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Relative-Risk Evaluation for Pesticides Used in the Central Valley Pesticide Basin Plan Amendment Project Area

Final Staff Report

February 2009

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

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Relative-Risk Evaluation for Pesticides Used in the Central Valley Pesticides Basin Plan Amendment Project Area

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Executive Summary
This Relative-Risk Evaluation report describes a process that was used to identify a target list of pesticides that pose the highest overall relative risk to aquatic life beneficial uses in surface water within the Central Valley Pesticide Basin Plan Amendment Project Area. The Project Area includes the Sacramento River, San Joaquin River, and Delta watersheds below the major reservoirs in California's Central Valley.

The target list, presented in Tables 2A and 2b, contains 38 pesticides that are highly toxic to aquatic organisms and have had relatively high total annual reported use amounts. The 38 target pesticides were ranked into either a high (28 pesticides) or a moderate (10 pesticides) overall relative-risk. All 38 target pesticides were also ranked by their sediment relative-risk according to the organic carbon partition coefficient Koc value.

The report is intended to be a screening level analysis to assist Regional Board staff identify and prioritize work efforts. The target pesticides list will be used in the development of the Central Valley Pesticide Basin Plan Amendment and to prioritize development of future Basin Plan amendments, and in development of monitoring and compliance programs within the Central Valley Region.

1.0 INTRODUCTION

This Relative-Risk Evaluation report is one component of the Central Valley Pesticide Basin Plan Amendment (CVPBPA) Project[1] (Project). The report is organized into the following sections: Data Sources (Section 2.0), Methodology (Section 3.0), Results and Limitations (Section 4.0), and Appendices.

This report describes the process steps, and presents the results of, a simple screening-level evaluation methodology for identifying and prioritizing a target list of current-use pesticides that pose a generally high or moderate overall relative risk to aquatic life in surface waters in the Project Area.

The methodology described in this report is not intended to be a rigorous and comprehensive risk assessment for pesticides used in the Project Area. Rather, the methodology in this report is a higher-level relative-risk evaluation designed to help the California Regional Water Quality Control Board - Central Valley Region (Regional Water Board) determine priorities for further pesticide evaluation. In particular, the work involved in creating this report does not consider:

- Either probabilistic or deterministic risk characterization
- Pesticide degradation/dissipation information
- Fate and transport analysis
- Human-health risk evaluation

Mention of trade names, commercial products, or specific chemicals in this report does not constitute endorsement or recommendation for or against use.

1.1 Project Area

The CVPBPA Project Area is composed of three subareas: the Lower Sacramento River Watershed (Sacramento Subarea, SacR), the Lower San Joaquin River Watershed (San Joaquin Subarea, SJR), and the Lower Delta Watershed (Delta Subarea, Delta). Together, the three subareas encompass 19,473 square miles, or 32% of the entire Central Valley Region (60,000 square miles).

The Sacramento Subarea includes the watersheds downstream of major reservoirs in the Sacramento River and Feather River basin within the Central Valley Region boundary (Figure 1). The water from this area flows to the Sacramento-San Joaquin Delta ("legal Delta", as defined in California Water Code, Section 12220).

The San Joaquin Subarea includes the watersheds downstream of major reservoirs in the San Joaquin River basin within the Central Valley Region boundary (Figure 2). The water from this area flows to the legal Delta. The Delta Subarea includes the legal Delta and its direct tributaries downstream of major reservoirs (excluding the Sacramento and San Joaquin Subareas; Figure 3).

[1] See http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/central_valley_pesticides/index.html for more information on the Central Valley Pesticide Basin Plan Amendment Project.

1.2 Background

Several hundred pesticides have reportedly been applied in the Project Area (DPR, 2005). Most of these have not been evaluated for their potential to impact surface water quality in the Project Area. Several pesticides have previously been identified as causing water quality impairment in the Project Area and are included in the current Clean Water Act Section 303(d) list (SWRCB, 2006).

This Relative-risk evaluation report will provide information that will assist Central Valley Board staff in prioritizing resources for the CVPBPA on the pesticides that pose the greatest relative risk to the freshwater aquatic life uses based on toxicity and use. Aquatic life uses are generally the uses that are most sensitive to pesticides in surface water in the Central Valley (Hann *et al.* 2007; McClure *et al.* 2006).

A literature review showed that there were no comprehensive published reports that include an evaluation of the relative risk of agricultural pesticide use in the Project Area. For the urban pesticide use, information provided by the Urban Pesticide Pollution Prevention (UP3) Project for the San Francisco Estuary Project was reviewed (http://www.up3project.org/up3_documents.shtml#doc_sales). This project evaluated state-wide urban pesticide use trends and water quality in urban areas, and then proposed a list of pesticides which have the greatest potential to cause adverse effects in aquatic ecosystems.

Monitoring data for surface water and sediment samples collected from rural and urban waterbodies throughout the Project Area has shown the presence of detectable levels of approximately one hundred pesticides.

2.0 DATA SOURCES

The methodology described in this report relies on information on pesticide use (Section 2.1), chemical and physical property data for pesticides (Section 2.2), aquatic life toxicity values (Section 2.3), and water column pesticide concentration data (Section 2.4). These data sources are described below.

2.1 Pesticide Use Report Database

The Department of Pesticide Regulation (DPR) maintains a pesticide use report (PUR) database which includes the records of reported individual applications (uses) of registered pesticides for agricultural and some non-agricultural purposes in California. At the time the technical work for this Relative-Risk Evaluation report was being prepared, the publicly available version of the PUR database contained data from 1990 through 2004 (DPR, 2005).

Under the PUR program, all agricultural pesticide applications must be reported monthly to the county agricultural commissioners, who in turn, report the data to DPR. Based on the PUR database definition of "agricultural use", the reporting requirements apply to pesticide applications “to parks, golf courses, cemeteries, rangeland, pastures, and along roadside and railroad rights-of-way. In addition, all post-harvest pesticide treatments of agricultural commodities must be reported, along with all pesticide treatments in poultry and fish production, as well as some livestock applications. The primary exceptions to the full use reporting requirements are home and garden use and most industrial and institutional uses" (DPR, 2007). Therefore, the PUR does not directly represent most urban pesticide use.

For each agricultural pesticide application record, the PUR database includes the application date (day, month, and year), the amount applied (typically in pounds), the area treated (typically in acres), the crop type, and the application location described to the square-mile section. Records associated with reported non-agricultural pesticide applications (primarily structural and landscaping) include only the month and year for the application date, and only the county for the location information. These differences in the PUR application data were leveraged to evaluate the reported agricultural pesticide applications separately from the reported non-agricultural pesticide applications (Section 3.1).

2.2 Pesticide Chemical and Physical Properties Databases

Three databases were consulted for chemical and physical property data, including:

(1) Agricultural Research Service (ARS database; ARS, 2004),
(2) Extension Toxicology Network (EXTOXNET database; EXTOXNET, 2003),
(3) An unpublished chemical/physical database (maintained by DPR for their internal use).

The ARS database was the primary source of chemical and physical property data. The EXTOXNET and unpublished DPR databases were used to identify physical and chemical properties when no data were available in the ARS database. Unpublished data maintained by DPR was used when there was no information in the previous two sources.

2.2.1 ARS Database

The ARS database was selected as the main data source for the chemical and physical property values because it contains relevant data for most pesticides. The ARS database was developed for predicting the potential for pesticides to move into groundwater and surface water. The database includes original values and references and also provides suggested values (marked with "*") for modeling purposes when multiple values are listed. The suggested values were selected for this study. If no suggested value is available, for water solubility, the value at temperature 20ºC or 25ºC is selected; for partitioning coefficient, Koc (see definition in Section 3.4), an average Koc is selected.

2.2.2 EXTOXNET Database

The EXTOXNET database includes toxicity data for more than 100 commonly used pesticides. The database includes brief summaries of the ecological effects on non-target animals and aquatic organisms, and very limited physical properties data for some pesticides. For pesticides that have no data available in the ARS database, the data provided in the EXTOXNET database were selected.

2.2.3 Unpublished DPR Database

The DPR maintains a pesticide property database for use by their staff. It contains some chemical and physical properties data. For the pesticides that have no data available from the ARS and EXTOXNET databases, data from the DPR database were requested through DPR staff.

2.3 Pesticide Toxicity Database

The USEPA Ecotoxicity Database contains over 14,000 acute and chronic pesticide toxicity results for aquatic invertebrates, amphibians, fish, plants, insects, and birds (USEPA, 2005). The data have been reviewed by the USEPA Office of Pesticide Programs, Ecological Effects Branch biologists and deemed acceptable for ecological risk assessment use. Two types of acute toxicity values were used for relative-risk evaluation: the 96-hour LC_{50} (lethal concentration that kills 50% of tested organisms in a 96-hour period) and the 96-hour or 120-hour EC_{50} (effect concentration in 50% of organisms in a 96-hour or 120-hour period). The lowest aquatic life toxicity value for each pesticide was considered in this Relative-Risk Evaluation report in order to be protective of all aquatic organisms.

Where available, toxicity results with relatively pure products (>80% active ingredient) were preferred. However, in certain cases the only toxicity studies found were conducted with less than 80% pure product. Because of the way the tests are reported in the database (multiple active ingredients are reported if present), the remaining material is assumed to be inert, with the result being that reported toxicity values may be underestimated in these studies.

2.4 Pesticide Concentration Database

The DPR compiled and maintains a surface water database (SWDB) that contains pesticide concentration data for rivers, creeks, urban streams, agricultural drains, and urban stormwater runoff in California. The database has over 183,000 chemical analysis records from nearly 7,000 samples collected from 285 sample sites from 1992-2003 (DPR, 2004). Samples were collected by federal, state, and local agencies, private industries, and environmental groups. The data used was both whole water (including suspended solids) and filtered (dissolved only) concentrations.

3.0 METHODOLOGY

The screening-level, relative-risk evaluation methodology used to create and prioritize a target list of pesticides is described below.

1) An initial list of pesticides was created, based on the total annual reported amounts of over 300 pesticides used in the Project Area (Section 3.1).
2) The initial list was narrowed to a small group of pesticides (target list), based on aquatic life toxicity data and some pesticides chemical and physical properties (Section 3.2).

3) The pesticides in the target list were prioritized and split into two sublists – one each for moderate and high overall relative-risk levels - based on water solubility data, water concentration data, and pesticide use trends (Section 3.3).

Figures 4 through 6 are flow charts that illustrate the methodology process.

Since some pesticides have a tendency to adsorb to sediment particles, they could pose a higher risk to benthic aquatic organisms. The target list pesticides were also ranked according to the tendency of pesticide to sorb to sediment particles (Section 3.4).

3.1 Initial Pesticide List Creation

The first process step consisted of creating a relatively short "initial list" of pesticides from the hundreds of pesticides used (as reported in the PUR Database from 1998 to 2004) in the three subareas and in four selected counties, based on the total annual reported use amounts. The initial list was created from ten "working" lists, each based on either high reported use amounts for agricultural applications (six "ag working lists") or high reported use amounts for non-agricultural applications (four "non-ag working lists"). Agricultural pesticide application records include information specifying the county, township, section, and actual date of each application. Non-agricultural pesticide application records specify only the county and month associated with each application.

For agricultural pesticide applications, two "ag working lists" were created in each of the three subareas (resulting in a total of six "ag working lists"). Each "ag working list" consists of the 30 pesticides that were reported in the greatest amounts, either by total pounds of pesticide applied or by total acres to which pesticides were applied (DPR, 2005). Together, the pesticides in the six "ag working lists" account for more than half of the total reported pesticide use (by weight) for agricultural applications in the Project Area.

For non-agricultural pesticide applications, one "non-ag working list" was created for each of four high-population counties - Butte, Sacramento, San Joaquin, and Stanislaus (resulting in a total of four "non-ag working lists"). Each "non-ag working list" consists of the 60 pesticides that were reported in the greatest amounts by pounds of pesticide applied (DPR, 2005). Together, the pesticides in the four "non-ag working lists" account for more than half of the total reported pesticide use (by weight) for non-agricultural applications in the Project Area.

The pesticides in the six "ag working lists" and the four "non-ag working lists" were combined (and replicate entries were removed) to create the initial list.

3.2 Target Pesticide List Creation

The second process step resulted in narrowing the initial list to a target list of those pesticides that have high or very high relative-risk toxicity values and for which additional pesticide property parameter data is readily available for further prioritizing the target list pesticides (see Sections 3.3 and 3.4).

To create the target list, pesticides from the initial list were included if they met the following conditions:

1) Their lowest associated aquatic life LC_{50} or EC_{50} values are less than 99 micrograms per liter (µg/L); i.e., they have high or very high toxicity values (see Table 1).
2) They are not generally considered to be used as adjuvants (chemicals that augment the effectiveness of pesticides) or inert ingredients.

Condition 1) is based on the assumption that the relative risks that pesticides pose to surface water quality are proportional to their toxicity. Toxicity values from the Ecotoxicity Database are concentrations causing toxicity. Therefore, lower toxicity values indicate higher toxicity to aquatic organisms. In general, the lowest aquatic life toxicity values obtained from the Ecotoxicity Database were used for ranking the relative risks that pesticides pose to surface water quality due to toxicity. For insecticides and fungicides, the lowest 96-hour (acute) LC_{50} values (typically reported for aquatic animal species) were used. For most herbicides, the lowest 96-hour or 120-hour EC_{50} values (typically reported for aquatic plant species) were used. However, if the lowest LC_{50} value for a given pesticide is less than its lowest EC_{50} value, the LC_{50} value was used for ranking purposes. LC_{50} and EC_{50} toxicity values for the target herbicides are provided in Table 3.

Target pesticides ranked as having *very high toxicity* values were designated to the high overall relative-risk level (see Figure 5). Target pesticides ranked as having *high toxicity* values were further evaluated (Section 3.3).

Condition 2) is based on the assumption that adjuvants and inert ingredients are in themselves relatively low or non-toxic. Evaluation of the toxicity of adjuvants after they have been formulated was beyond the scope of this report.

3.3 Target Pesticide List Prioritization

The third process step involved designating the high toxicity target pesticides to either the moderate or high overall relative-risk level based on a prioritization synthesis of three additional pesticide property parameters (see Figure 6):

1. Water solubility values
2. Total reported annual and seasonal use trends
3. Comparison of available water column sample pesticide concentration data to associated pesticide LC_{50} or EC_{50} values

Each of these parameters are discussed below (Sections 3.3.1 – 3.3.3), followed by a discussion of the synthesis of these factors (Section 3.3.4).

3.3.1 <u>Water Solubility Values</u>

Water solubility values indicate how much pesticide can be dissolved in a specified amount of water (typical at environmentally relevant conditions). For the purposes of this report, it was assumed that water solubility values are proportional to the amounts of pesticides in the soluble form in field runoff. Higher water solubilit indicate higher likelihoods for pesticide to be in the dissolved form in runoff water. Further, it was assumed that the greater the likelihood of a pesticide to occur in runoff, the higher its risk to impair surface water quality.

Water solubility values were ranked as very high, high, moderate, low, or very low based on the ranges of the logarithms of the water solubility values, as shown in Table 1. For pesticides with water solubility values ranked as very high, high, or moderate, concentration data was used in the overall relative-risk evaluation. For pesticides with water solubility values ranked as low or very low, concentration data was not used in the overall relative-risk evaluation.

3.3.2 Pesticide Use Amount TrendsTotal reported annual and monthly pesticide use amounts (DPR, 2005) were calculated and compared over a 7-year period (1998 to 2004). Pesticide use trends are discussed for each target pesticide in Appendices A and B.The reported total annual use amounts for each target pesticide were evaluated for the 7-year period to identify strong and consistent increasing or decreasing use trends. Pesticides with decreasing use trends were assigned a lower priority than pesticides with increasing total annual reported use trends.

The reported total monthly use amounts for each target pesticide were also evaluated to identify the months (and associated seasons) with the highest use amounts. Studies have shown that high concentrations of organophosphate pesticides were found in surface waters (due to runoff from orchards) during winter storms (Kuivila and Foe, 1995; Holmes et al., 2000; Nordmark et al., 1998). Therefore, for the purposes of this report, it was assumed that pesticides with greater total monthly use amounts during winter (storm season) months rank as higher relative-risk to surface water quality than pesticides with greater total monthly use amounts during other seasons.

3.3.3 Pesticide Concentration Data

For the purposes of this report, pesticide concentrations in water-column samples reported in the DPR SWDB were used (DPR, 2004). The database contains data from 1992 to 2003. The database does not contain concentration data for all of the target pesticides. For those pesticides that have concentration data and that have higher water solubility (moderate to very high rank), their maximum concentration values were compared to their lowest aquatic life toxicity values. The pesticides with maximum concentration values that exceed their lowest aquatic life toxicity values are considered higher priority (i.e., they pose a higher risk) than the pesticides with maximum concentration values that are below their lowest aquatic life toxicity values.

3.3.4 Synthesis of Prioritization Parameters
Based on a qualitative synthesis of the relative-risk ranking and prioritization of the three factors discussed in the previous three subsections, the high-toxicity ranked pesticides were designated to either the moderate or high overall relative-risk level (see Figure 6). The discussions for each of these target pesticides are presented in Appendices A and B.

Concentration data was not evaluated for the pesticides with very high aquatic life toxicity values (the lowest toxicity value is less than 1 μg/L). Water-column concentration data was also not used to evaluate the overall relative-risk levels of pesticides with low or very low water solubility, since sediment quality data would be a more applicable measure of the risk from these pesticides.

Pesticides with high Koc values have a greater potential to move with sediment particles in runoff water from fields and orchards. It should be noted that some pesticides (e.g., pyrethroids) have low water solubility values and high Koc values, yet may still have high potentials to impact aquatic organisms (particularly benthic organisms) via exposure to contaminated sediments in water column. Therefore, pesticides with very high toxicity were not evaluated using water solubility and concentration data. They were designated directly to the high overall relative-risk level.

The concentration data was not a critical factor for designating the pesticides with high toxicity values and relatively low water solubility values (Figure 6). The overall relative-risk for these pesticides was determined based on the application seasons and annual use trends. The overall relative-risk is higher for pesticides with relatively higher amount use during winter and with increased annual trend use.

The concentration data was used as a possible factor in the overall relative-risk evaluation only for the pesticides with high toxicity values and relatively high water solubility (Figure 6). If the highest observed concentration is higher than the lowest concentration, the overall relative-risk is high. Otherwise, the overall relative-risk is moderate. For example, diuron was assigned to the high overall relative-risk level because its highest water column concentration was higher than its lowest toxicity value. Similarly, bromacil was designated to the moderate overall relative-risk level because its maximum water column concentration is less than its lowest toxicity value.

3.4 Sediment Risk Evaluation
Evaluation of the potential risk of a pesticide to impact sediment quality can be very complex. This study provides a simple ranking based on the Koc values only for the pesticides already identified as having high or very high toxicity rank. The unitless soil/sediment organic carbon water partitioning coefficient (Koc) value is a ratio of how much chemical (e.g., pesticide) adheres to the organic fraction of sediment relative to how much chemical remains dissolved in water, under equilibrium conditions.

In this study it was assumed that pesticides that are strongly absorbed by organic carbon (e.g. have a higher Koc value) pose a greater risk to benthic aquatic organisms than pesticides that preferentially remain dissolved in the water column, since sediments can accumulate organic carbon. Koc values were ranked as very high, high, moderate, low, or very low, as shown in Table 1.

The results showed that 20 pesticides within either the high or the very high Koc value ranks were designated as “potential” risks, 12 pesticides were designated as “possible” risks, and 4 target pesticides were designated as “unlikely” risks to impact sediment quality.

4.0 RESULTS AND LIMITATIONS

This study identified and prioritized 36 pesticides. Among the 36 pesticides, 26 pesticides are ranked as overall high relative-risk, 10 pesticides are ranked as overall moderate relative-risk. Table 2A contains a list of the pesticides that were found to be in the high overall risk category and Table 2B contains a list of the pesticides that were found to be in the medium overall risk category.

A report prepared by TDC Environmental indicated that more than half of the total amount of pesticides sold in California for urban applications is not reported in the PUR database (TDC, 2007). Of the total amount of pesticides reported as used statewide (in the PUR database), only 8% were reported for urban uses. Thus, the PUR database significantly under-reports all pesticide use, and particularly urban pesticide use.

TDC Environmental (TDC, 2007) identifies “Study-List Pesticides” composed of “pesticides of concern for urban surface water quality” that are typically applied by non-professionals (i.e., unlicensed applicators) and are, therefore, under-reported in the PUR database. All but two of the “Study-List Pesticides” (tralomethrin and PHMB) were initially identified as target pesticides in this report. Although tralomethrin and PHMB were not included in the initial pesticide list (or in the subsequent target pesticide list) for this report because of their relatively low total annual reported use amounts, they were added to the target list of high risk pesticides at the recommendation of TDC Environmental based on the results of the TDC report (Kelly Moran, pers. comm. 2007), which considered non-reported uses in urban areas.

The list of pesticides identified may not include all pesticides of high potential risk to aquatic life. Some pesticides (e.g. acrolein, chlorsulfuron, MCPP, dithiopyr, and pyriproxyfen) could not be assessed due to the lack of physical properties data in the data sources used. Some pesticides which were excluded due to low overall use may pose local risks to aquatic life in the areas where they are used. The pesticide screening process excluded any consideration of possible joint toxicity through interactions with other pesticides or contaminants. There are three basic types of mixture interactions:

- Antagonistic – the toxicity of a mixture of chemicals is less than a simple summation of individual toxicities of individual chemicals

- Additive – the toxicity of a mixture of chemicals is approximately equal to that expected from a simple summation of toxicities of individual chemicals

- Synergistic – the toxicity of the mixture is greater than expected from a simple summation of toxicities of individual chemicals

In addition, the toxicity might be increased by cumulative effects, toxic degradates, or other environmental effects. However, as data for these factors are not readily available for all of the pesticides, consideration of these factors was beyond the scope of this report.

The final list of pesticides identified in this report will be one source of information on high-priority pesticides to consider for water quality criteria development.

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Figure 1. Lower Sacramento River Watershed (SacR)

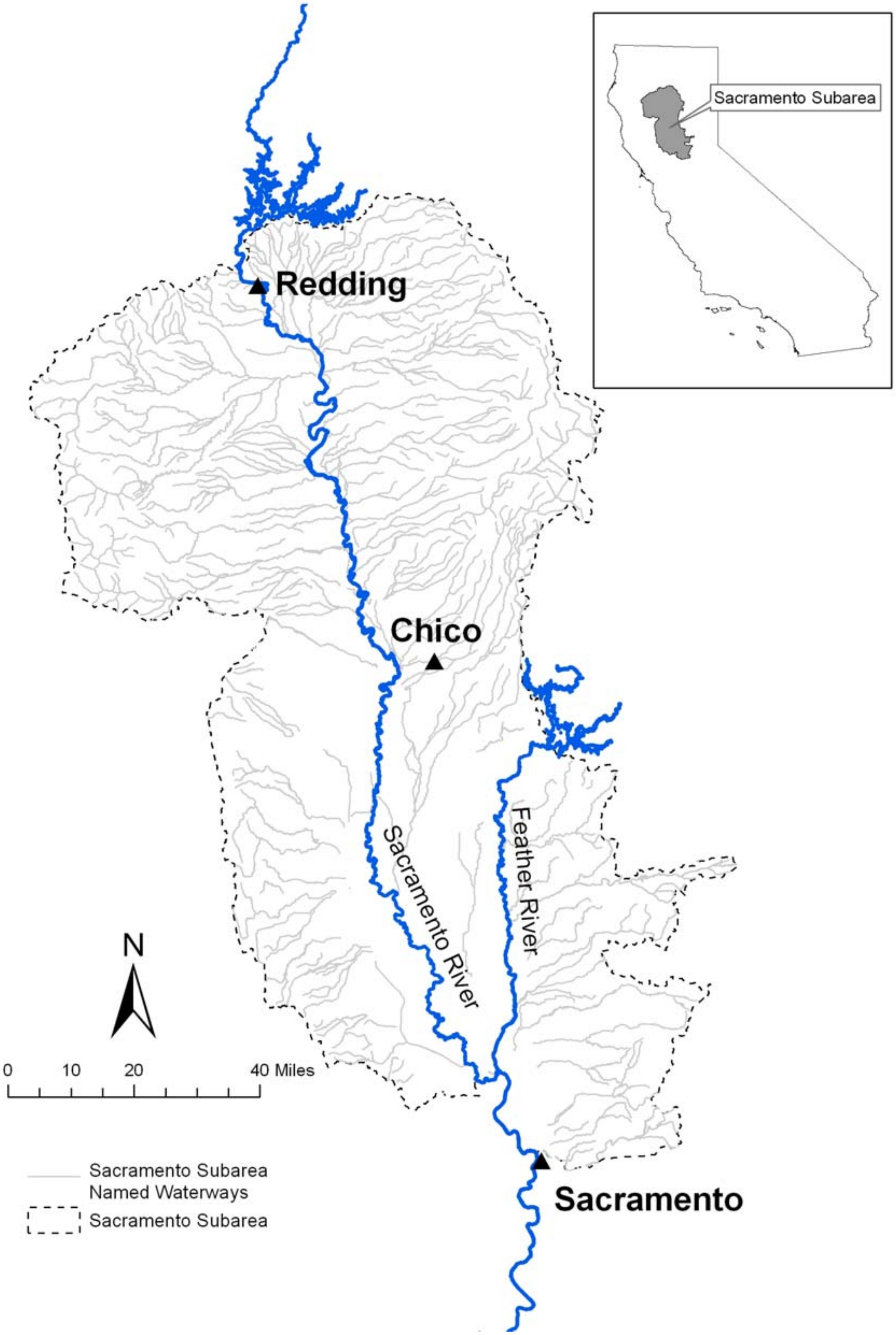


Figure 2. Lower San Joaquin River Watershed (SJR)

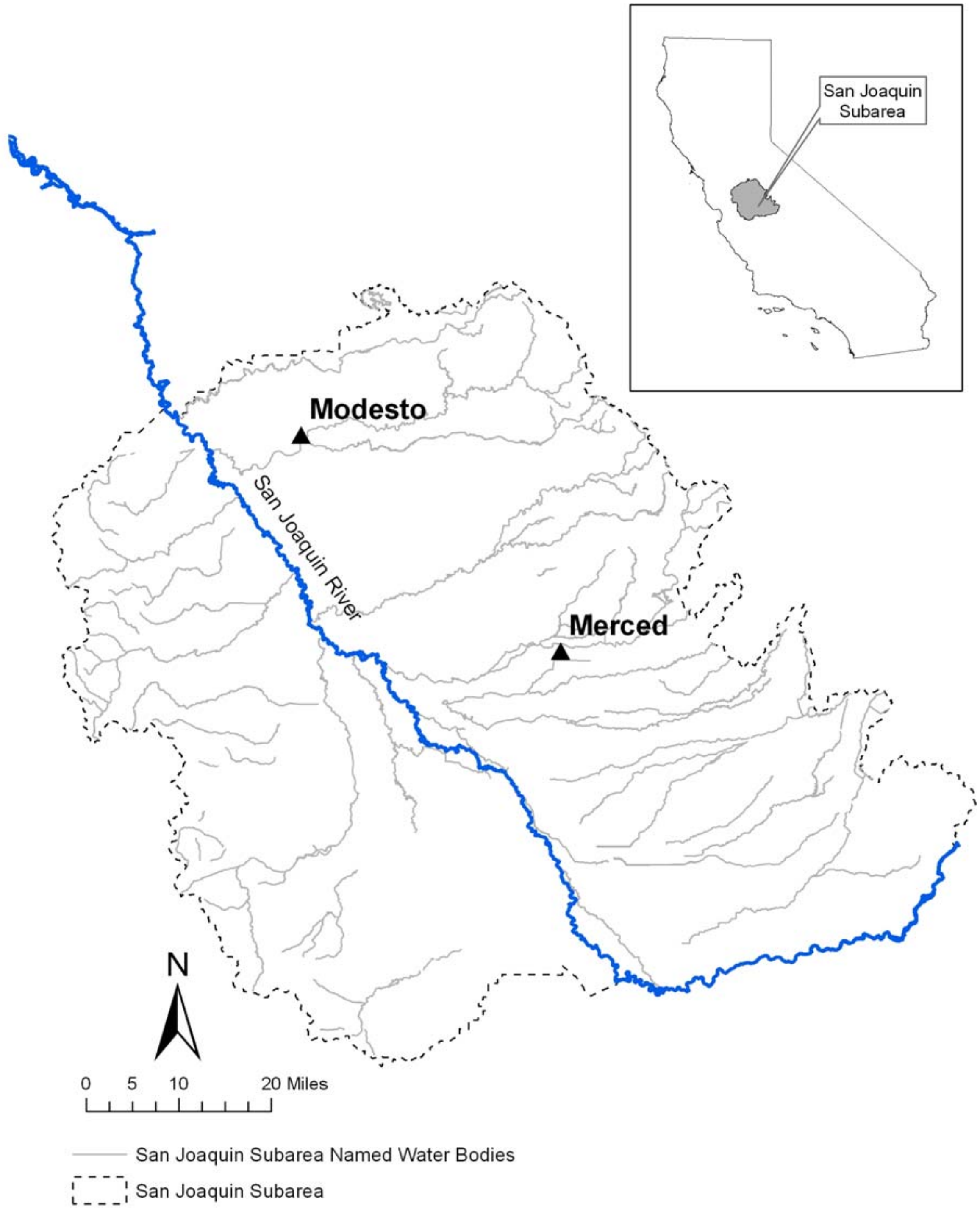


Figure 3. Lower Delta Watershed (Delta)

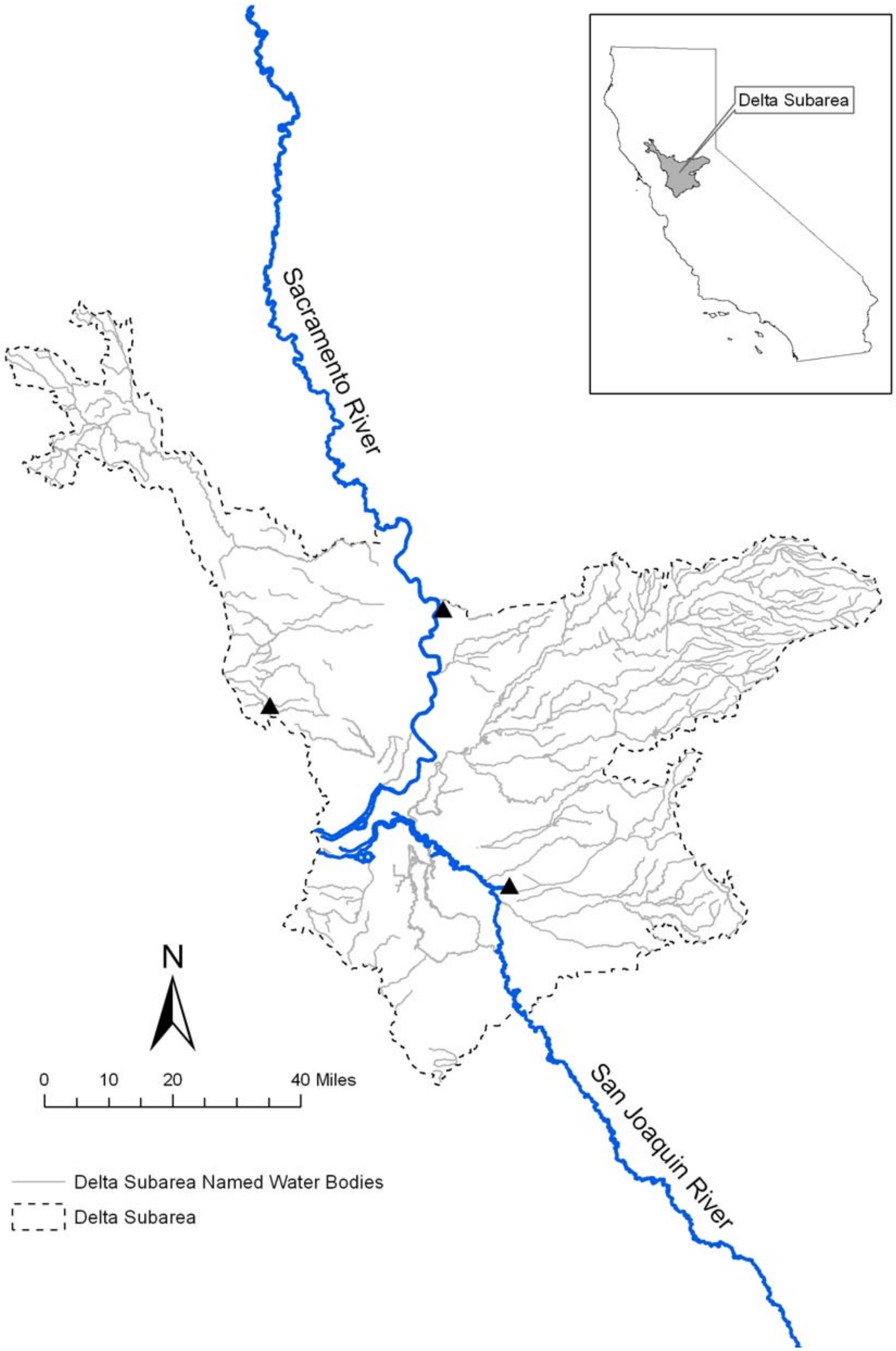


Figure 4. Flow Chart of the Relative-Risk Evaluation Process

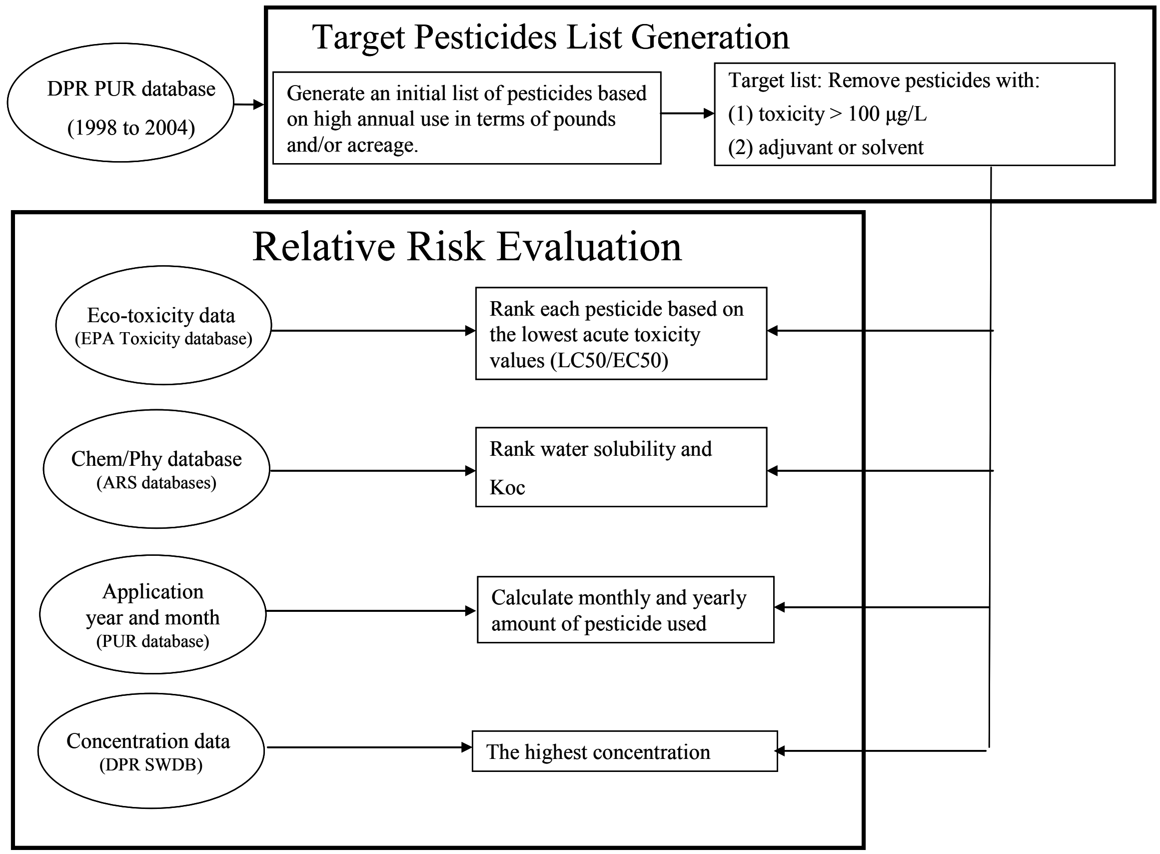


Figure 5. Flow Chart Showing Designation of High and Very High Toxicity Value Pesticides to Overall Relative-Risk Levels

