PESTICIDE USE ANNUAL REPORT

2019 Data Summary

Pesticide Use Report Program

California Department of Pesticide Regulation
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STATE OF CALIFORNIA
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For information on obtaining electronic data files, see the [Pesticide Use Annual Report Data Access, References, and Definitions Guide, How to Access Pesticide Use Report Data section](https://www.cdpr.ca.gov/docs/pur/pur_references_definitions.pdf)
<https://www.cdpr.ca.gov/docs/pur/pur_references_definitions.pdf>
This report is available on [DPR's Web site](www.cdpr.ca.gov/docs/pur/purmain.htm) <www.cdpr.ca.gov/docs/pur/purmain.htm>. If you have questions concerning this report, [email DPR's PUR program](mailto:PUR.Inquiry@cdpr.ca.gov) <PUR.Inquiry@cdpr.ca.gov>

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Year in Summary

Overview:

Reported pesticide use for California in 2019 totaled 210 million pounds of applied active ingredients (AIs) and 109 million acres treated. Seven percent of the pounds applied and 28 percent of the acres treated were adjuvants[1]. Since 2018, pounds of AIs decreased by 469,321 pounds applied (0.22 percent decrease), while the acres treated rose by around 3.5 million acres (3.3 percent increase).

Biopesticides and petroleum/mineral oils, which are considered to be lower risk to human health and the environment, increased in both the pounds applied and the acres treated in 2019. Most oil pesticides used in California serve as alternatives to more toxic pesticides. Some highly refined petroleum-based oils are used by organic growers.

Pesticides characterized as reproductive toxins, cholinesterase inhibitors, toxic air contaminants, groundwater contaminants, and fumigants decreased in both pounds applied and acres treated. Pesticides with carcinogenic potential decreased in pounds applied but increased in acres treated.

Since 2010, acres treated with biopesticides and oils increased by 95 and 40 percent, respectively, while use of all other categories has decreased by 2 to 50 percent. Similarly, the pounds applied of biopesticides and oils increased by 68 and 47 percent, respectively, while use of all other categories has decreased by 0 to 71 percent.

Category	Change in Pounds Applied	Percent Change Pounds Applied	Change in Acres Treated	Percent Change Acres
Biopesticides	↑ 240,509	3	↑ 935,029	11
Oils	↑ 416,451	1	↑ 43,445	1
Carcinogens	↓ -2,285,204	-5	↑ 159,805	2
Cholinesterase Inhibitors	↓ -633,643	-17	↓ -403,224	-14
Fumigants	↓ -2,288,360	-6	↓ -33,723	-13
Groundwater Contaminants	↓ -44,818	-12	↓ -30,114	-6
Reproductive Toxins	↓ -325,189	-4	↓ -544,551	-12
Toxic Air Contaminants	↓ -2,860,824	-7	↓ -422,135	-16

[1] An adjuvant is broadly defined as any non-pesticide material used with a pesticide product or pesticide spray mixture to improve the pesticide's performance or the physical properties of the spray mixture (Examples: spreader stickers, surfactants, oils, buffering agents, etc.). California law requires registration of adjuvants, which are not considered pesticides under federal law.

The AIs with the highest total reported pounds applied were sulfur (fungicide/insecticide), petroleum and mineral oils (fungicide/insecticide), glyphosate (herbicide), 1,3-dichloropropene (fumigant), and copper (fungicide). Fungicide/insecticide AIs have both fungicidal and insecticidal activity, although they may be used solely as a fungicide or an insecticide depending on the crop. The AIs with the highest reported acres treated were glyphosate, sulfur, petroleum and mineral oils, copper, and abamectin (miticide/insecticide).

2019 TOP FIVE

Top 5 AIs by Pounds Applied

- Sulfur
- Oils
- Glyphosate
- 1,3-Dichloropropene
- Copper

Top 5 AIs by Acres Treated

- Glyphosate
- Sulfur
- Oils
- Copper
- Abamectin

2019 Regulatory Highlights

In 2019, DPR took additional regulatory actions against several specific active ingredients due to human health and environmental concerns related to their use. These actions align with DPR's mission to protect human health and the environment and foster reduced risk pest management.

Chlorpyrifos Cancellation

In May 2019, DPR announced that it was cancelling the registration of chlorpyrifos after listing the pesticide as a toxic air contaminant. In August 2019, DPR and CDFA announced the formation of a cross-sector working group created to identify, evaluate and recommend safer, sustainable pest management solutions to replace chlorpyrifos.

In October 2019, DPR reached an agreement with pesticide manufacturers to end virtually all sales of chlorpyrifos by February 6, 2020, with all use and possession of chlorpyrifos products (except granular formulations) prohibited after December 31, 2020. Starting in 2019, DPR funded six research grants totaling $2.33 million; each project focuses on finding and evaluating alternatives to chlorpyrifos.

Granular chlorpyrifos use still allowed after December 2020 is now being reported quarterly in accordance with Senate Bill 86 passed in 2020. The quarterly chlorpyrifos reports requirements became effective January 2021.

Acephate Occupational Mitigation

Acephate is an organophosphate insecticide/miticide registered in California for agricultural and residential use. In 2019 DPR determined that acute occupational exposure to acephate constituted a health concern. DPR staff are currently working with acephate registrants to implement acute occupational exposure mitigation options through product label amendments.

Carbaryl Expanded Designation as a Restricted Material

Carbaryl is a carbamate insecticide used in both agricultural and residential settings; while agricultural carbaryl products have been designated as restricted materials, most non-agricultural carbaryl products were exempt from these limitations. To reduce residential exposures, DPR introduced regulation in 2019 that amended the restricted material status of carbaryl to include nearly all carbaryl products (exception: baits labeled only for agricultural use). This regulation became effective on August 1, 2020.

SGAR Reevaluation

In 2019, DPR initiated the reevaluation of several second-generation anticoagulation rodenticides (SGARs): brodifacoum, bromadiolone, difenacoum, and difethialone. This action was taken based on data provided by the California Department of Fish and Wildlife that showed significant detrimental impacts on non-target wildlife and the environment caused by SGAR use. Per California Notice 2018-01, while SGARs are under reevaluation, DPR will not approve any labels that expand their use through label amendments or new registrations.

Pesticide Use Measures

This report focuses on two different measures of pesticide use: pounds of AI applied and acres treated. Pesticide use trends measured in pounds applied tend to be driven by pesticides with large application rates, such as sulfur, oil, or fumigants. Trends reported in acres treated focus more on widespread use weighted by the number of applications. Both measures taken together give a more nuanced understanding of how pesticide use changes over time.

Pounds of AI Applied: 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 applied will emphasize pesticides used at high rates, such as sulfur, horticultural oils, and fumigants.

Acres treated: The acres treated is the cumulative sum of the acres treated with an AI (applications reported in square feet are converted to acres). The acres treated is often greater than the total planted acreage due to multiple applications being made to the same area during a given year. For example, if a one-acre field is treated with an AI three times in a year, then the cumulative acres treated for the year is three acres, although the field itself is only one acre.

As a pesticide use measure, acres treated reflects application frequency and geographic coverage and is not influenced by high application rates that bias rankings by pounds applied. It is limited as a use measure, however, in that it is only a partial representation of the total pesticide use reported: Only applications reported with units of acres or square feet are included in the total. Applications with volume or weight units cannot be converted to acres so they are excluded. In addition, the acres treated is not always reported for non-agricultural ("NonAg") pesticide use reports (PURs) such as structural and other types of urban uses, so these pesticide applications are also excluded from acres treated totals (For more information about agricultural and non-agricultural pesticide uses, see the Agricultural (Ag) versus Nonagricultural (NonAg) Pesticide Uses section of the [Pesticide Use Annual Report Data Access, References, and Definitions Guide] <https://www.cdpr.ca.gov/docs/pur/pur_references_definitions.pdf>.

DID YOU KNOW?

Pesticide use trends may differ depending on what "pesticide use metric" is used to measure pesticide use. Pesticide use metrics include *pounds applied, acres treated, and application counts.*

Pounds applied is a use metric that tends to be biased toward pesticides with high application rates, such as oil, sulfur, kaolin clay, and fumigants. These pesticides will top most lists when pesticide use is measured by pounds applied.

Acres Treated and **Application Counts** are use metrics that do not have this bias toward pesticides with high application rates, but they are not available for all types of pesticide use. The legal requirements for certain types of NonAg PURs do not require acres treated or application counts to be reported.

Analyzing trends using multiple pesticide use metrics can offer a more nuanced, complete understanding of pesticide use.

The number of applications can also be a useful measure of pesticide use, however its utility is limited because of inconsistencies in reporting methodologies for NonAg use and because it is no longer required for structural use reporting. For Ag use, each PUR represents a single application. For NonAg use, each PUR is a monthly summary of all the applications of a single product on a specific type of application site. Inconsistency in NonAg use reporting arises because there is not a standardized definition for what is to be considered as a single application, as opposed to the standard quantified definitions that exist for a single acre or a single pound. The interpreted definition of a single application in NonAg use can therefore vary greatly among different pesticide applicators or businesses. For example, one business may treat an apartment building for termites and consider the building application as a whole to be a single application, while another business may treat a similar apartment building but consider each room in the building to be a single application. The differences in the interpreted definition of a single application results in large variation in the total number of applications for very similar pesticide applications, especially in NonAg pesticide uses. As a result, application counts for agricultural uses are included in some of the larger tables available on the Annual Report website, but are rarely used in Annual Report graphs or discussion.

The trends in use for a single AI will usually follow similar patterns of increases or decreases for both pounds applied and acres treated. However, when pounds applied and acres treated move in different directions for one AI, it is often due to fluctuations in NonAg uses of the AI which do not legally have to report acreage, or it could be from a change in use of products with higher or lower percentage concentration of the AI. Most NonAg PURs are not legally required to include acres treated values.

Data Summary

This report is a snapshot summary based on 2019 data submitted to DPR as of August 20, 2020. The PUR data is continually updated, so this snapshot summary may not fully correlate to later PUR data queries, including those from the California Pesticide Information Portal (CalPIP, an online query tool, https://calpip.cdpr.ca.gov/main.cfm), that contain record corrections made after August 20, 2020.

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:

- New regulations,
- Changes in planted acreage,
- Types of crops planted,
- 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 use trend, but rather may represent variations related to changes in weather, pricing, supply of raw ingredients, or regulations. Regression analysis on use since 1990 does not indicate a significant trend of either increase or decrease in total pesticide use. However, there can be significant changes in the types of pesticides that makeup the statewide total, such as changes in the use of AIs with higher or lower risk to human health or the environment. See Evaluating Risk chapter of the Pesticide Use Annual Report History and Background document for more information on the relationship between use amounts and risk.
< https://www.cdpr.ca.gov/docs/pur/pur_history_background.pdf>

Trends by Use Type

Pesticide use can be classified into broad use types based on the overall generalized pest categories targeted by the pesticide. Examples of use types include herbicides (for treating various weeds); insecticides, including miticides (for treating many arthropod pests); fungicides (for treating assorted fungal diseases); and many more. The PUR data does not include information on the pest targeted by any individual pesticide application, which can make it difficult to determine the intended use type. Trends were analyzed for the most common use types: insecticides, fungicides, fungicide/insecticides, herbicides, and fumigants. Given the high reported use of sulfur, oils, and other similar AIs which have both fungicidal and insecticidal activity, the fungicide/insecticide category was created. "Fumigant" is technically an application method rather than a use type, often spanning multiple target pest categories, such as a soil fumigant that treats insect, fungal disease, nematodes, and weeds.

Figures 1 and 2 measure six pesticide use types:

- Fungicides,
- Insecticides (including miticides),
- Fungicide/Insecticides (pesticides with both fungicide and insecticide/miticide properties, such as sulfur and some oils),
- Fumigants,
- Herbicides, and
- Other (all remaining pesticide types that did not have large enough amounts used to warrant their own graph trend line).

Fumigants and fungicide/insecticides typically have high application rates, and therefore ranked high in use at the top of the graph when measured by pounds applied (Figure 1), but ranked near the bottom of the graph when measured by acres treated (Figure 2) due to less widespread use compared to other types of pesticides.

