allethrins

Review Date: 04/27/2012

CAS #: 584-79-2

Type	Insecticide - synthetic pyrethroid
Controls	Flying and crawling insects (wasps, hornets, ants, roaches, mosquitoes, etc.).
Mode of Action	Allethrins are used as a knockdown chemical that is typically used along with another pesticide ingredient. Allethrins cause blocking of the sodium channels at the nerve endings causing hyperactivity, paralysis, or death.

Thurston County Review Summary:

The term "allethrin" is commonly used to include the active ingredients: bioallethrin, esbiol, esbiothrin, and pynamin forte (also known as "d-allethrin"). Allethrins are comprised of eight different stereo-isomers that are present in the active ingredients but in different percentages. The data in this review combines data that was used by the EPA to register all allethrin containing products.

Insecticides containing allethrins as an active ingredient fail Thurston County's review criteria because, although there are some uses with potential exposures that are rated moderate in hazard, many uses have risk that is rated high in hazard.

MOBILITY

Property	Value	Reference	Value Rating
Water Solubility (mg/L)	0.0001	1	Low
Soil Sorption (Kd=mL/g)	Value not found		
Organic Sorption (Koc=mL/g)	1,400	1	Moderate

Mobility Summary:

Allethrins are not soluble in water and are expected to adhere moderately to soil containing organic matter. Although allethrin products are used inside and outdoors, the rating for mobility is rated on their potential to move off the site of an outdoor application (from vegetation or soil). When allethrins reach the ground, they pose a moderate hazard to move with rain or irrigation water.

PERSISTENCE

Property	Value	Reference	Value Rating
Vapor Pressure (mm Hg)	0.00033	6	Low
Biotic or Aerobic Half-life (days)	60	1	Moderate
Abiotic Half-life (days)	Data gap		
Terrestrial Field Test Half-life (days)	Data gap		
Hydrolysis Half-life (days)	Stable at pH 4 to 7	4	High
Anaerobic Half-life (days)	Value not found		
Aquatic Field Test Half-life (days)	Value not found		

Persistence Summary:

Outside, the route of dissipation is expected to be a combination of evaporation and degradation by sunlight and soil microbes. Indoor use will likely have allethrins degrade by sunlight. Allethrins degrade within hours in sunlight but degrade much slower on soil. Soil degradation can take up to 60 days to reach half of the applied concentration. The hazard for chemical persistence is rated low in air and moderate on soil.

BIOACCUMULATION

Property	Value	Reference	Value Rating
Bioaccumulation Factor	Value not found		
Bioconcentration Factor	3,281	1	Moderate
Octanol/Water Partition Coefficient	log Kow = 4.96	1	High

Bioaccumulation Summary:

The EPA stated that the physical and chemical properties of allethrins indicate that there is a low potential for bioaccumulation although studies with a structurally similar type I pyrethroid chemical show that the potential is high. Bioconcentration studies with allethrin compounds indicate that there is some accumulation in fish tissue although the accumulation is moderate. Human metabolism studies show that allethrins are quickly metabolised and eliminated with peak urine concentrations reached within 24 hours. Rat studies indicate that half of the ingested bioallethrin is eliminated from the body within 48 hours (References 5 and 6). The hazard of bioaccumulation of allethrin compounds is rated moderate.

ACUTE WILDLIFE TOXICITY VALUES and Risk Assessment

Test Subject	Value	Reference	Value Rating
Mammalian (LD50)	709 mg/kg	2	Moderate
Avian (LD50)	2030 mg/kg	1	Low
Honey bee or insect (LD50)	3.4 ug/bee	1	Moderate
Annelida -worms (LC50)	Value not found		
Fish (LC50)	0.0094 mg/L	6	High
Crustacean (LC50)	0.150 mg/L	6	High
Mollusk (LC50)	Value not found		
Amphibian (LD50 or LC50)	Value not found		

Acute Toxicity Testing and Ecotoxicity Summary:

Single-dose toxicity testing of bioallethrin indicates that it is low in toxicity to birds, moderate in toxicity to animals and bees, but highly toxic to fish and other aquatic organisms.

Uses of allethrin insecticides involve spot spraying as well as fogger uses. Use of foggers will create a concentration of allethrins in a small area that is above the level of concern for birds and small mammals - but these animals would have to eat their entire diet within the sprayed area to be at risk. Areas outside of the pesticide fog will have concentrations of allethrins that are below the level of concern and are considered low in hazard. The EPA's risk assessment for honey bees used the lethal dose values for oral and contact exposure concentrations and compared them to allethrin concentrations from foggers and calculated the risk to bees as low.

Overall, the hazard of producing toxicity to non-target organisms from exposures to allethrins from insecticidal use is rated low.

ACUTE HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Child exposure to indoor spray	Inhalation	0.0013 mg/kg/day	Up to 0.001 mg/kg/day	1.3 to 3	2	Moderate to high
Child exposure following contractor treatment	Incidental oral	0.02 mg/kg/day	0.017 mg/kg/day	1.2	2	High
Child exposure following spot/fog floor treatment	Incidental oral	0.02 mg/kg/day	Up to 0.009 mg/kg/day	2.2 to 3.6	2	Moderate
Child exposure to outdoor fogger	Inhalation	0.0013 mg/kd/day	Up to 0.0013 mg/kg/day	None to 3	2	High

Acute Toxicity Risk Assessment Summary:

Intended uses of allethrin insecticides are not expected to cause contamination to surface water or groundwater, therefore drinking water is not considered at risk from allethrin insecticide use. There are currently no food or crop uses of allethrin insecticides. Dermal (skin absorption) toxicity testing with allethrin did not produce toxicity - therefore risk assessment for skin exposures were not required.