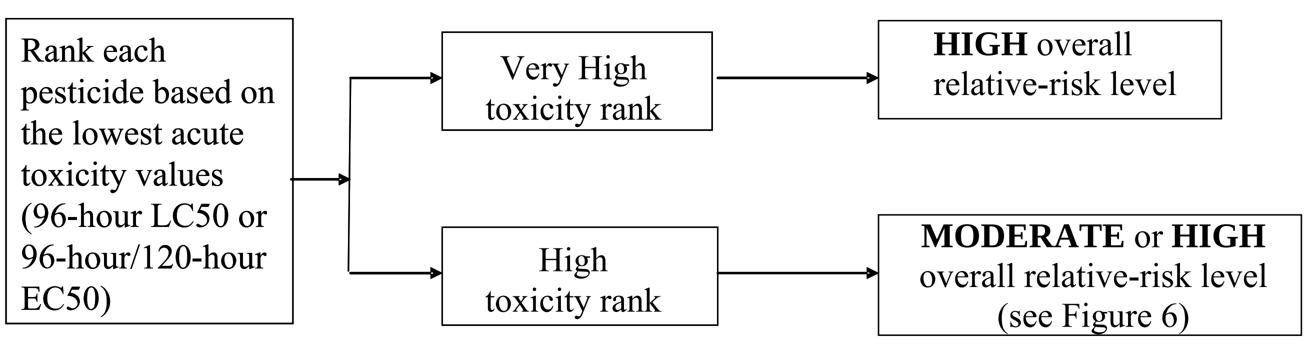


Figure 6. Flow Chart of Overall Relative-Risk Evaluation Process for Pesticides with High Toxicity Rank

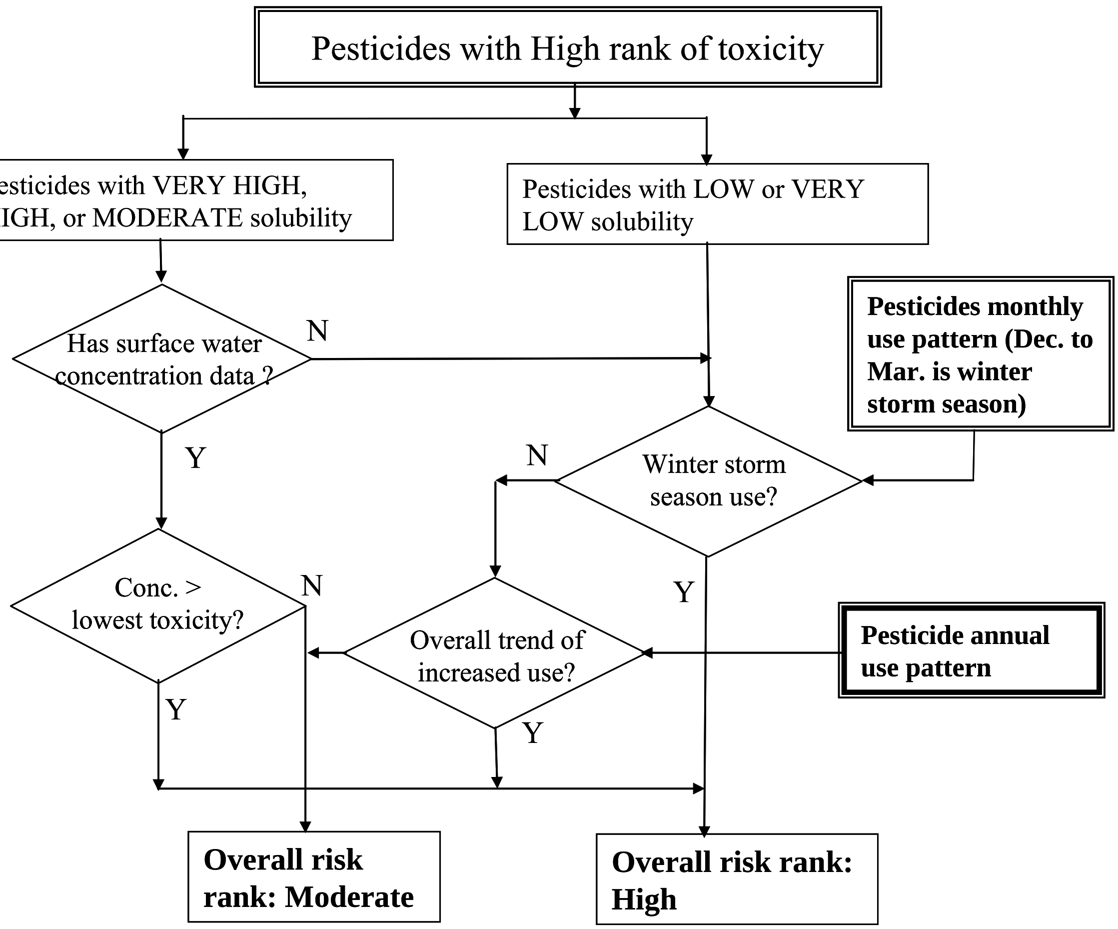


Table 1. Criteria for Relative-Risk Ranking, by Parameter

	Ranking				
Parameter	**Very high**	**High**	**Moderate**	**Low**	**Very low**
Toxicity (96 hour LC50 or EC50)	<1 μg/L	1 to 99 μg/L	100 to 999 μg/L	1 to 99 mg/L	>100 mg/L
Log(water solubility (mg/L))	≥ 3	≥2 and <3	≥1 and <2	≥0 and <1	<0
Koc	>10,000	1,000 to 9,999	100 to 999	10 to 99	<10

Table 2A. High Overall Relative-Risk Level Pesticides

ChemName	Pesticides Type	Toxicity (ug/L)	Rank of Toxicity	Rank of Water solubility	Rank of Koc	Rank of Sediment
(S)-METOLACHLOR	Herbicide	8	High	High	Moderate	Possible
ABAMECTIN	Insecticide	0.21	Very high	Low	High	Potential
BIFENTHRIN	Insecticide	0.00397	Very high	Very Low	Very High	Potential
CHLOROTHALONIL	Fungicide	26.3	High	Very Low	High	Potential
CHLORPYRIFOS	Insecticide	0.035	Very high	Low	High	Potential
CYFLUTHRIN	Insecticide	0.002	Very high	Very Low	Very High	Potential
CYPERMETHRIN	Insecticide	0.0047	Very high	Very Low	Very High	Potential
DELTAMETHRIN	Insecticide	0.0017	Very high	Very Low	Very High	Potential
DIAZINON	Insecticide	2	Very high	Moderate	High	Potential
DIURON	Herbicide	2.4	High	Moderate	Moderate	Possible
ESFENVALERATE	Insecticide	0.07	Very high	Very Low	High	Potential
FIPRONIL	Insecticide	0.14	Very high	Low	Moderate	Possible
LAMBDA-CYHALOTHRIN	Insecticide	0.0041	Very high	Very Low	Very High	Potential
MALATHION	Insecticide	0.5	Very high	High	High	Potential
MANCOZEB	Fungicide	9.5	High	Low	High	Potential
MANEB	Fungicide	33	High	Low	Moderate	Possible
OXYFLUORFEN	Herbicide	0.29	Very high	Very Low	Very High	Potential
PARAQUAT DICHLORIDE	Herbicide	0.55	Very high	Very high	Very High	Potential
PENDIMETHALIN	Herbicide	5.2	High	Very Low	Very High	Potential
PERMETHRIN	Insecticide	0.019	Very high	Very Low	Very High	Potential
PROPANIL	Herbicide	16	High	High	Moderate	Possible
PROPARGITE	Insecticide	31	High	Very Low	High	Potential
PYRACLOSTROBIN	Fungicide	4.16	High	Low	High	Potential
SIMAZINE	Herbicide	36	High	Low	Moderate	Possible
TRIFLURALIN	Herbicide	8.4	High	Very Low	High	Potential
ZIRAM	Fungicide	8	High	Moderate	Moderate	Possible
PHMB*	Fungicide	25.4	High			Unlikely
Tralomethrin*	Insecticide	1.6	High	Very Low	Very High	Potential

*Recommended by TDC

Table 2B. Moderate Overall Relative-Risk Level Pesticides.

ChemName	Pesticides Type	Toxicity (ug/L)	Rank of Toxicity	Rank of Water solubility	Rank of Koc	Rank of Sediment
BROMACIL	Herbicide	6.8	High	High	Low	Unlikely
CAPTAN	Fungicide	26.2	High	Low	Moderate	Possible
CARBARYL	Insecticide	1.7	High	High	Moderate	Possible
DIMETHOATE	Insecticide	43	High	Very high	Low	Unlikely
HEXAZINONE	Herbicide	6.8	High	Very high	Low	Unlikely
IMIDACLOPRID	Insecticide	38	High	High	Moderate	Possible
INDOXACARB	Insecticide	24	High	Very Low	High	Potential
METHOMYL	Insecticide	19	High	Very high	Low	Unlikely
NALED	Insecticide	8	High	Low	Moderate	Possible
NORFLURAZON	Herbicide	9.7	High	Moderate	Moderate	Possible

Table 3. Toxicity Values for Selected Herbicides

ChemName	Test Time	Lowest Toxicity Value (ug/L)	Species (Lowest value tested on)	Lowest 96-hr/120-hr EC50	Lowest 96hr LC50 (ug/L)
(S)-METOLACHLOR	120-hr EC50	8	Green algae	8	1,410
BROMACIL	120-hr EC50	6.8	Green algae	6.8	36
DIURON	96-hr EC50	2.4	Green algae	2.4	160
HEXAZINONE	120-hr EC50	6.8	Green algae	6.8	78,000
NORFLURAZON	120-hr EC50	9.7	Green algae	9.7	5,530
OXYFLUORFEN	96-hr EC50	0.29	Green algae	0.29	32
PARAQUAT DICHLORIDE	96-hr EC50	0.55	Freshwater diatom	0.55	11,000
PENDIMETHALIN	120-hr EC50	5.2	Marine diatom	5.2	138
PROPANIL	120-hr EC50	16	Freshwater diatom	16	400
SIMAZINE	120-hr EC50	36	Bluegreen algae	36	4300
TRIFLURALIN	96-hr LC50	8.4	Bluegill sunfish	15.3	8.4

Shaded: toxicity rank is based on the lowest LC50, not the lowest EC50

Appendices

Appendix A. High Overall Relative-Risk Pesticides

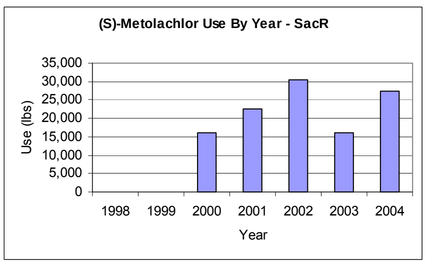
(S)-metolachlor
Use: Herbicide

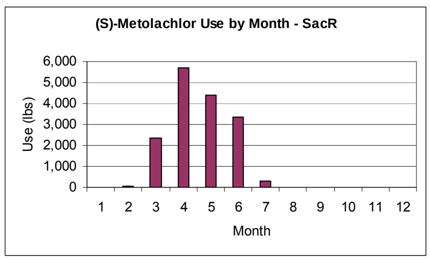
Physical properties: High water solubility (480 mg/L) and moderate Koc (185).

Toxicity: The lowest 96-hour LC_{50} was 1,410 μg/L for mysid (*Americamysis bahia*). The lowest 5-d EC_{50} was 8 μg/L for green algae (*Selenastrum capricornutum*).

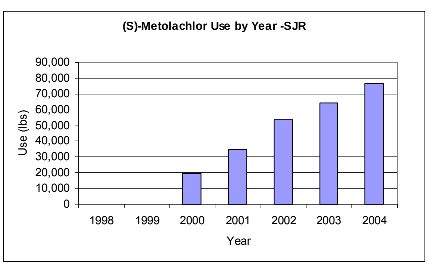
Usage: Selected as a target pesticide because of its relatively high amount of applications for agricultural uses in three sub-areas: Sacramento River Watershed (SacR), San Joaquin River Watershed (SJR), and Delta Watershed (Delta).

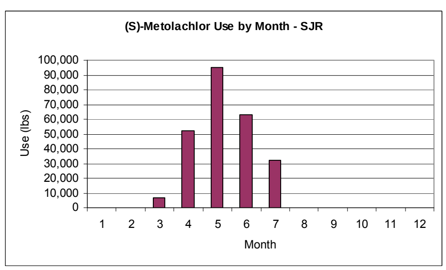
SacR: The average annual use was 22,550 lbs between 2000 and 2004 with no use reported in 1998 and 1999. The highest annual use was 30,580 lbs in 2002. The relatively high monthly uses were between April and June with the highest use in May. The major applications were to tomato (54%), corn (15%), and cotton (13%). The annual average area of applications was 19,313 acres from 2000 to 2004.



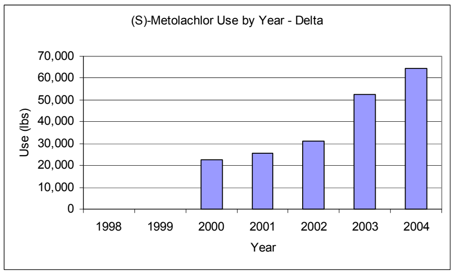


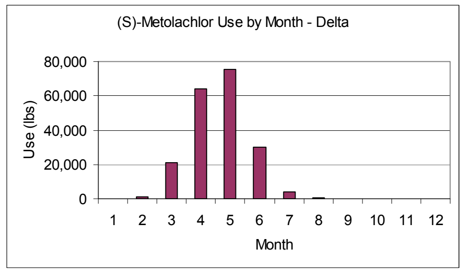
SJR: The average annual use was 49,741 lbs between 2000 and 2004 with no use reported in 1998 and 1999. The highest annual use was 76,425 lbs in 2004. The annual uses had in an increased trend from 2000 and 2002. The relatively high monthly uses were between April and July with the highest use in May. The major reported applications were to tomato (34%), cotton (29%), and corn (16%). The annual average area was 40,958 acres from 2000 to 2004.





Delta: The average annual use was 39,202 lbs between 2000 and 2004 with no use reported in 1998 and 1999. The highest use was 64,350 lbs in 2004. The annual uses had an increased trend from 2000 to 2004. The relatively high monthly uses were between March and June with the highest use in May. The major applications were to tomato (52%) and corn (29%). The annual average area was 40,958 acres from 2000 to 2004.





Water quality data: No (S)-metolachlor data were available in the SWDB.

Conclusion: (S)-metolachlor is ranked as high overall relative-risk because of its high toxicity and increased trend of annual use. The risk to sediment contamination is ranked as “possible” because of its moderate Koc.

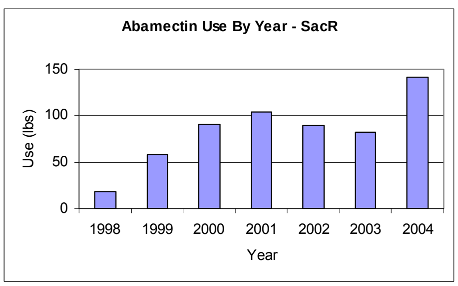
Abamectin (Avermectin or Ivermectin)
Use: Insecticide

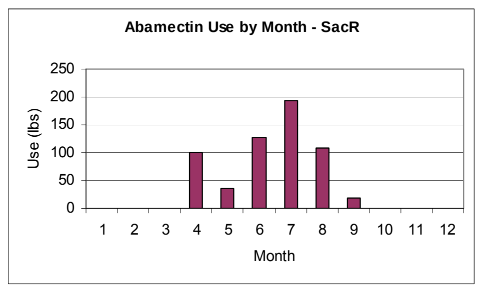
Physical properties: Low water solubility (5 mg/L) and high Koc (5,000).

Toxicity: The lowest 96-hour LC_{50} was 0.21 µg/L for mysid (*Americamysis bahia*).

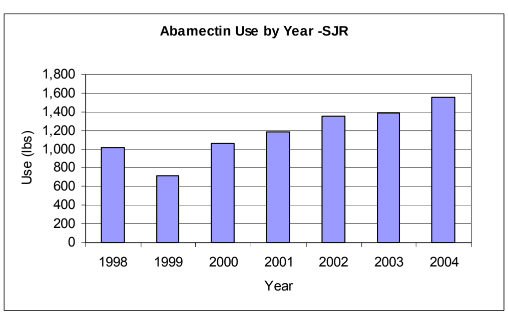
Usage: Selected as a target pesticide because of its relatively high acreages (not amount) of applications for agricultural uses in three sub-areas: Sacramento River Watershed (SacR), San Joaquin River Watershed (SJR), and Delta Watershed (Delta).

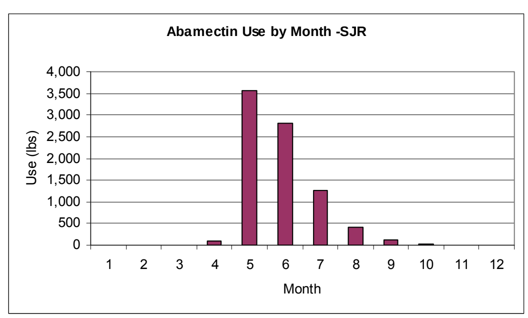
SacR: The average annual use was 84 lbs from 1998 to 2004 with the highest annual use (142 lbs) in 2004. The annual uses had an increased trend from 1998 to 2004 except for 2002 and 2003. The relatively high monthly uses were from April to August with the highest use in July. The major applications were to almond (58%), cotton (16%), and tomato (5%). The annual average area of application was 21,298 acres from 1998 to 2004.



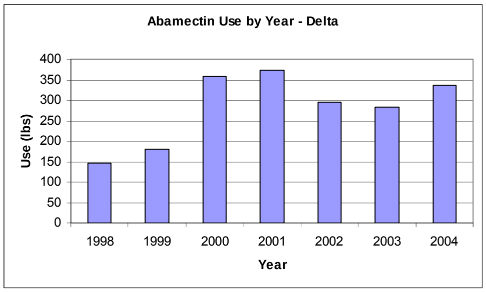


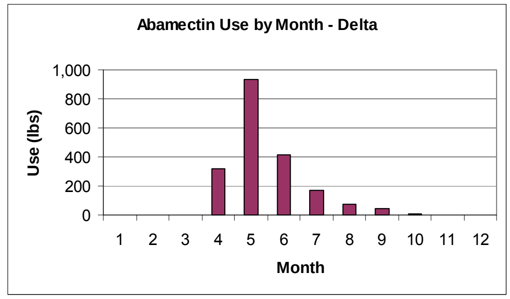
SJR: The average annual use was 1,183 lbs from 1998 to 2004 with the highest amount used (1,549 lbs) in 2004. The annual use had an increased trend from 1999 to 2004. The relatively high monthly uses were from May to July with the highest use in May. The major applications were to almond (44%), cotton (41%), and cantaloupe (4%). The annual average area of applications was 161,143 acres from 1998 to 2004.





Delta: The average annual use was 282 lbs from 1998 to 2004 with the highest annual use (374 lbs) in 2001. The annual uses had an increased trend from 1998 to 2004 except in 2000 and 2001. The relatively high monthly uses were from April to July with the highest use in May. The major applications were to pear (25%), grape (21%), and almond (16%). The annual average area of application was 21,223 acres.





<u>Water quality data:</u> No concentration data were available in the SWDB.

<u>Conclusion:</u> Abamectin is ranked as high overall relative-risk because of its very high toxicity. The risk to surface water may be reduced because of its relatively rapid degradation in water (4 days). Abamectin has very low amount of use but very high application area. The risk to sediment contamination is ranked as “potential” because of its high Koc.

Bifenthrin

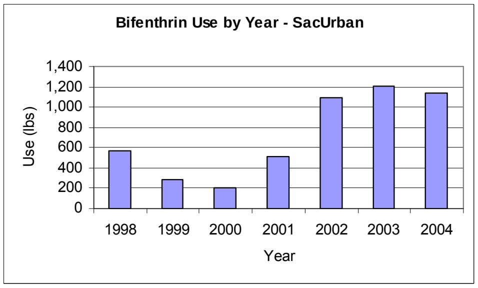
Use: Insecticide, one of pyrethroids.

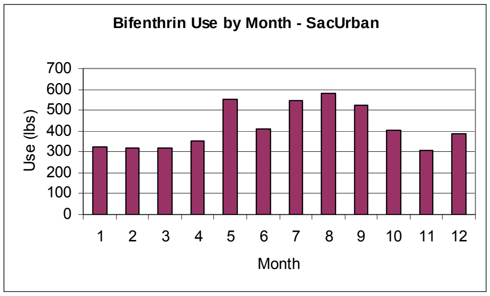
Physical properties: Very low water solubility (0.1 mg/L) and very high Koc (237,000).

Toxicity: The lowest 96-hour LC_{50} was 0.00397 µg/L for mysid (*Americamysis bahia*).

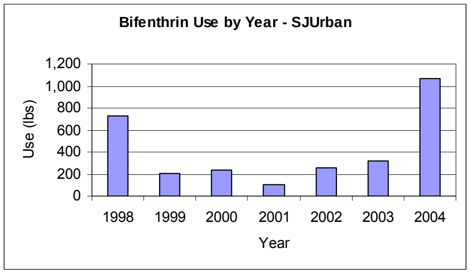
Usage: The total annual amounts of bifenthrin associated with agricultural uses in the three subareas (as reported in the PUR database) were not high enough to include bifenthrin in the initial short list (see Section 3.1). Bifenthrin was added to the target pesticide list because of the relatively high total annual amounts reported for non-agricultural uses in three counties: Sacramento (SacUrban), San Joaquin (SJUrban), and Stanislaus (StanUrban). It should be noted that, since the total annual amounts of bifenthrin reported for agricultural uses in the three subareas are higher than total annual amounts reported for non-agricultural uses in the three counties, bifenthrin runoff from agricultural use areas should still be considered as a potential source of bifenthrin concentrations measured in surface water samples.

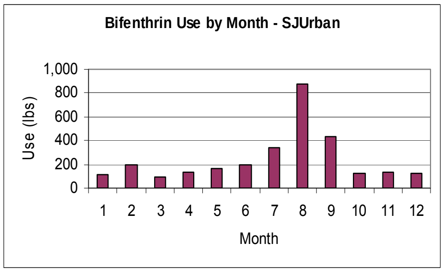
SacUrban: The average annual use was 716 lbs between 1998 and 2004 with the highest use (1,204 lbs) in 2003 for non-agricultural applications. The amounts of annual use increased between 2000 and 2003. The monthly use shows that the applications were year-round with the relatively high uses between May and September.



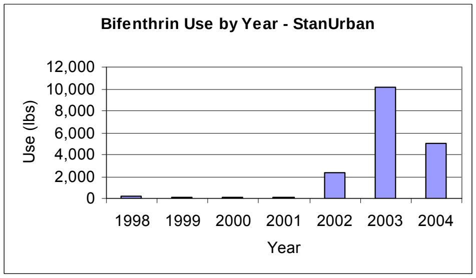


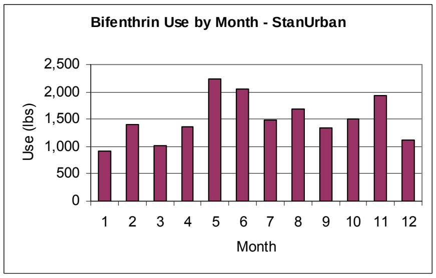
SJUrban: The average annual use was 417 lbs between 1998 and 2004 with the highest use (1,070 lbs) in 2004 for non-agricultural applications. The annual uses were in an increased trend from 2001 to 2004. The monthly uses of bifenthrin were year-round with the highest use in August.



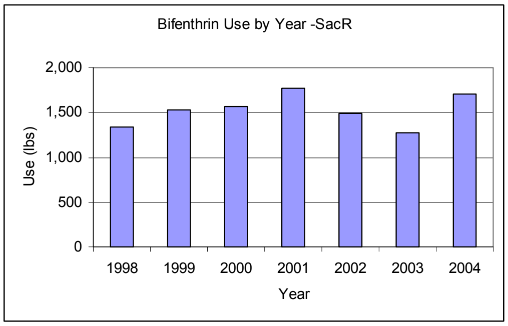


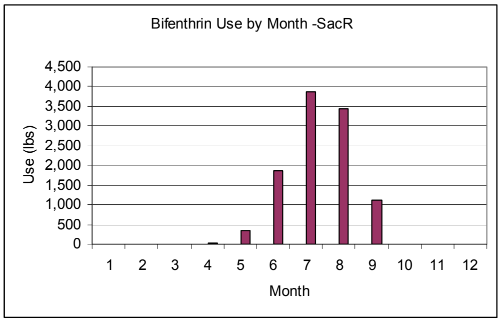
StanUrban: The average annual use was 2,579 lbs between 1998 and 2004 with the highest use (10,192 lbs) in 2003 for non-agricultural applications. The annual uses were very low between 1998 and 2001. The monthly uses were year-round with the highest use in May. The highest use was to structural use in 2003.



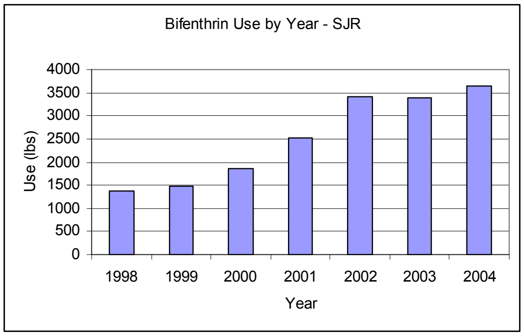


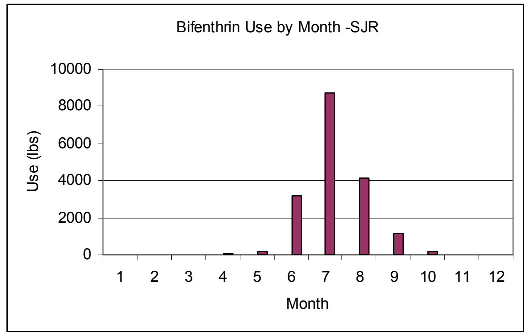
SacR: The average annual use was 1,525 lbs between 1998 and 2004 with the highest use (1,777 lbs) in 2001 for agricultural applications. The annual uses increased from1998 to 2001, then decreased slightly from 2001 to 2003, but increased again in 2004. The monthly uses show that relatively high uses were between June and August with the highest use in July. The average annual area of application was 16,681 acres.



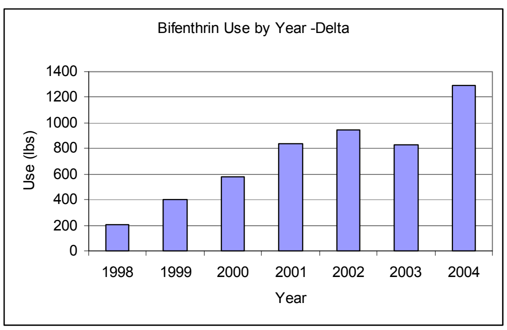


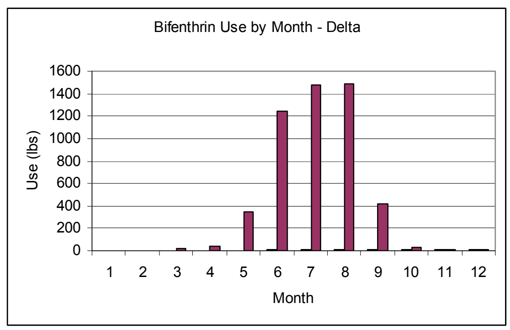
SJR: The average annual use was 2,526 lbs between 1998 and 2004 with the highest use (3,636 lbs) in 2004 for agricultural applications. The annual uses were increasing from 1998 to 2004. The monthly uses show that relatively high uses were between June and August with the highest use in July. The average annual area of application was 29,017 acres.





Delta: The average annual use was 727 lbs between 1998 and 2004 with the highest use (1,294lbs) in 2004 for agricultural applications. The annual uses increased from1998 to 2004 in general. The monthly uses show that relatively high uses were between June and August with the highest uses in July and August. The average annual area of application was 7,311 acres.





Water quality data: There were 68 concentration data and about 15% of them exceeded LOQ (0.005 µg/L). The highest concentration was 0.0554 µg/L in July 2003.

Conclusion: Bifenthrin is ranked as high overall relative-risk because of its very high toxicity. The amounts of applications were in increased trend for both of non-agricultural and agricultural uses. The observed concentration exceeded the lowest toxicity value. The risk to sediment contamination is ranked as “potential” because of its high Koc.

Chlorothalonil

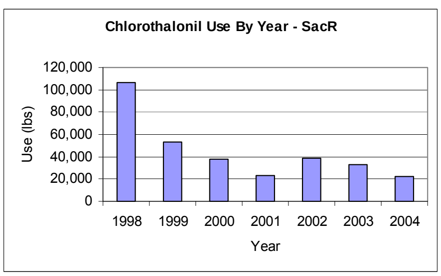
Use: Fungicide.

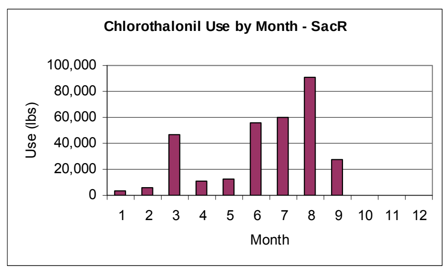
Physical properties: Very low water solubility (0.6 mg/L) and high Koc (5,000).

Toxicity: The lowest 96-hour LC_{50} was 26.3 µg/L for bluegill sunfish (*Lepomis macrochirus*).

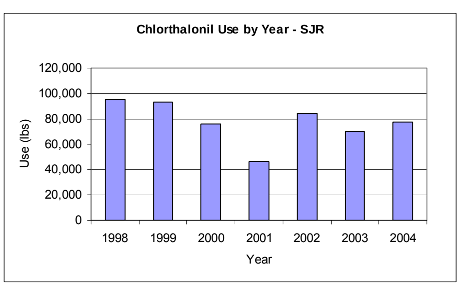
Usage: Selected as a target pesticide because of its relatively high amount of annual uses for both agricultural and non-agricultural uses. The relatively high uses for agricultural applications were in three project sub-areas: Sacramento River Watershed (SacR), San Joaquin River Watershed (SJR), and Delta Watershed (Delta). The relatively high uses for non-agricultural applications were in two counties: Sacramento (SacUrban) and San Joaquin (SJUrban).

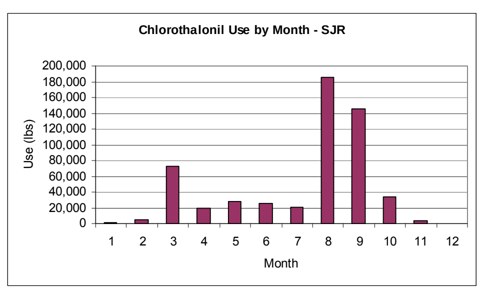
SacR: The average annual use was 44,860 lbs with the highest use (106,399 lbs) in 1998. The annual uses decreased from 1998 to 2004. The monthly use shows that the relatively high uses were between June and August with the highest use in August. The major applications were to tomato (78%). The average annual area of application was 25,538 acres.





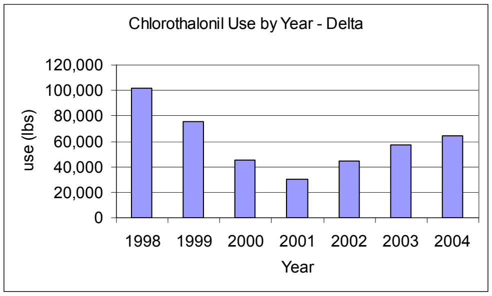
SJR: The average annual use was 77,538 lbs between 1998 and 2004 with the highest use (95,461 lbs) in 1998. The annual uses decreased from 1998 to 2001 and then increased from 2001 to 2004. The monthly use shows that the highest uses were in August and September. The major applications were to tomato (78%). The average annual area was 41,293 acres.

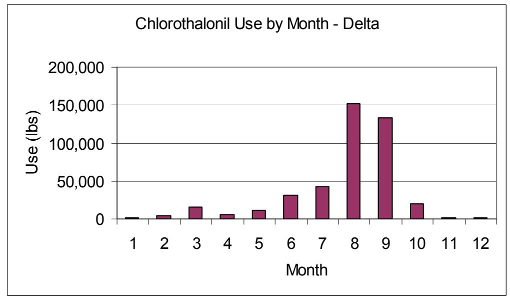




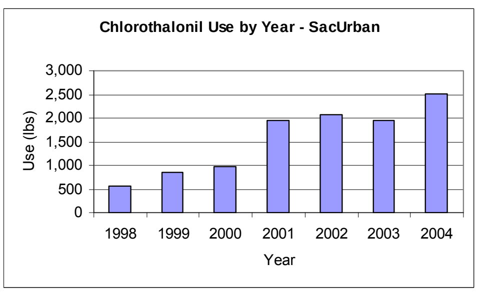
Delta: The average annual use was 59,783 lbs between 1998 and 2004 with the highest use (101,816 lbs) in 1998. The annual uses decreased from 1998 to

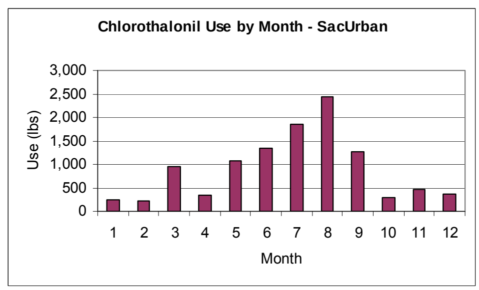
2001 and then increased from 2001 to 2004. The monthly use shows that the highest uses were in August and September. The major applications were to tomato (86%). The average annual area of applications was 37,230 acres.