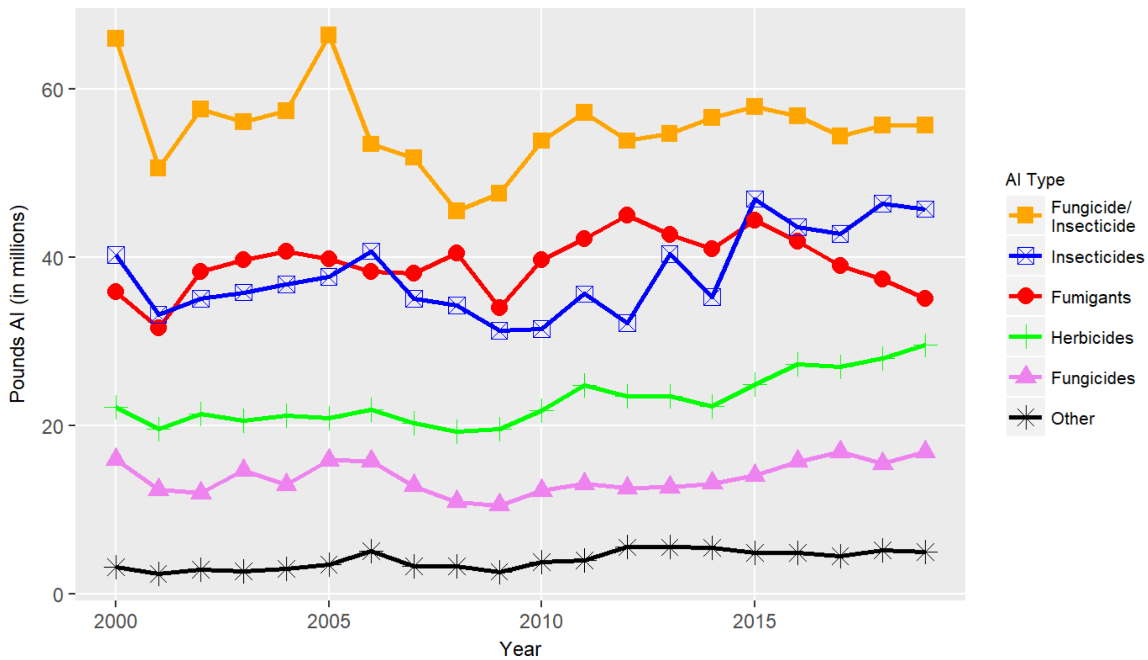


Figure 1. Pounds applied of all AIs in the major types of pesticides from 2000 to 2019, where "Other" includes pesticides such as rodenticides, molluscicides, algaecides, repellents, antimicrobials, antifoulants, disinfectants, and biocides. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

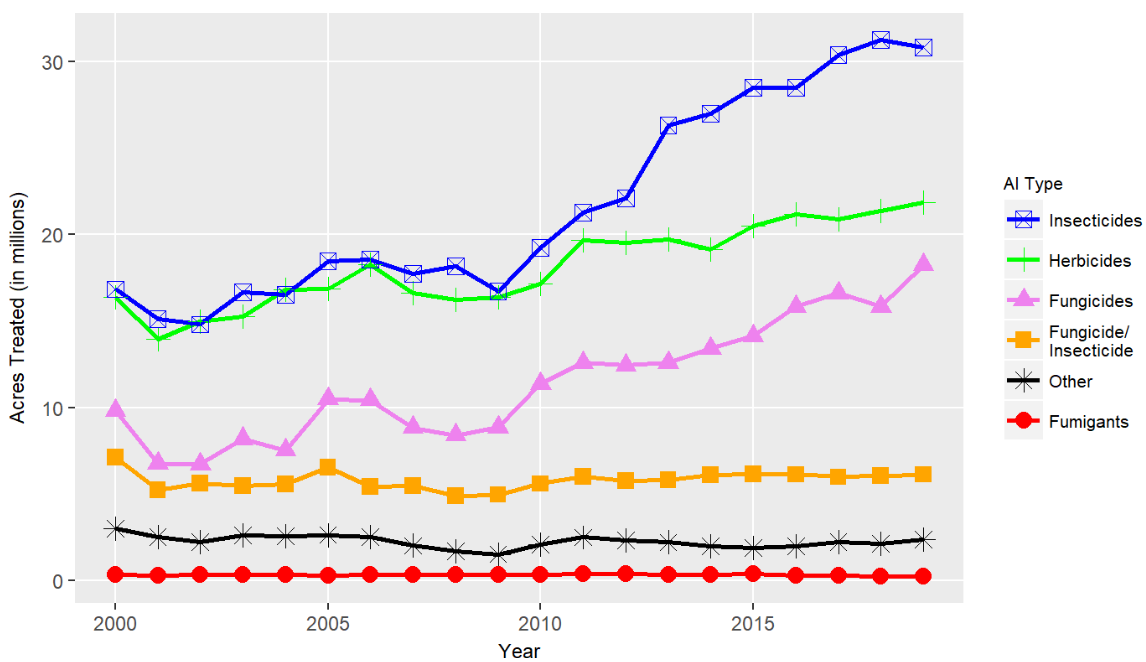


Figure 2. Acres treated by all AIs in the major types of pesticides from 2000 to 2019, where "Other" includes pesticides such as rodenticides, molluscicides, algaecides, repellents, antimicrobials, antifoulants, disinfectants, and biocides. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

The top five AIs for each use type by acres treated and pounds applied are detailed below.

Insecticide (including miticide)

Petroleum and mineral oils ("Oil") used in insecticides ranked highest when measured by either acres treated or by pounds applied. The insect growth regulator methoxyfenozide also ranked in the top five under both measures. The botanical miticide abamectin, the pyrethroid lambda-cyhalothrin, and the anthranilic diamide chlorantraniliprole were the remaining three of the top five insecticide AIs by acres treated. Boric acid, the microbial *Bacillus thuringiensis*, and the neonicotinoid imidacloprid made up the remainder of the top five insecticides measured by pounds applied (Figure 3, Table 1, and Table 2).

Table 1. Top five insecticides in California by acres treated for 2019.

Top Five	Acres Treated
Oil	4,298,075
Abamectin	2,621,006
Lambda-cyhalothrin	2,597,131
Chlorantraniliprole	2,454,493
Methoxyfenozide	1,785,258

Table 2. Top five insecticides in California by pounds applied for 2019.

Top Five	Pounds Applied
Oil	37,408,533
Boric acid	590,725
Bacillus thuringiensis	527,744
Imidacloprid	523,770
Methoxyfenozide	512,946

Fungicide

The inorganic fungicide copper was the most used fungicide when ranked by either acres treated or pounds applied. Three strobilurin fungicides (azoxystrobin, pyraclostrobin, and trifloxystrobin) and the pyradine fluopyram comprised the remaining four of the top five fungicides by acres treated. The inorganic potassium phosphite, the carbamates mancozeb and ziram, and the substituted benzene chlorothalonil made up the remainder of the top five fungicides by pounds applied (Figure 3, Table 3, and Table 4).

Table 3. Top five fungicides in California by acres treated for 2019.

Top Five	Acres Treated
Copper	3,193,557
Azoxystrobin	1,519,776
Fluopyram	1,304,338

Top Five	Acres Treated
Pyraclostrobin	1,062,909
Trifloxystrobin	971,288

Table 4. Top five fungicides in California by pounds applied for 2019.

Top Five	Pounds Applied
Copper	6,567,100
Potassium phosphite	1,651,325
Mancozeb	1,540,119
Chlorothalonil	1,160,779
Ziram	585,681

Fungicide/Insecticide

The category fungicide/insecticide includes a number of AIs which are able to control insects, mites, and fungal diseases. Sulfur represents most of the use in this category, with relatively minimal use of the remaining four of the top five AIs. Three inorganic AIs—sulfur, lime-sulfur, and the biopesticide kaolin clay—along with petroleum and mineral oils ("Oil"), ranked in the top five when measured by either acres treated or by pounds applied. The botanical clarified hydrophobic extract of neem oil ("Neem oil") ranked fifth by acres treated and the inorganic AI disodium octaborate ranked fifth by pounds applied (Figure 3, Table 5, and Table 6).

Table 5. Top five fungicide/insecticides in California by acres treated for 2019.

Top Five	Acres Treated
Sulfur	5,734,234
Oil	204,579
Kaolin	80,602
Lime-sulfur	73,834
Neem oil	52,387

Table 6. Top five fungicide/insecticides in California by pounds applied for 2019.

Top Five	Pounds Applied
Sulfur	49,038,554
Kaolin	2,720,806
Oil	1,764,078
Lime-sulfur	1,448,877
Disodium octaborate	262,165

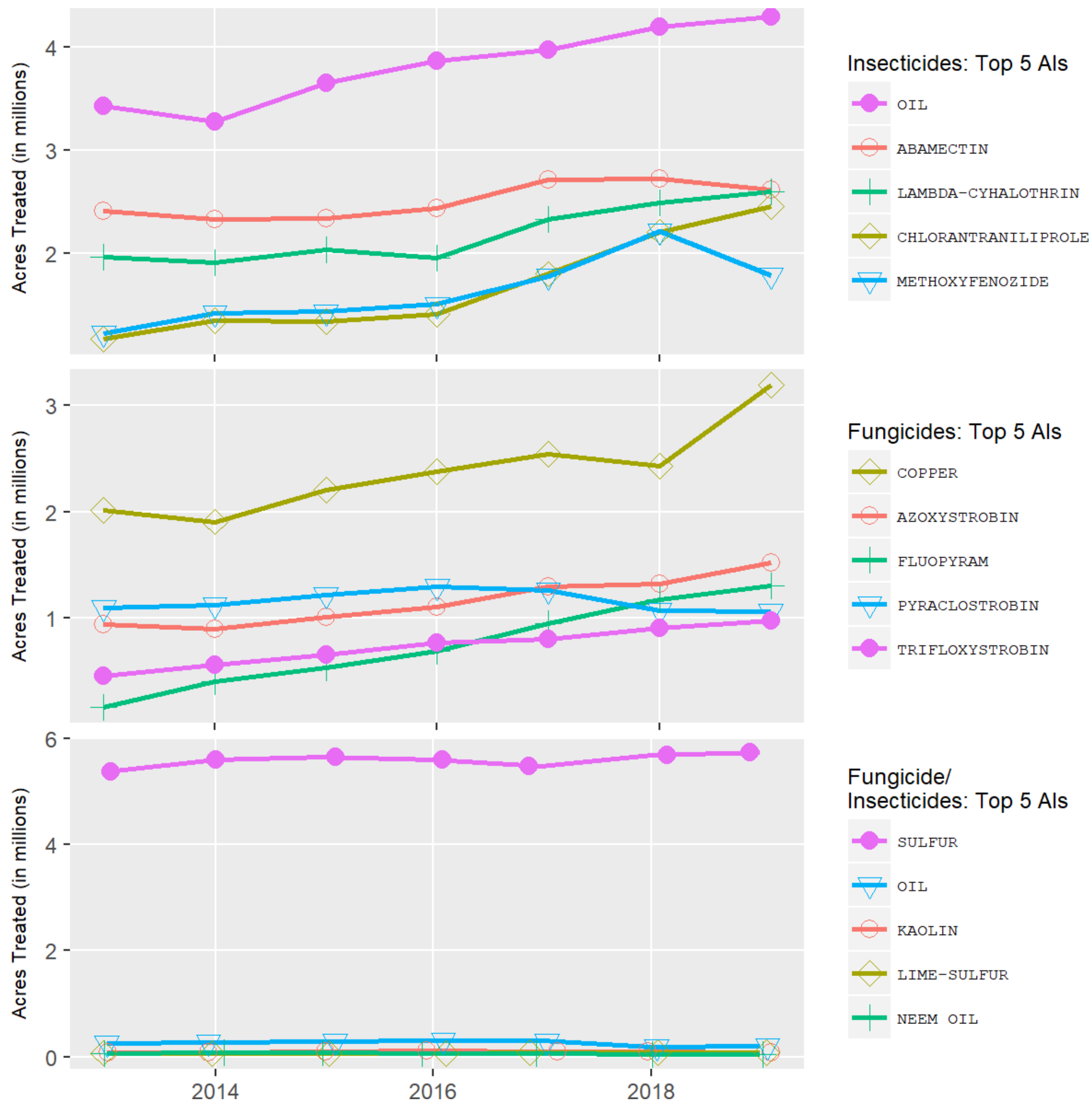


Figure 3. Acres treated by the top five AIs in each of the major types of pesticides from 2013 to 2019. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Herbicides

Glyphosate, pendimethalin, and glufosinate-ammonium ranked in the top five herbicide AIs when measured by both acres treated and by pounds applied. Oxyfluorfen and paraquat dichloride made up the remaining two top five herbicides by acres treated, while propanil and copper made up the remaining top five when ranked by pounds applied. Copper is used as an herbicide in a number of pesticide products that claim to control or suppress weeds in aquatic sites (Figure 4, Table 7, and Table 8).

Table 7. Top five herbicides in California by acres treated for 2019.

Top Five	Acres Treated
Glyphosate	5,807,702
Oxyfluorfen	2,058,201
Glufosinate-ammonium	1,936,502
Paraquat dichloride	1,237,110
Pendimethalin	1,094,200

Table 8. Top five herbicides in California by pounds applied for 2019.

Top Five	Pounds Applied
Glyphosate	12,559,134
Pendimethalin	2,319,035
Glufosinate-ammonium	1,975,045
Propanil	1,855,890
Copper	1,474,585

Fumigants:

1,3-dichloropropene, chloropicrin, and potassium N-methyldithiocarbamate (metam-potassium) were in the top five fumigant AIs when ranked by either acres treated or pounds applied. Aluminum phosphide and zinc phosphide made up the remainder of the top five by acres treated, while metam sodium and sulfuryl fluoride comprised the final two top five fumigant AIs by pounds applied (Figure 4, Table 9, and Table 10).

Table 9. Top five fumigants in California by acres treated for 2019.

Top Five	Acres Treated
Aluminum phosphide	62,760
1,3-dichloropropene	62,143
Chloropicrin	46,357
Metam-potassium	32,751
Zinc phosphide	23,599

Table 10. Top five fumigants in California by pounds applied for 2019.

Top Five	Pounds Applied
1,3-dichloropropene	11,300,809
Chloropicrin	8,056,246
Metam-potassium	6,629,298
Metam-sodium	4,124,364
Sulfuryl fluoride	3,019,149

The remaining "Others" category was largely comprised of plant growth regulators and harvest aids, with gibberellins leading in acres treated, followed by ethephon, mepiquat chloride, thidiazuron, and peroxyacetic acid, a bactericide/fungicide (Figure 4).

