E X T O X N E T

Extension Toxicology Network

A Pesticide Information Project of Cooperative Extension Offices of Cornell University, Michigan State University, Oregon State University, and University of California at Davis. Major support and funding was provided by the USDA/Extension Service/National Agricultural Pesticide Impact Assessment Program.

Pesticide
Information
Profile

Abamectin

Publication Date: 5/94

TRADE OR OTHER NAMES

Also known as Avermectin B1 and MK-936. Trade names include Affirm, Agri-Mek, Avid, Dynamec, Vertimec and Zephyr.

INTRODUCTION

Abamectin is a mixture of avermectins containing > 80% avermectin B1a and < 20% avermectin B1b (1). These two components, B1a and B1b have very similar biological and toxicological properties (5). The avermectins are insecticidal or anthelmintic compounds derived from the soil bacterium Streptomyces avermitilis (2). Abamectin is a natural fermentation product of this bacterium (5). Abamectin is used to control insect and mite pests of a range of agronomic, fruit, vegetable and ornamental crops, and it is used by homeowners for control of fire ants (5). Doses of 50 to 200 ug/kg of ivermectin, a similar member of the avermectin family of comounds, is widely used to treat humans in the World Health Organization onchocerciasis (river blindness) program (2, 8).

TOXICOLOGICAL EFFECTS

ACUTE TOXICITY

Abamectin is a highly toxic material, however most formulated products containing abamectin are of low toxicity to mammals (5, 7). Emulsifiable concentrate formulations may cause moderate eye irritation and mild skin irritation (1). Symptoms of poisoning observed in laboratory animals include pupil dilation, vomiting, convulsions and/or tremors, and coma (5).

Abamectin acts on insects by interfering with neural and neuromuscular transmission. It acts on a specific type of synapse located only within the brain and is protected by the blood-brain barrier. However, at very high doses, the mammalian blood-brain barrier can be penetrated, causing symptoms of CNS depression such as incoordination, tremors, lethargy, excitation and pupil dilation. Very high doses have caused death from respiratory failure (2).

Abamectin is not readily absorbed through skin. Tests with monkeys show that less than 1% of dermally applied abamectin was absorbed into the bloodstream through the skin (5). Abamectin does not cause allergic skin reactions (7).

The amount of a chemical that is lethal to one-half (50%) of experimental animals fed the material is referred to as its acute oral lethal dose fifty, or LD50. The oral LD50 for abamectin in rats is 11 mg/kg, and in mice range from 14 (5) to > 80 mg/kg (7). The dermal LD50 for technical abamectin on rats and rabbits is > 330 mg/kg (4). The oral LD50 for the product Affirm 0.011% Fire Ant Bait in rats is > 5,000 mg/kg, and its dermal LD50 on rabbits is > 2,000 mg/kg (1). The oral LD50 for the 1.8% w/v Abamectin EC product in rats is 300 mg/kg, and the dermal LD50 for this product on rabbits is > 2,000 mg/kg (8).

CHRONIC TOXICITY

In a 1-year study with dogs given oral doses of 0, 0.25, 0.5, or 1 mg/kg/day, there were no changes in tissue at any dose level. However, some dogs at the 0.5 and 1 mg/kg/day levels had pupillary dilation, weight loss, lethargy, tremors and recumbency. The NOEL for this study was 0.25 mg/kg/day (5, 8). Similar results were seen in a 2-year study with rats fed 0, 0.75, 1.5, or 2 mg/kg/day. No changes in the nervous or muscular systems were observed, but rats in all the dosage levels exhibited body weight gains significantly higher than the controls. A few individuals in the high dose group exhibited tremors (5).

When mice were fed 8 mg/kg/day, the highest dose tested, for 94 weeks, the males developed dermatitis and changes in blood formation in the spleen, while females exhibited tremors and weight loss (7).

Reproductive Effects

In rats, the pup toxicity NOEL was 0.12 mg/kg/day. At 0.40 mg/kg/day, there were increased stillbirths, decreased pup viability, decreased lactation, and decreased pup weights (7).

Teratogenic Effects

Abamectin has produced cleft palate in the offspring of treated mice and rabbits, but only at doses that were also toxic to the mothers (5). There were no birth defects in the offspring of rats given up to 1 mg/kg/day (7).

Mutagenic Effects

Abamectin is not mutagenic. The microbial mutagenesis and mutagenicity tests in live mice were negative. One test on rat liver cell cultures was positive (7).

Carcinogenic Effects

Abamectin was not carcinogenic in rats or mice fed the maximum tolerated doses. The rats were fed dietary doses of 0.75, 1.5, or 2 mg/kg/day for 24 months, and the mice were fed 2, 4 or 8 mg/kg/day for 22 months (5).