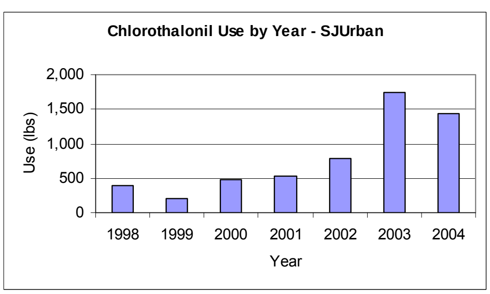


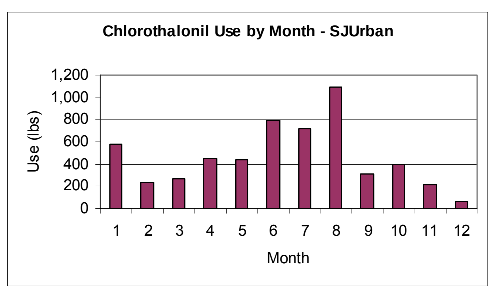
SacUrban: The average annual use was 1,553 lbs between 1998 and 2004 with the highest use (2,560 lbs) in 2004. The annual uses increased from 1998 to 2004. The monthly use shows that the highest use was in August. The major applications were to landscaping.





SJUrban: The average annual use was 795 lbs between 1998 and 2004 with the highest use (1,744 lbs) in 2003. The annual uses increased from 1998 to 2003 and then decreased slightly in 2004. The monthly use shows that the highest use was in August. The major applications were to landscaping.





Water quality data: There were 75 concentration data points collected from 1996 to 1998 in the SWDB. None of the samples exceeded the LOQ (0.035 and 0.48 µg/L).

Conclusion: Chlorothalonil is ranked as high overall relative-risk because of its high toxicity and increased annual uses. However, the overall risk rank could be lower if considering the concentration in water column only. Chlorothalonil has very low water solubility and high Koc. The risk to sediment contamination is ranked as “potential” because of its high Koc.

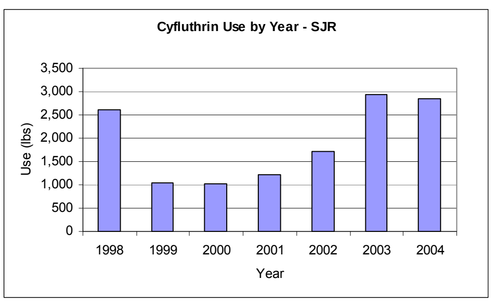
Cyfluthrin
Uses: Insecticide, one of pyrethroids insects.

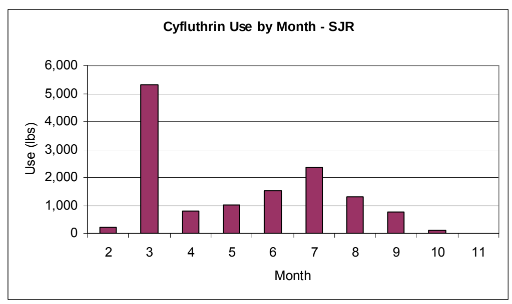
Physical properties: Very low water solubility (0.022 mg/L) and very high Koc (31,000).

Toxicity: The lowest 96-hour LC_{50} was 0.002 μg/L for mysid (*Americamysis bahia*).

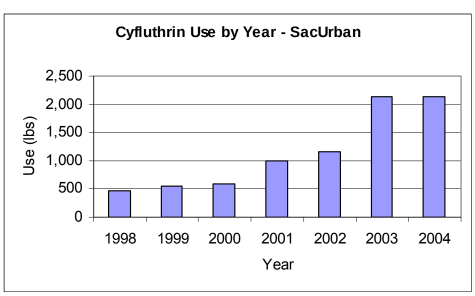
Usage: Cyfluthrin was selected as a target pesticide due to the relatively high uses on agricultural use in San Joaquin watershed (SJR) and non-agricultural uses in three counties: Sacramento (SacUrban), San Joaquin (SJUrban), and Stanislaus (StanUrban).

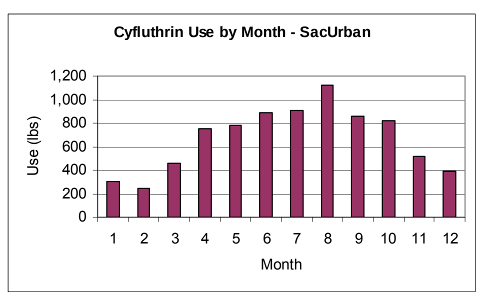
SJR: The average annual use was 1,913 lbs with the highest use (2,936 lbs) in 2003. From 1999 to 2003, the amounts of annual use increased. The reported monthly use of cyfluthrin showed that the highest use was in March. The average annual application area is 45,840 acres from 1998 to 2004. The major reported crops of use include alfalfa (50%), cotton (33%), and nursery (8%).



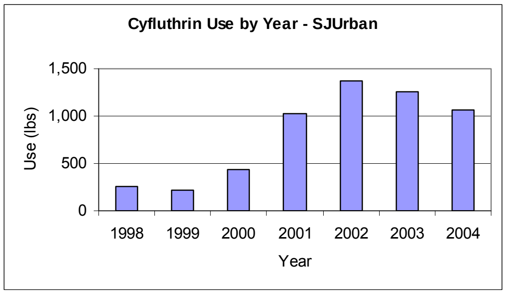


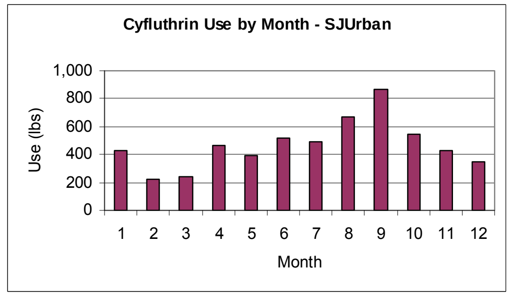
SacUrban: The average annual use was 1,146 lbs with the highest use (2,140 lbs) in 2003. From 1998 to 2003, the amounts of annual use increased. The reported monthly use of cyfluthrin showed that the applications were yearly around with relatively high uses between April and October.



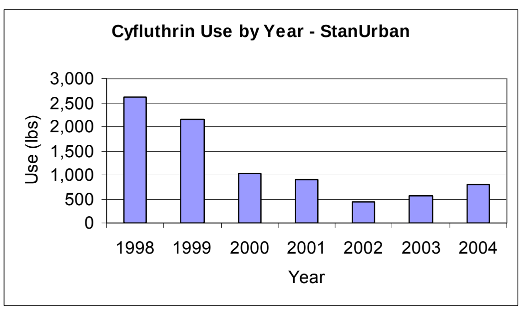


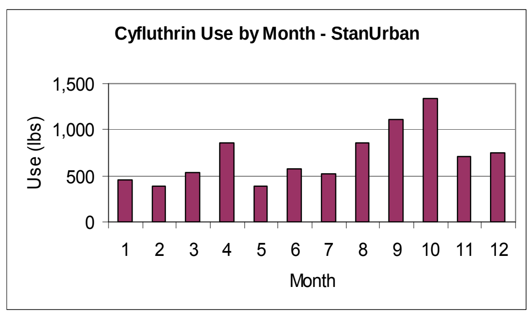
SJUrban: The average annual use was 804 lbs between 1998 and 2004 with the highest use (1,370 lbs) in 2002. From 1999 to 2002, the amounts of annual use increased and then decreased from 2002 to 2004. The reported monthly use showed that the highest use was in September.





StanUrban: The average annual use was 1,214 lbs between 1998 and 2004 with the highest use (2,624 lbs) in 1998. The annual use decreased from 1998 to 2002, and then increased slightly from 2002 to 2004. The reported monthly use of cyfluthrin showed that the applications were yearly around with the highest use in October.





Water quality data: The SWDB has no concentration data.

Conclusion:
Cyfluthrin is ranked as high overall relative-risk because of its very high toxicity to aquatic organisms. The annual uses showed increase trend for agricultural uses for San Joaquin River watershed and non-agricultural uses for Sacramento and San Joaquin Counties but not for Stanislaus County. The risk to sediment contamination is ranked as “potential” because of its very high Koc.

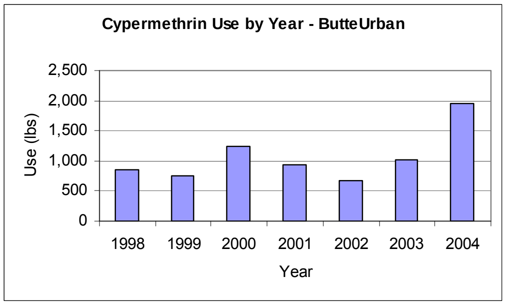
Cypermethrin
Use: Insecticide, one of pyrethroids.

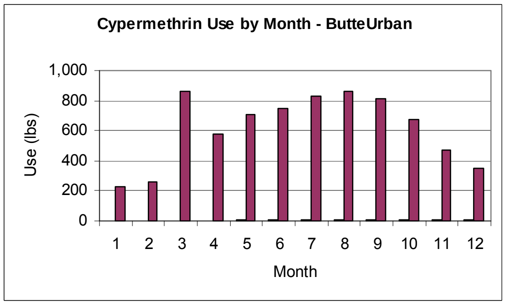
Physical properties: Very low water solubility (0.004 mg/L) and very high Koc (61,000).

Toxicity: The lowest 96-hour LC_{50} was 0.0047 µg/L for mysid (*Americamysis bahia*).

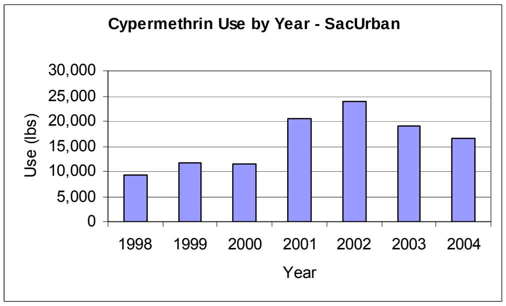
Usage: Selected as a target because of the relatively high amounts of annual use for non-agricultural uses in four counties: Butte (ButteUrban), Sacramento (SacUrban), San Joaquin (SJUrban), and Stanislaus (StanUrban).

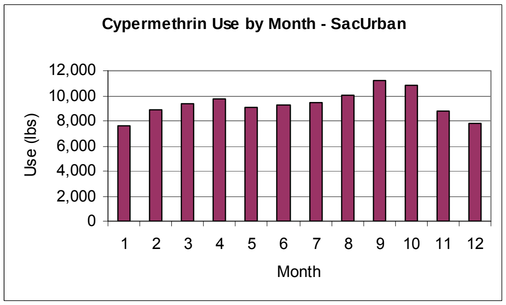
ButteUrban: The average annual use was 1,057 lbs between 1998 and 2004 with the highest use (1,954 lbs) in 2004. From 2002 to 2004, the annual uses were in an increased trend. The monthly use shows that the applications were year-round with the highest use in March.



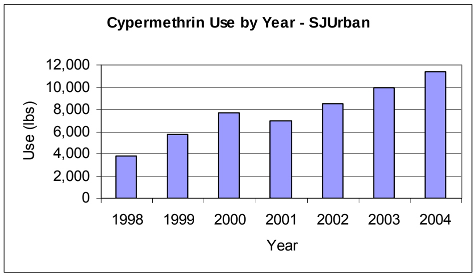


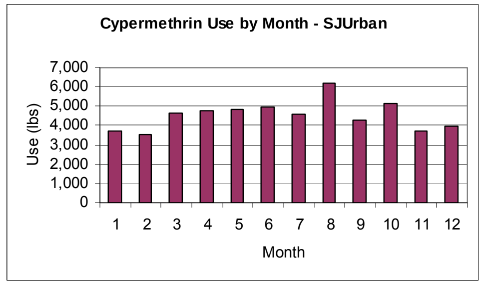
SacUrban: The average annual use was 16,036 lbs with the highest use (23,885 lbs) in 2002. From 1998 to 2002, the amounts of annual use increased but then slightly decreased from 2002 to 2004. The monthly use shows that the applications were year-round with slightly higher use in September and October.



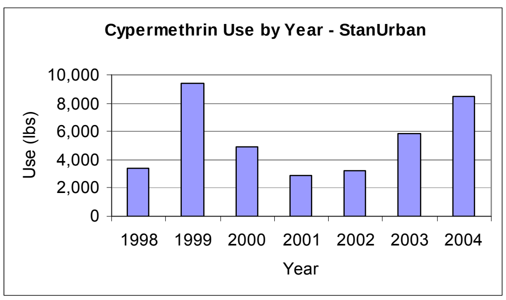


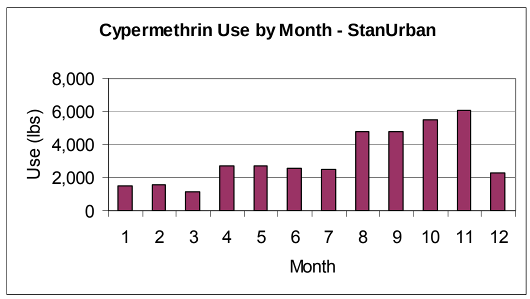
SJUrban: The average annual use was 7,742 lbs between 1998 and 2004 with the highest use (11,748 lbs) in 2004. The annual use has an increased trend from 1998 to 2004. The monthly use shows that the applications were year-round with relatively higher use in August.





StanUrban: The average annual use was 5,454 lbs between 1998 and 2004 with the highest use (9,424 lbs) in 1999. The annual use increased from 2001 to 2004. The monthly use shows that the applications were year-round with relatively higher uses between August and November. The high annual use in 1999 was to structural pest control.





Water quality data: There were 70 concentration data available in the SWDB, and none of them exceeded LOQ (0.08 µg/L). The LOQ is higher than the lowest toxicity value (0.0047 µg/L).

Conclusion: Cypermethrin is ranked as high overall relative-risk because of its very high toxicity to aquatic organisms. The annual uses showed increase trends in ButteUrban, SJUrban, and StanUrban, but SacUrban. The risk to sediment contamination is ranked as “potential” because of its very high Koc.

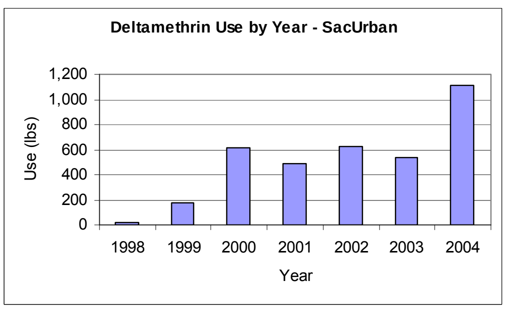
Deltamethrin
Uses: Insecticide, one of pyrethroids.

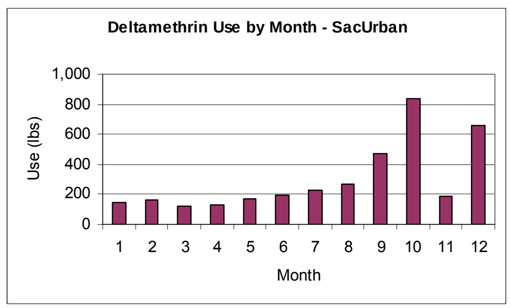
Physical properties: Very low water solubility (0.002 mg/L) and very high Koc (755,647).

Toxicity: The lowest 96-hour LC_{50} was 0.0017 µg/L for mysid (*Americamysis bahia*).

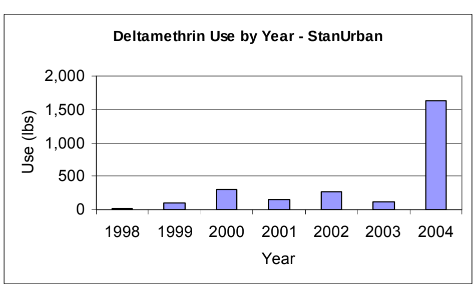
Usage: Selected as a target because of the TDC Environmental recommendation (TDC, 2007). The relatively high applications for non-agricultural uses in two counties: Sacramento (SacUrban) and Stanislaus (StanUrban). The applications of deltamethrin for agricultural uses are not presented because very low annual uses were reported (less than 50 lbs for one sub-area in seven years).

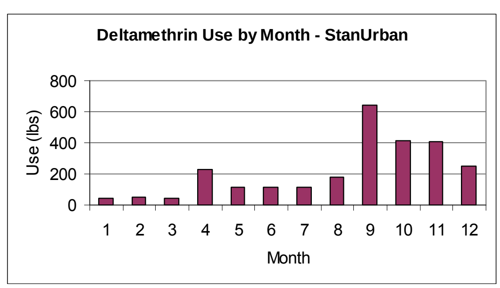
SacUrban: The average annual use was 509 lbs between 1998 and 2004 with the highest use (1,115 lbs) in 2004. The amounts of annual use had an increased trend from 1998 to 2004. The monthly uses were year-round with the highest uses in October. The main applications were to structural pest control.





StanUrban: The average annual use was 371 lbs between 1998 and 2004 with the highest use (1,638 lbs) in 2004. The annual uses were low from 1998 to 2004 but very high use was in 2004. The monthly use shows that the applications were year-round with the highest use in September. The main applications were to structural pest control.





Water quality data: No concentration data were available in the SWDB.

Conclusion: Deltamethrin is ranked as high overall relative-risk because of its very high toxicity to aquatic organism. Comparing to the amounts of other pyrethroid insecticides, the amounts of deltamethrin use were very low but in an increasing trend. The major applications were to non-agricultural uses. There were almost no uses for agricultural use reported in the project area. The risk to sediment contamination is ranked as “potential” because of its very high Koc.

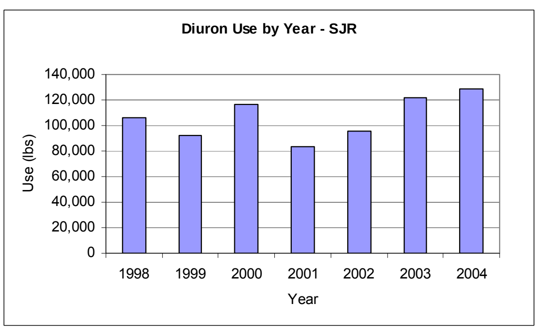
Diuron
Use: Herbicide.

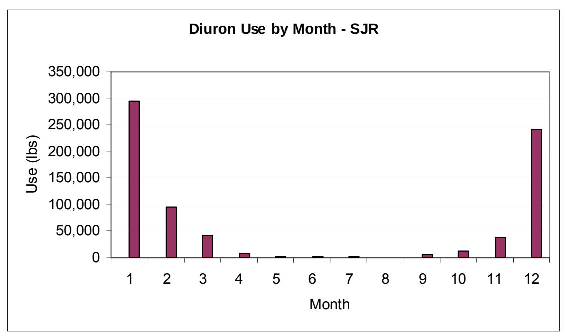
Physical properties: Moderate water solubility (42 mg/L) and moderate Koc (477).

Toxicity: The lowest 96-hour LC_{50} was160 µg/L for scud (*Gammarus fasciatus*). The lowest 96-hour EC_{50} was 2.4 µg/L for green algae (*Selenastrum capricornutum*).

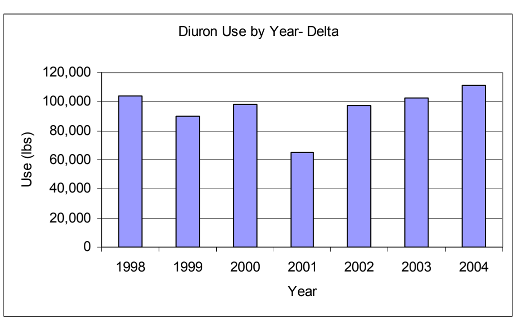
Usage: Selected as a target pesticide because of the relatively high amounts of applications for both agricultural and non-agricultural uses. The relatively high agricultural uses were in two sub-areas: San Joaquin River Watershed (SJR), and Delta Watershed (Delta). For non-agricultural uses, the relatively high uses were in four counties: Butte (ButteUrban), Sacramento (SacUrban), San Joaquin (SJUrban), Stanislaus (StanUrban).

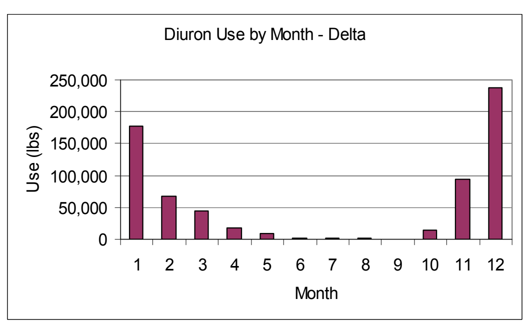
SJR: The average annual use was 106,328 lbs from 1998 to 2004 with the highest use (128,983 lbs) in 2004. The amount of annual use increased from 2001 to 2004. The monthly use shows that relatively high uses occurred during the winter storm season with the highest uses in December and January. The major applications were to cotton (43%), alfalfa (39%) and grape (7%). The average annual area application was 152,185 acres.



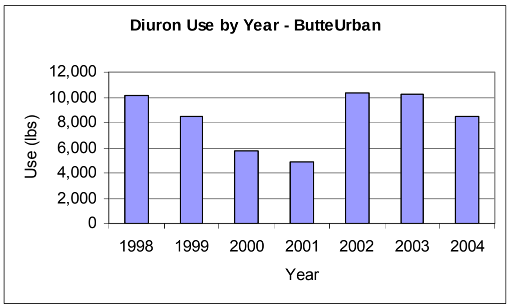


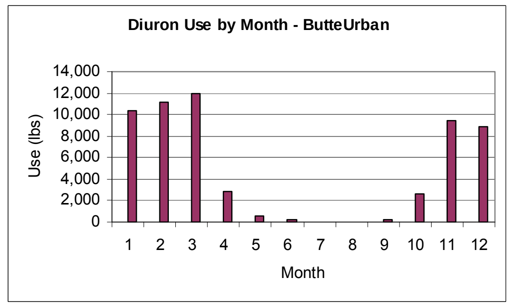
Delta: The average annual use was 95,574 lbs from 1998 to 2004 with the highest use (111,557 lbs) in 2004. The amount of use increased from 2001 to 2004. The monthly use shows that relatively high uses occurred during the winter storm season, and the highest use was in December. Diuron is mainly applied to alfalfa (52%), grape (21%), and asparagus (9%). The average annual area application was 152,185 acres.



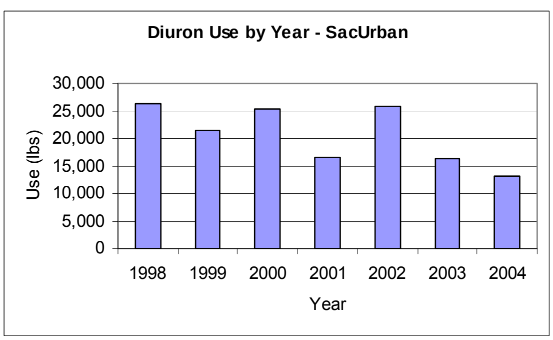


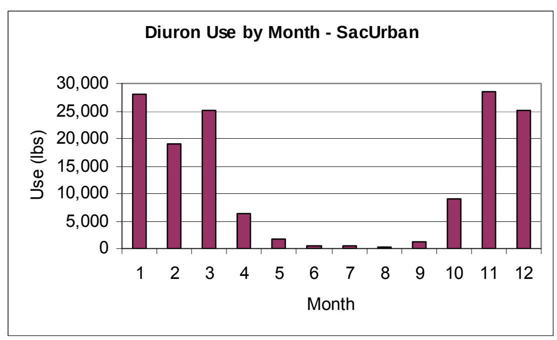
ButteUrban: The average annual use was 8,322 lbs from 1998 to 2004 with the highest use (10,333 lbs) in 2002. The amounts of annual use decreased from 1998 to 2001, and then increased in 2002, but decreased again from 2002 to 2004. The monthly use shows that relatively high uses occurred during the winter storm season, and the highest use was in March.



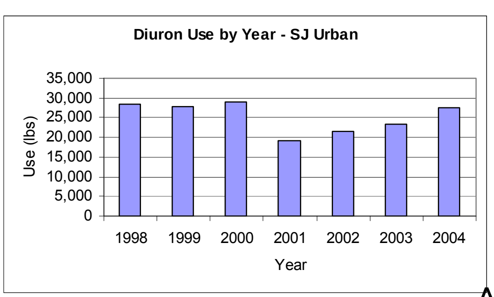


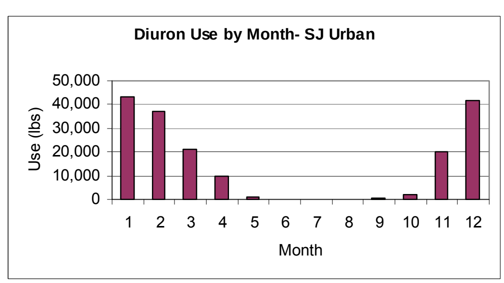
SacUrban: The average annual use was 20,719 lbs from 1998 to 2004 with the highest use (26,243 lbs) in 1998. The annual uses had a decreased trend from 1998 to 2004, but the amount of use in 2000 and 2002 were high. The monthly use shows that relatively high uses occurred during the winter storm season, and the highest use was in November.



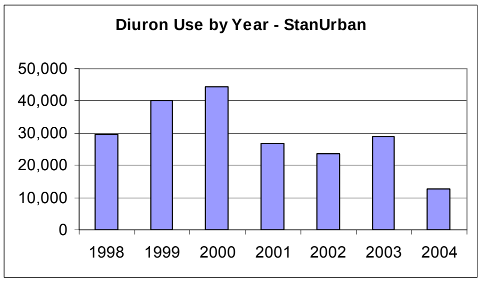


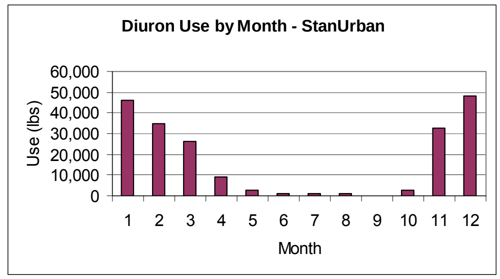
SJUrban: The average annual use was 25,261 lbs from 1998 to 2004 with the highest use (29,043 lbs) in 2000. The amounts of annual use increased from 2001 to 2004. The monthly use shows that relatively high uses occurred during the winter storm season, and the highest use was in January.





StanUrban: The average annual use was 29,461 lbs from 1998 to 2004 with the highest use (44,474 lbs) in 2000. The amounts of annual use increased from 1998 to 2000, and then decreased from 2000 to 2004. The monthly use shows that relatively high uses occurred during the winter storm season, and the highest use was in December.





<u>Water quality data:</u> There were 528 records of diuron concentration in the SWDB and 44% of the data exceeded the LOQ (0.01 to 1 µg/L). The highest observed concentration in surface water was 30.6 µg/L observed in February 1992. The highest observed concentration was lower than the lowest 96-hour LC_{50} (160 µg/L) but higher than the lowest EC_{50} value (2.4 µg/L).

<u>Conclusion:</u> Diuron is ranked as high overall relative-risk because of its high toxicity, high observed concentration in surface water, and high uses in the winter storm season. The annual applications had an increased trend for agricultural use, but a decreased trend for non-agricultural use recent years.

Diuron is ranked as “possible” to contaminate sediment because of its moderate Koc. Diuron has been detected in groundwater in low concentrations (2 to 3 µg/L).

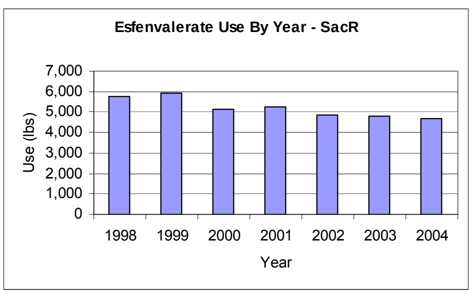
Esfenvalerate
Use: Insecticide, one of pyrethroids.

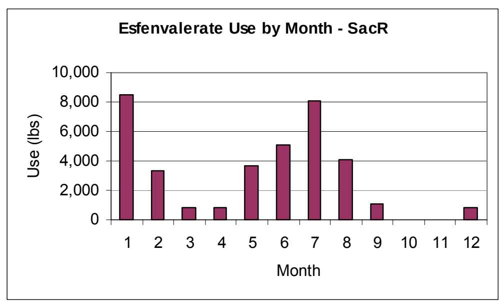
Physical properties: Very low water solubility (0.0002 mg/L) and high Koc (5,273).

Toxicity: The lowest 96-hour LC_{50} was 0.07 µg/L for rainbow trout (*Oncorhynchus mykiss*).

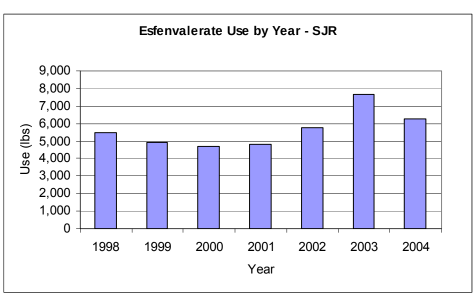
Usage: Selected as a target pesticide because of the relatively high uses for agricultural uses in Sacramento River Watershed (SacR), San Joaquin River Watershed (SJR), and Delta Watershed (Delta).

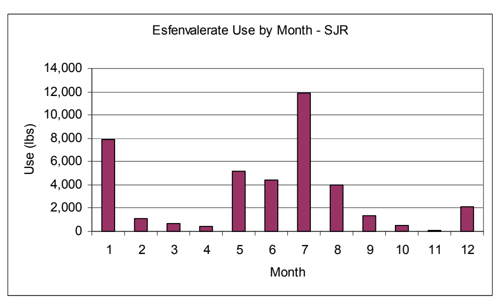
SacR: The average annual use was 5,204 lbs with the highest use (5,940 lbs) in 1999. The amounts of annual use had a slightly decreased trend from 1998 to 2004. The monthly use shows that relatively high uses were in January and July. The major applications were to prune (26%), almond (17%), and peach (15%). The average annual application area was 105,967 acres from 1998 to 2004.



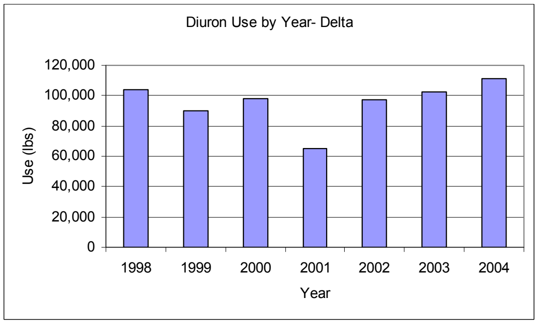


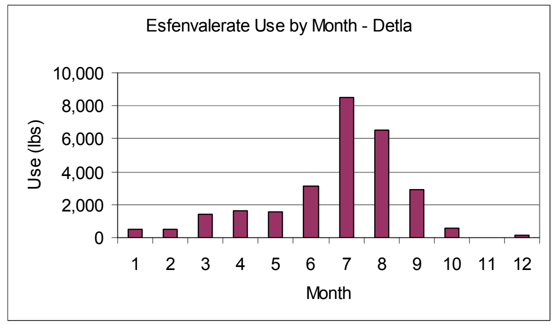
SJR: The average annual esfenvalerate use was 5,660 lbs between 1998 and 2004 with the highest use (7,667 lbs) in 2003. The amounts of annual use increased from 2000 to 2003, and then slightly decreased in 2004. The monthly use shows that the relatively high uses were in January and July. The major applications were to almond (44%), peach (14%), and tomato (11%). The average annual application area was 121,230 acres from 1998 to 2004.





Delta: The average annual use was 3,913 lbs from 1998 to 2004 with the highest use (5,184 lbs) in 1998. The amounts of annual use were in an increased trend from 2001 to 2004. The monthly use shows that relatively high uses were in July and August. The major applications were to tomato (41%) and cherry (18%). The average annual application area was 83,921 acres from 1998 to 2004.





<u>Water quality data:</u> The SWDB had 204 concentration data, and 3 of them exceeded LOQ (0.019 and 0.05 µg/L). The highest concentration was 0.166 µg/L.

<u>Conclusion:</u> Esfenvalerate is ranked as high overall relative-risk because of its very high toxicity. The annual applications had an increased trend and the major applications were in both winter storm and irrigation seasons. The observed concentration exceeded the lowest toxicity value. The risk to sediment contamination is ranked as “potential” because of its high Koc.

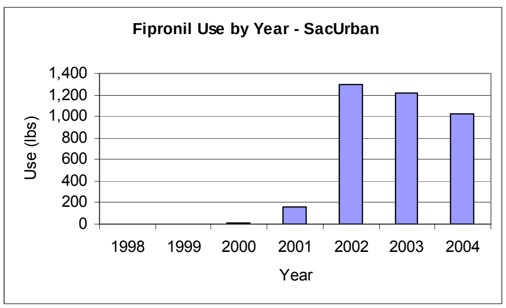
Fipronil
Use: Insecticide.

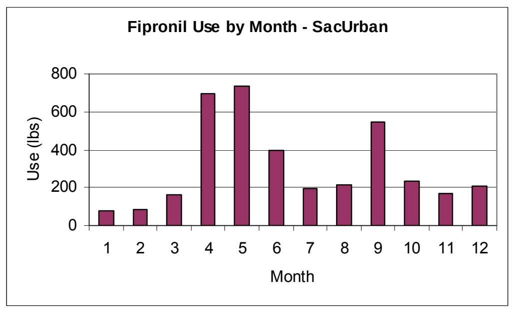
Physical properties: Moderate water solubility (2.4 mg/L) and moderate Koc (825).

Toxicity: The Lowest 96-hour LC_{50} was 0.14 µg/L for mysid (*Americamysis bahia*).

Usage: Selected as a target pesticide because of the relatively high applications for non-agricultural uses in Sacramento County (SacUrban).

SacUrban: The average annual use was 530 lbs from 1998 to 2004 with the highest use (1,299 lbs) in 2002. The amounts of annual uses were very low from 1998 to 2001 but increased in 2002, and then decreased slightly from 2002 to 2004. The monthly uses shows that the highest uses were in April and May.





Fipronil is used to control cockroaches, ants, fleas, mole crickets, ticks, mites, subterranean termites, and flea treatments for cats and dogs for non-agricultural applications. Fipronil is also used outdoors for ornamentals and lawns.

Water quality data: There were no concentration data available in the SWDB.

Conclusion: Fipronil is ranked as high overall risk because of its very high toxicity. The risk to sediment is ranked as "possible" because of its moderate Koc.

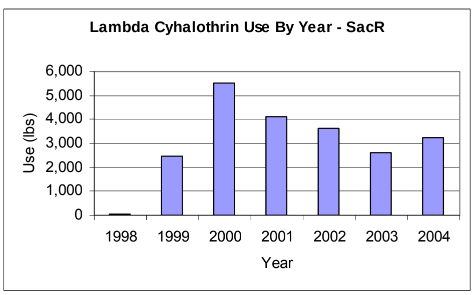
Lambda-cyhalothrin
Use: Insecticide, one of the pyrethroids.

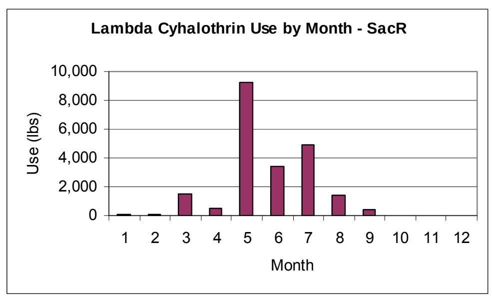
Physical properties: Very low water solubility (0.005 mg/L) and very high Koc (180,000).

Toxicity: The lowest 96-hour LC_{50} was 0.0041 µg/L for mysid (*Americamysis bahia*).

