Val Dolcini
Acting Director

Department of Pesticide Regulation

Gavin Newsom
Governor

Jared Blumenfeld
Secretary for Environmental Protection

MEMORANDUM

TO: Edgar Vidrio
Environmental Program Manager II
Environmental Monitoring Branch

VIA: Minh Pham *Original Signed by*
Senior Environmental Scientist (Supervisory)
Environmental Monitoring Branch

FROM: Justin Kroes *Original Signed by*
Environmental Scientist
Environmental Monitoring Branch

DATE: September 6, 2019

SUBJECT: PRELIMINARY ESTIMATES OF VOLATILE ORGANIC COMPOUND EMISSIONS FROM PESTICIDES IN THE SAN JOAQUIN VALLEY: EMISSIONS FOR 2018

SUMMARY

This document summarizes the preliminary adjusted emissions inventory for the San Joaquin Valley based on data reported to or produced by the Department of Pesticide Regulation (DPR) from May 1, 2018, to October 31, 2018, the peak ozone season in California.

Preliminary estimates of 2018 show that compared to the previous year:

- Volatile Organic Compound (VOC) emissions from nonfumigant products decreased 4% (0.546 tons/day (tpd)), from 12.751 to 12.205 tpd.
- Fumigant emissions decreased by 7% (0.295 tpd) from 4.219 to 3.924 tpd.
- Total pesticide VOC emissions decreased 5%, from 16.970 to 16.129 tpd. This is below the State Implementation Plan (SIP) goal of 18.1 tpd and the regulatory trigger level of 17.2 tpd (95% of SIP goal).

In 2013, DPR's pesticide VOC emissions inventory for the San Joaquin Valley nonattainment area (NAA) exceeded 17.2 tpd. As a result, certain uses of high-VOC products were prohibited starting in 2015. The calculated hypothetical emissions for 2017 exceeded the regulatory trigger level; therefore, the regulations' prohibition of certain uses of high-VOC products will continue until at least 2020, as stated in Title 3 California Code of Regulations (3 CCR) 6884(c).

The 2018 preliminary pesticide VOC emissions inventory suggests that these prohibitions continue to effectively reduce emissions in this NAA. Though the final 2018 VOC emissions estimates may change slightly, it is unlikely that the final emissions inventory will exceed the SIP goal for this nonattainment area.

VOC INVENTORY RESULTS: SAN JOAQUIN VALLEY

PUR data for statewide pesticide use from 2015-2018 were obtained from the PUR database on June 25, 2019, to produce the preliminary VOC emissions estimates for 2018 and update VOC emissions estimates for 2015-2017. Unless otherwise stated, all VOC emissions from fumigants are reported as adjusted emissions.

DPR requests that registrants provide thermogravimetric analysis (TGA) data for new and existing products subject to the VOC data requirements. TGA data is 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 have a significant impact on the emissions inventory.

Table 1 shows the nonfumigant products with EP values that changed as a result of either a) error corrections; b) the AB1011 process; or c) TGA data submission. The AB1011 process allows DPR to consider previous data evaluations to support new and amended pesticide product registrations and to maintain product registrations. The table also includes the resultant changes in VOC emissions for these products within the San Joaquin Valley NAA during the 2018 ozone season. The EP value for Abamex Miticide/Insecticide (228-734-AA) changed to correct a past data entry error. The EP value for Drexel PIN-DEE 3.3 EC (19713-668-AA) changed to reflect TGA data submission. The EP value for DuPont Fontelis Fungicide (352-834-AA) also changed to reflect TGA data submission. Changes to default median EP values that resulted from corrected formulation codes are not included in Table 1.

In the San Joaquin Valley NAA, total VOC emissions decreased 5% (0.841 tpd) since 2017, from 16.970 tpd to 16.129 tpd, and were 11% (1.971 tpd) below the SIP goal of 18.1 tpd and 6% (1.071 tpd) below the SIP trigger level of 17.2 tpd (Table 2, Figure 1). Nonfumigant emissions decreased 4% (0.546 tpd), from 12.751 tpd to 12.205 tpd, accounting for 76% of the total VOC emissions in the San Joaquin Valley (Table 3). VOC emissions from emulsifiable concentrate formulations decreased 11% (0.758 tpd), from 6.761 tpd to 6.004 tpd (Table 4, Figure 2). Emissions from products with emulsifiable concentrate formulations accounted for 37% of the total VOC emissions for this NAA. Fumigant emissions decreased 7% (0.295 tpd), from 4.219 tpd to 3.924 tpd (Table 3).

VOC emissions from five of the top ten active ingredients increased in 2018 (Table 5). Use of the top ten primary active ingredients collectively contributed 52% of the total VOC emissions in this NAA. Emissions from 1,3-dichloropropene products increased 4% (0.072 tpd) since 2017, from 1.987 tpd to 2.059 tpd. 1,3-dichloropropene products continue to be the primary contributors to VOC emissions and account for 13% of the total emissions in the San Joaquin Valley NAA (2) (Table 5, Figures 3a, 3b).

VOC emissions from all pesticide products applied to the top ten crops/sites are shown in Table 6. Pesticide use on the top ten crops/sites comprised 74% of the total VOC emissions in this NAA. Emissions from three of the top ten crops/sites increased since 2017 (Table 6). Pesticide applications to almonds remain the largest contributors to VOC emissions (33%) in this NAA, and emissions from applications to almonds increased 9% (0.413 tpd), from 4.840 to 5.253 tpd (Table 6, Figures 3c and 3d).

California Regulations (3 CCR 6880) establish 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 6886) and prohibitions on use on certain crops when emission limits are triggered (3 CCR 6884).

Table 7 lists the 2018 ozone season emissions of abamectin, chlorpyrifos, gibberellins, and oxyfluorfen. All except for gibberellins were among the top ten active ingredients by emission (Table 5, Figures 3a, 3b). These active ingredients contributed 13% (2.041 tpd) of 2018 emissions in San Joaquin Valley NAA (2), down from 14% (2.334 tpd) in 2017. Abamectin had the largest share of total emissions of the four active ingredients (7%; 1040 tpd).

Table 8 and Figure 4 show the emissions of high-VOC and low-VOC products containing abamectin, chlorpyrifos, gibberellins, and oxyfluorfen. During these years nonfumigant regulations continued to be in effect. The high-VOC share of emissions from these products increased from 27.6% to 34.8%. High-VOC emissions increased from 5.1% (0.644) to 5.8% (0.710 tpd) of nonfumigant emissions; however, low-VOC emissions decreased from 13.2% (1.689 tpd) to 10.9% (1.331 tpd) of nonfumigant emissions. In particular, the decrease of 0.325 tpd in low-VOC chlorpyrifos emissions constitutes the majority of the difference between 2017 and 2018 combined emissions from these four active ingredients.

