Appendix 1
Registrant Proposed Field Adjustment Factors for
Methyl Bromide and Chloropicrin
Analysis of Methyl Bromide Emissions in the San Joaquin Valley in 1990 and 2004

Abstract

This report calculates and summarizes the total amount of methyl bromide emitted from agricultural and non-agricultural usage in the San Joaquin Valley in 1990 and 2004 during the peak ozone season (May 1 to October 31 of each year). All methyl bromide use data were obtained from the CDPR Pesticide Information Portal (CALPIP) – Pesticide Use Report (PUR) online database. Using the method that CDPR historically has used, which assumes that 100% of the applied methyl bromide is emitted into the air, approximately 2.56 million pounds of methyl bromide was emitted in the eight counties comprising the San Joaquin Valley in 1990 (6.974 tons/day); and approximately 884,615 pounds of methyl bromide was emitted in 2004. The difference between 1990 and 2004 represents a 65.4% reduction in methyl bromide total emissions. An alternative VOC equation, based on mass loss studies and discrete usage data, was developed that takes into account the proportion of methyl bromide that is degraded in the soil (for soil fumigations). It is believed that this alternative VOC emission equation more accurately reflects the total amount of methyl bromide emitted by each crop or site and method of application. Using this new equation, approximately 1.6 million pounds of methyl bromide was emitted in 1990 (4.387 tons/day), and approximately 423,358 pounds of methyl bromide were emitted in 2004 (1.150 tons/day). The difference between 1990 and 2004, using the corrected VOC equation, represents a 73.8% reduction in methyl bromide total emissions.

Data Acquisition and Overall Use Statistics

The CALPIP search queries were by Year (“1990” and “2004”) and Chemical Name (“methyl bromide”). In this way, all PUR data for methyl bromide were included, regardless of formulation, product name, crop or site of application, etc. Both Agricultural and Non-Agricultural (under Other Criteria: Reporting Type) use reports were included.

The aggregate 1990 and 2004 PUR files for methyl bromide were downloaded and contained all PUR reports for the entire State of California. The 1990 Statewide PUR file contained 11,475 records of application that, collectively, totaled 20,139,409.92 pounds of methyl bromide. The 2004 Statewide PUR file contained 5,186 records of application that, collectively, totaled 7,105,109.84 pounds of methyl bromide (Table 1).

The 1990 and 2004 Statewide PUR files were then processed to include only the 8 counties that comprise the San Joaquin Valley: Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare. While only part of Kern County is technically included in the San Joaquin Valley VOC non-attainment area, all PUR records for Kern County were included in these analyses as a conservative measure, because it was not possible to distinguish between the applications that occurred in the non-attainment area and those that did not.

The 1990 PUR file for the San Joaquin Valley contained 3,319 records of application that, collectively, totaled 6,381,933.24 pounds of methyl bromide. The 2004 PUR file for the San Joaquin Valley contained 1,805 records of application that, collectively, totaled 1,494,252,924 pounds of methyl bromide (Table 1).
The 1990 and 2004 San Joaquin Valley PUR files were then processed to include only the applications that occurred between May 1 and October 31 of each year, as this period is considered the “peak ozone season”. The 1990 PUR file for the San Joaquin Valley Ozone Season contained 1,125 records of application that, collectively, totaled 2,556,412.799 pounds of methyl bromide. These 1,125 records consisted of 512 records for which the dates of application were listed and occurred between May 1 and October 31, and an additional 613 records for which no date of application was listed. As a conservative measure, these 613 no-date records were assumed to have occurred during the peak ozone season. The 2004 PUR file for the San Joaquin Valley Ozone Season contained 735 records of application that, collectively, totaled 884,615.4696 pounds of methyl bromide (Table 1).

The total amount of methyl bromide applied in the San Joaquin Valley during the peak ozone season in 2004 (884,615.4696 lbs.) is approximately 34.6% of what was applied in 1990 (2,556,412.799 lbs.), representing a 65.4% reduction in usage.

Table 1. Cumulative number of records and total pounds of methyl bromide applied in California (whole-year) and the San Joaquin Valley (whole-year and during the “peak ozone season”) for all Agricultural and Non-Agricultural applications in 1990 and 2004.

<table>
<thead>
<tr>
<th>Year</th>
<th>Area &amp; Period</th>
<th>No. of Records</th>
<th>Amount of MeBr Applied (total lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>Statewide, 12-month</td>
<td>11,475</td>
<td>20,139,409.92</td>
</tr>
<tr>
<td></td>
<td>San Joaquin Valley, 12-month</td>
<td>3,319</td>
<td>6,381,933.24</td>
</tr>
<tr>
<td></td>
<td>San Joaquin Valley, May 1 to October 31</td>
<td>1,125</td>
<td>2,556,412.799</td>
</tr>
<tr>
<td>2004</td>
<td>Statewide, 12-month</td>
<td>5,186</td>
<td>7,105,109.84</td>
</tr>
<tr>
<td></td>
<td>San Joaquin Valley, 12-month</td>
<td>1,805</td>
<td>1,494,252.924</td>
</tr>
<tr>
<td></td>
<td>San Joaquin Valley, May 1 to October 31</td>
<td>735</td>
<td>884,615.4696</td>
</tr>
</tbody>
</table>
Analysis of VOC Emissions based on CDPR Procedures

CDPR uses the following equation to calculate VOC emissions from pesticide applications, where $EP$ is defined as the Emissions Potential (VOC fraction) of a given pesticide product:

$$VOC \text{ emission (lbs.)} = [\text{lbs. of product applied}] \times [\text{product-specific EP}]$$

For all methyl bromide products, CDPR assigns a default EP value of 100%. This assumes that 100% of the applied amount of methyl bromide is volatized from the soil or other site, such that the total methyl bromide VOC emissions are equal to the amount of methyl bromide applied during a specific period, location, etc.

Using this equation for the total amounts applied in Table 1, it can be calculated that the average daily VOC emissions in the San Joaquin Valley during the peak ozone season were approximately 6.947 tons/day in 1990 and 2.404 tons/day in 2004 (2000 pounds = 1 ton; 184 days in May 1 to October 31 period) (Table 2). This represents a 4.543 tons/day (or 65.4%) reduction in methyl bromide VOC emissions in 2004 compared to 1990.

Alternative Analysis of VOC Emissions based on Mass Loss Studies

While 100% of the applied methyl bromide can theoretically be emitted from a given end-use site, numerous studies have demonstrated that, at least for soil fumigation, a portion of the methyl bromide is degraded in the soil and is not emitted into the air (i.e., via mass loss studies). With respect to this fact, any methyl bromide VOC emission calculation that assumes 100% emission would considerably overestimate methyl bromide’s contribution to the VOC burden in the San Joaquin Valley or any other area with significant methyl bromide use in soil fumigation. For non-soil fumigation sites (commodity fumigation, structural fumigation, etc.), where there is little opportunity for methyl bromide degradation, the 100% emissions is likely accurate.

Yates et al. (1996) provide a detailed review of the techniques and mass loss studies that have determined estimates of methyl bromide emission loss and degradation in the soil from various soil fumigation application methods. These mass loss studies can be used to more accurately estimate total methyl bromide emissions from soil fumigation activity. Based primarily on Yates et al. (1996) review, an additional component to the VOC emissions calculation was added, where $EF =$ the Emissions Factor, or the proportion of methyl bromide that is emitted from the application field or site. This alternative calculation is:

$$VOC \text{ emission (lbs.)} = [\text{lbs. of product applied}] \times [\text{product-specific EP}] \times [\text{application-specific EF}]$$

By example, if methyl bromide was applied to 10 acres of almond at 200 lbs. a.i. (active ingredient) per acre, the total amount applied would be 2,000 lbs. of methyl bromide. The EP value remains 100% (1.0 by proportion), based on 100% of the product being volatile. The EF value would be based on mass loss studies where, in this case, the application is a deep injection (20+ in.) with HDPE tarp, which was estimated to result in 26% emission (0.26 by proportion) of the applied chemical. So, for this example:

$$VOC \text{ emission (lbs.)} = [2000 \text{ lbs.}] \times [1.0] \times [0.26] = 520 \text{ lbs. emitted.}$$

Therefore, based on this approach, only 520 lbs. of the 2,000 lbs. of methyl bromide that was applied, was emitted during this application.
Based on Yates et al. (1996), the following EF values were used to calculate total emissions for each crop or site (e.g., soil fumigation vs. structural fumigation), type of fumigation (e.g., almond acres vs. almond nuts prior to packaging), type of application (e.g., shallow vs. deep shank; tarp or no tarp; hot-gas), where the type of application was determined by the “Unit Treated” field of the PUR records:

Unit Treated:
- A = acres
  - Shallow injection (6-15 in.), bed or broadcast, no tarp = 82% emission (EF = 0.82)
  - Shallow injection (6-15 in.), bed or broadcast, LDPE tarp = 82% emission* (EF = 0.82)
  - Shallow injection (6-15 in.), bed or broadcast, HDPE tarp = 43% emission (EF = 0.43)
  - Deep injection (20+ in.), bed or broadcast, no tarp = 38% emission (EF = 0.38)
  - Deep injection (20+ in.), bed or broadcast, LDPE tarp = 38% emission* (EF = 0.38)
  - Deep injection (20+ in.), bed or broadcast, HDPE tarp = 26% emission (EF = 0.26)

* Note: No studies were found that determined mass loss of methyl bromide through LDPE films, regardless of injection depth. However, based on Yates et al. (1996), LDPE film is at least twice as permeable to methyl bromide as HDPE films. Because of this, it is assumed that LDPE film provides virtually no retention properties and, therefore, the EF values for shallow injection + LDPE tarp and deep injection + LDPE tarp were considered to be equal to the EF values for shallow injection + no tarp (82%) and deep injection + no tarp (38%).

- C = cubic feet (for commodity, potting media, etc.; assume 100% loss; EF = 1.0)
- K = thousand cubic feet (for commodity, potting media, etc.; assume 100% loss; EF = 1.0)
- P = pounds (for commodity, potting media, etc.; assume 100% loss; EF = 1.0)
- S = square feet (for greenhouse treatments, etc.; assume 100% loss; EF = 1.0)
- T = tons (for commodity, potting media, etc.; assume 100% loss; EF = 1.0)
- U = miscellaneous unit (for commodity, potting media, etc.; assume 100% loss; EF = 1.0)
- Not Listed = (for commodity, potting media, etc.; assume 100% loss; EF = 1.0)

As an aggregate example, the following data for 2004 methyl bromide Almond fumigation is used to illustrate the incorporation of application-specific EF values into the VOC equation:

**ALMOND (2004)**

Number of Records: 92
Total Pounds of Chemical Applied: 25,789.45151
Units Treated: A (acres), C (cubic feet), K (thousand cubic feet), T (tons), U (misc. unit)
Pounds Applied by Unit Treated:
- 58 records = A (deep injection + HDPE tarp; EP = 1.0; EF = 0.26) for 19,946.71286 total lbs.
- 17 records = C (assume 100% loss; EP = 1.0; EF = 1.0) for 1278.769651 lbs.
- 3 records = K (assume 100% loss; EP = 1.0; EF = 1.0) for 2387.379 lbs.
- 6 records = T (assume 100% loss; EP = 1.0; EF = 1.0) for 989 lbs.
- 4 records = U (assume 100% loss; EP = 1.0; EF = 1.0) for 1187.59 lbs.

VOC emissions for treated acres of almond = 19,946.71286 x 0.26 = 5,186.14534 lbs.
VOC emissions for all other almond applications = 5,842.73865 x 1.0 = 5,842.73865 lbs.

Total VOC emissions for Almond = 11,028.884 lbs.
This same aggregate analysis was performed for all SITE/CROP listings within both the 1990 and 2004 PUR files. The aggregate analysis and summary table for 1990 applications are provided in Appendix A. The aggregate analysis and summary table for 2004 applications are provided in Appendix B. These analyses assume the following:

- Approximately 90% of methyl bromide soil fumigations in 1990 were non-tarped and 10% were tarped using LDPE film.
- LDPE film is considered to have little gas retention properties, and therefore, any 1990 applications with LDPE film had EF values that were the same as non-tarped applications.
- LDPE film was only used in 1990 and not in 2004.
- All CDPR-approved HDPE films were assigned the same EF, which was based on mass loss studies.
- All 2004 soil applications used HDPE film, regardless of injection depth.
- All non-acre applications are assumed to result in 100% emission of product.

Based on the sum values for the \( EF \)-corrected VOC emission equations that were applied to each Crop/Site by year, it is calculated that 1,614,281.682 lbs. of methyl bromide were emitted in the eight counties comprising the San Joaquin Valley during the peak ozone season in 1990 (4.387 tons/day), and 423,357.7978 lbs. of methyl bromide were emitted in 2004 (1.150 tons/day). The 2004 VOC total is approximately 26.2% of the 1990 total, which equates to a 73.8% reduction in methyl bromide emissions.

