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MEMORANDUM

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DATE: October 2, 2020

SUBJECT: PRELIMINARY ESTIMATES OF VOLATILE ORGANIC COMPOUND EMISSIONS FROM PESTICIDES IN THE SAN JOAQUIN VALLEY: EMISSIONS FOR 2019

SUMMARY

This document summarizes the preliminary adjusted emissions inventory for the San Joaquin Valley based on data reported to or produced by the California Department of Pesticide Regulation (CDPR) from May 1 to October 31, 2019, the peak ozone season in California.

Preliminary estimates show that volatile organic compound (VOC) emissions from pesticides increased 1% (0.206 tons/day (tpd)) since 2018, from 16.221 to 16.427 tpd. Emissions remain below the State Implementation Plan (SIP) goal of 18.1 tpd and the regulatory trigger level of 17.2 tpd (95% of the SIP goal). Fumigant emissions increased 12% (0.468 tpd), from 3.951 to 4.419 tpd. Emissions from nonfumigant products decreased 2% (-0.262 tpd), from 12.270 to 12.008 tpd. In 2013, CDPR's pesticide VOC emissions inventory for the San Joaquin Valley nonattainment area (NAA) exceeded 17.2 tpd. As a result, certain uses of designated high-VOC products were prohibited starting in 2015. The calculated hypothetical emissions for 2018 exceeded the regulatory trigger level; therefore, the regulations' prohibition of certain uses of specified high-VOC products will continue until at least 2021, as stated in Title 3 California Code of Regulations (3 CCR) section 6884(c). Though the final 2019 VOC emissions estimates may change slightly, it is unlikely that the final emissions inventory will exceed the SIP goal for this NAA.

VOLATILE ORGANIC COMPOUND (VOC) INVENTORY RESULTS: SAN JOAQUIN VALLEY

Pesticide Use Report (PUR) data for statewide pesticide use from 2016 to 2019 were obtained from the PUR database on June 1, 2020, to produce the preliminary VOC emissions estimates for 2019 and update VOC emissions estimates for 2016 to 2018. Unless otherwise stated, all VOC emissions from fumigants are reported as adjusted emissions.

CDPR requests that registrants provide thermogravimetric analysis (TGA) data for new and existing products subject to the VOC data requirements. TGA data are used to determine a product's emission potential (EP), the fraction of a product that is assumed to contribute to atmospheric VOCs. Previous inventories have shown that changes in a widely used product's EP can significantly impact the emissions inventory.

Preliminary estimates show that VOC emissions from pesticides increased 1% (0.206 tons/day (tpd)) since 2018, from 16.221 to 16.427 tpd. Emissions remain below the State Implementation Plan (SIP) goal of 18.1 tpd and the regulatory trigger level of 17.2 tpd (95% of the SIP goal) (Table 1, Figure 1). Fumigant emissions increased 12% (0.468 tpd), from 3.951 to 4.419 tpd. Emissions from nonfumigant products decreased 2% (-0.262 tpd), from 12.270 to 12.008 tpd (Table 2). Emissions from products with emulsifiable-concentrate formulations decreased 11% (-0.672 tpd), from 6.201 to 5.529 tpd (Table 3, Figure 2).

Table 4 and Figures 3a and 3b show emissions from products whose active ingredients (AIs) were the top ten contributors to 2019 emissions in the San Joaquin Valley NAA, representing 51% of total emissions. Nine of the top ten emitting AIs in 2019 were also among the top ten in 2018. Of these, five AIs increased emissions: 1,3-dichloropropene; glufosinate-ammonium; methyl bromide; potassium n-methyldithiocarbamate; and mineral oil. Glufosinate-ammonium had the largest percent increase in emissions for this group: 21% (0.152 tpd). Four of these AIs decreased emissions: glyphosate, isopropylamine salt; abamectin; bifenthrin; and hexythiazox. Abamectin had the largest percent decrease in emissions for this group: 22% (-0.234 tpd). At 14% of total emissions, 1,3-dichloropropene had the highest emissions (2.208 tpd) of any other AI used in this NAA. Chloropicrin had the largest percent change in emissions: 45% (0.165 tpd).

Table 5 and Figures 3c and 3d show emissions from pesticide products applied to agricultural commodities that were the top ten contributors to 2019 emissions in the San Joaquin Valley NAA, representing 75% of total emissions. Eight of the top ten commodities in 2019 were also among the top ten in 2018. Of these eight commodities, four increased emissions: almond, pistachio, soil application (preplant-outdoor), and carrots. Soil application (preplant-outdoor) had the largest percent increase in emissions for this group: 71% (0.334 tpd). Four of these eight commodities decreased emissions: cotton (general), walnut, orange, and grapes. Walnut had the largest percent decrease in emissions for this group: 15% (-0.106 tpd). At 33% of total emissions, almond had the highest emissions (5.393 tpd) of any other commodity used in this NAA. Tangerine had the largest percent change in emissions: 77% (0.190 tpd).

Title 3 California Code of Regulations (3 CCR) section 6880 establishes EP thresholds to designate nonfumigant pesticide products containing abamectin, chlorpyrifos, gibberellins, and oxyfluorfen as high-VOC or low-VOC. These products have restrictions on sales (3 CCR section 6886) and prohibitions on use on certain crops when emission limits are triggered (3 CCR section 6884).

Table 6 lists the 2019 ozone season emissions of abamectin, chlorpyrifos, gibberellins, and oxyfluorfen. Only abamectin was among the top ten AIs by emission in 2019 (Table 4, Figures 3a, 3b). Chlorpyrifos use declined by more than 99% in 2019. This is likely the result of more restrictive use requirements that became effective on January 1, 2019, followed by the May 2019 announcement that CDPR was initiating cancellation for most chlorpyrifos products. These four AIs collectively contributed 9% (1.382 tpd) of 2019 emissions in San Joaquin Valley NAA, down from 13% (2.043 tpd) in 2018. Abamectin had the largest share of total emissions of the four AIs: 5% (0.808 tpd).

Table 7 and Figure 4 show the emissions of high-VOC and low-VOC products containing abamectin, chlorpyrifos, gibberellins, and oxyfluorfen. During these years nonfumigant regulations on high-VOC pesticides products continued to be in effect. The high-VOC share of emissions from these AIs increased slightly from 35% to 36%. Emissions of both low- and high-VOC products decreased in 2019, due to declines in emissions from abamectin and chlorpyrifos that offset increases in gibberellins and oxyfluorfen.

Table 10 lists emissions aggregated by combinations of AI (abamectin, chlorpyrifos, gibberellins, and oxyfluorfen) and agricultural commodity. Table 8 further aggregates by low-VOC and high-VOC products and includes columns for changes in emissions since 2018. This table shows that modest increases in emissions of gibberellins and oxyfluorfen for some commodities are overshadowed by larger decreases across a greater number of commodities for all four AIs.

Figure 5 shows combined emissions for abamectin, chlorpyrifos, gibberellins, and oxyfluorfen products since 2014, aggregated across low-VOC or high-VOC product categories and whether applications were for the seven crops listed in 3 CCR section 6884 or other crops. In 2013, emissions in the San Joaquin Valley NAA exceeded the SIP goal and triggered the implementation of nonfumigant regulations in 2015. Emissions from abamectin, chlorpyrifos, gibberellins, and oxyfluorfen decreased in 2014, but high-VOC product emissions still accounted for more than 3 tpd of emissions. As shown in Figure 5, when nonfumigant regulations became effective in 2015, emissions from all applications of these four AIs decreased substantially, and emissions from high-VOC products declined to 0.759 tpd. Emissions from these AIs totaled 1.382 tpd in 2019, and emissions from high-VOC products totaled 0.498 tpd, substantially lower than past years since 2015 (Figure 5).