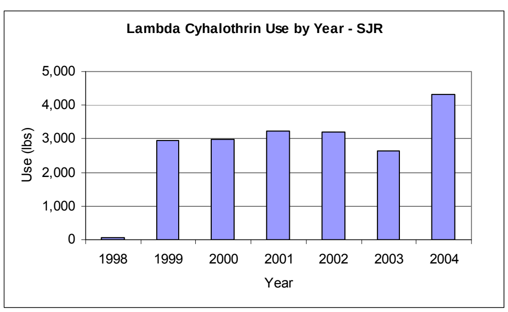
Usage: Selected as a target pesticide because the relatively high amounts of applications for agricultural uses were in the three project sub-areas: Sacramento River Watershed (SacR), San Joaquin River Watershed (SJR), and Delta Watershed (Delta).

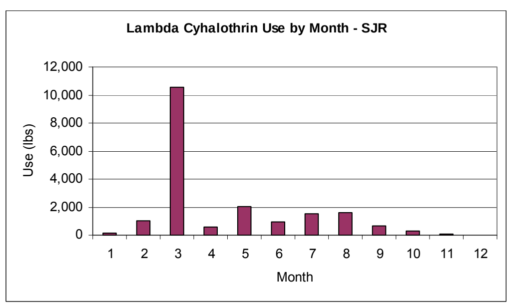
SacR: The average annual use was 3,090 lbs from 1998 to 2004 with the highest use (5,530 lbs) in 2000. The annual use had a decreased trend from 2000 to 2003, but it slightly increased in 2004. The monthly uses shows that the relatively high uses were between May and July with the highest use in May. The major applications of lambda cyhalothrin were to rice (56%), tomato (23%), and alfalfa (10%). The average annual use area was 93,491 acres from 1998 to 2004.



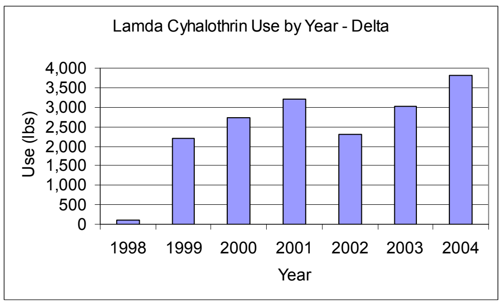


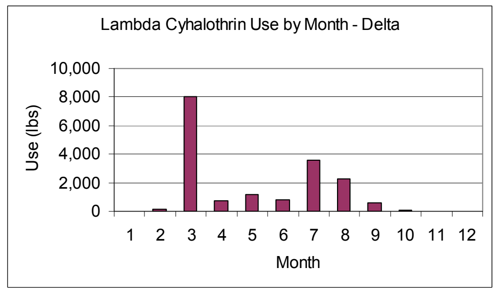
SJR: The average annual use was 2,775 lbs from 1998 to 2004 with the highest use (4,319 lbs) in 2004. The amounts of annual use were similarly from 1999 to 2002 but decreased in 2003, and then increased in 2004. The monthly uses shows that very high use was in March. The major applications were to alfalfa (66%), tomato (8%), and almond (8%). The average annual use was 84,810 acres from 1998 to 2004.





Delta: The average annual use was 2,482 lbs from 1998 to 2004 with the highest use (3,802 lbs) in 2004. The annual uses had increased trends from 1998 to 2001, and then from 2002 to 2004. The monthly uses shows that the highest use was in March. The major applications of lambda cyhalothrin were to alfalfa (54%), tomato (30%), and corn (5%). The average annual use was 72,471 acres.





Water quality data: The SWDB had 86 concentration data, and none of them exceeded the LOQ (0.01 and 0.02 µg/L). The LOQs were higher than the lowest toxicity value (0.0041 µg/L).

Conclusion: Lambda cyhalothrin is ranked as high overall relative-risk because of its very high toxicity. The risk of sediment contamination is ranked as “potential” because of its very high Koc value.

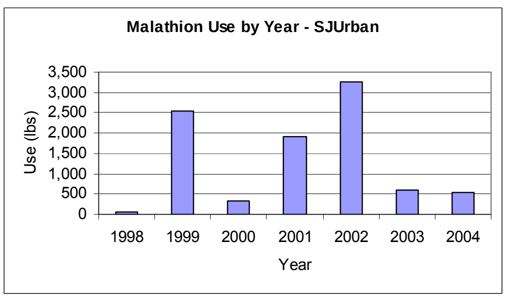
Malathion
Use: Insecticide.

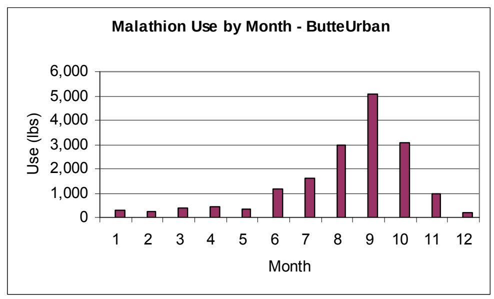
Physical properties: High water solubility (130 mg/L) and high Koc (1,200).

Toxicity: The lowest 96-hour LC_{50} was 0.5 µg/L for scud (*Gammarus fasciatus*).

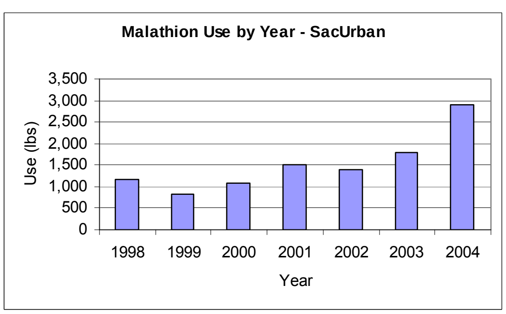
Usage: Selected as a target pesticide because of relatively high amount of applications for non-agricultural uses in four counties: Butte (ButteUrban), Sacramento (SacUrban), San Joaquin (SJUrban), and Stanislaus (StanUrban). Although malathion was not selected as a target for agricultural use, the amounts used for agricultural uses were much higher than the non-agricultural uses. Therefore, malathion used for agricultural in Sacramento River Watershed (SacR) and San Joaquin River Watershed (SJR) were presented.

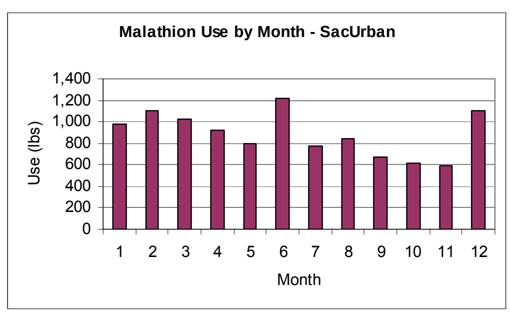
ButteUrban: The average annual use was 2,396 lbs between 1998 and 2004 with the highest use (3,589 lbs) in 2002. The annual uses had an increase trend from 1999 to 2002, but the annual uses decreased in 2003 and 2004. The monthly use shows that the relatively high applications were between July and November with the highest use in September.



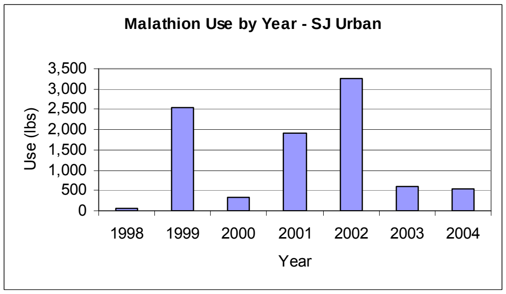


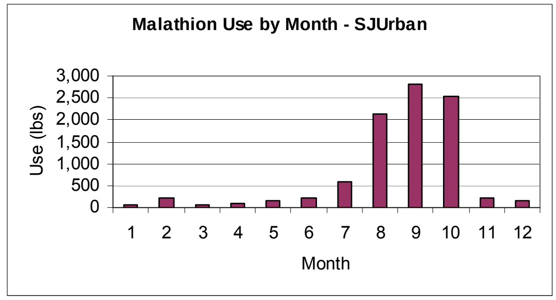
SacUrban: The average annual use was 1,521 lbs between 1998 and 2004 with the highest use (2,890 lbs) in 2004. The annual uses had an increased trend from 1999 to 2004. The monthly use shows that the applications were year-round with the highest uses in June and December.



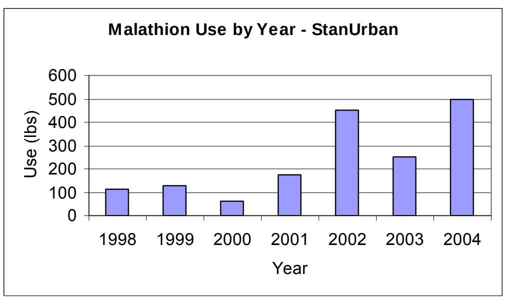


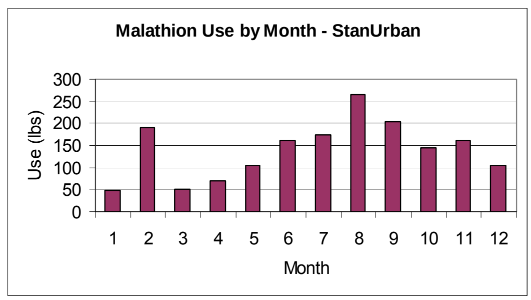
SJUrban: The average annual use was 1,323 lbs between 1998 and 2004 with the highest use (3,247 lbs) in 2002. The annual uses varied without clear trend. The monthly application shows that the relatively high uses were between August and October with the highest use in September.





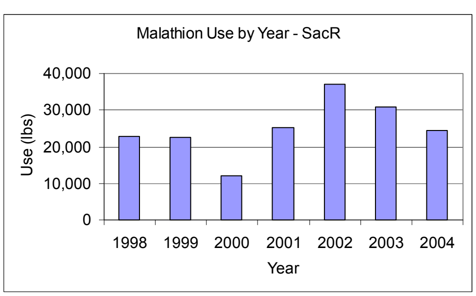
StanUrban: The average annual use was 240 lbs between 1998 and 2004 with the highest use (500 lbs) in 2004. The annual uses had an increased trend between 2000 and 2004 except for 2003. The monthly application were year-round with the relatively high uses in February, August, and September.

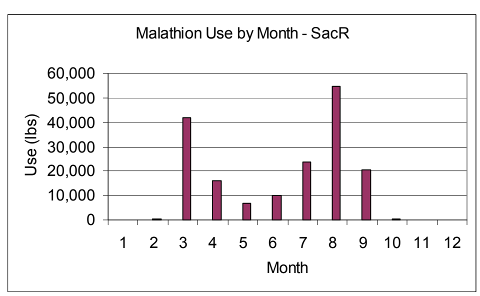




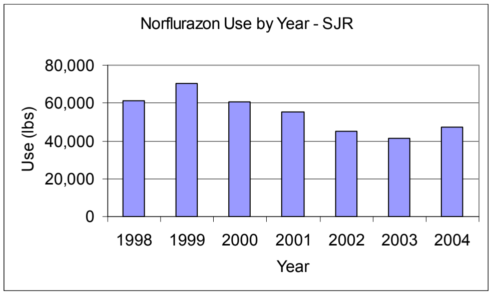
The major applications were to structural use for non-agricultural application. Malathion is also used for agricultural applications, such as alfalfa and walnut.

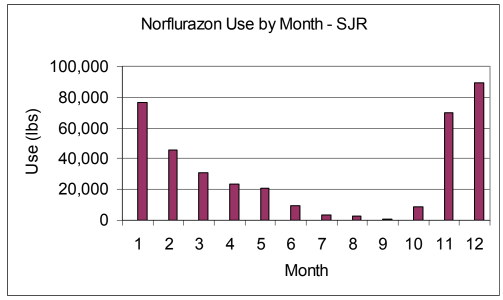
SacR: The average annual use was 24,960 lbs between 1998 and 2004 with the highest use (37,089 lbs) in 2002. The annual uses increased from 2000 to 2002, and then decreased from 2002 to 2004. The monthly use shows that the relatively high applications were between March and September with the highest uses in March and August.





SJR: The average annual use was 32,402 lbs between 1998 and 2004 with the highest use (40,265 lbs) in 1998. The annual uses had a decreased trend between 1999 and 2003. The monthly use shows that the applications were year-round with the relatively high uses in the winter storm season. The highest uses were in December and January.





Water quality data: The SWDB had 2,886 concentration data, and approximately 3% of concentration data exceeded LOQ (0.005 to 0.4 µg/L). The data were collected from 1991 to 2002 with the highest concentration (6 µg/L) observed in May 1996.

Conclusion: Malathion is ranked as high overall relative-risk because of its very high toxicity. The observed concentrations exceeded the lowest toxicity value. Although malathion was not selected as a target pesticide due to the agricultural use, the amounts of malathion used for agricultural use in SacR and SJR were much higher than the amounts applied for non-agricultural use. Malathion is ranked as "potential" risk to contaminate sediments because of its high Koc.

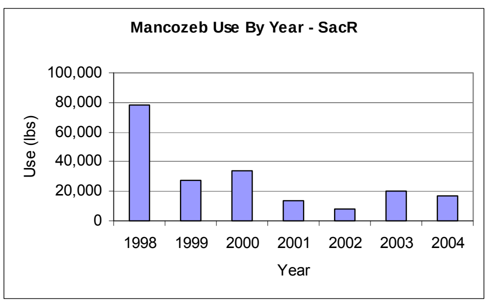
Mancozeb
Use: Fungicide

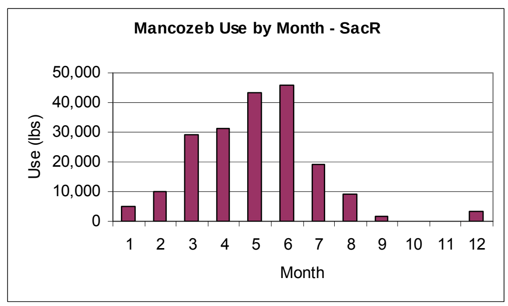
Physical properties: Low water solubility (6.2 mg/L) and high Koc (6,000).

Toxicity: The lowest 96-hour LC_{50} was 9.5 μg/L for mysid (*Americamysis bahia*).

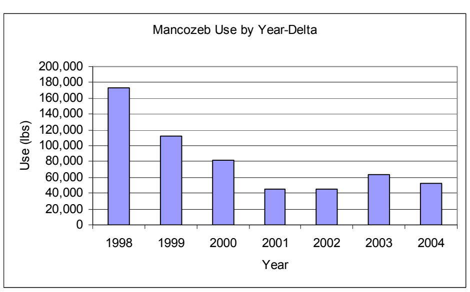
Usage: Selected as a target pesticide because of its relatively high amounts of applications for agricultural and non-agricultural uses. The uses for agricultural were in the two sub-areas: Sacramento River watershed (SacR) and Delta watershed (Delta). The uses for non-agricultural applications were in Sacramento County (SacUrban).

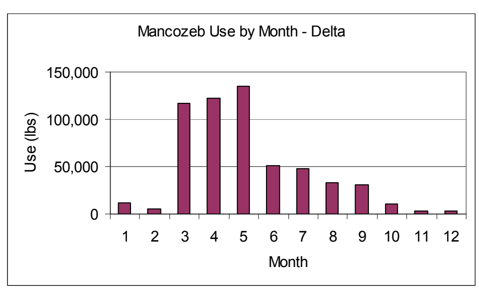
SacR: The average annual use was 28,327 lbs with the highest use (78,557 lbs) in 1998. The amount of use decreased from 1998 to 2004. The monthly uses shows that relatively high uses were between March and July with the highest use in June. The major applications were to tomato (71%), onion (18%), and pear (5%). The average annual applications area was 20,547 acres.





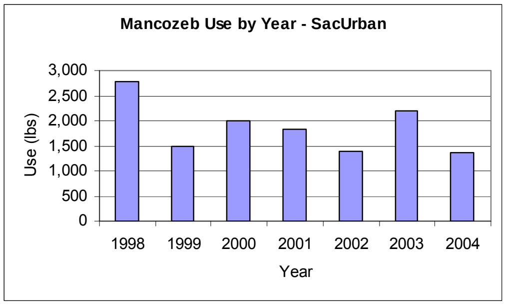
Delta: The average annual use was 81,805 lbs with the highest use (173,670 lbs) in 1998. The amount of use was in a decreased trend from 1998 to 2004. The monthly use shows that the relatively high uses were between March and May with the highest use in May. The major applications were to tomato (26%), potato (13%), and pear (12%). The average annual application area was 47,827 acres.

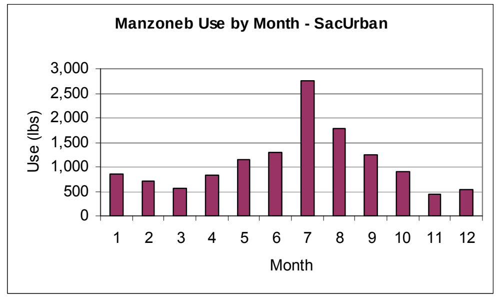




SacUrban: The average annual use was 1,864 lbs with the highest use (2,781 lbs) in 1998. The amount of use was in a decrease trend in general from 1998 to

2004. The monthly use shows that the applications were year-round with the highest use in July.





Water quality data: There were no concentration data in the SWDB.

Conclusion: Mancozeb is ranked as high overall relative-risk because of its high toxicity and relatively high applications during the winter storm season (in March). However, the overall relative-risk could be lower if considering the reduction of annual use in recently years. In addition, its low water solubility and short half-life in water (less than 1.5 days) may pose lower risk to contaminate in water column. The risk to sediment contamination is ranked as "potential" because of its high Koc.

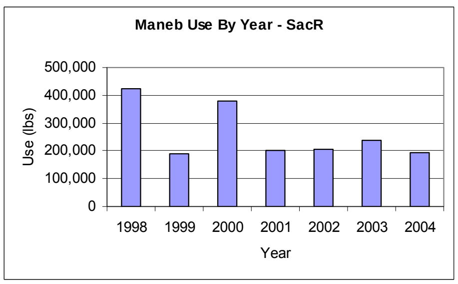
Maneb
Use: Fungicide.

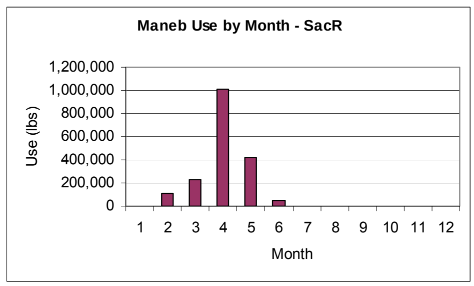
Physical properties: Low water solubility (6 mg/L) and moderate Koc (240).

Toxicity: The lowest 96-hour LC_{50} was 33 µg/L for mysid (*Americamysis bahia)*.

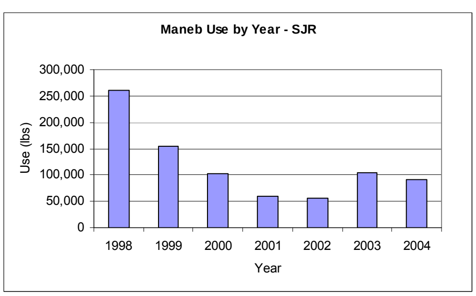
Usage: Selected as a target pesticide because of its relatively high applications for agricultural uses in Sacramento River Watershed (SacR), San Joaquin River Watershed (SJR), and Delta Watershed (Delta).

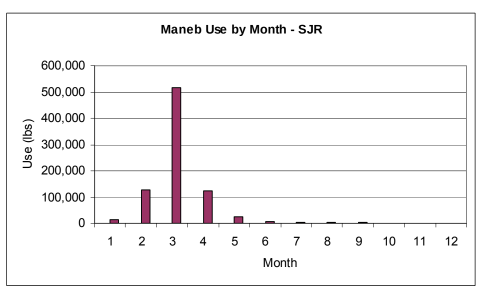
SacR: The average annual use was 261,282 lbs between 1998 and 2004 with the highest use (442,443 lbs) in 1998. The annual uses decreased from 2001 to 2004 except for 2000. The monthly use shows that the relatively high applications were between March and May with the highest use in April. The major applications were to walnut (84%) and almond (12%). The average annual application area was 128,882 acres.





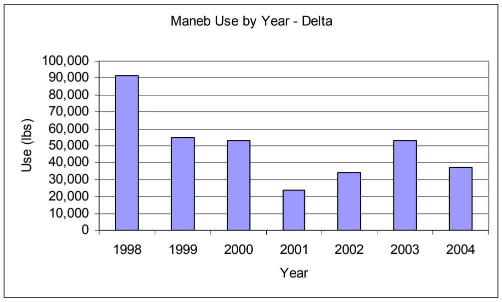
SJR: The average annual use was 118,150 lbs between 1998 and 2004 with the highest use (261,543 lbs) in 1998. The annual uses had a decreased trend between 1998 and 2002. The annual uses in 2003 and 2004 were slightly higher than the amount used in 2002. The monthly use shows that the highest use was in March. The major crops applied were to almond (75%), walnut (17%), and tomato (3%). The average annual application area was 41,339 acres.

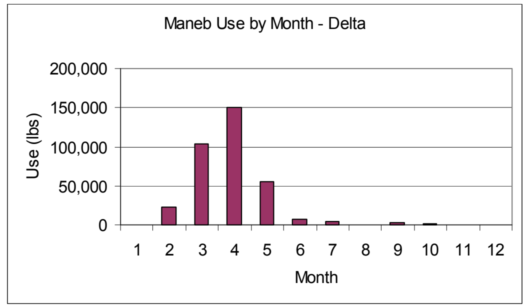




Delta: The average annual use was 49,721 lbs between 1998 and 2004 with the highest use (91,673 lbs) in 1998. The annual uses decreased from 1998 to

2001, and then increased from 2001 to 2003. The amount of annual use in 2004 was lower than that used in 2003. The monthly use shows that the relatively high uses were between March and May with the highest use in April. The major crops applied were to walnut (68%), almond (21%), and tomato (6%). The average annual application area was 26,302 acres.





Water quality data: There were no concentration data in the SWDB.

Conclusion: Maneb is ranked as high overall relative-risk because of its high toxicity, and the relatively high amount used in the winter storm season (March). The overall relative-risk could be lower if considering the high reduction of annual use. The sediment contamination risk is ranked as "possible" because of its moderate Koc.

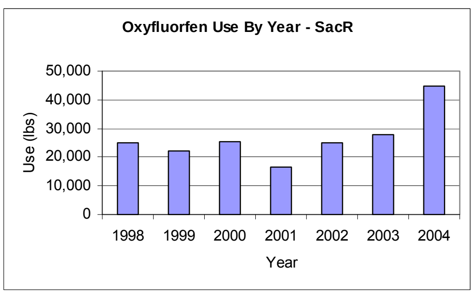
Oxyfluorfen
Use: Herbicide.

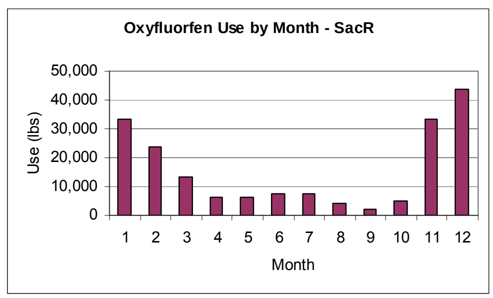
Physical properties: Very low water solubility (0.1 mg/L) and very high Koc (100,000).

Toxicity: The lowest 96-hour LC_{50} was 31.7 µg/L for grass shrimp (*Palaemonetes pugio*). The lowest 96-hour EC_{50} was 0.29 µg/L for green algae (*Selenastrum capricornutum*).

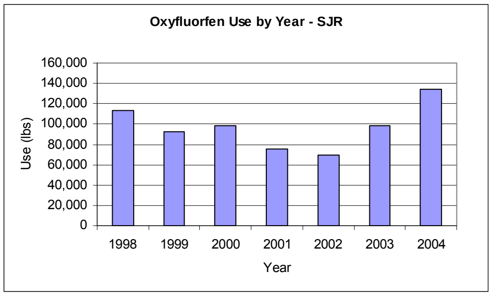
Usage: Selected as a target pesticide because of its relatively high amounts of applications for agricultural uses in three sub-areas, and for non-agricultural uses in two counties. The three sub-areas are Sacramento River Watershed (SacR), San Joaquin River Watershed (SJR), and Delta Watershed (Delta). The two counties are San Joaquin (SJUrban) and Stanislaus (StanUrban).

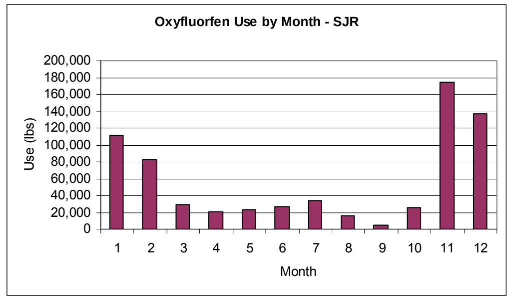
SacR: The average annual use was 26,615 lbs from 1998 to 2004 with the highest use (44,601 lbs) in 2004. The annual uses had an increase trend between 2001 and 2004. The relatively high use months were November, December, January, and February. The major applications were to almond (45%), walnut (18%), and uncultivated agricultural area (9%). The average annual application area was 149,900 acres.



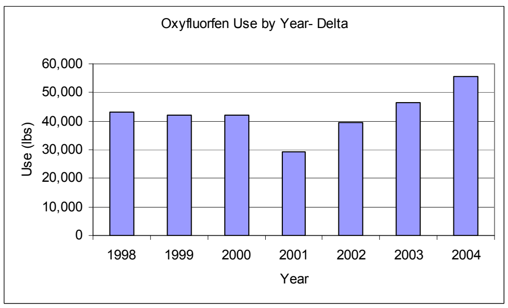


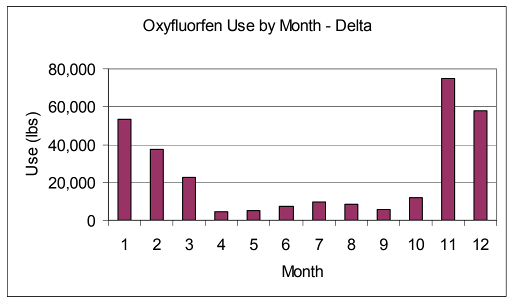
SJR: The average annual use was 97,477 lbs from 1998 to 2004 with the highest use (134,626 lbs) in 2004. The annual uses decreased slightly from 1998 to 2001, and then increased from 2001 to 2004. The relatively high use months are November, December, January, and February. The highest monthly use was in December. The major applications were to almond (51%), cotton (13%), and grape (11%). The average annual application area was 338,679 acres.



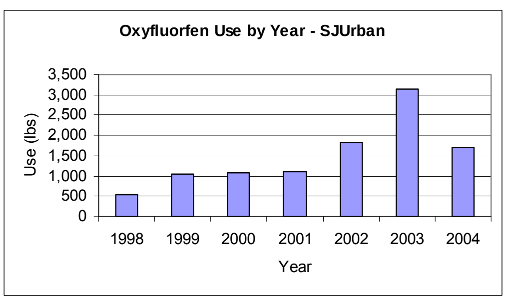


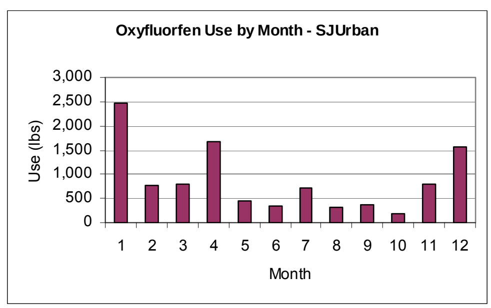
Delta: The average annual use was 42,629 lbs from 1998 to 2004 with the highest use (55,616 lbs) 2004. The annual uses decreased from 1998 to 2001, and then increased from 2001 to 2004. The relatively high use months were November, December, January, and February. The highest use was in November. The major applications are to grape (38%) and walnut (17%). The average annual application area was 159,478 acres.



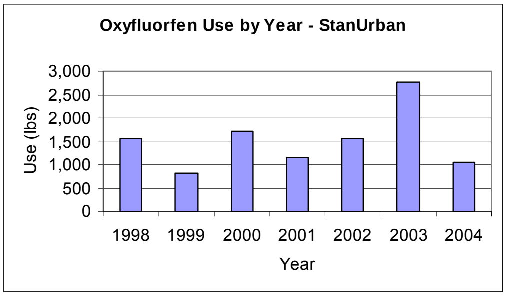


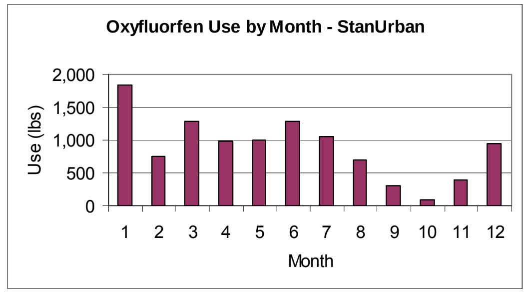
SJUrban: The average annual use was 1,490 lbs from 1998 to 2004 with the highest use (3,131 lbs) in 2003. The annual uses increased from 1998 to 2003, and then decreased in 2004. The monthly use shows the highest use in January.





StanUrban: The average annual use was 1,519 lbs from 1998 to 2004 with the highest use (2,776 lbs) in 2003. The annual use had an increased trend from 1999 to 2003. The monthly use shows that the applications were year-round with the highest use in January.





Water quality data: There were no concentration data in the SWDB.

Conclusion: Oxyfluorfen is ranked as high overall relative-risk because of its very high toxicity. The annual uses had increased trends for both of agricultural and non-agricultural uses. The risk to sediment contamination is ranked as "potential" because of its very high Koc.

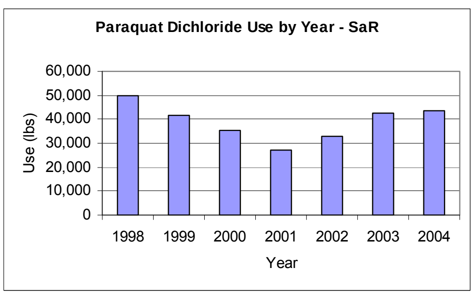
Paraquat dichloride
Use: Herbicide.

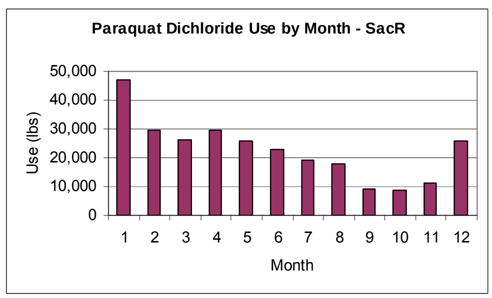
Physical properties: Very high water solubility (620,000 mg/L) and very high Koc (162,000).

Toxicity: The lowest 96-hour LC_{50} was 11,000 µg/L for scud (*Gammarus fasciatus*). The lowest EC_{50} was 0.55 for freshwater diatom (*Navicula pelliculosa*).

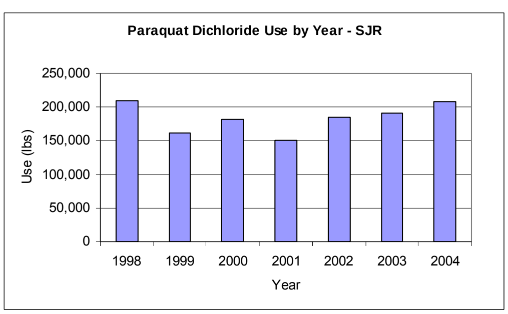
Usage: Selected as a target pesticide because of the relatively high uses for agricultural applications in three sub-areas: Sacramento River Watershed (SacR), San Joaquin River Watershed (SJR), and Delta Watershed (Delta).

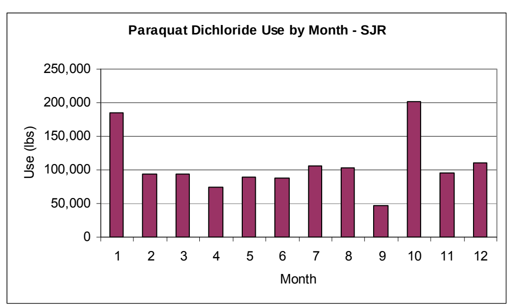
SacR: The average annual use was 38,999 lbs with the highest use (4,978 lbs) in 1998. The annual use decreased from 1998 to 2001, and then increased from 2001 to 2004. The monthly use shows the applications were almost year-round with the highest use in January. The major applications were to alfalfa (28%), almond (22%), and walnut (11%). The average annual area of applications was 52,936 acres.



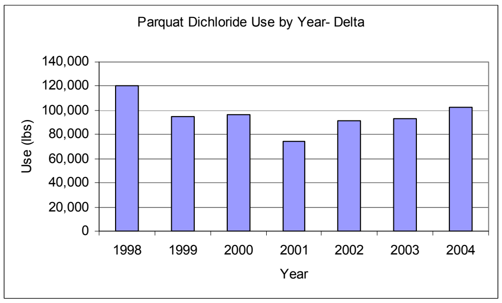


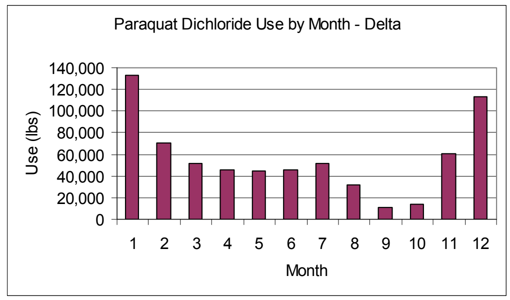
SJR: The average annual use was 184,083 lbs with the highest use (209,602 lbs) in 1998. The annual uses were in a slightly increased trend between 2001 and 2004. The monthly uses were year-round, and the highest uses were in October and January. The major applications were to almond (26%), cotton (25%), and alfalfa (19%). The average annual area of application was 292,804 acres.





Delta: The average annual use was 96,194 lbs with the highest use (120,697 lbs) in 1998. The annual use decreased from 1998 to 2001, and then slightly increased from 2001 to 2004. The monthly applications were almost year-round with the highest uses in January and December. The major applications were to grape (37%) and alfalfa (31%). The average annual area of application was 158,685 acres.





Water quality data: There were no concentration data available in the SWDB.

Conclusion: Paraquat dichloride is ranked as high overall relative-risk because of its very high toxicity. The annual applications had increased trends, and relatively high amount uses in the winter storm season. Sediment contamination risk is ranked as “potential” because of its very high Koc.

Pendimethalin

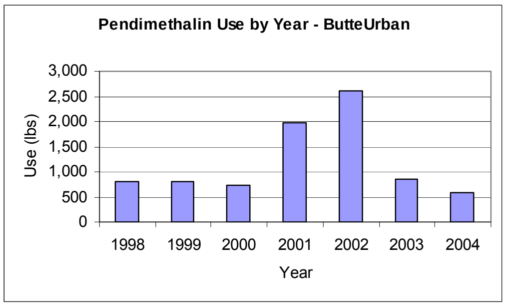
Use: Herbicide

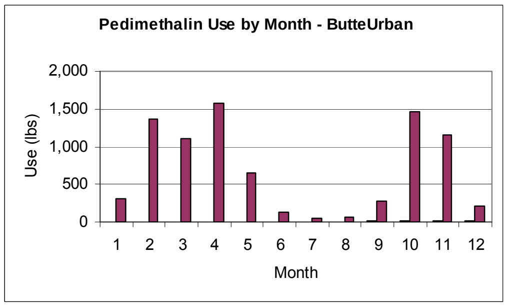
Physical properties: Very low water solubility (0.3 mg/L) and very high Koc (13,400).

