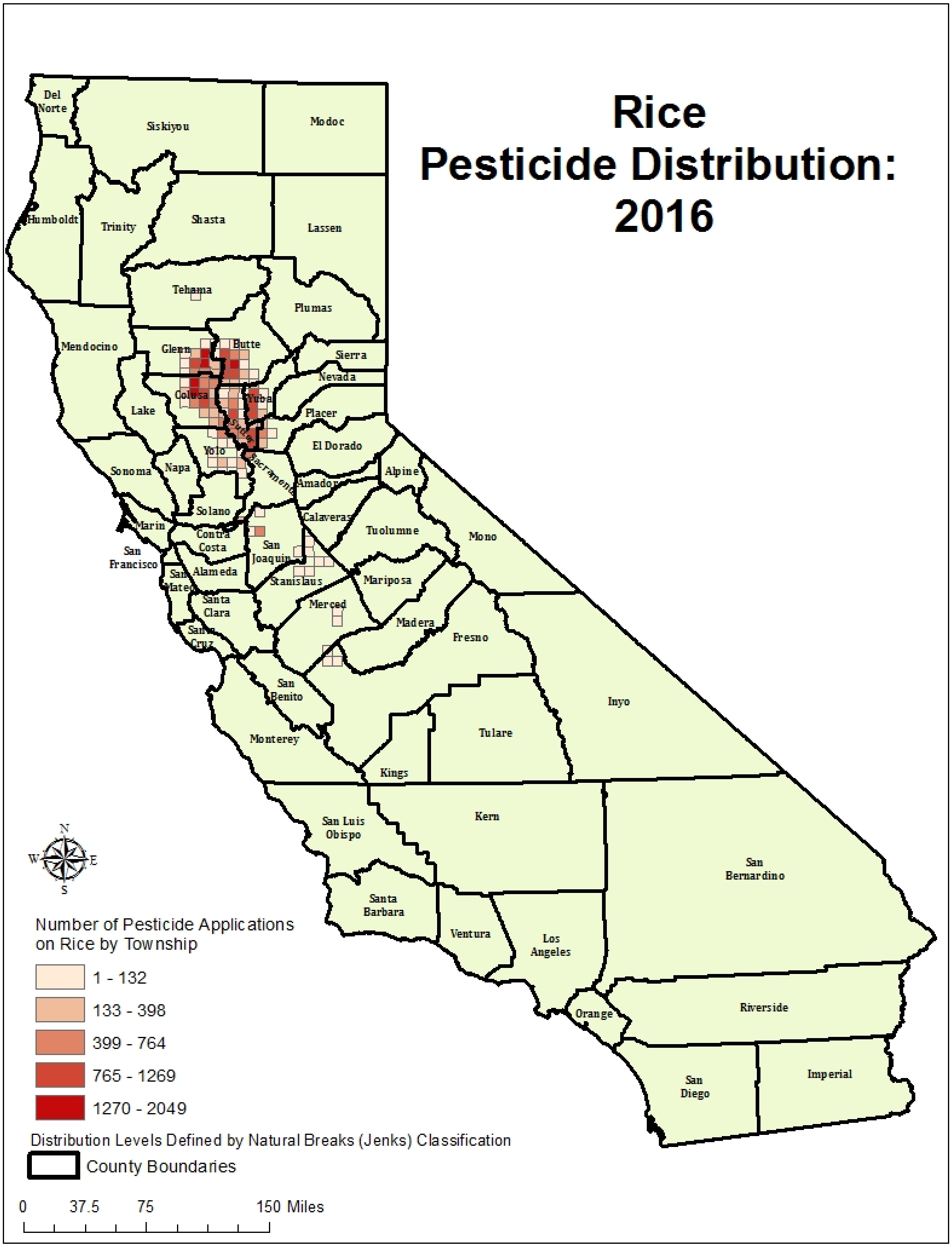
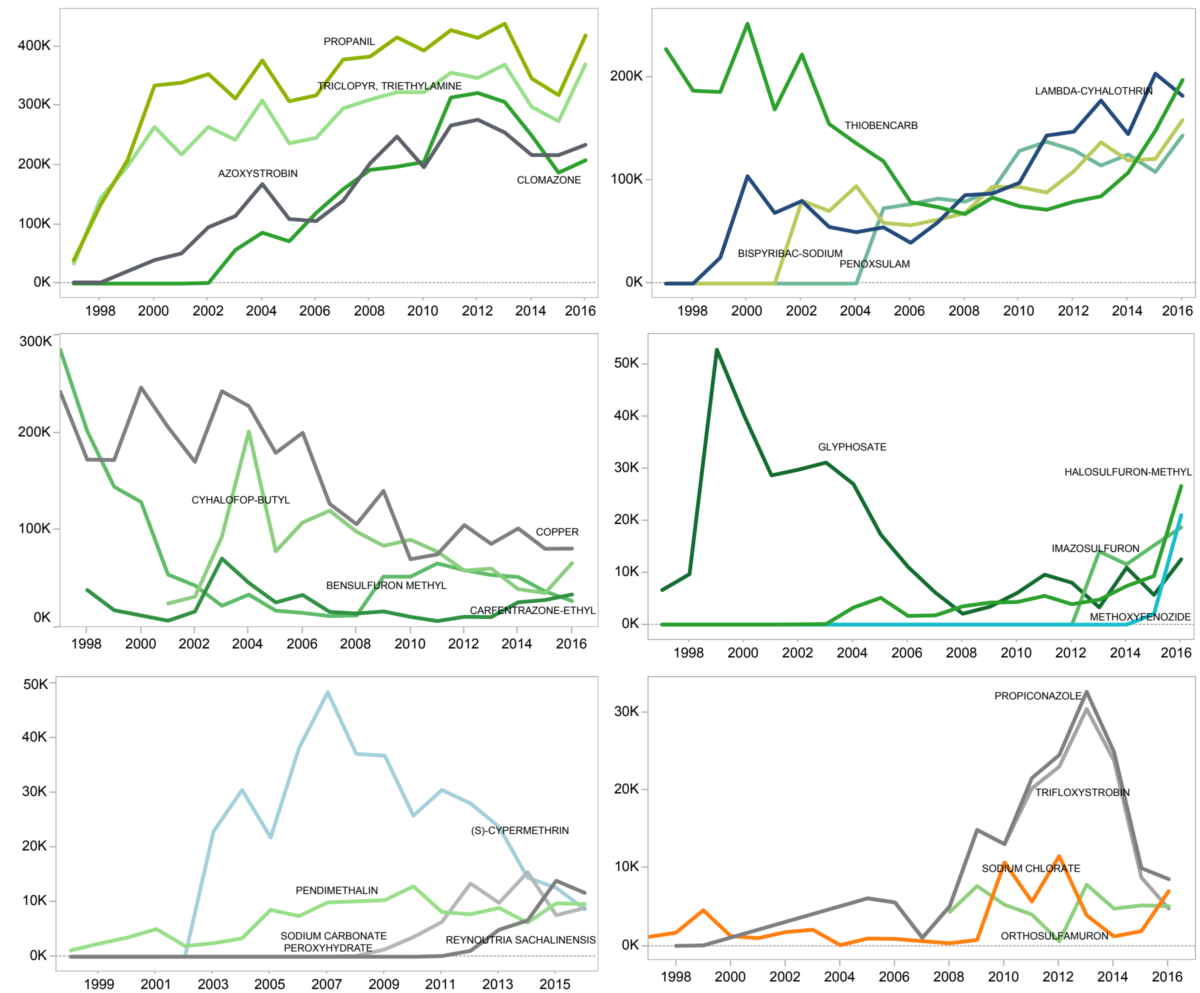


Figure A-27: *Number of pesticide applications in rice by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Figure A-28: *Acres of rice treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*



Rice acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities.