Since 2013, between 88% and 91% of emissions from these four AIs in San Joaquin Valley NAA are attributed to seven crops: alfalfa, almonds, citrus, cotton, grapes, pistachios, and walnuts. Combined 2013 emissions of these AIs on all crops were 5.333 tpd, of which 77% (4.123 tpd) are attributed to high-VOC products applied to the seven crops. In 2019, emissions from high-VOC products applied to the seven crops accounted for 32% (0.444 tpd) of combined emissions

(1.382 tpd). The majority of combined emissions has consisted of low-VOC products applied to the seven crops since 2015 (Figure 5).

In 2019, 1.858 million pounds of products containing abamectin, chlorpyrifos, gibberellins, and oxyfluorfen AIs were used in the San Joaquin Valley NAA, compared to 2.814 million pounds in 2018 (Table 9). For these four AI, the ratio between the pounds of VOC emissions and pounds of product used increased by 2% since 2018. The emissions per pound of abamectin and chlorpyrifos products applied decreased by 13% and 80%, respectively; they increased for giberellins and oxyfluorfen products by 5% and 12%, respectively. With the decline of chlorpyrifos use and emissions, abamectin is now the top contributor to emissions among these four AIs. Despite the slight overall increase in emissions over use of these four AIs, low-VOC products are still the largest source of emissions from these AIs in the San Joaquin Valley NAA.

HYPOTHETICAL VOC EMISSIONS

Hypothetical VOC emissions are calculated for each AI used on each crop specified in 3 CCR section 6884 to see if the emissions comply with the limit specified in 3 CCR section 6452.2(f). The hypothetical emissions are calculated by assuming the relative mixture of high- and low-VOC products used in the current year of prohibitions would have been the same as in the most recent year without prohibitions (2014). The VOC emissions are then calculated using that product mixture for the amount of AI used in the current year.

The following formula is used to calculate the hypothetical VOC emissions described above for each pesticide-crop combination:

$$\underset{\textbf{\textit{(Table 10 column D)}}}{\text{Hypothetical emissions for a pesticide-crop combination listed in section 6884 during May-Oct for the year of prohibitions}} = \frac{\underset{\textbf{\textit{(Table 10 column A)}}}{\text{Emissions for the pesticide-crop combination during May-Oct for the most current year without prohibitions}} \ \mathbf{X} \ \underset{\textbf{\textit{(Table 10 column B)}}}{\text{Pounds active ingredient for the crop during May-Oct for the year of prohibitions}}}{\underset{\textbf{\textit{(Table 10 column C)}}}{\text{Pounds active ingredient for the crop during May-Oct for the most current year without prohibitions}}}$$

Table 10 details the hypothetical emissions for 2019 calculated using the formula above. The total hypothetical emissions for the pesticides and crops listed in 3 CCR section 6880 for 2019 are 18.066 tpd, 10% (1.639 tpd) higher than the actual inventory emissions. Total hypothetical VOC emissions equal emissions for the pesticide-crop combinations not listed in 3 CCR section 6880—shown below as total emissions across all pesticides and crops minus the emissions for each pesticide-crop combination listed in 3 CCR section 6880—plus the hypothetical emissions for each pesticide-crop combination:

$$\text{Total hypothetical emissions} = 16.427 - 1.247 + 2.886 = 18.066 \text{ tpd}$$

The high-VOC prohibitions went into effect during 2015. As specified in 3CCR section 6884, the hypothetical emissions must be less than the trigger level for at least two consecutive years before CDPR can lift the high-VOC prohibitions. The 2018 annual report extended these prohibitions through the end of 2021. The preliminary 2019 estimate of hypothetical emissions is 18.066 tpd in 2019, which is higher than the trigger level of 17.2 tpd for the San Joaquin Valley NAA. Therefore, the high-VOC, nonfumigant, ozone-season prohibitions will remain in effect through 2022.

Although the application of high-VOC abamectin, chlorpyrifos, gibberellins, and oxyfluorfen products on alfalfa, almonds, citrus, cotton, grapes, pistachios, and walnuts during the months of May through October has been prohibited in the San Joaquin Valley NAA since 2015, pesticide use reports suggest that prohibition does not always result in annual VOC emission reductions from use of these products on these seven crops within the San Joaquin Valley NAA. The use of high-VOC oxyfluorfen products at a rate of 0.125 pounds per acre or less, and the use of high-VOC chlorpyrifos products to control aphids on cotton are exempt from use restrictions. Other factors that could explain continued use of high-VOC products include: (a) applications of products with emergency or 'special local needs' exemptions, which the inventory cannot currently identify; or (b) errors in the PUR submission process. Table 11 lists the high-VOC products with the highest reported use in this NAA during 2018 and 2019. Products with greater than 100 lbs of AI applied during 2019 are included in the table.

REFERENCES

Kroes, J. July 2020. Annual Report on Volatile Organic Compound Emissions from Pesticides: Emissions for 1990-2018
https://www.cdpr.ca.gov/docs/emon/vocs/vocproj/2018_voc_annual_report.pdf

Spurlock, F.S., 1/7/2002. Memo to John Sanders. Methodology for Determining VOC Emission Potentials of Pesticide Products.

Table 1. SIP Goal, regulatory trigger, and total emissions in the San Joaquin Valley NAA.

Year	Emissions (tpd)
SIP Goal	18.1
Trigger Level	17.2
2019	16.427
2018	16.221
2017	17.053
2016	15.432
2015	15.368
2014	16.815
2013	19.520
2012	16.921
2011	16.376
2010	15.228
2009	12.965
2008	14.525
2007	17.093
2006	21.305
2005	20.740
2004	17.322
1990	20.517