Table 11 lists emissions aggregated by combinations of active ingredient (abamectin, chlorpyrifos, gibberellins, and oxyfluorfen) and commodity. Table 9 further aggregates by low-VOC and high-VOC products. Chlorpyrifos use across all commodities decreased since 2017. The largest decrease in chlorpyrifos emissions was for low-VOC products applied to alfalfa (0.049 tpd; 73%).

Figure 5 shows combined emissions for abamectin, chlorpyrifos, gibberellins and oxyfluorfen products since 2013, aggregated across low-VOC or high-VOC product categories and whether applications were for the seven crops listed in 3 CCR 6884 or other crops. In 2013, emissions in the San Joaquin Valley NAA (2) 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 three tpd of emissions. As shown in Figure 5, after nonfumigant regulations became effective in 2015, emissions from all applications of these four active ingredients decreased substantially, and emissions from high-VOC products declined to 0.759 tpd. Emissions from these active ingredients totaled 2.041 tpd in 2018, and emissions from high-VOC products totaled 0.710 tpd, similar to past years since 2015 (Figure 5).

Since 2013, about 90% of emissions from these four active ingredients in San Joaquin Valley NAA (2) have come from seven crops: alfalfa, almonds, citrus, cotton, grapes, pistachios, and walnuts. Combined 2013 emissions of these active ingredients on all crops were 5.333 tpd, of which 77% (4.123 tpd) came from applications of high-VOC products on the seven crops. In 2018, high-VOC products applied to the seven crops accounted for only 28% (0.579 tpd) of combined emissions

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

In 2018, 2.81 million pounds of products containing abamectin, chlorpyrifos, gibberellin and oxyfluorfen active ingredients were used in the San Joaquin Valley nonattainment area, compared to 3.33 million pounds in 2017 (Table 10). For these four active ingredients, the ratio between the pounds of VOC emitted per pound of product used increased by 3.8% since 2017. The amount of VOC emissions produced per pound of gibberellins products applied decreased 12.2%, whereas the amount of VOC emissions produced per pound of abamectin, chlorpyrifos, and oxyfluorfen products applied increased between 0.8% and 2.3%. Since 2017, chlorpyrifos had a larger decline in use than emissions, which stemmed from a decrease in use of low-VOC products. As the most widely used and second-highest emitting of the four active ingredients in 2017, chlorpyrifos' relative shift toward high-VOC products drove the slight increase in the 2018 ratio. Despite this increase in the ratio, low-VOC products are still the largest source of emissions from these active ingredients in the San Joaquin Valley NAA, in contrast to emissions from years prior to the implementation of the nonfumigant regulations.

HYPOTHETICAL VOC EMISSIONS

Hypothetical VOC emissions are calculated for each active ingredient 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 active ingredient used in the current year.

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

$$\begin{array}{c}\text{Hypothetical emissions}\\ \text{for a pesticide-crop}\\ \text{combination listed in}\\ \text{section 6884 during}\\ \text{May-Oct for the year of}\\ \text{prohibitions}\\ \textbf{\textit{(Table 11 column D)}}\end{array} = \frac{\begin{array}{c}\text{Emissions for the pesticide-crop}\\ \text{combination during May-Oct for the}\\ \text{most current year without prohibitions}\\ \textbf{\textit{(Table 11 column A)}}\end{array} \times \begin{array}{c}\text{Pounds active ingredient for}\\ \text{the crop during May-Oct for}\\ \text{the year of prohibitions}\\ \textbf{\textit{(Table 11 column B)}}\end{array}}{\begin{array}{c}\text{Pounds active ingredient for the crop during May-Oct for the most current year}\\ \text{without prohibitions}\\ \textbf{\textit{(Table 11 column C)}}\end{array}}$$

Table 11 details the hypothetical emissions for 2018 calculated using the formula above. The total hypothetical emissions for the pesticides and crops listed in section 6880 for 2018 are 18.095 tpd, 12% (1.966 tpd) more than the actual inventory emissions. Total hypothetical VOC emissions equal the sum of the hypothetical emissions for each pesticide-crop combination, plus the actual VOC emissions for the remaining pesticides and crops not listed in section 6880:

Total hypothetical VOC emissions = 16.129 tpd – 1.816 tpd + 3.782 tpd = 18.095 tpd

The total hypothetical VOC emissions for the San Joaquin Valley NAA (2) are 0.03% (0.005 tpd) lower than the VOC regulation benchmark of 18.1 tpd and 5.20% (0.895 tpd) higher than the VOC trigger of 17.2 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 DPR can lift the high-VOC prohibitions. The hypothetical emissions were calculated to be 19.097 tpd in 2017 and 19.143 tpd in 2018, which are both greater than the 17.2 trigger level for the San Joaquin Valley NAA (2). Therefore, the high-VOC nonfumigant, ozone season prohibitions will remain in effect through 2020.

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 permitted exceptions to 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 pesticide use report submission process. Table 12 lists the high-VOC products with the highest reported use in this NAA during 2017 and 2018. Products with greater than 100 lbs of active ingredient applied during 2018 were included in the table.

REFERENCES

Kroes, J., Wofford, P., Vidrio, E., Pham, M. April 2019. Annual Report on Volatile Organic Compound Emissions from Pesticides: Emissions for 1990 – 2017 https://www.cdpr.ca.gov/docs/emon/vocs/vocproj/2017_voc_annual_report.pdf

Spurlock, F.S., 1/7/2002. Memo to John Sanders. Methodology for Determining VOC Emission Potentials of Pesticide Products. http://www.cdpr.ca.gov/docs/emon/vocs/vocproj/intro.pdf

Table 1. Nonfumigant products with substantially changed Emission Potential values between the **2017** and **2018** EP databases, and the estimated change in emissions (tpd) for San Joaquin Valley **NAA (2)** during **2018** compared to **2017**.

		EP Database 2017 Inventory		EP Database 2018 Inventory		Change in EP	Change in emissions (tpd)
Product	AI	EP	method	EP	method		
DREXEL PIN-DEE 3.3 EC	PENDIMETHALIN	39.15	default median	59.25	TGA	20.1	<0.001
ABAMEX MITICIDE/INSECTICIDE	ABAMECTIN	21.4	TGA	24.1	TGA	2.7	0.006
DUPONT FONTELIS FUNGICIDE	PENTHIOPYRAD	5.71	default median	0	TGA	-5.71	-0.011

Table 2. May–October (ozone season) pesticide VOC emissions and goals.