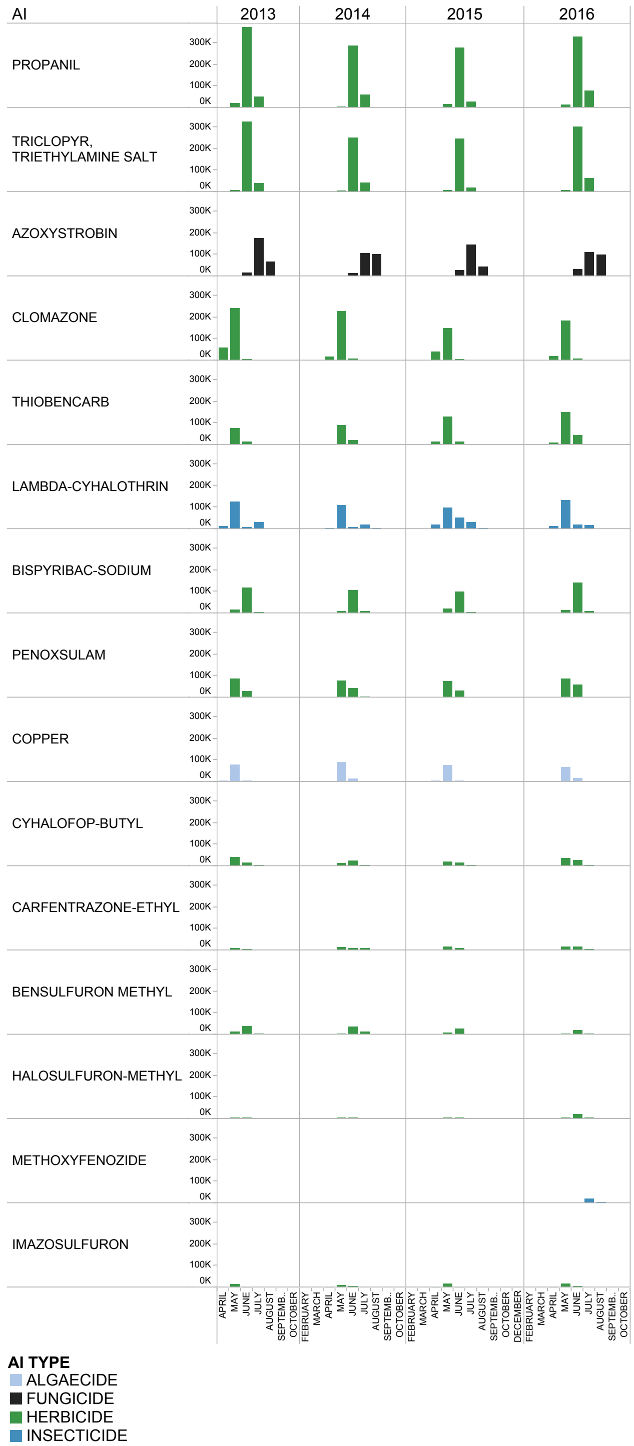


Figure A-29: *Acres of rice treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

