# Pesticide Toxicity Profile: Synthetic Pyrethroid Pesticides[1]

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*This document provides a general overview of human toxicity, a listing of laboratory animal and wildlife toxicities, and a cross reference of chemical and common names with their trade names of many synthetic pyrethroid pesticides registered for use in Florida.*

## General

Pyrethrins were originally derived from East African chrysanthemum flowers and were shown to have insecticidal activity. In a natural environment, they were chemically unstable and broke down rapidly upon exposure to air and sunlight. Beginning in the 1970s, synthetic pyrethroids came into the market for agricultural purposes as they were synthesized from petroleum derivatives. They are also widely used as home and garden insecticides along with uses on pets and livestock, mosquito control, treatment of transport vehicles, and for treatment of ectoparasitic disease. Their desirable features provide a quick knockdown of insects at low rates, relatively low mammalian toxicity, and improved stability in outdoor environments, which has increased their marketability in agriculture. They are effective against a wide range of insect and mite pests and may be mixed with other pesticides for a broad spectrum of pest control. Formulations that are commercially available include aerosols, dips, emulsifiable concentrates, wettable powders, granules, and concentrates for ultra low volume applications targeting mosquitoes. Pyrethroids may be mixed with piperonyl butoxide, a synergist, which enhances the effect of the active ingredient. Their mode of action is interference with transmission of nerve impulses.

## Toxicity

Pyrethroids are one of the least acutely toxic insecticides to mammals because they are quickly deactivated by metabolic processes. However, rats fed high doses (1,000 mg/kg of body weight) showed liver damage (Hayes 1982). Toxicity by inhalation and dermal absorption is low. Sensitization sometimes occurs in some individuals after a single exposure, which causes either an asthmatic condition or a skin rash or inflammation. After the initial exposure to the sensitizing agent, the sensitized individual responds to a dose smaller than the initial dose. Symptoms are more common with exposure to the pyrethroids whose structures include cyano-groups. Sensations are described as stinging, burning, itching, and tingling, progressing to numbness, with the face most commonly affected. Persons treated with permethrin for lice or flea infestations sometimes experience itching and burning at the site of application, but this is more of a reaction to the effects of the parasites themselves. Due to the inclusion of certain solvents, some

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formulations of fluvalinate are corrosive to the eyes. Scientists have no data from work-related, accidental poisonings, or epidemiological studies that indicate whether or not pyrethrins are likely to cause cancer in humans. There were no birth defects in pups of rabbits exposed to pyrethrins (Vettorazzi 1979); however, rat pups born to rats fed very high doses of pyrethrins for three weeks prior to mating were of low body weights (Hayes 1982). Pyrethrins are highly toxic to fish and tadpoles. They affect their skin touch receptors and balance organs (Tomlin 1994). Mammalian toxicities for pyrethroid pesticides registered in Florida are shown in Table 1. Table 2 lists the toxicities to wildlife by the common name of the pyrethroid pesticide. Table 3 provides a cross listing of many of the trade names that these products are registered and sold by in Florida.

## Additional Information

Hayes, W.J. 1982. Pesticides studied in man. Baltimore: Williams and Wilkins.

Nesheim, O.N., F.M. Fishel and M.A. Mossler. 2005. *Toxicity of Pesticides*. PI-13. Gainesville: University of Florida Institute of Food and Agricultural Sciences. https://edis.ifas.ufl.edu/pdffiles/PI/PI00800.pdf

Reigart, J.R. and J.R. Roberts. 2013. "Recognition and Management of Pesticide Poisonings." (6th ed.) *United States Environmental Protection Agency Publication* EPA-735K-13001.

Seyler, L.A., et.al. 1994. *Extension Toxicology Network (EXTOXNET)*. Cornell University and Michigan State University. http://extoxnet.orst.edu/index.html (Visited February 2014)

Tomlin, C. (Ed.). 1994. "A World Compendium. The Pesticide Manual. Incorporating the Agrochemicals Handbook." (10th ed.). Bungay, Suffolk, U.K.: *Crop Protection Publications*.

Vettorazzi, G. 1979. "International Regulatory Aspects for Pesticide Chemicals." *Toxicity Profiles (vol. 1)*, Boca Raton, FL: CRC Press, Inc.