				VOC Emissions (tons/day)												
NAA	**1990**	**SIP Goal**	**Trigger Level †**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
San Joaquin Valley																
Unadjusted (tpd)	22.472	18.1	17.2	29.532	24.720	23.849	21.005	24.472	26.491	27.625	30.170	26.455	26.528	26.178	27.414	26.200
Adjusted (tpd)	20.517	18.1	17.2	21.305	17.093	14.525	12.965	15.228	16.376	16.921	19.520	16.815	15.368	15.425	16.970	16.129

† Trigger Level is 95% of SIP Goal

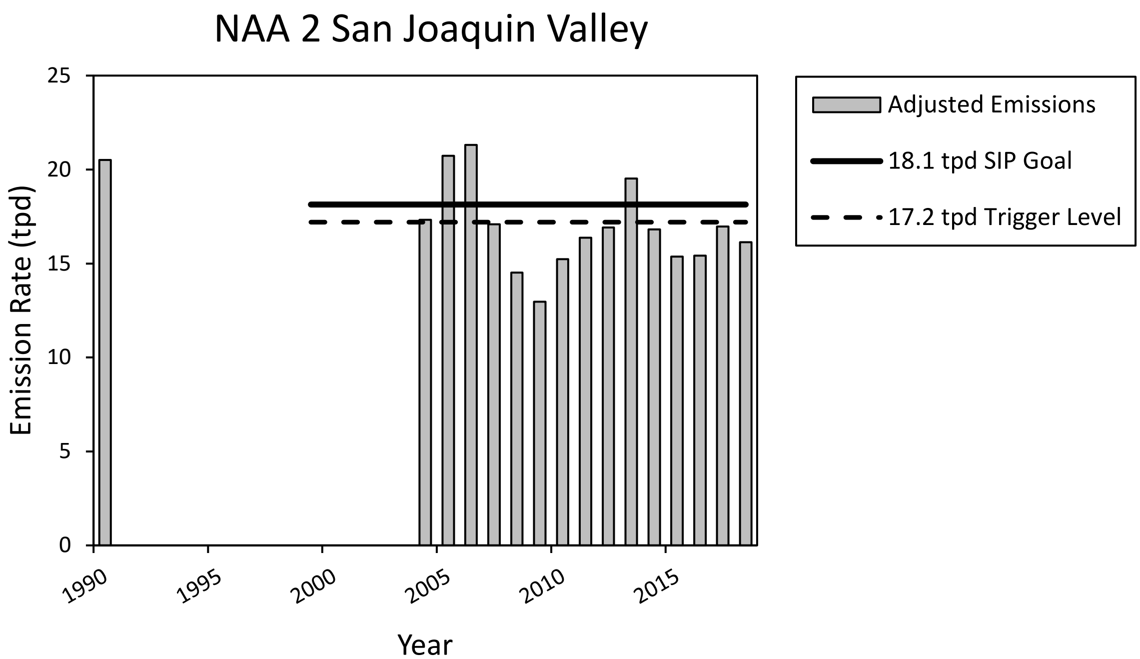

Figure 1. Annual ozone season pesticide VOC emissions in the San Joaquin Valley **NAA (2)**.

Table 3. San Joaquin Valley **NAA (2)** May–October (ozone season) fumigant and nonfumigant pesticide VOC emissions.

	VOC Emissions tpd (percentage of total)													
NAA	**1990**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
San Joaquin Valley														
Fumigants	5.536 (27%)	6.808 (32%)	4.399 (26%)	3.370 (23%)	3.078 (24%)	3.700 (24%)	4.001 (24%)	4.265 (25%)	4.353 (22%)	4.026 (24%)	4.777 (31%)	4.237 (27%)	4.219 (25%)	3.924 (24%)
Nonfumigants	14.981 (73%)	14.498 (68%)	12.375 (74%)	11.154 (77%)	9.887 (76%)	11.528 (76%)	12.375 (76%)	12.656 (75%)	15.167 (78%)	12.789 (76%)	10.591 (69%)	11.188 (73%)	12.751 (75%)	12.205 (76%)

Table 4. San Joaquin Valley **NAA (2)** May-October (ozone season) nonfumigant pesticide VOC emissions derived from Emulsifiable Concentrate formulations (ECs) and all other formulations (Others).

	VOC Emissions tpd (percentage of total)													
NAA	**1990**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
San Joaquin Valley														
ECs	12.162 (81%)	10.119 (70%)	7.547 (69%)	7.491 (67%)	5.921 (60%)	6.608 (57%)	6.854 (55%)	7.263 (57%)	8.760 (58%)	7.298 (57%)	6.034 (57%)	6.268 (56%)	6.761 (53%)	6.004 (49%)
Others	2.819 (19%)	4.379 (30%)	3.423 (31%)	3.663 (33%)	3.966 (40%)	4.921 (43%)	5.521 (45%)	5.392 (43%)	6.407 (42%)	5.491 (43%)	4.557 (43%)	4.921 (44%)	5.990 (47%)	6.202 (51%)

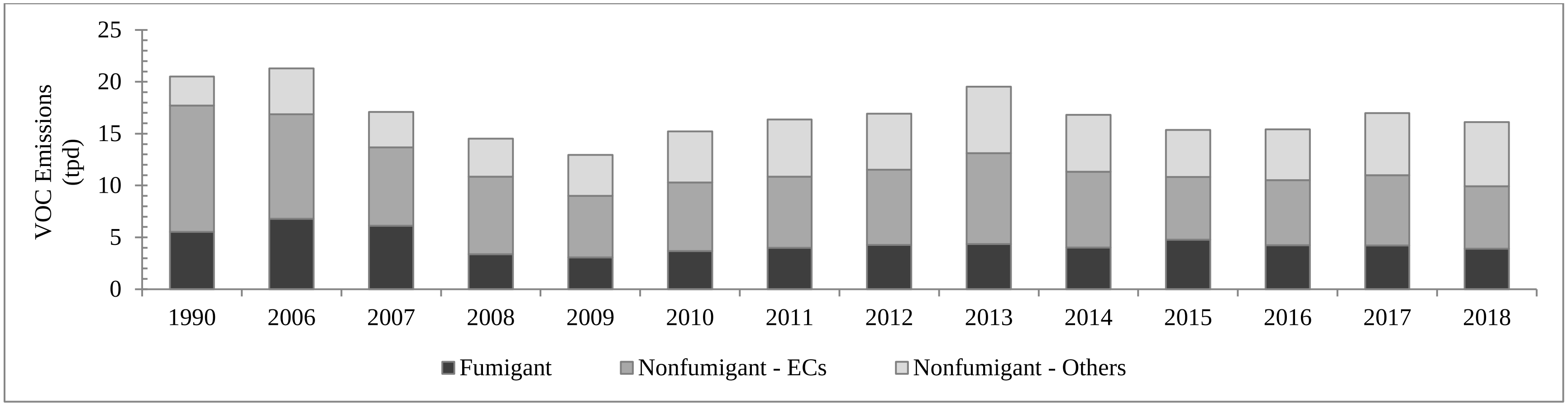

Figure 2. May-October (ozone season) VOC emissions derived from fumigant and nonfumigant pesticides (emulsifiable concentrate formulations (ECs) compared to all others) in the San Joaquin Valley **NAA (2)**.