**Table 2. Default and Corrected methyl bromide VOC emissions.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Default VOC emissions (tons/day) ( z )</th>
<th>VOC emissions corrected using mass loss data (tons/day) ( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>6.947</td>
<td>4.387</td>
</tr>
<tr>
<td>2004</td>
<td>2.404</td>
<td>1.150</td>
</tr>
</tbody>
</table>

\( z \) Values assume 100% emission of applied material.

\( y \) Values incorporate empirically-derived mass loss data.

**CONCLUSION**

When the type of application is not considered and 100% of the applied methyl bromide is assumed to be emitted, the total VOC emissions of methyl bromide were reduced from 6.947 tons/day in 1990 to 2.404 tons/day in 2004. When the type of application is considered relative to the proportion of methyl bromide which is degraded in the soil, the total VOC emissions of methyl bromide were reduced from 4.387 tons/day in 1990 to 1.150 ton/day in 2004. The Product Names listed in the PUR database files are presented in Appendix 3.

**Reference Cited:**

APPENDIX A

1990 Methyl Bromide VOC Emissions in the San Joaquin Valley

[since the default EP value is 100% (1.0) for all methyl bromide applications, this component of the equation was not included in the following calculations, as it does not affect the equations’ product]

ALFALFA (FORAGE – FODDER) (ALL OR UNSPEC) -- 1990
Number of Records: 3
Total Pounds Chemical Applied: 16,193.625
Units Treated: A (acres), U (misc. unit)
Pounds Applied by Unit Treated:
2 records = A (shallow injection + LDPE or no tarp; EF = 0.82) for 16,019.5 lbs.
1 record = U (assume 100% loss; EF = 1.0) for 174.125 lbs.
VOC emissions for treated acres of Alfalfa = 16,019.5 x 0.82 = 13,135.99 lbs.
VOC emissions for all other Alfalfa applications = 174.125 x 1.0 = 174.125 lbs.
Total VOC emissions for Alfalfa = 13,210.115 lbs.

ALMOND -- 1990
Number of Records: 120
Total Pounds of Chemical Applied: 97,562.641
Units Treated: A (acres), C (cubic feet), K (thousand cubic feet), P (pounds), S (square feet), T (tons), U (misc. unit).
Pounds Applied by Unit Treated:
26 records = A (deep injection + LDPE or no tarp, EF = 0.38) for 70,709.065 lbs.
19 records = C (assume 100% loss; EF = 1.0) for 3,472.831 lbs.
10 records = K (assume 100% loss; EF = 1.0) for 6,262.7 lbs.
6 records = P (assume 100% loss; EF = 1.0) for 1,316 lbs.
4 records = S (assume 100% loss; EF = 1.0) for 716.125 lbs.
18 records = T (assume 100% loss; EF = 1.0) for 10,159.375 lbs.
37 records = U (assume 100% loss; EF = 1.0) for 4,926.545 lbs.
VOC emissions for treated acres of almond = 70,709.065 x 0.38 = 26,869.4447 lbs.
VOC emissions for all other almond applications = 26,853.576 x 1.0 = 26,853.576 lbs.
Total VOC emissions for Almond = 53,723.0207 lbs.

APPLE -- 1990
Number of Records: 4
Total Pounds Chemical Applied: 11,968.9
Unit Treated: A (acres)
EF based on Application Method: 0.38 (deep injection + LDPE or no tarp)
VOC emissions for Apple = 11,968.9 x 0.38 = 4,548.182 lbs.
APRICOT -- 1990
Number of Records: 5
Total Pounds Chemical Applied: 1,529.485
Units Treated: A (acres), U (misc. unit)
Pounds Applied by Unit Treated:
   - 2 records = A (deep injection + LDPE or no tarp; EF = 0.38) = 1,395.985 lbs.
   - 3 records = U (assume 100% loss; EF = 1.0) = 133.5 lbs.
VOC emissions for treated acres of Apricot = 1,395.985 x 0.38 = 530.4743 lbs.
VOC emissions for all other Apricot applications = 133.5 x 1.0 = 133.5 lbs.
Total VOC emissions for Apricot = 663.9743 lbs.

BEANS (ALL OR UNSPEC) -- 1990
Number of Records: 12
Total Pounds Chemical Applied: 3,207
Units Treated: K (thousand cubic feet), P (pounds), S (square feet), T (tons), U (misc. unit)
Pounds Applied by Unit Treated:
   - 1 record = K (assume 100% loss; EF = 1.0) for 76 lbs.
   - 2 records = P (assume 100% loss; EF = 1.0) for 35 lbs.
   - 2 records = S (assume 100% loss; EF = 1.0) for 216 lbs.
   - 6 records = T (assume 100% loss; EF = 1.0) for 2,490 lbs.
   - 1 record = U (assume 100% loss; EF = 1.0) for 390 lbs.
VOC emissions for Beans (All or Unspec) = 3,207 x 1.0 = 3,207 lbs.

BEANS, DRIED-TYPE -- 1990
Number of Records: 7
Total Pounds Chemical Applied: 3,349
Units Treated: C (cubic feet), P (pounds), T (tons)
Pounds Applied by Unit Treated:
   - 2 records = C (assume 100% loss; EF = 1.0) for 304 lbs.
   - 1 record = P (assume 100% loss; EF = 1.0) for 204 lbs.
   - 4 records = T (assume 100% loss; EF = 1.0) for 2,805 lbs.
VOC emissions for Beans, Dried-Type = 3,349 x 1.0 = 3,349 lbs.

BEEHIVES (ALL OR UNSPEC) -- 1990
Number of Records: 4
Total Pounds Chemical Applied: 497.5
Units Treated: A (? Acres of beehives?)
EF value based on Application method: 1.0 (assume 100% loss; bee equipment)
VOC emissions for Beehives (all or Unspec) = 497.5 x 1.0 = 497.5 lbs.

BEEHIVES, BEE COLONY (DISEASED, NUISANCE) -- 1990
Number of Records: 2
Total Pounds Chemical Applied: 53.9
Unit Treated: C (cubic feet)
EF value based on application method: 1.0 (assume 100% loss)
VOC emissions for Beehives, Bee Colony = 53.9 x 1.0 = 53.9 lbs.
CARROT, GENERAL -- 1990
Number of Records: 2
Total Pounds Chemical Applied: 398
Unit Treated: A (acres)
EF value based on application method: 0.82 (shallow injection + no tarp)

\[ \text{VOC emissions for Carrots, General} = 398 \times 0.82 = 326.36 \text{ lbs.} \]

CHERRY -- 1990
Number of Records: 53
Total Pounds Chemical Applied: 23,246.8726
Units Treated: A (acres), T (tons), U (misc. unit)

Pounds Applied by Unit Treated:
- 40 records = A (deep injection + LDPE or no tarp, EF = 0.38) for 20,653.5776 lbs.
- 1 record = T (assume 100% loss; EF = 1.0) for 737 lbs.
- 12 records = U (assume 100% loss, EF = 1.0) for 1,856.295 lbs.

\[ \text{VOC emissions for treated acres of Cherry} = 20,653.5776 \times 0.38 = 7,848.359488 \text{ lbs.} \]
\[ \text{VOC emissions for all other Cherry applications} = 2,593.295 \times 1.0 = 2,593.295 \text{ lbs.} \]
\[ \text{Total VOC emissions for Cherry} = 10,441.654488 \text{ lbs.} \]

COMMODITY FUMIGATION -- 1990
Number of Records: 25
Total Pounds Chemical Applied: 5,070.745
Unit Treated: Unknown (assume 100% loss)
EF based on application Method: 1.0

\[ \text{VOC emissions for Commodity Fumigation} = 5,070.745 \times 1.0 = 5,070.745 \text{ lbs.} \]

COTTON, GENERAL -- 1990
Number of Records: 2
Total Pounds Chemical Applied: 6,500.335
Unit Treated: A (acres)
EF based on Application Method: 0.82 (shallow injection + LDPE or no tarp)

\[ \text{VOC emissions for Cotton} = 6,500.335 \times 0.82 = 5,330.2747 \text{ lbs.} \]

FIG -- 1990
Number of Records: 9
Total Pounds Chemical Applied: 1,267.88
Units Treated: A (acres), T (tons)

Pounds Chemical Applied by Unit Treated:
- 2 records = A (deep injection + LDPE or no tarp; EF = 0.38) for 200 lbs.
- 7 records = T (assume 100% loss; EF = 1.0) for 1,067.88 lbs.

\[ \text{VOC emissions for treated acres of Fig} = 200 \times 0.38 = 76 \text{ lbs.} \]
\[ \text{VOC emissions for all other Fig applications} = 1,067.88 \times 1.0 = 1,067.88 \text{ lbs.} \]
\[ \text{Total VOC emissions for Fig} = 1,143.88 \text{ lbs.} \]
FOREST TREES, FOREST LANDS (ALL OR UNSPEC) -- 1990
Number of Records: 4
Total Pounds Chemical Applied: 32.34
Unit Treated: C (cubic feet)
EF value based on application method: 0.82 (shallow injection + LDPE or no tarp)
\[ VOC \text{ emissions for Forest Trees} = 32.34 \times 0.82 = 26.5188 \]

FRUITS (ALL OR UNSPEC) -- 1990
Number of Records: 6
Total Pounds Chemical Applied: 2,648.95
Units Treated: C (cubic feet), K (thousand cubic feet), U (misc. unit)
Pounds Chemical Applied by Unit Treated:
2 records = C (assume 100% loss; EF = 1.0) for 680 lbs.
1 record = K (assume 100% loss; EF = 1.0) for 1,617 lbs.
3 records = U (assume 100% loss; EF = 1.0) for 351.95 lbs.
\[ VOC \text{ emissions for Fruits (all or unspec)} = 2,648.95 \times 1.0 = 2,648.95 \text{ lbs.} \]

GRAINS (ALL OR UNSPEC) -- 1990
Number of Records: 1
Total Pounds Chemical Applied: 0.98
Unit Treated: U (misc. unit)
EF value based on Application Method: 1.0
\[ VOC \text{ emissions for Grains} = 0.98 \times 1.0 = 0.98 \text{ lbs.} \]

GRAPES -- 1990
Number of Records: 34
Total Pounds Chemical Applied: 76,258.236
Units Treated: A (acres), C (cubic feet), K (thousand cubic feet), S (square feet), T (tons),
U (misc. unit)
Pounds Chemical Applied by Unit Treated:
16 records = A (deep injection + LDPE or no tarp; EF = 0.38) for 61,348.381 lbs.
3 records = C (assume 100% loss; EF = 1.0) for 1,135 lbs.
7 records = K (assume 100% loss; EF = 1.0) for 11,659.105 lbs.
1 record = S (assume 100% loss; EF = 1.0) for 360 lbs.
1 record = T (assume 100% loss; EF = 1.0) for 3 lbs.
6 records = U (assume 100% loss; EF = 1.0) = 1,752.75
VOC emissions for treated acres of Grapes = 61,348.381 \times 0.38 = 23,312.38478 \text{ lbs.}
VOC emissions for all other Grape applications = 14,909.855 \times 1.0 = 14,909.855 \text{ lbs.}
\[ \text{Total VOC emissions for Grapes} = 38,222.23978 \text{ lbs.} \]

GRAPES, WINE -- 1990
Number of Records: 13
Total Pounds Chemical Applied: 537,163.545
Units Treated: A (acres)
EF value based on application method: 0.38 (deep injection + LDPE or no tarp)
\[ VOC \text{ emissions for Grapes, Wine} = 537,163.545 \times 0.38 = 204,122.1471 \text{ lbs.} \]
KIWIFRUIT -- 1990
Number of Records: 1
Total Pounds Chemical Applied: 2,585.01
Unit Treated: A (acre)
EF value based on application method: 0.38 (deep injection + LDPE or no tarp)
VOC emissions for Kiwifruit = 2,585.01 x 0.38 = 982.3038 lbs.

LANDSCAPE MAINTENANCE -- 1990
Number of Records: 28
Total Pounds Chemical Applied: 3,802.02
Unit Treated: Unknown
EF value based on application method: 0.82 (assume shallow injection + LDPE or no tarp)
VOC emissions for Landscape Maintenance = 3,802.02 x 0.82 = 3,117.6564 lbs.

NECTARINE -- 1990
Number of Records: 111
Total Pounds Chemical Applied: 192,746.285
Units Treated: A (acres), C (cubic feet), T (tons), U (misc. unit)
Pounds Chemical Applied by Unit Treated:
29 records = A (deep injection + LDPE or no tarp; EF = 0.38) for 163,243.605 lbs.
1 record = C (assume 100% loss; EF = 1.0) for 55.9 lbs.
1 record = T (assume 100% loss; EF = 1.0) for 155 lbs.
80 records = U (assume 100% loss; EF = 1.0) for 29,502.88 lbs.
VOC emission for treated acres of Nectarine = 163,243.605 x 0.38 = 62,032.5699 lbs.
VOC emission for all other Nectarine applications = 29,502.88 x 1.0 = 29,502.88 lbs.
Total VOC emissions for Nectarine = 91,535.4499 lbs.

