

Staff Report

**Use Information and Air Monitoring
Recommendations for Field Fumigations with the
Pesticide Active Ingredients 1,3-Dichloropropene,
Chloropicrin, Metam Sodium, and Methyl Bromide**

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ENVIRONMENTAL HAZARDS ASSESSMENT PROGRAM

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USE INFORMATION AND AIR MONITORING RECOMMENDATION FOR FIELD FUMIGATIONS WITH THE PESTICIDE ACTIVE INGREDIENTS 1,3-DICHLOROPROPENE, CHLOROPICRIN, METAM SODIUM, AND METHYL BROMIDE

A. BACKGROUND

This recommendation contains general information regarding the physical-chemical properties and the historical uses of 1,3-dichloropropene, chloropicrin, metam sodium, and methyl bromide. The Department of Pesticide Regulation (DPR) provides this information to assist the Air Resources Board (ARB) in their selection of appropriate locations for conducting pesticide air monitoring operations.

1,3-Dichloropropene

Table 1 describes some of the physical-chemical properties of 1,3-dichloropropene.

Table 1. Some Physical-Chemical Properties of 1,3-Dichloropropene¹.

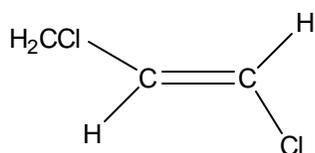
Chemical name	(<i>EZ</i>)-1-3-dichloropropene
Common name	1,3-dichloropropene
Some tradenames [†]	Telone II, Tri-Form
CAS number	542-75-6
Molecular formula	C ₃ H ₄ CL ₂
Molecular weight	111.0
Form	Colorless-to-amber liquid with sweet penetrating odor (Tomlin, 1997)
Solubility	Water: 2.18 g/L at 20°C
Vapor pressure	34.3 mmHg at 25°C
Henry's Law Constant (KH)	2.29 X 10 ⁻³ at 25°C
Soil adsorption Coefficient (Kd)	0.391
Aerobic soil metabolism half-life	11.5 to 53.9 days
Anaerobic soil metabolism half-life	2.5 days at 25°C (Tomlin, 1997)

¹Data from Kollman and Segawa, 1995

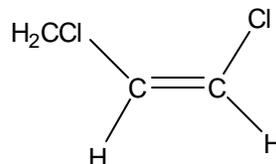
The technical product is a mixture of approximately equal quantities of (*E*)- and (*Z*)- isomers (figures 1a and 1b), of which the (*Z*) isomer is more nematocidally active. The chemical is phytotoxic to plants and is rapidly metabolized to normal plant constituents. In soil, 1,3-dichloropropene undergoes hydrolysis to the respective 3-chloroallyl alcohols and is considered non-persistent (Tomlin, 1997).

[†] Disclaimer: The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as either an actual or implied endorsement of such products.

Figure 1. The Chemical Structures of the 1,3-Dichloropropene Isomers.



(a) E-1-3-dichloropropene



(b) Z-1-3-dichloropropene

1,3- Dichloropropene is reported to hydrolyze to 3-chloro-2-propen-1-ol, which may be biologically oxidized to 3-chloropropenoic acid (Montgomery, 1997). Breakdown of this chemical eventually yields carbon dioxide (Connors *et al.*, 1990). Chloroacetaldehyde, formyl chloride, and chloroacetic acid are formed from the ozonation of 1,3-dichloropropene at 25°C and 730 mmHg (Tuazon *et al.*, 1984).

1,3-Dichloropropene has an LC₅₀ (96 hour) of 3.9 mg/L for rainbow trout and 7.1 mg/L bluegill sunfish and an oral and contact LD₅₀ (90 hour) of 6.6 µg/bee (Tomlin, 1994).

Chloropicrin

Table 2 describes some of the physical-chemical properties of chloropicrin.

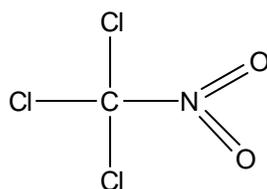
Table 2. Some Physical-Chemical Properties of Chloropicrin¹.

Chemical name	trichloronitromethane
Common name	Chloropicrin
Some tradenames	Chlor-O-Pic
CAS number	76-06-2
Molecular formula	CCl ₃ NO ₂
Molecular weight	164.4
Form	Colorless liquid with a lachrymatory action (Tomlin, 1997).
Solubility	Water: 2.00 g/L at 25°C
Vapor pressure	23.8 mmHg at 25°C
Henry's Law Constant (KH)	2.51 x 10 ⁻³ at 25°C
Soil adsorption Coefficient (Kd)	0.139- 0.311
Aerobic soil metabolism half-life	.374- 5.13 days

¹Data from Kollman and Segawa, 1995

Chloropicrin (figure 2) moves rapidly in soils within twelve inches of injection, but may diffuse to maximum of four feet in sandy soil (EXTOXNET, 1996). Chloropicrin is metabolized in soils by sequential reductive dechlorination (Mongomery, 1997). The end products are thought to be nitromethane and small amounts of carbon dioxide. Since it is only slightly soluble in water, chloropicrin will not move rapidly into aquatic environments. Chloropicrin has a higher density than water and will tend to sink to the bottom of surface water. Chloropicrin photodegrades to carbon dioxide, bicarbonate, chloride, nitrate, and nitrite with a half-life of 31.1 hours (EXTOXNET, 1996).

Figure 2. The Chemical Structure of Chloropicrin.



Chloropicrin

Chloropicrin vapor is heavier than air and spreads along the ground (Howard, 1991). It is efficiently photolyzed in the atmosphere to phosgene, nitric oxide, chlorine, nitrogen dioxide, and dinitrogen tetroxide (EXTOXNET, 1996; Mongomery, 1997). When chloropicrin is heated to decomposition, toxic fumes of nitrogen oxides and chlorine are released (Montgomery, 1997).

Chloropicrin is toxic to fish with an LC₅₀ (96 hour) of 0.0765 mg/L for rainbow trout and 0.105 mg/L bluegill sunfish. It is nontoxic to bees when used as recommended (Tomlin, 1997).

Metam sodium

Table 3 describes some of the physical-chemical properties of metam sodium.

Table 3. Some Physical-Chemical Properties of Metam Sodium¹.

Chemical name	Sodium methyldithiocarbamate
Common name	Metam sodium
Some tradenames	Vapam
CAS number	137-42-8
Molecular formula	C ₂ H ₄ NNaS ₂
Molecular weight	129.2
Form	Colorless crystalline dihydrate (The Agrochemicals Handbook, 1991).

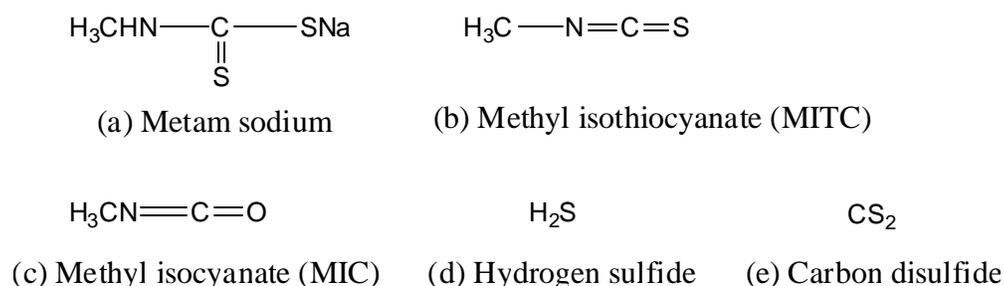
Solubility	Water: 9.6×10^4 g/L at 25°C
Vapor pressure	Nonvolatile (The Agrochemicals Handbook, 1991).
Aerobic soil metabolism half-life	1.6×10^{-2} days
Anaerobic soil metabolism half-life	<1 day

¹Data from Kollman and Segawa, 1995

Metam sodium (figure 3a) is a soil fumigant, which acts by decomposition to methyl isothiocyanate (MITC) (figure 3b) with a DT₅₀ of 23 minutes to 4 days when in contact with moist soil (Tomlin, 1997). While metam-sodium is non-volatile, MITC has a relatively high vapor pressure (16.0 mmHg at 25°C) and leaves the soil primarily due to volatilization (Leistra and Crum, 1990). Factors affecting the volatilization rate of MITC from soils include: soil temperature, soil type, soil pH, and soil moisture content (Ashley *et al.*, 1963).

In air, the primary MITC transport and transformational pathway is gas phase photolysis. In laboratory experiments, using ambient solar radiation, MITC half-lives ranged from 29 to 39 hours and resulted in the production of methyl isocyanide, methyl isocyanate (MIC) (figure 3c), methylamine, N-methyl formamide, sulfur dioxide, hydrogen sulfide (figure 3d), and carbonyl sulfide (figure 3e). Research suggests that MIC may be the major stable photoproduct formed in the atmosphere (Geddes *et al.*, 1995; Alvarez and Moore, 1994).

Figure 3. The Chemical Structures of Metam Sodium and its Breakdown Products of Concern.



The decomposition of metam sodium results in low concentrations of two other highly volatile decomposition products: hydrogen sulfide (H₂S) and carbon disulfide (CS₂). The dominant reactions of H₂S and CS₂ in the atmosphere are by daytime reaction with the OH radical. Calculated half-lives of H₂S and CS₂ are 2.5 days and approximately 2 weeks, respectively (Atkinson *et al.*, 1997; Hein *et al.*, 1997).

Metam sodium is toxic to fish with an LC₅₀ (96 hour) of 0.079 mg/L for rainbow trout and 0.39 mg/L bluegill sunfish. It is nontoxic to bees when used as recommended (Tomlin, 1997).

Methyl Bromide

Table 4 describes some of the physical-chemical properties of methyl bromide.

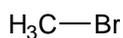
Table 4. Some Physical-Chemical Properties of Methyl Bromide¹.

Chemical name	Bromomethane
Common name	Methyl bromide
Some tradenames	Metabrom, Terr-O-Gas 75
CAS number	74-83-9
Molecular formula	CH ₃ Br
Molecular weight	94.9
Form	Non-flammable, colorless, odorless gas at room temperature (Tomlin, 1997).
Solubility	Water: 13.4 g/L at 25°C
Vapor pressure	1.7x 10 ³ mmHg
Henry's Law Constant (KH)	1.59x10 ⁻² (calculated value)
Soil adsorption Coefficient (Kd)	3.45- 9.4
Aerobic soil metabolism half-life	.15- 17 days
Anaerobic soil metabolism half-life	1.63- 6.0 days

¹Data from Kollman and Segawa, 1995

Methyl bromide (figure 4) readily evaporates at temperatures normally encountered during fumigation, but some of the chemical may become entrapped in soil microspores following application (EXTOXNET, 1996). Transformation of methyl bromide to bromide increases as the amount of organic matter in the soil increases. Methyl bromide hydrolyzes in water forming methane and hydrobromic acid with an estimated hydrolysis half-life of 20 days at a water temperature of 25°C and pH 7 (Montgomery, 1997).

Figure 4. The Chemical Structure of Methyl Bromide.



methyl bromide

Methyl bromide is moderately toxic to fish with an LC₅₀ (96 hour) of 3.9 mg/L. It is nontoxic to bees when used as recommended (Tomlin, 1997).