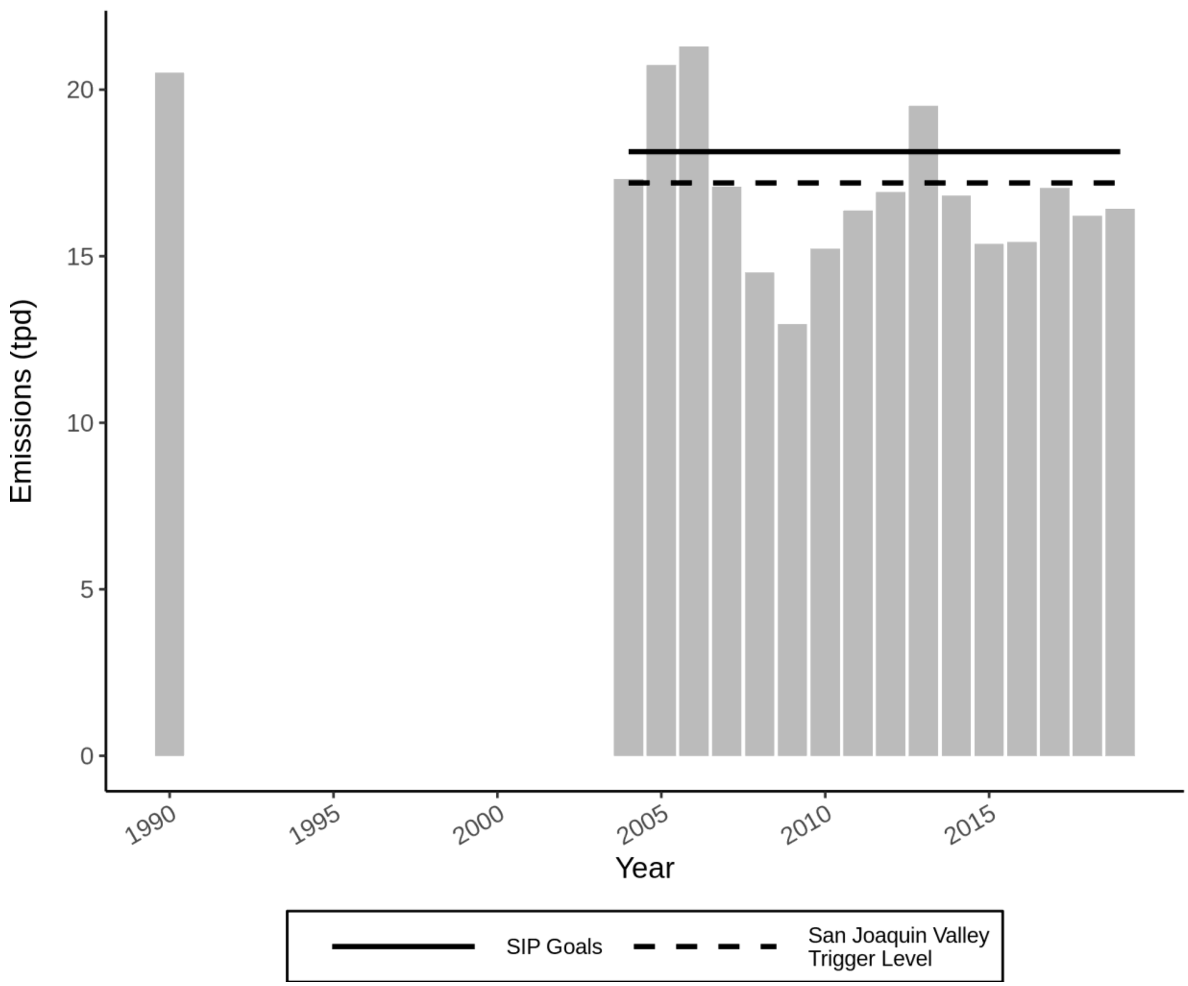

Figure 1. SIP Goal, regulatory trigger, and total emissions in the San Joaquin Valley NAA.

Table 2. Fumigant and nonfumigant emissions in the San Joaquin Valley NAA.

Year	Category	Emissions (tpd)	Percent Total Emissions
2019	Fumigant	4.419	27
2019	Nonfumigant	12.008	73
2018	Fumigant	3.951	24
2018	Nonfumigant	12.270	76
2017	Fumigant	4.219	25
2017	Nonfumigant	12.833	75
2016	Fumigant	4.237	27
2016	Nonfumigant	11.195	73
2015	Fumigant	4.777	31
2015	Nonfumigant	10.591	69
2014	Fumigant	4.026	24
2014	Nonfumigant	12.789	76
2013	Fumigant	4.353	22
2013	Nonfumigant	15.167	78
2012	Fumigant	4.265	25
2012	Nonfumigant	12.656	75
2011	Fumigant	4.001	24
2011	Nonfumigant	12.375	76
2010	Fumigant	3.700	24
2010	Nonfumigant	11.528	76
2009	Fumigant	3.078	24
2009	Nonfumigant	9.887	76
2008	Fumigant	3.370	23
2008	Nonfumigant	11.154	77
2007	Fumigant	6.123	36
2007	Nonfumigant	10.970	64
2006	Fumigant	6.808	32
2006	Nonfumigant	14.498	68
2005	Fumigant	6.910	33
2005	Nonfumigant	13.831	67
2004	Fumigant	6.362	37
2004	Nonfumigant	10.960	63
1990	Fumigant	5.536	27
1990	Nonfumigant	14.981	73

Table 3. Emissions from emulsifiable concentrate (EC) and all other nonfumigant formulations in the San Joaquin Valley NAA.

Year	Category	Emissions (tpd)	Percent Total Emissions	Percent Nonfumigant Emissions
2019	EC	5.529	34	46
2019	Other	6.479	39	54
2018	EC	6.201	38	51
2018	Other	6.069	37	49
2017	EC	7.043	41	55
2017	Other	5.791	34	45
2016	EC	6.517	42	58
2016	Other	4.678	30	42
2015	EC	6.300	41	59
2015	Other	4.291	28	41
2014	EC	7.298	43	57
2014	Other	5.491	33	43
2013	EC	8.760	45	58
2013	Other	6.407	33	42
2012	EC	7.263	43	57
2012	Other	5.392	32	43
2011	EC	6.854	42	55
2011	Other	5.521	34	45
2010	EC	6.608	43	57
2010	Other	4.921	32	43
2009	EC	5.921	46	60
2009	Other	3.966	31	40
2008	EC	7.491	52	67
2008	Other	3.663	25	33
2007	EC	7.547	44	69
2007	Other	3.423	20	31
1990	EC	12.162	59	81
1990	Other	2.819	14	19