Toxicity: The lowest 96-hour LC_{50} was 400 µg/L for Rainbow trout (*Oncorhynchus mykiss*). The lowest 5-d EC_{50} was 5.2 µg/L for marine diatom (*Skeletonema costatum*).

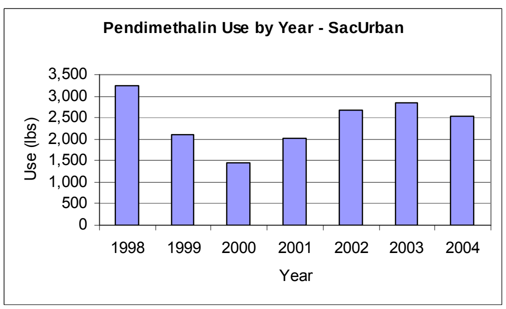
Usage: Selected as a target pesticide because of its relatively high uses for non-agricultural applications in three counties: Butte (ButteUrban), Sacramento (SacUrban), and San Joaquin (SJUrban).

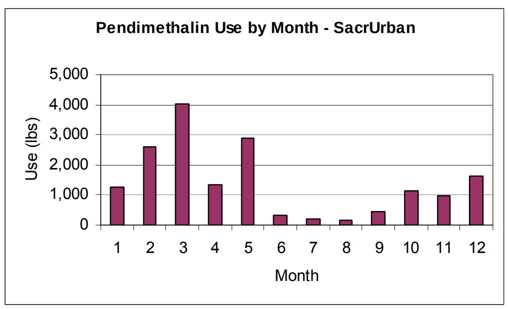
ButteUrban: The average annual use was 1,193 lbs from 1998 to 2004 with the highest use (2,598 lbs) in 2002. The annual uses increased from 2000 to 2002, and then decreased from 2002 to 2004. The monthly use shows that relatively high uses were in February, March, April, October, and November.



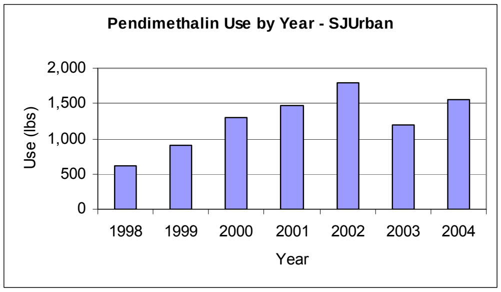


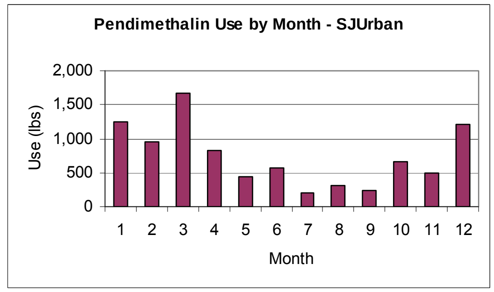
SacUrban: The average annual use was 2,413 lbs from 1998 to 2004 with the highest use (3,255 lbs) in 1998. The annual use increased from 2000 to 2003, and then slightly decreased in 2004. The monthly use shows that the highest use was in March.





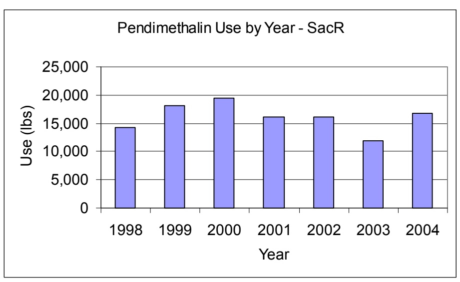
SJUrban: The average annual use was 1,262 lbs from 1998 to 2004 with the highest use (1,790 lbs) in 2002. The annual use increased from 1998 to 2002, and then slightly decreased in 2003 and 2004. The monthly use shows that the highest use was in March.

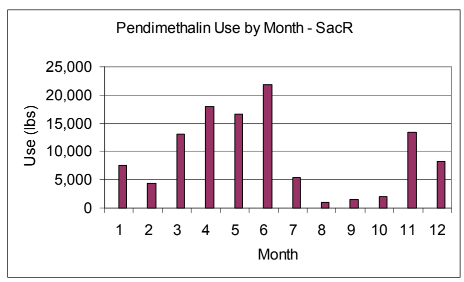




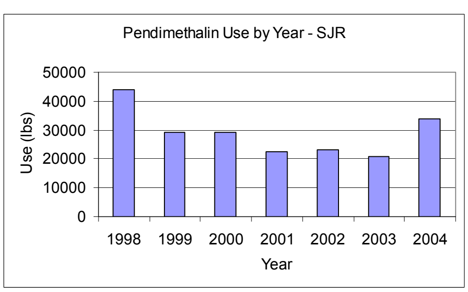
Pendimethalin was mainly applied for "rights of way" for control grasses and broadleaf weeds. Pendimethalin was also used for agricultural applications and the amounts of annual uses were much higher than that for non-agricultural uses. The main uses were to almond, walnut, and rice field.

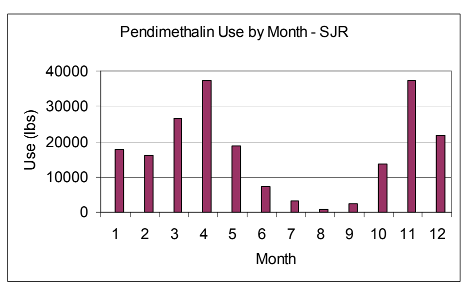
SacR: The average annual use was 16,113 lbs from 1998 to 2004 with the highest use (1,790 lbs) in 2002. The annual use decreased from 2000 to 2003, and then slightly increased in 2004. The monthly use shows that the relatively high uses were between March to June and the highest use was in June.





SJR: The average annual use was 28,962 lbs from 1998 to 2004 with the highest use (44,097 lbs) in 1998. The annual use decreased from 1998 to 2003, and then slightly increased in 2004. The monthly use shows that the relatively low uses were between June and September. The highest uses were in April and November.





Water quality data: There were over 500 pendimethalin concentration data in the SWDB and about 11% of data exceeded LOQ (0.004 to 0.1 µg/L). The highest concentration was 0.7 µg/L observed in January 1996. The highest concentration was lower than the lowest toxicity value (5.2 µg/L).

Conclusion: Pendimethalin is ranked as high overall relative-risk because of its high toxicity, relatively high use in the winter storm season (November to March), and slightly increased annual uses in recent years in some sub-areas. The highest observed concentration (0.7 µg/L) was lower than the lowest toxicity value (5.2 µg/L) but higher than one tenth of the toxicity value (0.52 µg/L). The risk to sediment contamination is ranked as "potential" because of its high Koc.

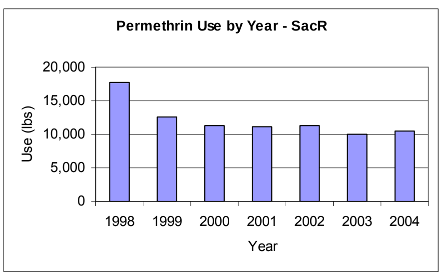
Permethrin
Use: Insecticide, one of the pyrethroids.

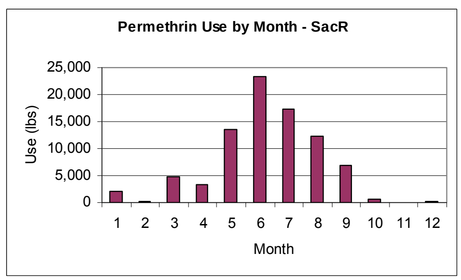
Physical properties: Very low water solubility (0.006 mg/L) and very high Koc (39,300).

Toxicity: The lowest 96-hour LC_{50} was 0.019 µg/L for mysid (*Americamysis bahia*).

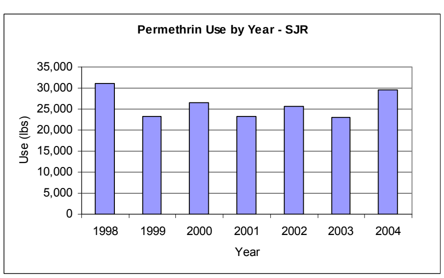
Usage: Selected as a target pesticide because of its relatively high amounts of application for agricultural uses in three sub-areas and for non-agricultural uses in four counties. The three sub-areas are Sacramento River Watershed (SacR), San Joaquin River Watershed (SJR), and Delta Watershed (Delta). The four counties are Butte (ButteUrban), Sacramento (SacUrban), San Joaquin (SJUrban), and Stanislaus (StanUrban).

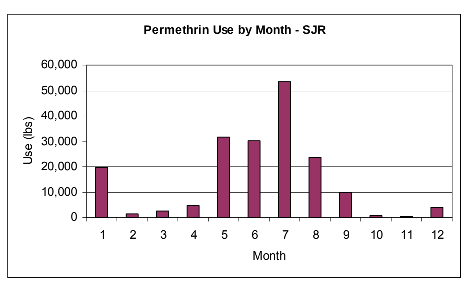
SacR: The average annual use was 12,075 lbs with the highest use (17,697 lbs) in 1998. The annual uses had a decreased trend from 1998 to 2004. The relatively high monthly uses were from May to September with the highest use in June. The major applications were to peach (31%), walnut (19%), and alfalfa (13%). The average annual area of applications was 59,212 acres.



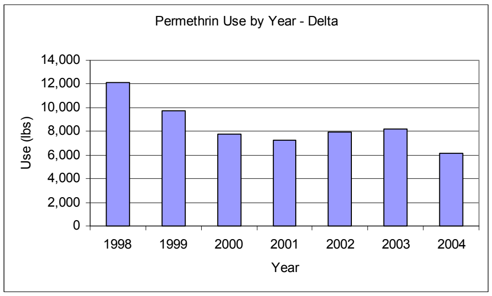


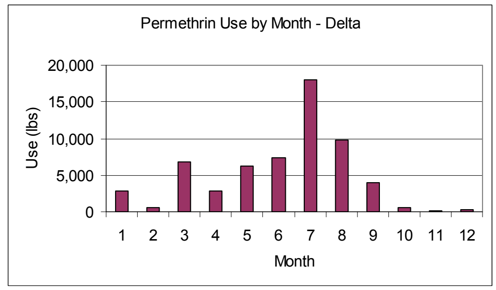
SJR: The average annual use was 26,055 lbs with the highest use (31,102 lbs) in 1998. The annual uses had a slightly decreased trend from 1998 to 2003 but 2004. The relatively high monthly uses were in January and from May to August. The highest use was in July. The major applications were to almond (46%), pistachio (27%), and peach (7%). The average annual area of application was 124,536 acres.



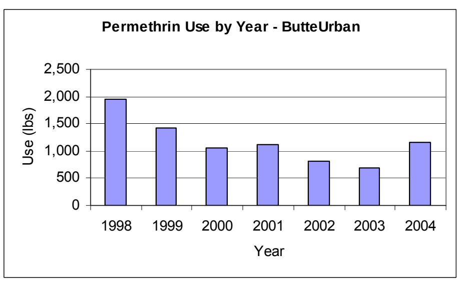


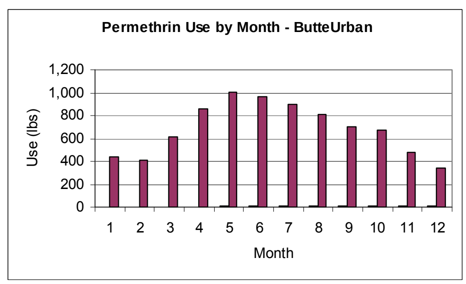
Delta: The average annual use was 8,448 lbs with the highest use (12,116 lbs) in 1998. The annual uses had a decreased trend from 1998 to 2004. The monthly use shows that the relatively high uses were from March to September with the highest use in July. The major applications were to alfalfa (23%), almond (22%), and tomato (15%). The average annual application area was 47,843 acres.



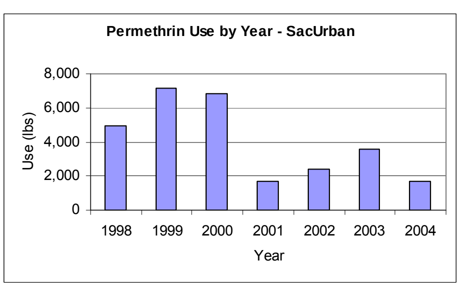


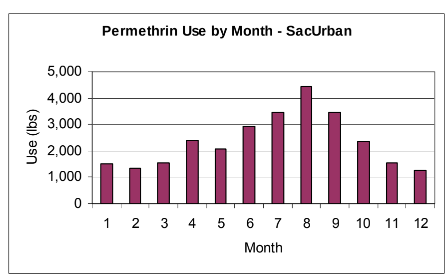
ButteUrban: The average annual use was 1,172 lbs with the highest use (1,954 lbs) in 1998. The annual uses had a decreased trend from 1998 to 2003 but slightly higher in 2004. The monthly use were year-round with relatively high uses from March to October, and the highest use was in May.



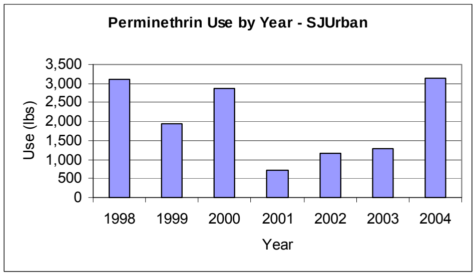


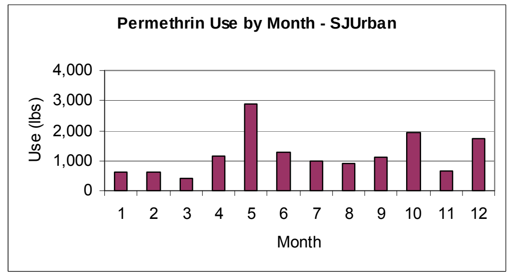
SacUrban: The average annual use was 4,048 lbs with the highest use (7,165 lbs) in 1999. The annual uses were much lower between 2001 and 2004 than the period of 1998 to 2000. The monthly uses were year-round with the highest use in August.



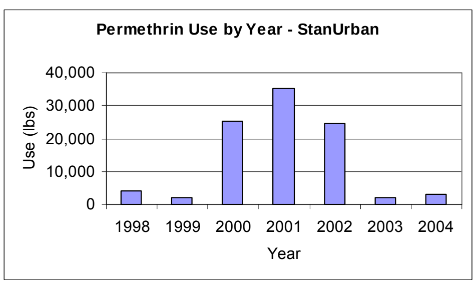


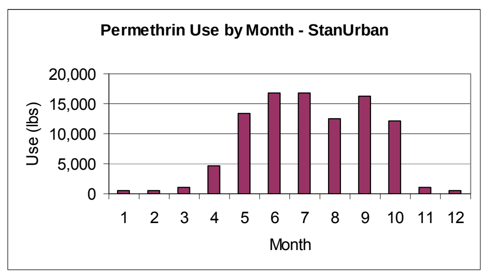
SJUrban: The average annual use was 2,038 lbs with the highest use (3,142 lbs) in 2004. The annual uses had an increased trend from 2001 to 2004. The monthly use shows that the applications were year-round with the highest use in May.





StanUrban: The average annual use was 13,763 lbs with the highest use (35,214 lbs) in 2001. The annual uses between 2000 and 2002 were much higher than the other years'. The monthly use shows that relatively high uses were between May and October with the highest uses in June and July.





Water quality data: There were over 400 concentration data in the SWDB, and none of them exceeded the LOQ (0.0005 to 0.05 µg/L). The data were from six monitoring studies between 1994 and 2003. The LOQ (0.05 µg/L) is higher than the lowest toxicity value (0.019 µg/L).

Conclusion: Permethrin is ranked as high overall relative-risk because of its very high toxicity. The annual uses had increased trends in SJR and SJUrban but decreased trends in Delta and StanUrban. The sediment risk is ranked as "potential" because of its very high Koc.

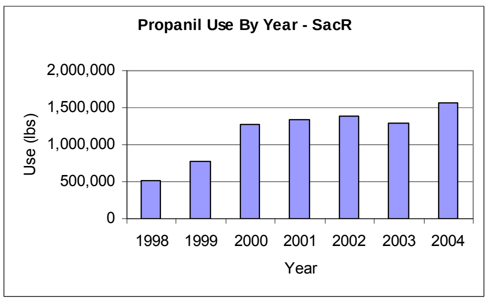
Propanil
Use: Herbicide.

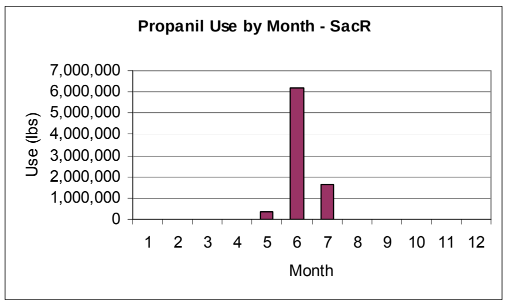
Physical properties: High water solubility (152 mg/L) and moderate Koc (400).

Toxicity: The lowest 96-hour LC_{50} was 400 µg/L for mysid (*Americamysis bahia*). The lowest 5-day EC_{50} was 16 µg/L for freshwater diatom (*Navicula pelliculosa*).

Usage: Selected as a target pesticide because of its relatively high amounts of use for agricultural applications in Sacramento River Watershed (SacR).

SacR: The average annual use was 1,167,069 lbs from 1998 to 2004 with the highest use (1,564,306 lbs) in 2004. The annual uses had an increased trend from 1998 to 2004. The monthly use shows that the highest use was in June. Over 99% of applications were to rice. The average annual area was 274,496 acres.





Water quality data: There were 406 concentration data in the SWDB, and almost 10% of data exceeded LOQs (0.004 to 0.25 µg/L) but only one data exceeded the lowest toxicity value (16 µg/L). The highest concentration (20.6 µg/L) was detected in May 2001. The highest concentration was far below the lowest LC_{50} (400 µg/L) for aquatic animals but higher than the lowest EC50 (16 µg/L) for aquatic plants.

Conclusion: Propanil is ranked as high overall relative-risk because it has high toxicity to aquatic plant and the observed concentration exceeded the lowest toxicity value. The overall relative-risk could be lower because only one concentration data exceeded the lowest EC50 value. It is highly toxic to aquatic plant but moderately toxic to aquatic animals. The risk to sediment is ranked as "possible" because of its moderate Koc.

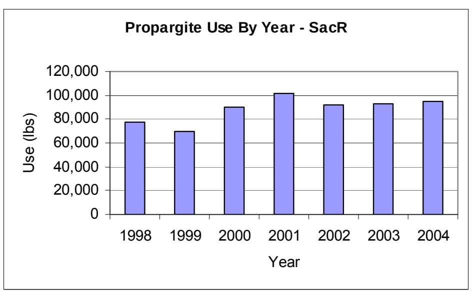
Propargite
Use: Insecticide.

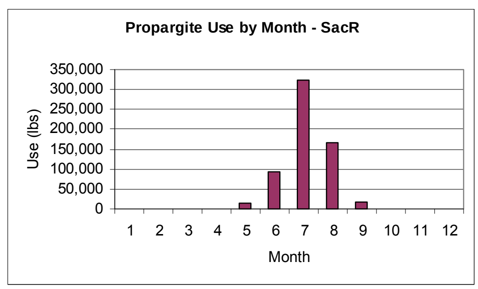
Physical properties: Very low solubility (0.6 mg/L) and high Koc (5,578).

Toxicity: The lowest 96-hour LC_{50} was 31 µg/L for bluegill sunfish (*Lepomis macrochirus*).

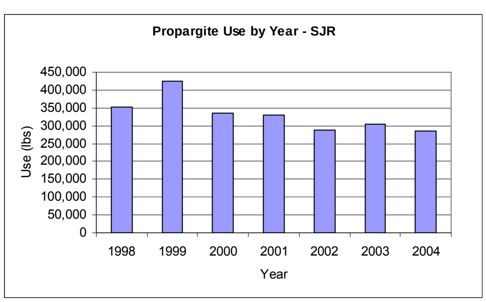
Usage: Selected as a target pesticide because of its relatively high amount of applications for agricultural uses in the three project sub-areas: Sacramento River Watershed (SacR), San Joaquin River Watershed (SJR), and Delta Watershed (Delta).

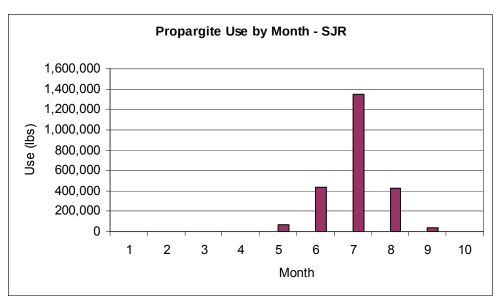
SacR: The average annual propargite use was 88,129 lbs from 1998 to 2004 with the highest use (101,261 lbs) in 2001. The annual use had a slight increased trend from 1998 to 2004. The monthly use shows that the applications were between June and August with the highest use in July. The major applications were to almond (43%), walnut (23%), and cotton (9%). The average annual application area was 59,777 acres.



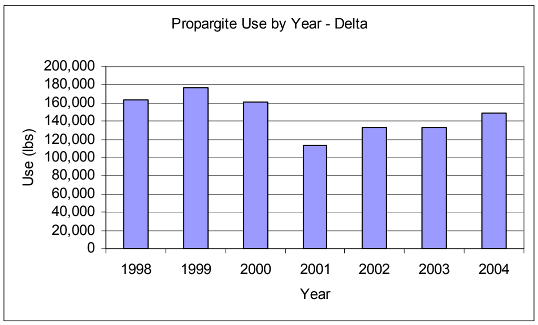


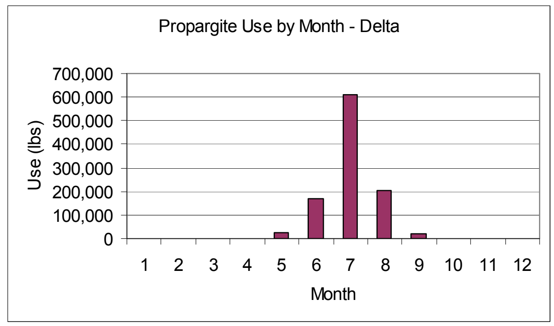
SJR: The average annual propargite use was 331,618 lbs from 1998 to 2004 with the highest use (424,962 lbs) in 1999. The annual uses had a decreased trend from 1999 to 2004. The monthly use shows that the relatively high uses were between June and August with the highest use in July. The major applications were to almond (35%), corn (34%), and grape (7%). The average annual application area was 180,899 acres.





Delta: The average annual use was 147,001 lbs from 1998 to 2004 with the highest use (177,435 lbs) in 1999. The annual use decreased from 1999 to 2001, and then increased from 2001 to 2004. The monthly use shows that the relatively high uses were between June and August with the highest use in July. The major applications were to corn (21%), walnut (21%), and grape (20%). The average annual application area was 81,703 acres.





Water quality data: The SWDB had 324 concentration data and 11% of data exceeded LOQ (0.013, 0.014, and 0.023 µg/L). The highest concentration (20 µg/L) was detected in August 2001.

Conclusion: Propargite is ranked as high overall relative-risk because of its high toxicity and slightly increased trends of annual uses. Concentration data was not used as a factor in ranking overall relative-risk because of its very low water solubility. The highest observed concentration (20 µg/L) is lower than the lowest toxicity value (31 µg/L) but was higher than one tenth of the lowest toxicity value (3.1 µg/L).

The risk to sediment contamination is ranked as "potential" because of its high Koc.

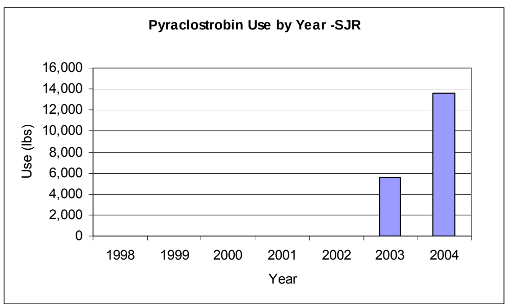
Pyraclostrobin
<u>Use:</u> Fungicide

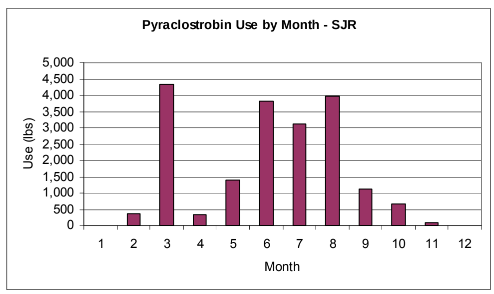
Physical properties: Low water solubility (1.9 mg/L) and high Koc (9,300).

Toxicity: The lowest 96-hour LC_{50} was 4.16 µg/L for mysid (*Americamysis bahia*).

Usage: Selected as a target pesticide because of the applications for agricultural use in San Joaquin River Watershed (SJR).

SJR: The PUR database has only two years (2003 and 2004) data reportedly during the seven-year period (1998 to 2004). The annual average use was 9,611 lbs between 2003 and 2004 with the highest use (13,642 lbs) in 2004. The annual use in 2004 was about twice of used in 2003. The monthly use shows that relatively high uses were in March, and between June and August. The major applications were to pistachio (28%), almond (24%), and tomato (22%). The annual average application area was 75,522 acres between 2003 and 2004.





Water quality data: There were no concentration data available in the SWDB.

Conclusion: Pyraclostrobin is ranked as a high overall relative-risk because of its high toxicity and high amount of applications in the winter storm season (March). Pyraclostrobin is a relatively new pesticide and only have two years pesticides use data. Monitoring may be needed. The sediment contamination risk is ranked as “potential” because of its high Koc.

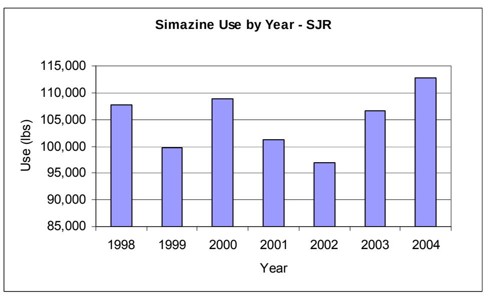
Simazine
Use: Herbicide.

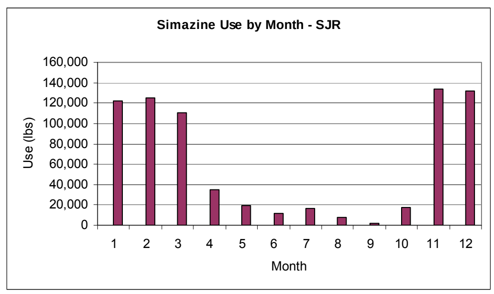
Physical properties: Low solubility (3.5mg/L), moderate Koc (140).

Toxicity: The lowest 96-hour LC_{50} was 4,300 µg/L for sheepshead minnow (*Cyprinodon variegates*). The lowest 5-day EC_{50} was 36 µg/L for bluegreen algae (*Anabaena flos-aquae*).

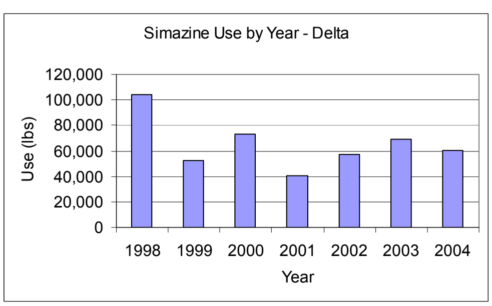
Usage: Selected as a target pesticide because of the relatively high applications for both agricultural and non-agricultural uses. The agricultural uses are in two sub-areas: San Joaquin River Watershed (SJR) and Delta Watershed (Delta). The non-agricultural uses are in three counties: Sacramento (SacUrban), San Joaquin (SJUrban), and Stanislaus (StanUrban).

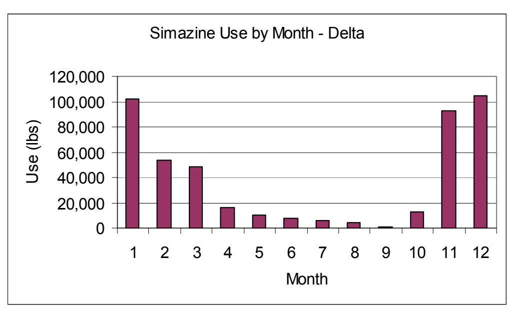
SJR: The annual average use was 104,800 lbs from 1998 to 2004 with the highest amount of use (112,786 lbs) in 2004. The annual uses deceased from 2000 to 2002 and then increased from 2002 to 2004. The relatively high monthly applications were in the winter storm season, and the highest use was in November. The major applications were to almond (54%) and grape (33%). The average annual area of use was 151,596 acres.



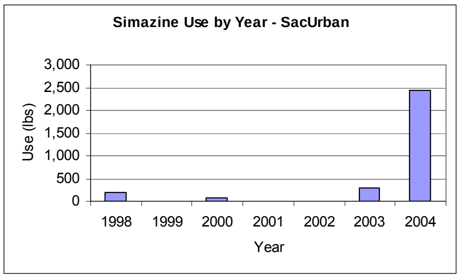


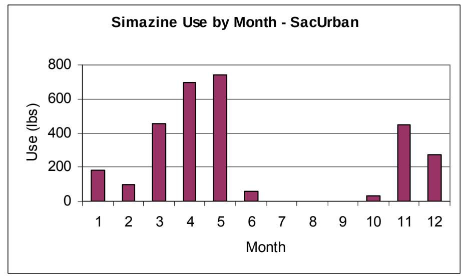
Delta: The annual average use was 65,370 lbs from 1998 to 2004 with the highest amount of use (103,873 lbs) in 1998. The annual uses decreased from 1998 to 2001, and then slightly increased from 2001 to 2003. The relatively high monthly uses were in the winter storm season, and the highest use was in December. The major applications were to grape (68%) and almond (15%). The average annual area of use was 61,235 acres.



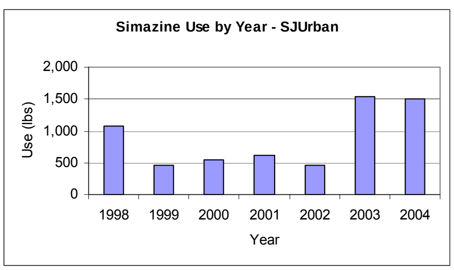


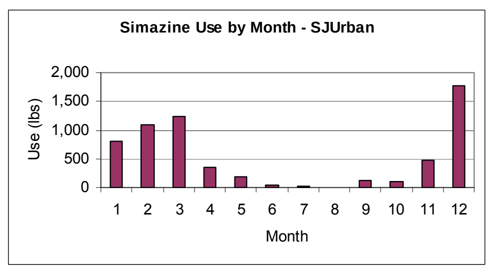
SacUrban: The annual average use was 498 lbs from 1998 to 2004 with the highest amount of use (2,428 lbs) in 1998. The annual use in 2004 was much higher than the other years'. The monthly use shows that the relatively high uses were between March and May with the highest use in May.



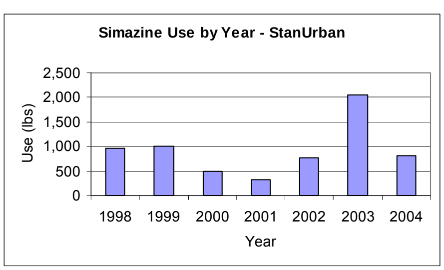


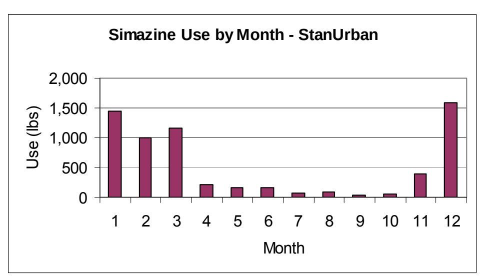
SJUrban: The annual average use was 885 lbs from 1998 to 2004 with the highest use (1,542 lbs) in 2003. The annual uses in 2003 and 2004 were much higher than the other years'. The monthly use shows that the relatively high uses were in the winter season with the highest use in December.





StanUrban: The annual average use was 912 lbs from 1998 to 2004 with the highest use (2,047 lbs) in 2003. The annual use in 2003 was much higher than the other years'. The monthly use shows that the relatively high uses were in the winter season with the highest use in December.





Water quality data: The SWDB had 1,848 concentration data, and 35% of data exceeded LOQ (0.005 to 0.5 µg/L). The highest concentration was 6.1 µg/L observed in April 1996. The highest observed concentration (6.1 µg/L) was lower than the lowest LC_{50} (4,300 µg/L) and EC_{50} (36 µg/L).

Conclusion: Simazine is ranked as high overall relative-risk because the major applications were during the winter storm season and the annual uses had increased trend for both agricultural and non-agricultural applications. Simazine has low water solubility, so observed concentration is not used as a factor in overall risk ranking. However, the highest observed concentration (6.1 µg/L) was lower than the lowest EC_{50} (36 µg/L) but higher than one tenth of the value (3.6 µg/L). Sediment contamination is ranked as "possible" because of its moderate Koc.

In addition, the DPR staff recommended including simazine in the target list because it has been detected in surface water.

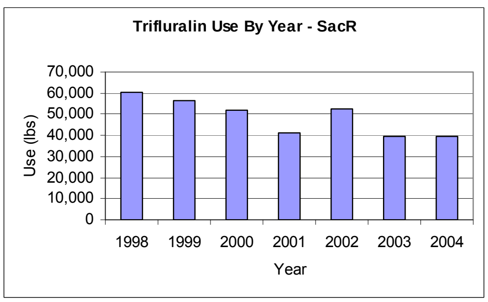
Trifluralin
Use: Herbicide.

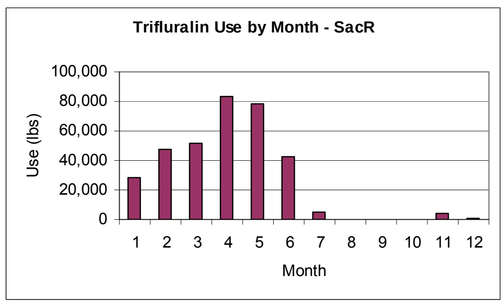
Physical properties: Very low water solubility (0.32 mg/L) and high Koc (7,200).

Toxicity: The lowest 96-hour LC_{50} was 8.4 µg/L for bluegill sunfish (*Lepomis macrochirus*). The lowest 5-day EC_{50} value was 15.3 µg/L for freshwater diatom (*Navicula pelliculosa*).

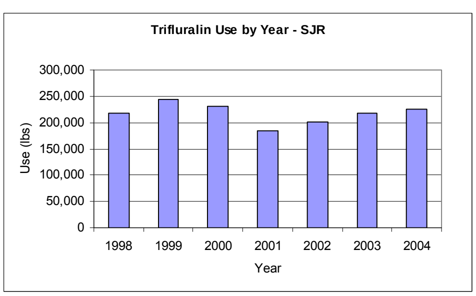
Usage: Selected as a target pesticide because of its relatively high amounts of uses for agricultural and non-agricultural applications. The relatively high uses for agricultural applications are in three sub-areas: Sacramento River Watershed (SacR), San Joaquin River Watershed (SJR), and Delta Watershed (Delta). The non-agricultural applications are in Sacramento County (SacUrban).

