tdc environmental

MEMO

TO: Bill Johnson, RWQCB | **DATE:** July 8, 2002

FROM: Kelly D. Moran | **PROJECT:** 33a

SUBJECT: Pesticide Market Trends and Potential Water Quality Implications—Basic Information About Selected Pesticides

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Under contract to the San Francisco Estuary Project, TDC Environmental is reviewing the water quality implications of the new pesticide products entering the marketplace as a result of the phase out of most urban uses of diazinon and chlorpyrifos. This project, which is funded by the San Francisco Bay Regional Water Quality Control Board, is intended to provide information that will support government actions to prevent future incidents of pesticide-related surface water toxicity.

In the first phase of this project, a priority list of urban use pesticides ("study list") was selected, based on a screening process intended to identify those pesticide with greatest potential to be of concern for water quality. The second phase of the project was to compile basic information about the pesticides on the study list: chemical properties, environmental decomposition rates, commercial product characteristics, and product sales and use data. This basic information will be the foundation for the evaluation of the potential for pesticides on the study list to affect surface water quality. The purpose of this memorandum is to summarize the second phase of the project.

As the work on this project proceeds, TDC Environmental is preparing memoranda[1] documenting each project phase for two purposes:

- to share information with water quality agencies as soon as it is developed, and
- to provide an opportunity for review and discussion of project elements while the work is in progress.

The information in this memorandum, as modified by comments received,[2] will be incorporated into the final project report, which will be prepared this fall.

SUMMARY

Using information from reliable sources, this memorandum compiles basic background data on the study list pesticides. Tables 1 through 8[3] contain compilations of chemical properties, commercial product characteristics, and uses of the pesticides on the study list.

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[1] Memoranda are available on the Internet at www.tdcenvironmental.com/Pesticides.html

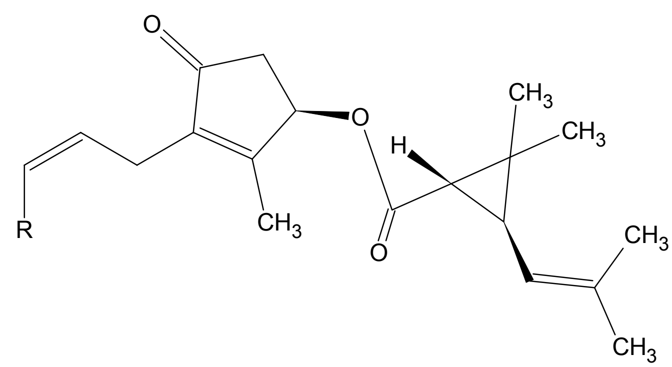
[2] Comments can be e-mailed to kmoran@tdcenvironmental.com or mailed or faxed to TDC Environmental (information at the foot of this page).

[3] Tables may be found at the end of this memorandum.

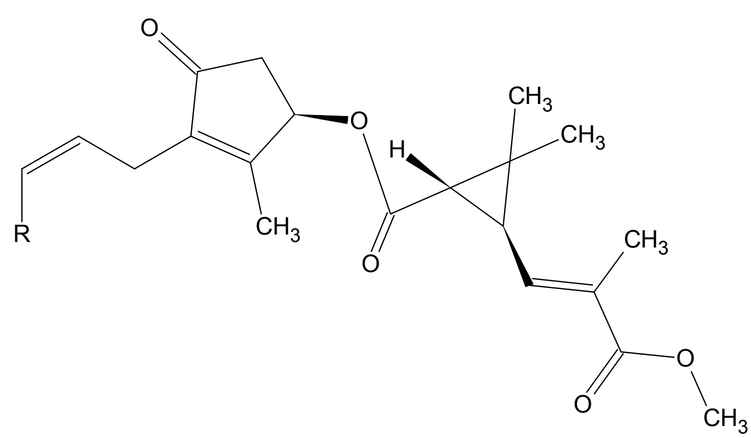
BACKGROUND ON SELECTED PESTICIDES

A. Pyrethrins and Pyrethroids[4]

Pyrethrins are naturally occurring pesticidal chemicals that are the active component of "pyrethrum," which is a powder made by drying and breaking up the flower heads of chrysanthemums. Pyrethrins are a mixture of chemicals: three esters of chrysanthemic acid (known as "pyrethrins I"), and three esters of pyrethric acid (called "pyrethrins II"). Generic structures for the pyrethrins are shown below.[5]



Pyrethrins I



Pyrethrins II

Pyrethroids are a family of chemical insecticides that are synthetic analogs of the pyrethrins. This project includes a detailed evaluation of six pyrethroids, the structures for which are shown on the next two pages.