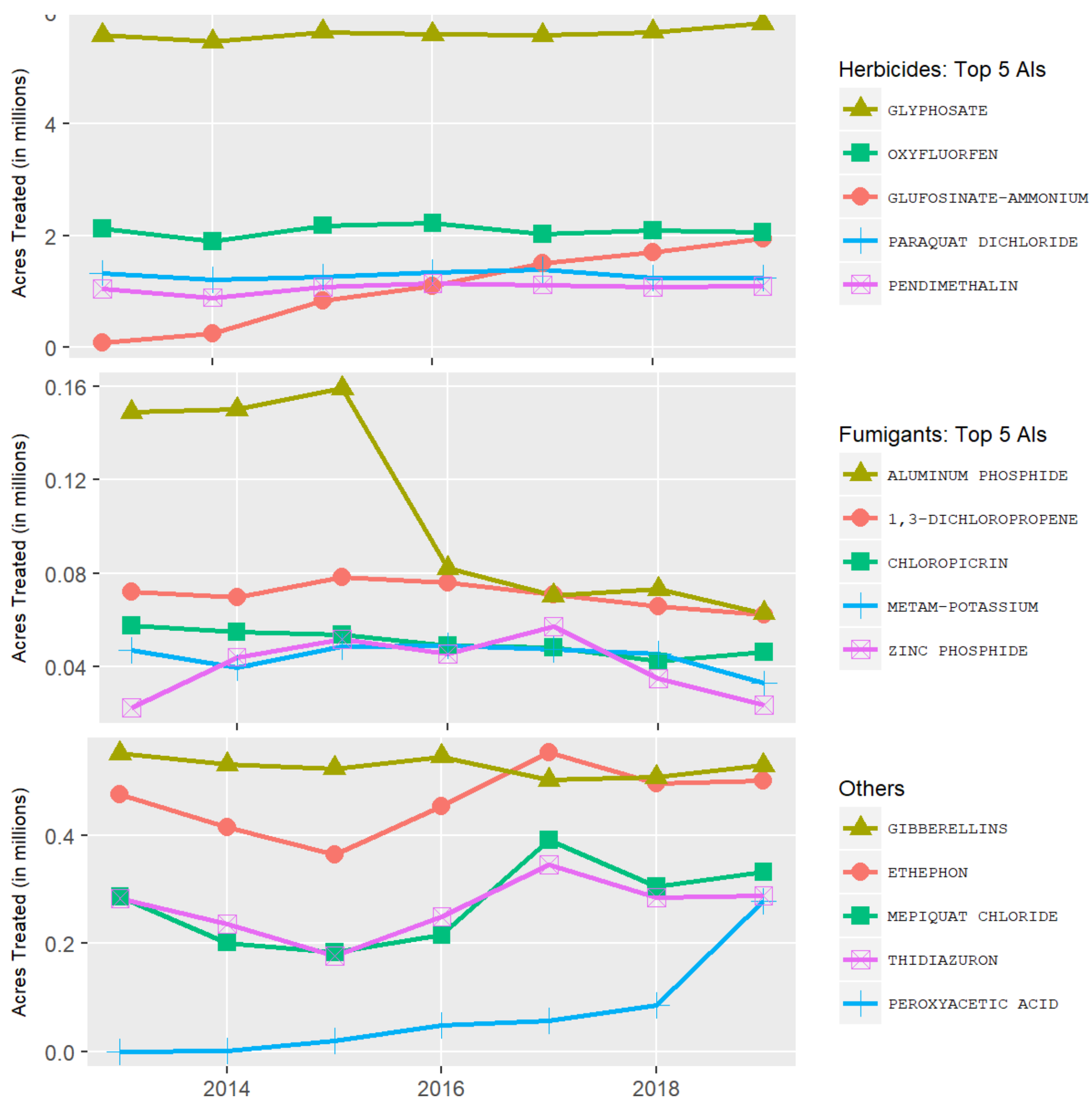


Figure 4. Acres treated by the top five AIs in each of the major types of pesticides from 2013 to 2019. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Pesticide Use by County

In 2019, as in previous years, the region of greatest pesticide use was California's San Joaquin Valley (Table 11). 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.

DID YOU KNOW?

50% of California counties decreased pounds of pesticide applied between 2018 and 2019:

A reduction of over 5 million pounds.

Table 11. Total pounds applied of active ingredients by county, rank, and the percent change from 2018 and 2019, ordered by 2019 rank, descending. Shaded rows show the counties where pounds applied decreased. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

County	2018 Lbs Applied	2018 Rank	2019 Lbs Applied	2019 Rank	Percent change
Fresno	35,750,831	1	35,442,789	1	-1
Kern	29,513,352	2	29,536,797	2	0.1
Tulare	19,251,549	3	20,034,689	3	4
San Joaquin	13,623,912	4	13,869,256	4	2
Madera	10,133,341	5	9,535,643	5	-6
Merced	9,474,457	6	9,393,165	6	-1
Stanislaus	8,808,374	7	9,041,945	7	3
Monterey	8,282,621	8	8,971,966	8	8
Kings	8,255,641	9	7,904,121	9	-4
Imperial	5,089,336	11	6,328,369	10	24
Ventura	6,115,948	10	5,438,461	11	-11
Santa Barbara	4,865,627	13	5,164,703	12	6
Sacramento	5,080,420	12	4,530,566	13	-11
Yolo	4,394,317	14	4,200,940	14	-4
Sutter	3,165,204	15	3,317,632	15	5
Riverside	2,822,187	19	2,980,957	16	6
Butte	2,966,490	17	2,919,763	17	-2
San Luis Obispo	3,063,466	16	2,722,539	18	-11
Sonoma	2,575,434	21	2,585,080	19	0.4
Colusa	2,903,580	18	2,509,788	20	-14
Glenn	2,572,887	22	2,405,823	21	-6
Mendocino	2,598,437	20	2,271,251	22	-13
Los Angeles	2,343,179	23	1,980,928	23	-15
Napa	1,500,612	25	1,563,421	24	4
Solano	1,511,616	24	1,476,581	25	-2
Tehama	1,318,439	29	1,473,743	26	12
San Diego	1,418,908	27	1,412,170	27	-0.5
Santa Cruz	1,253,377	30	1,330,361	28	6

County	2018 Lbs Applied	2018 Rank	2019 Lbs Applied	2019 Rank	Percent change
Siskiyou	1,393,250	28	1,304,848	29	-6
Yuba	1,135,882	31	1,250,292	30	10
Orange	1,425,661	26	1,093,171	31	-23
Lake	739,710	33	828,483	32	12
Santa Clara	900,852	32	745,395	33	-17
San Benito	637,366	34	648,382	34	2
Contra Costa	516,270	35	563,860	35	9
San Bernardino	482,292	36	551,132	36	14
Placer	434,432	37	404,822	37	-7
Shasta	281,996	39	292,889	38	4
Alameda	285,890	38	284,338	39	-1
Del Norte	206,514	41	228,105	40	10
El Dorado	160,006	43	194,256	41	21
Modoc	172,037	42	177,343	42	3
San Mateo	226,278	40	167,059	43	-26
Lassen	90,953	45	156,499	44	72
Amador	102,326	44	135,875	45	33
Marin	64,003	47	74,109	46	16
Calaveras	73,868	46	60,952	47	-17
Nevada	56,705	48	52,931	48	-7
Trinity	22,014	52	45,881	49	108
Tuolumne	39,976	50	40,998	50	3
Humboldt	42,273	49	33,938	51	-20
Plumas	31,071	51	29,203	52	-6
San Francisco	20,401	53	22,282	53	9
Mariposa	6,826	56	15,230	54	123
Mono	14,302	55	11,468	55	-20
Inyo	17,871	54	9,095	56	-49
Sierra	3,465	57	2,819	57	-19
Alpine	890	58	466	58	-48
Total	**210,238,921**		**209,769,569**		**-0.2**

Production Ag and Largest NonAg Uses

Production agricultural pesticide use (Ag PURs) has always made up the large majority of total pounds applied in California. In 2019, Ag PURs made up 91 percent of the total pounds applied. Post-harvest treatments, structural pest control, and landscape maintenance are typically the largest non-production-agricultural pesticide uses (NonAg PURs), contributing 1, 2 and 1 percent of the total pounds applied in 2019, respectively. Post-harvest treatments are predominantly commodity fumigations, but can also include pesticide treatments to irrigation ditches and other parts of fields not planted in crops. "All Other" uses include the remaining assortment of NonAg types of pesticide applications that are not high enough in volume on their own to warrant their own individual group heading, such as 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. Together, the "All Other" category represented 6 percent of total pounds applied. In 2019, production agriculture and structural pesticide pounds applied decreased by 1 and 2 percent, respectively. Landscape maintenance, post-harvest pesticide use, and all other uses ("All Others") increased by 48, 6, and 2 percent, respectively.

Table 12. Pounds applied (in millions) of pesticide active ingredients, from 2000 to 2019, by general use categories. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Year	Production Agriculture	Post-Harvest Treatment	Structural Pest Control	Landscape Maintenance	All Others	Total Pounds Applied
2000	175.77	2.17	5.19	1.42	6.86	191.40
2001	142.76	1.46	4.92	1.29	6.33	156.76
2002	159.22	1.86	5.47	1.45	6.84	174.84
2003	161.06	1.79	5.18	1.98	7.53	177.52
2004	165.92	1.87	5.12	1.61	7.00	181.52
2005	178.37	2.27	5.63	1.78	8.52	196.56
2006	168.67	2.22	5.27	2.29	10.27	188.72
2007	157.49	2.28	3.97	1.67	7.35	172.75
2008	151.55	2.54	3.20	1.59	7.24	166.12
2009	147.14	1.48	2.91	1.35	6.02	158.89
2010	160.57	2.16	3.70	1.73	8.03	176.20
2011	177.98	1.55	3.15	1.72	8.74	193.15
2012	172.18	1.23	3.46	1.56	9.30	187.73
2013	179.37	1.50	3.80	1.47	9.96	196.10
2014	174.86	1.33	3.71	1.62	8.90	190.43
2015	195.21	1.48	4.22	1.69	9.32	211.91
2016	192.08	1.79	3.93	1.74	10.35	209.89
2017	188.87	1.67	3.64	1.58	10.32	206.09
2018	191.82	1.50	3.46	1.54	11.91	210.24
2019	190.33	1.59	3.37	2.29	12.18	209.77

Trends in Use for Select Pesticide Categories

Pesticide use is summarized for eight different categories based on a pesticide's potential to cause health or environmental impacts or type of pesticide. The same pesticide may appear in multiple categories:

- Reproductive toxins,
- Carcinogens,
- Cholinesterase inhibitors,
- Groundwater contaminants,
- Toxic air contaminants,
- Fumigants,
- Oils, and
- Biopesticides

The summaries and the data are not intended to serve as indicators of pesticide risks to the public or the environment as they do not account for label restrictions, mitigation methods, and other practices that may significantly reduce offsite movement of pesticide and potential for exposure. Rather, the data supports DPR regulatory functions to enhance public safety and environmental protection by increasing the understanding of the change in use of lower and higher risk active ingredients over time.

Note that the pounds of AI applied include both Ag and NonAg PURs, while the reported acres treated include primarily Ag PURs since most NonAg uses do not require reporting of acres treated. Tables of the amount used of the individual chemicals in each category can be downloaded using the Pesticide Category Lists drop-down menus on the 2019 Summary Data website < https://www.cdpr.ca.gov/docs/pur/pur19rep/19_pur.htm>.

Table 13. The total pounds applied for eight different pesticide categories with the change and percent change from 2018 and 2019. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Category	2018 Pounds Applied	2019 Pounds Applied	Change	Percent Change
Biopesticides	8,397,346	8,637,854	240,509	3
Oils	40,039,946	40,456,397	416,451	1
Cholinesterase inhibitors	3,827,481	3,193,838	-633,643	-17
Reproductive toxins	7,557,183	7,231,993	-325,189	-4
Fumigants	37,450,297	35,161,936	-2,288,360	-6
Toxic air contaminants	41,413,379	38,552,554	-2,860,824	-7
Carcinogens	41,648,965	39,363,761	-2,285,204	-5
Groundwater contaminants	372,012	327,194	-44,818	-12

Table 14. The total acres treated for eight different pesticide categories with the change and percent change from 2018 and 2019. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Category	2018 Acres Treated	2019 Acres Treated	Change	Percent Change
Biopesticides	8,635,253	9,570,282	935,029	11
Oils	5,504,667	5,548,111	43,445	1
Cholinesterase inhibitors	2,970,889	2,567,665	-403,224	-14
Reproductive toxins	4,636,984	4,092,433	-544,551	-12
Fumigants	266,303	232,580	-33,723	-13
Toxic air contaminants	2,565,640	2,143,506	-422,135	-16
Carcinogens	8,623,280	8,783,085	159,805	2
Groundwater contaminants	470,528	440,414	-30,114	-6

Reproductive Toxins

The reproductive toxins category included all AIs listed on the State's Proposition 65 list of chemicals known to cause reproductive toxicity in the form of birth defects or reproductive harm. Reproductive toxins decreased from 2018 to 2019 by 325 thousand pounds applied (4 percent decrease) and by 545 thousand acres treated (12 percent decrease). The decrease in use was largely due to a 98 percent decline in both pounds applied and acres treated with chlorpyrifos. Chlorpyrifos is an organophosphate that has been increasingly restricted in use since 2015. Its registration was canceled and nearly all use (all use other than granular applications) ceased as of the end of December, 2020 (Figure 5).