B. CHEMICAL USES

1,3-Dichloropropene

As of December 2000, thirteen products containing 1,3-dichloropropene were registered for use in California. 1,3-dichloropropene is a multi-purpose liquid fumigant used to control nematodes, wireworms, and certain soil borne diseases in cropland. It is used for pre-planting control of most species of nematode in deciduous fruit and nuts, citrus fruit, berry fruit, vines, strawberries, hops, field crops, vegetables, tobacco, beet, pineapples, peanuts, ornamental and flower crops and tree nurseries. It also has secondary insecticidal and fungicidal activity (Tomlin, 1994).

In California's agricultural setting, growers primarily use 1,3-dichloropropene on carrots, sweet potatoes, potatoes, wine grapes, and for preplant soil preparation. 1,3-dichloropropene recommended label use rates range from 85 to 522 pounds active ingredient (AI) per acre depending on soil type or texture for a broadcast application and 2 to 12 pounds AI per 1000 feet of row per outlet depending on soil type or texture.

The 1,3-dichloropropene product label offers several methods for application, including: broadcast (using chisel, offset swing shank, Nobel plow or plow-sole application equipment) and row application. Immediately after application, the soil must be "sealed" to prevent fumigant loss and to ensure that an effective concentration of fumigant is maintained within the soil for a period of several days. Sealing for a broadcast treatment can be accomplished by uniformly mixing the soil to a depth of 3 to 4 inches to eliminate chisel or plow traces. Sealing for row treatments can be accomplished by disrupting the chisel trace using press sealers, ring rollers, or by reforming the beds and following with such equipment. Application of a non-perforated plastic film can improve sealing but does not do away with the need to eliminate chisel traces. 1,3-dichloropropene is available as a liquid fumigant, is a restricted use pesticide due to its high acute inhalation toxicity and carcinogenicity, and includes the Signal Word "Warning" on the label.

Chloropicrin

As of December 2000, forty-seven products containing chloropicrin were registered for use in California. Chloropicrin is primarily used as a preplant soil fungicide to control root-attacking pathogens and for the control of nematodes, insects and weed seeds. It is also used as a fumigant for stored cereals and grains, to treat wood poles and timber for internal decay, and as a warning agent for odorless structural and soil fumigants.

In California's agricultural setting, chloropicrin is mainly used on strawberries, preplant soil application, tomatoes, and outdoor grown transplants. According to the label for Chlor-O-Pic® (which contains 99% of active ingredient), chloropicrin's primary use is for control or suppression of plant parasitic causing organisms including nematodes, the bacterial pathogen *Pseudomonas solanacearum*, fungi in the genera *Cylindrocladium*, *Fusarium*, *Phytophthora*, *Pyrenochaeta*, *Ptythium*, *Rhizoctonia*, *Sclerotium*, and *Verticillium*, the clubroot organism *Plasmodiophora*, and the soil pox organism *Actinomyces ipomoea*.

Control of certain soil-infesting insects such as cutworms, grubs, and wireworms may also be obtained as well as suppression of weeds if used with a tarpaulin. The label gives soil fumigation rates of 148.5 to 495 pounds AI per acre depending on soil and crop; dosage is reduced by 33% if area is covered by a plastic tarp immediately after application. Fumigations should take place at least 14 days prior to planting whenever soil conditions are suitable. Soil should be tilled to a fine, loose condition with a temperature between 60°F and 85°F for best results. For space fumigations the label suggests rates of 0.35 to 0.69 pounds AI per 1000 cubic feet for empty potato cellars, houses, and storages, and 2 to 4 pounds AI per 1000 square feet for empty grain bins.

The chloropicrin product label offers several methods for application including: overall field treatment using a chisel type applicator, row or bed treatment, and probe type point injection for small areas or volumes. The label recommends sealing the field with a plastic tarp or by the use of drag, cultipacker, roller, or float to firm the soil surface immediately behind chisels. Chloropicrin is a restricted use pesticide due to its acute toxicity and includes the Signal Word “Danger” on the label.

Metam Sodium

As of December 2000, twenty-six products containing metam sodium were registered for use in California. Metam sodium is a soil fumigant that acts by decomposition to methyl isothiocyanate, which is phytotoxic to all green plants (The Agrochemicals Handbook, 1991). It is used as a soil sterilant that is applied prior to planting edible crops and controls soil fungi, nematodes, weed seeds, and soil insects.

Metam sodium is used in California mainly on carrots, processing/canning tomatoes, potatoes, and cotton. It is recommended for the suppression or control of soil-borne pests that attack ornamental, food, and fiber crops, weeds and germinating weed seeds such as chickweed, dandelions, pigweed, etc., and soil-borne diseases such as *Rhizoctonia*, *Pythium*, *Phytophthora*, etc. Nematode suppression is achieved when metam sodium converts to MITC and makes contact with active forms of the nematode, preferable juveniles. The label suggests that pre-irrigation may induce some species eggs to hatch and enhance overall performance. Metam sodium recommended label use rates range from 159 to 318 pounds AI per acre depending on crop, target pest, and soil properties. The metam sodium product label recommends sealing the soil at the time of application. Sealing methods include applying a water seal by sprinkler irrigation, tarping, or packing soil with a roller drag, or press wheel.

The metam sodium product label offers several methods for application, including: chemigation (using only those sprinkler systems which deliver large water droplets to prevent excessive loss), soil injection (using shanks, blades, fertilizer wheels, plows, etc.), and by use of rotary tiller or power mulcher. Metam sodium is available as a water-soluble liquid and includes the Signal Word “Danger” on the label.

Methyl Bromide

As of December 2000, fifty-four products containing methyl bromide were registered for use in California. Methyl bromide is a multi purpose fumigant used for insecticidal, acaricidal, and rodenticidal control in mills, warehouses, grain elevators, ships, etc., stored products, soil fumigations, greenhouses, and

mushroom houses. In field fumigations it is used to treat a wide range of insects, nematodes, soil-borne diseases, and seed weeds.

In California's agricultural setting, growers primarily use methyl bromide on strawberries, preplant soil preparation, outdoor container/field grown plants, and outdoor grown transplants. Methyl bromide recommended label use rates range from 1 to 20 pounds AI per 1000 cubic feet for non-food products, 0.2-9 pounds AI per 1000 cubic feet for structures associated with raw or processed commodities, 1 to 2 pounds AI per 1000 cubic feet for processed foods, and 1.5 to 9 pounds AI per 1000 cubic feet for raw agricultural commodities. The methyl bromide product label recommends use rates of 1.5 to 3 pounds AI per 100 cubic feet for almonds and strawberries and 2 to 4 pounds AI 100 cubic feet for sweet potatoes (where fumigations below 70°F may result in damage). The label for methyl bromide also lists tolerances (ppm) and exposure times for raw agricultural commodities and processed foods. For structures and non-food products exposure times are listed. For field applications of methyl bromide, the label suggests waiting two weeks after the exposure period before introducing transplants or vegetative plant parts and waiting 96 hours before planting crop seeds. Methyl bromide is odorless, except at high concentrations, and is generally used with a warning agent such as chloropicrin.

The methyl bromide product labels offer several methods for application, including: chamber and vault fumigation, vacuum chamber fumigation, tarpaulin fumigation, warehouse, grain elevator, food processing plant, restaurant and other structures containing commodities, and shipboard fumigations. Methyl bromide is available as a gas fumigant, is a restricted use pesticide due to its acute toxicity, and includes the Signal Word "Danger" on the label.

Pesticide Use Summary

With DPR's implementation of full pesticide use reporting in 1990, all users must report the agricultural use of any pesticide to their county agricultural commissioner, who subsequently forwards this information to DPR. DPR compiles and publishes the use information in the annual Pesticide Use Report (PUR). Because of California's broad definition for agricultural use, DPR includes data from pesticide applications to parks, golf courses, cemeteries, rangeland, pastures, and rights-of-way, postharvest applications of pesticides to agricultural commodities, and all pesticides used in poultry and fish production, and some livestock applications in the PUR. DPR does not collect use information for home and garden use, or for most industrial and institutional uses. The information included in this monitoring recommendation reflects widespread cropland applications of 1,3-dichloropropene, chloropicrin, metam sodium, and methyl bromide. Use rates were calculated by dividing the total pounds of each chemical used (where the chemical was applied to acreage) by the total number of acres treated.

According to the PUR, the total amount of 1,3-dichloropropene, chloropicrin, metam sodium, and methyl bromide used in California from 1996 to 1999 has ranged annually between slightly under 30,000,000 to over 33,000,000 pounds (Table 5). The majority of California's total use of these chemicals occurred in five counties—Kern, Fresno, Monterey, Imperial, and Ventura. On average the total use for the 15 counties with the highest use accounted for 85% of the total use in California. Tables

6 through 9 display 1,3-dichloropropene, chloropicrin, metam sodium, and methyl bromide use for each county with use for the years 1996- 1999.

In California, growers use 1,3-dichloropropene primarily to control nematodes in carrots, sweet potatoes, preplant soil application and potatoes (Table 10). Chloropicrin is generally used on strawberries, preplant soil applications, outdoor grown transplant/ propagative material, and tomatoes (Table 11). Metam sodium use is dominated by use on carrots, tomatoes, potatoes, and cotton (Table 12). Methyl bromide is used primarily on strawberries, preplant soil applications, and outdoor container/ field grown plants (Table 13). 1,3-dichloropropene is used primarily in March October, and November; chloropicrin and methyl bromide are primarily used in August, September, and October; and metam sodium is used most in July, August, and September (Table 14). Use of these chemicals is difficult to predict as disease and nematode pressure is somewhat dependent on weather and other factors, such as cultural practices. However, assuming that no significant changes in weather occur, use is not expected to change.

Table 5. Annual Cropland Use of 1,3-Dichloropropene, Chloropicrin, Metam Sodium, and Methyl Bromide by County (Pounds Of Active Ingredient)

County	1996	1997	1998	1999	Total
KERN	6,179,916	6,343,794	5,078,461	6,538,208	24,140,379
FRESNO	5,322,191	4,424,105	3,436,569	4,927,546	18,110,410
MONTEREY	3,672,813	3,856,405	3,924,679	4,015,262	15,469,159
IMPERIAL	2,698,543	3,060,034	3,985,985	3,329,458	13,074,021
VENTURA	1,937,362	1,933,891	2,294,369	2,925,988	9,091,609
SANTA BARBARA	1,677,888	1,644,438	1,951,895	2,284,290	7,558,511
MERCED	2,206,557	1,893,274	1,676,518	1,717,253	7,493,602
RIVERSIDE	1,067,009	1,007,764	1,577,736	1,681,653	5,334,162
SANTA CRUZ	1,186,142	1,217,192	1,380,775	1,274,695	5,058,804
STANISLAUS	1,139,627	1,221,184	1,006,163	933,860	4,300,835
TULARE	932,252	1,591,740	658,930	901,350	4,084,272
SAN JOAQUIN	1,053,285	1,143,267	929,413	825,832	3,951,797
LOS ANGELES	540,509	944,109	619,267	884,220	2,988,105
ORANGE	680,472	657,943	762,424	743,593	2,844,432
KINGS	603,013	616,537	664,186	741,837	2,625,573
Total for Top 15 Counties	30,899,575	31,557,674	29,949,368	33,727,044	126,125,671
Percent of CA Total	85	84	86	85	85
Total Statewide Use	36,424,497	37,492,647	34,652,786	39,843,109	148,413,039