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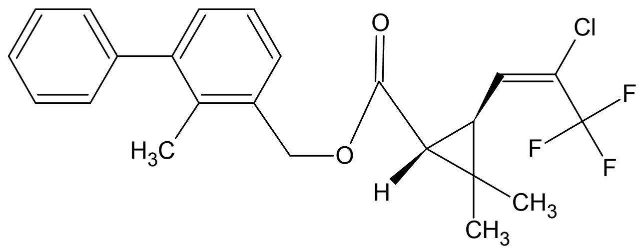
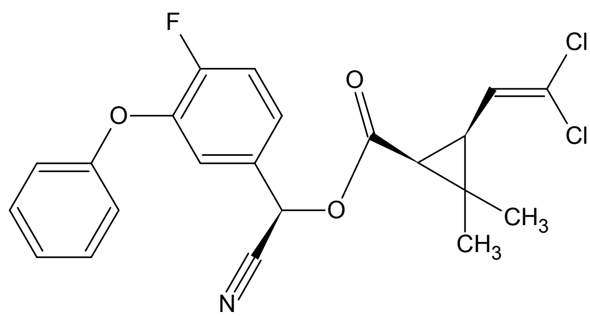
[4] Background information on pyrethroids obtained from Kamrin, 1997; Olkowski et al., 1991; and Casida and Quistad, 1995.

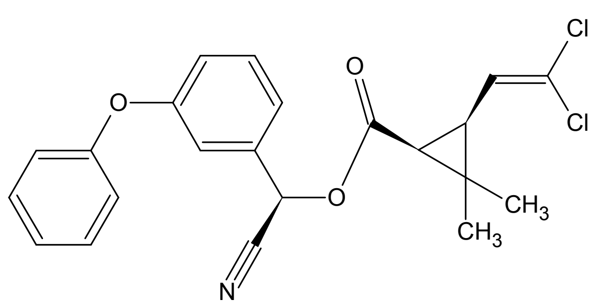
[5] "R" represents methyl (cinerin I and II), ethyl (jasmolin I and II), or ethylene (pyrethrin I and II).



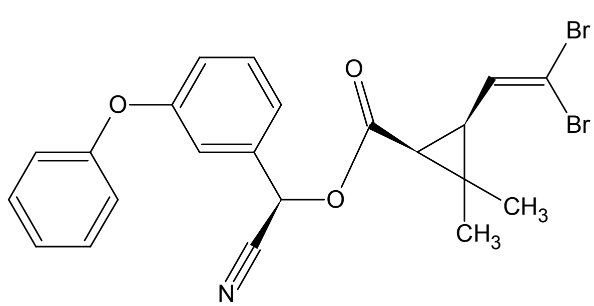
Bifenthrin



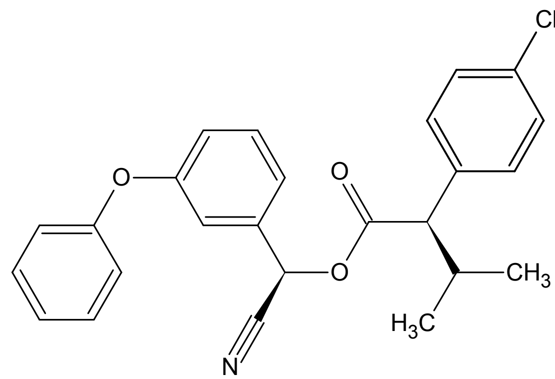
Cyfluthrin



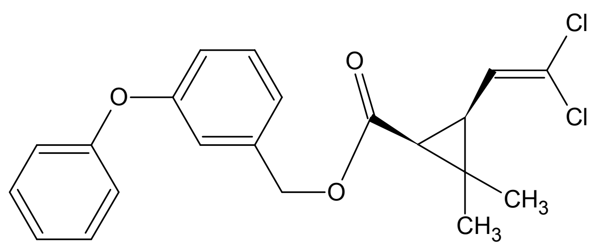
Cypermethrin



Deltamethrin



Esfenvalerate



Permethrin

In general, the synthetic pyrethroids are more chemically stable and more toxic than the naturally occurring pyrethrins. Both pyrethrins and pyrethroids interfere with the function of the nervous system, specifically the sodium channel. Humans and other mammals are generally less sensitive to pyrethrins and pyrethroids than are insects because mammals have the ability to break down pyrethrins and most pyrethroid molecules relatively quickly.[6] Although pyrethrins have been sold for more than a century and pyrethroids have been marketed since the 1960s, their use has increased greatly in recent years to fill the market openings created by regulatory restrictions on other types of pesticides.