N-GRNHS GRWN CUT FLWRS OR GREENS -- 1990
Number of Records: 5
Total Pounds Chemical Applied: 103.3099
Units Treated: A (acres), C (cubic feet), S (square feet)
Pounds Chemical Applied by Unit Treated:
2 records = A (shallow injection + LDPE or no tarp; EF = 0.82) for 91.54 lbs.
2 records = C (assume 100% loss; EF = 1.0) for 11.76 lbs.
1 record = S (assume 100% loss; EF = 1.0) for 0.0099 lbs.
VOC emissions for treated acres of N-GGCFOG = 91.54 x 0.82 = 75.0628 lbs.
VOC emissions for all other N-GGCFOG = 11.7699 x 1.0 = 11.7699 lbs.
Total VOC emissions for N-GGCFOG = 86.8327

N-GRNHS GRWN TRNSPLNT/PRPGTV MTRL -- 1990
Number of Records: 7
Total Pounds Chemical Applied: 86.645
Units Treated: S (square feet), Unknown
Pounds Chemical Applied by Unit Treated:
3 records = S (assume 100% loss; EF = 1.0) = 25.95 lbs.
4 records = Unknown (assume 100% loss; EF = 1.0) = 60.695 lbs.
VOC emissions for N-GGT/PM = 86.645 x 1.0 = 86.645 lbs.
N-OUTDR CONTAINER/FLD GRWN PLANTS -- 1990
Number of Records: 66
Total Pounds Chemical Applied: 794,109.03
Unit Treated: A (acres)
EF value based on Application Method: 0.82 (shallow injection + LDPE tarp or no tarp)
VOC emissions for N-OC/FGP = 794,109.03 x 0.82 = 651,169.4046 lbs.

N-OUTDR GRWN TRNSPLNT/PRPGTV MTRL -- 1990
Number of Records: 47
Total Pounds Chemical Applied: 186,321.0915
Units Treated: A (acres), K (thousand cubic feet), S (square feet); Unknown
Pounds Chemical Applied by Unit Treated:
34 records = A (shallow injection + LDPE or no tarp; EF = 0.82) for 184,581.4965 lbs.
1 record = K (assume 100% loss; EF = 1.0) for 1,194 lbs.
2 records = S (assume 100% loss; EF = 1.0) for 464.05 lbs.
10 records = Unknown (assume 100% loss; EF = 1.0) = 81.545 lbs.
VOC emissions for N-OGT/PM = 184,581.4965 x 0.82 = 151,356.82713 lbs.
VOC emissions for all other N-OGT/PM = 1,739.595 x 1.0 = 1,739.595 lbs.
Total VOC emissions for N-OGT/PM = 153,096.42213 lbs.

NUT CROPS, NUT TREES (ALL OR UNSPEC) -- 1990
Number of Records: 12
Total Pounds Chemical Applied: 4,938.55
Units Treated: C (cubic feet), S (square feet), T (tons), U (misc. unit)
Pounds Chemical Applied by Unit Treated:
6 records = C (assume 100% loss; EF = 1.0) for 77.61 lbs.
1 record = S (assume 100% loss; EF = 1.0) for 39.8 lbs.
4 records = T (assume 100% loss; EF = 1.0) for 4,817.14 lbs.
1 record = U (assume 100% loss; EF = 1.0) for 4 lbs.
VOC emissions for Nut Crops = 4,938.55 x 1.0 = 4,938.55 lbs.

ONION -- 1990
Number of Records: 7
Total Pounds Chemical Applied: 8,648.54
Units Treated: A (acres), S (square feet)
Pounds Chemical Applied by Unit Treated:
6 records = A (shallow injection + LDPE or no tarp; EF = 0.82) for 8,529.14 lbs.
1 record = S (assume 100% loss; EF = 1.0) for 119.4 lbs.
VOC emissions for treated acres of Onion = 8,529.14 x 0.82 = 6,993.8948 lbs.
VOC emissions for all other Onion applications = 119.14 x 1.0 = 119.14 lbs.
Total VOC emissions for Onion = 7,113.0348 lbs.
**ORANGE -- 1990**
Number of Records: 3
Total Pounds Chemical Applied: 4,956.865
Unit Treated: A (acres)
EF based on Application Method: 0.38 (deep injection + LDPE or no tarp)

*VOC emissions for Orange = 4,956.865 x 0.38 = 1,883.6087 lbs.*

**PEACH -- 1990**
Number of Records: 77
Total Pounds Chemical Applied: 188,637.64
Units Treated: A (acres), T (tons), U (misc. unit)
Pounds Chemical Applied by Unit Treated:
- 53 records = A (deep injection + LDPE or no; EF = 0.38) for 187,714.41 lbs.
- 1 record = T (assume 100% loss; EF = 1.0) for 13 lbs.
- 23 records = U (assume 100% loss; EF = 1.0) for 910.23 lbs.

VOC emission for treated acres of Peach = 187,714.41 x 0.38 = 71,331.4758 lbs.
VOC emission for all other Peach applications = 923.23 x 1.0 = 923.23 lbs.

*Total VOC emissions for Peach = 72,254.7058 lbs.*

**PEAR -- 1990**
Number of Records: 1
Total Pound Chemical Applied: 1,333.3
Units Treated: A (acres)
EF value based on Application Method: 0.38 (deep injection + LDPE or no tarp)

*VOC emissions for Pear = 1,333.3 x 0.38 = 506.654 lbs.*

**PEAS, FIELD OR SOUTHERN (BLACKEYED, ETC.) -- 1990**
Number of Records: 1
Total Pounds Chemical Applied: 450
Unit Treated: T (tons)
EF value based on Application Method: 1.0 (assume 100% loss)

*VOC emissions for Peas, Field or Southern (Blackeyed, etc.) = 450 x 1.0 = 450 lbs.*

**PEAS, GENERAL -- 1990**
Number of Records: 5
Total Pounds Chemical Applied: 706
Units Treated: C (cubic feet), K (thousand cubic feet), S (square feet), T (tons)
Pounds Chemical Applied by Unit Treated:
- 1 record = C (assume 100% loss; EF = 1.0) for 171 lbs.
- 1 record = K (assume 100% loss; EF = 1.0) for 38 lbs.
- 2 records = S (assume 100% loss; EF = 1.0) for 252 lbs.
- 1 record = T (assume 100% loss; EF = 1.0) for 245 lbs.

*Total VOC emissions for Peas, General = 706 x 1.0 = 706 lbs.*
PEAS, SOUTHERN (COWPEAS, BLACKEYED, CROWDER, ETC.) -- 1990
Number of Records: 2
Total Pounds Chemical Applied: 1,692
Units Treated: C (cubic feet), S (square feet)
Pounds Chemical Applied by Unit Treated:
   1 record = C (assume 100% loss; EF = 1.0) for 1,008 lbs.
   1 record = S (assume 100% loss; EF = 1.0) for 684 lbs.

VOC emissions for Peas, Southern (Cowpeas, etc.) = 1,692 x 1.0 = 1,692 lbs.

PETS (ALL OR UNSPEC) -- 1990
Number of Records: 2
Total Pounds Chemical Applied: 9.95
Unit Treated: S (square feet)
EF value based on application method: 1.0 (assume 100% loss)

VOC emissions for Pets = 9.95 x 1.0 = 9.95 lbs.

PISTACHIO (PISTACHE NUT) -- 1990
Number of Records: 38
Total Pounds Chemical Applied: 10,449.525
Unit Treated: A (acres), C (cubic feet), K (thousand cubic feet), U (misc. unit)
Pounds Chemical Applied by Unit Treated:
   1 record = A (deep injection + LDPE or no tarp; EF = 0.38) for 721 lbs.
   28 records = C (assume 100% loss; EF = 1.0) for 8,619.545 lbs.
   1 record = K (assume 100% loss; EF = 1.0) for 731 lbs.
   3 records = U (assume 100% loss; EF = 1.0) for 377.98 lbs.

VOC emissions for treated acres of Pistachio = 721 x 0.38 = 273.98 lbs.
VOC emissions for all other Pistachio applications = 9,728.525 x 1.0 = 9728.525 lbs.
Total VOC emissions for Pistachio = 10,002.505 lbs.

PLUM (INCLUDES WILD PLUMS FOR HUMAN CONSUMPTION) -- 1990
Number of Records: 16
Total Pounds Chemical Applied: 51,002.88
Unit Treated: A (acres)
EF value based on application method: 0.38 (deep injection + LDPE or no tarp)

Total VOC emissions for Plum = 51,002.88 x 0.38 = 19,381.0944 lbs.

PUBLIC HEALTH PEST CONTROL -- 1990
Number of Records: 2
Total Pounds Chemical Applied: 405.52
Unit Treated: Unknown
EF value based on application method: 1.0 (assume 100% loss)

VOC emissions for Public Health Pest Control = 405.52 x 1.0 = 405.52 lbs.
RICE -- 1990
   Number of Records: 3
   Total Pounds Chemical Applied: 14
   Units Treated: C (cubic feet), T (tons)
Pounds Chemical Applied by Unit Treated:
   2 records = C (assume 100% loss; EF = 1.0) for 6 lbs.
   1 record = T (assume 100% loss; EF = 1.0) for 8 lbs.

   VOC emissions for RICE = 14 x 1.0 = 14 lbs.

RIGHTS OF WAY -- 1990
   Number of Records: 12
   Total Pounds Chemical Applied: 4,228.52
   Unit Treated: A (acres), Unknown (assume shallow injection + LDPE or no tarp)
Pounds Chemical Applied by Unit Treated:
   1 record = A (shallow injection + LDPE or no tarp; EF = 0.82) for 199 lbs.
   11 records = Unknown (EF = 0.82) for 4,029.52 lbs.

   Total VOC emissions for Rights of Way = 4,228.52 x 0.82 = 3,467.3864 lbs.

SOIL APPLICATIONS, (HOUSEPLANT POTTING SOIL) -- 1990
   Number of Records = 1
   Total Pounds Chemical Applied: 8.9555
   Unit Treated: S (square feet)
   EF value based on application method: 1.0 (assume 100% loss))

   VOC emissions for Soil Applications (Houseplant Potting Soil) = 8.9555 x 1.0 = 8.9555 lbs.

SOIL APPLICATIONS, PREPLANT – OUTDOOR (SEEDBEDS, ETC.) -- 1990
   Number of Records: 14
   Total Pounds Chemical Applied: 6,214.595
   Units Treated: A (acres), C (cubic feet), K (thousand cubic feet), S (square feet)
Pounds Chemical Applied by Unit Treated:
   5 records = A (shallow injection + LDPE or no tarp; EF = 0.82) for 5,398.675 lbs.
   7 records = C (assume 100% loss; EF = 1.0) for 638.795 lbs.
   1 record = K (assume 100% loss; EF = 1.0) for 3 lbs.
   1 record = S (assume 100% loss; EF= 1.0) for 174.125 lbs.

   VOC emissions for treated acres of Soil Applications = 5,398.675 x 0.82 = 4,426.9135 lbs.
   VOC emissions for all other Soil Applications = 815.92 x 1.0 = 815.92 lbs.
   Total VOC emissions for Soil Applications, Preplant = 5,242.8335 lbs.

STRAWBERRY -- 1990
   Number of Records: 23
   Total Pounds Chemical Applied: 65,198.27616
   Unit Treated: A (acres)
   EF value based on application method: 0.82 (shallow injection + LDPE or no tarp)

   VOC emissions for Strawberry = 65,198.27616 x 0.82 = 53,462.5864512 lbs.
STRUCTURAL PEST CONTROL -- 1990
Number of Records: 189
Total Pounds Chemical Applied: 40,433.14062
Unit Treated: Unknown (assume 100% loss)
EF value based on Application method: 1.0
\[VOC\text{ emissions from Structural Pest Control} = 40,433.14062 \times 1.0 = 40,433.14062 \text{ lbs.}\]

TOMATO -- 1990
Number of Records: 7
Total Pounds Chemical Applied: 3,583.58
Units Treated: A (acres), S (square feet)
Pounds Chemical Applied by Unit Treated:
\[3 \text{ records} = A \text{ (shallow injection + LDPE or no tarp; EF = 0.82) for 3,384.58 lbs.}\]
\[4 \text{ records} = S \text{ (assume 100% loss; EF = 1.0) for 199 lbs.}\]
\[VOC\text{ emissions for treated acres of Tomato} = 3,384.58 \times 0.82 = 2,775.3556 \text{ lbs.}\]
\[VOC\text{ emissions for all other Tomato applications} = 199 \times 1.0 = 199 \text{ lbs.}\]
\[Total \ VOC\text{ emissions for Tomato} = 2,974.3556 \text{ lbs.}\]

UNCULTIVATED AGRICULTURAL AREAS (ALL OR UNSPEC) -- 1990
Number of Records: 21
Total Pounds Chemical Applied: 59,089.7157
Unit Treated: A (acres), S (square feet)
Pounds Chemical Applied by Unit Treated:
\[20 \text{ records} = A \text{ (shallow injection + LDPE or no tarp; EF = 0.82) for 59,077.9557 lbs.}\]
\[1 \text{ record} = S \text{ (assume 100% loss; EF = 1.0) for 11.76 lbs.}\]
\[VOC\text{ emissions for treated acres of Uncult. Ag} = 59,077.9557 \times 0.82 = 48,443.923674 \text{ lbs.}\]
\[VOC\text{ emissions for all other Uncultivated Ag applications} = 11.76 \times 1.0 = 11.76 \text{ lbs.}\]
\[Total \ VOC\text{ emissions from Uncultivated Ag Areas} = 48,455.683674 \text{ lbs.}\]