Table 5. Top ten primary active ingredients contributing to **2018** May-October ozone season VOC emissions in the San Joaquin Valley **NAA (2)**.

Primary AI	2018 Total Product Emissions (tpd)	Percent of 2018 Emissions	Percent Change from 2017 to 2018
1,3-DICHLOROPROPENE	2.059	12.95	4
ABAMECTIN	1.040	6.54	3
GLYPHOSATE, ISOPROPYLAMINE SALT	0.931	5.86	2
BIFENTHRIN	0.842	5.30	17
GLUFOSINATE-AMMONIUM	0.719	4.52	12
HEXYTHIAZOX	0.638	4.01	-1
METHYL BROMIDE	0.527	3.32	-3
CHLORPYRIFOS	0.517	3.25	-39
POTASSIUM N-METHYLDITHIOCARBAMATE	0.501	3.15	-38
MINERAL OIL	0.444	2.79	-1

Table 6. Top ten crops/sites contributing to **2018** May-October ozone season pesticide VOC emissions in the San Joaquin Valley **NAA (2)**.

Primary AI	2018 Total Product Emissions (tpd)	Percent of 2018 Emissions	Percent Change from 2017 to 2018
ALMOND	5.253	32.57	9
COTTON	1.717	10.64	-16
PISTACHIO	1.144	7.09	18
WALNUT	0.687	4.26	3
ORANGE	0.620	3.84	-15
GRAPES	0.593	3.68	-17
CARROTS	0.578	3.58	-21
SOIL APPLICATION, PREPLANT*	0.472	2.93	-30
GRAPES, WINE	0.444	2.75	-2
TOMATOES	0.394	2.44	-16

*Treatment of an area prior to crop planting

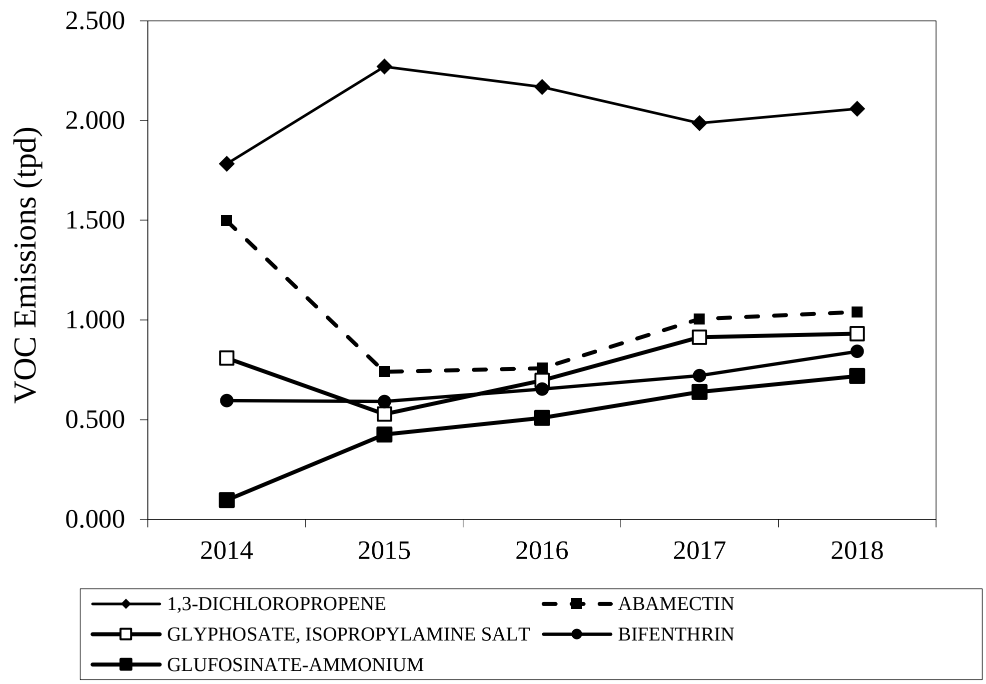

Figure 3a. Emissions of top five AIs in the San Joaquin Valley **NAA (2)** from **2014** to **2018**.

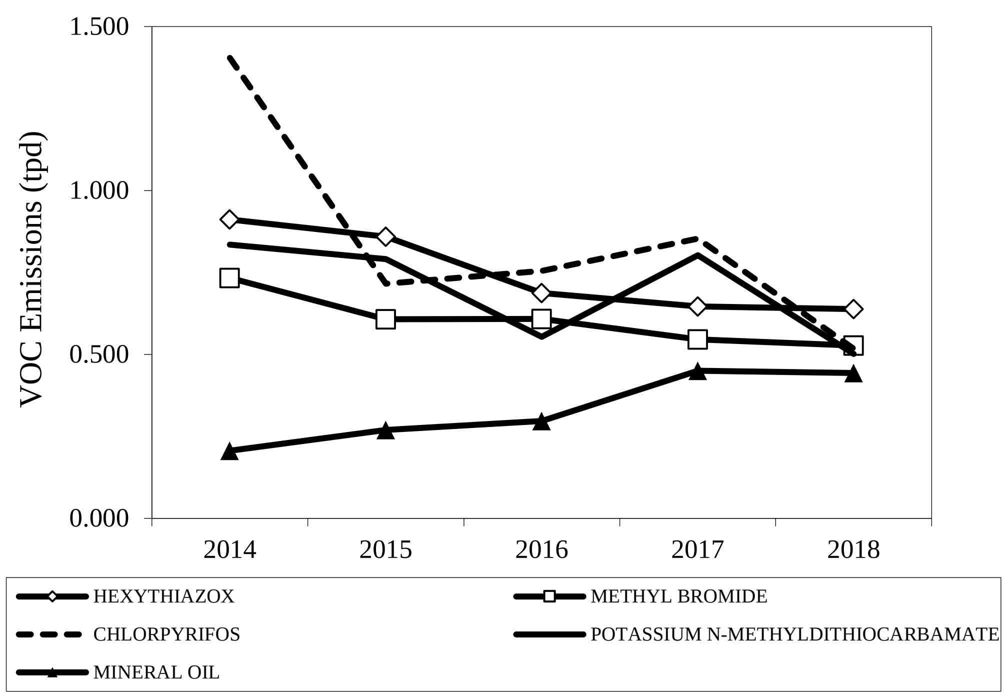

Figure 3b. Emissions of top six to ten active AIs in the San Joaquin Valley **NAA (2)** from **2014** to **2018**.