B. Malathion[7]

Like diazinon and chlorpyrifos, malathion is one of the organophosphorous pesticides (which are often called "organophosphates" even though all members of the class do not have a phosphate chemical group). Developed from compounds first created in wartime nerve gas research, organophosphorous pesticides became common when more environmentally persistent chlorinated pesticides fell out of favor in the 1970s and 1980s.

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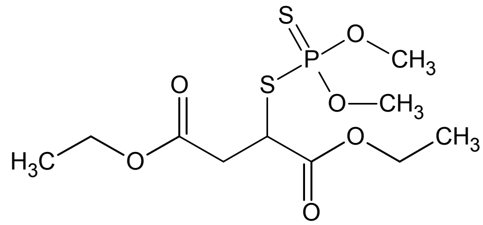
6 By metabolism by oxidative and hydrolytic pathways.
7 Background information on malathion obtained from Kamrin, 1997.

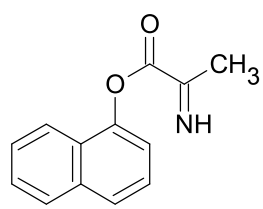


Malathion

Organophosphorous pesticides control insects (and can affect humans) by inhibiting a neural enzyme called acetylcholinesterase. Until recent regulatory changes reduced their use, organophosphorous pesticides were the most common insecticides used in the U.S. Since the 1940s, commercial producers have sold organophosphorous pesticides for a wide range of urban and agricultural uses.

C. Carbaryl[8]

Carbaryl is probably the most well known member of a class of pesticides known as carbamates. The carbamates are synthetic analogs of pesticidal chemicals found in the extracts of the West African calabar bean. Most carbamates (including carbaryl) are esters of carbamic acid.



Carbaryl

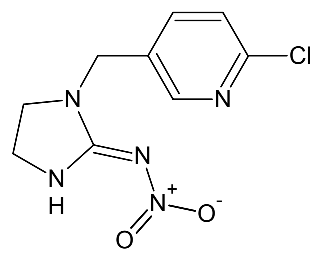
While some carbamates serve as herbicides and fungicides, their primary application is to control insects. Like organophosphorous pesticides, carbamates control insects (and can affect humans) by inhibiting the neural enzyme acetylcholinesterase. Since the 1950s, carbamates have been sold commercially in the U.S. for both urban and agricultural uses. Carbaryl is most often recognized by consumers under its most common retail name, "Sevin."

D. Imidacloprid[9]

Imidacloprid is the first member of a relatively new group of pesticides—the cloronicotinyl nitroguanidines—to be developed for commercial use. The cloronicotinyl

[8] Background information on carbaryl obtained from Kamrin, 1997.
[9] Background information on imidacloprid obtained from NPTN, 1998; USEPA, 1994; and Cox, 2001.

nitroguanidines are part of a larger family of insecticides, the "nicotinoids," which are chemically similar to nicotine, a natural insecticide in tobacco.

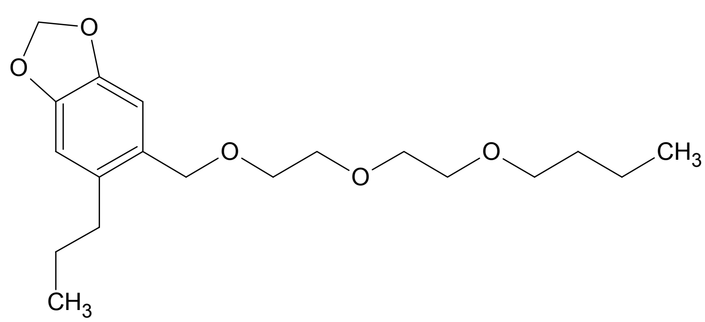


Imidacloprid

Imidacloprid affects insect (and to a lesser extent human) neural systems by blocking signals passed through the neural system. (Specifically, acetylchloline receptors are blocked by competitive inhibition.) Imidacloprid was commercially developed in the early 1990s and first registered by the U.S. Environmental Protection Agency (USEPA) in 1994. Imidacloprid has been marketed commercially since the mid-1990s, first for urban uses and then later for both urban and agricultural insect control.