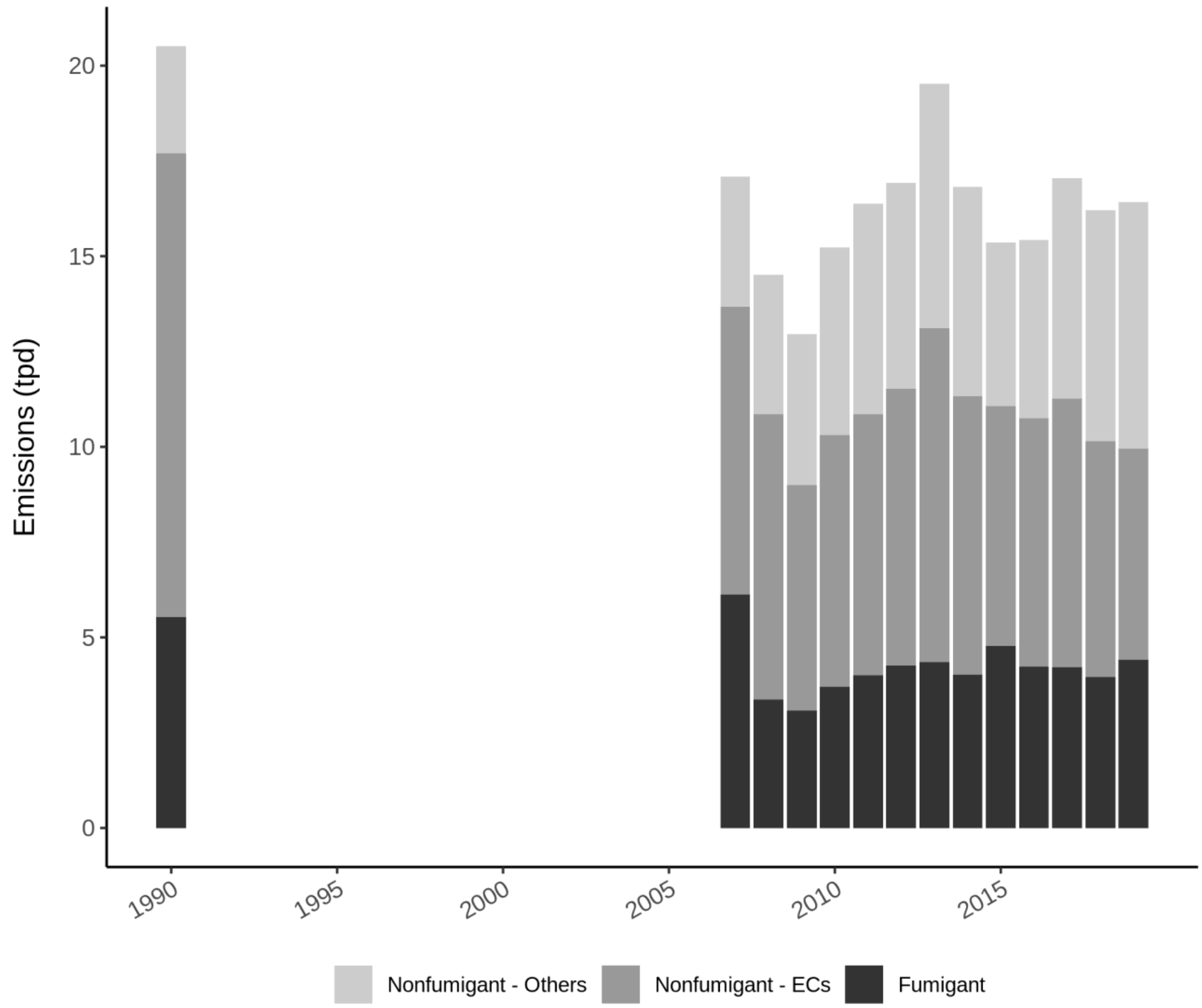

Figure 2. Emissions from fumigants, nonfumigants with emulsifiable-concentrate formulations, and other nonfumigant formulations in the San Joaquin Valley NAA.

Table 4. Top ten primary active ingredients (AIs) in terms of product-application emissions in the San Joaquin Valley NAA during 2019.

Primary AI	Emissions (tpd)	Percent Total Emissions	Change from 2018 to 2019 (tpd)	Percent Change from 2018 to 2019
1,3-DICHLOROPROPENE	2.208	13.64	0.126	6
GLUFOSINATE-AMMONIUM	0.871	5.38	0.152	21
GLYPHOSATE, ISOPROPYLAMINE SALT	0.853	5.27	-0.080	-9
ABAMECTIN	0.808	4.99	-0.234	-22
BIFENTHRIN	0.797	4.92	-0.047	-6
METHYL BROMIDE	0.600	3.70	0.072	14
POTASSIUM N-METHYLDITHIOCARBAMATE	0.544	3.36	0.041	8
HEXYTHIAZOX	0.538	3.32	-0.101	-16
CHLOROPICRIN	0.532	3.28	0.165	45
MINERAL OIL	0.523	3.23	0.079	18

Table 5. Top ten application sites in terms of product-application emissions in the San Joaquin Valley NAA during 2019.

Application Site	Emissions (tpd)	Percent Total Emissions	Change from 2018 to 2019 (tpd)	Percent Change from 2018 to 2019
ALMOND	5.393	32.83	0.133	3
COTTON (GENERAL)	1.684	10.25	-0.034	-2
PISTACHIO	1.150	7.00	0.009	1
SOIL APPLICATION (PREPLANT-OUTDOOR)	0.807	4.91	0.334	71
CARROTS	0.665	4.05	0.088	15
WALNUT	0.607	3.70	-0.106	-15
ORANGE	0.591	3.60	-0.030	-5
GRAPES	0.518	3.15	-0.076	-13
TANGERINE	0.436	2.65	0.190	77
CORN (FORAGE - FODDER)	0.409	2.49	0.029	8

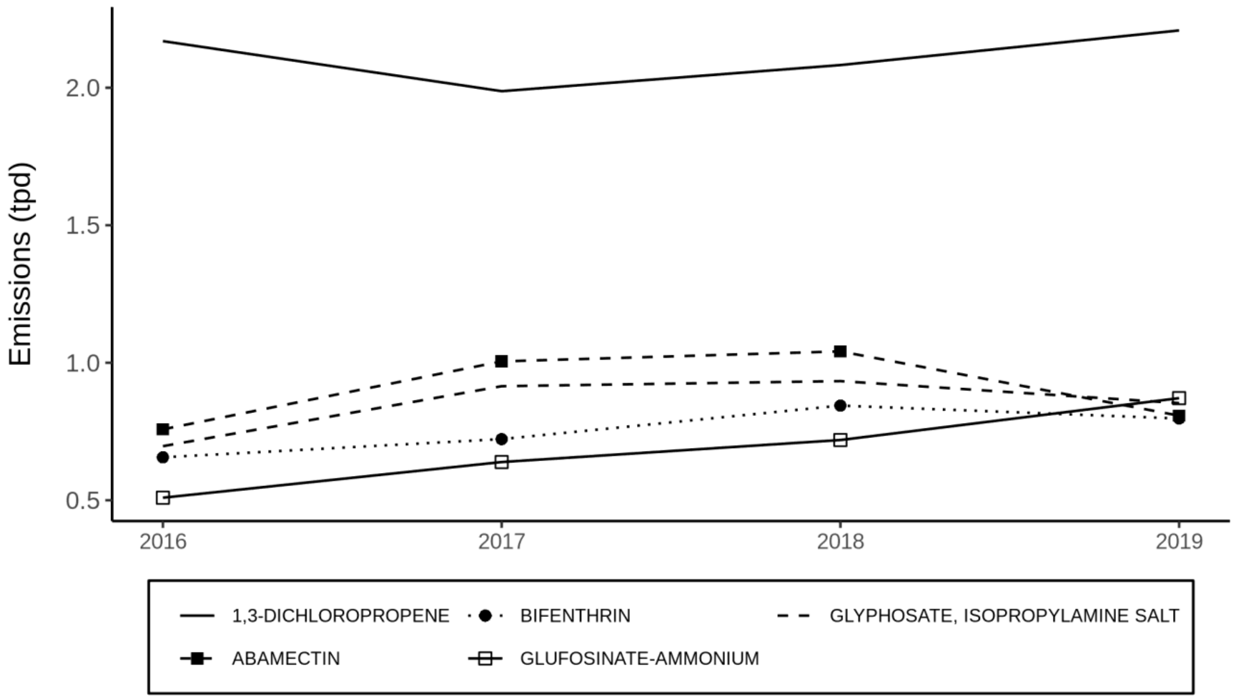

Figure 3a. Top five active ingredients (AI) in terms of product-application emissions in the San Joaquin Valley NAA from 2016 to 2019.