Table 6. 1,3-Dichloropropene Use by County for the Years 1996-1999

COUNTY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
ALAMEDA			1,498									
AMADOR					5,256							
BUTTE	4,580		3,766					5,111	31,828	9,037	21,953	5,642
COLUSA							4,381					
DEL NORTE							6,967	86,982				
EL DORADO			5									
FRESNO	43,007	75,950	113,535	27,590	13,833	21,374	8,774	31,820	98,265	174,382	371,827	42,808
GLENN												2,522
HUMBOLDT								248	11,279			
IMPERIAL	149,875	36,382	25,195				11,986	38,980	335,458	350,040	97,612	75,791
KERN	103,715	302,427	126,199	36,105	24,765	126,468	723,419	330,359	28,453	268,253	433,043	220,902
KINGS		13,692	27,816	9,719			52,702	11,476	19,113		18,247	5,343
LOS ANGELES	33		300					214	6	19		
MADERA	24,637	41,270	208,790	8,736		9,125					70,258	14,694
MARIN		12										
MENDOCINO										2		
MERCED	17,310	14,968	210,787	120,867	61,943			117	7,254	22,753	238,342	133,959
MODOC				45,362								
MONO				558								
MONTEREY	89,811	68,411	76,629	145,516	247,023	133,280	67,073	31,337	53,952	132,997	242,415	77,919
ORANGE				1			396	400	278			
PLACER				5,783	13,821	5,913		23,211	3,066	6	3	
RIVERSIDE	2,046		14,874			3,344	706	15,457	5,071	22,927		
SACRAMENTO					6,339					7,235	3,460	
SAN BENITO	3,043			4,987		8,972	2,428	161	2,623	18,014	37,671	5,277
SAN DIEGO	6	1,820	3	403	2	1,017	4	1	613			2
SAN FRANCISCO						9						
SAN JOAQUIN	368	20,325	20,373	71,359	42,899	73,571	11,778	111	7,542	80,485	127,232	10,447
SAN LUIS OBISPO			3,076		39,153	806	721	3,038	502	1,480	19,453	2,705
SAN MATEO				1,951	19,489	5,859		717				
SANTA BARBARA	158	22,733	28,162	10,090	39,079	21,326	4	19,046	2	580	225	6,106
SANTA CLARA			5,323	518		233			2,537	4,341	12,738	
SANTA CRUZ		963	4,041	27,016	101,754	31,710	3,449	6,360	5,530	3,638	4,606	1,251
SHASTA				5,970				590				
SISKIYOU				115,464	6,037	3,129		560	5,692	7,023		
SOLANO		967	30	512	474				32		8,629	
SONOMA				9,345				5		6,970		
STANISLAUS	18,404	6,730	21,670	42,115	38,327		4,988	26,925	40,598	153,663	261,430	47,774
SUTTER			10,588	6,358	2,578			3,916	5,073	49,900	58,195	2,456
TEHAMA										1,497		
TULARE		4,265	27,143		3,936		7,385	11,863	54,682	157,153	146,275	36,403
VENTURA	1,591	11,507	43,212	30,858	30,752	3,476	1,397	22,074	1,663	1,074	11,094	5
YOLO	91		52	1,146					1,490	25,687	10	
YUBA				2,418						17,676	10,819	

Table 7. Chloropicrin Use by County for Years 1996-1999

COUNTY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
ALAMEDA	25				118	62	177	7	55		21	1
AMADOR	35								1	94	40	28
BUTTE			18		209		1	1,823	4,335	1,402	1,411	
COLUSA					3		34					
CONTRA COSTA	1		1	1	1	140	1,350	919	376	253	1	
DEL NORTE				1			161	19,905	1,904			
EL DORADO	59		562	332	78			3,552	248			
FRESNO	19,771	7,019	10,841	3,551	1,322	15,810	31,603	11,538	19,276	27,829	19,673	8,804
GLENN			3,793	14,527								
HUMBOLDT						754		446	11,647			
IMPERIAL	393	74			1		5,779	2,907	16,397	24,393	4,380	786
INYO												
KERN	1,943	3,537	1,294	736	15,482	1,015	8,720	21,726	28,454	8,193	14,820	2,204
KINGS	388	299	278	134	29	22	438	102	46	1,658	714	248
LAKE							1	144	1	8		1
LASSEN		3,629	21,716	1,301				108,183	41,303	566		
LOS ANGELES	433	892	525	368	516	608	685	8,565	4,399	2,367	434	282
MADERA	77	89	189	81	135		361	212	83	111	96	207
MARIN	1	4	3	3	5	11	15	6	3	3	2	42
MARIPOSA									1			
MENDOCINO	26	1	2	1	19	1	12	236	174	270	75	1
MERCED	11,576	3,955	55,241	26,687	5,759	5,468	9,689	11,159	22,513	12,246	23,000	44,395
MODOC								15,258	6,341			
MONTEREY	3,708	1,010	11,473	4,622	63,502	189,448	361,720	700,335	1,325,12	1,226,48	5	6
NAPA	18			1	4	1	409	403	628	9,049	326	34
NEVADA			39				23					
ORANGE	7,139	14,311	8,166	18,913	16,977	11,232	55,921	300,906	157,995	4,327	2,839	17,762
PLACER			1	54	4,998	2,603		1,908	2,710	7	2	526
RIVERSIDE	16,980	38,290	185	151	75	176	3,427	5,110	2,292	578	9,968	11,759
SACRAMENTO	419	517	134	3,449	541	4,226	3,498	695	6	3,027	1,161	178
SAN BENITO	1,745		1,499	1,747	2,516	2,130	4,026	12,367	26,477	49,995	30,062	3,024
SAN BERNARDINO	13	12	20	352	30	24	23	687	13,830	6,220	24	19
SAN DIEGO	12,927	30,324	63,129	111,047	58,098	57,932	62,225	42,325	48,025	9,846	12,877	17,370
SAN FRANCISCO							2					
SAN JOAQUIN	3,225	49	26,462	78,440	21,936	3,077	2,697	8,095	8,579	7,584	7,494	1,466
SAN LUIS OPISBO	3,240	18,910	30,295	9,874	5,727	7,208	6,179	3,651	58,615	53,906	7,138	7,167
SAN MATEO	895	848	233	10	4,363	3,692	1,231	773	2,674	2,994	486	3
SANTA BARBARA	573	8,076	16,895	12,610	19,150	7,366	2,534	23,299	394,568	471,160	22,481	7,313
SANTA CLARA	8	105	1,959	3,151	81	8,825	11,214	161	18,014	32,384	6,840	591
SANTA CRUZ	1,670	2,160	8,028	7,280	14,840	25,311	64,872	263,473	624,088	517,447	82,408	3,649
SHASTA			7,787	13,022	3,491	6,087	30,853	119,441	42,772	4,068		
SOLANO			62,844	35,078	14			108,107	36,600	1,799		
SONOMA	1	21	658	1,760	12	42	2,036	5,618	557	750	459	36
STANISLAUS	5	3	7	5,370	115	140	410	3,815	1,640	3,055	1,869	6
SUTTER	2,700	468	2,107	542	18,339	5,877	7,355	13,303	100,667	20,992	9,738	1,124
TEHAMA		1	1	17	1,137	6	6,389	68,637	9,499	5,028	4,771	404
TEHEMA		910	7,421	25,511	8	3			1,692	1,360	1	19
TULARE	288	3,838	8,472	118	601	254	7,538	1,746	2,343	2,681	2,119	585

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TUOLUMNE	61											
VENTURA	3,025	4,141	10,421	24,647	63,661	184,927	287,095	810,524	507,354	20,116	9,823	2,824
COUNTY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
YOLO	20	3	1,047	1,127	14	4	509	1,518	1,104	23	12	
YUBA				1,516	1	1		599	20	574	43	16



Table 8. Metam Sodium Use by County for the Years 1996-1999

COUNTY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
ALAMEDA	3,746	3,418	2,222	343	292	739	413	140	36	224	179	369
AMADOR				105	35		20					
BUTTE				382	231	527	14	1,955	2,006	1,202	723	1,286
CALAVERAS				16					57	39		18
COLUSA	23,253	8,642	52,046	17,206	2,559	1,305	8,515	21,287	17,089	678	1,839	585
CONTRA COSTA	1,152	1,252	7,450	130	119	5	1	479	3,050	6,454	14,498	840
DEL NORTE							89,100	308,811	4,741	2,275		
EL DORADO	1,881	2,250	1,607	1,633	553	1,212	823	350	1,292	1,601	1,614	2,491
FRESNO	3,209,06	1,933,12	4,385,62									1,402,77
FRESNO	6	5	0	852,082	88,634	30,482	299,853	32,594	30,857	201,418	860,837	0
GLENN		3,175		693	689	874		1,676		254	444	460
HUMBOLDT	19		225	43					38	272	159	
IMPERIAL	133,381	7,146	418	75,983	78	88,015	393,120	7	3	8	550,030	530,877
IMPERIAL	1,007,24					1,394,52	4,384,18	2,560,81		1,618,77	1,439,63	1,676,24
KERN	7	697,391	318,414	156,091	212,300	7	0	7	863,876	2	0	2
KINGS	274,520	180,583	377,715	260,333	112	123,098	348,509	286,362	8,206	42,796	48,768	19,876
LAKE			98	21						74		
LOS ANGELES	46,388	346,405	502,582	114,231	161,289	389	112	243	35,101	59,443	2,114	2,232
MADERA	7,721	69,285	12,671	12,987	1,181	2,999		20,303	58,226	21	24,533	33
MARIN	379	414	247	1	29		3	14	79	582	229	379
MARIPOSA												3
MENDOCINO	22	2,017	411		22				75	139	1,994	17
MERCED	10,879	12,320	537,011	1,090,25	2	291,407	15,806	12,326	70,511	55	32,032	603
MODOC			84,197	431,854	58,722					13,907	54,111	4,344
MONO				169								
MONTEREY	24,457	40,078	23,550	52,838	153,011	29,389	35,936	46,975	106,644	99,752	56,520	27,675
NAPA	13	70	24					81	77	22		
NEVADA	58	58	463	717	865	1,704	1,613	1,615	617	1,694	1,186	775
ORANGE	10,499	37,506	1,228	36,936	56,485	64,954	5,096	28,980	123,048	2,421	500	6,952
PLACER	1,776	2,163	2,883	2,498	2,364	1,261	1,373	1,274	797	881	881	6,348
PLUMAS	41	140	137	169	13				25			
RIVERSIDE	166,297	113,192	98,121	101,174	139,605	245,581	237,119	310,911	199,406	93,034	63,004	94,166
SACRAMENTO	906	822	53,359	210,188	25,963	3,527	1,460	21,391	6,640	10,086	4,534	2,922
SAN BENITO	296	1,210	45,684	40,083	6,461	1,185	1,184	7,033	502	4,249	514	223
SAN BERNARDINO	2,048	2,353	2,709	5,080	7,663	16,300	12,701	3,248	11,009	1,303	714	53
SAN DIEGO	10,804	31,860	25,366	51,769	13,322	43,865	32,422	69,272	38,121	1,980	2,351	2,695
SAN FRANCISCO	91	31	8	8	644	2				643	964	309