E. Piperonyl Butoxide[10]

Although it is technically registered as a pesticide, piperonyl butoxide's primary function in commercial pesticides is as a synergist—a substance that enhances the pesticidal activity of another ingredient in the formulation. In the late 1940s, piperonyl butoxide (PBO) was derived from safrole, a pesticidal component of oils from a variety of natural sources like black pepper and sassafras root bark.



Piperonyl Butoxide

PBO functions by inhibiting the mechanism that insects and other organisms use to detoxify pyrethroids and certain other pesticides, enhancing or prolonging the toxic response. Specifically, PBO inhibits a group of enzymes called mixed-function oxidases

[10] Background information on piperonyl butoxide obtained from Olkowski et al., 1991; Cox, 2002; Zimmerman *et al.*, 2001; and USEPA, 2000.

that—when operating normally—break down many insecticides, including pyrethroids. PBO is the most common synergist used in insecticides, appearing in more than 750 California-registered urban and agricultural use pesticide products. PBO appears in products with many different active ingredients such as pyrethrins, pyrethroids, rotenone, limonene, and linalool. Piperonyl butoxide is the most common pesticide used in households.

CHEMICAL PROPERTIES

Chemical and environmental fate properties for the study list pesticides are provided in Tables 1 through 4. Most chemical property data was obtained from the U.S. Department of Agriculture (USDA) Agricultural Research Service's (ARS's) Pesticide Properties Database, managed by the USDA's Alternate Crops & Systems Laboratory. A review of other commonly referenced data sources (*e.g.*, EXTOXNET, National Library of Medicine Hazardous Substances Data Bank, Pesticide Action Network Pesticide Database, *The Pesticide Manual*) revealed that the ARS Pesticide Properties Database is the most complete and current of the publicly available databases. According to ARS, the ARS Pesticide Properties Database was "developed to provide water quality modelers and managers with a list of the pesticide properties most important for predicting the potentials of pesticides to move into ground and surface waters" (ARS, 2002). The ARS database also has two major advantages over other sources: references are given for all values, and all data have been verified by the manufacturers to confirm that they are the latest and most reliable values. Where data were not available from the ARS Pesticide Properties Database, information was taken from other reliable sources, with preference given to California Department of Pesticide Regulation and USEPA peer-reviewed publications.

Table 1 lists the molecular formula, molecular weight, common synonyms (generally commercial brand names), and the unique identifying number for each chemical assigned by the American Chemical Society's Chemical Abstract Service. Table 2 provides basic chemical properties for each pesticide: solubility in water, vapor pressure, octanol-water partition coefficient, and organic carbon sorption coefficient. In Table 3, the half-lives for various environmental decomposition pathways are provided.

Table 4 gives the commonly referenced "field dissipation half-life" for each pesticide. The field dissipation half-life is a measure of the overall rate of disappearance of a pesticide from field soil—it is not necessarily a measure of the environmental degradation of the pesticide. "Dissipation" may include leaching, runoff, hydrolysis, photolysis, microbial degradation, and vaporization. Field dissipation half-life data typically have wide ranges, as they are a function of the site, climate, and soil as well as the chemical characteristics of the pesticide. While field dissipation values are commonly used in descriptions of the environmental fate of pesticides (and therefore have been tabulated for the study list pesticides), they are not particularly relevant to a surface water quality analysis, since they may reflect losses due to pesticide runoff to surface waters.

PRODUCTS, SALES, AND USE

Product characteristics, sales data, and use estimates for the California-registered pesticide products containing study list pesticides are assembled in Tables 5 through 8. Data about pesticide products was obtained from the California Department of Pesticide Regulation (DPR). The DPR Pesticide Product/Label database (DPR, 2002) provided pesticide product registration and formulation information. Sales and use information were taken from DPR annual summaries of pesticide sales and pesticide use (DPR, 1999, 2000, 2001; and DPR, October 2001). The most recent pesticides sales and reported use data are for the year 2000, which means that market changes due to the reduction of diazinon and chlorpyrifos uses may not be evident. Additionally, it is important to recognize that sales data may not be reflective of actual pesticide use, as sales data are based on a tax paid by the pesticide manufacturer when products are shipped, which (due to shipment scheduling practices) may not be directly related to retail sales of pesticides or to applications by commercial and residential users in the same time period.