UNCULTIVATED NON-AG AREAS (ALL OR UNSPEC) -- 1990
Number of Records: 5
Total Pounds Chemical Applied: 7,229.9
Units Treated: A (acres); C (cubic feet), S (square feet)
Pounds Chemical Applied by Unit Treated:
\[3 \text{ records} = A \text{ (shallow injection + LDPE or no tarp; EF = 0.82) = for 7,210.98 lbs.}\]
\[1 \text{ record} = C \text{ (assume 100% loss; EF = 1.0) for 15 lbs.}\]
\[1 \text{ record} = S \text{ (assume 100% loss; EF = 1.0) for 3.92 lbs.}\]
\[VOC\text{ emissions for treated acres of Uncult. Non-Ag Areas} = 7,210.98 \times 0.82 = 5,913.0036 \text{ lbs.}\]
\[VOC\text{ emissions for all other Uncult. Non-Ag applications} = 18.92 \times 1.0 = 18.92 \text{ lbs.}\]
\[Total \ VOC\text{ emissions from Uncultivated Non-Ag Areas} = 5,921.9236 \text{ lbs.}\]

VERTEBRATE PEST CONTROL -- 1990
Number of Records: 1
Total Pounds Chemical Applied: 33.67866
Units Treated: Unknown (assume 100% loss)
EF value based on application method: 10.
\[VOC\text{ emissions for Vertebrate Pest Control} = 33.67866 \times 1.0 = 33.67866 \text{ lbs.}\]
WALNUT -- 1990

Number of Records: 109
Total Pounds Chemical Applied: 130,416.4909
Units Treated: A (acres), C (cubic feet), K (thousand cubic feet), P (pounds), S (square feet), T (tons), U (misc. unit)
Pounds Chemical Applied by Unit Treated:
38 records = A (deep injection + LDPE or no tarp; EF = 0.38) for 68,035.46945 lbs.
14 records = C (assume 100% loss; EF = 1.0) for 2,358.75 lbs.
1 record = K (assume 100% loss; EF = 1.0) for 70 lbs.
9 records = P (assume 100% loss; EF = 1.0) for 2,322.5 lbs.
2 records = S (assume 100% loss; EF = 1.0) for 1,213 lbs.
20 records = T (assume 100% loss; EF = 1.0) for 49,984.99 lbs.
25 records = U (assume 100% loss; EF = 1.0) for 6,431.7815 lbs.
VOC emissions for treated acres of Walnut = 68,035.46945 x 0.38 = 25,853.478391 lbs.
VOC emissions for all other Walnut applications = 62,381.0215 lbs.
Total VOC emissions for Walnut = 88,234.499891 lbs.

WOOD PROTECTION TREATMENTS (ALL OR UNSPEC) -- 1990

Number of Records = 3
Total Pounds Chemical Applied: 27.86
Unit Treated: C (cubic feet)
EF value based on application method: 1.0 (assume 100% loss)
VOC emissions for Wood Protection Treatments = 27.86 x 1.0 = 27.86 lbs.
### Summary of 1990 Default and Corrected VOC Emissions Data by Crop/Site

<table>
<thead>
<tr>
<th>CROP/SITE</th>
<th>Default VOC emission (lbs.)</th>
<th>Corrected VOC emission (lbs.)</th>
</tr>
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<tbody>
<tr>
<td>Alfalfa</td>
<td>16,193.625</td>
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<tr>
<td>Almond</td>
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<td>Apricot</td>
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<td>Grapes, Wine</td>
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<td>Kiwifruit</td>
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<td>Landscape Maintenance</td>
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<td>Rice</td>
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<td>Rights of Way</td>
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<td>Soil Applications (houseplant soil)</td>
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<td>Soil Applications (preplant)</td>
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<td>Strawberry</td>
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<td>Tomato</td>
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<td>2,974.3556</td>
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<td>Uncultivated Ag Areas</td>
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<tr>
<td>Uncultivated Non-Ag Areas</td>
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<td>5,921.9236</td>
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<tr>
<td>Vertebrate Pest Control</td>
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<td>33,678.66</td>
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<tr>
<td>Walnut</td>
<td>130,416.4909</td>
<td>88,234.49891</td>
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<td>Wood Protection treatments</td>
<td>27.86</td>
<td>27.86</td>
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<td><strong>TOTAL</strong></td>
<td><strong>2,556,412.779</strong></td>
<td><strong>1,614,281.682</strong></td>
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</tbody>
</table>
APPENDIX B

2004 Methyl Bromide VOC Emissions in the San Joaquin Valley

[since the default EP value is 100% (1.0) for all methyl bromide applications, this component of the equation was not included in the following calculations, as it does not affect the equations’ product]

ALFALFA (FORAGE – FODDER) (ALL OR UNSPEC) -- 2004
Number of Records: 1
Total Pounds Chemical Applied: 11.76
Unit Treated: A (acres)
EF based on Application Method: 0.43 (shallow injection + HDPE tarp)
VOC emissions for Alfalfa = 11.76 x 0.43 = 5.0586 lbs.

ALMOND -- 2004
Number of Records: 92
Total Pounds of Chemical Applied: 25,789.45151
Units Treated: A (acres), C (cubic feet), K (thousand cubic feet), T (tons), U (misc. unit)
Pounds Applied by Unit Treated:
58 records = A (deep injection + HDPE tarp, EF = 0.26) for 19,946.71286 lbs.
17 records = C (assume 100% loss; EF = 1.0) for 1278.769651 lbs.
3 records = K (assume 100% loss; EF = 1.0) for 2387.379 lbs.
6 records = T (assume 100% loss; EF = 1.0) for 989 lbs.
4 records = U (assume 100% loss; EF = 1.0) for 1187.59 lbs.
VOC emissions for treated acres of almond = 19,946.71286 x 0.26 = 5,186.14534 lbs.
VOC emissions for all other almond applications = 5,842.73865 x 1.0 = 5,842.73865 lbs.
Total VOC emissions for Almond = 11,028.884 lbs.

APPLE -- 2004
Number of Records: 1
Total Pounds Chemical Applied: 997.2991
Unit Treated: A (acres)
EF based on Application Method: 0.26 (deep injection + HDPE tarp)
VOC emissions for Apple = 997.2991 x 0.26 = 259.297766 lbs.

APRICOT -- 2004
Number of Records: 9
Total Pounds Chemical Applied: 784.700504
Units Treated: C (cubic feet), P (pounds), U (misc. unit)
Pounds Applied by Unit Treated:
2 records = C (assume 100% loss; EF = 1.0) for 15.70275 lbs.
4 records = P (assume 100% loss; EF = 1.0) for 638.2216 lbs.
3 records = U (assume 100% loss; EF = 1.0) for 130.776154 lbs.
Total VOC emissions for Apricot = 784.700504 lbs.
CASHEW -- 2004
Number of Records: 1
Total Pounds Chemical Applied: 3
Unit Treated: T (tons; assume 100% loss)
EF based on application method: 1.0

\[ \text{VOC emissions for Cashew} = 3 \times 1.0 = 3.0 \text{ lbs.} \]

CHERRY -- 2004
Number of Records: 33
Total Pounds Chemical Applied: 25,753.4966
Units Treated: A (acres), P (pounds), S (square feet)
Pounds Applied by Unit Treated:
   31 records = A (deep injection + HDPE tarp, EF = 0.26) for 25,214.4966 lbs.
   1 record = P (assume 100% loss; EF = 1.0) for 68.6 lbs.
   1 record = S (assume 100% loss, EF = 1.0) for 470.4 lbs.

\[ \text{VOC emissions for treated acres of cherry} = 25,214.4966 \times 0.26 = 6,562.78912 \text{ lbs.} \]
\[ \text{VOC emissions for all other cherry applications} = 539 \times 1.0 = 539 \text{ lbs.} \]

\[ \text{Total VOC emissions for Cherry} = 7,101.78912 \text{ lbs.} \]

COMMODITY FUMIGATION -- 2004
Number of Records: 38
Total Pounds Chemical Applied: 16,300.83535
Unit Treated: Unknown
EF based on application Method: 1.0 (assume 100% loss)

\[ \text{VOC emissions for Commodity Fumigation} = 16,300.83535 \times 1.0 = 16,300.83535 \text{ lbs.} \]

COTTON -- 2004
Number of Records: 1
Total Pounds Chemical Applied: 54.1034
Unit Treated: A (acres)
EF based on Application Method: 0.43 (shallow injection + HDPE tarp)

\[ \text{VOC emissions for Cotton} = 54.1034 \times 0.43 = 23.264462 \text{ lbs.} \]

CRANBERRY -- 2004
Number of Records: 3
Total Pounds Chemical Applied: 9.1
Unit Treated: T (tons)
EF based on Application Method: 1.0 (assume 100% loss)

\[ \text{VOC emissions for Cranberry} = 9.1 \times 1.0 = 9.1 \text{ lbs.} \]

EGGPLANT (ORIENTAL EGGPLANT) -- 2004
Number of Records: 1
Total Pounds Chemical Applied: 799.98
Unit Treated: A (acres)
EF based on Application Method: 0.43 (shallow injection + HDPE tarp)

\[ \text{VOC emissions for Eggplant} = 799.98 \times 0.43 = 343.9914 \text{ lbs.} \]
FIG -- 2004
   Number of Records: 9
   Total Pounds Chemical Applied: 4,653.4975
   Units Treated: C (cubic feet), K (thousand cubic feet)
   Pounds Chemical Applied by Unit Treated:
   8 records = C (assume 100% loss; EF = 1.0) for 64.815 lbs.
   1 record = K (assume 100% loss; EF = 1.0) for 4,588.6925 lbs.
   Total VOC emissions for Fig = 4,653.4975 lbs.

FRUITS (DRIED OR DEHYDRATED) -- 2004
   Number of Records: 20
   Total Pounds Chemical Applied: 5,967.549
   Units Treated: C (cubic feet), T (tons)
   Pounds Chemical Applied by Unit Treated:
   19 records = C (assume 100% loss; EF = 1.0) for 5,409.229 lbs.
   1 record = T (assume 100% loss; EF = 1.0) for 558.32
   Total VOC emission for Fruits (dried or dehydrated) = 5,967.549 lbs.

FUMIGATION, OTHER -- 2004
   Number of Records: 49
   Total Pounds Chemical Applied: 14,239.27303
   Unit Treated: Unknown
   EF value based on Application Method: 1.0 (assume 100% loss)
   VOC emissions for Fumigation, Other = 14,239.27303 x 1.0 = 14,239.27303 lbs.

GRAPES -- 2004
   Number of Records: 27
   Total Pounds Chemical Applied: 13,182.7389
   Units Treated: C (cubic feet), P (pounds), T (tons)
   Pounds Chemical Applied by Unit Treated:
   24 records = C (assume 100% loss; EF = 1.0) for 11,916.1638 lbs.
   2 records = P (assume 100% loss; EF = 1.0) for 1,264.576 lbs.
   1 record = T (assume 100% loss; EF = 1.0) for 2 lbs.
   Total VOC emissions for Grapes = 13,182.7389 lbs.

NECTARINE -- 2004
   Number of Records: 29
   Total Pounds Chemical Applied: 9,771.0202
   Units Treated: A (acres), C (cubic feet), P (pounds), T (tons), U (misc. unit)
   Pounds Chemical Applied by Unit Treated:
   2 records = A (deep injection + HDPE tarp; EF = 0.26) for 6,188.2 lbs.
   1 record = C (assume 100% loss; EF = 1.0) for 175.8 lbs.
   11 records = P (assume 100% loss; EF = 1.0) for 986.9432 lbs.
   5 records = T (assume 100% loss; EF = 1.0) for 1,008.607 lbs.
   10 records = U (assume 100% loss; EF = 1.0) for 1,411.47 lbs.
   VOC emission for treated acres of Nectarine = 6,188.2 x 0.26 = 1,608.932 lbs.
   VOC emission for all other Nectarine applications = 3,582.8202 x 1.0 = 3,582.8020 lbs.
   Total VOC emissions for Nectarine = 5,191.734 lbs.
N-OUTDR CONTAINER/FLD GRWN PLANTS -- 2004
Number of Records: 67
Total Pounds Chemical Applied: 414,159.2887
Unit Treated: A (acres)
EF value based on Application Method: 0.43 (shallow injection + HDPE tarp)
VOC emission for N-Outdr Container Plants = 414,159.2887 x 0.43 = 178,088.494 lbs.

N-OUTDR GRWN TRNSPLNT/PRPGTV MTRL -- 2004
Number of Records: 52
Total Pounds Chemical Applied: 131,928.32
Unit Treated: A (acres)
EF value based on Application Method: 0.43 (shallow injection + HDPE tarp)
VOC emission for N-Outdr Trnsplnt/Prpgtv = 131,928.32 x 0.43 = 56,752.3976 lbs.

