indoxacarb

Review Date: 11/27/2012
CAS #: 173584-44-6

Type	Insecticide, miticide
Controls	Various and numerous insects found in agricultural crops, but in residential settings it is mainly used for control of fire ants and mole crickets in turf or for flea control on pets.
Mode of Action	Indoxacarb causes a blockage of the sodium channel within nerves.

Thurston County Review Summary:

Indoxacarb is found in insecticides with three main use areas; on pets for flea control, agricultural areas, and non-agricultural areas. There are potential exposures from use on pets that could result in potential exposures that are rated moderate in hazard and there are potential exposures from agricultural and non-agricultural applications that are rated high in hazard. Thurston County does not perform insect control on pets or in agricultural settings, so, indoxacarb products are rated by uses for insect control outdoors for non-agricultural sites. Indoxacarb is rated high in hazard because of its risk to birds from broadcast applications of granular products used on turf, or ground surface, which is the most likely outdoor residential or Thurston County use.

MOBILITY

Property	Value	Reference	Value Rating
Water Solubility (mg/L)	0.2	1	Low
Soil Sorption (Kd=mL/g)	29 to 113	1	Moderate / low
Organic Sorption (Koc=mL/g)	6,450	2	Low

Mobility Summary:

Indoxacarb is not very soluble in water and attaches strongly to most soil types. Indoxacarb degrades to several chemicals in the environment but the chemical IN-JT333 causes the toxic mode of action in insects. The binding coefficient for degradation chemical IN-JT333 (Kd = 115 to 308) indicates that it binds tightly to soil and is not likely to move off the site of application or leach deeply into soil. Other degradation chemicals of indoxacarb were reported to have binding coefficients that indicate that they are high in hazard for chemical mobility (Kd = 1 to 11). So, the hazard for indoxacarb and the its degradation chemicals to move off the site of application with rain or irrigation water is rated moderate.

PERSISTENCE

Property	Value	Reference	Value Rating
Vapor Pressure (mm Hg)	0.00000000019	1	High
Biotic or Aerobic Half-life (days)	3 - 693	1	Low to high
Abiotic Half-life (days)	126 (photolysis on soil)	1	High
Terrestrial Field Test Half-life (days)	29 to 119	1	Moderate to high
Hydrolysis Half-life (days)	22 to 36 (pH = 7)	1	Moderate
Anaerobic Half-life (days)	147 to 231	1	High
Aquatic Field Test Half-life (days)	18 - 34	1	Moderate

Persistence Summary:

In the environment, indoxacarb degradation begins rapidly and then slows down. The different rates of degradation have resulted in a wide range of published half-life rates.. Indoxacarb also degrades to several chemicals that vary greatly in persistence. The shortest chemical half-lives for degradation chemicals were reported to be in the range of 1 to 16 days and the longest were in the range of 128 to 327 days. Overall, the persistence of indoxacarb and its degradation chemicals are rated high in hazard (potential to take over 60 days to degrade to half of the applied concentration).

BIOACCUMULATION

Property	Value	Reference	Value Rating
Bioaccumulation Factor	Value not found		
Bioconcentration Factor	504 (edible) and 1351 (whole fish)	1	Moderate
Octanol/Water Partition Coefficient	log Kow = 4.65	1	Moderate

Bioaccumulation Summary:

The octanol/water partition coefficient (log Kow = 4.65) and calculated bioconcentration factor (BCF= 504 to 1351) indicate a moderate potential for indoxacarb to bind to fish or animal tissue. Depuration studies with fish show that half of the accumulated indoxacarb and its degradation chemicals were eliminated from fish when they were moved to clean water within 6 to 8 days (Reference 1). The bioaccumulation hazard of indoxacarb is rated moderate.

ACUTE WILDLIFE TOXICITY VALUES and Risk Assessment

Test Subject	Value	Reference	Value Rating
Mammalian (LD50)	179 mg/kg (KN128)	1	Moderate
Avian (LD50)	98 mg/kg	1	Moderate
Honey bee or insect (LD50)	0.18 ug/bee	1	Very high
Annelida -worms (LC50)	>625 mg/kg	2	Moderate to low
Fish (LC50)	0.65 mg/L	2	High
Crustacean (LC50)	0.6 mg/L	2	High
Mollusk (LC50)	Value not found		
Amphibian (LD50 or LC50)	Value not found		

Acute Toxicity Testing and Ecotoxicity Summary:

Ecological risk assessments were evaluated by the EPA for characterizing the potential risk from granular products used on turf for control of fire ants and mole crickets, they also evaluated risk to wildlife from many crop (agricultural) applications. Risk to pets from the use of flea control products were not found. Risk from agricultural applications are not rated as part of Thurston County's pesticide reviews.