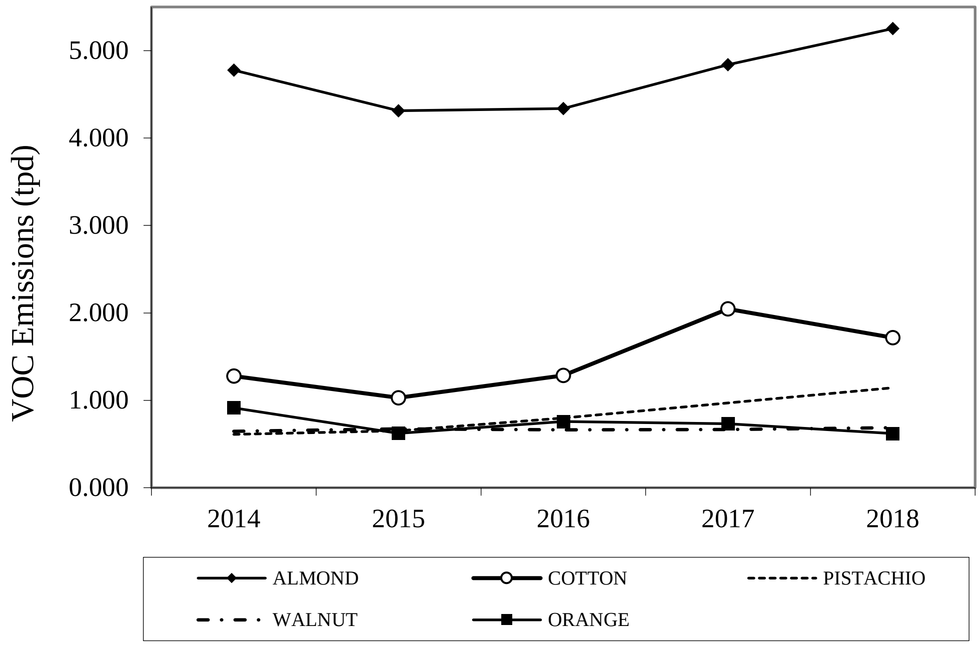

Figure 3c. Emissions of top five crops/sites in the San Joaquin Valley **NAA (2)** from **2014** to **2018**.

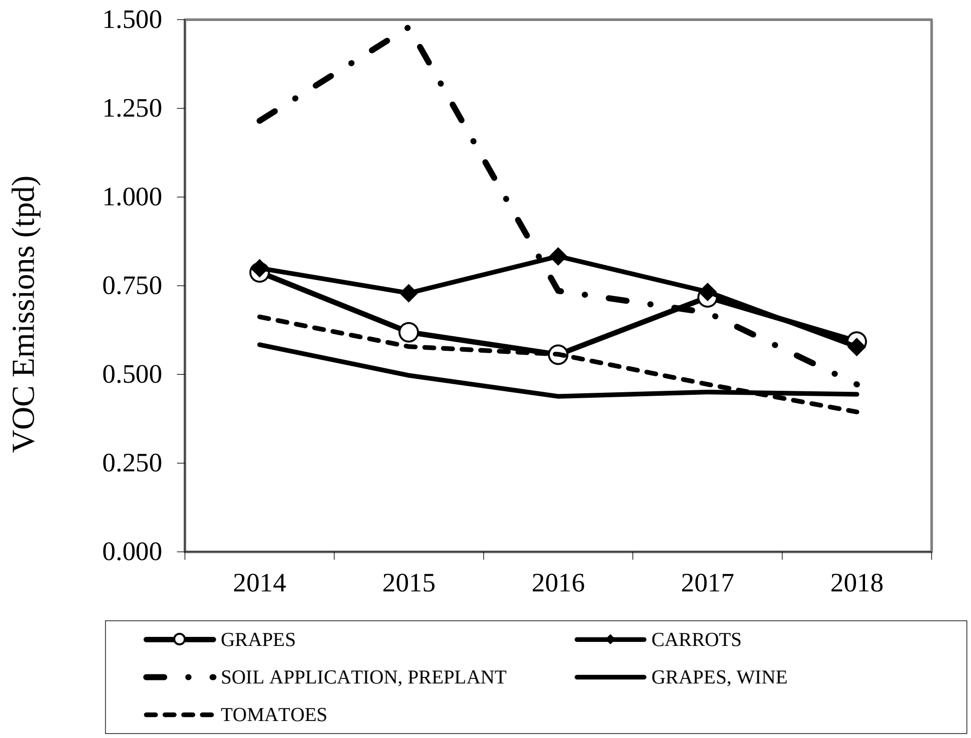

Figure 3d. Emissions of top six to ten crops/sites in the San Joaquin Valley **NAA (2)** from **2014** to **2018**.

Table 7. Abamectin, chlorpyrifos, gibberellins and oxyfluorfen contributions to **2018** May-October ozone season VOC emissions in the San Joaquin Valley **NAA (2)**.

Primary AI	2018 Total Product Emissions (tpd)	Percent of 2018 Emissions	Percent Change from 2017 to 2018
ABAMECTIN	1.040	6.54	3
CHLORPYRIFOS	0.517	3.25	-39
GIBBERELLINS	0.066	0.42	-1
OXYFLUORFEN	0.417	2.63	2

Table 8. Emissions from **2017** and **2018** applications of high- and low-VOC products containing abamectin, chlorpyrifos, gibberellins and oxyfluorfen on all crops/sites in the San Joaquin Valley **NAA (2)**.