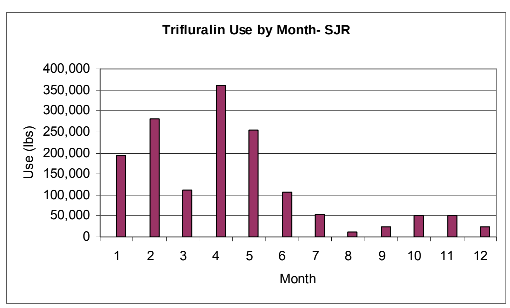
SacR: The average annual use was 48,844 lbs with the highest use (60,164 lbs) in 1998. The annual use had a slightly decreased trend from 1998 to 2004 except for 2002. The monthly use shows that relatively high uses were from January to June with the highest uses in April and May. The major applications were to tomato (51%), safflower (18%), and alfalfa (9%). The average annual application area was 63,142 acres.



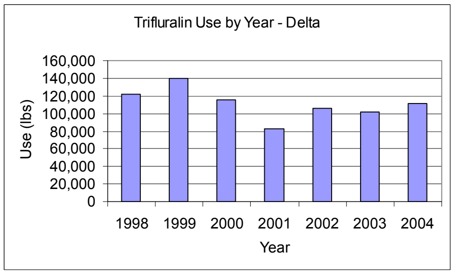


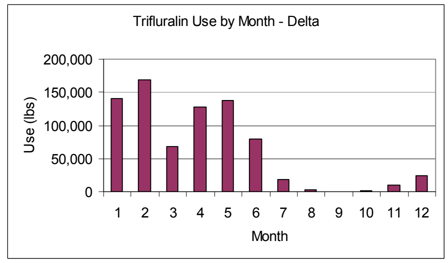
SJR: The average annual use was 217,512 lbs with the highest use (245,029 lbs) in 1999. The annual use had a slightly increased trend from 2001 to 2004. The monthly use shows that the relatively high uses were from January to June with the highest use in April. The major applications were to alfalfa (37%), cotton (24%), and tomato (17%). The average annual area was 63,142 acres.



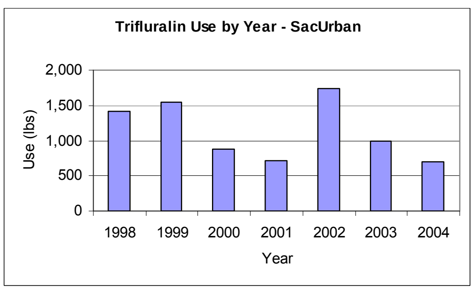


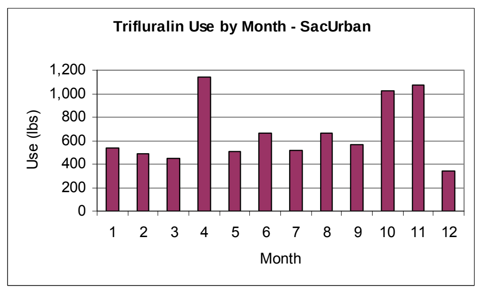
Delta: The average annual use was 111,221 lbs with the highest use (139,904 lbs) in 1999. The annual use had a slightly increased trend from 2001 to 2004. The monthly use shows that the relatively high uses were from January to June with the highest use in February. The major applications were to tomato (45%), alfalfa (27%), and safflower (12%). The average annual area was 63,142 acres.





SacUrban: The average annual use was 1,139 lbs with the highest use (1,741 lbs) in 2002. The annual use had a slightly decreased trend from 2002 to 2004. The monthly use shows that the applications were year-round with the highest use in April.





Water quality data: The DPR SWDB had 1,279 concentration data, and about 11% of data exceeded LOQ (0.002 to 0.1 µg/L). The highest concentration was 1.74 µg/L observed in May 2001.

Conclusion: Trifluralin is ranked as high overall relative-risk because of its high toxicity value, and relatively high uses in the storm season. Concentration data was not used in ranking the overall relative-risk because of its low water solubility. However, over 11% of samples tested for Trifluralin had concentration that exceeded the LOQ, and the highest observed concentration (1.7 µg/L) was higher than one tenth of the lowest toxicity value (0.84 µg/L). The risk for sediment contamination is ranked as “potential” because of its high Koc.

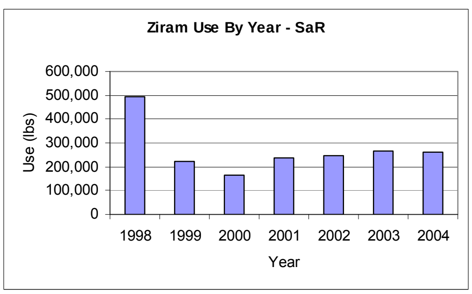
Ziram
Use: Fungicide.

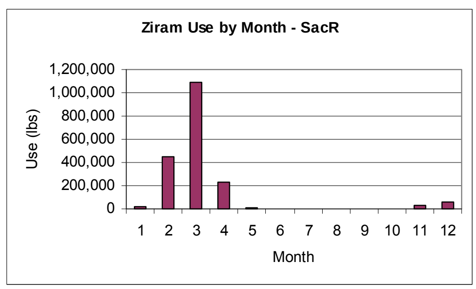
Physical properties: Moderate solubility (65 mg/L) and moderate Koc (400).

Toxicity: The lowest 96-hour LC_{50} was 8 µg/L for fathead minnow (*Pimephales promelas).*

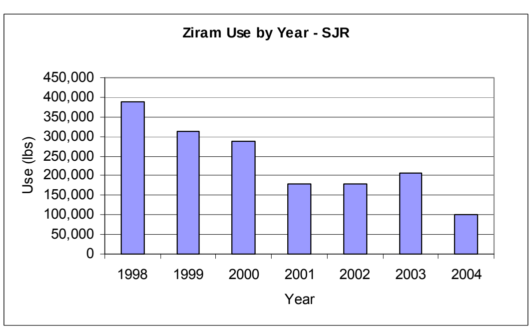
Usage: Ziram was selected as a target pesticide because of its relatively high applications for agricultural applications in Sacramento River Watershed (SacR) and San Joaquin River Watershed (SJR).

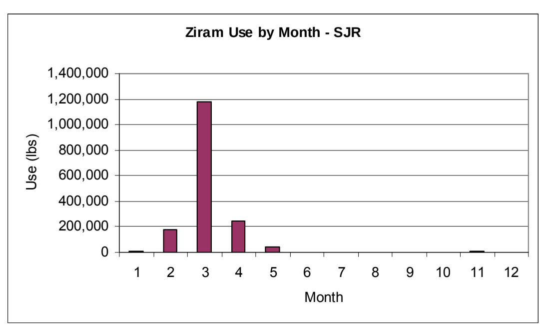
SacR: The average annual use was 270,515 lbs with the highest amount of use (494,527 lbs) in 1998. The annual use had a slightly increased trend from 1999 to 2004. The monthly use shows that relatively high applications were between February and April with the highest use in March. The major applications were to almond (68%), peach (26%), and pear (5%). The average annual application area was 52,671 acres.





SJR: The average annual use was 236,447 lbs with the highest amount of use (389,423 lbs) in 1998. The annual uses were in a decreased trend between 1998 and 2004. The monthly use shows that the highest use was in March. The major applications were to almond (76%), peach (7%), and grape (7%). The average annual application area was 52,671 acres.





Water quality data: There was no concentration data in the SWDB.

Conclusion: Ziram is ranked as high overall relative-risk because of its high toxicity and high use during winter storm season (March). The annual use trend various with locations. The SacR has increased trend but the SJR has decreased trend. The sediment contamination is ranked as “possible” because of its moderate Koc.

Appendix B. Moderate Overall Relative-Risk Pesticides

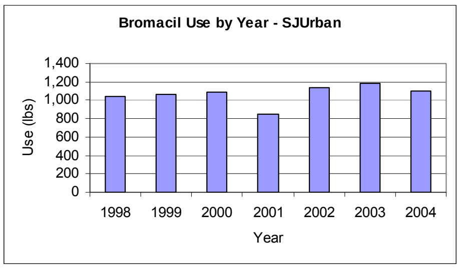
Bromacil
Use: Herbicide

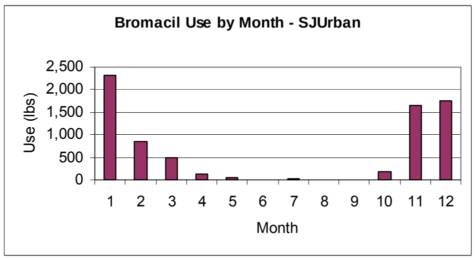
Physical properties: High water solubility (700 mg/L) and low Koc (14).

Toxicity: The lowest 96-hour LC_{50} was 36,000 µg/L for rainbow trout (*Oncorhynchus mykiss)*. The lowest 5-d EC_{50} was 6.8 µg/L for green algae (*Selenastrum capricornutum*).

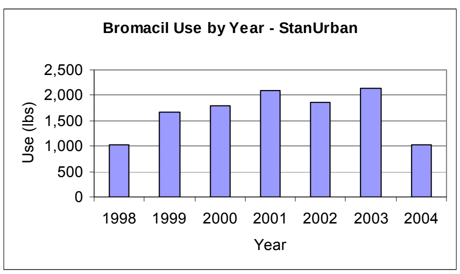
Usage: Selected as a target pesticide because of its relatively high uses for non-agricultural applications in two counties: San Joaquin (SJUrban) and Stanislaus (StanUrban).

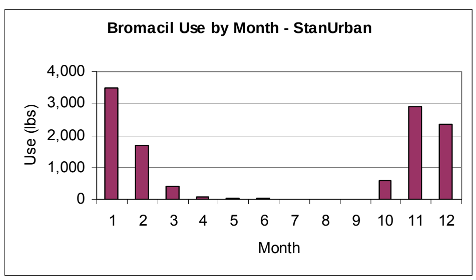
SJUrban: The average annual use was 1,066 lbs from 1998 to 2004 with the highest use (1,182 lbs) in 2004. The annual uses increased slightly from 2001 to 2003. The monthly use shows that relatively high uses were in the winter storm season and the highest use was in January.





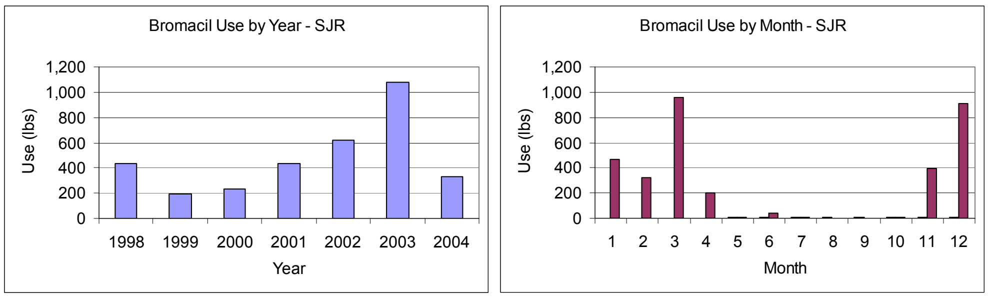
StanUrban: The average annual use was 1,654 lbs from 1998 to 2004 with the highest use (2,132 lbs) in 2003. The annual uses had slightly increased trend from 1998 to 2003. The monthly use shows that the relatively high uses were in the winter storm season, and the highest use was in January.





The major applications of bromacil were to “right of way” brush control for non-agricultural use. Bromacil was also applied for agricultural use but the amount of use was much lower than the non-agricultural uses. The annual use in San Joaquin River Watershed (SJR) is presented.

SJR: The average annual use was 476 lbs from 1998 to 2004 with the highest use (1,083 lbs) in 2003. The annual uses had an increased trend from 1999 to 2003, and then decreased in 2004. The monthly use shows that the relatively high uses were in the winter storm season with the highest use in March.



Water quality data: There were more than 600 concentration data in the SWDB, and 7% of data exceeded LOQ (0.035 to 5 µg/L). The highest concentration (1 µg/L) was detected in October 2000.

Conclusion: Bromacil is ranked as moderate overall relative-risk because of the highest observed concentrations (1 µg /L) in surface water below the lowest toxicity value (6.8 µg /L). However, the highest observed concentration (1 µg/L) was higher than one tenth of the toxicity value (0.68 µg /L). The risk to sediment contamination is ranked as “unlikely” because of low Koc.

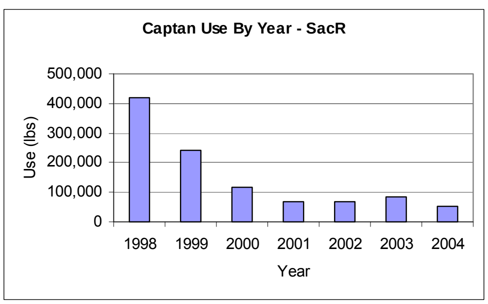
Captan
Use: Fungicide.

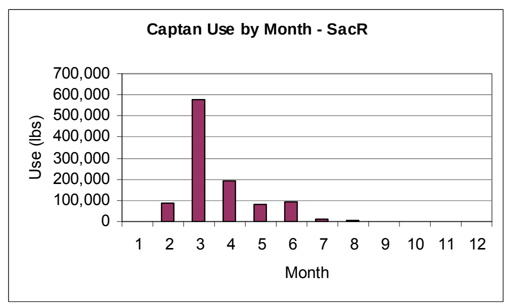
Physical properties: Low water solubility (5.1 mg/L) and moderate Koc (151).

Toxicity: The lowest 96-hour LC_{50} was 26.2 µg/L for brown trout (*Salmo trutta*).

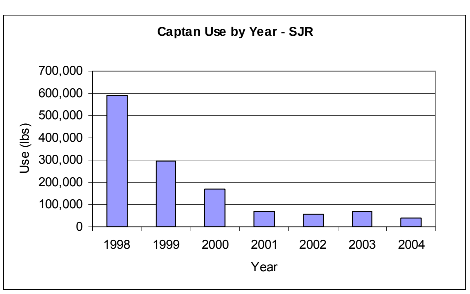
Usage: Selected as a target pesticides because of its relatively high uses in both agricultural and non-agricultural applications. The relatively high amount uses for agricultural uses are in Sacramento River Watershed (SacR) and San Joaquin River Watershed (SJR). The two counties with relatively high uses for non-agricultural applications are Butte (ButteUrban) and Stanislaus (StanUrban).

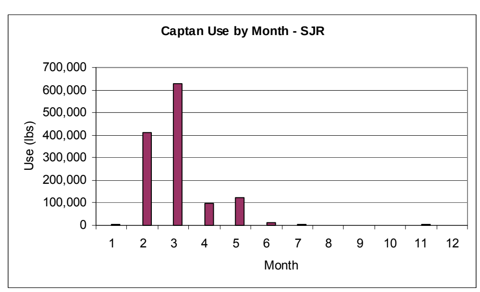
SacR: The average annual use was 150,086 lbs from 1998 to 2004 with the highest use (418,150 lbs) in 1998. The amounts of annual use were in a decreased trend from 1998 to 2004. The monthly use shows the relatively high uses were between February and June with the highest use in March. The major applications were to almond (51%), prune (42%), and corn (3%). The average annual use was 50,358 acres.



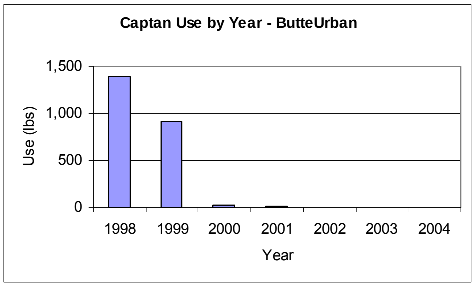


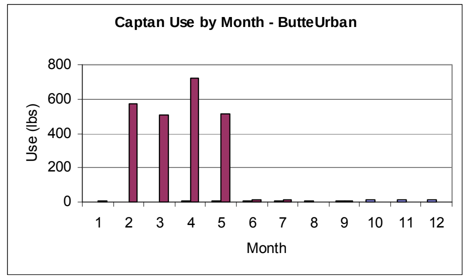
SJR: The average annual use was 184,363 lbs from 1998 to 2004 with the highest use of 590,450 lbs in 1998. The annual use was in a decreased trend from 1998 to 2004. The monthly use shows that the relative high uses were in February and March with the highest use in March. The major applications were to almond (82%), peach (5%), and corn (4%). The average annual use was 70,655 acres.



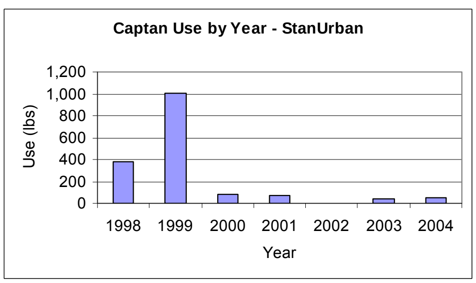


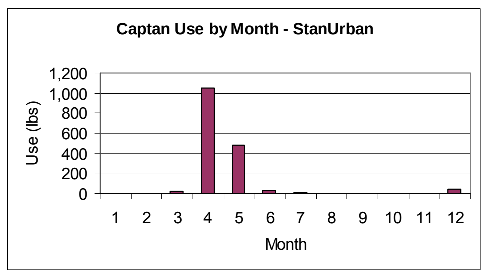
ButteUrban: The average annual use was 470 lbs from 1998 to 2004 with the highest use of 1,393 lbs in 1998. The amounts of annual use were in a decreased trend with no any uses from 2002 to 2004. The relative high uses were between February and May with the highest use occurring in April.





StanUrban: The average annual use was 272 lbs from 1998 to 2004 with the highest use of 1,009 lbs in 1998. The amounts of annual uses were very low from 2000 to 2004. The relative high uses were in April and May with the highest use occurring in April.





<u>Water quality data:</u> There were no concentration data in the SWDB.

<u>Conclusion:</u> Captan is ranked as moderate overall relative-risk because of its high reduction of use. The risk to sediment contamination is ranked as “possible” because of its moderate Koc.

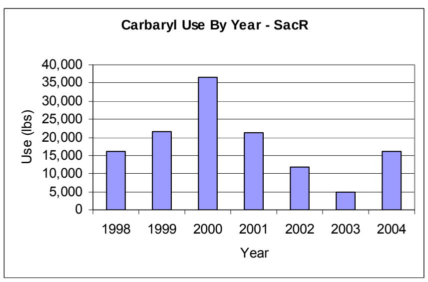
Carbaryl
Use: Insecticide.

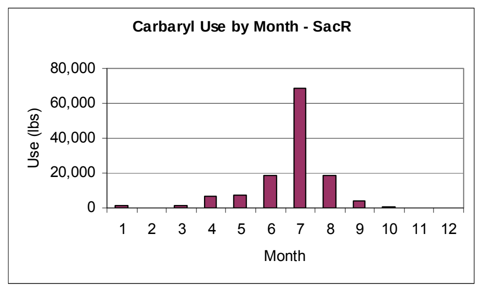
Physical properties: High water solubility (110 mg/L) and moderate Koc (288).

Toxicity: The lowest 96-hour LC_{50} was 1.7 µg/L for stonefly (*Pteronarcella badia*).

Usage: Selected in the target list because of the relatively high amount of use for agricultural applications in Sacramento River watershed (SacR).

SacR: The annual average use was 18,335 lbs between 1998 and 2004 with the highest amount of use (36,645 lbs) in 2000. The amount of annual use decreased from 2000 to 2003, and then slightly increased in 2004. The monthly use shows that the relatively high uses were from June to August with the highest use in July. The major applications were to melon (29%), rice (23%), and tomato (11%). The average annual area was 17,179 acres.





Water quality data: The SWDB had almost 2,000 concentration data and about 4% of the data exceeded LOQ (0.003 to 1 µg/L). The highest concentration was 0.5 µg/L observed in May 1997. The highest concentration was lower than the CDFG[2] proposed CMC and CCC values (2.53 µg/L), and also lower than the lowest LC_{50} value (1.9 µg/L).

Conclusion: Carbaryl is ranked as moderate overall relative-risk because the observed concentrations are lower than the lowest toxicity value and proposed CMC. However, the highest observed concentration was higher than one tenth of the toxicity value (0.19 µg/L). Carbaryl is ranked as "possible" because of its moderate Koc.

[2] CDFG: California Department of Fish and Game
http://www.cdpr.ca.gov/docs/emon/surfwtr/hazasm/hazasm98_1.pdf

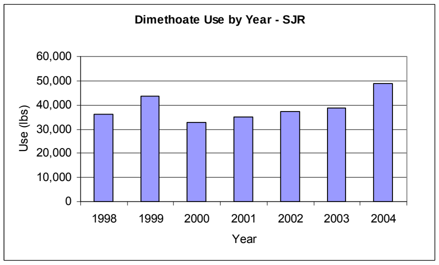
Dimethoate
Use: Insecticide, in class of organophosphates.

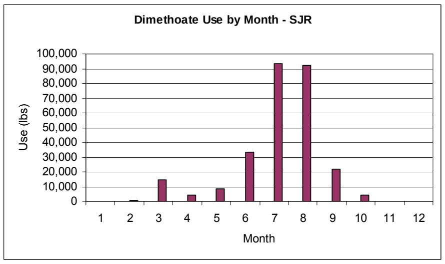
Physical properties: Very high solubility (39,800 mg/L) and low Koc (20).

Toxicity: The lowest 96-hour LC_{50} was 43 µg/L for stonefly (*Pteronarcys californica*).

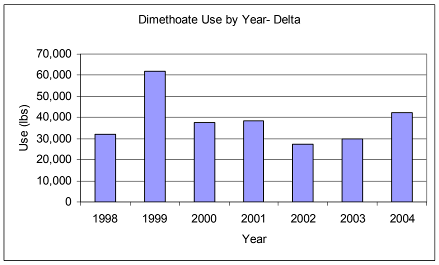
Usage: Dimethoate has been selected as a target pesticide because of the relatively high use for agricultural applications in two sub-areas: San Joaquin River Watershed (SJR), and Delta Watershed (Delta).

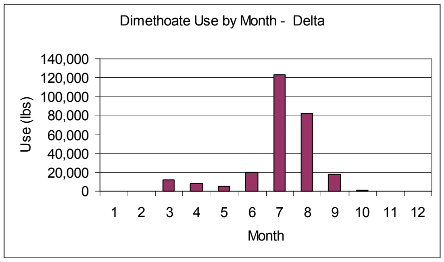
SJR: The average annual use of dimethoate was 38,902 lbs with the highest annual use (48,889 lbs) in 2004. The amounts of annual use had a slightly increased trend from 2000 to 2004. The monthly use shows that relatively high amounts were applied in July and August. The major reported applications were to bean (27%), tomato (19%), and alfalfa (14%). The annual average area was 92,289 acres.





Delta: The average annual use was 38,438 lbs with the highest annual use (61,700 lbs) in 1999. The annual use decreased from 1999 to 2002, and then increased from 2002 to 2004. The relatively high monthly uses were in July and August. The major applications were to tomato (70%) and bean (8%). The average annual application area was 76,055 acres.





Water quality data: The SWDB had over 1,000 data, and about 12% of data exceeded LOQ (0.024 to 0.1 µg/L). The highest observed concentration (7.73

μg/L) was observed in September 2003, and it was lower than the lowest 96-hour LC_{50} value (43 μg/L).

Conclusion: Dimethoate is ranked as moderate overall relative-risk because of low observed concentrations in the surface water. The highest observed concentration (7.73 μg/L) was lower than the lowest toxicity value (43 μg/L) but higher than the one tenth of the toxicity value (4.3 μg/L).

The relative-risk to sediment contamination is ranked as “unlikely” because of its low Koc.

Hexazinone

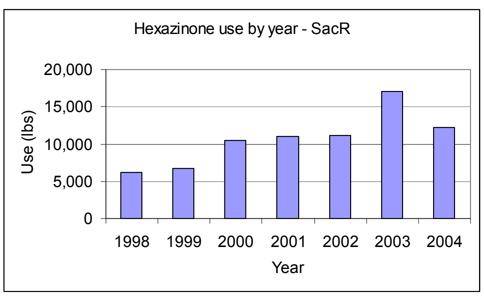
Use: Herbicide. A triazine.

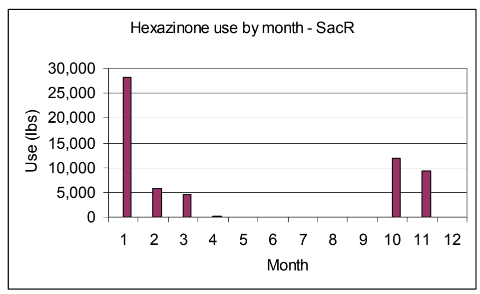
Physical properties: Very high solubility (29,800 mg/L) and low Koc (54).

Toxicity: The lowest 96-hour LC_{50} was 78,000 µg/L for grass shrimp (*Palaemonetes pugio*). The lowest EC_{50} was 6.8 µg/L for green algae (*Selenastrum capricornutum*) for a 120-hour.

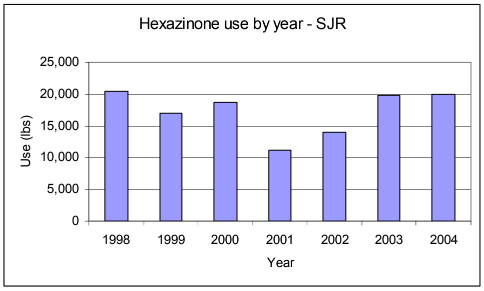
Usage: Selected in the target list because of the agricultural use in Delta Watershed (Delta). Although hexazinone was not selected for agricultural use in Sacramento River Watershed (SacR) and San Joaquin Watershed (SJR), the amounts of use were relatively high. The summaries of use in SacR and SJR are also presented.

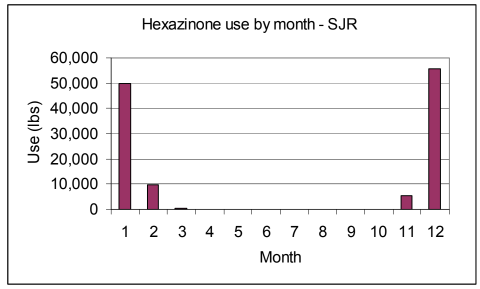
SacR: The average annual use was 10,677 lbs between 1998 and 2004 with the highest use (17,051 lbs) in 2003. The amounts of annual use increased from 1998 to 2003, and then decreased in 2004. The monthly use shows that the relatively high uses were in the winter storm season with the highest use in January. The major applications were to alfalfa (63%) and forest tree (37%). The average annual application area was 11,908 acres from 1998 to 2004.



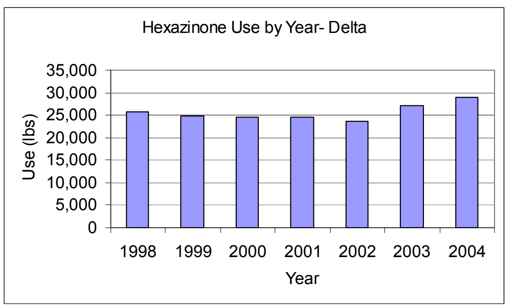


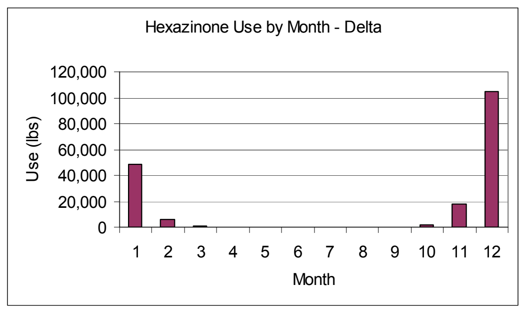
SJR: The average annual use was 17,300 lbs between 1998 and 2004 with the highest use (20,392 lbs) in 1998. The annual use decreased from 1998 to 2001, and then increased from 2001 to 2004. The month use shows that the relatively high uses were in the winter storm season with the highest monthly uses in December and January. The major applications were to alfalfa (99%). The average annual application area was 39,533 acres from 1998 to 2004.





Delta: The average annual use was 25,635 lbs between 1998 and 2004 with the highest use (28,900 lbs) in 2004. The annual use had a slightly increased trend from 2002 to 2004. The month use shows that the relatively high uses were in the winter storm season with the highest monthly uses in December and January. The major applications were to alfalfa (99%). The average annual application area was 39,987 acres.





<u>Water quality data:</u> The SWDB database had 439 concentration data and the samples were collected between 1997 and 2002. Eleven of the concentration data were over the LOQ (0.05 and 0.2 µg/L), and the highest concentration was 0.581 µg/L (February 2000).

<u>Conclusion:</u> Hexazinone is ranked as moderate overall relative-risk because of its high toxicity and low observed concentration. The highest observed concentration (0.581 µg/L) was even lower than the one tenth of the toxicity value (0.68 µg/L). The risk to sediment contamination is ranked as “unlikely” because of its low Koc.

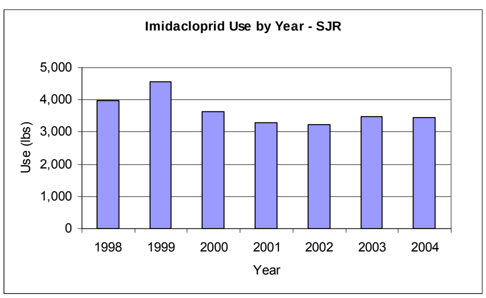
Imidacloprid
Use: Insecticide.

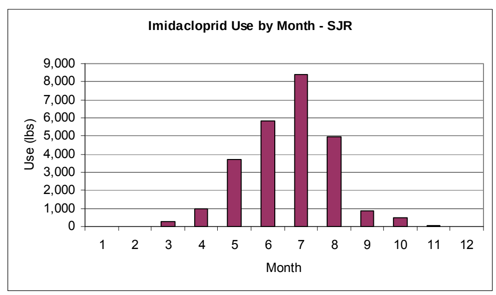
Physical properties: High water solubility (514 mg/L) and moderate Koc (262).

Toxicity: The lowest 96-hour LC_{50} was 38 µg/L for mysid (*Americamysis bahia*).

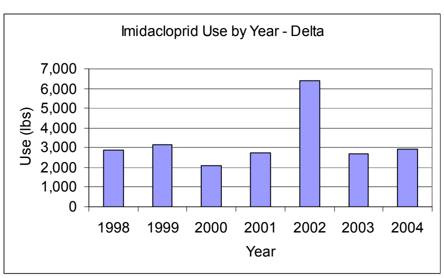
Usage: Selected as a target pesticide because of the relatively high applications for both agricultural and non-agricultural uses. The relatively high uses for agricultural uses were in San Joaquin River Watershed (SJR) and Delta Watershed (Delta). The relatively high uses for non-agricultural uses were in three counties: Butte (ButteUrban), Sacramento (SacUrban), and San Joaquin (SJUrban).

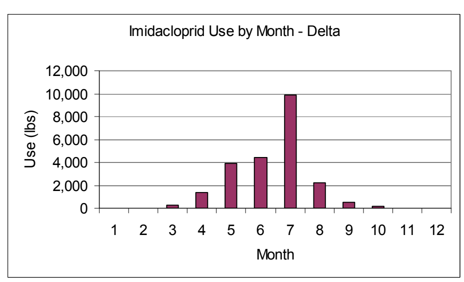
SJR: The average annual use was 3,662 lbs between 1998 and 2004 with the highest use (4,561 lbs) in 1999. The annual use had a slightly decreased trend between 1999 and 2004. The relatively high monthly uses were between May and August with the highest use in July. The major uses of pesticide were to grape (56%) and cotton (26%). The average annual application area was 66,860 acres.





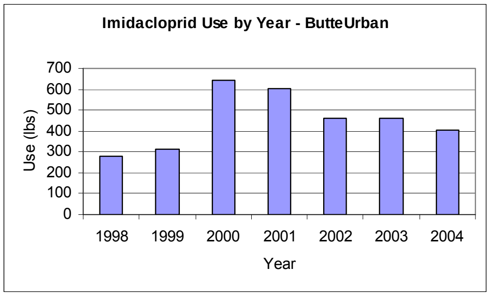
Delta: The average annual use was 3,265 lbs between 1998 and 2004 with the highest use (6,410 lbs) in 2002. The annual use shows slightly increased trend from 2000 to 2004 except for very high use in 2002. The relatively high monthly uses were between April and August with the highest use in July. The major uses of pesticide were to grape (85%). The average annual area was 46,256 acres.

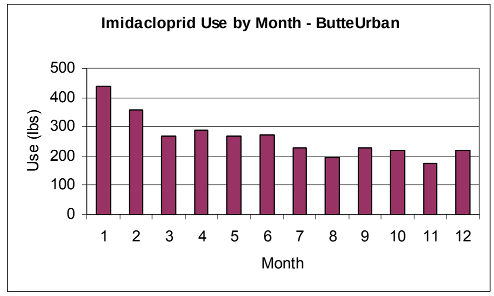




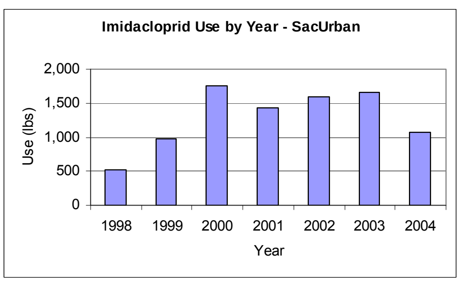
ButteUrban: The average annual use was 481 lbs between 1998 and 2004 with the highest use (641 lbs) in 2000. The annual use had a decreased trend from

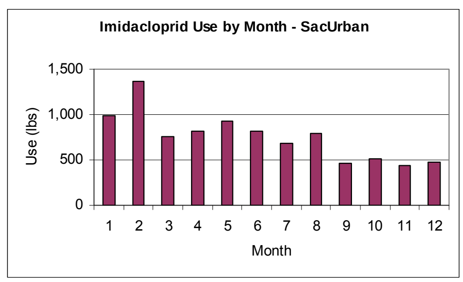
2000 to 2004. The monthly use shows that the applications were year-round with the highest use in January.



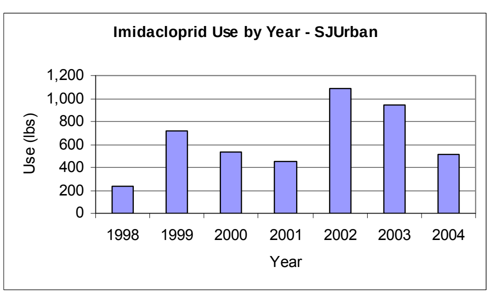


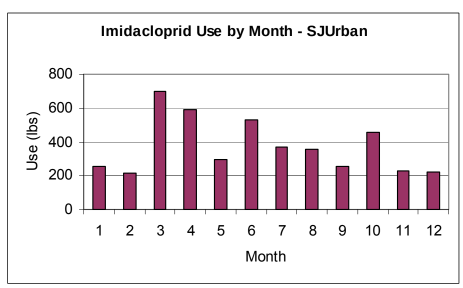
SacUrban: The average annual use was 1,288 lbs between 1998 and 2004 with the highest use (1,751 lbs) in 2004. The annual uses increased from 1999 to 2003 except for 2000 and 2004. The monthly application shows that the applications were year-round with the highest use in February. The main applications were to structural and landscaping.





SJUrban: The average annual use was 638 lbs between 1998 and 2004 with the highest use (1,086 lbs) in 2002. The annual use had a decreased trend between 2002 and 2004. The monthly use shows that the use were year-round with the highest use in March.





<u>Water quality data:</u> No concentration data were available in the SWDB.

<u>Conclusion:</u> Imidacloprid is ranked as moderate overall relative-risk because the major applications for agricultural applications are not in the winter storm season and slightly decreased use in recent years. However, the relatively high amount of uses for non-agricultural were in the winter storm season. In addition,

imidacloprid has high water solubility and relatively long half-life in water. The risk in urban area may be higher than the agricultural area. The risk of sediment contamination is ranked as “possible” because of its moderate Koc.