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SAN JOAQUIN	80	468	100,496	130,609	65,526	10,066	8,870	4,347	8,176	39,226	35,997	331
SAN LUIS OBISPO	47,410	118,797	334,208	187,917	143,256	148,856	40,903	30,098	32,761	43,902	61,781	20,709
SAN MATEO	2,642	3,683	10,012	51,041	67,407	37,403	5,405	3,604	4,808	8,043	2,475	3,959
SANTA BARBARA	137,962	83,023	217,270	550,752	685,178	326,559	265,287	198,043	319,700	121,060	129,810	85,923
SANTA CLARA	8,874	20,699	60,637	12,841	5,953	6,334	5,177	5,867	3,953	1,902	45,999	2,127
SANTA CRUZ		0		70,975	139,303	17,399	3,585	906	480	4,692	635	61
COUNTY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
SHASTA	20	16	28	82	116	65	41	94	105	200	17	125
SIERRA	463	463	463	717	717				2	225	90	
SISKIYOU			15,584	259,049	3,807							
SOLANO	10,906	71,822	330,166	302,902	24,897	33,986	9,431	54,848	21,958	82,758	34,673	
SONOMA	3,306	1,978	3,333	10,004	18,861	32,076	37,062	5,004	3,086	1,001	1,615	2,200
STANISLAUS	3,325	18,698	135,727	298,651	82,015	33,840	61,951	65,148	81,682	68,419	14,635	7,621
SUTTER	141	14,220	87,278	53,061	15,349	678	801	5,406	680	652	872	1,886
TEHAMA	73	118	178	118	235							
TULARE	68,145	28,856	159,086	55,690	77,324	5,053	6,111	252	17,987	7,762	50,168	89,854
TUOLUMNE			83	156						42		
VENTURA	18,966	16,676	129,658	110,349	96,451	45,181	90,802	80,605	29,463	17,679	31,043	15,906
			1,036,24									
YOLO	194,749	328,146	2	433,447	69,949	5,923	4,200	3,983	386	1,215	60,064	26,078
YUBA	92	161	106	6		2,289	1,168	1,141	1,154	628	885	1,043



Table 9. Methyl Bromide Use by County for Years 1996-1999

COUNTY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
ALAMEDA	9,883	4,662	5,709	6,877	14,663	18,374	13,300	7,444	16,620	7,818	9,892	5,022
AMADOR	46	65	78	187	201		90		666	198	53	100
BUTTE	3,066	604	3,240	5,844	26,211	48,315	53	32,065	103,503	383,035	80,154	7,135
CALAVERAS			119	341	50	80	220	399	887	351		399
COLUSA	285	160	126	852	2,684	924	512	1,713	1,163	6,775	1,676	242
CONTRA COSTA	1,900	1,925	2,276	2,452	2,552	2,442	4,020	5,786	4,148	6,645	5,861	2,946
DEL NORTE				149			32,107	186,361	3,901			150
EL DORADO	376	490	1,152	722	379	357	50	7,610	639	1,112	234	462
FRESNO	278,379	256,700	302,109	163,905	66,621	60,146	241,664	135,060	462,110	464,541	694,773	456,858
GLENN			43,571	45,653						15,666	7,896	3,555
HUMBOLDT			60			1,635	147	914	10,614	30	133	
IMPERIAL	489,918	80,509	4,312				21,560	23,359	14,877	117		240,264
INYO						109		110	48			
KERN	400,743	343,518	324,028	141,943	97,114	131,325	378,789	713,818	803,544	373,893	755,459	514,491
KINGS	31,761	16,827	52,608	26,108	5,122	10,104	12,119	10,857	20,417	88,096	188,268	29,943
LAKE			64	2		180	358	30,259	7,312	25,118	406	137
LASSEN		27,584	91,312	3,703				159,290	59,028	1,159		
LOS ANGELES	142,961	147,583	154,466	157,938	146,029	129,466	134,493	172,874	139,296	122,315	119,322	130,189
MADERA	25,137	16,310	53,789	55,070	42,749	354	10,367	27,804	63,474	16,501	20,438	73,015
MARIN	1,282	1,393	1,292	1,559	1,751	2,272	3,416	2,141	1,806	2,525	1,051	1,894
MARIPOSA					3	9	63			44		
MENDOCINO	649	264	771	392	4,583	1,212	4,795	35,919	50,201	67,550	32,884	1,000
MERCED	497,829	664,968	747,617	544,539	170,168	24,774	83,969	106,883	195,614	189,083	326,371	808,022
MODOC				2,283				30,977	12,874			

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MONO	76											
	1,434,11 2,550,62 2,697,82											
MONTEREY	63,321	53,261	183,944	119,009	180,586	377,216	626,175	9	1	0	899,159	28,950
NAPA	262	159	501	3,605	10,330	4,841	13,745	11,855	107,637	325,595	131,750	1,475
NEVADA	260	105	166	144		132	340	62	300	78	108	51
ORANGE	40,419	61,832	56,640	69,523	88,181	61,261	179,468	781,776	387,430	35,573	30,549	59,613
PLACER	607	649	606	838	15,310	8,971	806	6,365	9,055	2,161	4,691	2,170
RIVERSIDE	914,889	425,697	92,061	32,841	70,109	86,311	60,478	184,241	168,114	128,371	431,571	724,454
COUNTY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
SACRAMENTO	20,382	2,666	4,572	20,069	36,284	14,276	13,884	11,591	4,359	5,540	24,787	3,740
SAN BENITO	2,114	642	36,550	4,199	5,995	29,095	9,634	22,041	54,485	98,580	42,168	440
SAN BERNARDINO	2,873	16,419	3,350	4,552	5,853	3,093	5,499	5,323	42,586	21,846	3,983	3,761
SAN DIEGO	44,024	131,965	175,998	281,942	155,315	159,410	193,965	120,608	129,919	65,114	41,230	60,707
SAN FRANCISCO	168	303	188	382	376	232	448	528	248	187	636	258
SAN JOAQUIN	148,364	62,802	389,172	454,628	126,846	120,278	74,994	159,370	259,202	430,083	448,401	237,871
SAN LUIS OBISPO	22,987	46,517	68,799	26,027	34,881	35,874	36,695	26,525	197,377	184,480	33,111	22,436
SAN MATEO	4,845	4,755	3,431	3,774	17,998	14,792	8,290	8,306	16,205	11,912	4,870	1,768
SANTA BARBARA	9,102	37,099	67,124	76,961	157,071	60,256	32,592	116,267	2	5	112,941	34,496
SANTA CLARA	1,307	1,041	1,271	6,202	4,154	19,275	22,978	4,902	34,400	66,606	25,662	2,843
SANTA CRUZ	4,475	8,102	19,977	75,966	83,815	60,505	116,453	496,243	5	939,436	165,539	7,128
SHASTA			23,804	26,540	7,154	9,148	42,291	234,725	77,277	9,467		54
SIERRA									33	95		
SISKIYOU			131,117	71,872	28			227,095	58,412	3,686		
SOLONO	1,350	1,584	3,375	19,721	3,704	9,058	6,407	34,879	50,908	111,875	63,564	8,125
SONOMA	3,211	3,261	3,242	4,842	11,518	42,802	96,145	253,471	291,254	518,129	370,308	3,244
STANISLAUS	145,413	145,739	243,735	157,304	65,204	33,290	47,579	153,682	585,153	386,276	415,980	203,933
SUTTER	22,452	2,912	18,963	8,272	19,743	3,749	26,223	210,257	166,121	454,603	293,135	35,548
TEHAMA	2,748	5,739	14,050	42,203	7,258	2,388	1,122	40,438	97,726	88,951	28,030	18,108
TULARE	90,060	305,267	415,665	152,076	30,205	46,791	197,486	165,872	285,543	698,621	504,634	146,078
TUOLUMNE	51		78			123	54	45	50	176		
VENTURA	24,304	54,565	150,943	289,124	385,818	705,922	859,064	3	5	125,850	83,477	50,644
YOLO	5,925	5,349	12,029	19,548	35,287	4,493	7,736	48,681	44,430	33,168	19,095	4,804
YUBA	2,698	213	2,434	11,888	618	742	1,227	12,609	16,324	231,995	195,559	11,346

Table 10. Annual Cropland Use of 1,3- Dichloropropene by Commodity (Pounds of Active Ingredient)

Crop	1996	1997	1998	1999	Total
CARROTS, GENERAL	730,564	929,297	923,379	863,111	3,446,351
SWEET POTATO	73,194	75,080	279,827	191,558	619,659
SOIL APPLICATION, PREPLANT- OUTDOOR (SEEDBED)	296,937	144,061	273,525	310,194	1,024,717
POTATO (WHITE, IRISH, RED, RUSSET)	93,724	264,134	169,057	164,386	691,301
GRAPES, WINE	24,036	99,350	150,468	222,418	496,272
CANTALOUPE	35,918	15,759	129,331	73,993	255,001
ALMOND	108,408	56,052	109,414	169,054	442,928
BRUSSELS SPROUTS	70,784	72,516	94,870	32,249	270,419
TOMATOES, FOR PROCESSING/CANNING	14,175	42,176	88,090	208,364	352,805
WALNUT (ENGLISH WALNUT, PERSIAN WALNUT)	15,257	26,291	62,276	78,702	182,526
OUTDOOR GROWN CUT FLOWERS OR GREENS	199	414	61,125	6,035	67,773
BROCCOLI	24,646	56,417	60,923	139,206	281,192
Total	1,489,838	1,783,544	2,404,283	2,461,269	8,130,944



Table 11. Annual Cropland Use of Chloropicrin by Commodity (Pounds of Active Ingredient)

Crop	1996	1997	1998	1999	Total
STRAWBERRY	1,987,330	1,887,525	1,913,493	2,402,937	8,191,285
SOIL APPLICATION, PREPLANT- OUTDOOR (SEEDBED)	197,831	238,694	282,417	277,113	996,055
OUTDOOR GROWN TRANSPLANT	156,286	132,660	179,225	111,408	579,579
TOMATO	79,458	73,609	93,094	136,771	382,932
LETTUCE, HEAD	74,804	82,820	92,755	78,758	329,137
OUTDOOR GROWN CUT FLOWERS OR GREENS	49,097	69,143	69,197	92,797	280,234
OUTDOOR CONTAINER/FIELD GROWN PLANTS	64,323	49,531	67,626	90,557	272,037
UNCULTIVATED AGRICULTURAL AREAS	19,401	20,938	60,296	20,730	121,365
PEPPERS (FRUITING VEGETABLE), (BELL, CHILI, ETC.)	36,928	4,710	38,559	48,981	129,178
LETTUCE, LEAF)	25,965	16,690	26,920	14,756	84,331
CARROTS, GENERAL	3,344	8,422	25,424	43,158	80,348

CELERY, GENERAL	20,223	20,964	24,489	16,322	81,998
Total	2,716,986	2,607,703	2,875,493	3,336,287	11,528,479

Table 12. Annual Cropland Use of Metam Sodium by Commodity (Pounds of Active Ingredient)

Crop	1996	1997	1998	1999	Total
CARROTS, GENERAL	4,602,729	5,823,590	5,779,224	6,430,926	22,636,469
TOMATOES, FOR PROCESSING/CANNING	3,655,522	2,673,036	2,640,872	3,496,926	12,466,356
POTATO (WHITE, IRISH, RED, RUSSET)	1,438,776	1,260,222	1,205,154	181,280	4,085,432
COTTON, GENERAL	1,719,734	1,331,770	414,502	656,188	4,122,194
CANTALOUPE	220,529	391,616	335,611	390,573	1,338,329
LETTUCE, LEAF	228,925	269,145	303,975	130,285	932,330
ONION (DRY, SPANISH, WHITE, YELLOW, RED, SOIL APPLICATION, PREPLANT- OUTDOOR (SEEDBED)	124,647	182,958	280,294	318,855	906,754
PEPPERS (FRUITING VEGETABLE), (BELL, CHILI, ETC.)	235,749	166,472	223,210	343,179	968,610
SWEET POTATO	243,630	238,859	216,619	329,140	1,028,248
SPINACH	313,942	245,066	205,573	362,396	1,126,977
LETTUCE, HEAD	40,435	83,593	173,286	87,820	385,134
Total	548,924	81,316	147,418	34,909	812,567
Total	13,375,538	12,749,640	11,927,736	12,764,476	50,809,400