Short-term exposures (less than 30 days in duration) were evaluated for both inhalation and oral exposures. The risk of toxicity was compared to a dose of concern set from EPA toxicity data and their established safety factors. Risk to children or adults from potential oral exposures following an indoor fogger treatment to vinyl or carpet floors is rated moderate in hazard. Risk to children or adults following a homeowner's spot treatment of vinyl or carpet floors is also moderate in hazard. Potential exposures to children or adults following a professional contractor's application to vinyl or carpet floors is rated high in hazard.

Potential short-term inhalation exposures to children during the use of indoor space sprays ranges from moderate to high in hazard. Potential inhalation exposures to children and adults during the use of outdoor patio foggers range from moderate to high in hazard. Other potential high hazard exposures can occur from the use of total release foggers or continuously spraying an aerosol can for longer than 6 seconds.

The risk from expected inhalation exposures to applicators spraying a 16 ounce can to a wasp or hornet nest, hand held yard or patio fogger, or indoor surface / space spray are at least 10-times less than the dose of concern and are rated low in hazard.

CHRONIC HUMAN TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	"Suggestive evidence"	- -	2	Moderate
Mutagenicity	Value not found	None observed	6	Low
Neurotoxicity - (NOAEL)	Data gap	- -	2	Moderate
Endocrine Disruption	"No evidence"	- -	2	Low
Developmental Toxicity (NOAEL)	195 mg/kg/day	No teratogenic effects	6	Low
Reproductive Toxicity (NOAEL)	195 mg/kg/day	No reproductive toxicity	6	Low
Chronic Toxicity (NOAEL)	6 mg/kg/day	Microscopic liver changes	2	Check risk

Chronic Toxicity Hazard Summary:

The overall cancer classification for the allethrin compounds (except pynamin forte) is based on esbiothrin which has the EPA classification of: "suggestive evidence of carcinogenicity, but not sufficient to assess carcinogenic potential in humans" (Reference 2). Mutagenicity tests with bioallethrin were negative (Reference 6). The EPA stated that there was no evidence of endocrine toxicity in available toxicity testing of allethrins (Reference 2). Bioallethrin did not produce reproductive toxicity and the World Health Organization evaluated developmental toxicity and stated that the skeletal differences observed were variations rather than malformations and that there were no soft-tissue abnormalities attributable to the treatment (Reference 6). But, because there are specific developmental neurotoxicity testing data lacking for allethrins, the EPA placed an additional 10x safety factor on the human risk assessments to further protect infants and developing fetuses.

CHRONIC HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Child exposure following fogger floor treatment	Incidental oral	0.02 mg/kg/day	0.007 mg/kg/day	3	2	Moderate
Child exposure following spot floor treatment	Incidental oral	0.02 mg/kg/day	0.01 mg/kg/day	1.9		High
Child exposure after contractor surface treatment	Incidental oral	0.02 mg/kg/day	<0.02 mg/kg/day	None	2	High
Other intermediate exposures were not evaluated						

Chronic Toxicity Risk Assessment Summary:

Risk from potential intermediate exposures (1 month to 6 months) to allethrin insecticides were evaluated for incidental oral exposures following indoor use. Use of foggers for vinyl or carpet flooring can create potential exposures that are rated moderate in hazard. Potential oral exposures following a professional contractor's surface treatment spray are rated high in hazard for both adults and children. Children's potential oral exposures following a spot treatment to vinyl or carpet floors is also rated high in hazard.

Metabolites and Degradation Products:

The metabolites and degradation chemicals of the allethrin compounds could not be found although the EPA stated that the parent compound (allethrins) is the only residue of toxicological significance (Reference 2).

Comments:

Allethrins are comprised of eight different stereo-isomers that are present in the active ingredients but in different percentages. Esbiothrin and bioallethrin have the same Chemical Abstract Number (CAS #) because they are made up of the same stereo isomers, except in different ratios [esbiothrin is comprised of d-trans chrysanthemic acid of d-allethrolone (1R, trans; 1R) + d-trans chrysanthemic acid of l-allethrolone (1R, trans; 1S) in a 3:1ratio whereas, bioallethrin is d-trans chrysanthemic acid of d-allethrolone (1R, trans; 1R) + d-trans chrysanthemic acid of l-allethrolone (1R, trans; 1S) in a 1:1 ratio. Esbiol is comprised of over 90% d-trans chrysanthemic acid of d-allethrolone and pynamin forte is about 36.5% d-trans chrysanthemic acid of d-allethrolone (1R, trans; 1R) + 36.5% d-trans chrysanthemic acid of l-allethrolone (1R, trans; 1S) + 9% d-cis chrysanthemic acid of d-allethrolone + d-cis chrysanthemic acid of l-allethrolone (References 2 and 4).

Bioallethrin is considered a slight eye irritant (EPA Toxicity Category III), but is not a skin irritant (EPA Toxicity Category IV) and it is not considered a skin sensitizer (Reference 2).

References

1. International Union of Pure & Applied Chemistry. Pesticide Properties Database. allethrin (Ref: FMC 249). Accessed 9/13/11. http://sitem.herts.ac.uk/aeru/iupac/
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3. Center for Disease Control, Agency for Toxic Substances and Disease Registry. "Toxicological Profile for Pyrethrins and Pyrethroids". September 2003.
4. USEPA. Office of Pesticide Programs, Environmental Fate and Effects Division. Environmental Fate and Ecological Risk Assessment for the Reregistration of the Allethrins. April 4, 2007.
5. Leng G, Kühn KH, Wieseler B, Idel H. PubMed 107(1-3):109-21. "Metabolism of (S)-bioallethrin and related compounds in humans" June 30, 1999.
6. World Health Organization. International Programme on Chemical Safety. Environmental Health Criteria 87. ALLETHRINS. 1989.