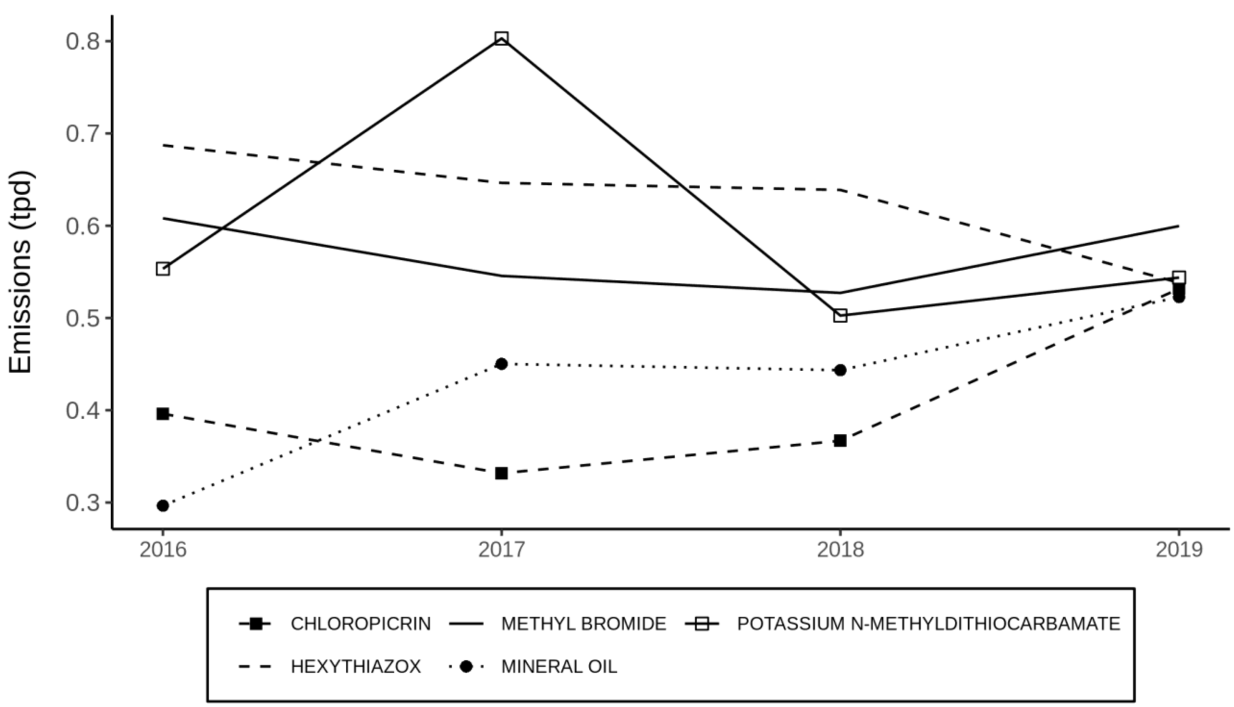

Figure 3b. Top six to ten active ingredients (AI) in terms of product-application emissions in the San Joaquin Valley NAA from 2016 to 2019.

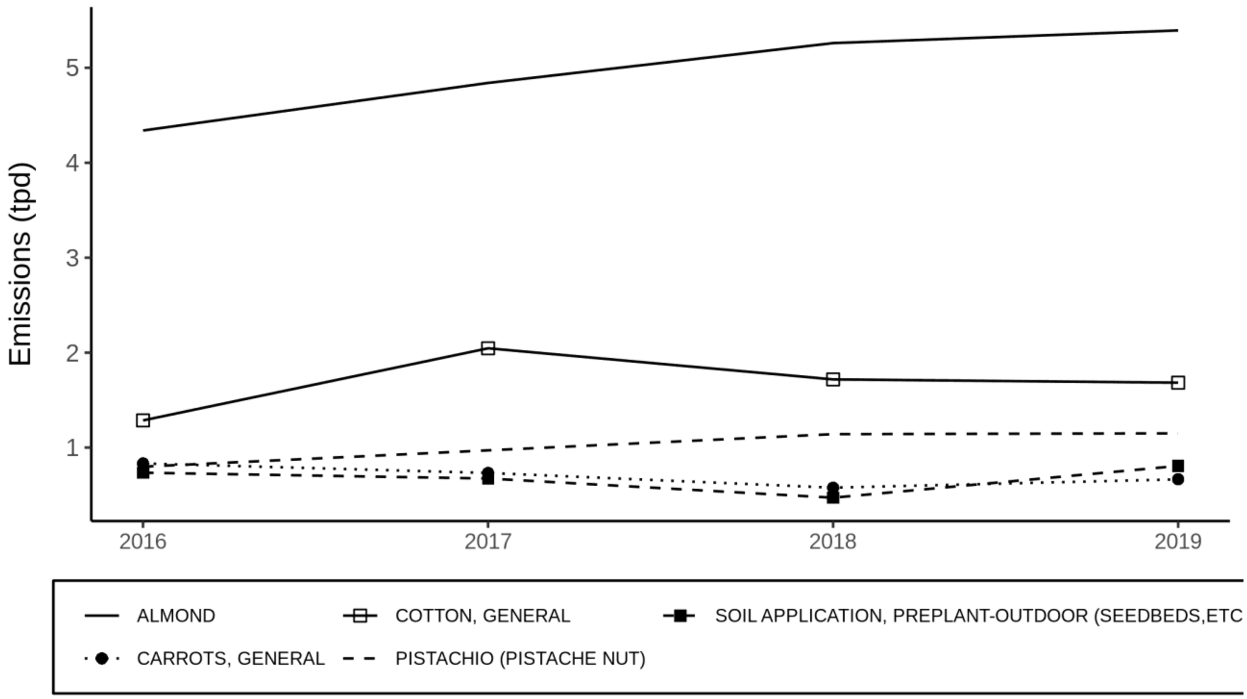

Figure 3c. Top five application sites in terms of product-application emissions in the San Joaquin Valley NAA from 2016 to 2019.

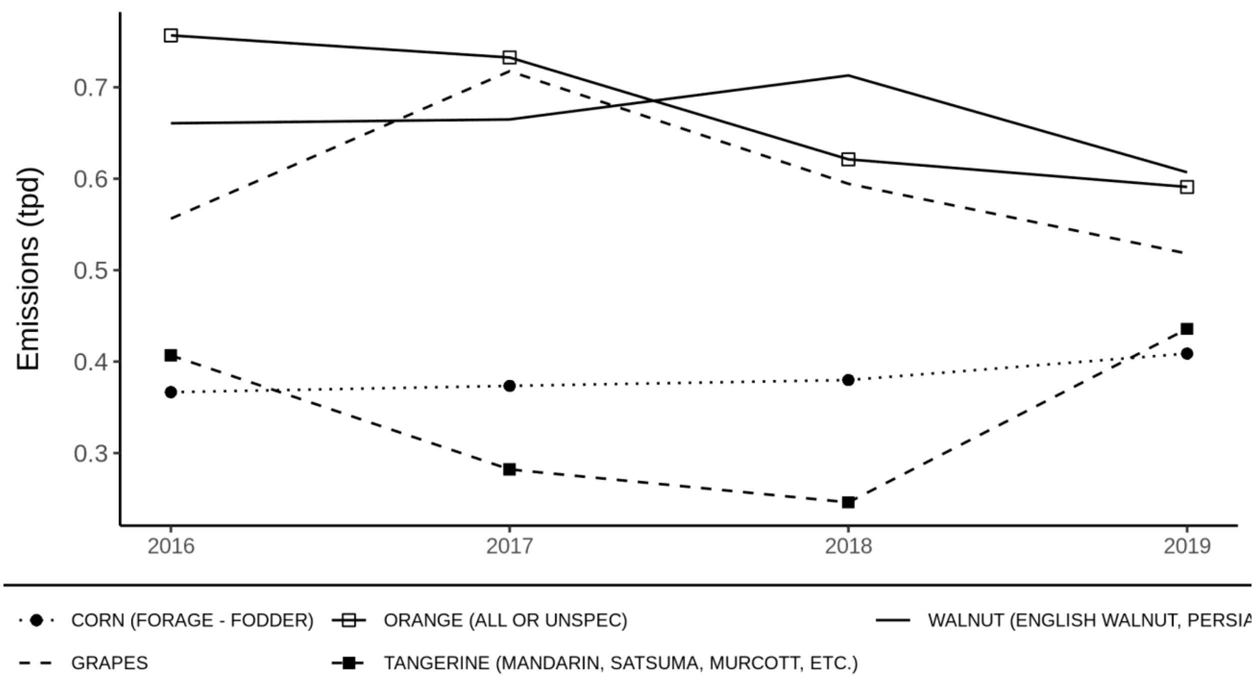

Figure 3d. Top six to ten application sites in terms of product-application emissions in the San Joaquin Valley NAA from 2016 to 2019.