Table 13. Annual Cropland Use of Methyl Bromide by Commodity (Pounds of Active Ingredient)

Crop	1996	1997	1998	1999	Total
STRAWBERRY	4,374,955	4,041,796	4,251,831	5,178,295	17,846,877
SOIL APPLICATION, PREPLANT- OUTDOOR (SEEDBED)	1,403,438	2,148,825	1,522,671	1,840,036	6,914,970
OUTDOOR CONTAINER/FIELD GROWN PLANTS	1,122,379	922,653	1,064,688	971,280	4,081,000
OUTDOOR GROWN TRANSPLANT	515,562	509,527	547,145	447,077	2,019,311
SWEET POTATO	611,586	766,042	541,923	403,442	2,322,993
ALMOND	613,743	881,792	502,949	267,471	2,265,955
GRAPES, WINE	1,480,701	897,380	478,272	681,834	3,538,187
OUTDOOR GROWN CUT FLOWERS OR GREENS	426,511	545,718	444,971	336,322	1,753,522

PEPPERS (FRUITING VEGETABLE), (BELL, CHILI, ETC.)	344,828	295,151	403,080	498,480	1,541,539
TOMATO	336,194	263,210	304,411	352,727	1,256,542
PEACH	248,082	287,120	280,028	254,673	1,069,903
GRAPES	299,627	569,054	273,836	251,243	1,393,760
Total	11,779,602	12,130,265	10,617,803	11,484,879	46,004,559

Table 14. Monthly Use of 1,3-Dichloropropene, Chloropicrin, Metam Sodium, and Methyl Bromide for 1996-1999 (Pounds of Active Ingredient)

Month	1,3-Dichloropropene	Chloropicrin	Metam sodium	Methyl bromide	Total
JANUARY	474,684	1,245,860	5,419,699	3,223,843	10,364,086
FEBRUARY	626,528	1,268,822	4,069,875	2,676,149	8,641,374
MARCH	1,040,229	2,552,276	8,976,219	4,021,847	16,590,571
APRIL	752,523	2,083,793	5,986,862	3,375,876	12,199,054
MAY	703,671	1,220,610	2,622,504	2,270,923	6,817,708
JUNE	470,029	1,847,256	2,823,720	2,615,827	7,756,832
JULY	926,301	3,227,341	6,472,440	4,211,424	14,837,506
AUGUST	693,268	8,176,708	7,362,082	10,196,781	26,428,839
SEPTEMBER	748,547	10,181,470	6,222,453	13,513,466	30,665,936
OCTOBER	1,543,406	8,297,229	4,632,445	12,340,886	26,813,966
NOVEMBER	2,236,167	2,925,324	3,196,179	6,048,516	14,406,186
DECEMBER	712,671	1,211,593	3,002,645	3,099,199	8,026,108
Total	10,928,024	44,238,282	60,787,123	67,594,737	183,548,166

C. RECOMMENDATIONS

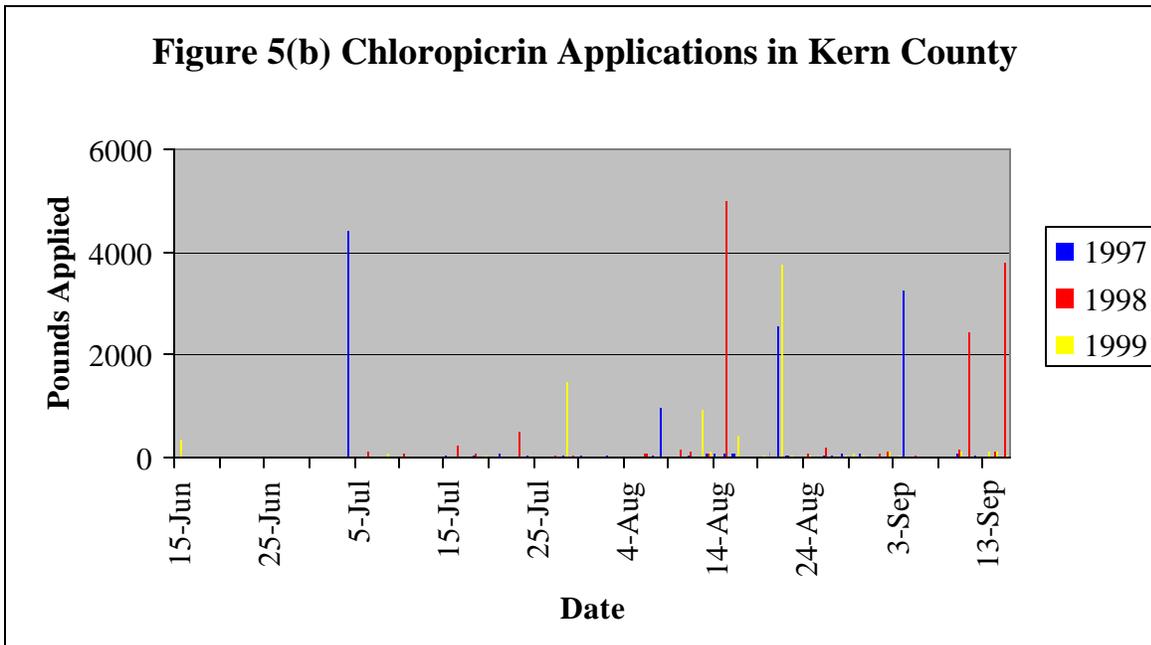
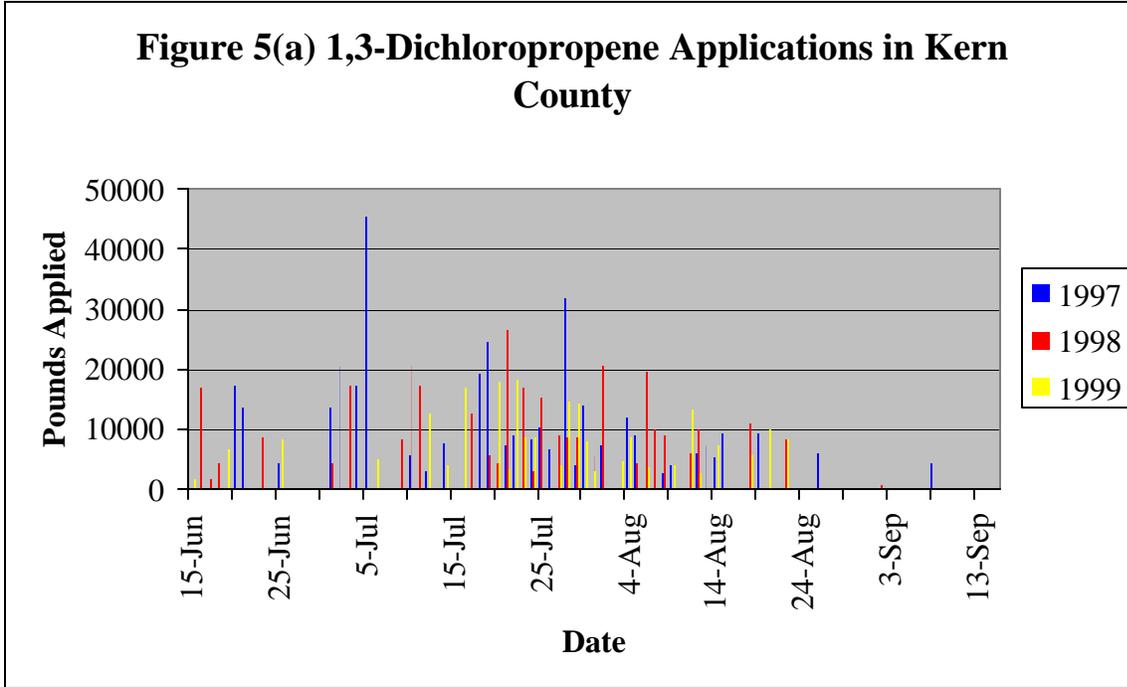
Ambient Air Monitoring

