Imidacloprid

Review Date: 04/10/2009
CAS #: 13826-41-3

Type	Neonicotinoid insecticide
Controls	Insects
Mode of Action	This chemical interferes with an insects nervous system's ability to transmit stimuli, which results in paralysis and death.

Thurston County Review Summary:

Imidacloprid is rated high in hazard and products containing it fail Thurston County's pesticide review criteria. Imidacloprid is considered high in in hazard because use on turf grass has resulted in mortality to birds as a result of secondary poisoning, and runoff from another application caused the death of thousands of crawfish in a nearby waterbody. The potential impacts to non-target organisms at expected environmental concentrations is considered high in hazard. In 2013, Thurston County Commissioners sent a letter to the Washington State Department of Agriculture (WSDA) requesting that they restrict the distribution, sale, purchase and application of the neonicotinoid class of insecticides, for ornamental use, to persons or entities with a valid WSDA pesticide applicator license.

MOBILITY

Property	Value	Reference	Value Rating
Water Solubility (mg/L)	580	1	Moderate
Soil Sorption (Kd=mL/g)	3.45	3	High
Organic Sorption (Koc=mL/g)	300-400	3	High

Mobility Summary:

Chemical testing of imidacloprid indicates that it is moderately soluble in water and adheres poorly to most soil types (more adhesion with increasing soil organic matter - in clays imidacloprid adheres moderately). These properties would indicate that this compound would be prone to move off the application site or leach into soils with rain or irrigation water. Based on the chemical properties of imidacloprid, the mobility hazard is conservatively rated as high.

PERSISTENCE

Property	Value	Reference	Value Rating
Vapor Pressure (mm Hg)	0.0000000015	1	High
Biotic or Aerobic Half-life (days)	40-190	3	High
Abiotic Half-life (days)	Not found		
Terrestrial Field Test Half-life (days)	40 - 174	3 & 6	Moderate
Hydrolysis Half-life (days)	Stable	3	High
Anaerobic Half-life (days)	27	3	Moderate
Aquatic Field Test Half-life (days)	22	3	Moderate

Persistence Summary:

Imidacloprid is not likely to evaporate or degrade from its interaction with water (hydrolyze), the majority of chemical break down appears to be by sunlight and microbial break down. Field testing has shown that degradation of imidacloprid varies quite a bit based on application location, application technique and environmental factors. Imidacloprid can take over 60 days to degrade to half of the application concentration which is rated as high in persistence hazard.

BIOACCUMULATION

Property	Value	Reference	Value Rating
Bioaccumulation Factor	Not found		
Bioconcentration Factor	3.7	3	Low
Octanol/Water Partition Coefficient	0.57	3	Low

Bioaccumulation Summary:

Testing showed that within 24-hours about 90% of ingested imidacloprid left the body in urine and feces, in 48-hours about 96% was eliminated (Reference 3). Imidacloprid has a much greater attraction to water than it does to organic solvents so it is unlikely to accumulate in animal tissue. The hazard of bioaccumulation from imidacloprid is considered low.

ACUTE WILDLIFE TOXICITY VALUES and Risk Assessment

Test Subject	Value	Reference	Value Rating
Mammalian (LD50)	131 mg/kg	1	Moderate
Avian (LD50)	31 mg/kg bw	7	High
Honey bee or insect (LD50)	0.0037 ug/bee	3	High
Annelida -worms (LC50)	0.1mg/kg soil	3	High
Fish (LC50)	>105 mg/L	3	Low
Crustacean (LC50)	10.4 - 0.5 mg/L	3	High
Mollusk (LC50)	145 mg/L	3	Low
Amphibian (LD50 or LC50)	82 mg/L	3	Moderate

Acute Toxicity Testing and Ecotoxicity Summary:

Acute toxicity testing of imidacloprid varies greatly from species to species. Imidacloprid is very highly toxic to honey bees and field testing shows that it is also very highly toxic to other beneficial insects (Reference 3). Imidacloprid is highly toxic to certain birds, and aquatic toxicity of imidacloprid varies from "practically non-toxic" to rainbow trout and oysters, "slightly toxic" to amphibians, and "highly toxic" to aquatic invertebrates. The greatest risk of an adverse effect to non-human species, after imidacloprid use, is to beneficial insects and aquatic invertebrates. Incident reports have been documented by the USEPA that state that several thousand crawfish died after a imidacloprid pesticide to turf, secondary toxicity after a grub control application to turf resulted in bird mortality (by consuming dead grubs), and imidacloprid is suspected to be the cause of "mad bee disease" noted in France. These exposure risks to non-target organisms are considered too high in hazard and pesticide products containing imidacloprid fail Thurston County's review criteria.