The ecological risk assessment for birds and animals is below the EPA's level of concern for broadcast granular applications for fire ant control, although, the risk to small mammals (35 grams or less) and birds is exceeded for granular product application rates for mole cricket control (Reference 1). Risk to aquatic organisms from broadcast applications of granular indoxacarb products on turf for mole cricket control is rated moderate in hazard because its degradation chemicals may reach marine water in concentrations that exceed the EPA's level of concern for "restricted use" and endangered invertebrate species (Reference 1). The EPA also states that there are no federally listed endangered marine invertebrates. Risk to non-target beneficial insects is high in hazard but because indoxacarb is an insecticide and toxicity to bees and insects is expected and therefore not part of the pesticide review.

Overall, the risk to birds and animals is rated low in hazard for single turf applications of granular products for fire ant control and high in hazard for mole cricket control (due to the much higher application rate for mole crickets).

ACUTE HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Adult spreading granular product to 0.5 acre	Dermal (skin)	0.38 mg/kg/day	0.0000033 mg a.i./kg/day	>115,000	7	Low
Child eating granular product from lawn	Oral	0.09 mg/kg/day	0.009 mg/kg bw/day	10	7	Low
Child's combined residential exposure to granular	oral, dermal, inhalation	Different doses for each route	Values not combined for	>700	7	Low
Child contacting a treated 90 pound dog	Dermal	0.38 mg/kg/day	0.24 mg/kg/day	1.6	3	High

Acute Toxicity Risk Assessment Summary:

The short- and intermediate-term human risk assessments for oral exposures were evaluated using a dose of concern of 1.5 mg/kg/day and a safety factor of 100. The short- and intermediate-term risk assessments for dermal (skin contact) exposures were evaluated using a dose of concern of 38 mg/kg/day and a safety factor of 100.

The potential exposures to a residential applicator of granular products with a push spreader to control fire ants in a 0.5 acre area is rated low in hazard. Post application exposures to adults and children contacting and even eating granular products are all at least 10 times less than the EPA's dose of concern and are rated low in hazard. Combining all potential the routes of exposure (inhalation, skin contact, hand-to-mouth activities) from granular applications to turf are at least 700 times less than the calculated dose of concern and are rated low in hazard.

The EPA evaluated the post-application risk to adults and children contacting a pet (dog) after a spot-on treatment of an indoxacarb flea control product. The risk evaluated for children included potential skin contact and incidental oral exposures and risk to adults only evaluated skin contact exposures. Risk to children contacting treated dogs under about 50 pounds are rated moderate in hazard while potential exposures from contacting dogs larger than about 50 pounds are rated high in hazard. Risk was higher for contacting big dogs due to the larger application on the dog. All potential exposures to adults contacting any sized dog is rated moderate in hazard. Because these products are applied to the pet's skin with a syringe-style applicator, the potential exposures to the applicator is expected to be small and is rated low in hazard. A similar risk assessment was evaluated for treated cats and the risk to children is the same as for a very small dog and is rated moderate in hazard.

CHRONIC HUMAN TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	Not likely	No evidence of carcinogenicity in rat or mouse	3	Low
Mutagenicity	10-5,000 ug/plate and 100-1,00 ug/ml	"No evidence of mutagenicity"	5	Low
Neurotoxicity - (NOAEL)	Value not found	Abnormal gait and mobility, head tilt, etc.	3	Check risk
Endocrine Disruption	Not a known endocrine disruptor	- -	4	Low
Developmental Toxicity (NOAEL)	2 mg/kg/day	Decreased fetal weight	5	Check risk
Reproductive Toxicity (NOAEL)	1.5 mg/kg/day	Decreased body weight in F1 pups	5	Check risk
Chronic Toxicity (NOAEL)	2 mg/kg (reduced to 1.5 mg/kg/day)	Hemolytic effects	5 and 3	Check risk

Chronic Toxicity Hazard Summary:

Toxicity testing observed signs of neurotoxicity but at high doses (some that caused mortality). Developmental toxicity in the form of lowered fetal body weights occurred at the same dose that caused maternal toxicity in the form of decreased body weight and less food consumption. Separate multi-generation reproductive toxicity testing observed lowered body weights in the F1 pups (first generation) during lactation at the same dose that caused lowered weight gain and food consumption, as well as spleen toxcity in the mothers of the F1 pups (Reference 3).