Primary AI	Emissions (tpd)		Percent of NAA 2 Emissions from All Products with this Active Ingredient		Percent of Total NAA 2 Nonfumigant Emissions	
	2017	2018	2017	2018	2017	2018
ABAMECTIN						
High VOC	0.130	0.200	12.9%	19.2%	1.0%	1.6%
Low VOC	0.875	0.840	87.1%	80.8%	6.9%	6.9%
CHLORPYRIFOS						
High VOC	0.136	0.126	16.0%	24.3%	1.1%	1.0%
Low VOC	0.717	0.391	84.0%	75.7%	5.6%	3.2%
GIBBERELLINS						
High VOC	0.010	0.006	14.5%	9.8%	0.1%	0.1%
Low VOC	0.057	0.060	85.5%	90.2%	0.4%	0.5%
OXYFLUORFEN						
High VOC	0.368	0.377	90.2%	90.4%	2.9%	3.1%
Low VOC	0.040	0.040	9.8%	9.6%	0.3%	0.3%
COMBINED						
High VOC	0.644	0.710	27.6%	34.8%	5.1%	5.8%
Low VOC	1.689	1.331	72.4%	65.2%	13.2%	10.9%

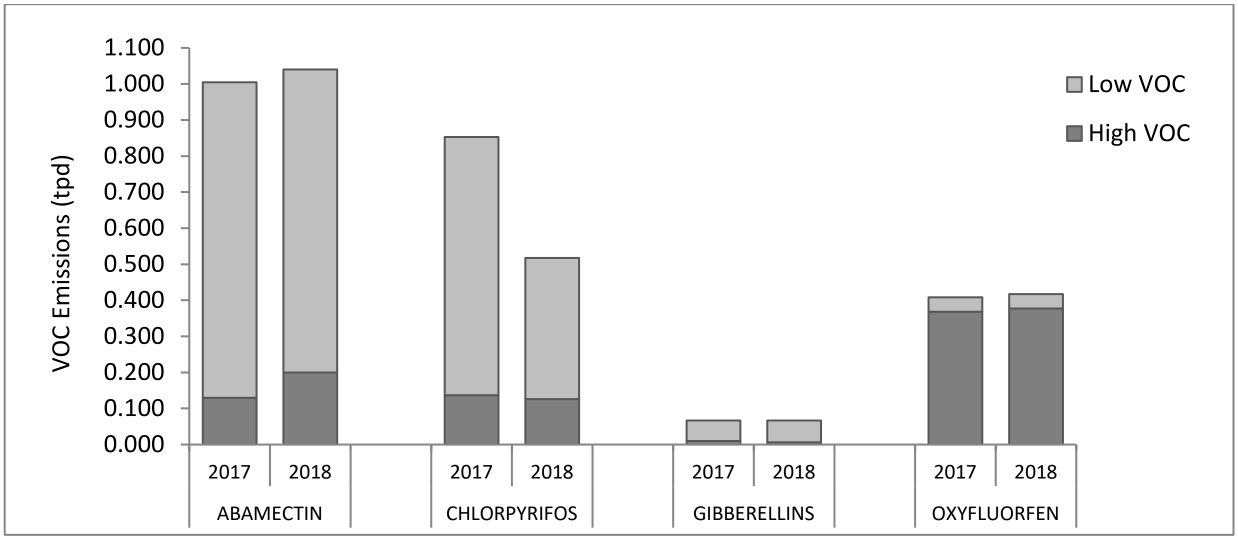

Figure 4. Emissions from **2017** and **2018** applications of high- and low- VOC products containing abamectin, chlorpyrifos, gibberellins and oxyfluorfen on all crops/sites in the San Joaquin Valley **NAA (2)**.

Table 9. Emissions from **2017** and **2018** applications of high- and low-VOC products for abamectin, chlorpyrifos, gibberellins and oxyfluorfen on alfalfa, almonds, citrus*, cotton, grapes†, pistachios, walnuts, and total emissions from applications to all crops in the San Joaquin Valley **NAA (2)**.

Primary AI	Total Emissions from High- and Low- VOC Products (tpd)																	
	Alfalfa		Almond		Citrus*		Cotton		Grape†		Pistachio		Walnut		Total		All Crops	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	**2017**	**2018**	**2017**	**2018**
High-VOC																		
ABAMECTIN	<0.001	0.000	0.023	0.057	0.028	0.026	0.002	0.014	0.012	0.010	<0.001	0.000	<0.001	<0.001	**0.066**	**0.108**	**0.130**	**0.200**
CHLORPYRIFOS	<0.001	<0.001	0.022	0.021	<0.001	<0.001	0.108	0.100	<0.001	0.000	0.000	0.000	0.001	<0.001	**0.133**	**0.123**	**0.136**	**0.126**
GIBBERELLINS	0.000	0.000	0.000	0.000	0.001	0.002	0.000	0.000	0.008	0.004	0.000	0.000	0.000	0.000	**0.009**	**0.006**	**0.010**	**0.006**
OXYFLUORFEN	<0.001	<0.001	0.249	0.249	<0.001	0.002	0.002	<0.001	0.013	0.009	0.028	0.042	0.037	0.039	**0.330**	**0.343**	**0.368**	**0.377**
TOTAL	**<0.001**	**<0.001**	**0.295**	**0.328**	**0.030**	**0.030**	**0.113**	**0.115**	**0.033**	**0.024**	**0.028**	**0.042**	**0.039**	**0.040**	**0.537**	**0.579**	**0.644**	**0.710**
Low-VOC																		
ABAMECTIN	<0.001	<0.001	0.403	0.421	0.051	0.046	0.140	0.102	0.128	0.131	0.004	0.004	0.048	0.054	**0.775**	**0.759**	**0.875**	**0.840**
CHLORPYRIFOS	0.067	0.018	0.144	0.130	0.255	0.089	0.132	0.090	0.053	0.048	0.000	0.000	0.048	0.011	**0.700**	**0.385**	**0.717**	**0.391**
GIBBERELLINS	0.000	0.000	0.000	0.000	0.038	0.037	0.000	0.000	0.017	0.020	<0.001	0.000	0.000	0.000	**0.055**	**0.057**	**0.057**	**0.060**
OXYFLUORFEN	0.000	0.000	0.019	0.019	<0.001	<0.001	<0.001	<0.001	0.006	0.006	0.005	0.006	0.004	0.003	**0.034**	**0.035**	**0.040**	**0.040**
TOTAL	**0.067**	**0.018**	**0.567**	**0.570**	**0.344**	**0.172**	**0.273**	**0.193**	**0.205**	**0.205**	**0.009**	**0.011**	**0.100**	**0.068**	**1.564**	**1.236**	**1.689**	**1.331**

*Citrus comprises the following crops: citrus fruits; grapefruit; lemon; lime; orange; pomelo; tangelo; tangerine (mandarin, satsuma, murcott, etc.).

†Grape comprises the following crops: grapes; grapes, wine.