Table 5 provides basic facts about the pesticide products that contain each of the study list pesticides: number of California-registered products, most common formulations, and the identity of the "basic manufacturer" (the manufacturer that takes the lead in preparing technical data necessary for registration of products containing the pesticide). Table 6 provides a detailed breakdown of product formulations. Table 7 gives total sales of each pesticide for 1998, 1999, and 2000 (the most recent data available), based on taxes paid by product manufacturers to DPR.

Table 8 contains information about use of the study list pesticides in the year 2000, including total reported use in California and an estimate of urban use. The estimate of urban use was made from reported use data and sales data. Reports of pesticide use were sorted to select urban pesticide applications. In California, pesticide uses for the production of any agricultural commodity, except livestock; for the treatment of post-harvest agricultural commodities; for landscape maintenance in parks, golf courses, and cemeteries; for roadside and railroad rights-of-way; for poultry and fish production; any application of a restricted material; any application of a pesticide designated by DPR has having the potential to pollute ground water[11] when used outdoors in industrial and institutional settings; and any application by a licensed pest control operator must be reported the County Agricultural Commissioner, who, in turn, reports the data to DPR. DPR prepares annual summary reports on the basis of this data. While the summary reports lack the detail necessary to allow a detailed tally of reported urban pesticide applications, they are sufficiently detailed to allow selection of "urban" categories (like

[11] Carbaryl, diazinon, and malathion are on this list. It should be noted such reporting is probably incomplete because of the ready availability of these products to persons other than licensed pest control applicators.

structural pest control and landscape maintenance) to create an estimate of the urban portion of the reported pesticide use.[12]

The primary exceptions to the use reporting requirements are home and garden use and most industrial and institutional pesticide applications not made by professional applicators.[13] Because these activities occur primarily in urban areas, it is reasonable to assume that essentially all unreported uses of the study list pesticides are urban. This assumption allows a rough estimate of unreported pesticide use to be made by subtracting reported use from sales data for the same time period. The total estimated urban use of each pesticide shown in Table 8 is a sum of the urban portion of the reported use data and estimated unreported use.

NEXT STEPS

The basic information presented in this memorandum, together with additional information that is still being assembled, will be the foundation for the evaluation of the potential for pesticides on the study list to affect surface water quality. Information that is currently being assembled includes:

- sites of use and inert ingredients in study list pesticide products;
- water quality monitoring data (with environmentally meaningful detection limits) and surface water toxicity data for toxicity linked to study list pesticides;
- water quality standards, guidelines, and comparison values developed by government agencies or respected scientific bodies for study list pesticides;
- available chemical analytical methods and detection limits;
- regulatory status details; and
- reliable studies documenting environmental fate and transport of study list pesticides that involve conditions similar to those found in urban areas.

Once all information is assembled, it will be analyzed and then used to estimate the potential for the study list pesticides to adversely affect water quality; and to recommend future strategies to protect water quality.

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[12] For purposes of this analysis, the following categories of use from DPR's annual compilation reports were defined as urban uses: landscape maintenance, public health, regulatory pest control, rights of way, structural pest control, vertebrate control, regulatory pest control, uncultivated non-agricultural sites, airports, buildings/non-ag outdoor, food processing plants, industrial sites. Most of the reported urban uses fell into a few categories (structural pest control, landscape maintenance, public health, and regulatory pest control). Many other categories may also include some applications in urban areas (*e.g.*, nurseries, greenhouses, sod/turf), so this "urban" estimate is likely to understate actual urban use.

[13] Pesticides used in consumer products are often unreported, or reported as applied at the product-manufacturing site rather than at the site where the products are used.