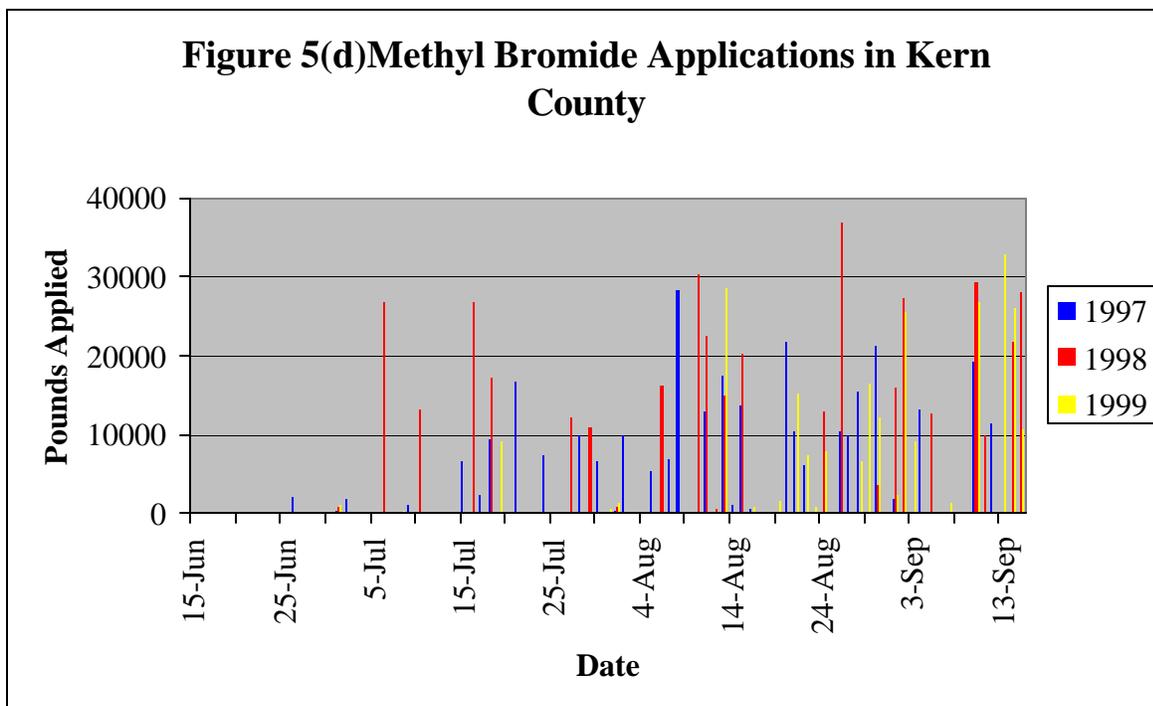
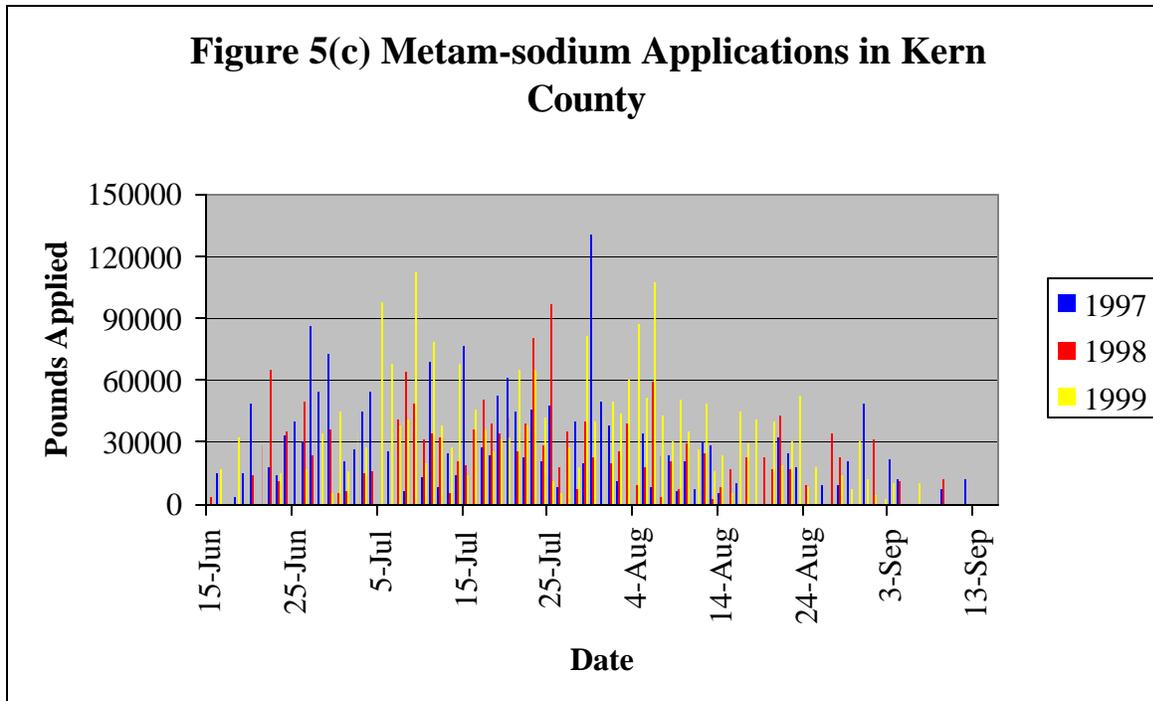
The historical trends in 1,3-dichloropropene and metam sodium use suggest that monitoring should occur over a two month period during July and August in Kern County. Monitoring in Kern County should focus on the use of 1,3-dichloropropene and metam sodium, but since there is significant use of all four chemicals, monitoring should be simultaneous for all four. Figures 5(a-d) display 1,3-dichloropropene, chloropicrin, metam sodium, and methyl bromide use in Kern County during the period from July 1 through September 15 for 1997, 1998, and 1999. Attachments E through H display 1,3-dichloropropene, chloropicrin, metam sodium, and methyl bromide use by section in the Central Valley during 1998 and 1999.

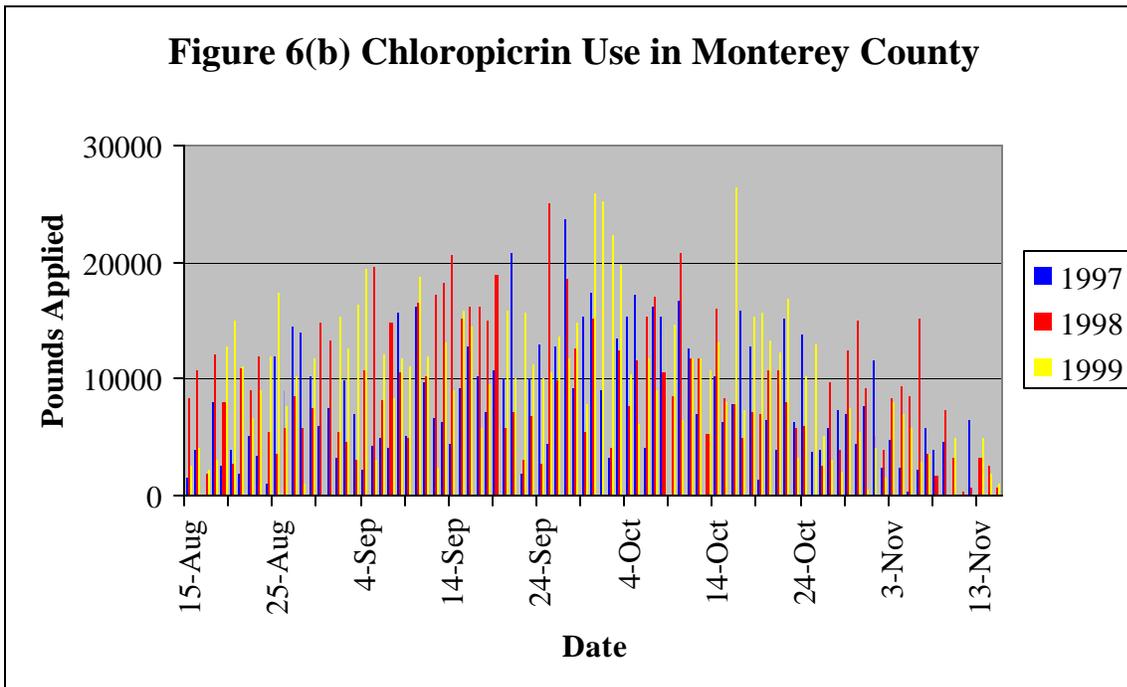
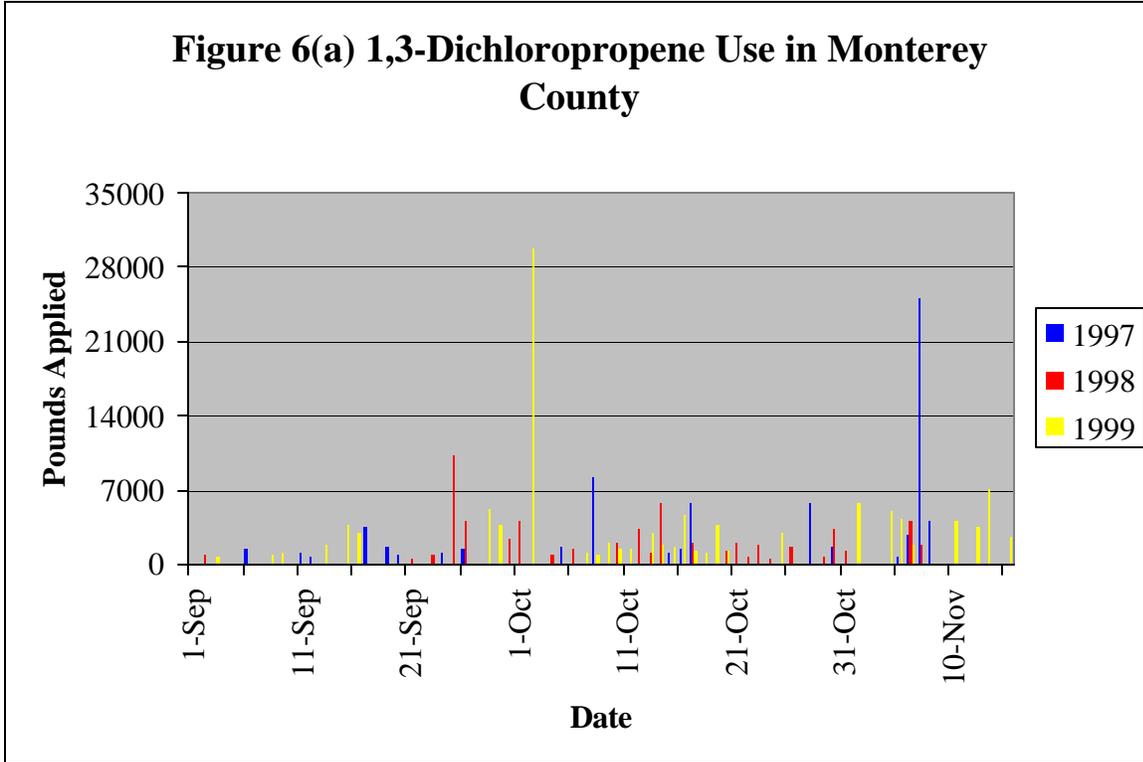
In Monterey and Santa Cruz Counties, historical trends indicate that monitoring for methyl bromide and chloropicrin should take place during September and October. Monitoring in Monterey or Santa Cruz County should focus on methyl bromide and chloropicrin, but since there is significant use of all four chemicals, monitoring should be done simultaneously. Figures 6(a-d) and Figures 7(a-d) display 1,3-dichloropropene, chloropicrin, metam sodium, and methyl bromide use in Monterey and Santa Cruz Counties during the period from September 1 through November 15 for 1997, 1998, and 1999; respectively. Attachments A through D display 1,3-dichloropropene, chloropicrin, metam sodium, and methyl bromide use by section in the Central Coast during 1998 and 1999.