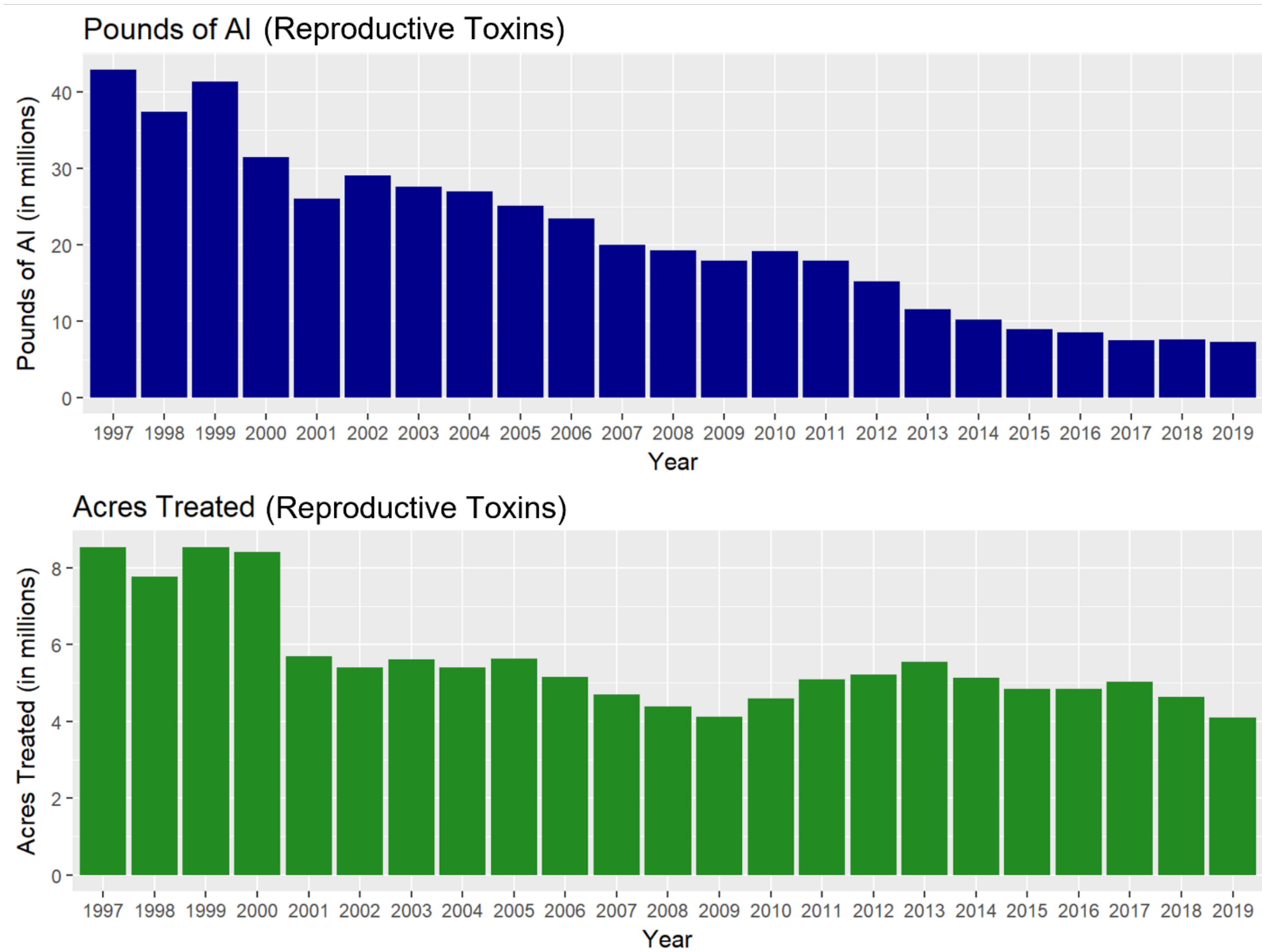
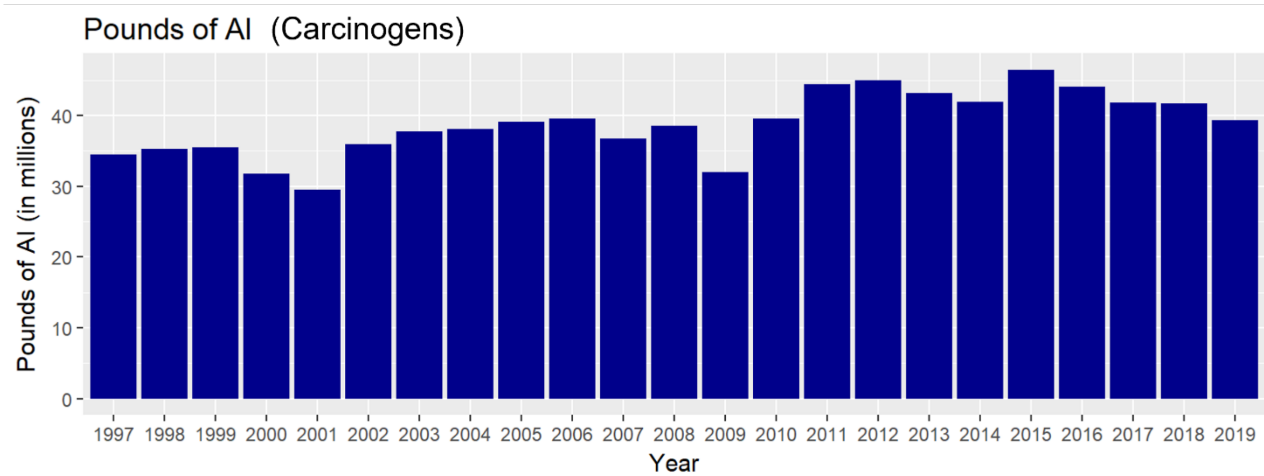


Figure 5. Use trends of pesticides that are on the State's Proposition 65 list of chemicals that are "known to cause reproductive toxicity." Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Carcinogens

The carcinogens category included all AIs listed by U.S. EPA as A or B carcinogens or on the State's Proposition 65 list of chemicals known to cause cancer. The amount of pesticides used classified as carcinogens decreased by 2.3 million pounds applied from 2018 to 2019 (5 percent decrease), while the acres treated increased by160 thousand acres (2 percent increase). The decrease in pounds applied was largely due to less use of the fumigant potassium N-methyldithiocarbamate (metam-potassium), which decreased by 1.9 million pounds applied (22 percent decrease), and use of the fumigant 1,3-dichloropropene, which decreased by 1.3 million pounds applied (10 percent decrease). The increase in acres treated was mostly due to the addition of 134 thousand acres treated with the fungicide mancozeb (19 percent increase) and an additional 133 thousand acres treated with glyphosate, potassium salt (4 percent increase), (Figure 6).



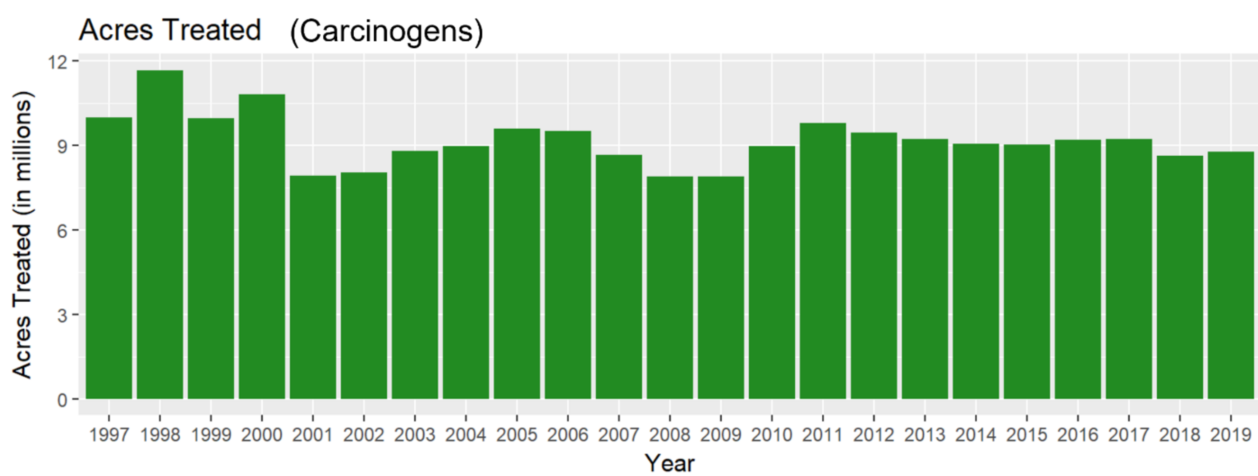


Figure 6. Use trends of pesticides that are listed by U.S. EPA as A or B carcinogens or on the State's Proposition 65 list of chemicals that are "known to cause cancer." Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Cholinesterase inhibitors

Use of organophosphorus and carbamate cholinesterase-inhibiting pesticides decreased from the previous year by 634 thousand pounds applied (17 percent decrease) and by 403 thousand acres treated (14 decrease). Most of the reduction was largely due to a 98 percent decrease in both pounds applied and acres treated with chlorpyrifos. Use of chlorpyrifos declined by 590 thousand pounds applied and 425 thousand acres treated. Registration of chlorpyrifos was canceled and all uses other than granular applications ceased by the end of December, 2020 (Figure 7).

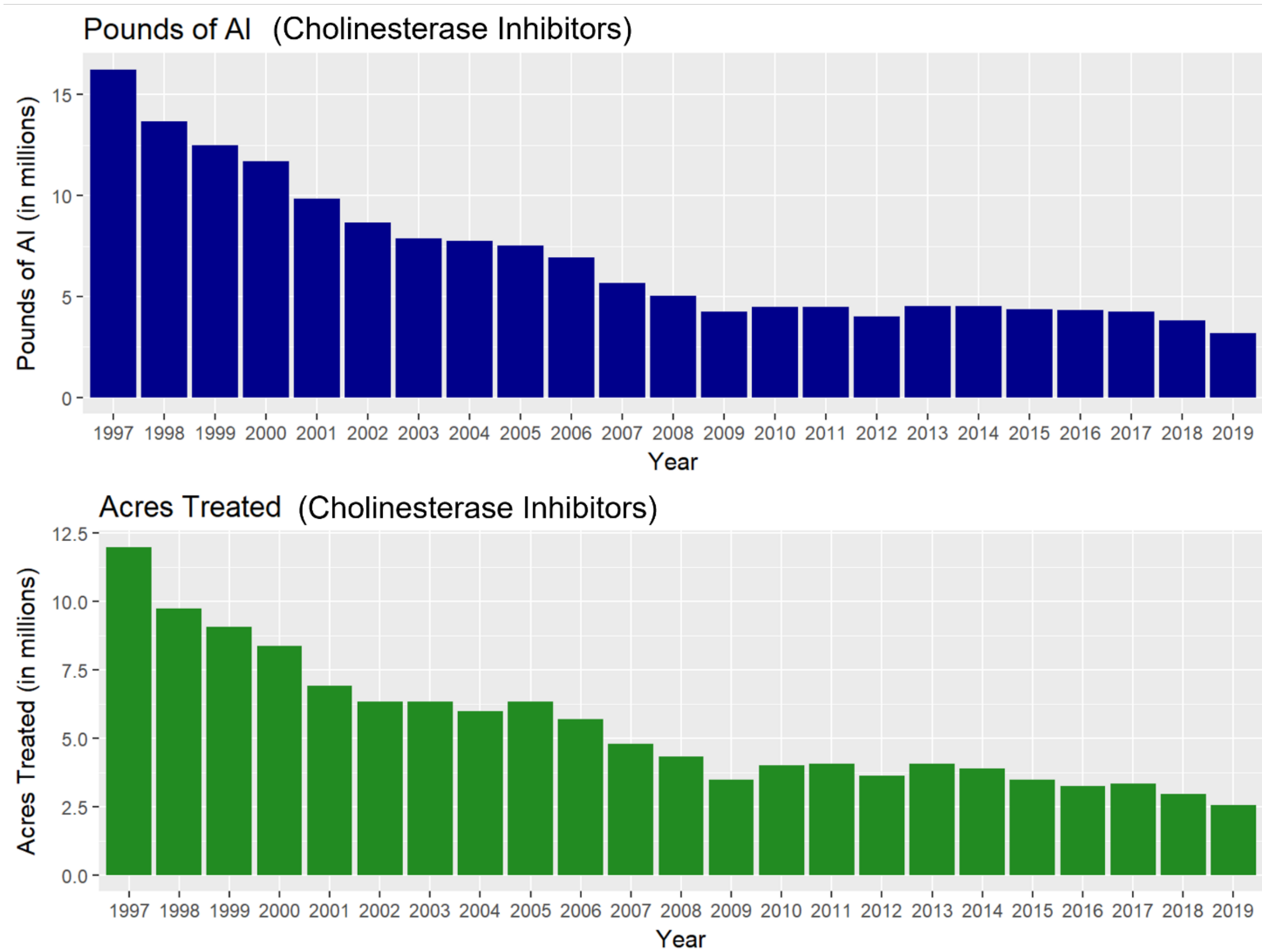


Figure 7. Use trends of pesticides that are organophosphorus or carbamate cholinesterase-inhibiting pesticides. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Groundwater contaminants

Groundwater contaminants are defined as the pesticides that have the potential to pollute groundwater based on their chemical properties and labeled use. The groundwater contaminant category included all AIs listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6800(a). Groundwater contaminants decreased by 45 thousand pounds applied (12 percent decrease) and by 30 thousand acres treated (6 percent decrease). The reduction was largely due to change in the use of the herbicides simazine and diuron. Simazine decreased by 17 thousand acres treated (20 percent decrease), while diuron decreased by 9 thousand acres treated (3 percent decrease) (Figure 8).