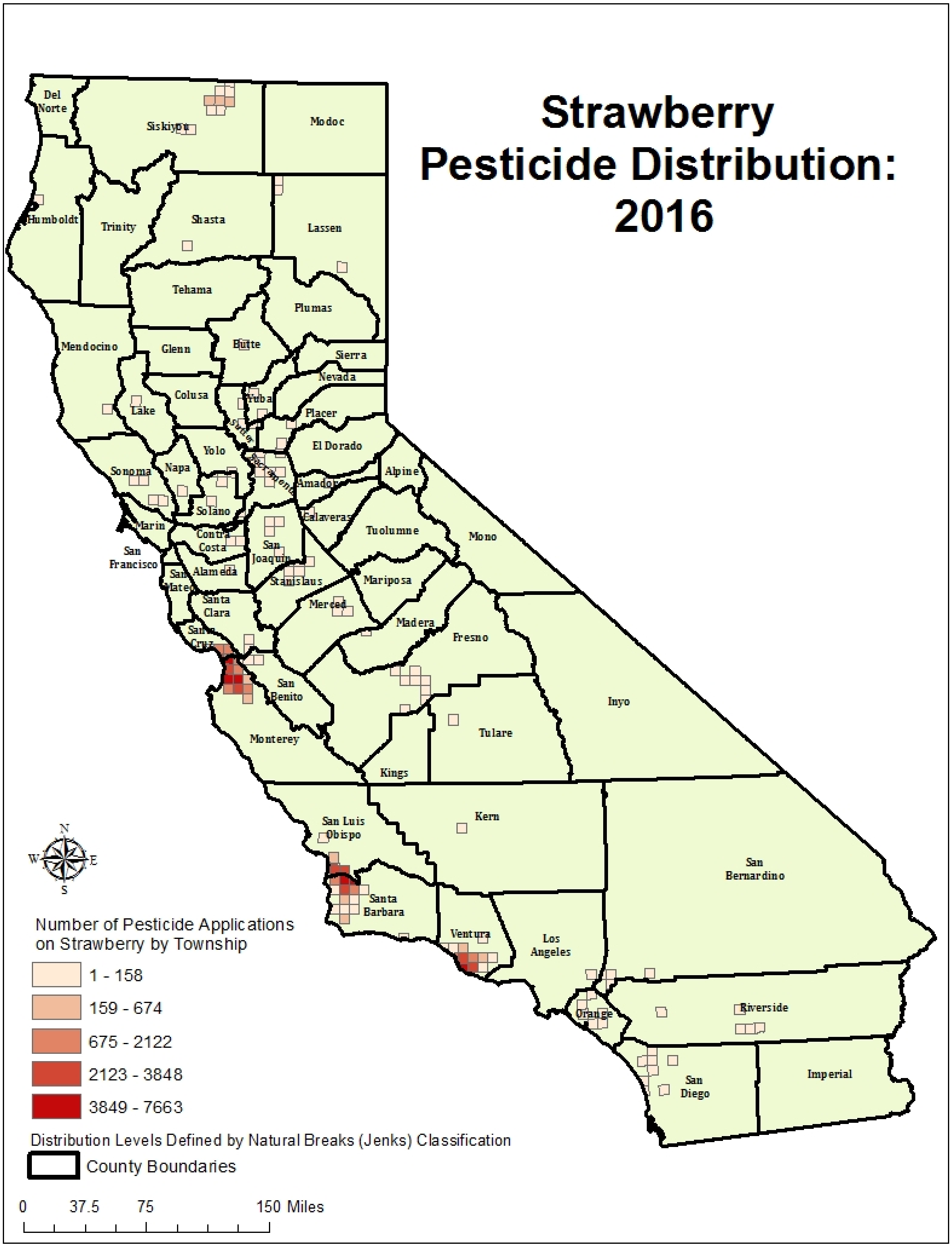
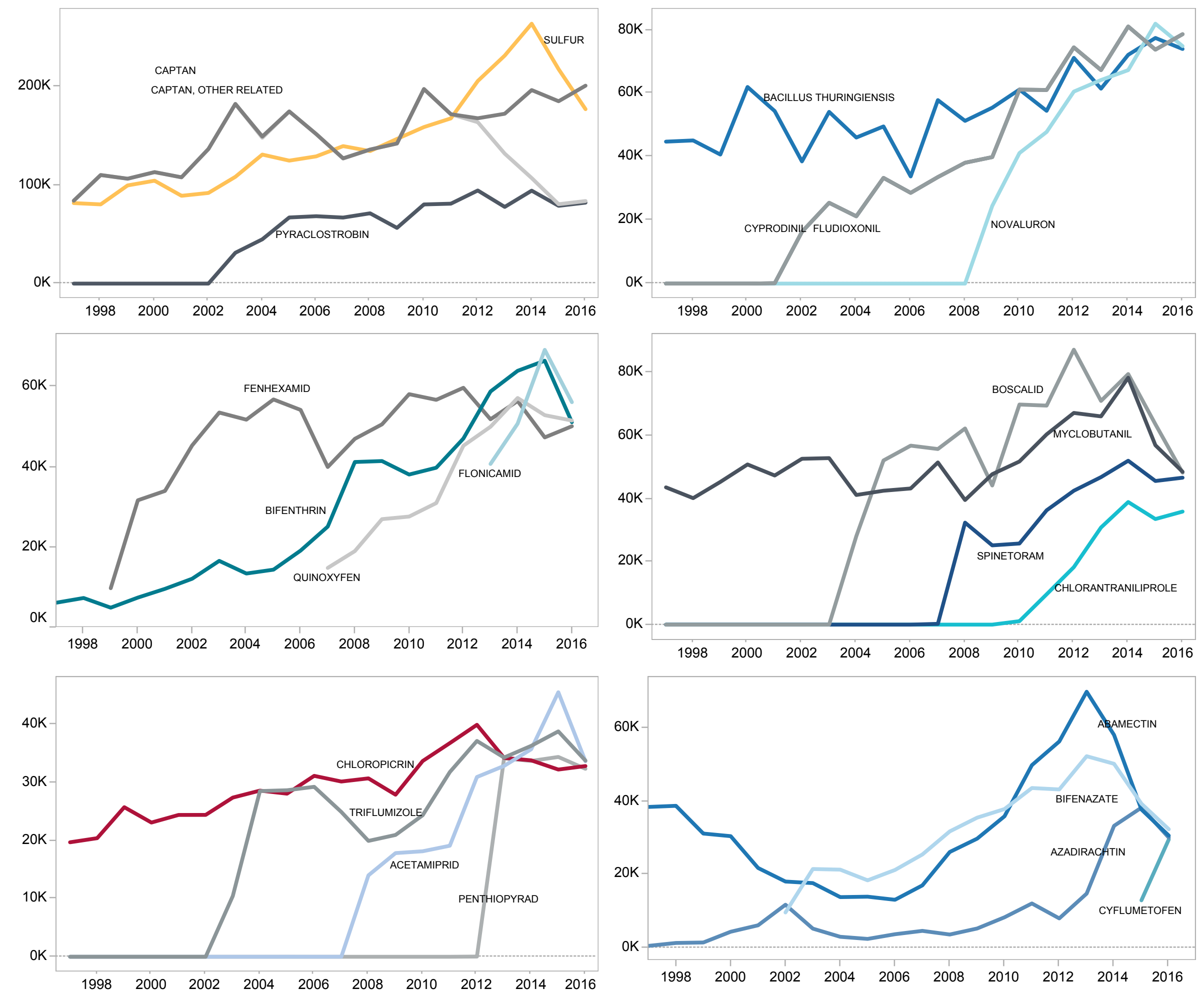


Figure A-30: *Number of pesticide applications in strawberry by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Figure A-31: *Acres of strawberry treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*



Strawberry acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities.

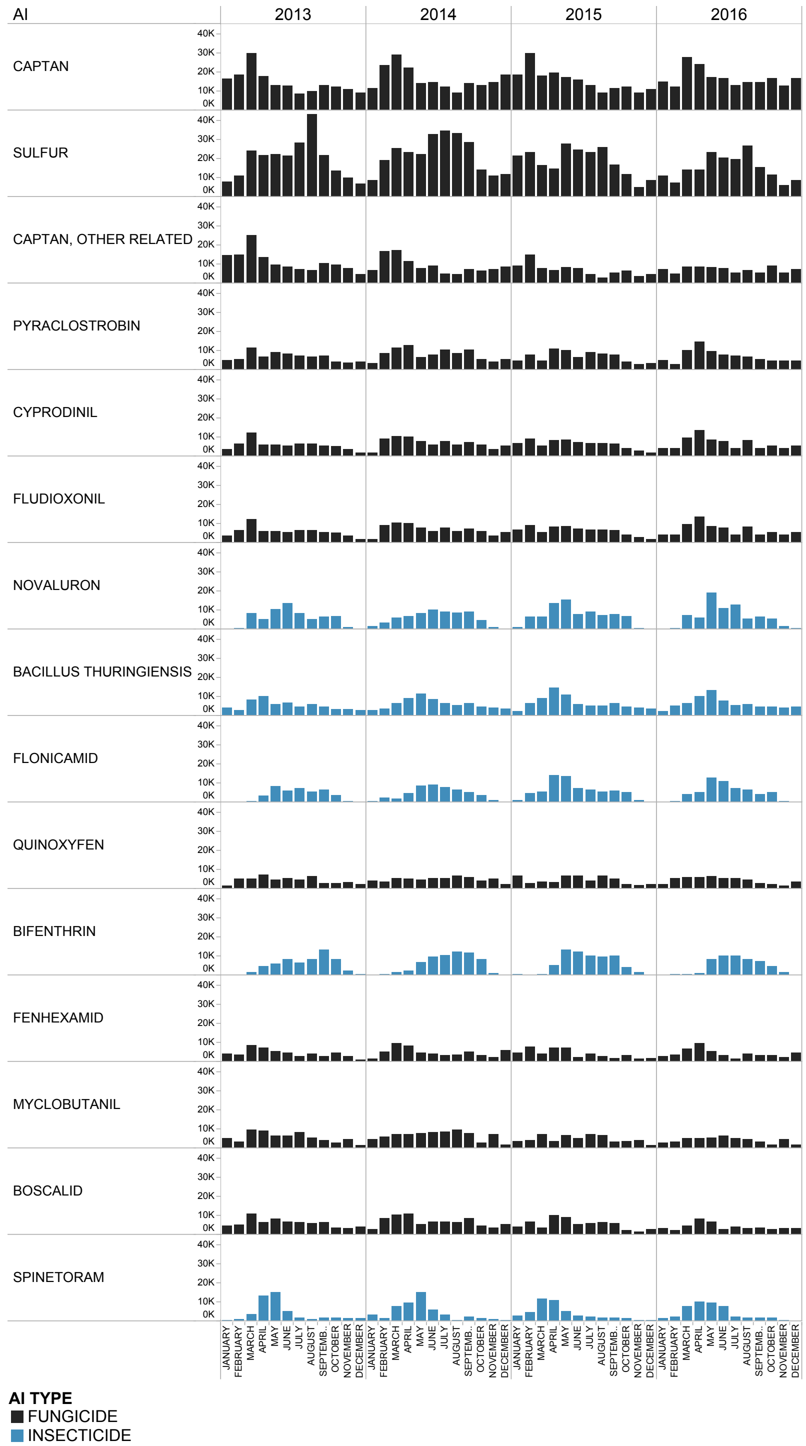


Figure A-32: *Acres of strawberry treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