NUT CROPS, NUT TREES (ALL OR UNSPEC) -- 2004
Number of Records: 5
Total Pounds Chemical Applied: 79
Unit Treated: T (tons)
EF value based on Application Method 1.0 (assume 100% loss)
VOC emission for Nut Crops = 79 x 1.0 = 79 lbs.

ONION -- 2004
Number of Records: 4
Total Pounds Chemical Applied: 4,416.64
Unit Treated: A (acres)
EF value based on Application Method: 0.43 (shallow injection + HDPE tarp)
VOC emissions for Onion = 4,416.64 x 0.43 = 1,899.1552

ORANGE -- 2004
Number of Records: 23
Total Pounds Chemical Applied: 4,417.24
Unit Treated: A (acres)
EF based on Application Method: 0.43 (shallow injection + HDPE tarp)
VOC emissions for Orange = 4,417.24 x 0.43 = 1,899.4132 lbs.

ORNAMENTAL TURF -- 2004
Number of Records: 7
Total Pounds Chemical Applied: 16,576.7
Unit Treated: A (acres)
EF based on Application Method: 0.43 (shallow injection + HDPE tarp)
VOC emissions for Ornamental Turf = 1,576.7 x 0.43 = 7,127.981 lbs.
PEACH -- 2004
Number of Records: 31
Total Pounds Chemical Applied: 18,962.44635
Units Treated: A (acres), C (cubic feet), P (pounds), T (tons), U (misc. unit)
Pounds Chemical Applied by Unit Treated:
  3 records = A (deep injection + HDPE tarp; EF = 0.26) for 10,492.12325 lbs.
  4 records = C (assume 100% loss; EF = 1.0) for 85.215 lbs.
  9 records = P (assume 100% loss; EF = 1.0) for 601.8271 lbs.
  7 records = T (assume 100% loss; EF = 1.0) for 6,505.4 lbs.
  8 records = U (assume 100% loss; EF = 1.0) for 1,277.88 lbs.
VOC emission for treated acres of Peach = 10,492.12325 x 0.26 = 2,727.95205 lbs.
VOC emission for all other Peach applications = 8,470.3231 x 1.0 = 8,470.3231 lbs.
Total VOC emissions for Peach = 11,198.2751 lbs.

PEAR -- 2004
Number of Records: 3
Total Pounds Chemical Applied: 72.54
Units Treated: A (acres), U (misc. unit)
Pounds Chemical Applied by Unit Treated:
  2 records = A (acres; deep injection + HDPE tarp; EF = 0.26) for 27.44
  1 record = U (misc. unit; assume 100% loss; EF = 1.0) for 45.1 lbs.
VOC emissions for treated acres of Pear = 27.44 x 0.26 = 7.1344
VOC emissions for all other Pear applications = 45.1 x 1.0 = 45.1 lbs.
Total VOC emissions for Pear = 52.2344 lbs.

PECAN -- 2004
Number of Records: 1
Total Pounds Chemical Applied: 6
Unit Treated: T (tons)
EF value based on Application Method: 1.0 (assume 100% loss)
VOC emissions for Pecan = 6 x 1.0 = 6 lbs.

PINEAPPLE -- 2004
Number of Records: 1
Total Pounds Chemical Applied: 68.3
Unit Treated: P (pounds)
EF value based on Application Method: 1.0 (assume 100% loss)
VOC emissions for Pineapple = 68.3 x 1.0 = 68.3 lbs.

PISTACHIO -- 2004
Number of Records: 6
Total Pounds Chemical Applied: 1,155.994
Unit Treated: C (cubic feet), T (tons)
Pounds Chemical Applied by Unit Treated:
  2 records = C (assume 100% loss; EF = 1.0) for 177 lbs.
  4 records = T (assume 100% loss; EF = 1.0) for 987.994 lbs.
Total VOC emissions for Pistachio = 1,155.994 x 1.0 = 1,155.994 lbs.
PLUM (INCLUDES WILD PLUMS FOR HUMAN CONSUMPTION) -- 2004

Number of Records: 33
Total Pounds Chemical Applied: 3,104.2867
Unit Treated: A (acres), C (cubic feet), P (pounds), T (tons), U (misc. unit)
Pounds Chemical Applied by Unit Treated:
  2 records = A (deep injection + HDPE tarp; EF = 0.26) for 999.6 lbs.
  8 records = C (assume 100% loss; EF = 1.0) for 231.9215 lbs.
  12 records = P (assume 100% loss; EF = 1.0) for 661.3392 lbs.
  1 record = T (assume 100% loss; EF = 1.0) for 0.026 lbs.
  10 records = U (assume 100% loss; EF = 1.0) for 1,211.4 lbs.
VOC emissions for treated acres of Plum = 999.6 x 0.26 = 259.896 lbs.
VOC emissions for all other Plum applications = 2,104.6867 x 1.0 = 2,104.6867 lbs.
Total VOC emissions for Plum = 2364.5827 lbs.

PRUNE -- 2004

Number of Records: 2
Total Pounds Chemical Applied: 555
Unit Treated: C (cubic feet), P (pounds)
Pounds Chemical Applied by Unit Treated:
  1 record = C (assume 100% loss; EF = 1.0) for 350 lbs.
  1 record = P (assume 100% loss; EF = 1.0) for 205 lbs.
Total VOC emissions for Prune = 555 x 1.0 = 555 lbs.

RESEARCH COMMODITY -- 2004

Number of Records:
Total Pounds Chemical Applied: 2,113.85
Unit Treated: A (acres)
EF value based on application method: 0.43 (shallow injection + HDPE tarp)
VOC emissions for Research Commodity = 2,113.85 x 0.43 = 908.9555 lbs.

RIGHTS OF WAY -- 2004

Number of Records: 2
Total Pounds Chemical Applied: 58.8
Unit Treated: Unknown
EF value based on application method: 0.82 (assume shallow injection, non-tarped)
VOC emissions for Rights of Way = 58.8 x 0.82 = 48.216 lbs.

SOIL APPLICATIONS, PREPLANT – OUTDOOR (SEEDBEDS, ETC.) -- 2004

Number of Records: 27
Total Pounds Chemical Applied: 60,945.91
Units Treated: A (acres), C (cubic feet)
Pounds Chemical Applied by Unit Treated:
  20 records = A (shallow injection + HDPE tarp; EF = 0.43) for 59,671.91 lbs.
  7 records = C (assume 100% loss; EF = 1.0) for 1,274 lbs.
VOC emissions for treated acres of Soil Applications = 59,671.91 x 0.43 = 25,658.9213 lbs.
VOC emissions for all other Soil Applications = 1,274 x 1.0 = 1,274 lbs.
Total VOC emissions for Soil Applications = 26,932.9213 lbs.
STORAGE AREAS & PROCESSING EQUIPMENT (ALL/UNSPEC) -- 2004
Number of Records: 23
Total Pounds Chemical Applied: 2,741.6668
Unit Treated: C (cubic feet)
EF value based on application method: 1.0 (assume 100% loss)
\[ VOC \text{ emissions for Storage Areas} = 2,741.6668 \times 1.0 = 2,741.6668 \text{ lbs.} \]

STRAWBERRY -- 2004
Number of Records: 31
Total Pounds Chemical Applied: 9,644.98
Unit Treated: A (acres)
EF value based on application method: 0.43 (shallow injection + HDPE tarp)
\[ VOC \text{ emissions for Strawberry} = 9,644.98 \times 0.43 = 4,147.3414 \text{ lbs,} \]

STRUCTURAL PEST CONTROL -- 2004
Number of Records: 28
Total Pounds Chemical Applied: 4,986.445
Unit Treated: Unknown
EF value based on Application method: 1.0 (assume 100% loss)
\[ VOC \text{ emissions from Structural Pest Control} = 4,986.445 \times 1.0 = 4,986.445 \text{ lbs.} \]

UNCULTIVATED AGRICULTURAL AREAS (ALL OR UNSPEC) -- 2004
Number of Records: 5
Total Pounds Chemical Applied: 51,265.76
Unit Treated: A (acres)
EF value based on Application method: 0.43 (shallow injection + HDPE tarp)
\[ VOC \text{ emissions from Uncultivated Ag Areas} = 51,265.76 \times 0.43 = 22,044.2768 \text{ lbs.} \]

UNCULTIVATED NON-AGRICULTURAL AREAS (ALL OR UNSPEC) -- 2004
Number of Records: 5
Total Pounds Chemical Applied: 1,657.8918
Unit Treated: A (acres)
EF value based on Application method: 0.43 (shallow injection + HDPE tarp)
\[ VOC \text{ emissions from Uncultivated Ag Areas} = 1,657.8918 \times 0.43 = 712.893474 \text{ lbs.} \]

WALNUT -- 2004
Number of Records: 63
Total Pounds Chemical Applied: 37,380.6043
Units Treated: A (acres), C (cubic feet), S (square feet), T (tons), U (misc. unit)
Pounds Chemical Applied by Unit Treated:
- 22 records = A (acres; deep injection + HDPE tarp; EF = 0.26) for 22,450.0859 lbs.
- 7 records = C (cubic feet; assume 100% loss; EF = 1.0) for 906.5 lbs.
- 3 records = S (square feet; assume 100% loss; EF = 1.0) for 85.2984 lbs.
- 20 records = T (tons; assume 100% loss; EF = 1.0) for 8,497.661 lbs.
- 11 records = U (misc. unit; assume 100% loss; EF = 1.0) for 5,441.059 lbs.
VOC emissions for treated acres of Walnut = 22,450.0859 x 0.26 = 5,837.022334 lbs.
VOC emissions for all other Walnut applications = 14,930.5184 lbs.
\[ Total \ VOC \text{ emissions for Walnut} = 20,767.540734 \text{ lbs.} \]
### Summary of 2004 Default and Corrected VOC Emissions Data by Crop/Site

<table>
<thead>
<tr>
<th>CROP/SITE</th>
<th>Default VOC emission (lbs.)</th>
<th>Corrected VOC emission (lbs.)</th>
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<tbody>
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<td>Alfalfa</td>
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<tr>
<td>Almond</td>
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<td>Apple</td>
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<td>Apricot</td>
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<td>784.700504</td>
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<td>3</td>
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<tr>
<td>Cherry</td>
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<tr>
<td>Commodity Fumigation</td>
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<td>16,300.83535</td>
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<td>Cotton</td>
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<td>Cranberry</td>
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<td>Eggplant</td>
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<td>Fruits (dried)</td>
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<td>Fumigation (other)</td>
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<td>14,239.27303</td>
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<td>Grapes</td>
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<td>13,182.7389</td>
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<td>Nectarine</td>
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<td>Nut Crops, Nut Trees</td>
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<td>Onion</td>
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<td>7,127.981</td>
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<td>Peach</td>
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<td>11,198.2751</td>
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<td>Pear</td>
<td>72.54</td>
<td>52.2344</td>
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<td>Pecan</td>
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<tr>
<td>Pineapple</td>
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<td>Pistachio</td>
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<td>1,155.994</td>
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<td>Plum</td>
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<td>2,364.5827</td>
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<tr>
<td>Prune</td>
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<td>Rights of Way</td>
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<td>Soil Applications (Preplant)</td>
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<td>Storage Areas &amp; Processing Eq.</td>
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<td>2,741.6668</td>
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<td>Strawberry</td>
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<td>4,417.3414</td>
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<td>Structural Pest Control</td>
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<td>Uncultivated Ag Areas</td>
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<td>22,044.2768</td>
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<td>Uncultivated Non-Ag Areas</td>
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<td>Walnut</td>
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<td>20,767.540734</td>
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<td><strong>TOTAL</strong></td>
<td><strong>884,615.4696</strong></td>
<td><strong>423,357.7978</strong></td>
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## APPENDIX C

PRODUCT NAMES from PUR database that are included in the analyses.