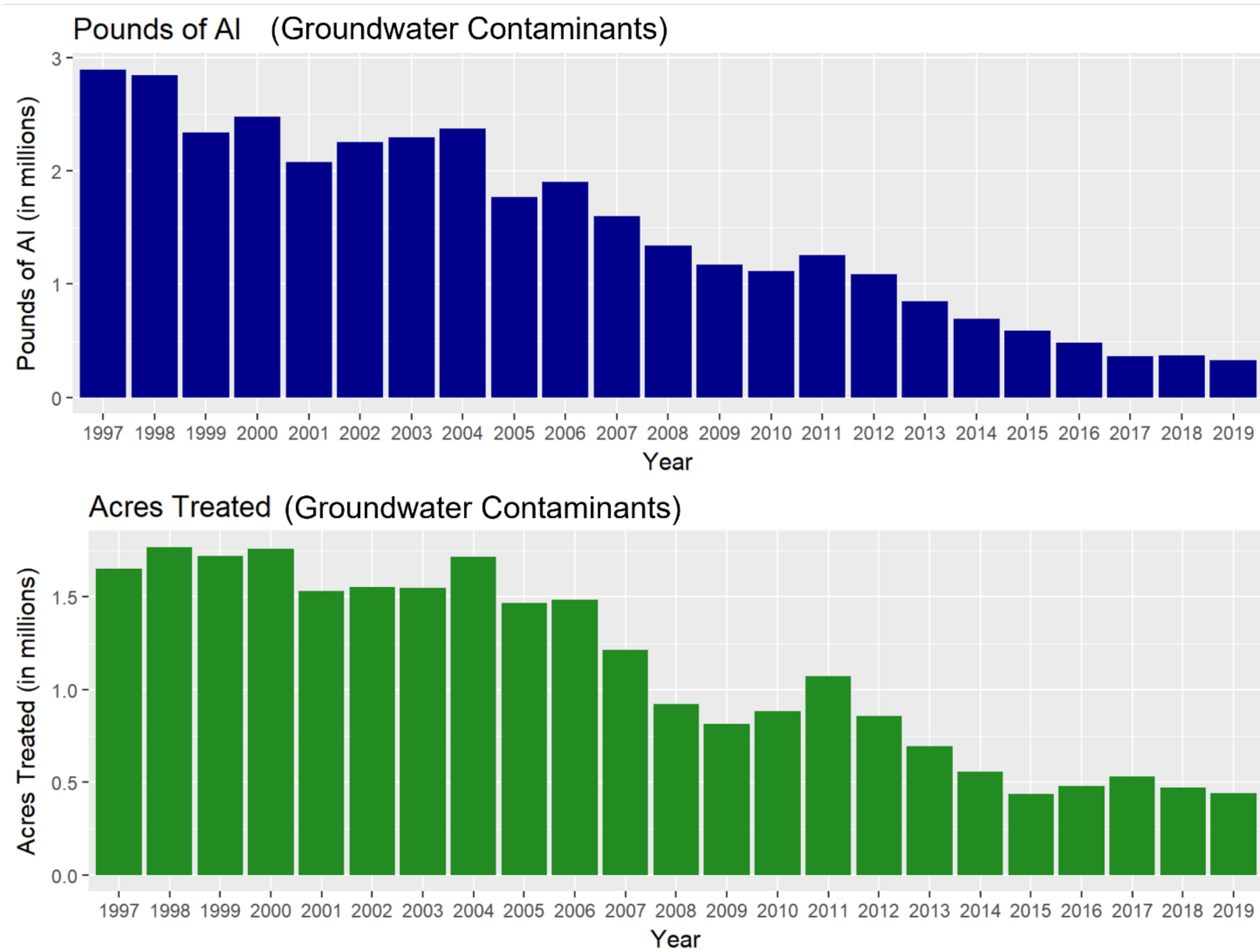


Figure 8. Use trends of pesticides from DPR's groundwater protection list. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Toxic air contaminants

Toxic air contaminants are defined as air pollutants that may cause or contribute to increases in serious illness or death, or that may pose a present or potential hazard to human health. The toxic air contaminants category included all AIs listed in the California Code of Regulations, Title 3, Division 6, Chapter 4, Subchapter 1, Article 1, Section 6860. Toxic air contaminants decreased in pounds applied by 2.9 million pounds (7 percent decrease), and declined in acres treated by 422 thousand acres (16 percent decrease). Most of the reduction in acres treated resulted from a drop in the use of the organophosphate insecticide chlorpyrifos, which decreased by 590 thousand pounds applied and 425 thousand acres treated (98 percent decrease). Registration of chlorpyrifos was canceled and nearly all uses other than granular applications) ceased by the end of December, 2020. The large decline in pounds applied was due to a 1.3 million pound decrease in the use of the fumigants 1,3-dichloropropene (10 percent decrease), and a 1.9 million pound decrease in potassium N-methyldithiocarbamate (metam-potassium), (22 percent decrease) (Figure 9).

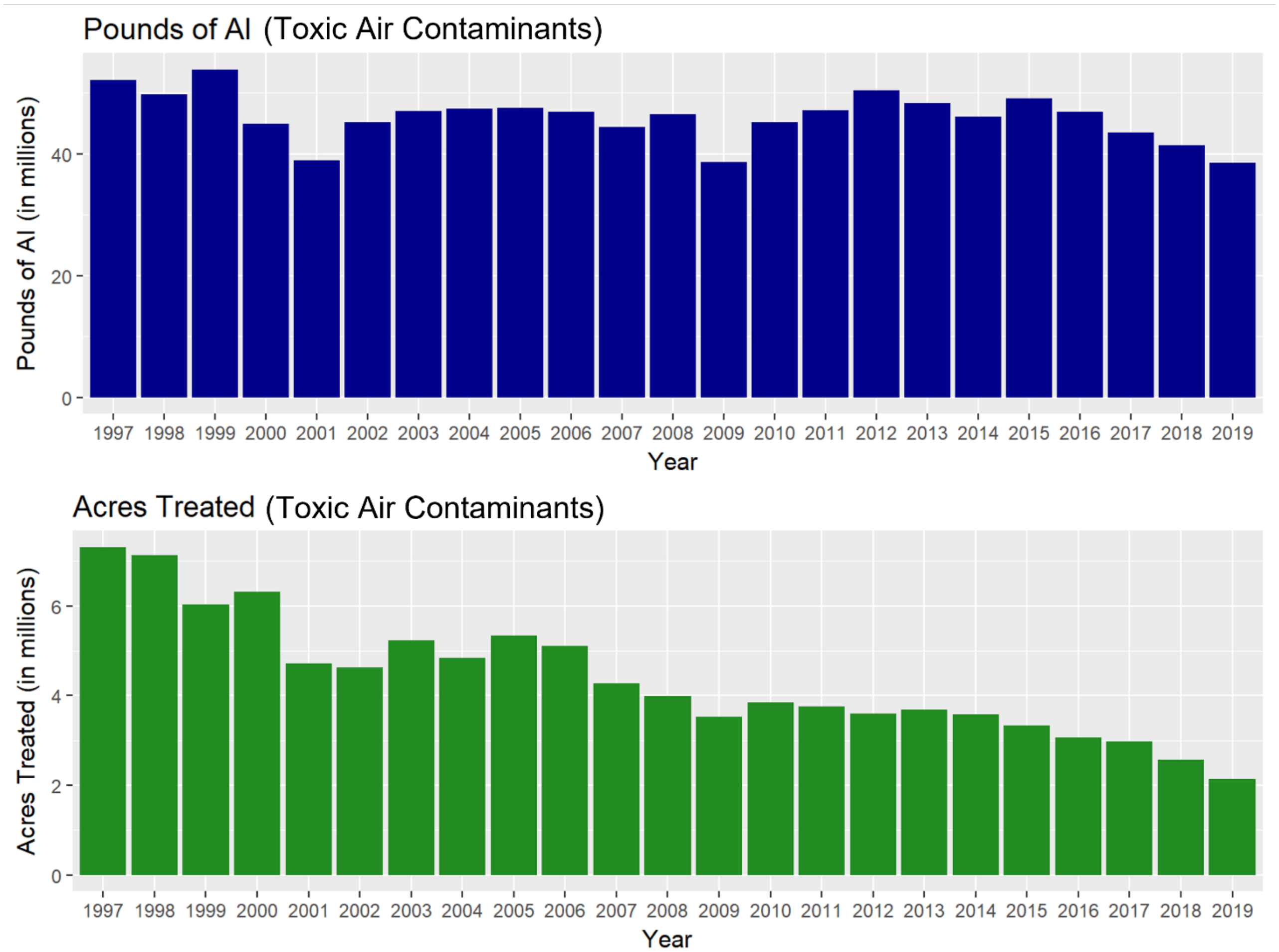


Figure 9. Use trends of pesticides that are on DPR's toxic air contaminants list. [Text files of data](https://files.cdpr.ca.gov/pub/outgoing/pur/data/) are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Fumigants

The use of fumigant AIs dropped by 2.3 million pounds applied (6 percent decrease) and by 34 thousand acres treated (13 percent decrease). Much of the decline in acres treated was due to 11 thousand less acres treated with zinc phosphide (32 percent decrease), 10 thousand less aces treated with aluminum phosphide (14 percent decrease), and 13 thousand less acres treated with potassium N-methyldithiocarbamate (28 percent decrease). The decline in pounds applied can be attributed to a 1.3 million pound decrease in 1,3-dichloropropene (10 percent decrease) and a 1.9 million pound decrease in potassium N-methyldithiocarbamate (22 percent decrease). Potassium n-methyldithiocarbamate (metam-potassium) and 1,3-dichloropropene are soil fumigants, while zinc phosphide and aluminum phosphide are largely used in the field to treat burrowing rodents (Figure 10).

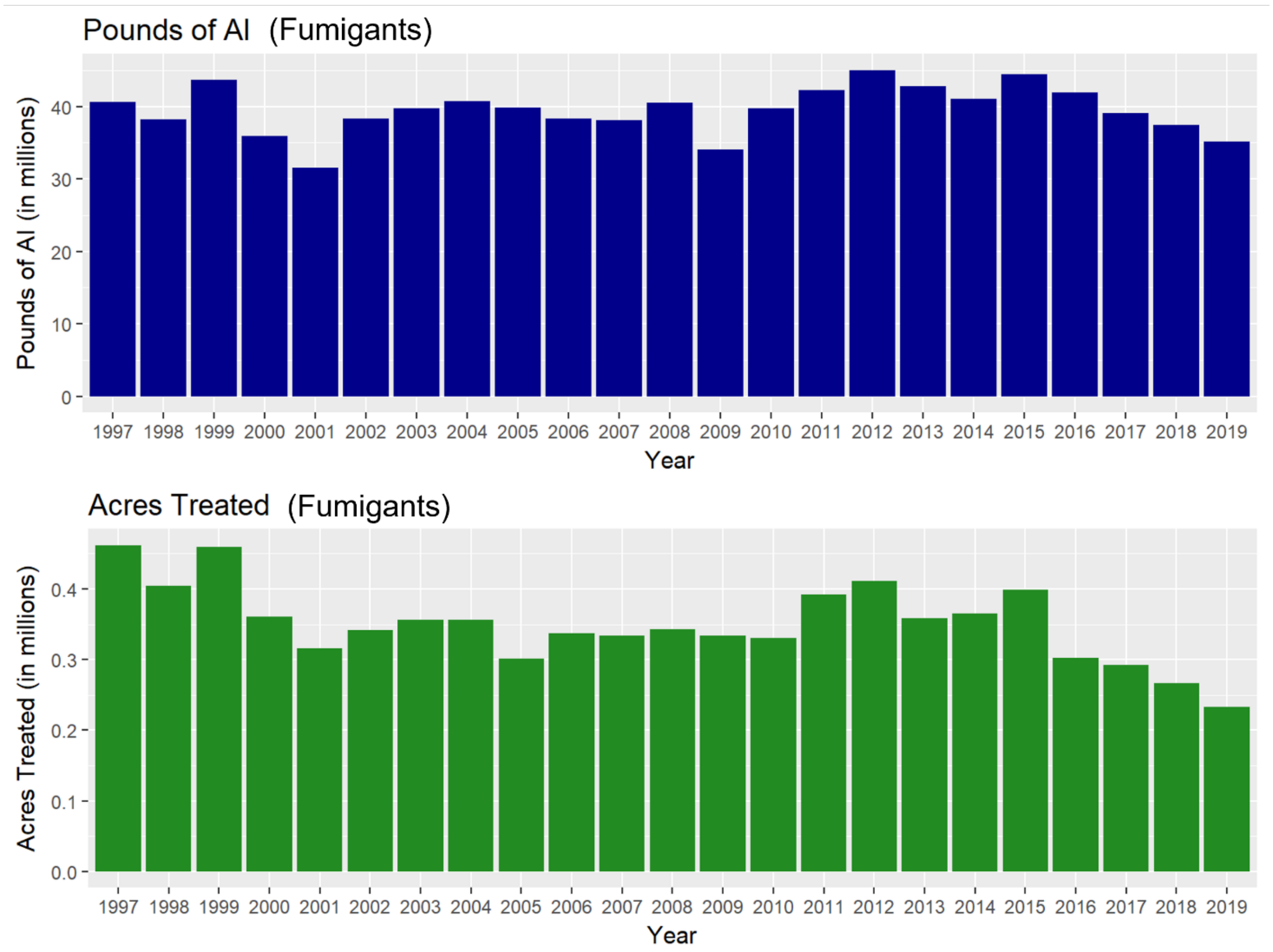


Figure 10. Use trends of pesticides that are fumigants. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Oils

Use of oil pesticides increased in amount by 416 thousand pounds applied (1 percent increase) and increased in acres treated by 43 thousand acres (1 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 more toxic pesticides. Some highly refined petroleum-based oils are used by organic growers (Figure 11).