Table 6. Emissions from applications of products containing the active ingredients (AIs) abamectin, chlorpyrifos, gibberellins, and oxyfluorfen in the San Joaquin Valley NAA during 2019.

Primary AI	Emissions (tpd)	Percent Total Emissions	Percent Nonfumigant Emissions	Change from 2018 to 2019 (tpd)	Percent Change from 2018 to 2019
ABAMECTIN	0.808	4.99	6.73	-0.234	-22
CHLORPYRIFOS	0.002	0.02	0.02	-0.515	-100
GIBBERELLINS	0.069	0.43	0.57	0.002	3
OXYFLUORFEN	0.503	3.11	4.19	0.086	21

Table 7. Emissions from applications of products containing the active ingredients (AIs) abamectin, chlorpyrifos, gibberellins, and oxyfluorfen on all commodity sites in the San Joaquin Valley NAA during 2019, categorized as high- or low-VOC.

Category	Primary AI	Emissions (tpd)	Percent Nonfumigant Emissions	Change from 2018 to 2019 (tpd)	Percent Change from 2018 to 2019
High-VOC	ABAMECTIN	0.022	0.19	-0.177	-89
High-VOC	CHLORPYRIFOS	<0.001	<0.01	-0.126	-100
High-VOC	GIBBERELLINS	0.007	0.06	0.001	9
High-VOC	OXYFLUORFEN	0.468	3.90	0.091	24
High-VOC	COMBINED	0.498	4.15	-0.211	-156
Low-VOC	ABAMECTIN	0.785	6.54	-0.056	-7
Low-VOC	CHLORPYRIFOS	0.002	0.02	-0.389	-99
Low-VOC	GIBBERELLINS	0.062	0.51	0.002	3
Low-VOC	OXYFLUORFEN	0.035	0.29	-0.005	-14
Low-VOC	COMBINED	0.884	7.36	-0.449	-117

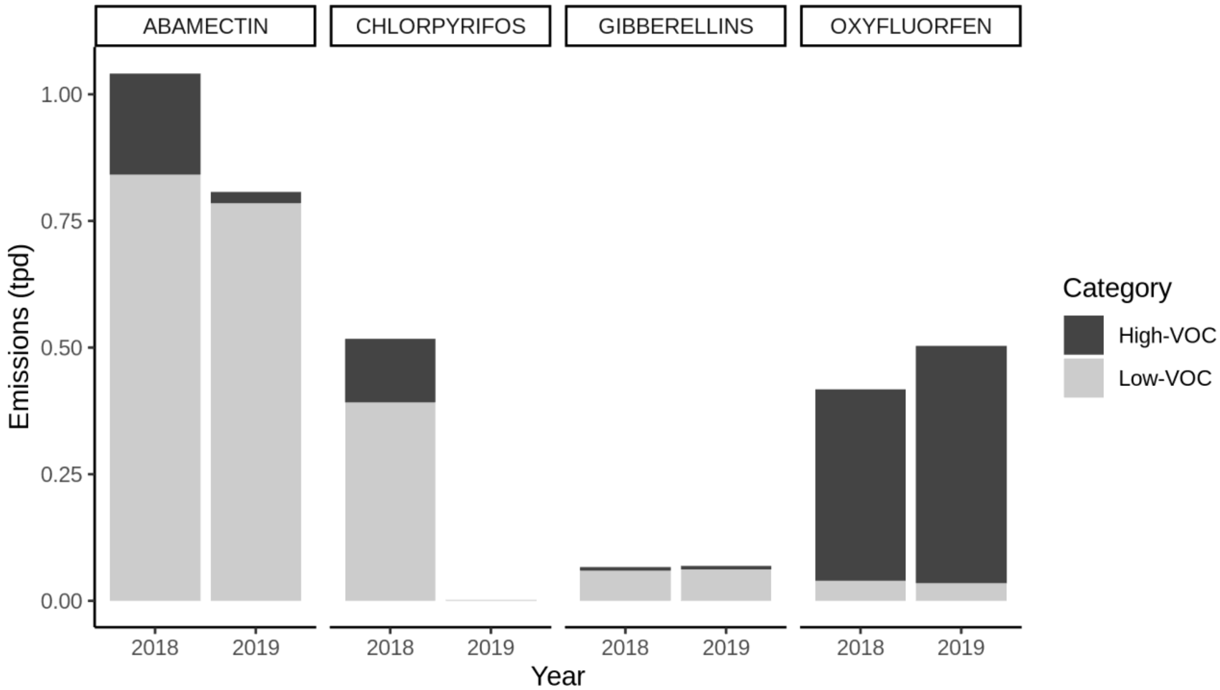

Figure 4. Emissions from 2018 and 2019 applications of high- and low-VOC products with primary active ingredients (AI) abamectin, chlorpyrifos, gibberellins, and oxyfluorfen in the San Joaquin Valley NAA.

Table 8. Emissions from applications of low- and high-VOC products containing the active ingredients (AIs) abamectin, chlorpyrifos, gibberellins, and oxyfluorfen on alfalfa, almonds, citrus, cotton, grapes, pistachios, walnuts, the combination of these seven crops, and the combination of all crops in the San Joaquin Valley NAA during 2019.

Category	Primary AI	Application Site	Emissions (tpd)	Change from 2018 to 2019 (tpd)	Percent Change from 2018 to 2019
High-VOC	ABAMECTIN	ALMOND	0.007	-0.050	-88
High-VOC	ABAMECTIN	CITRUS	0.004	-0.021	-83
High-VOC	ABAMECTIN	COTTON	0.001	-0.013	-90
High-VOC	ABAMECTIN	GRAPES	0.007	-0.003	-33
High-VOC	ABAMECTIN	COMBINED	0.019	-0.088	-82
High-VOC	ABAMECTIN	ALL CROPS	0.022	-0.177	-89
High-VOC	CHLORPYRIFOS	CITRUS	<0.001	<0.001	215
High-VOC	CHLORPYRIFOS	COMBINED	<0.001	-0.123	-100
High-VOC	CHLORPYRIFOS	ALL CROPS	<0.001	-0.126	-100
High-VOC	GIBBERELLINS	CITRUS	0.002	-0.001	-29
High-VOC	GIBBERELLINS	GRAPES	0.005	0.001	31
High-VOC	GIBBERELLINS	COMBINED	0.007	0.001	10
High-VOC	GIBBERELLINS	ALL CROPS	0.007	0.001	9
High-VOC	OXYFLUORFEN	ALFALFA	<0.001	<0.001	-88
High-VOC	OXYFLUORFEN	ALMOND	0.333	0.083	33
High-VOC	OXYFLUORFEN	CITRUS	0.001	-0.001	-48
High-VOC	OXYFLUORFEN	COTTON	0.001	0.001	101
High-VOC	OXYFLUORFEN	GRAPES	0.011	0.002	19
High-VOC	OXYFLUORFEN	PISTACHIO	0.035	-0.007	-16
High-VOC	OXYFLUORFEN	WALNUT	0.037	-0.002	-6
High-VOC	OXYFLUORFEN	COMBINED	0.418	0.075	22
High-VOC	OXYFLUORFEN	ALL CROPS	0.468	0.091	24
High-VOC	COMBINED	ALFALFA	<0.001	<0.001	-98
High-VOC	COMBINED	ALMOND	0.339	0.011	3
High-VOC	COMBINED	CITRUS	0.007	-0.023	-77
High-VOC	COMBINED	COTTON	0.002	-0.113	-98
High-VOC	COMBINED	GRAPES	0.023	<0.001	-1
High-VOC	COMBINED	PISTACHIO	0.035	-0.007	-16
High-VOC	COMBINED	WALNUT	0.037	-0.003	-8
High-VOC	COMBINED	COMBINED	0.444	-0.135	-23
High-VOC	COMBINED	ALL CROPS	0.498	-0.211	-30
Low-VOC	ABAMECTIN	ALFALFA	<0.001	<0.001	-36