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<th>2004</th>
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<tr>
<td>75/25</td>
<td>57-43</td>
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<tr>
<td>92-2 Contains 2% Chloropicrin</td>
<td>67-33 Preplant Soil Fumigant</td>
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<tr>
<td>Brom-O-Gas (Liquid)</td>
<td>92-2 Contains 2% Chloropicrin</td>
</tr>
<tr>
<td>Brom-O-Gas .5%</td>
<td>Brom-O-Gas (Liquid)</td>
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<tr>
<td>Brom-O-Gas 2%</td>
<td>Brom-O-Gas .5%</td>
</tr>
<tr>
<td>Brom-O-Gas Contains 1% Chloropicrin</td>
<td>MBC Concentrate Soil Fumigant</td>
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<td>DOW Methyl Bromide</td>
<td>MBC-33 Soil Fumigant</td>
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<td>Metabrom 100</td>
<td>Metabrom 100</td>
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<td>Metabrom Q</td>
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<td>Methyl Bromide 100</td>
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<td>Methyl Bromide 98%</td>
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<td>Methyl Bromide 99.75%</td>
<td>Methyl Bromide 98%</td>
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<td>Namco Namfume</td>
<td>Methyl Bromide 99.75%</td>
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<td>Shore Chemical Co. Methyl Bromide 100</td>
<td>Methyl Bromide Rodent Fumigant</td>
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Analysis of Chloropicrin Emissions in the San Joaquin Valley in 1990 and 2004

Abstract

This report calculates and summarizes the total amount of chloropicrin emitted from agricultural and non-agricultural usage in the San Joaquin Valley in 1990 and 2004 during the peak ozone season (May 1 to October 31 of each year). All chloropicrin use data were obtained from the CDPR Pesticide Information Portal (CALPIP) – Pesticide Use Report (PUR) online database. Using the method that CDPR historically has used, which assumes that 100% of the applied chloropicrin is emitted into the air, approximately 112,646 pounds of chloropicrin were emitted in the eight counties comprising the San Joaquin Valley in 1990 (0.306 tons/day); and approximately 120,808 pounds of chloropicrin were emitted in 2004 (0.328 tons/day). The difference between 1990 and 2004 represents a 7.2% increase in chloropicrin total emissions. An alternative VOC equation, based on mass loss studies and discrete usage data, was developed that takes into account the proportion of chloropicrin that is degraded in the soil (for soil fumigations). It is believed that this alternative VOC emission equation more accurately reflects the total amount of chloropicrin emitted by each crop or site and method of application. Using this new equation, approximately 70,931.59 lbs. of chloropicrin was emitted in 1990 (0.193 tons/day), and approximately 41,787.24169 pounds of chloropicrin were emitted in 2004 (0.114 tons/day). The difference between 1990 and 2004, using the corrected VOC equation, represents a 40.9% reduction in chloropicrin total emissions.

Data Acquisition and Overall Use Statistics

The CALPIP search queries were by Year (“1990” and “2004”) and Chemical Name (“chloropicrin”). In this way, all PUR data for chloropicrin were included, regardless of formulation, product name, crop or site of application, etc. Both Agricultural and Non-Agricultural (under Other Criteria: Reporting Type) use reports were included.

The aggregate 1990 and 2004 PUR files for chloropicrin were downloaded and contained all PUR reports for the entire State of California. The 1990 Statewide PUR file contained 6,418 records of application that, collectively, totaled 2,218,294.898 pounds of chloropicrin. The 2004 Statewide PUR file contained 3,551 records of application that, collectively, totaled 5,132,916.855 pounds of chloropicrin (Table 1).

The 1990 and 2004 Statewide PUR files were then processed to include only the 8 counties that comprise the San Joaquin Valley: Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare. While only part of Kern County is technically included in the San Joaquin Valley VOC non-attainment area, all PUR records for Kern County were included in these analyses as a conservative measure, because it was not possible to distinguish between the applications that occurred in the non-attainment area and those that did not.

The 1990 PUR file for the San Joaquin Valley contained 960 records of application that, collectively, totaled 188,762.2068 pounds of chloropicrin. The 2004 PUR file for the San Joaquin Valley contained 439 records of application that, collectively, totaled 328,917.2909 pounds of chloropicrin (Table 1).
The 1990 and 2004 San Joaquin Valley PUR files were then processed to include only the applications that occurred between May 1 and October 31 of each year, as this period is considered the “peak ozone season”. The 1990 PUR file for the San Joaquin Valley Ozone Season contained 530 records of application that, collectively, totaled 112,645.6355 pounds of chloropicrin. These 530 records consisted of 228 records for which the dates of application were listed and occurred between May 1 and October 31, and an additional 302 records for which no date of application was listed. As a conservative measure, these 530 no-date records were assumed to have occurred during the peak ozone season. The 2004 PUR file for the San Joaquin Valley Ozone Season contained 153 records of application that, collectively, totaled 120,807.6326 pounds of chloropicrin (Table 1).

The total amount of chloropicrin applied in the San Joaquin Valley during the peak ozone season in 2004 (120,807.6326 lbs.) is approximately 107.2% of what was applied in 1990 (112,645.6355 lbs.), representing a 7.2% increase in usage.

Table 1. Cumulative number of records and total pounds of chloropicrin applied in California (whole-year) and the San Joaquin Valley (whole-year and during the “peak ozone season”) for all Agricultural and Non-Agricultural applications in 1990 and 2004.

<table>
<thead>
<tr>
<th>Year</th>
<th>Area &amp; Period</th>
<th>No. of Records</th>
<th>Amount of Chloropicrin Applied (total lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>Statewide, 12-month</td>
<td>6,418</td>
<td>2,218,294.898</td>
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<tr>
<td></td>
<td>San Joaquin Valley, 12-month</td>
<td>960</td>
<td>188,762.2068</td>
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<tr>
<td></td>
<td>San Joaquin Valley, May 1 to October 31</td>
<td>530</td>
<td>112,645.6355</td>
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<tr>
<td>2004</td>
<td>Statewide, 12-month</td>
<td>3,551</td>
<td>5,132,916.855</td>
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<td></td>
<td>San Joaquin Valley, 12-month</td>
<td>439</td>
<td>328,917.2909</td>
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<td></td>
<td>San Joaquin Valley, May 1 to October 31</td>
<td>153</td>
<td>120,807.6326</td>
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</table>
Analysis of VOC Emissions based on CDPR Procedures

CDPR uses the following equation to calculate VOC emissions from pesticide applications, where \( EP \) is defined as the Emissions Potential (VOC fraction) of a given pesticide product:

\[
VOC \text{ emission (lbs.)} = \text{[lbs. of product applied]} \times \text{[product-specific EP]}
\]

For all chloropicrin products, CDPR assigns a default EP value of 100%. This assumes that 100% of the applied amount of chloropicrin is volatized from the soil or other site, such that the total chloropicrin VOC emissions are equal to the amount of chloropicrin applied during a specific period, location, etc.

Using this equation for the total amounts applied in Table 1, it can be calculated that the average daily VOC emissions in the San Joaquin Valley during the peak ozone season were approximately 0.306 tons/day in 1990 and 0.328 tons/day in 2004 (2000 pounds = 1 ton; 184 days in May 1 to October 31 period) (Table 2). This represents a 0.022 tons/day (or 7.2%) increase in chloropicrin VOC emissions in 2004 compared to 1990.

Alternative Analysis of VOC Emissions based on Mass Loss Studies

While 100% of the applied chloropicrin can theoretically be emitted from a given end-use site, studies have demonstrated that, at least for soil fumigation, a portion of the chloropicrin is degraded in the soil and is not emitted into the air (i.e., via mass loss studies). With respect to this fact, any chloropicrin VOC emission calculation that assumes 100% emission would considerably overestimate the chloropicrin’s contribution to the VOC burden in the San Joaquin Valley or any other area with significant chloropicrin use in soil fumigation. For non-soil fumigation sites (commodity fumigation, structural fumigation, etc.), where there is little opportunity for chloropicrin degradation, the 100% emissions is likely accurate.

Four unpublished studies previously submitted to CDPR provide an array of data on mass loss estimates of chloropicrin during various field fumigation scenarios. These mass loss studies can be used to more accurately estimate total chloropicrin emissions from soil fumigation activity. Based on these studies, an additional component to the VOC emissions calculation was added, where \( EF \) = the Emissions Factor, or the proportion of chloropicrin that is emitted from the application field or site. This alternative calculation is:

\[
VOC \text{ emission (lbs.)} = \text{[lbs. of product applied]} \times \text{[product-specific EP]} \times \text{[application-specific EF]}
\]

By example, if chloropicrin was applied to 10 acres of strawberry at 200 lbs. a.i. (active ingredient) per acre, the total amount applied would be 2,000 lbs. of chloropicrin. The EP value remains 100% (1.0 by proportion), based on 100% of the product being volatile. The EF value would be based on mass loss studies where, in this case, the application is a broadcast shallow (6-15 in.) injection with HDPE tarp, which was estimated to result in 37% emission (0.37 by proportion) of the applied chemical. So, for this example:

\[
VOC \text{ emission (lbs.)} = \text{[2000 lbs.]} \times \text{[1.0]} \times \text{[0.37]} = 740 \text{ lbs. emitted.}
\]

Therefore, based on this approach, only 740 lbs. of the 2,000 lbs. of chloropicrin that was applied, was emitted during this application.
Based on the studies, the following EF values were used to calculate total emissions for each crop or site (e.g., soil fumigation vs. structural fumigation), type of fumigation (e.g., almond acres vs. almond nuts prior to packaging), type of application (e.g., shallow vs. deep shank; tarp or no tarp; drip-applied), where the type of application was determined by the “Unit Treated” and “Product Name” fields of the PUR records:

**Unit Treated:**
- **A** = acres
  - Shallow injection (6-15 in.), broadcast, no tarp = 62% emission (EF = 0.62)
  - Shallow injection (6-15 in.), broadcast, LDPE tarp = 62% emission* (EF = 0.62)
  - Shallow injection (6-15 in.), broadcast, HDPE tarp = 37% emission (EF = 0.37)
  - Deep injection (20+ in.), broadcast, no tarp = 62% emission (EF = 0.62)
  - Deep injection (20+ in.), broadcast, LDPE tarp = 62% emission* (EF = 0.62)
  - Deep injection (20+ in.), broadcast, HDPE tarp = 37% emission (EF = 0.37)
  - Drip-application, surface or buried, HDPE tarp = 9% emission (EF = 0.09)


2 No studies were found that determined mass loss of chloropicrin through LDPE films, regardless of injection depth. However, based on data from other fumigants (e.g., methyl bromide, Yates et al. 1996), LDPE film is assumed to provide virtually no chloropicrin retention properties. Therefore, as a conservative measure, the EF values for all LDPE tarp applications were considered to be equal to the EF values for non-tarped applications.

3 The 37% mass loss estimate was derived as the average from the mass loss measurements from four different sites from which data are available. Using the average mass loss estimate allows for variability in soil type, soil moisture, and other factors that may influence mass loss of chloropicrin from field applications. Study sites and their mass loss estimates from which the average was derived were: Salinas, CA (15% mass loss; Lee et al. 1994); Yakima, WA (34% mass loss; Beard et al. 1996); Bradenton, FL (37% mass loss; Beard et al. 1996); and Phoenix, AZ (63% mass loss; Beard et al. 1996).

4 No studies were found that determined mass loss of chloropicrin at injection depths greater than what is considered shallow (6-15 in.) injection. Therefore, as a conservative measure, all deep injection EF estimates were based on the EF values for shallow injections, even though it is very plausible that deeper injection depths result in lower mass loss values, as was determined for methyl bromide (Yates et al. 1996).

5 The 9% mass loss estimate for drip applications was derived as the average from two mass loss studies because it was not possible to determine, from the PUR database, whether individual applications were buried-drip (3% mass loss; Gillis and Smith 2002) or surface-drip (15% mass loss; Rotondaro 2004).

- **C** = cubic feet (for commodity, potting media, etc.; assume 100% loss; EF = 1.0)
- **K** = thousand cubic feet (for commodity, potting media, etc.; assume 100% loss; EF = 1.0)
- **P** = pounds (for commodity, potting media, etc.; assume 100% loss; EF = 1.0)
- **S** = square feet (for greenhouse treatments, etc.; assume 100% loss; EF = 1.0)
- **T** = tons (for commodity, potting media, etc.; assume 100% loss; EF = 1.0)
- **U** = miscellaneous unit (for commodity, potting media, etc.; assume 100% loss; EF = 1.0)
- **Not Listed** = (for commodity, potting media, etc.; assume 100% loss; EF = 1.0)
As an aggregate example, the following data for 2004 chloropicrin applications to outdoor grown greenhouse transplant/propagative material is used to illustrate the incorporation of application-specific EF values into the VOC equation:

**N-OUTDR GRWN TRNSPLNT/PRPGTV MTRL**

Number of Records: 40  
Pounds Chemical Applied: 11,357.4905  
Unit Treated: A (acres), K (thousand cubic feet), Unknown  
Pounds Chemical Applied by Unit Treated:  
31 records = A (EF = 0.62) for 11,351.1205 lbs.  
1 record = K (assume 100% loss; EF = 1.0) for 6 lbs.  
8 records = Unknown (assume 100% loss; EF = 1.0) for 0.37 lbs.  

VOC emissions for shank-injected chloropicrin = 11,351.1205 x 0.62 = 7,037.69471 lbs.  
VOC emissions for drip-injected chloropicrin = 6.37 x 1.0 = 6.37 lbs.  

\[ \text{VOC emissions for N-Outdr Trnsplnt/Prpgtv Mtrl} = 7,044.06471 \text{ lbs.} \]

This same aggregate analysis was performed for all SITE/CROP listings within both the 1990 and 2004 PUR files. The aggregate analysis and summary table for 1990 applications are provided in Appendix A. The aggregate analysis and summary table for 2004 applications are provided in Appendix B. These analyses assume the following:

- Approximately 90% of chloropicrin soil fumigations in 1990 were non-tarped and 10% were tarped using LDPE film (primarily as co-formulations with methyl bromide).
- LDPE film is considered to have little gas retention properties, and therefore, any 1990 applications with LDPE film had EF values that were the same as non-tarped applications.
- LDPE film was only used in 1990 and not in 2004.
- All CDPR-approved HDPE films were assigned the same EF, which was based on mass loss studies.
- All 2004 soil applications where chloropicrin was co-formulated with methyl bromide used HDPE film, regardless of injection depth.
- All 2004 drip-applications of chloropicrin were assumed to be tarped with HDPE.
- All non-acre applications are assumed to result in 100% emission of product.