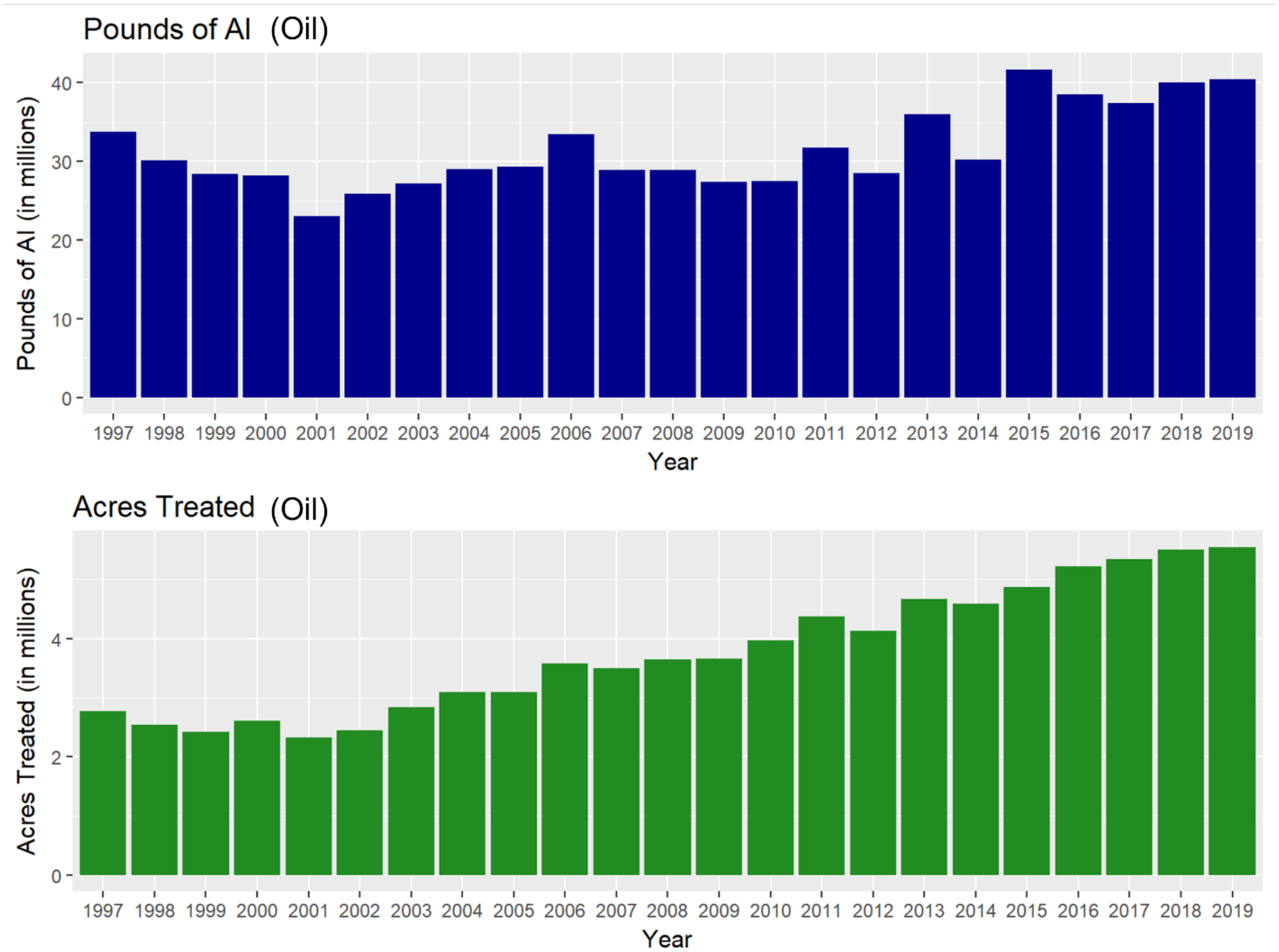


Figure 11. Use trends of pesticides that are oils. [Text files of data](https://files.cdpr.ca.gov/pub/outgoing/pur/data/) are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Biopesticides

Use of biopesticides and AIs considered to be lower risk to human health or the environment increased by 241 thousand pounds applied (3 percent increase) and by 935 thousand acres treated (11 percent increase). Hydrogen peroxide was responsible for much of the increase, largely due to its inclusion in some organically approved fungicide products. Hydrogen peroxide increased by 105 thousand pounds applied (30 percent increase) and 194 thousand acres treated (187 percent increase). The fungicides potassium phosphite and potassium bicarbonate increased by 446 thousand pounds applied (37 percent increase) and 118 thousand pounds applied (34 percent increase), respectively. Potassium phosphite increased by 133 thousand acres treated (32 percent increase), while potassium bicarbonate increased by 30 thousand acres treated (24 percent increase). In general, biopesticides are derived from natural materials such as animals, plants, bacteria, and minerals. In some cases, they are synthetic mimics of these natural materials (Figure 12).

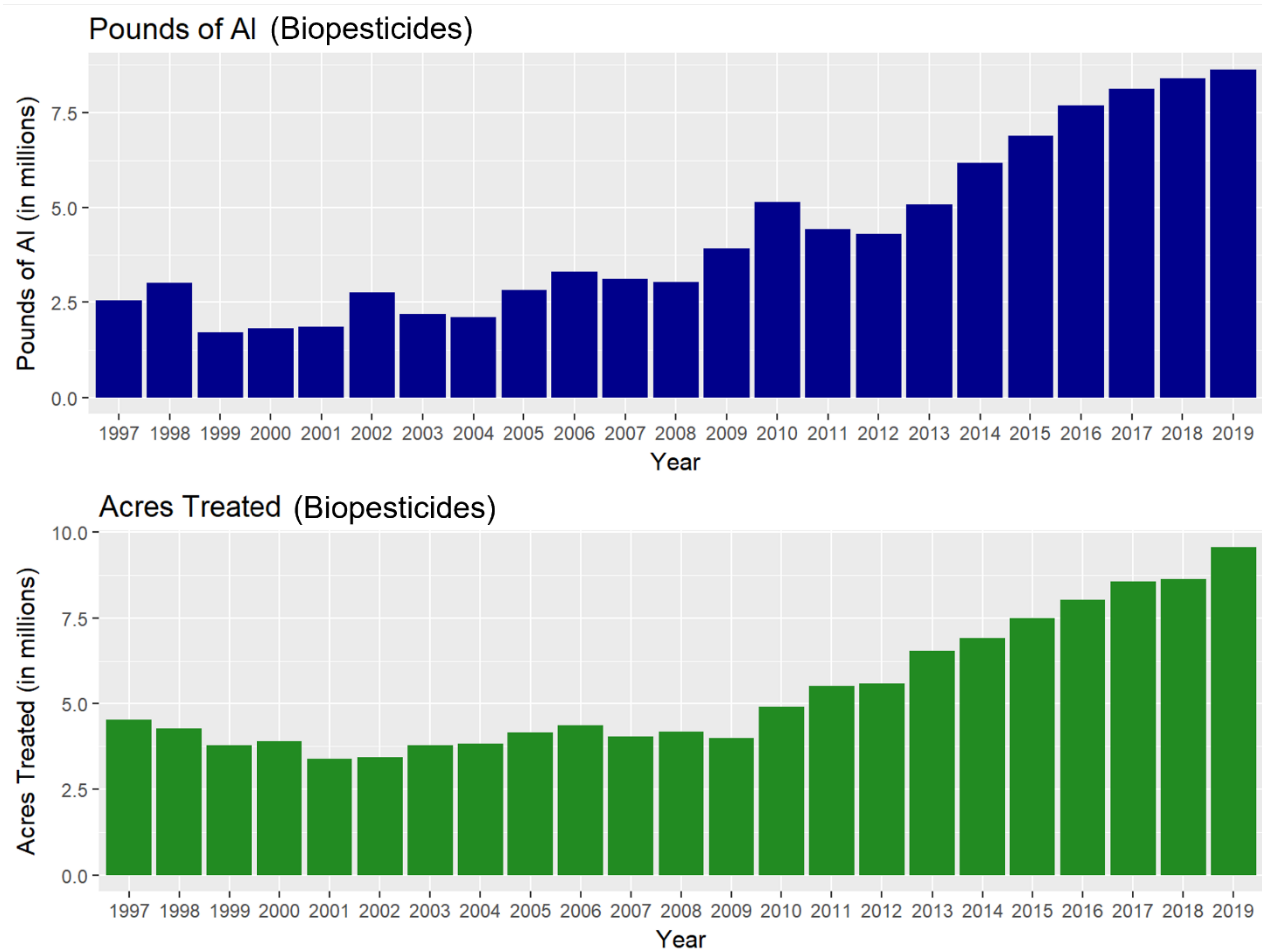


Figure 12. Use trends of pesticides that are biopesticides. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>.

Trends in Pesticide Use for Select Commodities

A grower's or applicator's decision to apply a particular pesticide depends on many factors, such as:

- Potential pesticide risk to the environment, farm workers, or general public,
- The presence of biological control agents (e.g., predatory insects and other natural enemies),
- Other available management practices,
- Pest pressure,
- Cost of pesticides and labor,
- Value of the crop, and
- Pesticide resistance and effectiveness.

Pest population and the resulting pest pressure is determined by complex ecological interactions. Weather is a critically important factor and affects different pest species in different ways. However, sometimes the causes of pest outbreaks are unknown.

Crops treated with the greatest total pounds applied of pesticides in 2019 were:

1. Almond,
2. Wine grape,
3. Orange and tangerine,
4. Table and raisin grape, and
5. Processing tomato.

Besides total pounds applied, the magnitudes of changes in use can be of interest in understanding pesticide use trends. Table 15 shows the change in pounds applied for ten crops (or sites): the first five rows are the crops with the greatest *increases* in pounds applied and the last five rows are the crops with the greatest *decreases* over the last year. Sometimes changes in use can be due to different pesticide practices, but other times the increase or decrease in use may simply be because the total crop acreage increased or decreased. Therefore, in addition to the change in pounds applied of pesticide since last year, the table also includes the change in acres planted or harvested, as measured by the Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service (USDA NASS).

Table 15 a,b: The change in pounds applied of active ingredient applied and acres planted, bearing, or harvested, and the percent change from 2018 to 2019 for the crops or sites with the greatest increase (a) and decrease (b) in pounds applied. NA means not available. Acre values sourced from the USDA NASS Quickstats database. Text files of data are available at <https://files.cdpr.ca.gov/pub/outgoing/pur/data/>

a. Crops or Sites with Greatest Increase	Change in pounds applied	Change in acres planted, bearing, or harvested	Percent Change in pounds applied	Percent Change in acres treated
Rights of way	1,013,744	NA	25	NA
Orange	942,862	2,000	8	1
Landscape maintenance	748,060	NA	48	NA
Tangerine	554,089	2,000	16	3
Grape	424,852	-3,000	3	-1

b. Crops or Sites with Greatest Decrease	Change in pounds applied	Change in acres planted, bearing, or harvested	Percent Change in pounds applied	Percent Change in acres treated
Lumber, treated	-439,819	NA	-24	NA
Potato	-459,436	1,800	-35	5
Walnut	-545,296	15,000	-7	4
Tomato, processing	-1,438,827	-6,000	-12	-2
Almond	-1,565,292	90,000	-4	8

Crops or sites with the greatest percentage *increase* in the pounds applied from 2018 to 2019 included rights of way, orange, landscape maintenance, tangerine, and grape. The increase in pounds applied to rights of way and landscape maintenance was largely driven by increased herbicide use. Orange and tangerine increased in acreage as well as pesticide use, while grape increased in pesticide use despite a decrease in acreage (Table 15a).

Crops or sites with the greatest percentage *decrease* in the pounds applied included almond, processing tomato, walnut, potato, and treated lumber. Processing tomato had decreasing pounds of pesticides applied accompanied by declining acreage, whereas pounds applied to almond, walnut, and potato decreased despite an increase in acreage (Table 15b).

Top Agricultural Commodities by Pesticide Use:

Top commodities by pesticide use were defined as the commodities that were treated with more than 4 million pounds of AIs applied or had more than 3 million acres treated in 2019. Thirteen commodities[1] were chosen based on this criteria, listed here in descending order by pounds applied:

1. Almond
2. Wine grape
3. Orange and tangerine
4. Table and raisin grape
5. Processing tomato
6. Strawberry
7. Walnut
8. Pistachio
9. Carrot
10. Peach and nectarine
11. Rice
12. Cotton
13. Alfalfa

DID YOU KNOW?

The pounds of pesticide applied to *carrot, almond, and walnut* decreased between 2018 and 2019 despite an increase in acreage planted, harvested or bearing.

Increased Production, Less Pesticide Use

Collectively, the pesticides used on these commodities represent 73 percent of the total amount of pounds applied and 76 percent of the acres treated in 2019 (Table 16).

Table 16. Pounds applied and acres treated of the top 13 crops, sorted by descending pounds applied, for 2019.

Crop	Million Pounds Applied	Million Acres Treated
Almond	37.74	27.06
Wine Grape	30.75	10.94
Orange and Tangerine	16.20	4.16
Table and Raisin Grape	15.27	6.56
Processing Tomato	10.59	3.06
Strawberry	9.98	2.36
Walnut	6.91	5.09
Pistachio	5.92	6.32
Carrot	5.39	0.47
Peach and Nectarine	4.57	1.62
Rice	4.53	3.01
Cotton	3.56	7.87
Alfalfa	2.55	4.65

[1] "Orange and tangerine", "peach and nectarine" and "table and raisin grapes" each contain two crops grouped together for the purposes of the Annual Report due to similar pesticide use

Pesticide use may increase or decrease due to new acreage put into production or acreage taken out of production. Using total acreage[1] values from the Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service (USDA NASS), Figure 13 shows that the increase in pounds applied of active ingredients for pistachio, strawberry, peach and nectarine, and orange and tangerine is likely due, at least in part, to increases in total acreage from 2018 to 2019. Similarly, the decrease in pounds applied for alfalfa, rice, and processing tomato may be due in part to less acreage in production in 2019 compared to 2018. Table and raisin grape, cotton, and wine grape had increases in pounds applied despite small decreases or no change in total acreage, while the pounds applied to walnut, almond, and carrot declined despite increasing acreage (Figure 13).