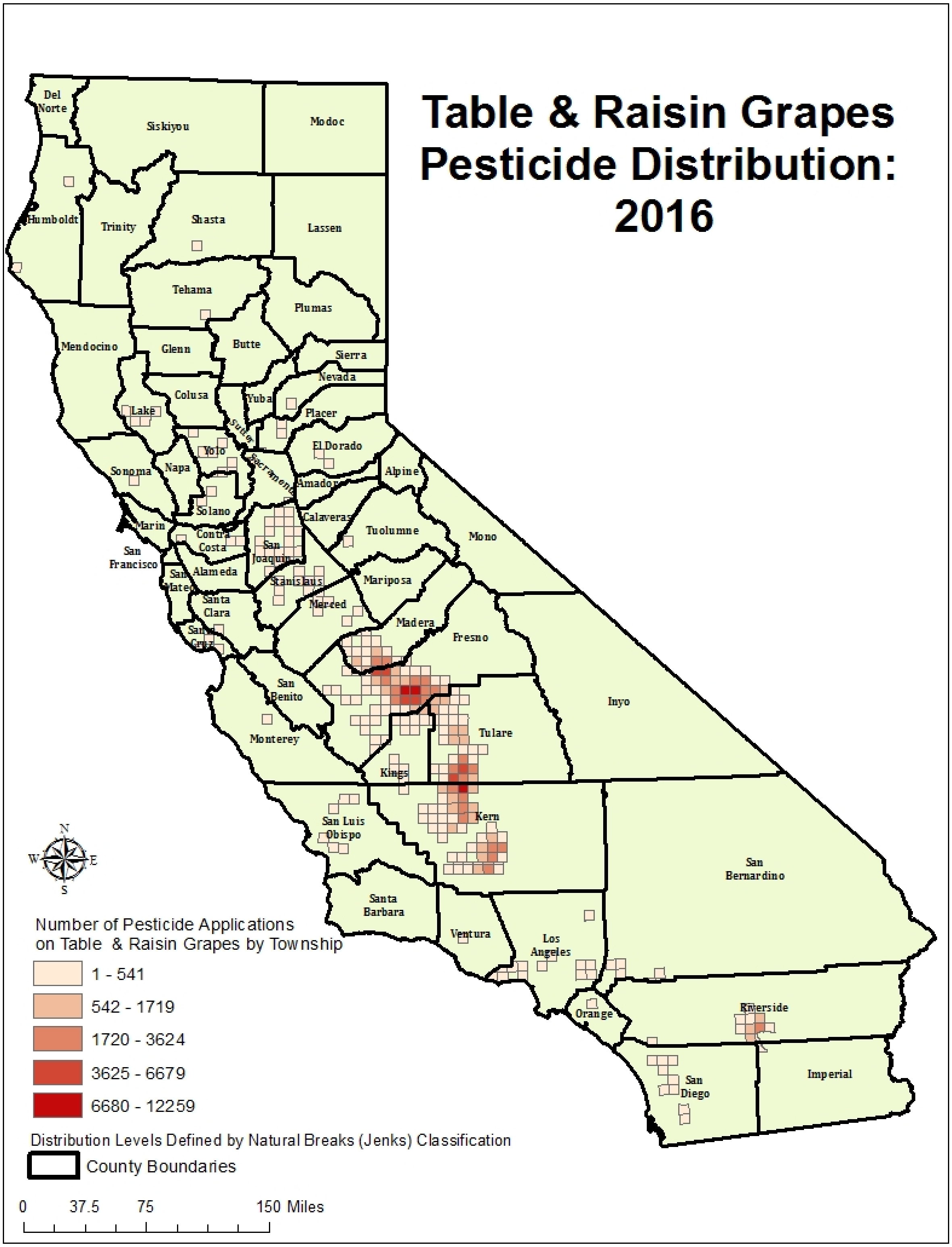


Figure A-33: *Number of pesticide applications in table and raisin grape by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Figure A-34: *Acres of table and raisin grape treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