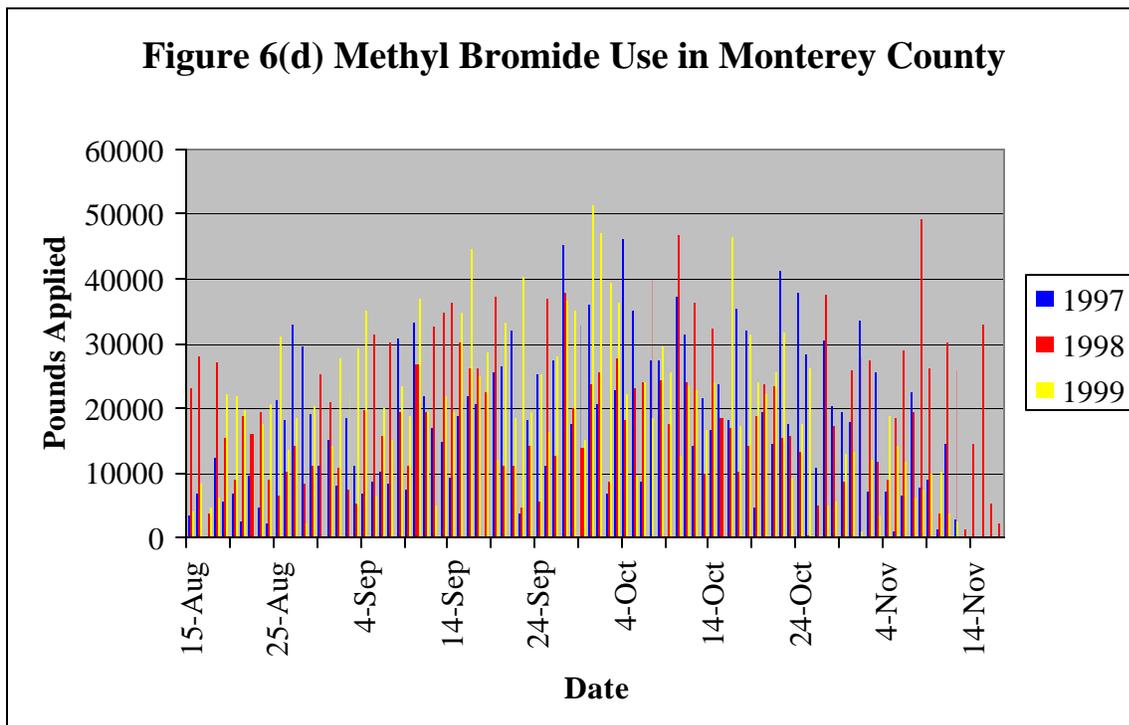
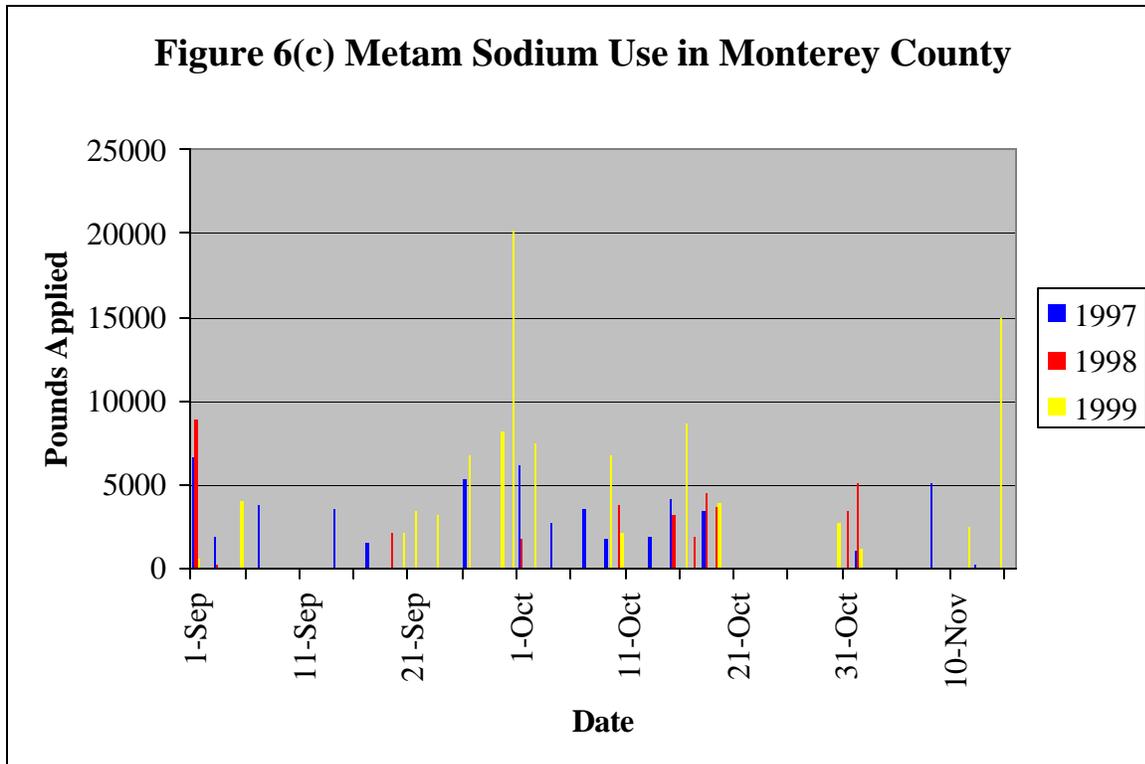
Five sampling sites (5 sites and one urban background site) should be selected in relatively high-population areas or in areas frequented by people (e.g., schools or school district offices, fire stations, or other public buildings). Samples should be collected and analyzed for 1,3-dichloropropene, chloropicrin, methyl bromide, and metam sodium (as the breakdown products methyl isothiocyanate and methyl isocyanate). Monitoring for all four chemicals should be performed simultaneously. At each site, 4 samples per week should be collected randomly over the full seven-day week during the sampling period. Background samples should be collected in an area distant to applications of 1,3-dichloropropene, chloropicrin, metam sodium, and methyl bromide. Target 24-hour quantitation limits of at least 0.01 $\mu\text{g}/\text{m}^3$ for 1,3-dichloropropene, 0.1 $\mu\text{g}/\text{m}^3$ for chloropicrin, 0.5 $\mu\text{g}/\text{m}^3$ for methyl isothiocyanate, 0.05 $\mu\text{g}/\text{m}^3$ for methyl isocyanate, and 0.4 $\mu\text{g}/\text{m}^3$ for methyl bromide are recommended.

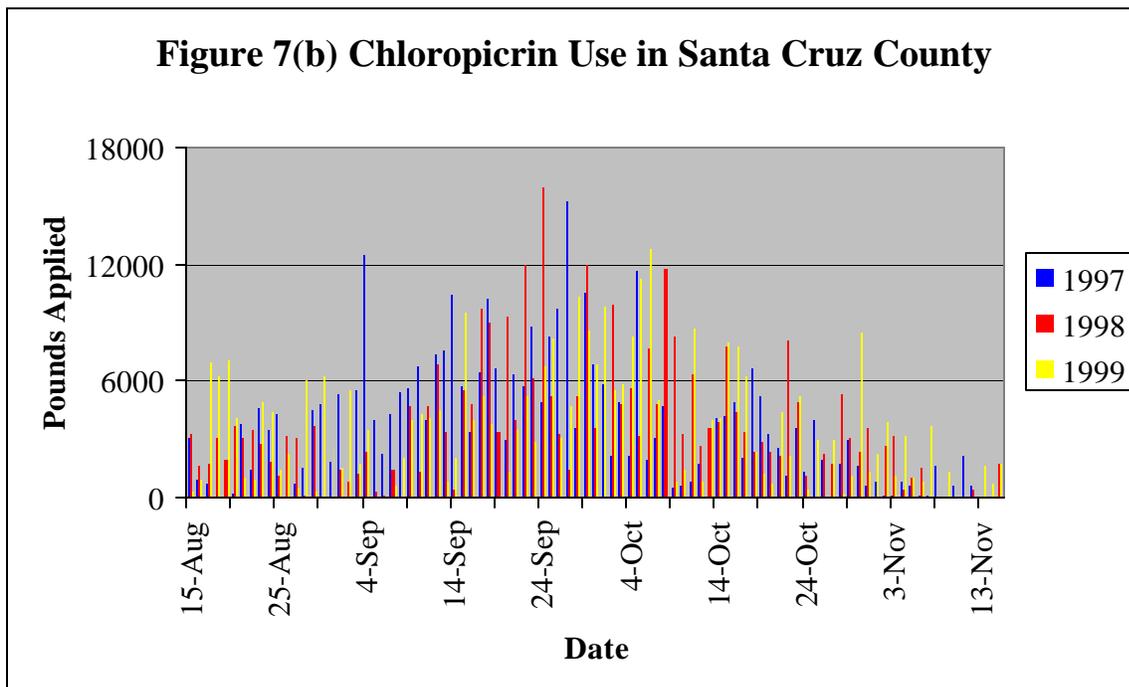
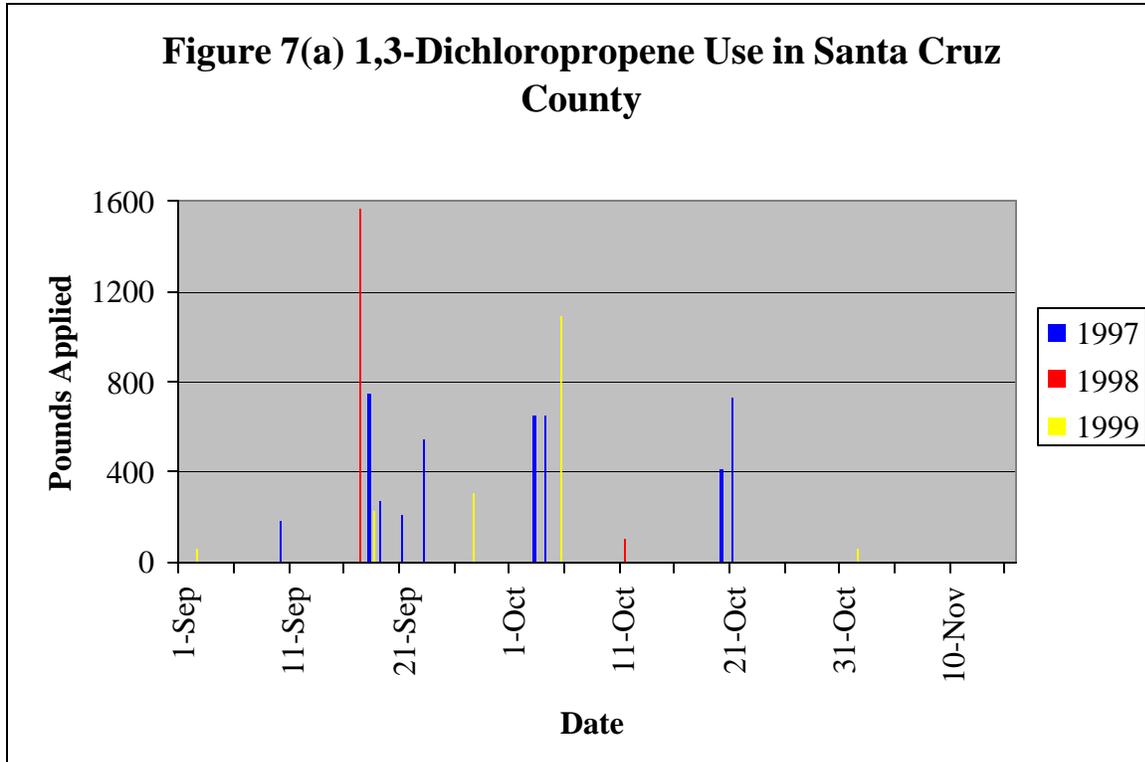
DPR recommends close coordination with the county agricultural commissioner to select the best sampling sites and periods. In addition to the primary samples, replicate (co-located) samples are needed for 4 dates at each sampling location. Field spike samples should be collected at the same environmental conditions (e.g., temperature, humidity, exposure to sunlight) and experimental conditions (e.g., air flow rates) as those occurring at the time of ambient sampling. Additionally, we request that you provide in the ambient monitoring report: 1) the proximity of the sampler to treated or potentially treated fields, including the distance and direction, and 2) the distance the sampler is located above the ground.