Based on the sum values for the EF-corrected VOC emission equations that were applied to each Crop/Site by year, it is calculated that 70,931.59 lbs. of chloropicrin were emitted in the eight counties comprising the San Joaquin Valley during the peak ozone season in 1990 (0.193 tons/day), and 41,787.24169 lbs. of chloropicrin were emitted in 2004 (0.114 tons/day). The 2004 VOC total is approximately 59.1% of the 1990 total, which equates to a 40.9% reduction in chloropicrin emissions.
Table 2. Default and Corrected Chloropicrin VOC emissions.

<table>
<thead>
<tr>
<th>Year</th>
<th>Default VOC emissions (tons/day)</th>
<th>VOC emissions corrected using mass loss data (tons/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>0.306</td>
<td>0.193</td>
</tr>
<tr>
<td>2004</td>
<td>0.328</td>
<td>0.114</td>
</tr>
</tbody>
</table>

Z Values assume 100% emission of applied material.
Y Values incorporate empirically-derived mass loss data.

CONCLUSION

When the type of application is not considered and 100% of the applied chloropicrin is assumed to be emitted, the total VOC emissions of chloropicrin increased from 0.306 tons/day in 1990 to 0.328 tons/day in 2004. When the type of application is considered relative to the proportion of chloropicrin that is degraded in the soil, the total VOC emissions of chloropicrin were reduced from 0.193 tons/day in 1990 to 0.114 tons/day in 2004.

The Product Names listed in the PUR database files are presented in Appendix 3.

References Cited:


Rotondaro, A. 2004. Monitoring of chloropicrin emissions from field and greenhouse drip irrigation applications, and implied worker inhalation exposure from applications of chloropicrin by shank injection, drip irrigation systems and at tree replant sites. Study # PRS02004. Unpublished study submitted to CDPR.

APPENDIX A

1990 Chloropicrin VOC Emissions in the San Joaquin Valley

ALFALFA (FORAGE, FODDER) (ALFALFA HAY)
Number of Records: 4
Pounds of Chemical Applied: 1,863.375
Units Treated: A (acres), T (tons), U (misc. unit)
Total Pounds Applied by Unit Treated:
2 records = A (EF = 0.62) for 80.5 lbs.
1 record = T (assume 100% loss; EF = 1.0) for 1,782 lbs.
1 record = U (assume 100% loss; EF = 1.0) for 0.875 lbs.
VOC emissions for shank-injected chloropicrin = 80.5 x 0.62 = 49.91 lbs.
VOC emissions for all other Alfalfa applications = 1,782.875 x 1.0 = 1,782.875 lbs.
\[ VOC \text{ emissions for } Alfalfa = 1,832.785 \text{ lbs.} \]

ALMOND
Number of Records: 22
Total Pounds of Chemical Applied: 80.076
Units Treated: A (acres), S (square feet), T (tons), U (misc. unit)
Total Pounds Applied by Unit Treated:
6 records = A (EF = 0.62) for 74.316 lbs.
1 record = S (assume 100% loss; EF = 1.0) for 0.875 lbs.
1 record = T (assume 100% loss; EF = 1.0) for 0.825 lbs.
14 records = U (assume 100% loss; EF = 1.0) for 7.06 lbs.
VOC emissions for shank-injected chloropicrin = 74.316 x 0.62 = 40.07592 lbs.
VOC emissions for all other Almond applications = 8.76 x 1.0 = 8.76 lbs.
\[ VOC \text{ emissions for Almond} = 54.83592 \text{ lbs.} \]

APRICOT
Number of Records: 2
Pounds Chemical Applied: 7.015
Unit Treated: A (acres)
EF based on application method: 0.62
\[ VOC \text{ emissions for Apricot} = 7.015 \times 0.62 = 4.3493 \text{ lbs.} \]

BEEHIVES (ALL OR UNSPEC)
Number of Records: 4
Pounds Chemical Applied: 2.5
Unit Treated: A (acres)
EF based on application method: 1.0 (assume 100% loss))
\[ VOC \text{ emissions for Beehives} = 2.5 x 1.0 = 2.5 \text{ lbs.} \]
CHERRY
Number of Records: 7
Total Pounds Chemical Applied: 9.8424
Units Treated: A (acres)
EF based on application method: 0.62
VOC emissions for Cherry = 9.8424 x 0.62 = 6.102288 lbs.

COTTON, GENERAL
Number of Records: 1
Pounds Chemical Applied: 7.3
Unit Treated: A (acres)
EF based on application Method: 0.62
VOC emissions for Cotton, General = 7.3 x 0.62 = 4.526 lbs.

GRAPE
Number of Records: 6
Pounds Chemical Applied: 186.179
Unit Treated: A (acres), K (thousand cubic feet)
EF based on Application Method: 0.62 (shank injection) for 177.284 lbs.
1.0 (commodity fumigation) for 8.895 lbs.
VOC emissions for shank-injected chloropicrin = 177.284 x 0.62 = 109.91608 lbs.
VOC emissions for all other Grape applications = 8.895 x 1.0 = 8.895 lbs.
VOC emissions Grapes = 118.81108 lbs.

GRAPE, WINE
Number of Records: 10
Pounds Chemical Applied: 2,876.135
Unit Treated: A (acres)
EF based on application method: 0.62
VOC emissions for Grapes, Wine = 2,876.135 x 0.62 = 1,783.2037 lbs.

KIWIFRUIT
Number of Records: 1
Pounds Chemical Applied: 12.99
Unit Treated: A (acres)
EF based on Application Method: 0.62
VOC emissions for Kiwifruit = 12.99 x 0.62 = 8.0538 lbs.

LANDSCAPE MAINTENANCE
Number of Records: 6
Pounds Chemical Applied: 0.35
Unit Treated: Unknown
EF based on Application Method: 1.0 (assume 100% loss)
VOC emissions for Landscape Maintenance = 0.35 x 1.0 = 0.35 lbs.
NECTARINE
Number of Records: 15
Pounds Chemical Applied: 576.575
Unit Treated: A (acres)
EF value based on Application Method: 0.62
\[ VOC \text{ emissions for Nectarine} = 576.575 \times 0.62 = 357.4765 \text{ lbs.} \]

N-GRNHS GRWN TRNSPLNT/PRPGTV MTRL
Number of Records: 7
Pounds Chemical Applied: 4.139
Units Treated: S (square feet); Unknown
EF value based on application method: 1.0 (assume 100% loss)
\[ VOC \text{ emissions for N-Grnhs Grwn Trnsplnt/Prpgtv Mtrl} = 4.139 \times 1.0 = 4.139 \text{ lbs.} \]

N-OUTDR CONTAINER/FLD GRWN PLANTS
Number of Records: 31
Pounds Chemical Applied: 57,373.252
Unit Treated: A (acres)
EF value based on Application Method: 0.62
\[ VOC \text{ emissions for N-Outdr Container Plants} = 57,373.252 \times 0.62 = 35,571.41624 \text{ lbs.} \]

N-OUTDR GRWN TRNSPLNT/PRPGTV MTRL
Number of Records: 40
Pounds Chemical Applied: 11,357.4905
Unit Treated: A (acres), K (thousand cubic feet), Unknown
Pounds Chemical Applied by Unit Treated:
- 31 records = A (EF = 0.62) for 11,351.1205 lbs.
- 1 record = K (assume 100% loss; EF = 1.0) for 6 lbs.
- 8 records = Unknown (assume 100% loss; EF = 1.0) for 0.37 lbs.
VOC emissions for shank-injected chloropicrin = 11,351.1205 x 0.62 = 7,037.69471 lbs.
VOC emissions for drip-injected chloropicrin = 6.37 x 1.0 = 6.37 lbs.
\[ VOC \text{ emissions for N-Outdr Trnsplnt/Prpgtv Mtrl} = 7,044.06471 \text{ lbs.} \]

NUT CROPS, NUT TREES (ALL OR UNSPEC)
Number of Records: 8
Pounds Chemical Applied: 15.45
Units Treated: C (cubic feet), S (square feet), T (tons)
EF value based on Application Method: 1.0 (assume 100% loss for C, S, T units)
\[ VOC \text{ emissions for Nut Crops} = 15.45 \times 1.0 = 15.42 \text{ lbs.} \]

ONION
Number of Records: 4
Pounds Chemical Applied: 22.86
Unit Treated: A (acres)
EF value based on Application Method: 0.62
\[ VOC \text{ emissions for Onion} = 22.86 \times 0.62 = 14.1732 \text{ lbs.} \]
ORANGE
Number of Records: 2
Pounds Chemical Applied: 24.835
Unit Treated: A (acres)
EF based on Application Method: 0.62

\[
VOC \text{ emissions for Orange} = 460 \times 0.62 = 285.2 \text{ lbs.}
\]

PEACH
Number of Records: 12
Pounds Chemical Applied: 218.3
Unit Treated: A (acres), U (misc. unit)
Pounds Chemical Applied by Unit Treated:
11 records = A (EF = 0.62) for 218.22 lbs.
1 record = U (assume 100% loss; EF = 1.0) for 0.08 lbs.

\[
VOC \text{ emissions for shank-injected chloropicrin} = 218.22 \times 0.62 = 135.2964 \text{ lbs.}
\]
\[
VOC \text{ emissions for all other Peach applications} = 0.08 \times 1.0 = 0.08 \text{ lbs.}
\]

\[
VOC \text{ emissions for Peach} = 135.3764 \text{ lbs.}
\]

PEAR
Number of Records: 1
Pounds Chemical Applied: 6.7
Unit Treated: A (acres)
EF value based on Application Method: 0.62

\[
VOC \text{ emissions for Pear} = 6.7 \times 0.62 = 4.154 \text{ lbs.}
\]

PETS
Number of Records: 2
Pounds Chemical Applied: 0.05
Unit Treated: S (square feet)
EF value based on Application Method: 1.0 (assume 100% loss)

\[
VOC \text{ emissions for Pests} = 0.05 \times 1.0 = 0.05 \text{ lbs.}
\]

PLUM (INCLUDES WILD PLUM FOR HUMAN CONSUMPTION)
Number of Records: 10
Pounds Chemical Applied: 180.765
Unit Treated: A (acres)
EF value based on Application Method: 0.62

\[
VOC \text{ emissions for Plum} = 180.765 \times 0.62 = 112.0743 \text{ lbs.}
\]

RIGHTS OF WAY
Number of Records: 1
Pounds Chemical Applied: 1
Unit Treated: A (acres)
EF value based on Application Method: 0.62

\[
VOC \text{ emissions for Rights of Way} = 1 \times 0.62 = 0.62 \text{ lbs.}
\]
SOIL APPLICATIONS, PREPLANT – OUTDOOR (SEEDBEDS, ETC.)
Number of Records: 1
Pounds Chemical Applied: 0.045
Units Treated: S (square feet)
EF based on application method: 1.0 (assume 100% loss)
\[ \text{VOC emissions for Soil Applications} = 0.045 \times 1.0 = 0.045 \text{ lbs.} \]

STRAWBERRY
Number of Records: 20
Pounds Chemical Applied: 35,693.099
Unit Treated: A (acres)
EF value based on application method: 0.62
\[ \text{VOC emissions for Strawberry} = 35,693.099 \times 0.62 = 22,129.72138 \text{ lbs.} \]

STRUCTURAL PEST CONTROL
Number of Records: 265
Pounds Chemical Applied: 967.196405
Unit Treated: Unknown
EF value based on Application method: 1.0 (assume 100% loss)
\[ \text{VOC emissions from Structural Pest Control} = 967.196405 \times 1.0 = 967.196405 \text{ lbs.} \]

TOMATO
Number of Records: 6
Pounds Chemical Applied: 144.787
Units Treated: A (acres); S (square feet)
Pounds Chemical Applied by Unit Treated:
\[ 2 \text{ records} = \text{A (EF = 0.62) for 144.787 lbs.} \]
\[ 4 \text{ records} = \text{S (assume 100% loss; EF = 1.0) for 1 lb.} \]
VOC emissions for treated acres of Tomato = 144.787 \times 0.62 = 89.76794 \text{ lbs.}
VOC emissions for all other tomato applications = 1 \times 1.0 = 1 \text{ lb.}
\[ \text{Total VOC emissions for Tomato} = 90.76794 \text{ lbs.} \]

UNCULTIVATED AGRICULTURAL AREAS (ALL OR UNSPEC)
Number of Records: 14
Pounds Chemical Applied: 448.295
Units Treated: A (acres)
EP value based on application method: 0.62
\[ \text{VOC emissions for Uncultivated Ag Areas} = 448.295 \times 0.62 = 277.9429 \text{ lbs.} \]