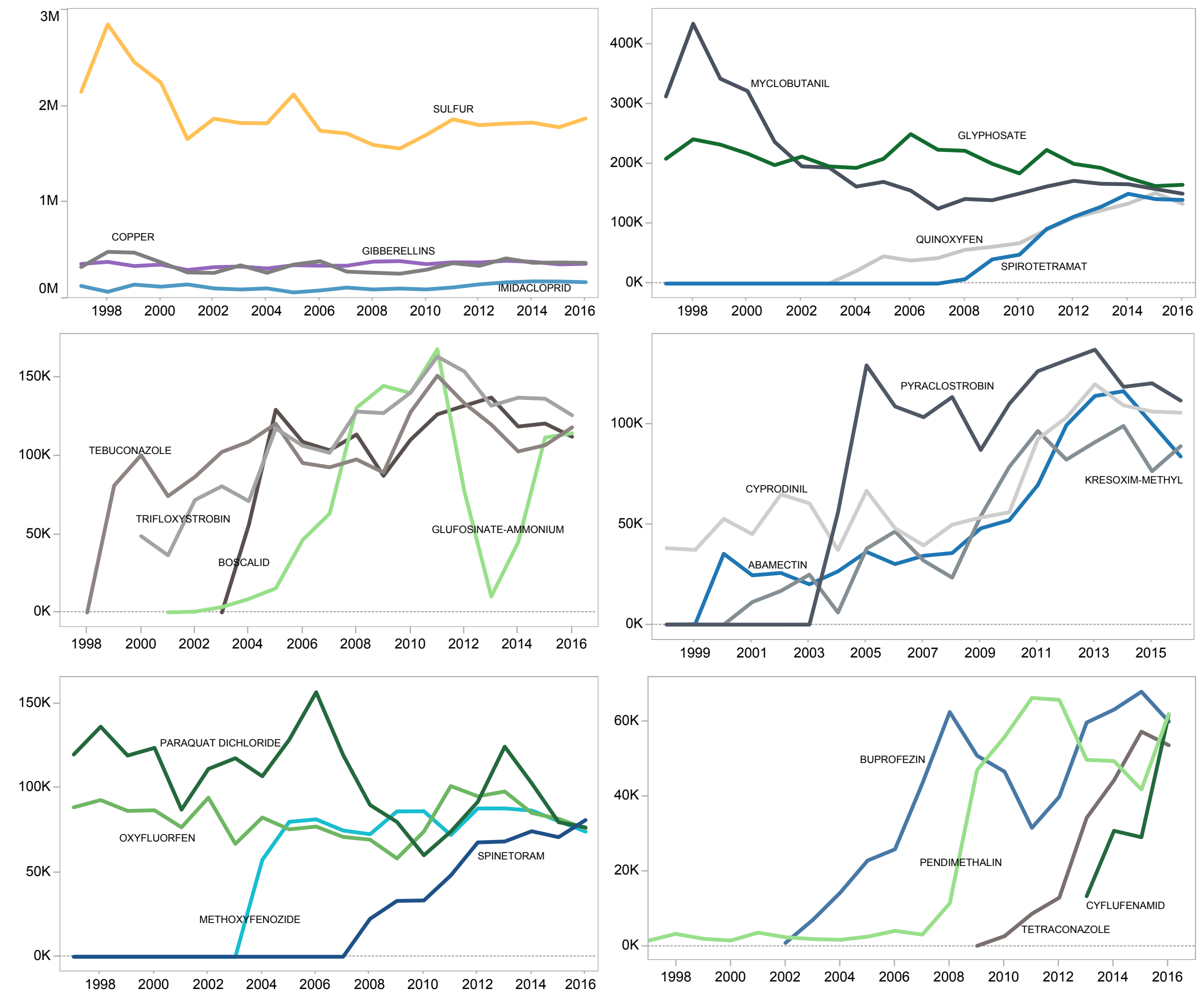


Table and raisin grape acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities.

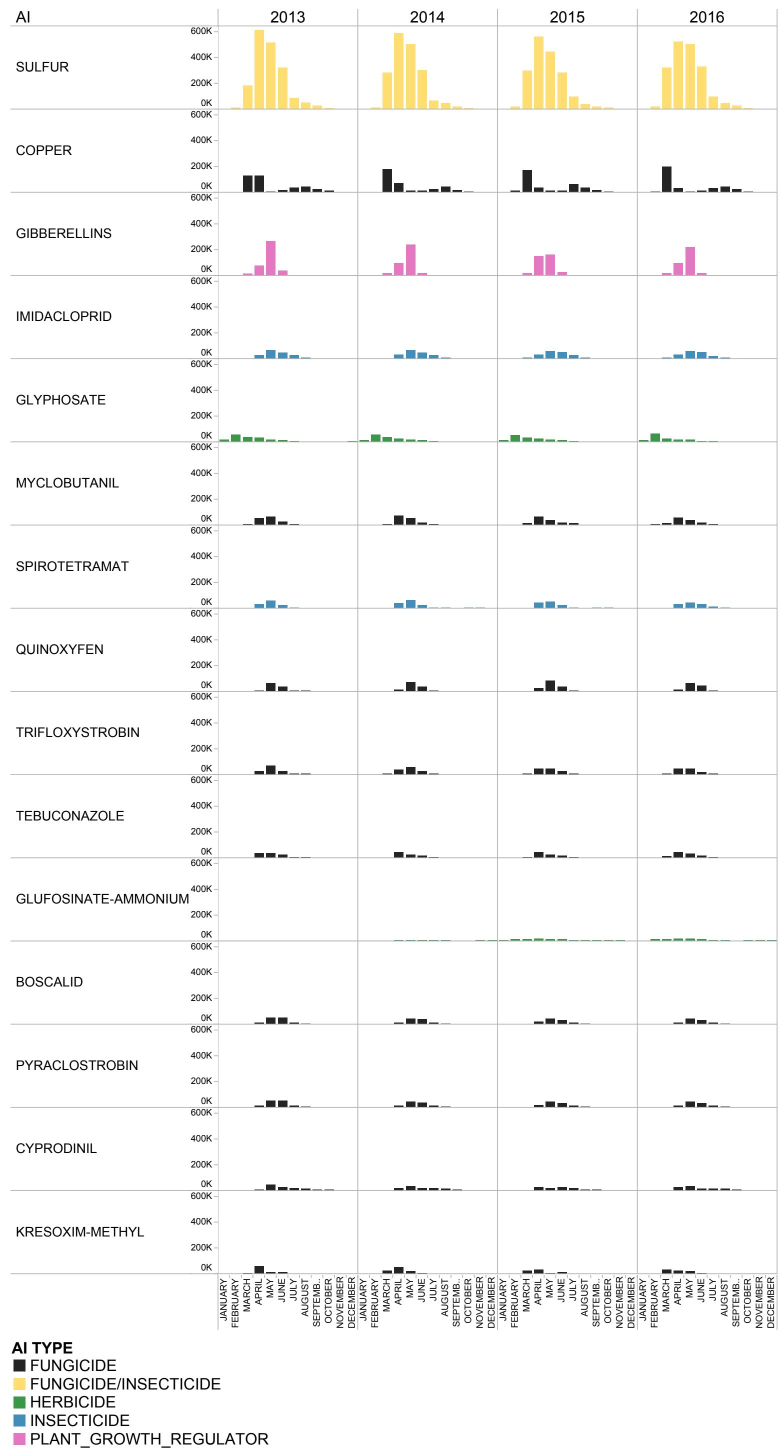


Figure A-35: *Acres of table and raisin grape treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