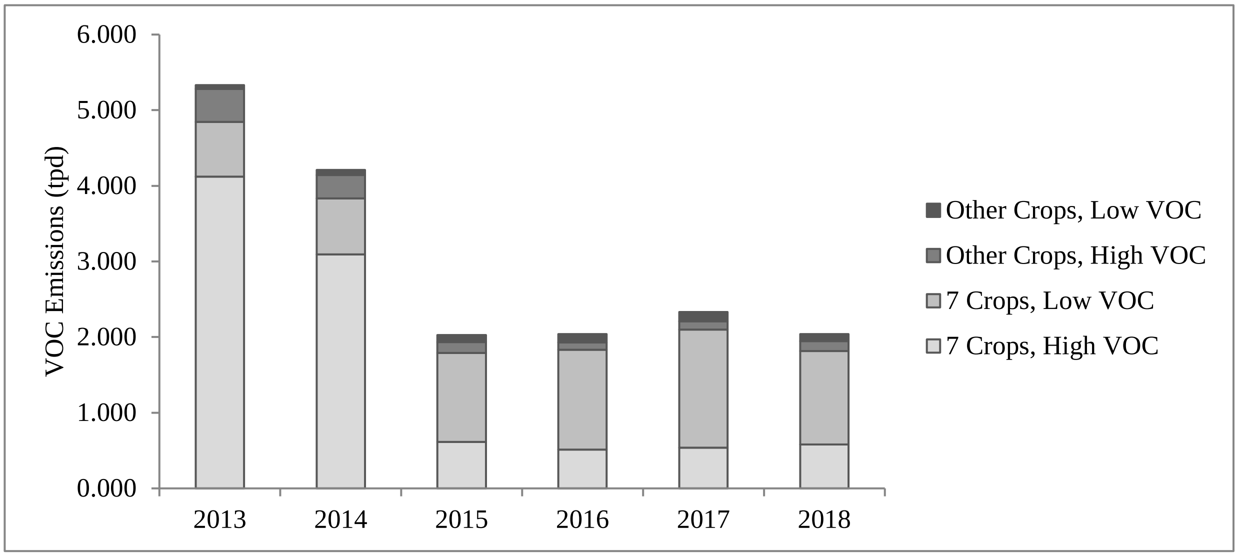

Figure 5. Combined emissions from applications of high- and low-VOC abamectin, chlorpyrifos, gibberellins and oxyfluorfen products on seven crops (alfalfa, almonds, citrus, cotton, grapes, pistachios, and walnuts) and remaining crops in the San Joaquin Valley **NAA (2)** from 2015 to 2018.

Table 10. Pounds of product and active ingredient (lbs x 10^3) and ratio of the pounds of VOC emissions per pound of product used in the San Joaquin Valley **NAA (2)** from **2017** to **2018**.

Primary AI		2017	2018	Change
ABAMECTIN	Products (lbs x 10^3)	1,350	1,386	36
	Active Ingredient (lbs x 10^3)	34	33	-1
	VOC/product (lbs/lb)	0.273	0.275	0.002 (0.8%)
CHLORPYRIFOS	Products (lbs x 10^3)	1,439	853	-586
	Active Ingredient (lbs x 10^3)	575	349	-225
	VOC/product (lbs/lb)	0.217	0.222	0.005 (2.3%)
GIBBERELLINS	Products (lbs x 10^3)	156	175	20
	Active Ingredient (lbs x 10^3)	13	15	2
	VOC/product (lbs/lb)	0.158	0.139	-0.019 (-12.2%)
OXYFLUORFEN	Products (lbs x 10^3)	389	395	6
	Active Ingredient (lbs x 10^3)	116	119	3
	VOC/product (lbs/lb)	0.384	0.386	0.003 (0.7%)
COMBINED	**Products (lbs x 10^3)**	**3,333**	**2,810**	**-524**
	Active Ingredient (lbs x 10^3)	**738**	**517**	**-221**
	VOC/product applied (lbs/lb)	**0.256**	**0.266**	**0.010 (3.8%)**

Table 11. Calculation of hypothetical emissions as described in section 6884(c). (D) = ((A) x (B))/(C).

Active Ingredient	Crop	2014 Emissions (tpd)	2018 Pounds AI (lbs)	2014 Pounds AI (lbs)	2018 Hypothetical Emissions (tpd)	2018 Actual Emissions (tpd)	Difference between Hypothetical and Actual (tpd)
		(A)	(B)	(C)	(D)		
ABAMECTIN	ALFALFA	<0.001	64	69	**<0.001**	<0.001	<0.001
	ALMOND	0.687	15,779	10,288	**1.054**	0.478	0.576
	CITRUS	0.074	2,616	1,151	**0.167**	0.072	0.095
	COTTON	0.109	3,414	1,509	**0.246**	0.116	0.130
	GRAPES	0.325	4,788	4,743	**0.328**	0.141	0.187
	PISTACHIO	0.002	221	25	**0.016**	0.004	0.011
	WALNUT	0.108	1,875	1,719	**0.117**	0.055	0.062
CHLORPYRIFOS	ALFALFA	0.138	7,658	59,071	**0.018**	0.018	<0.001
	ALMOND	0.403	114,081	181,926	**0.253**	0.151	0.102
	CITRUS	0.408	62,005	172,834	**0.146**	0.089	0.058
	COTTON	0.255	112,729	95,094	**0.302**	0.191	0.111
	GRAPES	0.025	38,053	20,173	**0.048**	0.048	<0.001
	WALNUT	0.113	8,184	65,398	**0.014**	0.011	0.003
GIBBERELLINS	CITRUS	0.255	6,066	6,287	**0.246**	0.039	0.207
	GRAPES	0.250	7,869	8,702	**0.226**	0.024	0.202
OXYFLUORFEN	ALFALFA	<0.001	12	10	**<0.001**	<0.001	<0.001
	ALMOND	0.469	66,312	80,138	**0.388**	0.268	0.120
	CITRUS	0.002	506	224	**0.003**	0.002	0.002
	COTTON	0.014	1,433	4,752	**0.004**	0.001	0.003
	GRAPES	0.072	12,778	10,302	**0.089**	0.016	0.073
	PISTACHIO	0.063	15,980	17,802	**0.057**	0.049	0.008
	WALNUT	0.065	10,190	11,268	**0.058**	0.042	0.016
TOTAL		**3.835**	**492,614**	**753,484**	**3.782**	**1.816**	**1.966**

Table 12. Highest 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 (2)** during **2017** and **2018** (May-October).

