PI-80

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Pesticide Toxicity Profile: Neonicotinoid Pesticides[1]

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

General

The mode of action of neonicotinoid pesticides is modeled after the natural insecticide, nicotine. They act on the central nervous system of insects. Their action causes excitation of the nerves and eventual paralysis which leads to death. Because they bind at a specific site (the postsynaptic nicotinic acetylcholine receptor), they are not cross-resistant to the carbamate, organophosphate, or synthetic pyrethroid insecticides, which was an impetus for their development. As a group, they are effective against sucking insects, but also chewing insects such as beetles and some Lepidoptera, particularly cutworms. All neonicotinoid products are classified as general use.

Acetamiprid is for use against sucking insects, such as aphids and whiteflies, on leafy vegetables, cole crops, citrus, cotton, ornamentals, and fruiting vegetables. Ready-to-use formulations are available in addition to wettable powders and water-dispersible granules.

Imidacloprid was first registered for use in the U.S. in 1992 and is possibly the most widely used insecticide of the group. It has a wide range of target pests and sites, including soil, seed, structural, pets, and foliar treatments in cotton, rice, cereals, peanuts, potatoes, vegetables, pome fruits, pecans, and turf. It is a systemic with long residual activity and particularly effective against sucking insects, soil insects, whiteflies, termites, turf insects, and Colorado potato beetle. Products are available in dusts, granules, seed dressings as flowable slurry concentrates, soluble concentrates, suspension concentrates, and wettable powders. The application rates for neonicotinoid insecticides are much lower than older, traditionally used insecticides.

Thiamethoxam's chemical structure is slightly different than the other neonicotinoid insecticides, making it the most water soluble of this family. Because of its greater water solubility, it moves readily in plant tissue. Products are labeled for soil, seed, and foliar treatments to a wide range of

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vegetable and field crops. Product formulations include emulsifiable concentrates, water dispersible granules, and soluble concentrates.

Toxicity

Neonicotinoids are classified by the EPA as both toxicity class II and class III agents and are labeled with the signal word "Warning" or "Caution." Because the neonicotinoids block a specific neuron pathway that is more abundant in insects than warm-blooded animals, these insecticides are more selectively toxic to insects than mammals. The most available toxicity data of the neonicotinoids is with imidacloprid. These data indicate that it is less toxic when absorbed by the skin or when inhaled compared to ingestion. It causes minor eye reddening, but is non-irritating to the skin. Signs of toxicity in rats include lethargy, respiratory disturbances, decreased movement, staggering gait, occasional trembling, and spasms. There are no accounts of human poisoning, but signs and symptoms of poisoning would be expected to be those similar for rats. A chronic toxicity study showed that rats fed up to 1,800 ppm resulted in a No Observable Effect Level (NOEL) of 100 ppm. The EPA categorizes imidacloprid as a "Group E" (no evidence of carcinogenicity). In animals and humans, imidacloprid is quickly and almost completely absorbed from the gastrointestinal tract, and eliminated via urine and feces within 48 hours. Of the neonicotinoids, imidacloprid is the most toxic to birds and fish. Both imidacloprid and thiamethoxam are highly toxic to honeybees. Mammalian toxicities for neonicotinoid pesticides registered in Florida are shown in Table 1. Table 2 lists the toxicities to wildlife by the common name of the neonicotinoid 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

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

Common name	Rat oral LD_{50}	Rabbit dermal LD_{50}
Acetamiprid	450	>2,000 (Tristar®)
Imidacloprid	4,870 (Gaucho®)	>2,000 (Admire®)
Thiamethoxam	>5,000	>2,000

Table 2. Neonicotinoid pesticide wildlife toxicity ranges.

Common name	Bird acute oral LD_{50} (mg/kg)*	Fish LC_{50} (ppm)**	Bee LD_{50} †
Acetamiprid	PNT	PNT	MT
Imidacloprid	MT	MT	HT
Thiamethoxam	ST	PNT	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 neonicotinoid insecticides.

Common name*	Trade names**	Chemical Name
Acetamiprid	Acetamiprid®, Assail®, Tristar®	(E)-N-(6-chloro-3-pyridinyl)methyl)-N ^{1}-cyano-N-methylacetamidine
Imidacloprid	Admire®, Advantage®, Gaucho®, Merit®, Premise®, Touchstone®	1-(6-chloro-3-pyridin-3-ylmethyl-N-nitroimidazolidin-2-ylidenamine
Thiamethoxam	Cruiser®, Platinum®	3-(2-chloro-1,3-thiazol-5-ylmethyl)-1,3,5-oxadiazinan-4-ylidenene(nitro)amine

*Basic molecule; isomers not listed.

**Does not include manufacturers' prepackaged mixtures; major agricultural brands for basic manufacturers.