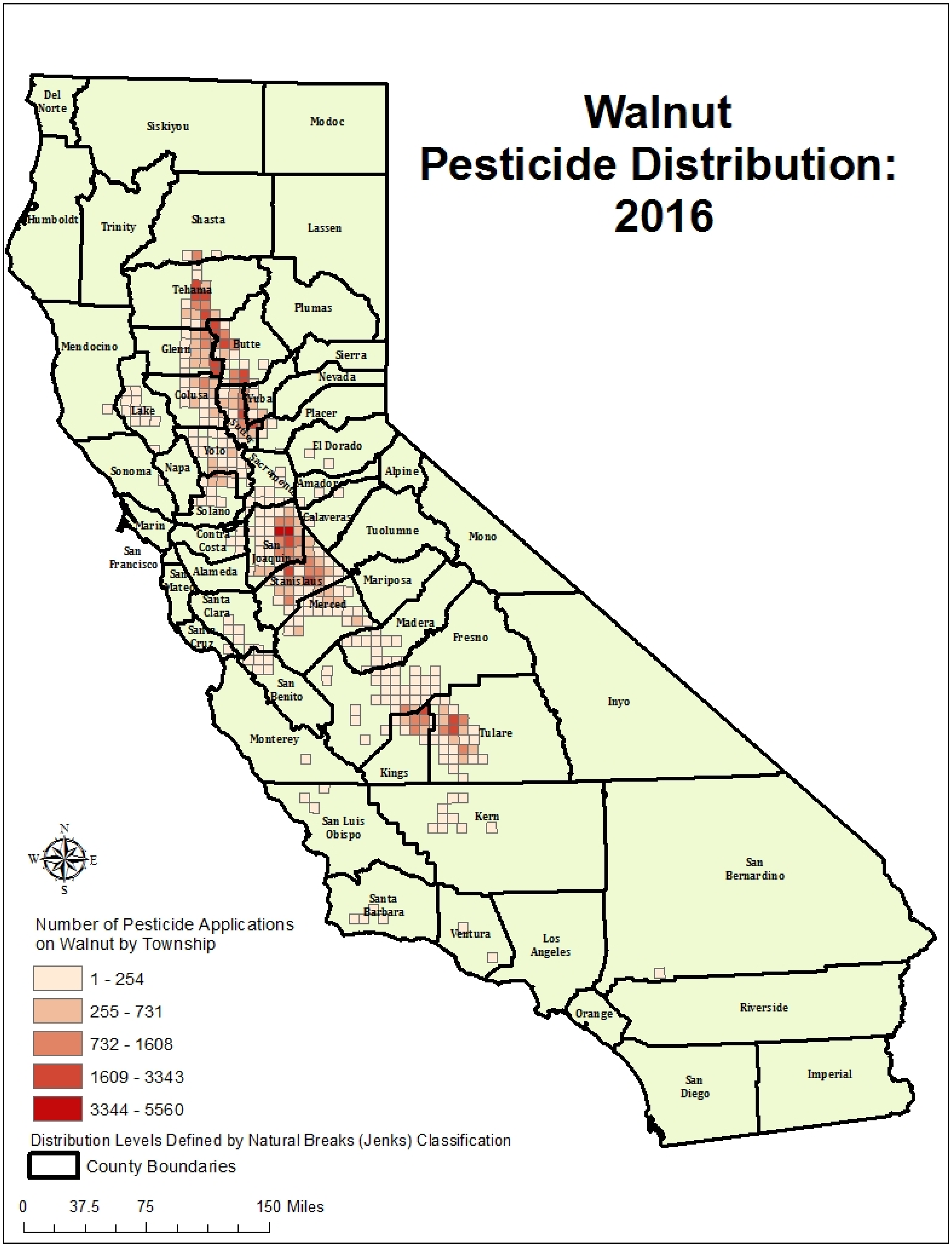
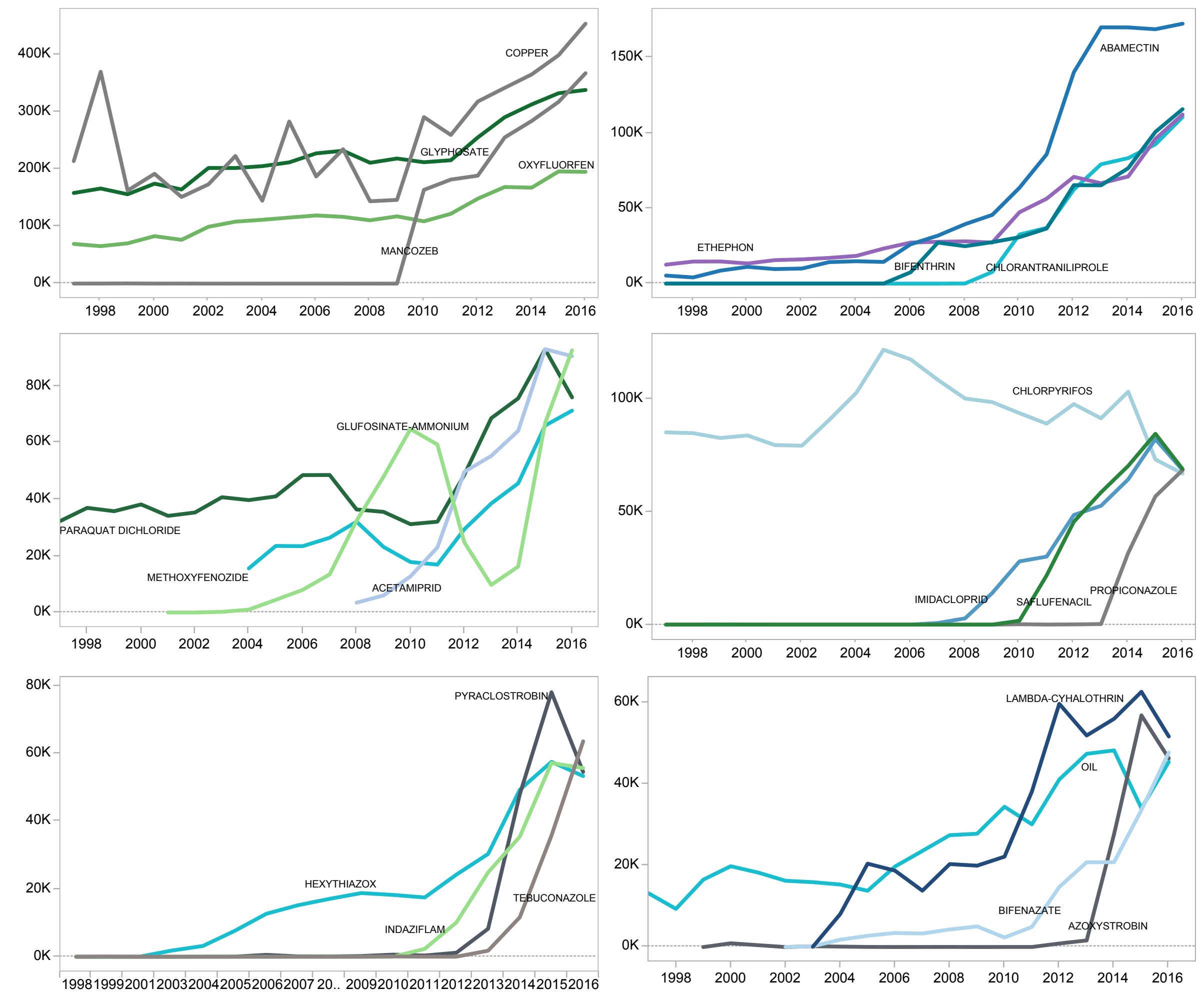


Figure A-36: *Number of pesticide applications in walnut by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

Figure A-37: *Acres of walnut treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/>.*



Walnut acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities.