Table 1. Pyrethroid pesticide mammalian toxicities (mg/kg of body weight).

| Common name | Rat oral $LD_{50}$ | Rabbit dermal $LD_{50}$ |
|---|---|---|
| Allethrin | 860 | 11,332 |
| Bifenthrin | 375 | >2,000 |
| Cyfluthrin | 869–1271 | >5,000 (rat) |
| Cyhalothrin | 79 | 632 (rat) |
| Cypermethrin | 250 | >2,000 |
| Deltamethrin | 31–139 (female) | >2,000 |
| Esfenvalerate | 451 | 2,500 |
| Fenpropathrin | 70.6–164 | >2,000 |
| Fluvalinate | 261–282 | >20,000 |
| Permethrin | 430–4,000 | >2,000 |
| Resmethrin | 1,244 - >2,500 | >2,500 |
| Tefluthrin | 969 | >2,000 (rat) |
| Tetramethrin | >5,000 | >2,000 |
| Tralomethrin | 284 | >2,000 |

Table 2. Pyrethroid pesticide wildlife toxicity ranges.

| Common name | Bird acute oral $LD_{50}$ (mg/kg)* | Fish $LC_{50}$ (ppm)** | Bee $LD_{50}$ † |
|---|---|---|---|
| Allethrin | PNT | HT | HT |
| Bifenthrin | ST–PNT | HT | HT |
| Cyfluthrin | PNT | VHT | HT |
| Cyhalothrin | PNT | HT | HT |
| Cypermethrin | PNT | VHT | HT |
| Deltamethrin | PNT | HT | HT |
| Esfenvalerate | PNT | VHT | HT |
| Fenpropathrin | ST | VHT | HT |
| Fluvalinate | PNT | VHT | MT |
| Permethrin | PNT | VHT | HT |
| Resmethrin | PNT | VHT | HT |
| Tefluthrin | ST–PNT | VHT | HT |
| Tetramethrin | PNT | HT | — |
| Tralomethrin | — | VHT | HT |

*Bird $LD_{50}$: Practically nontoxic (PNT) = >2,000; slightly toxic (ST) = 501–2,000; moderately toxic (MT) = 51–500; highly toxic (HT) = 10–50; very highly toxic (VHT) = <10.
**Fish $LC_{50}$: PNT = >100; ST = 10–100; MT = 1–10; HT = 0.1–1; VHT = <0.1.
†Bee: HT = highly toxic (kills upon contact as well as residues); MT = moderately toxic (kills if applied over bees); PNT = relatively nontoxic (relatively few precautions necessary).

Table 3. Cross reference list of common, trade and chemical names of pyrethroid insecticides.

| Common name* | Trade names** | Chemical name |
|---|---|---|
| Allethrin | Many household products | (RS)-3-allyl-2-methyl-4-oxycyclopent-2-enyl (1RS)-cis-trans chrysanthemate |
| Bifenthrin | Capture®, Talstar® | [1-alpha,3-alpha-(Z)]-(±)-(2 methyl[1,1'-biphenyl]-3yl) methyl 3-(2,chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethylcyclopropanecarboxylate |
| Cyfluthrin | Baythroid®, Tame® | Cyano(4-fluoro-3-phenoxyphenyl)methyl 3-(2,2-dichloro-ethenyl)-2,2-dimethylcyclopropanecarboxylate |
| Cyhalothrin | Karate®, Warrior®, Demand®, Scimitar® | alpha-cyano-3-phenoxybenzyl 3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate |
| Cypermethrin | Ammo®, Fury®, Mustang® | (±)-alpha-cyano-3-phenoxybenzyl (±)-cis,trans-3-(2,2-dichlorovinyl)-2,2-dimethycyclopropanecarboxylate |
| Deltamethrin | Decis®, DeltaGard®, Demand® | (S)-cyano(3-phenoxybenzyl) (1R,3R)-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate |
| Esfenvalerate | Asana® | (S)-cyano(3-phenoxyphenyl)methyl (S)-4-chloro-alpha-(1-methylethyl)-benzeneacetate |
| Fenpropathrin | Danitol®, Tame® | RS-alpha-cyano-3-phenoxybenzyl 2,2,3,3-tetramethylcyclopropanecarboxylate |
| Fluvalinate | Mavrik®, Zoecon® | Á-*RS*,*2R*)-fluvalinate [(RS)-alpha-cyano-3-phenoxybenzyl (R)-2-[2-chloro-4-(trifluoromethyl)anilino]-3-methyl-butanoate] |
| Permethrin | Ambush®, Pounce® | (3-phenoxyphenyl)methyl (±)-cis,trans-3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropanecarboxylate |
| Resmethrin | Many household products | ([5-(phenylmethyl)-3-furanyl]methyl 2,2-dimethyl-3-(2-methyl-1-proenyl) cyclopropanecarboxylate) |
| Tefluthrin | Force® | 2,3,5,6-tetrafluoro-4-methylbenzyl (Z)-(1 RS, 3RS)-3-(2-chloro-3,3,3-trifluoroprop-1-ethyl) -2,2-dimethylcyclopropanecarboxylate |
| Tetramethrin | Many household products | 3,4,5,6-tetrahydrophthalimidomethyl (1RS)-cis,trans-chrysanthemate |
| Tralomethrin | Scout® | (1R,3S)3[(1',2',2',2',-tetrabromoethyl)]-2,2-dimethylcyclopropanecarboxylic acid (S)-alpha-cyano-3-phenoxybenzyl ester |

*Basic molecule; isomers not listed.
**Does not include manufacturers prepackaged mixtures; major agricultural brands for basic manufacturers.