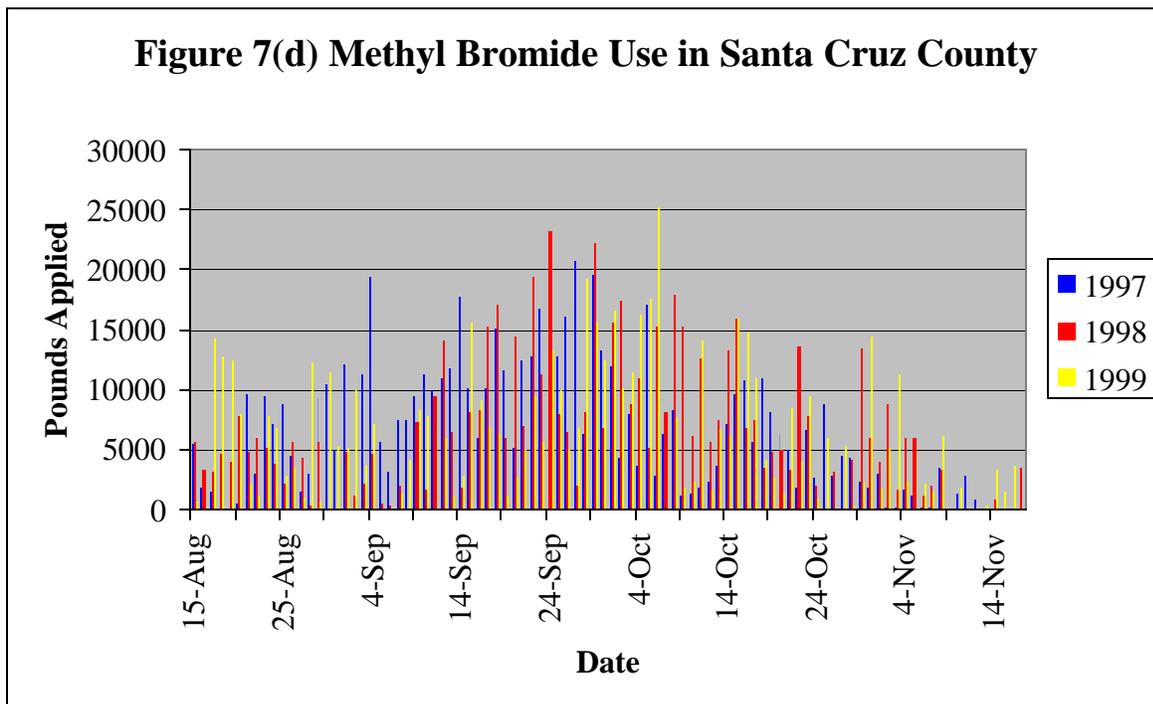
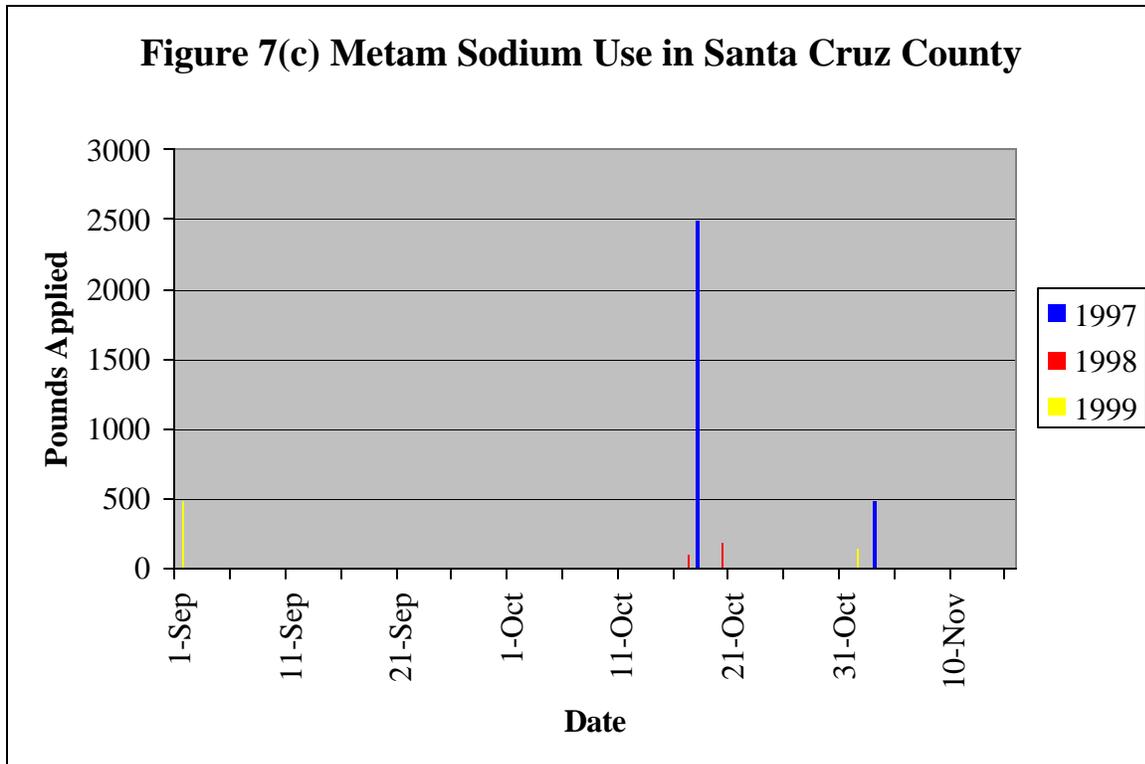












Application-Site Air Monitoring

*1,3-Dichloropropene, Chloropicrin, Metam Sodium,
and Methyl Bromide Monitoring Recommendation*

May 2001

Application monitoring should be done for the chemicals chloropicrin and metam sodium (as the breakdown products methyl isothiocyanate, methyl isocyanate, hydrogen sulfide, and carbon disulfide). No application monitoring is requested at this time for 1,3-dichloropropene or methyl bromide unless an application of methyl bromide and chloropicrin can be monitored simultaneously. DPR would prefer a bed fumigation of chloropicrin in which methyl bromide is also used so that they can be monitored simultaneously. Ideally, monitoring should occur at a site using the highest allowed rates of use (i.e., between 150 to 400 pounds per acre overall). DPR requests monitoring for metam sodium be a drip irrigation application at a site using the highest allowed rates of use (i.e. about 318 pounds AI per acre). Most applications of chloropicrin and metam sodium using these methods occur in the central coast area.

DPR recommends close coordination with the county agricultural commissioner to select the best sampling sites and date. Ideally, the monitoring study should include samples taken before, during, and post application for 72 hours. To minimize exposure to sampling personnel, we recommend the following revised sampling schedule:

Sample period begins:	Sample duration time
Background (pre-application)	Minimum 12 hours
During application and post-application	Start of application until 1 hour before sunset
1 hour before sunset	Overnight ¹ (until 1 hour after sunrise)
1 hour after sunrise	Daytime (until 1 hour before sunset)
1 hour before sunset	Overnight (until 1 hour after sunrise)
1 hour after sunrise	Daytime (until 1 hour before sunset)
1 hour before sunset	Overnight (until 1 hour after sunrise)

¹ All overnight samples must include the period from one hour before sunset to one hour after sunrise.

In the event that application occurs at night, the alternate day-night schedule should be followed. Frequently, fumigation may take two or more days. In these instances, follow the above schedule from the last day of application, since this will give the most representative air concentration trend following application.

The selected field should be 10 acres in area, or larger. A minimum of eight samplers should be positioned, one on each side of the field and one at each corner. A ninth replicate sampler should be co-located at one position. Ideally, samplers should be placed a minimum of 20 meters from the field. Field spike samples should be collected at the same environmental conditions (temperature humidity, exposure to sunlight) and experimental conditions (similar air flow rates) as those occurring at the time of sampling. Since the four chemicals are used in the area, background samples should collect enough volume to achieve the recommended target 24-hour quantitation limits (see ambient air monitoring section).

Additionally, we request that you provide in the monitoring report: 1) an accurate record of the positions of the monitoring equipment with respect to the field, including the exact distance that the sampler is positioned from the field, and if necessary how the field was divided to treat over several days; 2) an accurate drawing of the monitoring site showing the precise location of the meteorological equipment, trees, buildings, and other obstacles; 3) meteorological data collected at a minimum of 15-minute intervals including wind speed and direction, humidity, and air temperature, and comments regarding degree of cloud cover; 4) the elevation of each sampling station with respect to the field, and the orientation of the field with respect to North (identified as either true or magnetic North); and 5) the start and end time of the application.

Due to the high application rates and high volatility of these pesticides, the potential for exposure is higher than most other pesticides. This recommendation should not require any special safety equipment or precautions for sampling personnel. However, DPR personnel have extensive experience monitoring fumigations, as well as safety training and equipment, and can provide sampling assistance if desired.

D. SAFETY RECOMMENDATIONS

Most of the following safety precautions pertain to applicators. The sampling schedule is arranged so that sampling personnel do not need to be near the field during application, so these precautions are not necessary.

1,3-Dichloropropene

The 1,3-dichloropropene product labels warn that 1,3-dichloropropene may cause substantial, but temporary, eye injury if the product gets into the eyes. The product may cause skin irritation, skin burns, allergic skin reaction and be fatal if absorbed through the skin. The vapor may be fatal if inhaled and may cause lung, liver, and kidney damage and respiratory system irritation upon prolonged contact.

Monitoring personnel should use proper protective equipment to prevent exposure to the dust, vapors or spray mist. According to the product labels, proper protective equipment for applicators making direct contact or for applicators outside an enclosed cab includes coveralls, chemical-resistant gloves and footwear plus socks, face sealing goggles, chemical resistant headgear (for overhead exposure) and apron, and a respirator with an organic-vapor removing cartridge. Monitoring personnel should refer to the label of the actual product used for further precautions.

Chloropicrin

The chloropicrin product labels warn that chloropicrin is a poisonous liquid and vapor and is readily identifiable by smell. Inhalation of vapors may be fatal and exposures to low concentrations of vapor will cause irritation of the eyes, nose, and throat. Exposure to high concentrations or for a prolonged period of time may cause painful irritation to the eyes or temporary blindness. Contact with the liquid will cause chemical burns to the skin or eyes and is harmful or fatal if swallowed.

The acceptable air concentration for persons exposed to chloropicrin is 0.1 ppm. If air concentrations exceed 0.1 ppm, an air purifying respirator must be worn; if air concentrations exceed 4 ppm, an air supplying respirator must be worn. The highest concentrations of chloropicrin at 20 m from the field should not exceed 0.05 to 0.08 ppm. The label states that the applicator and other handlers must wear: loose fitting, long-sleeve shirt and long pants, shoes and socks, and full-face shield or safety glasses with brow and temple shields. Monitoring personnel should refer to the label of the product used and should use proper protective equipment to prevent exposure to the dust, vapors, or spray mist.

Metam sodium

The metam sodium product labels warn that metam sodium causes skin damage and may be fatal if absorbed through the skin. Prolonged or frequent contact may cause an allergic reaction. Metam sodium is harmful if inhaled or swallowed and is irritating to eyes, nose, and throat.

Monitoring personnel should use proper protective equipment to prevent exposure to the vapors or spray mist and refer to the label of the actual product used for further precautions. According to the product labels, proper protective equipment for applicators making direct contact or for applicators outside an enclosed cab includes coveralls, waterproof gloves, chemical resistant footwear plus socks, face sealing goggles, chemical resistant headgear (for overhead exposure) and apron, and a respirator with an organic-vapor removing cartridge. Concentrations should not exceed 0.5 ppm for any of the sampling intervals at the 60 foot sampling distance from the field.

Methyl bromide

According to the product labels for methyl bromide, it is an extremely hazardous liquid and vapor under pressure. Inhalation may be fatal or cause serious acute illness or delayed lung or nervous system injury. Liquid or vapor may cause skin or eye injury. Methyl bromide vapor is odorless and non-irritating to skin and eyes during exposure and toxic levels may occur without warning or detection.

The acceptable air concentration for persons exposed to methyl bromide is 5 ppm, except for those in residential or commercial structures. A respirator is required if air concentrations exceed 5 ppm at any time. According to the label, proper protective equipment for applicators include loose fitting or well-ventilated long-sleeved shirt and long pants, shoes and socks, full-face shield or safety glasses with brow and temple shields. Monitoring personnel should refer to the label of the actual product used for further precautions.

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