CHRONIC HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Adult spreading granular product to 5 acre	Dermal	0.38 mg/kg/day	0.000017 mg/kg/day	>22,000	7	Low
Adult treating 200 mounds with granular product	Dermal (scoop application with	0.38 mg/kg/day	0.000048 mg/kg/day	>7,900	7	Low
Adult applying granular product with tractor	Dermal	0.38 mg/kg/day	0.0000076 mg/kg/day	50,000	7	Low
Adult applying spray with groundboom	Dermal	0.38 mg/kg/day	0.0044 mg/kg/day	86	7	Low

Chronic Toxicity Risk Assessment Summary:

This section is being used to rate potential occupational exposures to indoxacarb instead of potential long-term exposures. The EPA expects potential occupational applicator exposures to be short (1 to 30 days) to intermediate (1 to 6 months) in duration. Non-agricultural application scenarios evaluated include; hand applications (spoon/scoop) to 200 fire ant mounds, push spreading granular products to 5 acres, applying granular products to 80 acres with tractor spreader, and applying sprays with groundboom equipment to 200 acres. All of these potential exposures were calculated to be ten times less than the EPA's dose of concern and are rated low in hazard.

Metabolites and Degradation Products:

The chemical names for indoxacarb's degradation chemicals are too long to list here, but they are referred to by the EPA as; IN-JT333, IN-ML438, IN-JU873, IN-KG433, In-ML437-OH, IN-KB687, and IN-MK643 (Reference 1).

The chemical that is believed to cause the toxic mode of action to insects is IN-JT433 also known as methyl 7-chloro-2,5-dihydro-2-[[[4-(trifluoro-methoxy)phenyl] amino] carbonyl] indeno[1,2-e][1,3,4]oxadiazine-4a(3H)-carboxylate (Reference 1).

Comments:

Indoxacarb is considered an eye irritant (EPA Category III) and a potential skin irritant (EPA Category III or IV) and is a skin sensitizer (Reference 3).

References

1. USEPA. Office of Prevention, Pesticides and Toxic Substances. Risk Assessment for Proposed New Users of Indoxacarb on Grapes, Fire Ants, Mole Crickets, Alfalfa, Peanut, Soybeans, Brassica leafy vegetables (Group 5), and Turnip Greens. 4/14/2005.
2. International Union of Pure & Applied Chemistry. Pesticide Properties Database. Indoxacarb (Ref: DPX KN128). Accessed 12/2/2012.
3. USEPA. Office of Prevention, Pesticides and Toxic Substances. Occupational and Residential Exposure Assessment for Proposed Section 3 Registration of Indoxacarb for Use on Dogs. 3/11/2010.
4. Scorecard - The Pollution Information Site. Health Effects / Endocrine Toxicants (Accessed 12/6/2012). Http://scorecard.goodguide.com/health-effects.
5. USEPA. Office of Prevention, Pesticides and Toxic Substances. Pesticide Fact Sheet. Indoxacarb, Conditional Registration. October 30, 2000.
6. USEPA. Office of Prevention, Pesticides and Toxic Substances. Occupational and Residential Exposure Assessment for Proposed Section 3 Registration of Indoxacarb for Use on Cats and Kittens. 4/21/2010.
7. USEPA. Office of Prevention, Pesticides and Toxic Substances. Indoxacarb. Health Effects Division (HED) Risk Assessment for Grapes; Vegetable, Brassica, Leafy, Group 5; Turnip Greens; Vegetable, Leafy, Except Brassica (Group 4); Pome Fruits (Group 11, except pear); Tuberous and Corm Vegetables (Subgroup 1C); Cucurbit Vegetables (Group 9); Stone Fruits (Group 12); Cranberry; Mint; Okra; Southern Pea; and Fire Ant Bait. 27-May-2007.