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Table 1. Basic Information About Study List Pesticides

Name	Chemical Abstracts Service Number	Synonyms	Molecular Formula	Molecular Weight
Bifenthrin	82657-04-3	Biphenthrin, Bifenthrine, Brigade, Capture, Talstar	$C_{23}H_{22}ClF_3O_2$	422.9
Carbaryl	63-25-2	Sevin	$C_{12}H_{11}NO_2$	201.2
Cyfluthrin	68359-37-5	Baythroid, Tempo	$C_{22}H_{18}Cl_2FNO_3$	434.3
Cypermethrin	52315-07-8	Stockade, Cymbush, Ammo, Cynoff, Demon	$C_{22}H_{19}Cl_2NO_3$	416.3
Deltamethrin	52918-63-5	Decamethrin	$C_{22}H_{19}Br_2NO_3$	505.2
Esfenvalerate	66230-04-4	(S)-Fenvalerate	$C_{25}H_{22}ClNO_3$	419.9
Imidacloprid	105827-78-9 and 138261-41-3	Merit, Admire, Advantage, Pre-Empt, Premise,	$C_9H_{10}ClN_5O_2$	255.7
Malathion	121-75-5	Cythion	$C_{10}H_{19}O_6PS_2$	330.4
Permethrin	52645-53-1	Ambush, Nix, Pounce	$C_{21}H_{20}Cl_2O_3$	391.3
Piperonyl Butoxide	51-03-6	PBO	$C_{19}H_{30}O_5$	338.4
Pyrethrins	121-21-1 121-21-9	Pyrethrins I Pyrethrins II	$C_{21}H_{28}O_3$ $C_{22}H_{28}O_5$	328.4* 372.4*

*Pyrethrins are a mixture of substances; the molecular weight is the average for the mixture.
Sources: Data from the ARS Pesticide Properties Database (ARS, 2002); synonyms compiled from those frequently mentioned in literature sources (see reference list).

Table 2. Chemical Properties

Name	Solubility in Water (ppb)*	K_{ow}	K_{oc}	Vapor Pressure (torr)
Bifenthrin	100[a]	1,000,000	240,000	1.80×10^{-07}
Carbaryl	110,000	204	288	1.17×10^{-06}[a]
Cyfluthrin	20	891,251	31,000	3.30×10^{-08}
Cypermethrin	4	3,981,072	61,000	1.30×10^{-09}[a]
Deltamethrin	2[c]	269,153[c]	46,000 to 1,630,000[b]	1.50×10^{-08}[c]
Esfenvalerate	0.2	10,000	5,273	1.50×10^{-09}
Imidacloprid	514,000[a]	5,012[a]	132 to 310[a]	1.00×10^{-07}[a]
Malathion	130,000	501	1,200	3.40×10^{-06}
Permethrin	6	1,258,925	39,300	2.20×10^{-08}
Piperonyl Butoxide	14,000[d]	56,234[e]	1,810[d]	2.60×10^{-07}[b]
Pyrethrins I	200[b]	794,328[b]	39,000 (predicted)[b]	2.03×10^{-05}[b]
Pyrethrins II	9,000[b]	19,953[b]	5,200 (predicted)[b]	3.98×10^{-07}[b]

*At 20º C to 25º C
Sources: All data from the ARS Pesticide Properties Database (ARS, 2002) unless marked as follows:
[a]California DPR Pesticide Environmental Fate Reviews (Bacey, 2000; Casjens, 2002; Fecko, 1999; Goh, 1990: Jones, 1999; Xu, 2000).
[b]Hazardous Substances Data Bank (NLM, 2002).
[c]*Deltamethrin Health and Safety Guide* (WHO *et al.*, 1989).
[d]Pesticide Action Network Pesticide Database (PAN, 2002).
[e]*The Pesticide Manual* (Tomlin, 2000).
Note: Where data give a range of K_{oc}, ARS calculates an average

Table 3. Environmental Fate Data—Pesticide Decomposition Half-Lives (Days)

Name	Aqueous Photolysis Half-Life	Hydrolysis Half-Life	Soil Photolysis Half-Life	Soil Anaerobic Half-Life	Soil Aerobic Half-Life
Bifenthrin	210	Stable	Stable	97 to 156[a]	65 to 95
Carbaryl	45	11	41[a]	46	4 to 27[a]
Cyfluthrin	12	193	2 to 16	34[a]	63[a]
Cypermethrin	56	Stable	165	<14 to 60	6 to 60
Deltamethrin	Stable[b]	Stable[b]	9[b]	31 to 36[b]	11 to 19[b]
Esfenvalerate	25	Stable	Stable	77	74
Imidacloprid	0.04[a]	>30[a]	39[a]	27[a]	997[a]
Malathion	94 to 143[c]	6	173[c]	Not available[c]	<1 to 3[c]
Permethrin	30	Stable	33	108	30
Piperonyl Butoxide	Stable[d]	Stable[d]	Stable (predicted)[d]	927[g]	14[f]
Pyrethrins	Unstable[d]	Stable[d]	Unstable (predicted)[e]	14 to 60 (predicted)[e]	Unstable (predicted)[d]