ACUTE HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Applicator / handler exposure not evaluated						
All infants eating treated food	Dietary	0.09 mg/kg/day	0.045 mg/kg/day	1.98	1	High
US population eating treated food	Dietary	0.09 mg/kg/day	0.021 mg/kg/day	4.3	1	Moderate
Aggregate exposure not evaluated						

Acute Toxicity Risk Assessment Summary:

Short-term human exposures of concern are related to imidacloprid from pesticidal use on food items, information about post-application contact exposures were not found and could not be evaluated. Thurston County pesticide reviews do not include pesticide exposures from food, but are presented to show the potential for exposure without ever using any imidacloprid products.

Risk assessments look at the potential for toxicity from a pesticide considering exposures from all potential applications. The single-day risk assessment looked at ingesting all the food items that are allowed to be sprayed with imidacloprid at the highest labeled rate. This risk scenario showed that there is a potential exposure scenario to infants that results in an exposure more than half of the USEPA's acute toxicity dose of concern (0.09 mg/kg/day) Reference 1. The potential dietary exposure to the general US population is more than 20% of the dose of concern.

CHRONIC HUMAN TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	E	Evidence of non-carcinogenicity for humans	2	Low
Mutagenicity	non-mutagenic		3	Low
Neurotoxicity - (NOAEL)	42 (LOAEL)	Decreased motor activity	3	Check risk
Endocrine Disruption	Potential	Disporportionate number of male pups	1	Moderate
Developmental Toxicity (NOAEL)	8	Skeletal abnormalities	4	Check risk
Reproductive Toxicity (NOAEL)	8	Reduced body weight	4	Check risk
Chronic Toxicity (NOAEL)	5.7	Thyroid lesion	1	Check risk

Chronic Toxicity Hazard Summary:

Imidacloprid is classified by the USEPA in "Group E - evidence of non-carcinogenicity in humans" (Reference 2). In developmental and reproductive toxicity testing, adverse effects were only seen at doses that were also toxic to the test parent (Reference 3). But, reproductive toxicity testing also showed that imidacloprid is an agonist to the acetylcholine receptors that regulates the endocrine system in the brain (Reference 1). Mutagenicity studies showed that imidacloprid is not mutagenic or genotoxic, but may make an organism more susceptible to DNA damage (Reference 3).

The long-term exposures to humans from pesticidal use of imidacloprid consist mostly of exposures from eating food that has been treated for insect control. The worst-case scenario involves eating all food items that could be sprayed with imidacloprid, and it is considered moderate in hazard. Thurston County does not look at dietary exposures from food in the rating of a pesticide - so, all other non-food long term exposures are considered moderate in hazard for toxicity because the potential for endocrine disruption is not fully evaluated.

CHRONIC HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Post-application contact exposure was not assessed						
Aggregate exposure not evaluated						
Drinking water exposure not evaluated						
Child (1-2 yrs) eating treated food	Dietary	0.06 mg/kg/day	0.007 mg/kg/day	8.6	1	Moderate

Chronic Toxicity Risk Assessment Summary:

The long-term risk assessment looked at ingesting all the food items that are allowed to be sprayed with imidacloprid at the highest labeled rate. This risk scenario showed that there is a potential exposure scenario to children 1-2 years of age that does not have a ten-times safety factor beyond the USEPA's dose of concern (0.06 mg/kg/day) Reference 1.

Metabolites and Degradation Products:

Potential, toxicologically significant, metabolites of imidacloprid include; 6-chloronicotonic acid, imidazolidine 4- and 5-hydroxy compounds, olefinic imidacloprid, desnitro-imidacloprid and the nitrosamine compound (Reference 1). The nitrosamine compound of imidacloprid is non-mutagenic and is of equal or lower toxicity than imidacloprid (Reference 3). However, some metabolites of imidacloprid have been shown to be of greater toxicity than imidacloprid (Reference 5).

Comments:

Imidacloprid is not irritating to the eyes and is not considered a skin irritant or a skin sensitizer (Reference 3). Some formulated products containing imidacloprid are slightly irritating to the eyes and skin.

References

1. California Environmental Protection Agency, Department of Pesticide Regulation. Feb. 9, 2006. Imidacloprid. Risk Characterization Document - Dietary and Drinking Water Exposure.
2. USEPA. July 19, 2004. Office of Pesticide Programs, Health Effects Division - Science Information Management Branch. "Chemicals Evaluated for Carcinogenic Potential".
3. Syracuse Environmental Research Associates, Inc. 12/28/2005. Prepared for: USDA, Forest Service. Imidacloprid - Human Health and Ecological Risk Assessment - Final Report.
4. EXTOXNET Extension Toxicology Network. Pesticide Information Profiles. "IMIDACLOPRID." http;//extoxnet.orst.edu/pips/imidaclo.htm
5. Fossen, Matthew PhD. California Department of Pesticide Regulation. Department of Pesticide Regulation, Environmental Monitoring. April 2006. "Environmental Fate of Imidacloprid".
6. International Union of Pure and Applied Chemistry (IUPAC). Pesticide Properties Database. January 27, 2009. http://sitem.herts.ac.uk/aeru/iupac/index.htm
7. Federoff, et al. USEPA. Problem Formulation for the Imidacloprid Environmental Fate and Ecological Risk Assessment. November 13, 2008.