

Type	Broad spectrum non-selective pyrethroid insecticide
Controls	Used to control a variety of indoor and outdoor insects in agriculture, commercial, residential, and industrial settings.
Mode of Action	Works on contact or by ingestion - effects nervous system (sodium channel modulator) resulting in constant firing of neurons, paralysis, and death.

Thurston County Review Summary:

The active ingredient esfenvalerate is rated high in hazard and fails Thurston County's pesticide review criteria.

Risk to non-target fish, aquatic organisms, endangered birds, and small mammals is rated high in hazard from many different labelled uses of esfenvalerate products. Risk of toxicity to humans is also rated high in hazard from numerous indoor and outdoor uses of esfenvalerate.

MOBILITY

Property	Value	Reference	Rating
Water Solubility (mg/L)	<0.01	1	Low
Soil Sorption (Kd=mL/g)	600-15,500	1	Low
Organic Sorption (Koc=mL/g)	5300 - 215,00	2 and 5	Low

Mobility Summary:

Esfenvalerate is not soluble in water and adheres very strongly to all soil types. The hazard for esfenvalerate to move off the site of application with rain or irrigation water is rated low.

PERSISTENCE

Property	Value	Reference	Rating
Vapor Pressure (mm Hg)	0.00000047	1	Moderate
Biotic or Aerobic Half-life (days)	75	1	High
Abiotic Half-life (days)	Not found		
Terrestrial Field Test Half-life (days)	6 to 126	2	High
Hydrolysis Half-life (days)	"Minimal"	1	High
Anaerobic Half-life (days)	77	1	High
Aquatic Field Test Half-life (days)	30	2	Moderate

Persistence Summary:

Field testing showed that degradation of esfenvalerate is highly variable. Most field tests indicate that it takes over 60 days to degrade to half of the applied concentration (which is rated high in hazard for persistence). Studies also show that a majority of esfenvalerate that reaches water bodies attaches to sediments where it persists longer than in the water column. The overall persistence hazard of esfenvalerate is rated high.

BIOACCUMULATION

Property	Value	Reference	Rating
Bioaccumulation Factor	Not found		
Bioconcentration Factor	334-3650	1	Moderate
Octanol/Water Partition Coefficient	log Kow = 5.6 to >6.2	1	High

Bioaccumulation Summary:

The high octanol / water partition coefficient for esfenvalerate indicates that it has a strong affinity to bind to organic solvents giving it the potential to bioaccumulate. Bioconcentration studies with carp showed that they accumulate esfenvalerate in their tissue although 50% is eliminated from the fish within a week. But, the EPA stated that carp metabolize these chemicals (pyrethroids) better than other fish (rainbow trout) and other aquatic organisms (developing frogs). The EPA also noted that mammals and birds metabolize pyrethroids better than other organisms and bioaccumulation may not be a problem for them. European evaluation of esfenvalerate in rats showed that it was 94-100% excreted within one week and that there was no potential for accumulation (Reference 6). The overall bioaccumulation hazard rating for esfenvalerate is moderate - because there may be a potential for accumulation to occur in some aquatic organisms.

ACUTE TOXICITY HAZARD - ECOTOXICITY

Test Subject	Value	Reference	Rating
Mammalian (LD50)	59.0 mg/kg-bw	1	Moderate
Avian (LD50)	381 mg ai/kg-bw	1	Moderate
Honey bee or insect (LD50)	0.017 ug/bee	1	High
Annelida -worms (LC50)	10.6 mg/kg	2	High
Fish (LC50)	0.07 ppb	1	High
Crustacean (LC50)	0.05 ppb	1	High
Mollusk (LC50)	Not found		
Amphibian (LD50 or LC50)	Not found		

Acute Toxicity Testing and Ecotoxicity Summary:

Single-dose toxicity testing indicates that esfenvalerate is moderately toxic to mammals and birds but highly toxic to insects, worms, fish, and other aquatic organisms.

A risk assessment was performed by the EPA for the California Red-legged Frog (an endangered species) and its potential food sources (other aquatic organisms, small mammals, and insects). The EPA's level of concern was exceeded for fish, amphibians, aquatic and terrestrial invertebrae, and terrestrial vertebrate, for all application scenarios (agricultural, commercial and residential). When describing the risk for all application scenarios, the EPA stated, "The probability of mortality is high for aquatic invertebrates and fish." (Reference 1). The level of concern to endangered birds was also exceeded for potential exposures from uses around buildings, lawns, turf grass, general outdoor surfaces, and for mosquito breeding areas. Risk to non-target organisms from esfenvalerate following insecticide applications is rated high in hazard.