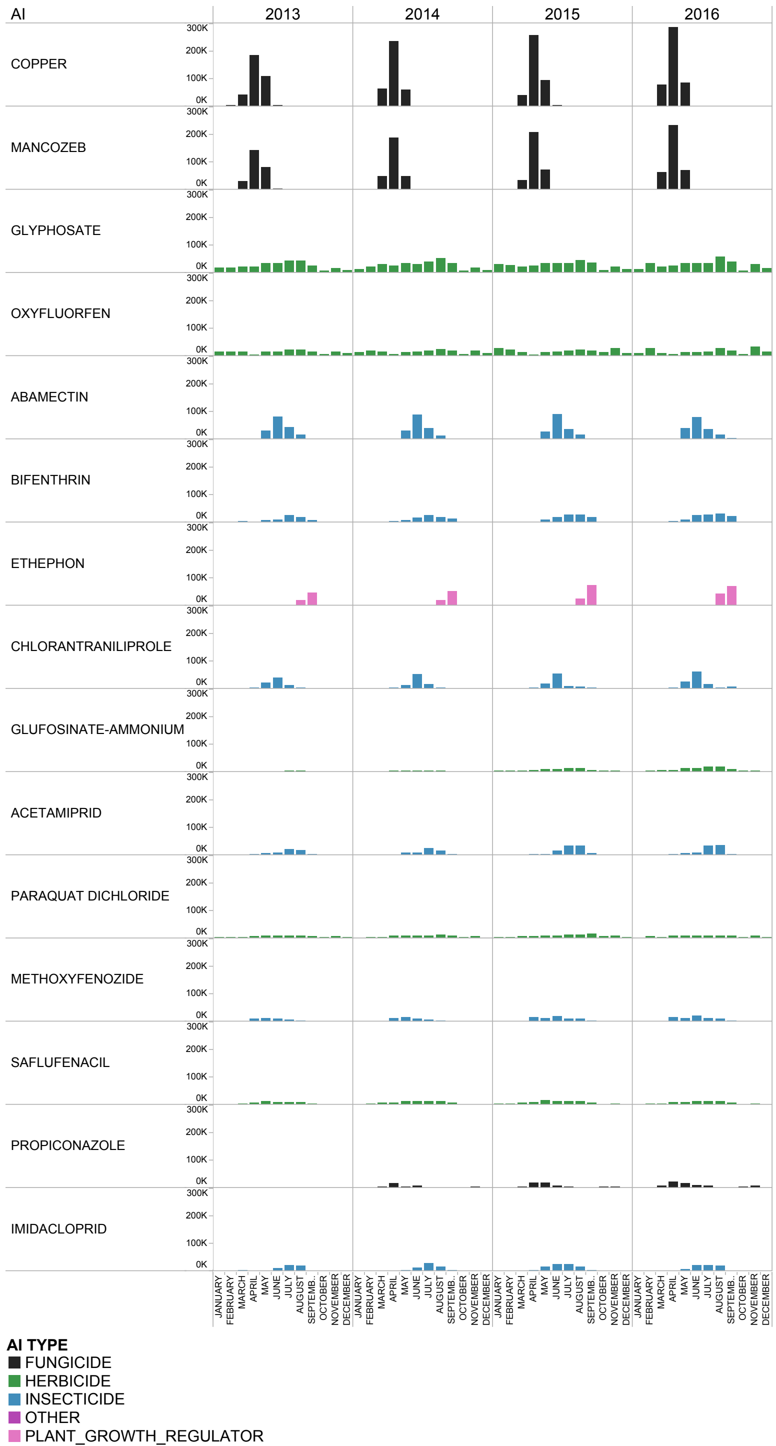


Figure A-38: *Acres of walnut treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*

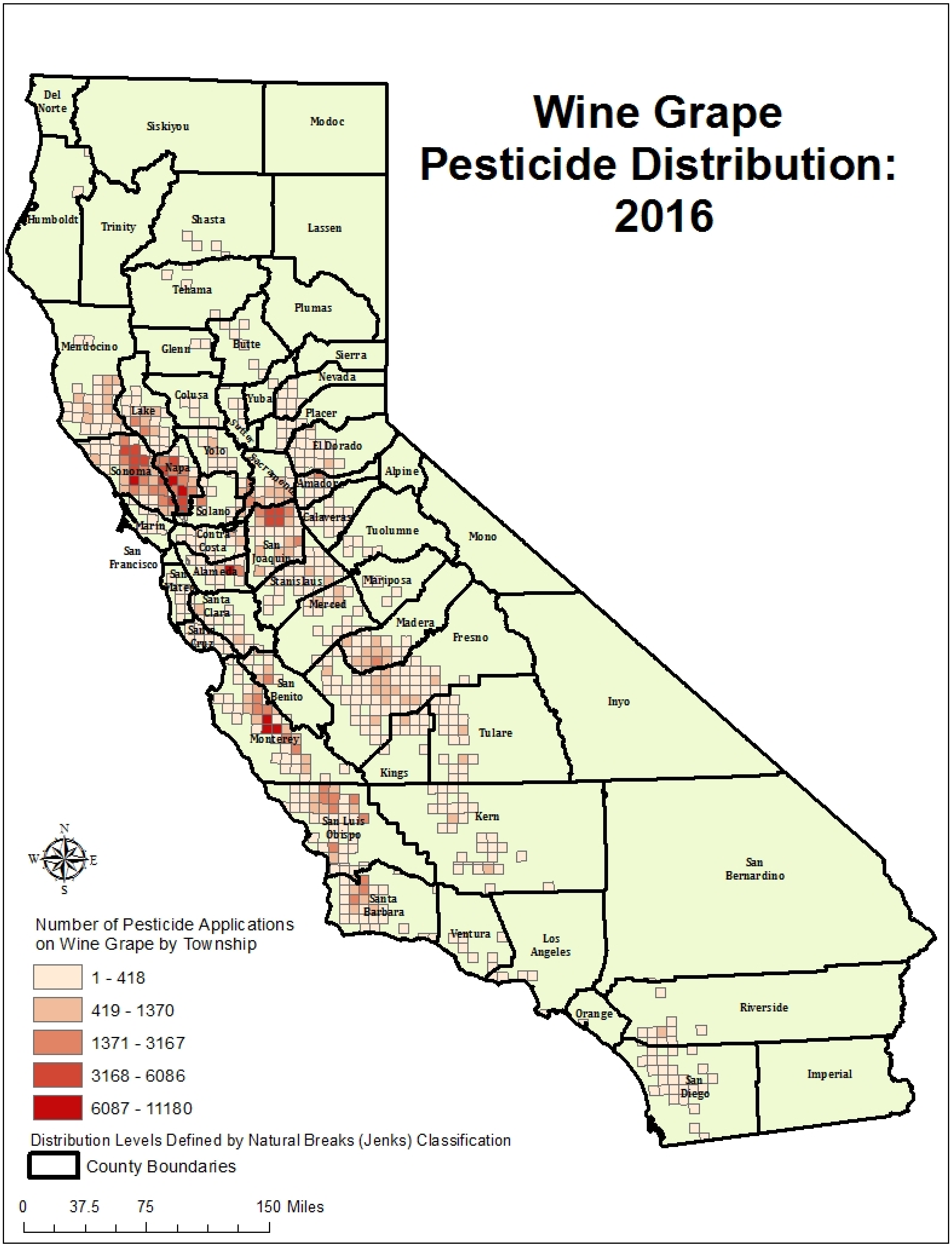
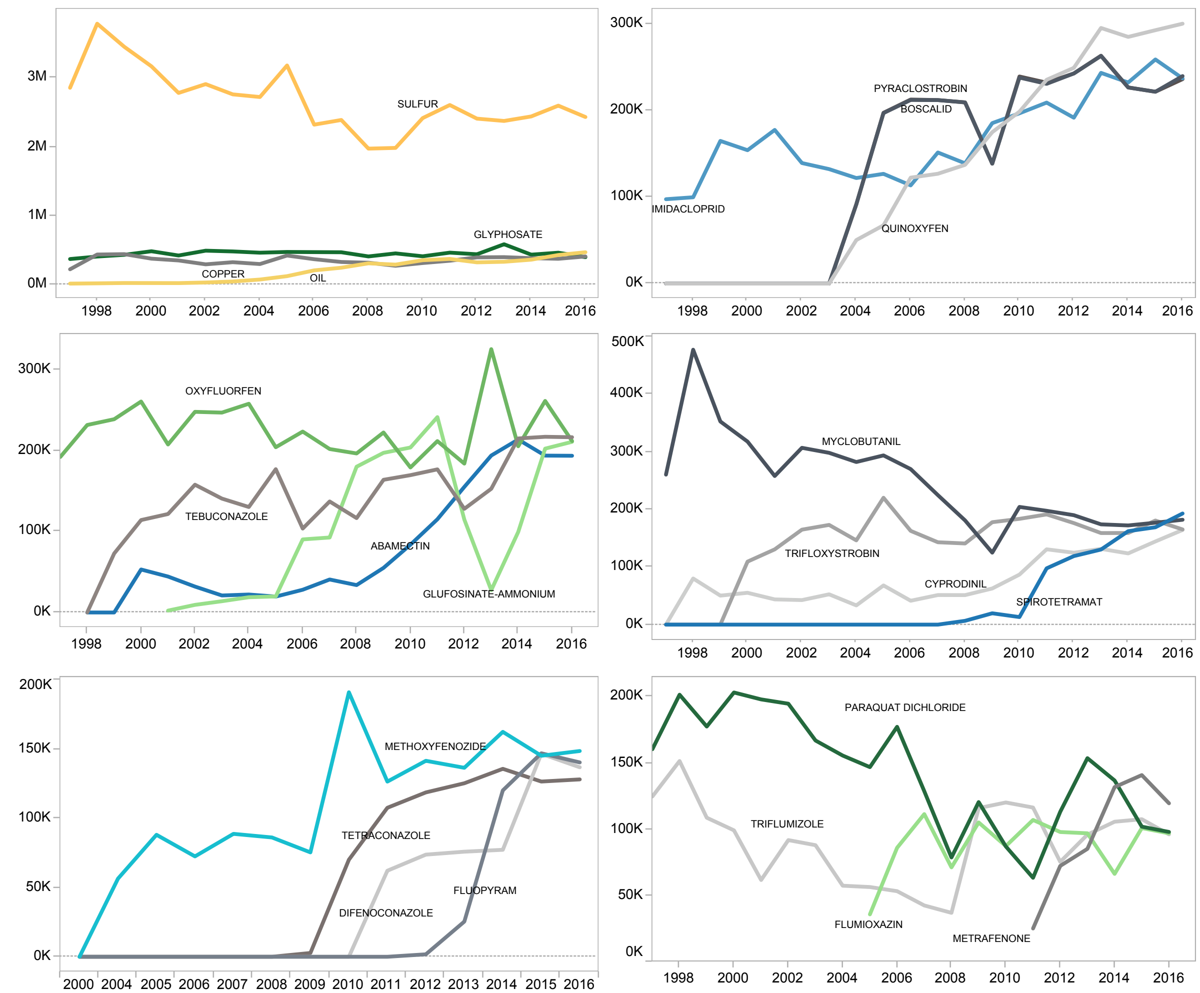