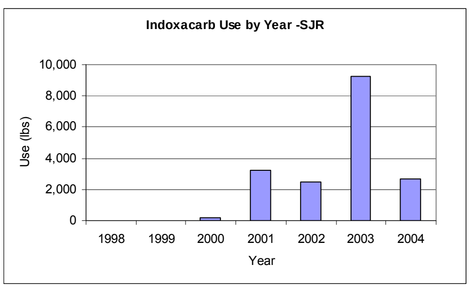
Indoxacarb
Use: Insecticide

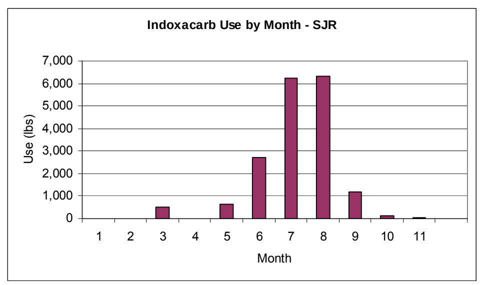
Physical properties: Very low water solubility (0.2 mg/L) and high Koc (5,626).

Toxicity: The lowest 96-hour LC_{50} was 24 µg/L for rainbow trout (*Oncorhynchus mykiss*).

Usage: Selected as a target pesticide because of its applications for agricultural uses in San Joaquin watershed (SJR).

SJR: The average annual use was 3,563 lbs with the highest use in 2003. The amount of use in 2003 was about three times of the used in other annual use. The monthly use shows that the relatively high applications were between June and September with the highest uses in July and August. The major uses were to alfalfa (41%), cotton (28%), and tomato (17%). The average annual area of application was 41,429 acres.





Water quality data: There were no concentration data in the SWDB.

Conclusion: Indoxacarb is ranked as moderate overall risk because of no heavy uses during the winter storm season. Indoxacarb is a relatively new pesticide that is considered as an organophosphate replacement. The risk of sediment contamination is ranked as “potential” because of its high Koc.

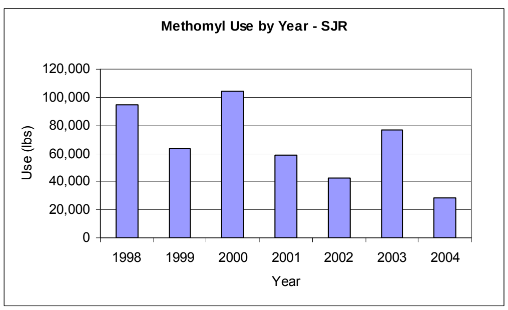
Methomyl
Use: Insecticide

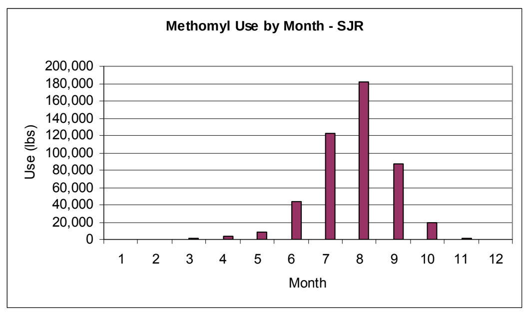
Physical properties: Very high solubility (58,000 mg/L) and low Koc (42).

Toxicity: The lowest 96-hour LC_{50} range from 19 µg/L for pink shrimp (*Penaeus duorarum*).

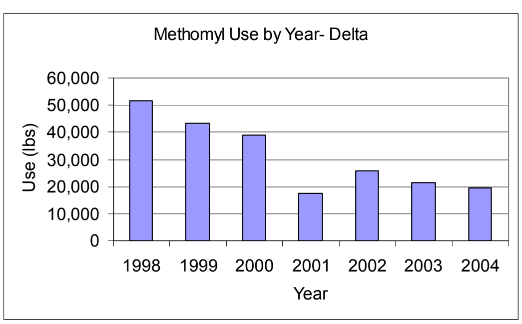
Usage: Selected as a target pesticide because of its applications for agricultural uses in San Joaquin River Watershed (SJR) and Delta Watershed (Delta).

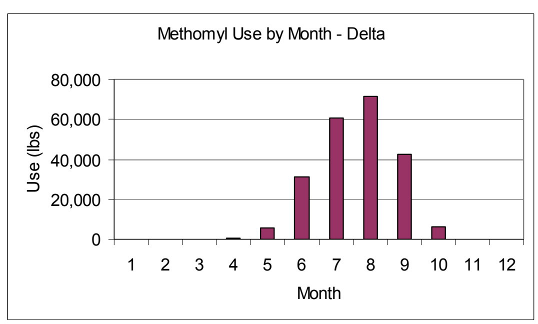
SJR: The average annual use was 67,002 lbs with the highest use (104,491 lbs) in 2000. The annual uses had a decreased trend from 1998 to 2004 except for 2000 and 2003. The monthly use shows that relatively high amounts were applied between June and September with the highest use in August. The major reported applications were to alfalfa (45%), tomato (11%), and sugar beet (9%). The annual average area was 130,559 acres from 1998 to 2004.





Delta: The average annual use was 31,299 lbs with the highest use (51,830 lbs) in 1998. The annual use was in a decreased trend from 1998 to 2004. The monthly use shows that high amounts were applied between June and September with the highest use in August. The major reported applications were to corn (36%), tomato (11%), and alfalfa (11%). The annual average area was 64,452 acres from 1998 to 2004.





Water quality data: The SWDB had 661 concentration data that were collected between 1991 and 2002. There were 119 of the concentrations over the LOQ (0.17 and 1 µg/L). The highest concentration (5.4 µg/L) observed in January 1992. The highest observed concentration was lower than the lowest toxicity value (19 µg/L).

Conclusion: methomyl is ranked as a moderate overall relative-risk because of the low observed concentration, reduction of annual use, and no uses in winter storm season. The highest observed concentration (5.4 µg/L) was lower than the lowest toxicity value (19 µg/L) but higher than the one tenth of the toxicity value (1.9 µg/L). Methomyl has very high water solubility. The risk of runoff during the irrigation season from row crops fields may need to be concerned because of high amount of use in June and July.

The sediment contamination risk is ranked as “unlikely” because of the low Koc.

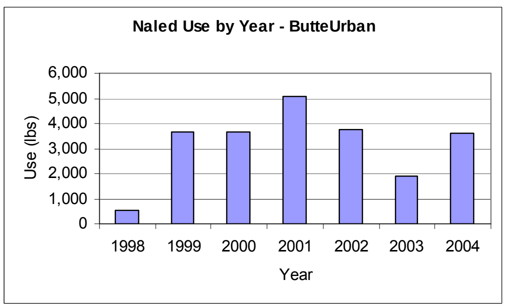
Naled
Use: Insecticide, an organophosphate (OP) pesticide.

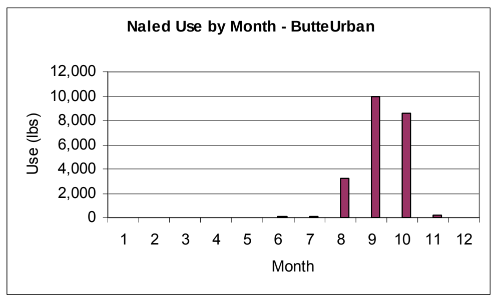
Physical properties: Low water solubility (1.5 mg/L) and moderate Koc (157).

Toxicity: The lowest 96-hour LC_{50} was 8.0 µg/L for stonefly (*Pteronarcys californica*).

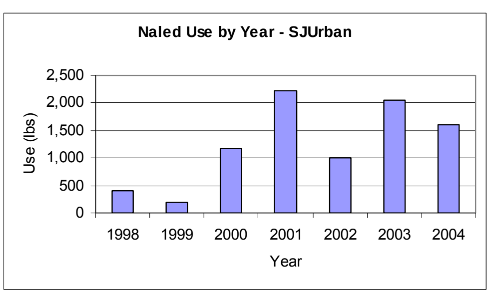
Usage: Selected as a target pesticide because of the relatively high application for non-agricultural uses in three counties: Butte (ButteUrban), San Joaquin (SJUrban), and Stanislaus (StanUrban).

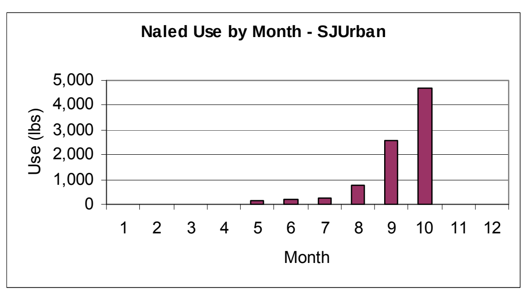
ButteUrban: The average annual use was 3,167 lbs from 1998 to 2004 with the highest use (5,074 lbs) in 2001. The annual uses decreased from 2001 to 2003, and then increased in 2004. The monthly use shows that the highest uses were in September and October.



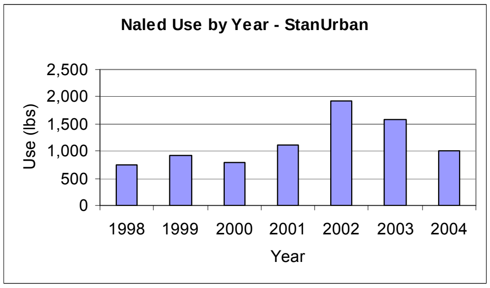


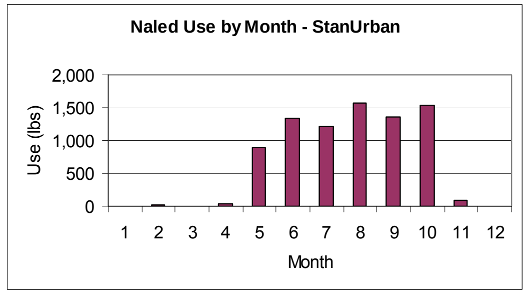
SJUrban: The average annual use was 1,236 lbs from 1998 to 2004 with the highest use (2,223 lbs) in 2001. The annual uses increased from 1999 to 2001, and then decreased from 2001 to 2004. The monthly use shows that the highest use was in October.





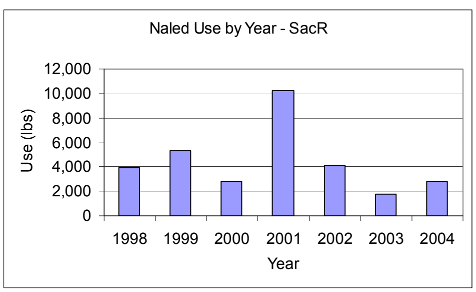
StanUrban: The average annual use was 1,154 lbs from 1998 to 2004 with the highest use (1,918 lbs) in 2002. The annual uses increased from 1998 to 2002, and then decreased from 2002 to 2004. The monthly use shows that the relatively high uses were between May and October with the highest use in August.

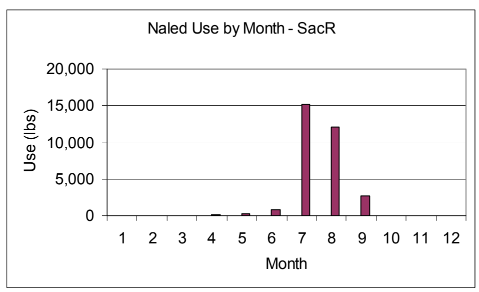




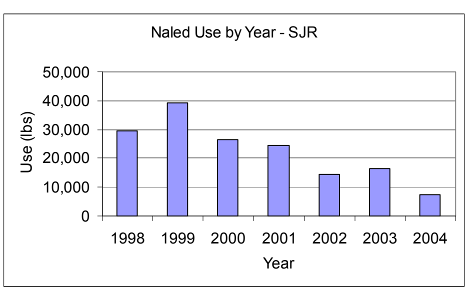
Naled was mainly applied on public health use (mosquito's control) for non-agricultural application. Naled was also used for agricultural application, and the annual use for agriculture was higher than the non-agricultural uses.

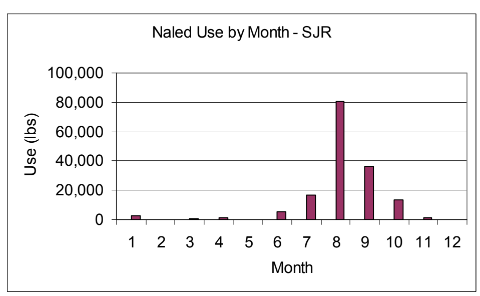
SacR: The average annual use was 4,441 lbs from 1998 to 2004 with the highest use (10,254 lbs) in 2001. The annual uses decreased from 2001 to 2004. The monthly uses shows that the relatively high uses were in July and August. The major applications were to cotton and beans.





SJR: The average annual use was 22,586 lbs from 1998 to 2004 with the highest use (39,153 lbs) in 1999. The annual uses decreased from 1998 to 2004. The monthly use shows that the highest use was in August.





Water quality data: There were 273 naled concentration data in the SWDB and none of them exceeded LOQ (0.5 µg/L).

Conclusion: Naled is ranked as moderate overall relative-risk to surface water because of low use in winter storm season and reduction of annual use. Concentration was not used as a factor in ranking naled because naled has low water solubility. There are over two hundreds concentration data, but none of them exceeded LOQ. Naled first registered in 1959 in the US. In 2006, it was in the list of OP insecticides used by US EPA as interim re-registration. Naled is ranked as "possible" to sediment risk because of its moderate Koc.

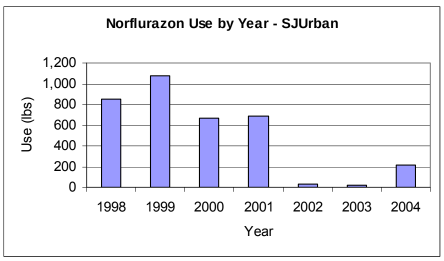
Norflurazon
Use: Herbicide.

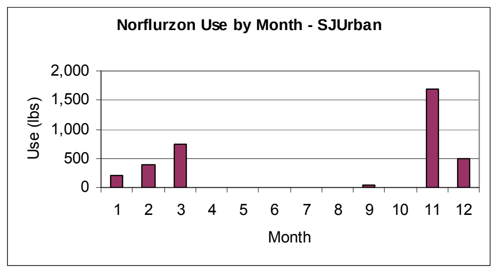
Physical properties: Moderate water solubility (34 mg/L) and moderate Koc (353).

Toxicity: The lowest 96-hour LC_{50} was 5,530 µg/L for mysid (*Americamysis bahia*). The lowest 5-day EC_{50} was 9.7µg/L for green algae (*Selenastrum capricornutum*).

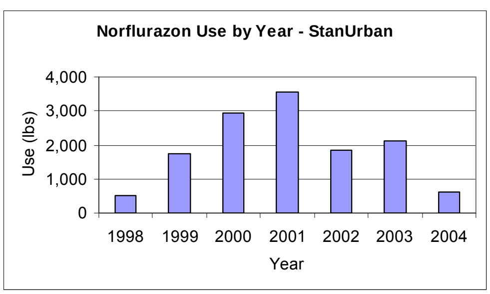
Usage: Selected as a target because of the annual uses for non-agricultural applications in two counties: San Joaquin (SJUrban) and Stanislaus (StanUrban).

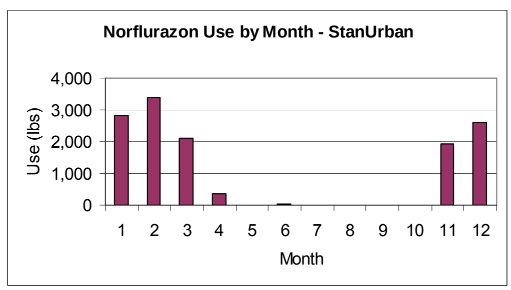
SJUrban: The average annual use was 507 lbs from 1998 to 2004 with the highest use (1,077 lbs) in 1999. The annual uses decreased from 1999 to 2003. The monthly use shows that the relatively high uses were in the winter with the highest use in November.





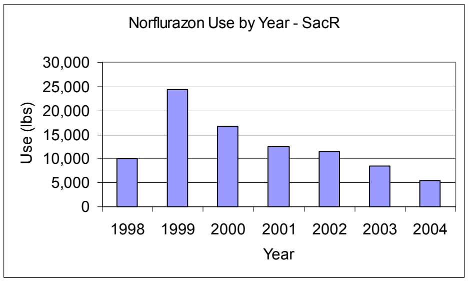
StanUrban: The average annual use was 1,894 lbs from 1998 to 2004 with the highest use (3,543 lbs) in 2001. The annual uses increased from 1998 to 2001 and then decreased from 2001 to 2004. The monthly use shows that the relatively high uses were in the winter with the highest use in February.

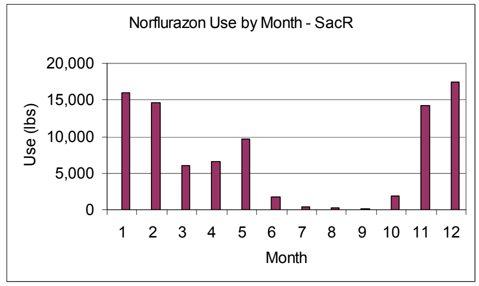




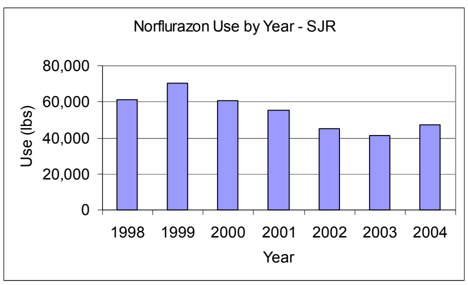
Norflurazon is mainly applied on “right of way” for non-agricultural uses. Norflurazon is also used for agricultural applications like almond and alfalfa.

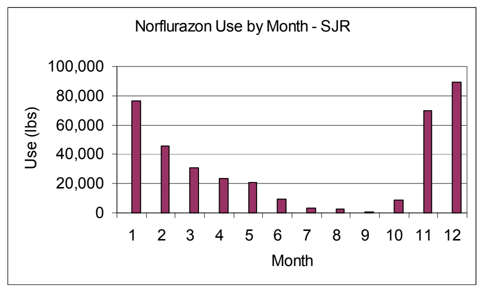
SacR: The average annual use was 12,723 lbs from 1998 to 2004 with the highest use (24,341 lbs) in 1999. The annual uses decreased from 1999 to 2004. The monthly uses showed that the relatively high uses were in the winter storm season with the highest uses in January, February, November, and December.





SJR: The average annual use was 1,894 lbs from 1998 to 2004 with the highest use (3,543 lbs) in 2001. The annual uses increased from 1998 to 2001 and then decreased from 2001 to 2004. The monthly use shows that the relatively high applications were in the winter storm season with the highest uses in January, November, and December.





Water quality data: There were 268 concentration data in the SWDB and 13% of the data exceeded LOQ (0.024 and 0.05 µg/L). The highest concentration was 1.49 µg/L observed in January 2001. The highest observed concentration (1.49 µg/L) was lower than the lowest EC_{50} value (9.7 µg/L) and much lower than the lowest 96-hour LC_{50} (5,530 µg/L).

Conclusion: Norflurazon is ranked as moderate overall relative-risk because of its high toxicity to aquatic plants, and low detected concentration in surface water. The highest observed concentration (1.49 µg/L) was lower than the lowest EC_{50} value (9.7 µg/L). The risk of sediment contamination is ranked as “possible” because of its moderate Koc.

Appendix C – Response to Public Comments

Comment Letter 1 – Jamesina Scott Ph.D., Mosquito and Vector Control Association of California.

> **Comment 1-1:** "This draft report is a component of the Central Valley Pesticide Basin Plan Amendment (CVPBA), the purpose of which is generating the technical information necessary to develop appropriate water quality objectives and policies for "natural water bodies" which are sources to which pesticides are not applied for public health purposes."
>
> "Nonetheless, this draft report raises several concerns among the Mosquito and Vector Control Districts (MVCDs) in our state. Seven of the ten mosquito adulticides registered for public health use in California are included on the High (chlorpyrifos, cyfluthrin, deltamethrin, lambda-cyhalothrin, malathion, and permethrin) or Moderate (naled) overall Relative-Risk Level Pesticide lists on pages 21 and 22."
>
> "Our main concern is that this report and the Central Valley Pesticide Basin Plan Amendment will lead to restrictions on when, where, and how MVCDs apply these products, which will compromise our ability to protect the public's health."

Response 1-1: This technical report does not constitute any current or proposed rule, regulation or policy by the Board. Also please note that the authority to regulate use of pesticides rests with DPR, not with the Regional Board. The Regional Board has the authority to regulate discharges of waste to waters of the state. The purpose of this report is to identify pesticides that pose the greatest risk to aquatic life beneficial uses. Some of these pesticides have already been identified as impairing beneficial uses in some water bodies. Information used in this report and other available information may be used to propose amendments to the Basin Plan relative to some of the pesticides mentioned in your letter.

> **Comment 1-2:** "We would like to have language added to this draft report and all related documents specifically excluding public health pesticide applications from consideration for the following reasons:
>
> 1) Mosquito and Vector Control Districts (MVCDs) make targeted applications based on surveillance data that demonstrates the need to do so in order to protect the public's health,
> 2) MVCDs do not apply these materials to "natural water bodies" as defined in the CVPBA*,
> 3) MVCDs' application rates and total materials applied are substantially lower than those used to control agricultural pests,

4) All of the public health pesticides used by MVCDs are registered with and approved by the EPA and CalEPA, and
5) MVCDs are signatories to a Cooperative Agreement administered by the California Department of Public Health, and are reviewed annually on-site by CDPH personnel. The Cooperative Agreement obligates signatory agencies to certain practices that promote safe and effective vector control and ensures that all state and federal pesticide use requirements are met."

Response 1-2: This technical report does not constitute any current or proposed rule, regulation or policy by the Board. The purpose of this technical report is to assist the Regional Board in prioritizing the efforts of this and other amendments. This has been clarified in the report. Once staff begins to work on actual proposed Basin Plan amendment language, we will consider your suggestions regarding public health considerations and suggestions we receive from other stakeholders.

> **Comment 1-3**: "On p. 6, Section 3.2 Target Pesticide List Creation, excluding pesticides because "aquatic life LC50 or EC50 data are not readily available" or because "chemical and physical properties are not readily available" may overlook many potentially high-risk pesticides. How many pesticides were excluded based on these criteria? Are there other useful criteria that could be used to justify why these pesticides were not considered?"

Response 1-3:
Five pesticides with relatively high toxicity were excluded due to lack of chemical and physical properties data from the listed chemical and physical properties databases (see Section 2.2). These five chemicals are acrolein, chlorsulfuron, MCPP, dithiopyr, and pyriproxyfen. No pesticides were excluded due to lack of aquatic life toxicity LC50 or EC50 data. The text of the report in sections 3.2 and 3.3 has been clarified to more clearly describe that step in the evaluation. Section 4 of the report now clearly acknowledges that the list may not include all potentially high risk pesticides, for this reason as well as others.

> **Comment 1-4**: "On p. A-70, the comments about naled seem to indicate that it was included specifically because of its public health uses ("Usage: Selected as a target pesticide because of the relatively high application for non-agricultural uses in three counties: Butte (ButteUrban), San Joaquin (SJUrban), and Stanislaus (StanUrban)") even though the agricultural uses were higher than the non-agricultural uses (p. A-71, "Naled was mainly applied on public health use (mosquito's control) for nonagricultural application. Naled was also used for agricultural

application, and the annual use for agriculture was higher than the non-agricultural uses."). A brief query of the DPR's PUR for 2003 and 2006 showed that roughly 10% of the amount of Naled applied in CA was for public health pest control uses (data available from http://calpip.cdpr.ca.gov/cfdocs/calpip/prod/main.cfm). Maintaining the availability of Naled is an important part of pesticide resistance management in mosquitoes, and amounts used for public health are negligible relative to the amounts used for agricultural pest control in California."

Response 1-4: Use quantities were used to select the pesticides. However, in terms of the amount of use, we agree, and the report states that the amount of use for agriculture is higher than the non-agricultural use. Also see Responses 1-1 and 1-2.

Comment 1-5: "Only 25 of the 29 High Overall Relative-Risk Level Pesticides were included in Appendix A. Chlorpyrifos was among the missing chemicals. What are the reasons for including it in the High Overall Relative-Risk Level Pesticide list?"

Response 1-5: Chlorpyrifos is among the list of High Overall Relative-Risk Level Pesticides (see Table 2A). In central Valley pesticide Basin Plan Amendment project scope of work, staff noted that diazinon and chlorpyrifos would be included as high risk pesticides due to the current impairment and TMDL status. Chlorpyrifos already has TMDLs developed, with staff reports that include much more detailed information than what was typically included in Appendix A of the current report. Therefore, there was no need to provide brief information in Appendix A.

Comment Letter 2 – Lenwood Hall Ph.D., University of Maryland

COMMENT 2-1: "The goal of this relative risk evaluation report for pesticides is to provide a screening level evaluation methodology for identifying and prioritizing a target list of current-use pesticides that pose the greatest overall relative risk to aquatic life in surface waters of the Central Valley region. In general, the process described in this report does provide some useful guidance on how to prioritize pesticides that may pose ecological risk in the Central Valley Region. Although the process used generally has various logical components, the authors have failed to provide sufficient references to support the approach that they used. For example, the Swanson and Socha (1997) book entitled " Chemical Ranking and Scoring: Guidelines for Relative Assessments of Chemicals' - a highly respected SETAC publication - could be cited and used to provide scientific credibility to the entire process. Other chemical ranking references could also be used (see numerous references in the Swanson and Socha 1997 book). The most common types of chemical ranking and scoring systems are: (1) simple categorizations based on expert judgement; (2) decision rule with predefined criteria; (3) endpoint scoring, with or without aggregations and (4) generic risk calculations. The authors need to clearly define what approach they have used and why."

Response 2-1:
While the authors didn't use the Swanson and Socha book as a resource during the study, this book was reviewed at the suggestion of the commenter. Table 1-1 in Swanson and Socha lists seven types of chemical ranking systems with many examples. The method used in this report corresponds most closely to what Swanson and Socha describe as a hybrid of endpoint scoring and decision rule approaches. However, as noted in the book, there are numerous variants of system structures in each class and many existing systems are actually hybrids of these broad classes. For this reason, the authors do not believe that classifying the approach used in this report would lend any additional value to its conclusions. The approach used is clearly described in the report and is not derivative of some other method.

Comment 2-2: "The executive summary should contain a summary of the results. For example, at least a list of the pesticides with high and moderate risk rankings should be included."

Response 2-2: The table is too lengthy to be included in it's entirety in an executive summary. However, a clear citation to the tables has en added to the executive summary.

Comment 2-3: "Page 2, last parag – Were the monitoring data properly screened for QA/QC procedures? All sources of monitoring data should be clearly identified with the associated QA/QC procedures. How were non-detection pesticide values addressed, particularly in cases where difference sources of data have different levels of detection for specific pesticides."

Response 2-3: All concentration data used in this report are from the DPR surface water database (DPR, 2004). As this method is a screening level effort, and does not constitute the scientific basis for any policy, staff depended on DPR's QA/QC procedures for their database. The database contains results from studies conducted by federal, state, and local agencies, private industry, and environmental groups. The database does not require submitted studies to have a detailed QA/QC plan but QA/QC plan should be described if there is one, otherwise, the submitted study should include a statement that no formal plan existed. Since no detailed data analysis (such as statistical analysis) is performed, the QA/QC procedure is not critical for the results of current study.

The method we used evaluated at the maximum concentration data for only 8 pesticides, and non-detects were not considered. The 8 pesticides are ranked as "high" toxicity and greater than "moderate" water solubility. The reported maximum concentrations for the 8 pesticides are accompanied by their limits of quantitation (LOQ) which in all cases are lower than the lowest toxicity values for those pesticides. Therefore, the ranking of these 8 pesticides was likely not affected by their detection limits.

> **Comment 2-4**: "Page 3, parag 2 – The most current PUR database was obtained from 2004. Can the authors provide some insight on how representative these older data are for current (2008) pesticide uses?"

Response 2-4: At the time of writing, the PUR data was only available up to 2004 when the project started. Currently the PUR data is available until 2006. Because the methodology is based on long term use trends (7 year's annual use), it is unlikely that changes in pesticide use in 2005 and 2006 will have a significant effect on this screening level analysis. As staff efforts proceed beyond a screening level analysis, additional data will be obtained. However, due to the time required to collect and process the pesticide use data, the PUR database is typically 1-2 years old before it is released by DPR.

> **Comment 2-5**: "Page 4, parag 6 – The influential benchmark for the toxicity data is the use of the lowest aquatic life value for each pesticide. All of these low values – which are key drivers in this entire process - need to be very carefully evaluated by reviewing the original document reporting these values. Have the authors considered using a species sensitivity distribution (SSD) approach with the receptor species for each pesticide (i.e., plants for herbicides) and using a 5th or 10 centile as the toxicity value for the ranking analysis. Using a centile developed from a distribution of toxicity values is much more credible that simply using the lowest toxicity value."

Response 2-5: The purpose of the relative-risk evaluation report is to help the Board prioritize which pesticides should be evaluated in greater detail. The goal of the report is not to perform a detailed risk assessment or otherwise determine the actual risk posed by any given pesticide, nor is it the purpose of the report to make any statements about the health of central valley waters or of their impairment status.

Several comments by this and other commenters recommend increasing the complexity of the analysis to something approaching a detailed risk assessment which is beyond the scope of available resources for this report. These suggestions include performing a quantitative exposure analysis, comparing the resultant exposures to criteria derived using species sensitivity distributions and interpreting these within a hazard quotient framework to provide quantitative ranking of risk and evaluation of actual risk to aquatic life. While such work is valuable, such a sophisticated analysis is beyond a screening level of effort, and would require a much greater level of resources than are currently available, given the number of pesticides in high use in the Central Valley Region.

While a more sophisticated analysis is not within the scope of this report, several of the suggestions recommended by this and other commenters are proposed for other tasks in the overall project. In particular, a species sensitivity distribution approach is currently under development by UC Davis (under contract to the Board) to be used to assist in developing alternative criteria for consideration by the Board. However, that project is separate from this prioritization exercise.

> **Comment 2-6**: "Page 5, parag 1 – As mentioned above for the PUR data, are the authors convinced that monitoring data collected from 1992-2003 represent current exposure patterns for the pesticides of interest?"

Response 2-6: The concentration data from 1992 to 2003 were available for the study. Similar to the response for PUR data, updated concentration data will be obtained as staff moves beyond screening level analyses.

> **Comment 2-7**: "Page 5, Section 3, parag 1 – For the three step process the authors should clearly state here (as they state on page 7 and 8) that a hazard quotient (HQ) approach (maximum environmental concentration/lowest toxicity value) is being used for risk ranking. Why not include the HQ for each pesticide in Table 2A?"

Response 2-7: The study does not use a hazard quotient approach (see response to comment 2-1). HQ is not feasible for this effort because not all high use pesticides are monitored at a level that provides meaningful concentration data. Also, a hazard quotient is not required for the next step in the process. Attempting to further rank pesticides within the assigned relative risk classes would suggest a level of analysis that was not intended and is not supported by the methodology.

> **Comment 2-8**: "Page 5, Section 3.1, parag 3 – What was the reason for selecting the top 30 pesticides based on application and/or total areas applied? Did the authors evaluate the distribution of application data and use these data to decide on a cutpoint of 30?"

Response 2-8: The choice of selecting the top 30 pesticides was based on the pesticides use data in Sacramento River watershed. The top 30 pesticides represented over 90% of pesticides used in terms of weight, and 60% of pesticides in terms of area treated. This was considered satisfactory for the current study.

> **Comment 2-9**: "Page 9, Section 3.4 – The sediment risk evaluation is very crude and only includes risk ranking categories of potential, possible and unlikely. It is based on the presence and degree (Koc values) of pesticides in sediment and does include a relationship to toxicity. A measured concentration of a pesticide in sediment is not equivalent to an adverse ecological effect."

Response 2-9: The Koc value ranking is just to provide brief information for sediment and is not intended to evaluate sediment risk.

> **Comment 2-10**: "Page 10, parag 5 – It appears that tralomethrin and PHMB were included as high risk pesticides based on best professional judgement by one individual. This type of action is subjective and does not follow the process used for ranking the other pesticides. Perhaps it would be more appropriate to add these two pesticides to a "Watch List" at this point in time until more data are available for a proper risk ranking."

Response 2-10: During early reviews of the draft report, TDC environmental, recommended considering urban pesticide sources and provided its study of urban pesticide use. The rationale used by TDC environmental in developing its list of urban pesticides of concern, described in TDC, 2007, was found to be adequate to include these two pesticides in the list. As discussed in section 2.1 of the report, the PUR database does not directly represent most urban pesticide. Therefore, the urban pesticides list from UP3 report was based on better sources for urban data and therefore was considered. Nearly all the pesticides highlighted in the TDC report were already identified by draft Relative Risk Evaluation technical report. The two additional pesticides identified in the TDC report were reviewed and added to the table of report. These two pesticides are marked using "*" in the table for readers (see Table 2A).

> **Comment 2-11**: "Page 10, parag 6 – The discussion of "joint toxicity" should be more balanced and state that there are three basic types of mixture interactions: antagonism – the toxicity of a mixture of chemicals is less than a simple summation of individual toxicities of individual chemicals; additive – the toxicity of a mixture of chemicals is approximately equal to that expected from a simple summation of toxicities of individual chemicals; and synergism – the toxicity of the

mixture is greater than expected from a simple summation of toxicities of individual chemicals."

Response 2-11: Discussion of Joint Toxicity has been added to the report.

> **Comment 2-12**: "Figure 5 – The HQ concept (maximum environmental concentration/lowest toxicity value) should be included in this flow chart to provide "real world context" for the toxicity data. For example, a very low pesticide LC50 value of say 50 ng/L would be irrelevant if the environmental concentration never exceeds 10 ng/L."

Response 2-12: A hazard quotient approach was not used in this report (see response to comment 2-1 and 2-7).

> **Comment 2-13**: "Table 2A – The lowest toxicity value reported for diazinon (0.2 µg/L for Gammarus fasciatus) is incorrect as this value should be 2.0 µg/L due to a units problem with data reporting from this 1966 study. This issue is explained in detail in Hall and Anderson (2005). This is good example of why the lowest toxicity value for each pesticide needs to be carefully checked by reviewing the original data.
>
> "If HQ values are reported in Table 2A as recommended above, this would provide a initial approach for determining which of the 29 pesticides ranked as high risk would have the highest risk priority."

Response 2-13: The data has been corrected in the table and its toxicity rank is changed to "High" from "very high". The change does not affect the overall relative-risk rank because diazinon was not evaluated in the current study.

See response to comment 2-1 and 2-7 for responses about hazard quotients.

Comment Letter 3 – Nassar Dean, Western Plant Health Association

> **Comment 3-1**: "As WPHA understands, the purported goal of this relative-risk evaluation report for pesticides is to provide a screening level evaluation methodology for identifying and prioritizing a target list of current-use pesticides to help the CVWQCB determine priorities for further pesticide evaluation and development of water quality objectives. Regarding the goal of conducting further pesticide evaluation, WPHA does NOT believe that the ranking process is necessary since the pesticides are all registered under FIFRA and have already been evaluated by simple and, where necessary, more sophisticated ecological and environmental risk assessment processes (and also for their human risk

> potential). Priorities for development of water quality objectives should be set by determining whether specific products are actually resulting in impairment of biological integrity by evaluation of multiple lines of evidence collected from specific water bodies. Instead, it appears that the CVWQCB's relative-risk evaluation is restricted to designing monitoring programs that generate data necessary to complete the lines of evidence useful for making impairment decisions. Accordingly, it would seem that the appropriate descriptive title of the report is probably best characterized as 'priority scheme' rather than 'relative-risk evaluation.'"