WALNUT
Number of Records: 18
Pounds Chemical Applied: 169.3191505
Units Treated: A (acres), U (misc. unit)
Pounds Chemical Applied by Unit Treated:
\[ 11 \text{ records} = \text{A (EF = 0.62) for 166.4606505 lbs.} \]
\[ 7 \text{ records} = \text{U (assume 100% loss; EF = 1.0) for 2.8585 lbs.} \]
VOC emissions for treated acres of Walnut = 166.4606505 x 0.62 = 103.20560331 lbs.
VOC emissions for all other Walnut applications = 2.8585 x 1.0 = 2.8585 lb.
\[ \text{VOC emissions for Walnut} = 106.06410331 \text{ lbs.} \]

**WOOD PROTECTION TREATMENTS**

Number of Records: 3  
Pounds Chemical Applied: 0.14  
Units Treated: C (cubic feet)  
EP value based on Application method: 1.0 (assume 100% loss)
\[ \text{Total VOC emissions for Wood Protection Treatments} = 0.14 \times 1.0 = 0.14 \text{ lbs.} \]

---

**Summary of 1990 Default and Corrected VOC Emissions Data by Crop/Site**

<table>
<thead>
<tr>
<th>CROP/SITE</th>
<th>Default VOC emission (lbs.)</th>
<th>Corrected VOC emission (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>1,863.375</td>
<td>1,832.785</td>
</tr>
<tr>
<td>Almond</td>
<td>80.076</td>
<td>54.83592</td>
</tr>
<tr>
<td>Apricot</td>
<td>7.015</td>
<td>4.3493</td>
</tr>
<tr>
<td>Beehives (all or unspec) – all beehives</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Cherry</td>
<td>9.8424</td>
<td>6.102288</td>
</tr>
<tr>
<td>Cotton</td>
<td>7.3</td>
<td>4.526</td>
</tr>
<tr>
<td>Grapes</td>
<td>186.179</td>
<td>118.81108</td>
</tr>
<tr>
<td>Grapes, Wine</td>
<td>2,876.135</td>
<td>1,783.2037</td>
</tr>
<tr>
<td>Kiwifruit</td>
<td>12.99</td>
<td>8.0535</td>
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<tr>
<td>Landscape Maintenance</td>
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<td>0.35</td>
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<tr>
<td>Nectarine</td>
<td>576.575</td>
<td>357.4765</td>
</tr>
<tr>
<td>N-Grnhs Grwn Trnsplt/Prptv Mtrl</td>
<td>4.139</td>
<td>4.139</td>
</tr>
<tr>
<td>N-Outdr Container/Fld Grwn Plants</td>
<td>57,373.252</td>
<td>35,571.41624</td>
</tr>
<tr>
<td>N-Outdr Grwn Trnsplt/Prptv Mtrl</td>
<td>11,357.4905</td>
<td>7,044.06471</td>
</tr>
<tr>
<td>Nut Crops, Nut Trees</td>
<td>15.45</td>
<td>15.45</td>
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<tr>
<td>Onion</td>
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<td>Orange</td>
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<td>Peach</td>
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<td>Pear</td>
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<td>4.154</td>
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<tr>
<td>Pets</td>
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<td>0.05</td>
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<tr>
<td>Plum</td>
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<tr>
<td>Rights of Way</td>
<td>1</td>
<td>0.62</td>
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<tr>
<td>Soil Applications (preplant)</td>
<td>0.045</td>
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</tr>
<tr>
<td>Strawberry</td>
<td>35,693.099</td>
<td>22,129.72138</td>
</tr>
<tr>
<td>Structural Pest Control</td>
<td>967.196405</td>
<td>967.196405</td>
</tr>
<tr>
<td>Tomato</td>
<td>144.787</td>
<td>90.76794</td>
</tr>
<tr>
<td>Uncultivated Ag Areas</td>
<td>448.295</td>
<td>277.9429</td>
</tr>
<tr>
<td>Walnut</td>
<td>169.3191505</td>
<td>106.06410331</td>
</tr>
<tr>
<td>Wood Protection treatments</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>112,645.6355</strong></td>
<td><strong>70.931.59</strong></td>
</tr>
</tbody>
</table>
APPENDIX B
2004 Chloropicrin VOC Emissions in the San Joaquin Valley

ALMOND
Number of Records: 5
Total Pounds of Chemical Applied: 67.23
Units Treated: C (cubic feet), U (misc. unit)
Total Pounds Applied by Unit Treated:
3 records = C (assume 100% loss; EF = 1.0) for 26.145 lbs.
2 records = U (assume 100% loss; EF = 1.0) for 41.085 lbs.
\[ \text{VOC emissions for Almond} = 67.23 \times 1.0 = 67.23 \text{ lbs.} \]

CARROTS
Number of Records: 1
Pounds Chemical Applied: 70
Unit Treated: A (acres)
EF based on application method: 0.37
\[ \text{VOC emissions for Carrots} = 70 \times 0.37 = 25.9 \text{ lbs.} \]

CHERRY
Number of Records: 2
Total Pounds Chemical Applied: 0.66
Units Treated: A (acres)
EF based on application method: 0.37
\[ \text{VOC emissions for Cherry} = 0.66 \times 0.37 = 0.2442 \text{ lbs.} \]

EGGPLANT
Number of Records: 1
Pounds Chemical Applied: 394.02
Unit Treated: A (acres)
EF based on application method: 0.37
\[ \text{VOC emissions for Eggplant} = 394.02 \times 0.37 = 145.7874 \text{ lbs.} \]

FUMIGATION, OTHER
Number of Records: 4
Pounds Chemical Applied: 12.874
Unit Treated: Unknown
EF based on Application Method: 1.0 (assume 100% loss)
\[ \text{VOC emission for Fumigation, Other} = 12.874 \times 1.0 = 12.874 \text{ lbs.} \]

MELONS
Number of Records: 1
Pounds Chemical Applied: 674.6642604
Unit Treated: A (acres)
EF based on Application Method: 0.09 (drip)
\[ \text{VOC emissions for Melons} = 674.6642604 \times 0.09 = 60.719783436 \text{ lbs.} \]
NECTARINE
Number of Records: 1
Pounds Chemical Applied: 17.8
Unit Treated: A (acres)
EF based on Application Method: 0.37
\[ VOC \text{ emissions for Nectarine} = 17.8 \times 0.37 = 6.586 \text{ lbs.} \]

N-OUTDR CONTAINER/FLD GRWN PLANTS
Number of Records: 28
Pounds Chemical Applied: 44,621.52827
Unit Treated: A (acres)
EF value based on Application Method: 0.37 (shank) and 0.09 (drip)
VOC emissions for shank injected chloropicrin = 41,342.75515 \times 0.37 = 15,296.8194055 lbs.
VOC emissions for drip-injected chloropicrin = 3,278.773123 \times 0.09 = 295.08949107 lbs.
Total VOC emissions for N-Outdr Container Plants = 15,591.90889657 lbs.

N-OUTDR GRWN TRNSPLNT/PRPGTV MTRL
Number of Records: 40
Pounds Chemical Applied: 45,867.845
Unit Treated: A (acres)
EF value based on Application Method: 0.37
\[ VOC \text{ emissions for N-Outdr Trnsplnt/Prpgtv} = 45,867.845 \times 0.37 = 16,971.10265 \text{ lbs.} \]

ONION
Number of Records: 5
Pounds Chemical Applied: 2,595.36
Unit Treated: A (acres)
EF value based on Application Method: 0.37
\[ VOC \text{ emissions for Onion} = 2,595.36 \times 0.37 = 960.2832 \]

ORANGE
Number of Records: 1
Pounds Chemical Applied: 460
Unit Treated: A (acres)
EF based on Application Method: 0.37
\[ VOC \text{ emissions for Orange} = 460 \times 0.37 = 170.2 \text{ lbs.} \]

RESEARCH COMMODITY
Number of Records: 2
Pounds Chemical Applied: 1,041.15
Unit Treated: A (acres)
EF value based on application method: 0.37
\[ VOC \text{ emissions for Research Commodity} = 1,041.15 \times 0.37 = 385.2255 \text{ lbs.} \]
SOIL APPLICATIONS, PREPLANT – OUTDOOR (SEEDBEDS, ETC.)
Number of Records: 14
Pounds Chemical Applied: 14,693.47
Units Treated: A (acres)
EF based on application method: 0.09 (drip) for 1,142.46 lbs.
0.37 (shank) for 13,551.01 lbs.
VOC emissions for shank injected chloropicrin = 13,551.01 x 0.37 = 5,013.8737 lbs.
VOC emissions for drip-injected chloropicrin = 1,142.46 x 0.09 = 102.2814 lbs.
Total VOC emissions for Soil Applications = 5,116.6951 lbs.

STRAWBERRY
Number of Records: 29
Pounds Chemical Applied: 4,804.89
Unit Treated: A (acres)
EF value based on application method: 0.37
VOC emissions for Strawberry = 4,804.89 x 0.37 = 1,777.8093 lbs.

STRUCTURAL PEST CONTROL
Number of Records: 15
Pounds Chemical Applied: 20.02974
Unit Treated: Unknown
EF value based on Application method: 1.0 (assume 100% loss)
VOC emissions from Structural Pest Control = 20.02974 x 1.0 = 20.02974 lbs.

WALNUT
Number of Records: 1
Pounds Chemical Applied: 0.2
Units Treated: A (acres)
EF value based on Application method: 0.37
VOC emissions for Walnut = 0.2 x 0.37 = 0.074 lbs.

WATERMELONS
Number of Records: 3
Pounds Chemical Applied: 5,465.911344
Units Treated: A (acres)
EF value based on Application method: 0.09 (drip) for 4,975.911373 lbs.
0.37 (shank) for 490 lbs.
VOC emissions for drip injected chloropicrin = 4,975.911373 x 0.09 = 447.83202357 lbs.
VOC emissions for shank-injected chloropicrin = 72.27 x 0.37 = 26.7399 lbs.
Total VOC emissions for Watermelons = 474.57192357 lbs.
## Summary of 2004 Default and Corrected VOC Emissions Data by Crop/Site

<table>
<thead>
<tr>
<th>CROP/SITE</th>
<th>Default VOC emission (lbs.)</th>
<th>Corrected VOC emission (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almond</td>
<td>67.23</td>
<td>67.23</td>
</tr>
<tr>
<td>Carrots</td>
<td>70</td>
<td>25.9</td>
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<tr>
<td>Cherry</td>
<td>0.66</td>
<td>0.2442</td>
</tr>
<tr>
<td>Eggplant</td>
<td>394.02</td>
<td>145.7874</td>
</tr>
<tr>
<td>Fumigation (other)</td>
<td>12.874</td>
<td>12.874</td>
</tr>
<tr>
<td>Melons</td>
<td>674.6642604</td>
<td>60.719783436</td>
</tr>
<tr>
<td>Nectarine</td>
<td>17.8</td>
<td>6.586</td>
</tr>
<tr>
<td>N-Outdr Container/Fld Grwn Plants</td>
<td>44,621.52827</td>
<td>15,591.90889657</td>
</tr>
<tr>
<td>N-Outdr Grwn Trnspnt/Prpgt Mtrnl</td>
<td>45,867.845</td>
<td>16,971.10265</td>
</tr>
<tr>
<td>Onion</td>
<td>2,595.36</td>
<td>960.2832</td>
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<tr>
<td>Orange</td>
<td>460</td>
<td>170.2</td>
</tr>
<tr>
<td>Research Commodity</td>
<td>1,041.15</td>
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</tr>
<tr>
<td>Soil Applications (Preplant)</td>
<td>14,693.47</td>
<td>5,116.6951</td>
</tr>
<tr>
<td>Strawberry</td>
<td>4,804.89</td>
<td>1,777.8093</td>
</tr>
<tr>
<td>Structural Pest Control</td>
<td>20.02974</td>
<td>20.02974</td>
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<tr>
<td>Walnut</td>
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<td>0.074</td>
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<tr>
<td>Watermelons</td>
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<td>474.57192357</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>120,807.6326</strong></td>
<td><strong>41,787.24169</strong></td>
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APPENDIX C

PRODUCT NAMES from PUR database that are included in the analyses.

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<tr>
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<th>2004</th>
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<tr>
<td>75/25</td>
<td>57-43</td>
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<tr>
<td>Chlor-O-Pic</td>
<td>67-33 Preplant Soil Fumigant</td>
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<tr>
<td>Chloropicrin-100</td>
<td>Chlor-O-Pic</td>
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<tr>
<td>Chloropicrin 100 Soweco Brand</td>
<td>Chloropicrin-100</td>
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<td>Larvacide 100</td>
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<tr>
<td>Methyl Bromide 98%</td>
<td>MBC-33 Soil Fumigant</td>
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<tr>
<td>Methyl Bromide 99.5%</td>
<td>Metapicrin</td>
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<tr>
<td>Methyl Bromide Fumigant</td>
<td>Methyl Bromide 98%</td>
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<tr>
<td>Namco Namfume</td>
<td>Methyl Bromide 99.5%</td>
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<tr>
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<td>Namco Namfume</td>
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<tr>
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<td>Tri-Con 80/20</td>
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</tbody>
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