Category	Primary AI	Application Site	Emissions (tpd)	Change from 2018 to 2019 (tpd)	Percent Change from 2018 to 2019
Low-VOC	ABAMECTIN	ALMOND	0.431	0.009	2
Low-VOC	ABAMECTIN	CITRUS	0.043	-0.003	-7
Low-VOC	ABAMECTIN	COTTON	0.119	0.017	17
Low-VOC	ABAMECTIN	GRAPES	0.085	-0.046	-35
Low-VOC	ABAMECTIN	PISTACHIO	0.003	-0.002	-39
Low-VOC	ABAMECTIN	WALNUT	0.036	-0.018	-33
Low-VOC	ABAMECTIN	COMBINED	0.717	-0.043	-6
Low-VOC	ABAMECTIN	ALL CROPS	0.785	-0.056	-7
Low-VOC	CHLORPYRIFOS	ALFALFA	<0.001	-0.018	-100
Low-VOC	CHLORPYRIFOS	ALMOND	<0.001	-0.130	-100
Low-VOC	CHLORPYRIFOS	CITRUS	<0.001	-0.088	-100
Low-VOC	CHLORPYRIFOS	COTTON	<0.001	-0.091	-100
Low-VOC	CHLORPYRIFOS	COMBINED	<0.001	-0.385	-100
Low-VOC	CHLORPYRIFOS	ALL CROPS	0.002	-0.389	-99
Low-VOC	GIBBERELLINS	CITRUS	0.038	0.001	3
Low-VOC	GIBBERELLINS	GRAPES	0.019	-0.002	-8
Low-VOC	GIBBERELLINS	COMBINED	0.057	-0.001	-1
Low-VOC	GIBBERELLINS	ALL CROPS	0.062	0.002	3
Low-VOC	OXYFLUORFEN	ALMOND	0.017	-0.002	-13
Low-VOC	OXYFLUORFEN	CITRUS	<0.001	<0.001	17
Low-VOC	OXYFLUORFEN	COTTON	0.001	<0.001	-3
Low-VOC	OXYFLUORFEN	GRAPES	0.005	-0.001	-15
Low-VOC	OXYFLUORFEN	PISTACHIO	0.004	-0.002	-38
Low-VOC	OXYFLUORFEN	WALNUT	0.002	-0.001	-22
Low-VOC	OXYFLUORFEN	COMBINED	0.029	-0.006	-18
Low-VOC	OXYFLUORFEN	ALL CROPS	0.035	-0.005	-14
Low-VOC	COMBINED	ALFALFA	<0.001	-0.018	-100
Low-VOC	COMBINED	ALMOND	0.448	-0.123	-22
Low-VOC	COMBINED	CITRUS	0.081	-0.091	-53
Low-VOC	COMBINED	COTTON	0.120	-0.073	-38
Low-VOC	COMBINED	GRAPES	0.109	-0.096	-47
Low-VOC	COMBINED	PISTACHIO	0.007	-0.004	-38
Low-VOC	COMBINED	WALNUT	0.039	-0.029	-43
Low-VOC	COMBINED	COMBINED	0.803	-0.435	-35
Low-VOC	COMBINED	ALL CROPS	0.884	-0.449	-34

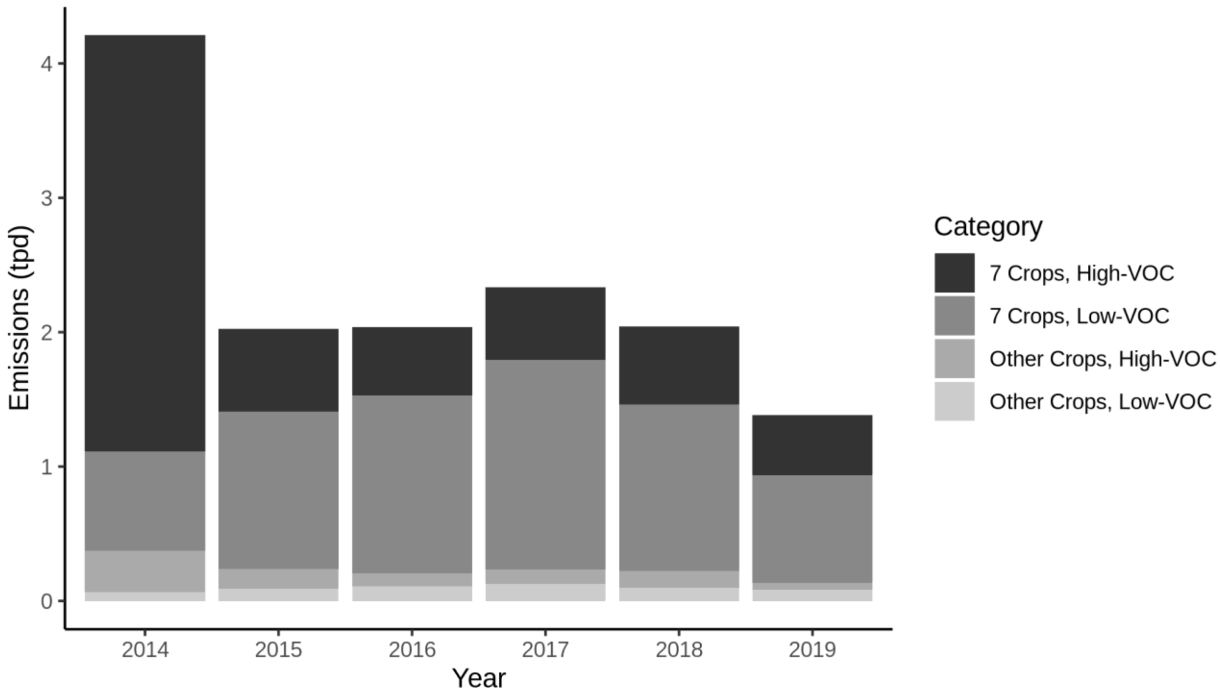

Figure 5. Emissions from applications of low- and high-VOC products containing the active ingredients (AIs) abamectin, chlorpyrifos, gibberellins, and oxyfluorfen on alfalfa, almonds, citrus, cotton, grapes, pistachios, walnuts, and remaining crops in the San Joaquin Valley NAA from 2014 to 2019.

Table 9. Pounds of product and active ingredient (AI) used and VOC emissions (tpd) per pound of product in the San Joaquin Valley NAA during 2019. The units of the Value and Change columns are specific to each row and listed in the Metric column. These units do not apply to the Percent Change column.