*Half-life decreases as pH increases. Value is for pH 7.
Sources: All data from the ARS Pesticide Properties Database (ARS, 2002) unless marked as follows:
[a]California DPR Pesticide Environmental Fate Reviews (Bacey, 2000; Casjens, 2002; Fecko, 1999; Goh, 1990; Jones, 1999; Xu, 2000).
[b]USEPA Pyrethroids Environmental Fate Assessment (USEPA, Undated).
[c]USEPA Malathion Risk Assessment (USEPA, November 2000).
[d]Hazardous Substances Data Bank (NLM, 2002).
[e]*Pyrethrum Flowers* (Casida and Quistad, 1995).
[f]*The Pesticide Manual* (Tomlin, 2000).
[g]California DPR Pesticide Chemistry Database Summary Download (Kollman and Segawa, 1995).

Table 4. Field Dissipation Data

Name	Reported Field Dissipation Half-Life (Days)
Bifenthrin	7 to 62; 122 to 345[a]
Carbaryl	4 to 22; 1 to 11[a]
Cyfluthrin	4 to 90; about 13.5[a]
Cypermethrin	7 to 82; 4 to 12[a]
Deltamethrin	6 to 209[b]
Esfenvalerate	22 to 75
Imidacloprid	27 to 229[a]
Malathion	0.2 to 25
Permethrin	6 to 106
Piperonyl Butoxide	about 4[c]
Pyrethrins	about 12

Note: Where data from two reliable sources differed significantly, both values were included.
Sources: All data from the ARS Pesticide Properties Database (ARS, 2002) unless marked as follows:
[a]California DPR Pesticide Environmental Fate Reviews (Bacey, 2000; Casjens, 2002; Fecko, 1999; Jones, 1999; Xu, 2000).
[b]USEPA Pyrethroids Environmental Fate Assessment (USEPA, Undated).
[c]Piperonyl Butoxide Fact Sheet (Cox, 2002).

Table 5. Product Data

Name	Number of California Registered Products	Most Common Formulation(s)	Basic Manufacturer
Bifenthrin	47	Granules, Ready-to-use liquids	FMC Corporation
Carbaryl	94	Dust, Granules	Rhone Poulenc
Cyfluthrin	53	Aerosols. Ready-to-use liquids	Bayer
Cypermethrin	36	Emulsifiable concentrates	Zeneca
Deltamethrin	48	Dust, Granules	AgrEvo
Esfenvalerate	49	Aerosols	DuPont
Imidacloprid	57	Granules, Ready-to-use liquids	Bayer
Malathion	47	Emulsifiable concentrates	Cheminova Agro
Permethrin	625	Aerosols, Ready-to-use liquids	Zeneca
Piperonyl Butoxide	783	Aerosols, Ready-to-use liquids	**[need information]**
Pyrethrins	750	Aerosols, Ready-to-use liquids	Pyrethrin Task Force (several manufacturers)

Sources: Product registration and formulation data from DPR Pesticide Product/Label Database as of July 1, 2002 (DPR, 2002); basic manufacturer information from EXTOXNET Pesticide Information Profiles (EXTOXNET, 1994-1996) **[note to reviewers: this information may be out of date; corrections would be appreciated]**.