ACUTE TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Rating
Adult / toddler contacting indoor broadcast spray	Dermal (skin)	0.083 mg/kg/day	0.26 mg/kg/d (adult) 0.37 mg/kg/d (child)	<1	7	High
Toddler's hand to mouth activities in treated turf	Ingestion	0.00175 mg/kg/day	0.00282 mg/kg/day	<1	7	High
Adult / toddler contacting indoor crack spray	Dermal (skin)	0.083 mg/kg/day	0.13 mg/kg/d (adult) 0.18 mg/kg/d (child)	<1	7	High
Toddler hand to mouth activity - indoor crack spray	Ingestion	0.00175 mg/kg/day	0.00625 mg/kg/day	<1	7	High

Acute Toxicity Risk Assessment Summary:

In evaluating the risk to humans, there were several potential exposures to residential applicators that exceeded the EPA's level of concern. The applications of concern include low-pressure handwand sprayer applications to building perimeters and outdoor surfaces; ready-to-use fogger applications to indoor spaces; pump sprayer applications using the wettable powder formulation to building perimeters, outdoor surfaces, residential lawns; and applications of ready-to-use (RTU) formulations with pump sprayers to indoor surfaces and outdoor perimeters (Reference 7).

Post-application exposures that exceeded the EPA's level of concern include: dermal exposures to adults and children from activities on treated indoor surfaces from applications by broadcast sprays or crack and crevice sprays; oral exposures to toddlers from transfer of pesticide from lawns to hand to mouth following wettable powder applications; oral exposures to toddlers from transfer of pesticide from indoor surfaces to hand to mouth from broadcast spray and crack or crevice spray applications.

All of these scenarios that exceed the EPA's level of concern are rated high in hazard.

CHRONIC TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	Group E	Evidence of non-carcinogenicity for humans	3	Low
Mutagenicity	Not found	"No mutagenic effects"	8	Low
Neurotoxicity - (NOAEL)	3 mg/kg bw/day	No irreversible neurotoxic effects	6	Check risk
Endocrine Disruption	"Suspect"	- -	4	Moderate
Developmental Toxicity (NOAEL)	2 mg/kg bw/day	Maternal toxicity	6	Low
Reproductive Toxicity (NOAEL)	<4.21 mg/kg-bw/day	Reduced body weight gain in parental animals	6	Low
Chronic Toxicity (NOAEL)	1.75 mg/kg	Tremors	7	Check risk

Chronic Toxicity Hazard Summary:

Esfenvalerate is not considered a human carcinogen or chemical mutagen but it is a suspected endocrine disruptor. Reproductive and developmental toxicity testing produced adverse effects to the parents before toxic effects were observed in the fetuses. The European Commission stated that toxicity testing showed "no irreversible neurotoxic effects" at doses up to 3 mg/kg-bw/day, although, the EPA's toxicological endpoints of concern are based on neurological toxic effects. The long-term toxicity hazards of esfenvalerate are rated moderate.

CHRONIC TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Rating
Long-term exposure risk assessments were not found						
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Chronic Toxicity Risk Assessment Summary:

Long-term exposure risk assessments were not found in any of the EPA documents (only risk from short-term and intermediate-term exposures - which are summarized in the acute risk assessment section).

Metabolites and Degradation Products:

Degradates of esfenvalerate in water include carbon dioxide, 4-chloro-alpha-(1-methylethyl) benzeneacetic acid (CPIA), 2-(3-phenoxyphenyl)-3-(4-chlorophenyl)-4-methylpentane-nitrile (decarboxy-fenvalerate), and 3-phenoxybenzoic acid (Reference 1). Carbamoyl-3-phenoxybenzyl 2-(4-chlorophenyl)-3-methylbutyrate has been identified as a soil metabolite (Reference 2).

Comments:

Esfenvalerate has the IUPAC chemical name of: (S)- α -Cyano-3-phenoxybenzyl-(S)-2-(4-chlorophenyl)-3-methylbutyrate (and is the S,S-isomer enriched version of fenvalerate [(which is a discontinued pesticide active ingredient because the enriched chemical has much more insecticidal activity) Reference 6].

European evaluation of esfenvalerate concludes that it is sensitizing to the skin, but is not considered an eye or skin irritant (Reference 6).

References

- USEPA. Environmental Fate and Effects Division. "Risks of Esfenvalerate Use to Federally Threatened California Red-Legged Frog" February 19, 2008.
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- USEPA. Health Effects Division. "Chemicals Evaluated for Carcinogenic Potential" July 19, 2004.
- Illinois EPA. Endocrine Disruptors Strategy. February, 1997.
- Kelley, Kevin. California Environmental Protection Agency. Environmental Fate of Esfenvalerate.
- European Commission. Directorate - General Health and Consumer Protection- "Review report for the active substance esfenvalerate". [6846/VI/97-final]. October, 2005.
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