Primary AI	Metric	Value	Change from 2018 to 2019	Percent Change from 2018 to 2019
ABAMECTIN	Product (lbs x 10^3)	1,241	-148	-11
ABAMECTIN	Active Ingredient (lbs x 10^3)	31	-2	-6
ABAMECTIN	VOC/Product (lbs/lb)	0.238	-0.036	-13
CHLORPYRIFOS	Product (lbs x 10^3)	20	-833	-98
CHLORPYRIFOS	Active Ingredient (lbs x 10^3)	3	-346	-99
CHLORPYRIFOS	VOC/Product (lbs/lb)	0.045	-0.177	-80
GIBBERELLINS	Product (lbs x 10^3)	173	-3	-2
GIBBERELLINS	Active Ingredient (lbs x 10^3)	14	-1	-7
GIBBERELLINS	VOC/Product (lbs/lb)	0.146	0.007	5
OXYFLUORFEN	Product (lbs x 10^3)	424	29	7
OXYFLUORFEN	Active Ingredient (lbs x 10^3)	120	<1	<1
OXYFLUORFEN	VOC/Product (lbs/lb)	0.434	0.048	12
COMBINED	Product (lbs x 10^3)	1,858	-956	-34
COMBINED	Active Ingredient (lbs x 10^3)	168	-349	-68
COMBINED	VOC/Product (lbs/lb)	0.272	0.007	2

Table 10. Calculation of hypothetical emissions in the San Joaquin Valley NAA, as described in Title 3, California Code Of Regulations, section 6884(c): D = (A / B) * C.

Primary AI	Application Site	2014 Emissions (tpd) (A)	2014 Pounds AI (B)	2019 Pounds AI (C)	2019 Hypothetical Emissions (tpd) (D)	2019 Actual Emissions	Difference between Hypothetical and Actual (tpd)
ABAMECTIN	ALFALFA	<0.001	69	37	<0.001	<0.001	<0.001
ABAMECTIN	ALMOND	0.687	10,288	16,019	1.070	0.438	0.633
ABAMECTIN	CITRUS	0.074	1,151	2,139	0.137	0.047	0.089
ABAMECTIN	COTTON	0.109	1,509	3,647	0.262	0.121	0.142
ABAMECTIN	GRAPES	0.325	4,743	3,967	0.272	0.092	0.180
ABAMECTIN	PISTACHIO	0.002	25	141	0.010	0.003	0.007
ABAMECTIN	WALNUT	0.108	1,719	1,662	0.104	0.036	0.068
CHLORPYRIFOS	ALFALFA	0.138	59,071	7	<0.001	<0.001	<0.001
CHLORPYRIFOS	ALMOND	0.403	181,926	95	<0.001	<0.001	<0.001
CHLORPYRIFOS	CITRUS	0.408	172,834	244	0.001	<0.001	<0.001
CHLORPYRIFOS	COTTON	0.255	95,094	32	<0.001	<0.001	<0.001
CHLORPYRIFOS	GRAPES	0.025	20,173	<1	<0.001	<0.001	<0.001
CHLORPYRIFOS	WALNUT	0.113	65,398	<1	<0.001	<0.001	<0.001
GIBBERELLINS	CITRUS	0.255	6,287	6,129	0.249	0.040	0.209
GIBBERELLINS	GRAPES	0.250	8,702	6,352	0.182	0.024	0.158
OXYFLUORFEN	ALFALFA	<0.001	10	2	<0.001	<0.001	<0.001
OXYFLUORFEN	ALMOND	0.469	80,138	72,447	0.424	0.349	0.075
OXYFLUORFEN	CITRUS	0.002	224	444	0.003	0.001	0.002
OXYFLUORFEN	COTTON	0.014	4,752	1,466	0.004	0.002	0.002
OXYFLUORFEN	GRAPES	0.072	10,302	11,242	0.078	0.016	0.062
OXYFLUORFEN	PISTACHIO	0.063	17,802	11,161	0.040	0.039	0.001
OXYFLUORFEN	WALNUT	0.065	11,268	8,715	0.050	0.039	0.011
COMBINED	COMBINED	3.835	753,484	145,947	2.886	1.247	1.639

Table 11. Ranked use of high-VOC abamectin, chlorpyrifos, gibberellins, and oxyfluorfen products on alfalfa, almonds, citrus, cotton, grapes, pistachios, and walnuts in the San Joaquin Valley NAA during 2019.

Primary AI	Product	prodno	Registration Number	EP	Method	Product Inactivity Date	Pounds Applied	Percent Change from 2018 to 2019
ABAMECTIN	AGRI-MEK SC MITICIDE/INSECTICIDE	62903	100-1351-ZA	6	Bridged		6,644	25
ABAMECTIN	REAPER CLEARFORM	65921	34704-1078-ZA	31	Bridged		6,532	15
ABAMECTIN	ABBA ULTRA MITICIDE/INSECTICIDE	70506	5481-621-AA	34	Derived		5,808	14
ABAMECTIN	ABBA ULTRA MITICIDE/INSECTICIDE	61871	66222-226-AA	34	TGA	12/31/2018	2,644	-26
ABAMECTIN	ABACUS V	65503	83100-32-AA-83979	27	TGA		2,055	-2
ABAMECTIN	TIMECTIN 0.15 EC AG INSECTICIDE/MITICIDE	58571	84229-2-AA	30	TGA		1,704	-48
ABAMECTIN	ABAMEX MITICIDE/INSECTICIDE	68295	228-734-AA	24	TGA		1,211	-15
ABAMECTIN	AGRI-MEK SC MITICIDE/INSECTICIDE	60883	100-1351-AA	6	TGA	12/31/2013	646	-19
CHLORPYRIFOS	LORSBAN ADVANCED	58202	62719-591-AA	18	TGA	12/31/2019	205	-100
CHLORPYRIFOS	DREXEL CHLORPYRIFOS 15G	68613	19713-505-AA	4	Default		101	-95
GIBBERELLINS	PROGIBB LV PLUS PLANT GROWTH REGULATOR SOLUTION	66308	73049-498-AA	12	TGA		6,282	-10
GIBBERELLINS	PROGIBB 40% PLANT GROWTH REGULATOR WATER SOLUBLE GRANULE	61609	73049-1-ZA	4	Default		3,586	3
GIBBERELLINS	FALGRO 2X LV	66024	62097-32-AA-82917	23	TGA		2,088	20
GIBBERELLINS	PROGIBB 40% WATER SOLUBLE GRANULES	44822	73049-1-AA	4	Default	12/31/2011	356	-78
OXYFLUORFEN	GOAL 2XL	48484	62719-424-AA	62	TGA/derived		50,872	21
OXYFLUORFEN	GOALTENDER	51277	62719-447-ZA	8	TGA		45,193	-21
OXYFLUORFEN	PINDAR GT	60833	62719-611-AA	11	TGA		4,887	36
OXYFLUORFEN	GALIGAN 2E OXYFLUORFEN HERBICIDE	44923	66222-28-AA	66	TGA/derived	12/31/2014	1,507	56
OXYFLUORFEN	GOAL 4F	51278	62719-447-AA	8	derived	09/15/2006	779	-12
OXYFLUORFEN	GALIGAN 2E HERBICIDE	65078	66222-28-ZA	66	TGA/derived		549	-39
OXYFLUORFEN	OXYSTAR 2E	56469	42750-136-AA	73	TGA		456	120
OXYFLUORFEN	GOAL 2XL HERBICIDE	32909	707-243-AA	39	Default	12/31/2004	431	122
OXYFLUORFEN	OXYFLUORFEN 2E HERBICIDE	64539	70506-295-AA-84237	66	derived	12/31/2018	418	196
OXYFLUORFEN	GALIGAN 2E	68799	66222-28-ZB	66	TGA/Derived		140	788