Figure A-39: *Number of pesticide applications in wine grape by township in 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*



Wine grape acres treated by the major AIs from 1997 to 2016. The graphs are ordered by the acres treated in 2016 starting with the largest amount in the upper left, moving to the right, then down. The line colors represent the AI type: blue represents insecticides, green herbicides, gray fungicides, red fumigants, insecticide/fungicides yellow, defoliants orange, and others purple. Within each graph, the lines of different AIs of one type have different color intensities.

Figure A-40: *Acres of wine grape treated by the major AIs from 1997 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >.*

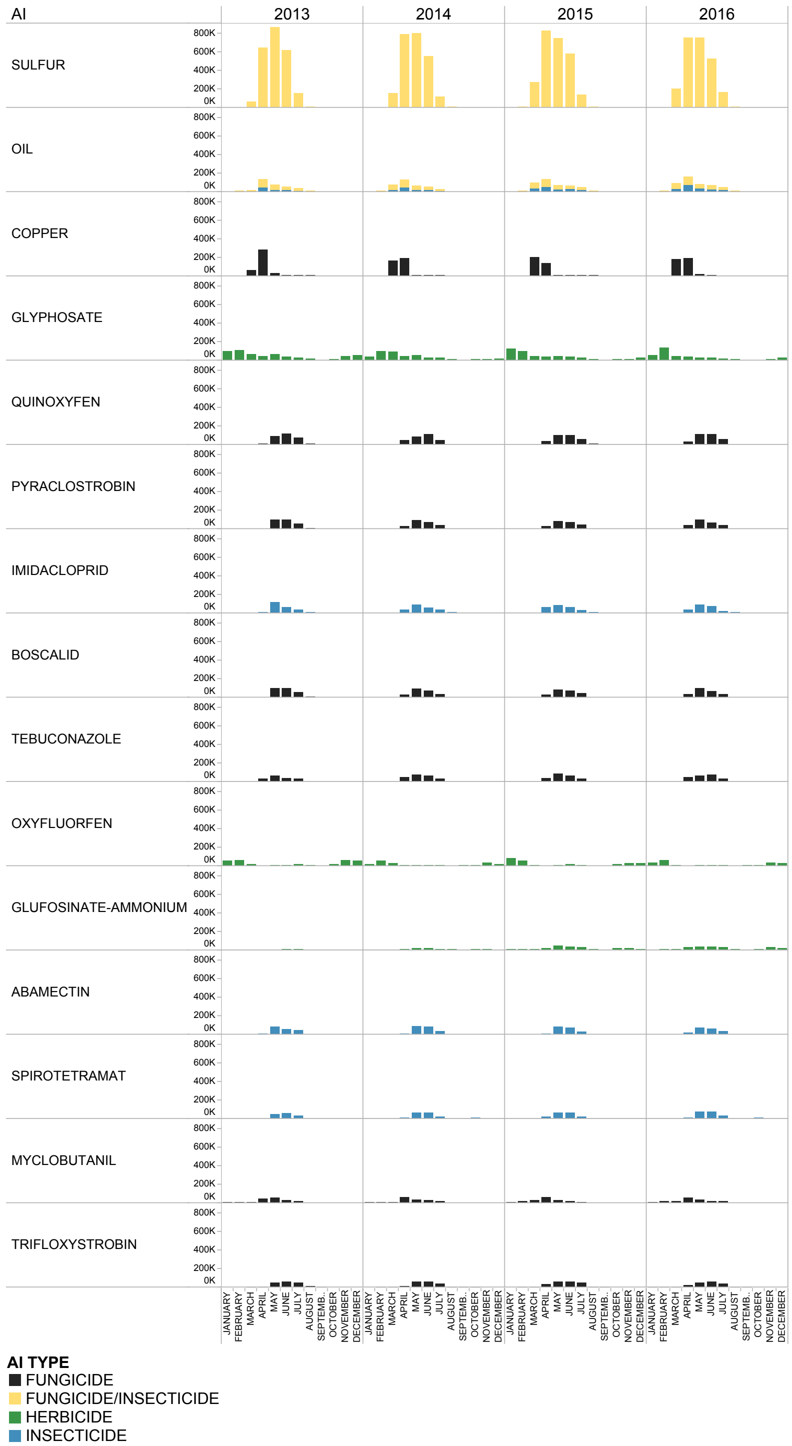


Figure A-41: *Acres of wine grape treated by the major AIs by month and AI type from 2013 to 2016. Data are available at <ftp://transfer.cdpr.ca.gov/pub/outgoing/pur/data/ >*