Table 6. Product Formulations

Name	Dust/Powder	Emulsifiable Concentrate	Flowable Concentrate	Gel, Paste, Cream	Granular/Flake	Impregnated Material	Microencapsulated	Oil	Paint/Coatings	Pellet/Tablet/ Cake/Briquet	Pressurized Gas	Pressurized Liquid/Sprays/ Foggers	Soluble Powder	Solution/Liquid (Ready-to-use)	Wettable Powder	Suspension	Aqueous Concentrate	Other (Liquid)	Other (Dry)
Bifenthrin	0	2	8	0	18	0	1	2	0	0	0	2	0	12	1	1	0	0	0
Carbaryl	25	2	7	2	27	5	1	1	0	4	0	1	2	5	6	1	5	0	0
Cyfluthrin	4	2	0	0	4	1	0	0	0	0	0	17	0	11	8	2	4	0	0
Cypermethrin	0	19	0	1	0	1	0	0	0	0	0	8	0	3	4	0	0	0	0
Deltamethrin	13	2	0	0	12	0	0	0	0	0	0	5	0	8	2	6	0	0	0
Esfenvalerate	0	9	1	0	0	0	0	0	0	0	1	23	0	5	3	0	7	0	0
Imidacloprid	1	2	6	1	17	2	0	0	0	2	0	0	0	12	9	0	5	0	0
Malathion	4	28	4	0	0	0	0	0	0	0	0	2	0	7	2	0	0	0	0
Permethrin	27	39	10	3	22	8	1	0	1	1	1	271	1	172	3	1	59	5	0
Piperonyl Butoxide	50	58	7	12	0	11	1	4	0	2	6	290	0	266	3	1	59	11	2
Pyrethrins	48	59	7	11	0	2	1	4	0	2	4	282	0	262	3	1	55	8	2

Note: No products were in the "dry flowable" or "pressurized dust" formulations.
Source: DPR Product/Label database, data from July 1, 2002 (DPR, 2002).

Table 7. Product Sales
(Data in Pounds of Active Ingredient)

Name	Number of Registrants[a]	Sales		
		2000	1999	1998
Bifenthrin	<4	NR[b]	NR[b]	NR[b]
Carbaryl	43	563,605	639,593	506,802
Cyfluthrin	9	39,126	30,579	62,181
Cypermethrin	9	50,573	43,845	72,052
Deltamethrin	8	8,323	2,103	NR
Esfenvalerate	35	42,878	41,163	41,384
Imidacloprid	12	95,908	106,710	77,054
Malathion	30	1,047,077	1,494,142	925,264
Permethrin	159	437,037	289,841	308,533
Piperonyl Butoxide	211	149,763	173,956	131,493
Pyrethrins	207	35,203	41,500	47,412

[a]In the year 2000.
[b]Not reported (fewer than four registrants).
Source: DPR Pesticides Sold reports (DPR, 1999, 2000, and 2001).

Table 8. Product Sales and Use Analysis for Calendar Year 2000
(Data in Pounds of Active Ingredient)

Name	Sales	Reported Use (Agricultural & Urban)	Urban Reported Use		Unreported Use[a]		Estimated Total Urban Use[b]
			Quantity	Fraction of Reported Use (%)	Quantity	Fraction of Product Sales (%)	
Bifenthrin	NR[c]	31,047	12,045	39%	Unknown[c]	Unknown	Unknown
Carbaryl	563,605	364,966	13,317	4%	198,639	35%	211,956
Cyfluthrin	39,126	27,083	15,320	57%	12,043	31%	27,363
Cypermethrin	50,573	136,285	126,974	93%	--[d]	--[d]	126,974
Deltamethrin	8,323	10,911	10,806	99%	--[d]	--[d]	10,806
Esfenvalerate	42,878	32,022	479	1%	10,856	25%	11,335
Imidacloprid	95,908	101,410	35,789	35%	--[d]	--[d]	35,789
Malathion	1,047,077	489,650	69,250	14%	557,427	53%	626,677
Permethrin	437,037	385,581	246,350	64%	51,456	12%	297,806
Piperonyl Butoxide	149,763	24,967	18,160	73%	124,796	83%	142,956
Pyrethrins	35,203	4,357	3,536	81%	30,846	88%	34,382

[a]Sales minus reported use. This generally consists of urban uses, such as household uses and non-reportable uses at commercial, industrial, and institutional facilities.
[b]Urban reported use plus unreported use (which was assumed to be zero if sales were less than total reported use).
[c]Sales data are not public (see Table 6).
[d]Sales less than reported use **[Imidacloprid is within typical year-to-year sales/use data variations for products where almost all use is reported. Not clear why the discrepancy is so large for cypermethrin and deltamethrin.]**
Note: the following categories in the use report were defined as "urban" for purpose of this analysis: landscape maintenance, public health, regulatory pest control, rights of way, structural pest control, vertebrate control, regulatory pest control, uncultivated non-ag, airport, buildings/non-ag outdoor, food processing plant, industrial site.
Source: DPR Summary of Pesticide Use Report for 2000 (preliminary data) (DPR, 2001).