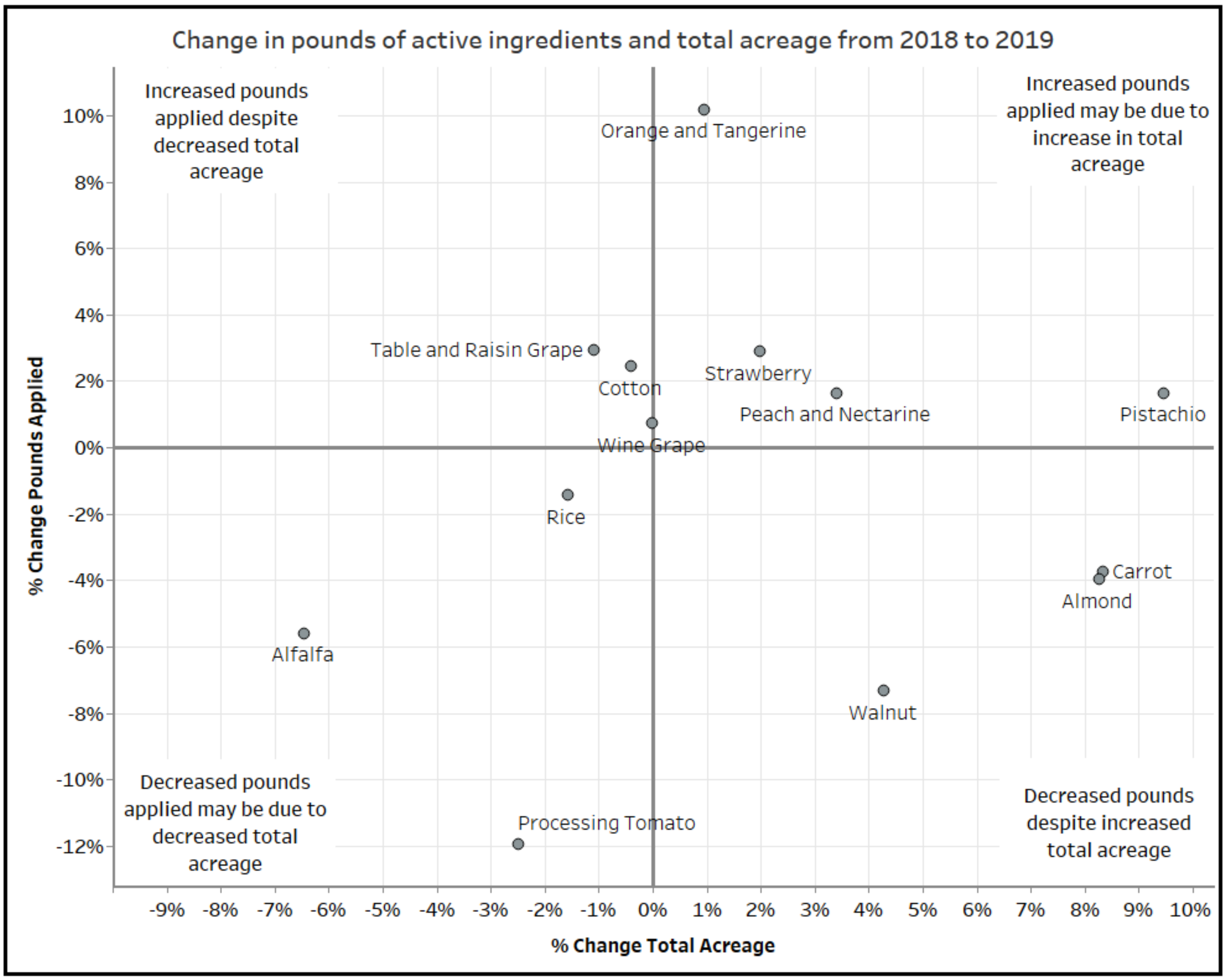


Figure 13. Graph showing percentage change in pounds of active ingredients applied from 2018 to 2019 against the change in the total acreage of the commodity. Pounds applied is determined from the PUR data while the total acreage comes from the Quick Stats database, USDA National Agricultural Statistics Service (NASS). Total acreage may be acres planted, harvested, or bearing depending on the unit reported for the commodity in NASS.

[1] Total acreage may be acres planted, harvested, or bearing depending on the unit reported for the commodity in NASS

The following section summarizes the changes in pesticide use and top five pesticides by pounds applied and acres treated for the 13 top commodities. A general use type (insecticide, fungicide, herbicide, etc.) is included for each AI. Note that use types may vary depending on the product that contains the AI, and there may be more than one use type for each AI. The tables contain the use type most often associated with the AI. Oil is listed as 'Many Types' due to the many different types of pesticides that contain oil as an AI. The majority are insecticides, fungicides, and adjuvants. Most oil pesticides used in California serve as alternatives to more toxic pesticides. For the top five tables for each of the thirteen crops, the following AIs are summations of all related salts, esters, subspecies/strains, or other closely related chemical derivatives: glyphosate, 2,4-D, *bacillus thuringiensis,* copper, and oil.

Alfalfa

In 2019, there were 2.5 million pounds of AI applied to alfalfa compared to 2.7 million pounds in 2018 (6 percent decrease). Similarly, the acres treated also decreased, going from 5.2 million acres treated in 2018 to 4.6 million in 2019(10 percent decrease). This decrease in pesticide use may be in part due to a 6 percent decrease in harvested acreage in 2019[1] (Figure 13).

The top five AIs used in alfalfa were mostly herbicides. Glyphosate and pendimethalin were in the top five when ranked by pounds applied and by acres treated. The insecticides lambda-cyhalothrin and indoxacarb, and the herbicide clethodim, made up the remainder of the top five by acres treated, while the herbicides trifluralin and EPTC and the fungicide/insecticide sulfur comprised the remaining top five when measure by pounds applied (Table 15, 16).

Table 17. The 2019 top five AIs by acres treated in alfalfa.

Top 5	Type	Acres Treated
Lambda-Cyhalothrin	Insecticide	324,231
Pendimethalin	Herbicide	259,862
Glyphosate	Herbicide	244,115
Indoxacarb	Insecticide	226,141
Clethodim	Herbicide	204,297

Table 18. The 2019 top five AIs by pounds applied to alfalfa. Fung/Insect = Fungicide/Insecticide

Top 5	Type	Pounds Applied
Pendimethalin	Herbicide	548,580
Glyphosate	Herbicide	385,801
Trifluralin	Herbicide	125,238
EPTC	Herbicide	109,217
Sulfur	Fung/Insect	99,562

ALFALFA

Alfalfa in bloom. DPR staff photo.

Field of alfalfa stubble. DPR staff photo

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

Almond

Despite an 8 percent increase in statewide bearing acreage[1], the pounds of AI applied to almonds decreased from 39.3 million in 2018 to 37.7 million in 2019 (4 percent decrease). In contrast, the acres treated with AIs increased from 25.4 million acres to 27 million acres treated (7 percent increase) (Figure 13).

Glyphosate and oil AIs made the top five AIs when ranked by both pounds applied and acres treated. Most of the top five AIs by acres treated were insecticides, while the top five AIs by pounds applied included oil, 1,3-dichloropropene, and sulfur (Table 19, 20).

Table 19. The 2019 top five AIs by acres treated in almond.

Top 5	Type	Acres Treated
Glyphosate	Herbicide	1,671,693
Abamectin	Insecticide	1,275,094
Oil	Many types	1,236,060
Chlorantraniliprole	Insecticide	1,086,652
Methoxyfenozide	Insecticide	967,568

Table 20. The 2019 top five AIs by pounds applied to almond. Fung/Insect = Fungicide/Insecticide.

Top 5	Type	Pounds Applied
Oil	Many types	17,157,323
Glyphosate	Herbicide	3,154,332
1,3-Dichloropropene	Fumigant	2,861,384
Sulfur	Fung/Insect	998,367
Glufosinate-Ammonium	Herbicide	864,203

ALMOND

Almond branch heavy with nuts. DPR staff photo

Almond nut. DPR staff photo

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

Carrot

The acres of carrots planted statewide increased by 8 percent in 2019[1]. Despite more planted acres, the pounds of AI applied and the acres treated both declined. In 2019, 5.4 million pounds were applied compared to 2018 with 5.6 million pounds (4 percent decrease). The amount of carrot acres treated with AIs decreased from 522 thousand acres in 2018 to 475 thousand acres in 2019 (9 percent decrease) (Figure 13).

Sulfur (fungicide/insecticide) and linuron (herbicide) made the top five lists by both acres treated and pounds applied. The herbicide pendimethalin and the fungicides mefenoxam and azoxystrobin made up the remainder of the top five by acres treated, while the fumigants potassium N-methyldithiocarbamate, metam sodium, and 1,3-dichloropropene rounded out the top five by pounds applied (Table 21, 22).

Table 21. The 2019 top five AIs by acres treated in carrot. Fung/Insect = Fungicide/Insecticide.

Top 5	Type	Acres Treated
Sulfur	Fung/Insect	95,087
Linuron	Herbicide	53,035
Mefenoxam	Fungicide	44,001
Pendimethalin	Herbicide	19,687
Azoxystrobin	Fungicide	17,978

Table 22. The 2019 top five AIs by pounds applied to carrot. Fung/Insect = Fungicide/Insecticide.

Top 5	Type	Pounds Applied
Potassium N-Methyldithiocarbamate	Fumigant	2,127,316
Metam-Sodium	Fumigant	1,553,936
1,3-Dichloropropene	Fumigant	770,086
Sulfur	Fung/Insect	725,663
Linuron	Herbicide	39,549

CARROT

Carrots. Creative Commons CC0 1.0 Universal Public Domain Dedication.

Harvested carrots. Gerald Holmes, Strawberry Center, Cal Poly San Luis Obispo, Bugwood.org

Field of carrots. DPR staff photo

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

Cotton

The acres treated and pounds of AI applied to cotton increased in 2019, although the total acres planted[1] deceased slightly by 0.4 percent. Pounds of AI applied increased from 3.5 million pounds in 2018 to 3.6 million in 2019 (2 percent increase). acres treated increased from 7.3 million acres in 2018 to 7.9 million acres in 2019 (8 percent increase) (Figure 13).

Herbicides, defoliants, and plant growth regulators made up the majority of the top five pounds applied and acres treated in cotton (Table 23, 24).

Table 23. The 2019 top five AIs by acres treated in cotton. PGR = Plant Growth Regulator. Herb/Def = Herbicide/Defoliant

Top 5	Type	Acres Treated
Glyphosate	Herbicide	523,255
Flonicamid	Insecticide	419,706
Mepiquat Chloride	PGR	331,505
Thidiazuron	Defoliant	288,684
Diuron	Herbicide	287,899

Table 24. The 2019 top five AIs by pounds applied to cotton.

Top 5	Type	Pounds Applied
Glyphosate	Herbicide	768,976
Urea Dihydrogen Sulfate	Herb/Def	390,182
Ethephon	PGR	283,867
Sodium Chlorate	Herb/Def	177,011
Paraquat Dichloride	Herb/Def	147,929

COTTON

Harvested cotton. USDA NRCS.

Cotton boll. Johnny Crawford, University of Georgia, Bugwood.org

Cotton field. USDA NRCS.

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

Orange and Tangerine

Orange and tangerine are grouped together due to similar pest management. Total statewide bearing acreage for orange and tangerine increased by just under 1 percent.[1] Pounds of AI applied increased from 14.7 million pounds to 16.2 million (10 percent increase). The acres treated decreased from 4.3 million to 4.2 million acres (3 percent decrease) (Figure 13).

Oil was the most used AI by both pounds and acres treated. The fungicide copper and the herbicide glyphosate were also ranked in the top five AIs when measured by either pounds applied or acres treated. The insecticide/miticide abamectin and the herbicide 2,4-D rounded out the top five AIs by acres treated, while the biopesticide kaolin clay and the fumigant 1,3-dichloropropene completed the top five list by pounds applied (Table 25, 26).

Table 25. The 2019 top five AIs by acres treated in orange and tangerine.

Top 5	Type	Acres Treated
Oil	Many types	434,254
Copper	Fungicide	221,028
Glyphosate	Herbicide	215,890
Abamectin	Insecticide	169,967
2,4-D	Herbicide	144,715

Table 26. The 2019 top five AIs by pounds applied to orange and tangerine. Fung/Insect = Fungicide/Insecticide.

Top 5	Type	Pounds Applied
Oil	Many types	8,404,849
Copper	Fungicide	873,841
Kaolin	Fung/Insect	503,575
Glyphosate	Herbicide	338,162
1,3-Dichloropropene	Fumigant	335,916

ORANGE AND TANGERINE


Tangerines. Photo by Forest and Kim Starr, Starr Environmental, Bugwood.org


Orange harvest. DPR staff photo


Orange. DPR staff photo

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

Peach and Nectarine

Peach and nectarine are grouped together due to similar pest management methods. A 3 percent increase[1] in statewide bearing acreage of peaches and nectarines may explain part of why pounds applied rose from 4.5 million in 2018 to 4.6 million in 2019 (2 percent increase). In contrast, the acres treated decreased in 2019, going from 1.7 million acres treated in 2018 to 1.6 million in 2019 (3 percent decrease) (Figure 13).