Response 3-1: The purpose of the report is to screen the various pesticides applied across large watersheds for the purposes of workload prioritization, not to assess the risk for any specific water body. In addition, this study focuses on the pesticides used in the study area. The risk assessment work performed under FIFRA does not consider the specific study sites and usage rates. In order to be pro-active staff has specifically not limited the analysis to only those pesticides with established records of impairment.

> **Comment 3-2**: "The process needs to be transparent. All data used should be reported and the classification process should be clear."

Response 3-2: The authors believe the approach used in the report is clearly described in the report and applied objectively and references are properly cited.

> **Comment 3-3**: "Objective criteria and methods should be used to rank the 'relative-risk.' Instead, the CVWQCB scheme described in the report appears to rely heavily on personal opinion and professional judgment."

Response 3-3: See Response to comment 2-10

> **Comment 3-4**: "Any relative-risk ranking or more correctly in this case, prioritization for future consideration, should be based on a standard and consistently selected data set. These data and selection criteria exist for pesticides but were not utilized in the CVWQCB process."

Response 3-4: With the exception of the urban use estimates, the data used for this screening process comes from commonly used and respected databases maintained by the US EPA and the DPR. As noted in comment 2-10, there is no current repository of urban use data so an urban use study prepared was consulted. The approach used in the report is clearly described in the report and applied objectively. The method used and subsequent results are similar to that used by DPR (Starner, 2007; see also response to comment 2-1).

> **Comment 3-5**: "WPHA recognizes that the process described in this report provides some useful guidance on how to prioritize pesticides to include in monitoring programs in the Central Valley Region. However, WPHA contends that CVWQCB's staff authors did NOT properly provide sufficient scientific references to support their methodology."

Response 3-5: See response 2-1.

> **Comment 3-6**: "WPHA would request that CVWQCB's staff authors clearly define what ranking and scoring system approach they have used and their respective justification for its use."

Response 3-5: See response 2-1.

> **Comment 3-7**: "WPHA would suggest that that you include a summary list of the pesticides with high and moderate risk rankings in the executive summary."

Response 3-5: See response 2-2.

> **Comment 3-6**: "Please answer, were the monitoring data properly tested to conform with the quality assurance and quality control (QA/QC) procedures? WPHA recommends that all sources of monitoring data should be clearly identified with the associated QA/QC procedures. How were non-detection pesticide values addressed, particularly in cases where difference sources of data have different levels of detection for specific pesticides?"

Response 3-6: See response 2-3.

> **Comment 3-7**: WPHA is concerned that the PUR was from reported usage from 1993-2004. WPHA requests that CVWQCB's staff authors provide some insight on just how representative these older data sets are for post-2007 pesticide uses. Do they represent current exposure patterns for the pesticides of interest?

Response 3-7: See response 2-4.

> Comment 3-8: "WPHA is concerned that the influential benchmark for the toxicity data is based on the lowest aquatic life value for each pesticide. All

of these low values, which are key drivers in this entire process, should be very carefully evaluated by reviewing the original document reporting these values."

Response 3-8: See response 2-5

Comment 3-9: "A glaring example to support this verification process was your lowest toxicity value reported for diazinon (0.2 µg/L for Gammarus fasciatus). This is incorrect. "The value should be 2.0 µg/L due to a unit conversion issue with the data from the original 1966 study. For more information, WPHA recommends that CVWQCB's staff authors review a paper by Hall and Anderson (2005) entitled 'Acute Toxicity of Diazinon to the Amphipod, Gammarus pseudolimnaeus: Implications for Water Quality Criteria Development'."

Response 3-9: See response 2-13.

Comment 3-10: "WPHA stresses that it is entirely insufficient to rely on the summary information in a database, although more confidence can be placed in those assembled by scientific regulatory agencies such as the USEPA. In addition, there are numerous factual corrections that will need to be made to the CVWQCB pesticide database as reflected in the tables within the draft report. Consequently, each impacted registrant plans to submit to the CVWQCB their respective and identified compound's correct data for the following emphasized criteria elements (as applicable):

1. Toxicity value
2. Water solubility value
3. Koc value
4. CAS number

"In view of this critical data, the correct numeric values will require the CVWQCB to re-evaluate/re-rank these impacted compounds according to the priority gradient scheme developed in Table 1."

Response 3-10: All data provided by commenters has been evaluated and values in the report have been changed as appropriate. Where a change in the value affected the rank, the pesticide rank has been adjusted. The range of toxicity values present in the appendix was just brief information from data sources used in the study. Since only the lowest value was used for ranking, the ranges of toxicity values are removed from the report. Since CAS number is not a critical number in ranking, it is removed.

Comment 3-11: "Since the CVWQCB staff authors have chosen to cite the PAN 2005 database, WPHA would recommend that as a government regulatory entity it would have been more credible and appropriate to first thoroughly and critically examine potentially prejudiced sources of information before its use."

Response 3-11: The data selected from PAN database can be found in other references, so PAN is removed from the reference.

Comment 3-12: "WPHA would recommend that CVWQCB consider using a species sensitivity distribution (SSD) approach with the receptor species for each pesticide (i.e., plants for herbicides) and using a 5th or 10th centile as the toxicity value for the ranking analysis. Using a centile developed from a SSD of toxicity values is much more credible that simply using the lowest toxicity value."

Response 3-12: See Response 2-3.

Comment 3-13: "WPHA would suggest that for the 3-step process your staff authors consider clearly stating here (that a hazard quotient (HQ) approach (maximum environmental concentration/lowest toxicity value) is being used for risk ranking. WPHA would suggest including the HQ for each pesticide in Table 2A."

Response 3-13: See Response to 2-5.

<u>Comment 3-14</u>: "To elaborate on this point, the methodology that CVWQCB's staff authors use determines risk in a 2-step ranking and scoring process. First, the likelihood of exposure is assessed and secondly, the toxicity is assessed. In reality, if a true risk evaluation is intended the process should NOT be separated into 2 steps. Rather, a comparison of likely water concentrations should be compared to a relevant ecological endpoint. WPHA emphasizes that the amount of usage determines the magnitude of the concentration. Then this concentration should be compared against the toxic endpoint. WPHA suggests that the CVWQCB review the 2005 work done by the US Geological Service (USGS) on Watershed Regressions for Pesticides (WARP) by Crawford CG, Larson SJ, and Gilliom RL entitled, "Development and Application of for Estimating Pesticide Concentration Distributions in Streams." The USGS draft report indicates that that about 50% of the variability in surface water concentrations can be attributed to use intensity. Please note: WARP was developed for rain-fed agriculture and may be most relevant to California winter conditions. CVWQCB should consider using a tool such as WARP to estimate a 95th percentile concentration which could be compared against an acute endpoint. Alternatively, a lower percentile such as the annual mean concentration could be used to compare against a chronic endpoint. Given the 2-step process, evaluating the compounds highest on a per pound basis as well as highest on a per acre basis is needed. However, the most straightforward and scientifically defensible procedure would be to calculate potential concentrations of all commonly used compounds and compare them to the relevant ecological endpoint."

Response 3-14: See response 2-5.

Comment 3-15: "Please describe the rationale that was used for selecting the top 30 pesticides based on application and/or total areas applied. How did CVWQCB's staff authors evaluate the distribution of application data and decide on 30 as a cut-off point?"

Response 3-15: See response 2-8.

Comment 3-16: "The sediment risk evaluation that CVWQCB's staff authors had used was highly unrefined and only included 3 risk ranking gradients of potential, possible and unlikely. This is based on the presence and degree (Koc values) of pesticides in sediment and does include a relationship to toxicity. WPHA must stress that the measured concentration of a pesticide in sediment is NOT equivalent to an adverse ecological effect."

Response 3-16: See response 2-9.

Comment 3-17: "WPHA is quite troubled that tralomethrin and PHMB were included as high risk pesticides based on the professional judgment by one individual. This sort of subjective interjection can only serve to cast doubt and undermine the scientific credibility of CVWQCB's report. In addition, this action fails to comply with the standardized format used for ranking the other pesticides. It would be more appropriate to add these 2 pesticides to a "Watch List" at this point in time until more data are available for a proper risk ranking."

Response 3-17: See response 2-10.

Comment 3-18: "WPHA recommends that draft report's discussion of joint toxicity should be clearly balanced and state that there are 3 basic types of mixture interactions:

1. Antagonism: the toxicity of a mixture of chemicals is less than a simple summation of individual toxicities of individual chemicals;
2. Additive: the toxicity of a mixture of chemicals is approximately equal to that expected from a simple summation of toxicities of individual chemicals; and
3. Synergism: the toxicity of the mixture is greater than expected from a simple summation of toxicities of individual chemicals."

Response 3-18: See response 2-11.

Comment 3-19: "WPHA recommends that the HQ concept (maximum environmental concentration/lowest toxicity value) should be included in this flow chart to provide "real world context" for the toxicity data. For instance, a very low pesticide LC50 value of 50ng/L would be irrelevant if the environmental concentration never exceeds 10ng/L."

Response 3-18: See response 2-5.

Comment 3-19: "The CVWQCB staff authors of the report did NOT state how a "value" was selected when multiple data points exist for a chemical property. Are the data: maxima, minima, arithmetic means, or another indicative value? Formal rules are necessary to deal with this situation, since the rankings can vary depending on the data selection process."

Response 3-19: Water solubility and Koc values are selected from the ARS database. When multiple values were available, a suggested value was denoted in the ARS database. This suggested value was used in the current study. If the database has no suggested value, for water solubility value, the selected value was based on temperature (around 20ºC and 25ºC) and pH (around 7). For Koc, the selected value was an average of all reported Koc. The report is clarified on this point.

Comment 3-20: "CVWQQB's draft report description concerning the role of water solubility required clarification. As stated later, the Koc value helps determine whether the residues are present in the sediment or runoff phase of water. Koc, not water solubility is the principle property regarding runoff, so the statement, "The higher the water solubility of a given pesticide, the higher is its risk to dissolve into irrigation or precipitation water and to move from the application site into a surface waterbody" is inaccurate. The important parameter in mechanistic runoff models is Koc and water solubility is not even an input variable unless volatilization is being considered. Water solubility is not usually relevant to maximum of concentration levels due to dissolved sediments and other impurities. While water solubility is generally correlated to Koc (high solubility implies low Koc), there are some notable exceptions where this relationship is inapplicable."

Response 3-20: The relative-risk evaluation is not intended to be a modeling exercise detailing the fate and transport of various pesticides. To be more accurate, the sentence has been changed to "…assumed that water solubility values are proportional to the amounts of pesticides in the soluble form in field runoff. Higher water solubilities indicate higher likelihoods for pesticides to be in the dissolved form in runoff water."

Comment 3-21: "The decision to focus on compounds applied during the winter months seems reasonable since runoff will occur primarily during this time. However, has the CVWQCB staff authors considered that untreated discharge of irrigation drainage water can also result in residues for applications made in the spring and summer?"

Response 3-21: For the pesticides ranked as "High" toxicity and either low solubility or without concentration data, the season that the pesticide is used is considered as an affecting factor. Previous staff experience with diazinon and chlorpyrifos have shown a high risk of runoff during storms for pesticides used during the winter season (e.g. diazinon and chlorpyrifos). As compared to the winter storm season runoff, irrigation runoff is more complex, varies with many environmental and human management factors, such as irrigation types and crops. At screening level, pesticides used in irrigation season have lower priority than the use in winter season.

Comment 3-22: "WPHA believes that the comparison of eco-toxicity endpoints with maximum concentrations seems overly simplistic. A single concentration could be the result of an unusual circumstance or even a false positive. A larger portion of the concentration distribution should be considered in the comparison of concentrations obtained in monitoring data and eco-toxicity endpoints. In addition, the location of the sample should be considered. For example, residues in a river would be of more concern than residues in a sample taken from an irrigation furrow in the middle of a treated field."

Response 3-22: See response to comment 2-5

Comment 3-23: “WPHA is quite troubled that CVWQCB’s staff authors have chosen to disregard the importance of environmental persistence and human management. Without these critical factors, the results will have significant distortions in the selection of pesticides. As mentioned earlier, human practices such as discharge of irrigation drainage water can significantly impact residues in surface water. Persistence in soil or water should also be considered. However, the effect of persistence may vary greatly depending on the specific situation. For a compound applied in late spring (in the absence of drainage water) minimal discharge will occur if the compound has degraded in the soil prior to the next large rainfall in the autumn. Because the time for a compound present in the water phase to move through surface water is usually measured in days, little difference would be observed between moderate and more persistent compounds. However, a degradation rate corresponding to a half-life of an hour would dramatically decrease potential adverse effects.”

Response 3-23: See response to comment 2-5.

Comment 3-24: “WPHA recognizes that while increasing or decreasing usage is a suitable criterion for assessing priority this does not change the actual concentrations in surface water, which for all of the compounds except for those with extremely high Koc, is dependent on use within a few days to a year - depending on the properties of the specific compound and the specific environmental conditions.”

Response 3-24: The overall relative-risk rank will be used to prioritize work efforts, not estimate the concentration in a specific water body. It should be pointed out that the pesticide use trend is the last factor (the less important factor) used in the ranking process.

Comment Letter 4 – James Wells, Environmental Solutions Group, LLC on behalf of the Pyrethroid Working Group.

Comment 4-1: “Members of the PWG are also members of the Western Plant Health Association ("WPHA") and we support the comments submitted by WPHA.”

Response 4-1: The Central Valley Water Board has received the WPHA comments and has provided responses in this report.

Comment 4-2: “As a matter of first impression, the PWG must express some reservations with the characterization of the report as a "Relative-Risk Evaluation." The term "risk evaluation" typically includes consideration of a number of different scientific factors including chemical, physical and biological data and information to determine the risk associated with pesticides. The process conducted here, as expressed in the Relative-Risk Evaluation, did not consider the three primary lines of evidence normally associated with a risk evaluation. The Relative Risk-Evaluation only considered pesticide usage information and toxicity information to develop a target list of pesticides. This target list does not reflect the consideration of any biological assessments that should also occur to determine the risk associated with pesticides. As such, the PWG recommends that the title of the report be changed to better reflect the actual process used for development of the target list of pesticides."

Response 4-2: See response 2-5.

Comment 4-3: "On a more general note, the PWG finds it necessary to remind the Regional Water Board that water quality objectives and water quality criteria developed for any of the target pesticides identified in the Relative-Risk Evaluation must be adopted in accordance with state law. In particular, when adopting water quality objectives, the Regional Water Board must ensure reasonable protection of beneficial uses and consider a number of factors, including, but not limited to, water quality conditions that can be reasonably achieved, and economics. (Wat. Code, § 13241.) The Regional Water Board is also required to adopt a program of implementation at the same time that includes a description of actions that are necessary to achieve the objectives, a time schedule for the actions, and a description of surveillance to be undertaken to determine compliance. (Wat. Code, § 13242.)"

Response 4-4: The larger Central Valley Pesticide Basin Plan Amendment project, of which this technical report is a part, will consider pesticide water quality objectives and implementation plans; but that work is not within the scope of this technical report. When water quality objectives and implementation plans are proposed, they will be evaluated in accordance with the requirements of Porter Cologne sections 13241 and 13242.

Comment 4-5: "To the extent that water quality criteria for pesticides on the target list are developed but not adopted as numeric water quality objectives, such pesticide criteria should not result in permit limitations and/or triggers for the development of agricultural water quality management plans because they have not been adopted pursuant to state law. To avoid misuse of the target list, the PWG recommends that the Relative-Risk Evaluation be revised to clarify the Regional Water Board's intent with regard to the target list of pesticides contained within the Report. We recommend it be revised to clearly state that the Relative-Risk

Evaluation is a technical document that has no regulatory force or effect and that the information contained therein is for the purpose of identifying pesticides for the potential development of numeric water quality objectives. It should also state that the inclusion of a pesticide on the target list is not intended to mean or imply that detection or presence of an identified pesticide results in an impact to aquatic life beneficial uses. Impacts to beneficial uses can only be determined after a water quality objective has been properly developed and adopted in accordance with applicable state and federal laws. Language that clarifies the intended purpose of the target list within the report will help to ensure its proper usage in the future."

Response 4-5: As discussed in response to comment 4-4, the Relative-Risk Evaluation report does not generate or evaluate any water quality criteria. The technical report already includes a prominently displayed disclaimer that no policy or regulation is either expressed or intended. However, the report has been revised to clarify the intent and proper use of the report. The Regional Board can use available criteria and information about the toxicity of a contaminant (including pesticides) to interpret compliance with the Basin Plan narrative toxicity objective. This approach has been used in some TMDLs. TMDL targets were established to comply with the Basin Plan narrative toxicity objective rather than establishing a specific numerical objective for a contaminant.

Comment Letter 5 – Roberta Firoved, California Rice Commission.

Comment 5-1: The commenter provided detailed background information on the California Rice Commission and provided some historical information about pesticide use and regulation as it relates to rice cultivation and more specifically to references that describe the use of thiobencarb and molinate pesticides. The complete text can be found in the attached comment letter.

Response 5-1: The author reviewed the two reports during the literature review period and determined that the current report had a different goal and could not use the same approach. This could have been clearer in the original report. Specifically, the report stated, "… the results of two previous efforts that addressed the same goal were reviewed", which was incorrect. Therefore, we have deleted the paragraph

Comment 5-2: "Page 3, 2.2 Pesticide Chemical and Physical Properties Databases. The Evaluation cites consultation of four databases for chemical and physical property data, including the Pesticide Action

Network (PAN pesticides database; PAN, 2005). On May 30, 2008, the CVRWQCB held a workshop to present the Evaluation. At the workshop, the CVRWQCB made a statement that the PAN database was not utilized and referenced the following resources:

1) Agricultural Research Service (ARS database; ARS, 2004)
2) Extension Toxicology Network (EXTOXNET database; EXTOXNET, 2003)
3) Pesticide Action Network (PAN pesticides database; PAN, 2005)
4) Unpublished DPR chemistry/physical database (for DPR internal use)

"On May 30, 2008, the CVRWQCB staff presentation listed the following databases:

1) DPR Pesticide Use Reporting (PUR) database (1998 – 2004)
2) U.S. EPA/Office of Pesticide Programs (OPP) toxicity database using the lowest 48/96/120 hour LC50 or EC50 values
3) U.S. Department of Agriculture (USDA) Agriculture Research Services (ARS)
4) database for water solubility values and Koc
5) DPR Surface Water Database for pesticide concentrations (1992 – 2003)

"The CRC understands that inclusion of the PAN database in the Evaluation document was an oversight. However, the CRC must comment on the content of the document and requests that the CVRWQCB not use data developed or distributed by advocacy groups for pesticide evaluations."

Response 5-2: See response 3-11.

Comment 5-3: The commenter stated support for the comments expressed by the Western Plant Health Association (Comment letter 3), and specifically quoted the comments listed in this response to comments report as comments number 3-1, 3-12 and 3-16.

Response 5-3: Comments from the Western Plant Health Association are responded to above. Specific responses to the quoted comments can be found in responses 2-3, 2-9 and 3-1.

Comment 5-4: "The CRC recommends inclusion of cultural practices to manage irrigation discharges. In addition, the current registration process assesses environmental effects of pesticides. It appears that the

CVRWQCB staff distrusts the pesticide regulatory process, which leads to assumptions in the Evaluation."

Response 5-5: See Response 3-21: Consideration of management practices is beyond the scope of this report.

Comment 5-6: "Page A-23, Fipronil - In California, no agricultural uses exist for fipronil other than turf and golf courses. No registration of fipronil ever existed for use on rice in California, nor was the product a replacement for carbofuran. The only carbofuran replacement was the pyrethroid insecticide, lambda cyhalothrin, which is not an acre-to-acre substitute. Rice growers modified cultural practices for insecticide applications, and do not typically treat the entire field to maintain insect control.

"The U.S. EPA registered fipronil for use on rice in other states. In California, all pesticides used and registered in the state must go through a registration process at the U.S. EPA and then favorably pass the process at DPR. The fipronil registrant never pursued registration of the product on rice in California, nor did the CRC support this action."

Response 5-6: The text in the report are changed, to remove the use for rice fields.

Comment 5-7: "Page A-26, Lambda cyhalothrin - The lambda cyhalothrin evaluation would benefit from inclusion of the PUR data from 2005 and 2006. Since 2004, rice use is less significant with dramatic increases in row, annual and tree crops. The Evaluation references relatively high uses during the winter storm season, which results from increases in applications during the dormant season to permanent crops."

Response 5-7: The change of use on rice fields is most likely for the sub-area, SacR only. For the other two sub-areas (SJR and Delta), the major applications are not on rice fields. Pesticides use trend and major crop applications could be changed after 2004, but the major crop application is not a factor in ranking relative-risk. For lambda cyhalothrin, PUR data does not affect its overall relative-risk ranking. However, staff thanks you for the information.

Comment 5-8: "Lambda cyhalothrin belongs to the pyrethroid class of pesticides currently under reevaluation by DPR. The pesticide registrants and their representatives formed a Pyrethroid Work Group (PWG) to assist DPR in the pesticide reevaluation. The CRC supports the DPR reevaluation process and trusts the expertise of the PWG. Therefore, the

CRC recommends the CVRWQCB allow resolution of the DPR pyrethroid reevaluation rather than develop standards that precede mitigation.

"DPR and Syngenta, the registrant, monitored lambda cyhalothrin in 2000 and 2001. DPR monitored lambda cyhalothrin in 2000 at Colusa Basin Drain 5 (CBD5) and Sacramento River 1 (SR1). The detection limit was 0.01 µg/L, less than the lowest ECOTOX data value. All results were non detect.

"Syngenta monitored lambda cyhalothrin in 2001 at CBD5, Tuttle Ranch (CBD at the Maxwell Diversion Dam), Johnson Ranch (at Butte Slough), Watt Ranch (CBD at Maxwell-Colusa Highway). The detection limit was 0.001 µg/L. Detections ranged from <0.001 to 0.0052 µg/L, less than the lowest AQUIRE value.

"Note: Rice water holding requirement is 7 days."

Response 5-9: Staff does not see a need to delay a screening level evaluation until completion of a registration process that may take many years. Also, the registration process does not have the same regulatory mandate and does not provide the information required by the Regional Water Board to meet its regulatory mandate. Specifically, the registration process does not necessarily generate a criteria value that is necessarily protective of aquatic life[3]. Therefore completion of the registration process will not alleviate the need for the Regional Water Board to perform the work included in this report. Finally, development of water quality objectives can assist the registration risk assessment work by providing a clear criterion against which to judge environmental exposures.

In regards to the specific studies referenced, staff thanks you for the information. These results are similar to the results included in Appendix A of the report. However, lambda cyhalothrin is included in the report because of its very high toxicity. For the pesticides with very high toxicity, observed concentration is not a factor in overall relative-risk ranking.

In addition, staff notes that the detection limit in the DPR/Syngenta monitoring is above the lowest toxicity value found (0.0041 µg/L) so there are some concerns about the environmental relevance of this data. The levels the commenter mentions in the subsequent Syngenta study exceed the lowest LC50s found for Lambda Cyhalothrin (0.0041ng/L). Using the current Basin Plan policy of interpreting the narrative pesticide objective using 1/10th of the lowest LC50, these levels could be exceeding the water quality objectives. In addition, there

[3] The 2002 Chlorpyrifos IRED (EPA 738-R-01-007) serves as a good example. The IRED specifically acknowledges that even with mitigation, "potential risk to invertebrates, particularly estuarine invertebrates may still be of concern. Risk quotients represent a screening level assessment and are inadequate to predict whether the levels of chlorpyrifos entering estuarine areas are sufficient to affect invertebrate populations or populations of the larger species that depend on them as a food source." (EPA. 2002b).

are three current impaired waters listings for pyrethroids (including lambda cyhalothrin) in Del Puerto Creek and Ingram Creek.

In regards to the holding time, the screening report did not consider the potential effects of hold times, since these are not applied for all uses on a watershed basis.

> **Comment 5-10**: "Page A-40, Pendimethalin - Pendimethalin is a pre-plant herbicide used on dry seeded rice, which accounts for approximately one percent of the total acreage (5,000 acres). The total rice acres treated from 1998 to 2004 ranged from 1,164 to 2,481 (average acres: 2,855) with the highest acreage recorded in 2001 at 5,072. These numbers do not constitute significant use of the product.
>
> "The U.S. EPA reevaluation notes that pendimethalin has low acute toxicity and was placed in Toxicity Category III, the second lowest of these standards (EPA RED 1997). The Evaluation assumes lower annual use of pendimethalin due to an U.S. EPA notice of voluntary cancellation. Pendimethalin is an older product mandated to undergo the U.S. EPA registration process where voluntary cancellations are common as registrants consolidate the list of registered products, and/or withdraw certain uses resulting from the tolerance reassessment (40CFR §180.361). In addition, pendimethalin is available for use by other registrants, so it is standard process to cancel registrations of products resulting in little or no sales.
>
> "As an example, voluntary cancellations of several propanil registrations resulted from the reregistration process. Registration cancellations for barley, oats and wheat took place in other states. In California, propanil [sic] was always a rice specific pesticide."

Response 5-10: Pendimethalin was selected due to the non-agricultural uses in three counties not agricultural uses in the three sub-areas. Therefore, the amount of use is relatively lower than the other pesticides. The U.S. EPA assessment did not consider plant data and Pendimethalin is an herbicide.

> **Comment 5-11**: "Page A-46, Propanil - Propanil is the only rice specific herbicide in the Evaluation, and economically the most important pesticide used on California rice. The U.S. EPA risk assessment preceding the reregistration process determined that the only issue of concern was human exposure to pesticide mixers/loaders and applicators. The reassessment of dietary risk, including public exposure through food and drinking water as required by the FFDCA indicates that propanil poses no risk concerns; therefore, no risk mitigation is needed and no further

actions related to dietary risk are warranted at this time (Federal Register: OPP-2002-0033; FRL-7179-4). Pursuant to the reregistration process, the U.S. EPA ordered a data call-in (DCI) of various studies including environmental fate for the metabolite N-(3,4-dichlorophenyl) propanamide (3,4-DCA).

"The U.S. EPA utilizes guidelines specifying data requirements for pesticide registration, which mandate the type of study, the number of studies and the amount of replications that a registrant must comply for data submission. The U.S. EPA Office of Prevention, Pesticides and Toxic Substances (OPPTS) developed harmonized guidelines to combine the testing guidance and requirements from the Office of Pollution Prevention and Toxics (OPPT) that appeared in 40CFR, chapter I, subchapter R, the Office of Pesticide Programs (OPP) from publications of the National Technical Information Service (NTIS), and the guidelines published by the Organization for Economic Cooperation and Development (OECD).
The purpose for harmonizing these guidelines into a single set of OPPTS guidelines is to minimize variations among the testing procedures that must be performed to meet the data requirements of the U. S. EPA under the Toxic Substances Control Act (TSCA) (15 U.S.C. 2601) and the FIFRA (7 U.S.C. 136 et seq.).

"Propanil has very low toxicity to aquatic organisms; therefore, the Evaluation uses EC50 (rather than the LC50) in evaluating water quality data for effects to aquatic plants. The rice water holding requirement is 7 days to address environmental fate concerns resulting from the RED (EPA RED 2003, amended 2006). Propanil is a California restricted material with stringent use regulations to mitigate drift onto sensitive crops (CCR 6462).

"DPR monitored propanil in 1987, 1988, 1998 and 2001 at Colusa Basin Drain 1 (CBD1), Colusa Basin Drain 5 (CBD5), Sacramento River at Freeport and the Feather River near Olivehurst. The detection limit was 0.004 - 0.5 μg/L. All reportable detection limits were less than the aquatic threshold. One sample had a detection of 20.6 μg/L at CBD5 on May 29, 2001, but did not exceed the toxicity threshold."

Response 5-11: Because Propanil is an herbicide and its EC50 is lower than the LC50, the lowest toxicity value is EC50 (16ug/L). Therefore, the observed 20.6 μg/L concentration exceeded the lowest EC50 (16 μg/L). The report has been revised to indicate that only one concentration data point exceeded the lowest toxicity value.

Comment 5-12: "The CVRWQCB staff expresses concerns with the U.S. EPA Aquatic Life Benchmarks. However, the U.S. EPA evaluates the same data whether it supports registration, develops benchmarks, or creates the EXOTOX database. The CRC is comfortable with the benchmark because the U.S. EPA evaluates the data that supports the values shown in the tables."

Response 5-12: The purpose of this technical report is to identify and prioritize pesticides that may require further evaluation as part of this or another project (see responses 1-2 and 2-1). This technical report does not derive criteria for consideration as water quality objectives. This comment will be addressed in the water quality criteria methodology work being performed separately as part of the overall Central Valley Pesticide Basin Plan amendment. Briefly summarized, the benchmarks suffer from several deficiencies that make them problematic for adoption as water quality standards. The benchmarks include a disclaimer that they are intended solely to be screening values. The benchmarks do not distinguish between acute and chronic exposures. The methodology used to derive the benchmark values has not been sufficiently documented. The benchmarks appear to only use registration data, instead of a broader literature search. The benchmarks do not necessarily generate protective criteria as evidenced by the invertebrate benchmark for chlorpyrifos, which is higher than available relevant toxicity data.

Comment 5-13: "It is irrelevant to use one number in exceedance of a chosen threshold to pursue a TMDL for propanil. In 2001, DPR monitored propanil at 20.6 µg/L at CBD5, and determined that the detections resulted in no toxic effects. DPR ended propanil water monitoring after 2001."

Response 5-13: The final list of pesticides identified in this report will be one source of high-priority pesticides to be considered for water quality criteria development. Development of a TMDL for propanil is not being proposed at this time. Also, see Response 5-11

Comment 5-14: "Page A-51, Carbaryl - The Evaluation lists carbaryl as a moderate overall relative-risk pesticide with rice a major use (23%). From 1998 to 2004, carbaryl applications to rice range from zero to 8,341 acres (average acres: 4,623). Current use patterns are consistent at less than 3,000 acres annually. This does not constitute a major use for carbaryl."

Response 5-14: The major use of carbaryl identified with rice was not identified based on total acreage to which it was applied, rather it was based on total pounds used.

Comment Letter 6 – Nick Poletika, Ph.D. – Dow AgroSciences

> **Comment 6-1**: "The mancozeb Koc was given as 6000 L/kg. USEPA, in its most recent publicly available assessment[4] gave a range of 860-1642 L/kg. Therefore, the value of 6000 is too large."

Response 6-1: Both ARS and EXTOXNET have Koc=6000. The reference given by reviewer has average Koc 1167, which would not change the rank of the pesticide using the current methodology. Since the given reference does not provide details about the Koc, a Koc of 6000 is still used in this report.

> **Comment 6-2**: "The oxyfluorfen Koc was stated to be 100,000 L/kg. This is excessively high, since the USEPA used the median value of 6831 L/kg (range of 5585-32,381) for groundwater exposure calculations and the lowest value of 5585 L/kg for surface water modeling[5]. Also, an upper range of 1,000,000 μg/L for a toxicity value is difficult to accept, given the water solubility of 100 μg/L. This is either an error or relates to the concentration of a formulated product, not the active ingredient."

Response 6-2: Both of ARS and EXTOXNET have a Koc of 100,000.
The value has been changed to 6831(a median value) (EPA, 2002a) to correspond to the USEPA value. Because of changing Koc value, the rank of Koc is changed from "Very High" to "High" but the "Sediment Risk" is still ranked as "Potential".

The upper range of toxicity value has been removed from the report because no upper range of toxicity value will be included in the report.

Comment Letter 7 – Patricia Rice Ph.D., BASF Corporation

> **Comment 7-1**: The commenter expressed support for the comments on the methodology submitted by the Western Plant Health Association (WPHA)

Response 7-1: Comments from the WPHA have been responded to above.

> **Comment 7-2**: The commenter provided recommended factual corrections and additions to the chemical/physical properties, LC50 data,

[4] Risks of Mancozeb and Maneb Uses to the Federally Listed California Red Legged Frog (*Rana aurora draytonii*) Pesticide Effects Determination. Environmental Fate and Effects Division, Office of Pesticide Programs, Washington, D.C. 20460, October 18, 2007
[5] USEPA. 2002. Reregistration Eligibility Decision for Oxyfluorfen.

registration status and use data for fipronil, pendimethalin, and pyraclostrobin. Specific details are included in the appendix to this report.

Response 7-2: The submitted information has been reviewed and the following changes to the text were made. These values are changed: Fipronil water solubility = 2.4, Koc = 825, and toxicity = 0.14 µg/L; pendimethalin water solubility =0.3 mg/L; pyraclostrobin water solubility= 1.9 mg/L and Koc=9300. pendimethalin Koc value has not been changed because the current study uses the selected value from ARS database. The commenter provided value is an average value (17,040) that will not affect the current Koc rank (based on the Koc value of 13,400 in the report).

Comment Letter 8 – Debbie Stubs, Syngenta

Comment 8-1: "As Syngenta understands, the purported goal of this relative-risk evaluation report for pesticides is to provide a screening level evaluation methodology for identifying and prioritizing a target list of current-use pesticides to help the CVWQCB determine priorities for further pesticide evaluation and development of water quality objectives. Regarding the goal of conducting further pesticide evaluation, Syngenta does NOT believe that the ranking process is necessary since the pesticides are all registered under FIFRA and have already been evaluated by simple and, where necessary, more sophisticated ecological and environmental risk assessment processes (and also for their human risk potential). Priorities for development of water quality objectives should be set by determining whether specific products are actually resulting in impairment of biological integrity by evaluation of multiple lines of evidence collected from specific water bodies."

Response 8-1: See Response to comment 3-1.

Comment 8-2: The commenter provided recommended factual corrections and additions to the chemical/physical properties, and LC50 data for (S)-metolachlor, abamectin, chlorothalonil, lambda-cyhalothrin, paraquat dichloride, simazine and norflurazon. Specific details are included in the appendix to this report.

Response 8-2: The submitted information has been reviewed and the following changes to the report: Abamectin toxicity=42 µg/L; Chlorothalonil Toxicity changed to 26.3 µg/L; Simazine water solubility =3.5 mg/L; Norflurazon toxicity =5,530. None of the changes affect the pesticides ranks.

References For Responses to Comments

Starner, Kieth. 2007. Memo from Keith Starner, (Environmental Scientist, Department of Pesticide Regulations, Environmental Monitoring Branch) to Kean S. Goh, Ph.D (Environmental Program Manager, Department of Pesticide Regulation, Environmental Monitoring Branch) Re: Assessment of Acute Aquatic Toxicity of Current-Use Pesticides In California, With Monitoring Recommendations. Sacramento, California. 26 October 2007

EPA. 2002a. Revised Environmental Fate and Effects Division Risk Assessment for the Oxyfluorfen Reregistation Eligibility Decision Document, 2002. US EPA, Washington, D.C. 20460.

EPA. 2002b. Interim Reregistration Eligibility Decision for Chlorpyrifos EPA 738-R-01-007. Report. United States Environmental Protection Agency, Washington, D. C.

Swanson, M. B., and A. C. Socha. 1997. Chemical Ranking and Scoring: Guidelines for Relative Assessments of Chemicals. A Special Publication of SETAC. pp154.