Product	Internal product number	Registration number	EP	method	Product inactivity date	Pounds used 2017	Pounds used 2018	Change (%)
ABAMECTIN								
REAPER CLEARFORM	65921	34704-1078-ZA	31.08	bridged	NA	6,103	5,679	-7%
AGRI-MEK SC MITICIDE/INSECTICIDE	62903	100-1351-ZA	5.63	bridged	NA	4,811	5,318	11%
ABBA ULTRA MITICIDE/INSECTICIDE	70506	5481-621-AA	34.18	Derived	NA	10	5,082	49757%
ABBA ULTRA MITICIDE/INSECTICIDE	61871	66222-226-AA	34.18	TGA	12/31/2018	11,260	3,572	-68%
TIMECTIN 0.15 EC AG INSECTICIDE/MITICIDE	58571	84229-2-AA	29.75	TGA	NA	2,894	3,248	12%
ABACUS V	65503	83100-32-AA-83979	27.26	TGA	NA	1,491	2,100	41%
ABAMEX MITICIDE/INSECTICIDE	68295	228-734-AA	24.1	TGA	NA	574	1,431	149%
AGRI-MEK SC MITICIDE/INSECTICIDE	60883	100-1351-AA	5.63	TGA	12/31/2013	1,501	794	-47%
REAPER 0.15 EC	54067	34704-923-AA	73.33	TGA	NA	197	507	157%
EPI-MEK 0.15 EC MITICIDE/INSECTICIDE	52213	100-1154-AA	55.1	bridged	12/31/2014	300	305	2%
ABACUS AGRICULTURAL MITICIDE/INSECTICIDE	56076	83100-4-AA-83979	60.54	TGA	NA	136	242	77%
WILLOWOOD ABAMECTIN 0.15LV	70054	87290-68-AA	7.61	TGA	NA	NA	221	NA
WILLOWOOD ABAMECTIN 0.15EC	67633	87290-58-AA	46.7	TGA	12/31/2018	NA	112	NA
CHLORPYRIFOS								
WARHAWK CLEARFORM	65612	34704-1077-AA	17.89	TGA	NA	141,814	137,465	-3%
LORSBAN ADVANCED	58202	62719-591-AA	18.45	TGA	NA	196,355	99,438	-49%
VULCAN	63154	66222-233-AA	24.24	TGA	NA	131,696	48,645	-63%
WARHAWK	52062	34704-857-AA	54.41	TGA	NA	7,432	15,869	114%
DREXEL CHLORPYRIFOS 4E-AG	56791	19713-520-AA	18.2	TGA	NA	24,298	9,612	-60%
GOVERN 4E INSECTICIDE	51349	62719-220-AA-55467	50	derived	NA	16,594	9,159	-45%
WHIRLWIND	51491	62719-220-AA-5905	50	derived	NA	11,760	7,753	-34%
LOCK-ON INSECTICIDE	38835	62719-79-ZA	20.9	derived	NA	14,029	4,474	-68%
CHLORPYRIFOS 4E AG	44024	66222-19-AA-51036	52.9	TGA/derived	12/31/2006	2,004	3,031	51%

Table 12 (continued). Highest 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 (2)** during **2017** and **2018** (May-October).

Product	Internal product number	Registration number	EP	method	Product inactivity date	Pounds used 2017	Pounds used 2018	Change (%)
CHLORPYRIFOS (continued)								
LOCK-ON INSECTICIDE	25121	62719-79-AA	20.9	TGA	12/31/2005	6,131	2,227	-64%
DREXEL CHLORPYRIFOS 15G	68613	19713-505-AA	3.7	default_median	NA	1,040	1,883	81%
WARHAWK	51399	62719-220-AA-34704	50	derived	12/31/2012	183	1,278	599%
LORSBAN 15G GRANULAR INSECTICIDE	38837	62719-34-ZA	5.33	derived	NA	163	578	254%
AGRISOLUTIONS YUMA 4E INSECTICIDE	54109	62719-220-AA-1381	50	derived	9/2/2014	NA	302	NA
NUFOS 4E	34621	67760-28-AA	52.3	TGA/derived	12/31/2018	NA	272	NA
LORSBAN-4E	29367	62719-220-ZA	51.32	TGA	NA	1,576	253	-84%
HATCHET	56101	62719-220-ZC	50	derived	NA	NA	222	NA
LORSBAN 4E-HF	29120	62719-220-AA	48.68	TGA	12/31/2005	2,843	211	-93%
GIBBERELLINS								
PROGIBB LV PLUS PLANT GROWTH REGULATOR SOLUTION	66308	73049-498-AA	11.54	TGA	NA	5,390	6,952	29%
PROGIBB 40% PLANT GROWTH REGULATOR WATER SOLUBLE GRANULE	61609	73049-1-ZA	3.7	default_median	NA	2,739	3,498	28%
FALGRO 2X LV	66024	62097-32-AA-82917	22.95	TGA	NA	2,416	1,726	-29%
PROGIBB 40% WATER SOLUBLE GRANULES	44822	73049-1-AA	3.7	default_median	12/31/2011	1,498	1,619	8%
OXYLFUORFEN								
GOALTENDER	51277	62719-447-ZA	8.28	TGA	NA	49,040	57,436	17%
GOAL 2XL	48484	62719-424-AA	62.3	TGA/derived	NA	38,292	42,213	10%
PINDAR GT	60833	62719-611-AA	10.6	TGA	NA	6,165	3,593	-42%
GALIGAN 2E OXYFLUORFEN HERBICIDE	44923	66222-28-AA	66.15	TGA/derived	12/31/2014	466	958	106%
GALIGAN 2E HERBICIDE	65078	66222-28-ZA	66.15	TGA/derived	NA	305	893	193%
GOAL 4F	51278	62719-447-AA	8.28	derived	9/15/2006	621	883	42%
OXYSTAR 4L	59632	42750-199-AA	10.63	TGA	NA	305	436	43%

Table 12 (continued). Highest 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 (2)** during **2017** and **2018** (May-October).

Product	Internal product number	Registration number	EP	method	Product inactivity date	Pounds used		
						2017	2018	Change (%)
OXYLFUORFEN (continued)								
OXYSTAR 2E	56469	42750-136-AA	73.09	TGA	NA	1,169	207	-82%
GOAL 2XL HERBICIDE	32909	707-243-AA	39.15	default_median	12/31/2004	252	187	-26%
OXYFLUORFEN 2E HERBICIDE	64539	70506-295-AA-84237	66.08	derived	12/31/2018	102	141	38%
GOAL 1.6E HERBICIDE	4145	707-174-AA	65.5	TGA	12/31/2004	157	140	-11%