Similar to orange and tangerine, oil and copper were included in the top five when measured by both pounds of AI applied and by acres treated. Ziram, a fungicide, was also in the top five when ranked under both pesticide use measures.

The fungicide propiconazole and the herbicide glyphosate were the remaining two AIs in the top five list when ranked by acres treated, while sulfur and the fumigant 1,3-dichloropropene ranked in the top five when measured by pounds applied (Table 27, 28).

Table 27. The 2019 top five AIs by acres treated in peach and nectarine.

Top 5	Type	Acres Treated
Oil	Many types	170,371
Propiconazole	Fungicide	66,985
Ziram	Fungicide	54,293
Glyphosate	Herbicide	50,869
Copper	Fungicide	49,829

Table 28. The 2019 top five AIs by pounds applied to peach and nectarine. Fung/Insect = Fungicide/Insecticide.

Top 5	Type	Pounds Applied
Oil	Many types	2,841,670
Ziram	Fungicide	311,010
Sulfur	Fung/Insect	274,812
1,3-Dichloropropene	Fumigant	226,250
Copper	Fungicide	218,795

PEACH AND NECTARINE

Peaches. DPR staff photo

Peach orchard in bloom. DPR staff photo

Nectarines on tree. DPR staff photo

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

Pistachio

The total bearing acreage of pistachio increased by 9 percent in 2019[1], which may in part account for the increase in pesticide use. Pounds of AI applied to pistachio increased from 5.8 million pounds in 2018 to 5.9 million pounds in 2019 (2 percent increase). Acres treated increased from 6.1 million acres in 2018 to 6.3 million acres in 2019 (4 percent increase) (Figure 13).

The herbicides glyphosate and glufosinate-ammonium made the top five AIs when ranked by both pounds applied and by acres treated. Three insecticides – lambda cyhalothrin, bifenthrin, and chlorantraniliprole – completed the top five when measured by acres treated, while sulfur, oil and pendimethalin made up the top five when measured by pounds applied (Table 29, 30).

Table 29. The 2019 top five AIs by acres treated in pistachio. Fung/Insect = Fungicide/Insecticide

Top 5	Type	Acres Treated
Glyphosate	Herbicide	478,818
Lambda-Cyhalothrin	Insecticide	464,668
Bifenthrin	Insecticide	334,479
Chlorantraniliprole	Insecticide	305,789
Glufosinate-Ammonium	Herbicide	228,118

Table 30. The 2019 top five AIs by pounds applied to pistachio.

Top 5	Type	Pounds Applied
Sulfur	Fung/Insect	1,401,414
Glyphosate	Herbicide	916,713
Oil	Many types	574,565
Glufosinate-Ammonium	Herbicide	235,970
Pendimethalin	Herbicide	231,623

PISTACHIO

Pistachio branch. Gerald Holmes, Strawberry Center, Cal Poly San Luis Obispo, Bugwood.org

Pistachio orchard. DPR staff photo

Pistachios. USDA ARS Photo Unit, USDA Agricultural Research Service, Bugwood.org

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

Processing Tomato

The statewide planted acreage of processing tomatoes decreased by 2 percent in 2019[1]. Similarly, there was a decrease in pounds of AI applied in 2019, going from 12 million pounds in 2018 to 10.6 million pounds in 2019 (12 percent decrease). The acres treated increased, however, rising from 2.9 million acres in 2018 to 3.1 million acres in 2019 (5 percent increase) (Figure 13).

Sulfur was ranked as the most-used AI in terms of both pounds applied and acres treated. Chlorothalonil, a fungicide, also ranked in the top five by both pounds applied and acres treated. The insecticide imidacloprid and the two fungicides, copper and azoxystrobin, made up the remaining three of the top five AIs by acres treated. The biopesticide kaolin and two fumigants, potassium N-methyldithiocarbamate and metam-sodium ranked in the top five by pounds applied (Table 31, 32).

Table 31. The 2019 top five AIs by acres treated in processing tomato. Fung/Insect = Fungicide/Insecticide

Top 5	Type	Acres Treated
Sulfur	Fung/Insect	288,684
Copper	Fungicide	153,682
Imidacloprid	Insecticide	149,598
Chlorothalonil	Fungicide	128,844
Azoxystrobin	Fungicide	128,038

Table 32. The 2019 top five AIs by pounds applied to processing tomato. Fung/Insect = Fungicide/Insecticide

Top 5	Type	Pounds Applied
Sulfur	Fung/Insect	7,247,746
Potassium N-Methyldithiocarbamate	Fumigant	1,227,755
Metam-Sodium	Fumigant	426,062
Chlorothalonil	Fungicide	253,413
Kaolin	Fung/Insect	235,090

PROCESSING TOMATO

Field of tomatoes. Gerald Holmes, Strawberry Center, Cal Poly San Luis Obispo, Bugwood.org

Tomatoes. Creative Commons CC0 1.0 Universal Public Domain Dedication.

Tomatoes on the vine. DPR staff photo

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

Rice

The statewide acres planted of rice decreased by 2 percent in 2019[1]. This decrease may explain the decline in the pounds of AI applied to rice in 2019, going from 4.6 million pounds in 2018 to 4.5 million pounds in 2019 (1 percent decrease). In contrast, the acres treated with AIs increased from 2.9 million acres treated in 2018 to 3 million acres in 2019 (3 percent increase) (Figure 13).

The herbicides propanil, triclopyr (triethylamine salt), and thiobencarb ranked in the top five AIs by both acres treated and pounds applied. The fungicide azoxystrobin and the insecticide lambda cyhalothrin were in the top five by acres treated, while the fungicide copper and the algaecide sodium carbonate peroxyhydrate ranked in the top five by pounds applied (Table 33, 34).

Table 33. The 2019 top five AIs by acres treated in rice.

Top 5	Type	Acres Treated
Propanil	Herbicide	354,195
Triclopyr, Triethylamine Salt	Herbicide	320,578
Azoxystrobin	Fungicide	260,963
Thiobencarb	Herbicide	190,275
Lambda-Cyhalothrin	Insecticide	168,983

Table 34. The 2019 top five AIs by pounds applied to rice.

Top 5	Type	Pounds Applied
Propanil	Herbicide	1,855,888
Copper	Fungicide	702,626
Thiobencarb	Herbicide	654,018
Sodium Carbonate Peroxyhydrate	Algaecide	207,511
Triclopyr, Triethylamine Salt	Herbicide	62,511

RICE


Rice grains. Photo courtesy of USDA NRCS


Rice field. Natalie Hummel, Louisiana State University AgCenter, Bugwood.org


Rice harvest in Northern California. Photo courtesy of USDA NRCS

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

Strawberry

The total planted acreage of strawberry in California increased by 2 percent in 2019[1]. The increase in acreage may in part account for the increase in pesticide use. The pounds applied increased from 9.7 million pounds in 2018 to 10 million pounds in 2019 (3 percent increase). The acres treated remained nearly the same at 2.4 million acres (0.2 percent increase) (Figure 13).

Captan, a fungicide, and sulfur, a fungicide/insecticide, ranked in the top five by both pounds applied and acres treated. The insecticides novaluron and *Bacillus thuringiensis* rounded off the top five by acres treated, while the fumigants chloropicrin, 1,3-dichloropropene, and potassium N-methyldithiocarbamate were in the top five AIs by pounds applied (Table 35, 36).

Table 35. The 2019 top five AIs by acres treated in strawberry. Fung/Insect = Fungicide/Insecticide.

Top 5	Type	Acres Treated
Captan	Fungicide	180,631
Sulfur	Fung/Insect	176,451
Captan, Other Related	Fungicide	77,939
Novaluron	Insecticide	73,104
Bacillus thuringiensis	Insecticide	64,151

Table 36. The 2019 top five AIs by pounds applied to strawberry. Fung/Insect = Fungicide/Insecticide.

Top 5	Type	Pounds Applied
Chloropicrin	Fumigant	5,967,873
1,3-Dichloropropene	Fumigant	1,368,568
Sulfur	Fung/Insect	572,435
Potassium N-Methyldithiocarbamate	Fumigant	374,024
Captan	Fungicide	323,188

STRAWBERRY

Row of strawberries. DPR staff photo.

Strawberry on vine. DPR staff photo.

Strawberry field. DPR staff photo.

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

Table and Raisin Grape

Pesticide use on table and raisin grapes increased in 2019, despite a decline in total bearing acreage by 1 percent in 2019[1]. The pounds of AI applied increased from 14.8 million pounds in 2018 to 15.3 million pounds in 2019 (3 percent increase). The acres treated also increased, rising from 6.5 million acres in 2018 to 6.6 million acres in 2019 (1 percent increase) (Figure 13).

Sulfur and copper made the top five AIs by acres treated and pounds applied. The plant growth regulator gibberellin, the herbicide glufosinate-ammonium, and the insecticide imidacloprid comprised the remaining three top five AIs by acres treated, while the fungicide/insecticide lime-sulfur, the fumigant 1,3-dichloropropene, and the plant growth regulator hydrogen cyanamide were in the top five AIs by pounds applied (Table 37, 38).

Table 37. The 2019 top five AIs by acres treated in table and raisin grape. Fung/Insect = Fungicide/Insecticide. PGR = Plant Growth Regulator.

Top 5	Type	Acres Treated
Sulfur	Fung/Insect	1,775,281
Copper	Fungicide	413,631
Gibberellins	PGR	332,341
Glufosinate-Ammonium	Herbicide	133,826
Imidacloprid	Insecticide	130,493

Table 38. The 2019 top five AIs by pounds applied to table and raisin grape. Fung/Insect = Fungicide/Insecticide. PGR = Plant Growth Regulator.

Top 5	Type	Pounds Applied
Sulfur	Fung/Insect	10,375,642
Lime-Sulfur	Fung/Insect	813,991
1,3-Dichloropropene	Fumigant	617,554
Copper	Fungicide	441,698
Hydrogen Cyanamide	PGR	373,966

TABLE AND RAISIN GRAPE

Raisins. Gerald Holmes, Strawberry Center, Cal Poly San Luis Obispo, Bugwood.org

Bunch of green grapes. DPR staff photo.

Raisin grapes drying on the vine. DPR staff photo.

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

Walnut

Total bearing acreage of walnuts increased by 4 percent in 2019[1]. Despite this increase in acreage, pesticide use declined. There was a decrease in pounds of AI applied from 7.5 million pounds in 2018 to 6.9 million pounds in 2019 (7 percent decrease). Acres treated decreased from 5.2 million in 2018 to 5.1 million acres treated in 2019 (2 percent decrease) (Figure 13).

The top five AIs used in walnut included the fungicides copper and mancozeb and the herbicide glyphosate for both pounds applied and acres treated. The remaining two AIs by acres treated were the herbicide oxyfluorfen and the insecticide chlorantraniliprole, while the biopesticide kaolin clay and the fumigant 1,3-dichloropropene made up the remaining two top five AIs when measured by pounds applied (Table 39, 40).

Table 39. The 2019 top five AIs by acres treated in walnut.

Top 5	Type	Acres Treated
Copper	Fungicide	447,922
Mancozeb	Fungicide	401,186
Glyphosate	Herbicide	324,294
Oxyfluorfen	Herbicide	171,160
Chlorantraniliprole	Insecticide	154,696

Table 40. The 2019 top five AIs by pounds applied to walnut. Fung/Insect = Fungicide/Insecticide

Top 5	Type	Pounds Applied
Copper	Fungicide	1,656,976
Kaolin	Fung/Insect	811,508
Mancozeb	Fungicide	712,696
Glyphosate	Herbicide	623,527
1,3-Dichloropropene	Fumigant	427,834

WALNUT

Walnuts. Creative Commons CC0 1.0 Universal Public Domain Dedication.

Walnut on branch. DPR staff photo.

Walnut orchard. DPR staff photo.

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

Wine Grape

The bearing acreage of wine grapes in California remained constant from 2018 to 2019 at 590 thousand acres[1]. Pounds of AI applied increased from 30.5 million pounds in 2018 to 30.7 million pounds in 2019 (0.6 percent increase). The acres treated decreased from 11.2 million acres in 2018 to 10.9 million acres in 2019 (2 percent decrease) (Figure 13).

Sulfur, oil, and glyphosate made up the top five AIs when ranked by either acres treated or pounds applied. The fungicide copper and the herbicide glufosinate-ammonium rounded out the top five AIs by acres treated, while the fumigant 1,3-dichloropropene and the fungicide/insecticide lime-sulfur comprised the remaining two AIs of the top five by pounds applied (Table 41, 42).

Table 41. The 2019 top five AIs by acres treated in wine grape. Fung/Insect = Fungicide/Insecticide.

Top 5	Type	Acres Treated
Sulfur	Fung/Insect	2,738,514
Copper	Fungicide	406,327
Glyphosate	Herbicide	346,667
Oil	Many types	342,629
Glufosinate-Ammonium	Herbicide	300,152

Table 42. The 2019 top five AIs by pounds applied to wine grape. Fung/Insect = Fungicide/Insecticide.

Top 5	Type	Pounds Applied
Sulfur	Fung/Insect	24,010,479
Oil	Many types	2,289,286
Glyphosate	Herbicide	600,983
1,3-Dichloropropene	Fumigant	324,422
Lime-Sulfur	Fung/Insect	289,492

WINE GRAPE

Wine grape bunches. William M. Brown Jr., Bugwood.org

Wine grape vineyard. DPR staff photo.

Rows of wine grapes. DPR staff photo.

[1] Quick Stats Database of US Department of Agriculture, National Agricultural Statistics Service

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