Fate in Humans and Animals

Tests with laboratory animals show that ingested avermectin B1a is absorbed into the bloodstream by mammals and that it is rapidly eliminated from the body within 2 days via the feces (7, 8). Rats given single oral doses of radio-labeled avermectin B1a excreted most of the dose (69 to 82%) unchanged in the feces. The half-life of avermectin B1a residues in rat tissues averaged 1.2 days (4). Similarly, when monkeys were given a single intravenous injection of avermectin B1a, more than 90% of the dose was excreted in the feces within 7 days of the dosing (5, 8). Lactating goats given daily oral doses for 10 days excreted 89% of the administered avermectin, mainly in the feces. Less than 1% was recovered in the urine (4).

ECOLOGICAL EFFECTS

Effects on Birds

Abamectin is relatively non-toxic to birds (7). The LD50 for abamectin in Bobwhite quail is 2,000 mg/kg. When exposed to abamectin in their feed for 5 days, the LC50 for bobwhite quail was 3,102 ppm, and for mallard ducks was 383 ppm. There were no adverse effects on reproduction when mallard ducks were fed dietary doses of 3, 6 or 12 ppm for 18 weeks (6).

Effects on Aquatic Organisms

Abamectin is highly toxic to fish and aquatic invertebrates (7). Its 96-hour LC50 in rainbow trout is 3.2 ppb, 9.6 ppb in bluegill sunfish, 15 ppb in sheepshead minnow, 24 ppb in channel catfish, and 42 ppb in carp. Its 48-hour LC50 in Daphnia magna, a small freshwater crustacean, is 0.34 ppb. The 96-hour LC50 for abamectin in pink shrimp (Panaeus duorarum) is 1.6 ppb, 0.022 ppb in mysid shrimp, 430 ppb in eastern oysters, and 153 ppb in blue crab (6).

While the above LC50 values are quite low, indicating a high level of toxicity to aquatic organisms, actual concentrations of abamectin in surface waters (fresh water) adjacent to treated areas are expected to be low. Application rates of 0.025 pounds of abamectin per acre (the highest recommended rate) should result in concentrations no higher than 26 parts per trillion in adjacent surface waters one day after the application. Rapid photodegradation and adsorption to sediments should produce even lower concentrations within days. The degradation products of abamectin are less toxic to aquatic organisms than abamectin itself (6).

Abamectin did not bioaccumulate in bluegill sunfish exposed to 0.099 ppb for 28 days in a flow-through tank. On day 28, the concentration of residues in the fish was 6.8 ppb, but this rapidly decreased to 0.32 ppb by day 42. The BCF value calculated from this study is 52, indicating that abamectin does not accumulate or persist in fish (6).

Effects on Other Animals (Nontarget species)

Abamectin is highly toxic to bees, with a 24-hour contact LC50 of 0.002 ug/bee and an oral LD50 of 0.009 ug/bee. Rapid degradation of abamectin will reduce the risk of bee deaths. Citrus and alfalfa foliage was not toxic to bees 24 to 48 hours after treatment with abamectin (6).

The 28-day LC50 for abamectin in earthworms is 28 ppm. Earthworms will not be adversely affected by use of abamectin at recommended application rates.

ENVIRONMENTAL FATE

Breakdown of Chemical in Soil and Groundwater

Because abamectin is nearly insoluble in water and has a strong tendency to bind to soil particles, it is therefore immobile in soil and unlikely to leach or contaminate groundwater (6, 7). Compounds produced by the degradation of abamectin are also immobile and unlikely to contaminate groundwater (6).

Abamectin is rapidly degraded in soil. At the soil surface, it is subject to rapid photodegradation, with half-lives of 8 and 21 hours (6) or 1 day (7) reported. When applied to the soil surface and not shaded, its soil half-life was about 1 week. Under dark, aerobic conditions, the soil half-life was 2 weeks to 2 months (7). The half-life for avermectin B1a in fine sandy loam, clay and construction grade sand was 20 to 47 days. Loss of abamectin from these soils is thought to be due to microbial degradation because abamectin remained undegraded in sterile soil. The rate of degradation was significantly decreased under anaerobic conditions (6).

Breakdown of Chemical in Surface Water

Abamectin is rapidly degraded in water. After an initial distribution, its half-life in artificial pond water was 4 days. Its half- life in pond sediment was 2 to 4 weeks (6). It undergoes rapid photodegradation, with a half-life of 12 hours in water (6, 7). When tested at pH levels common to surface and groundwater (pH 5, 7, and 9), abamectin did not hydrolyze (6).

Breakdown of Chemical in Vegetation

Plants do not absorb abamectin from the soil (6). Abamectin is subject to rapid degradation when present as a thin film, as on treated leaf surfaces. Under laboratory conditions and in the presence of light, its half-life as a thin film was 4 to 6 hours (6).

PHYSICAL PROPERTIES AND GUIDELINES

Abamectin is a white to yellowish crystalline powder (4). It poses a slight fire hazard if exposed to heat or flame, and a fire and explosion hazard in the presence of strong oxidizers. It may burn but will not readily ignite. Avoid contact with strong oxidizers, excessive heat, sparks or open flame. Thermal decomposition may release toxic oxides of carbon (3). Workers handling abamectin should wear goggles to prevent eye contact and protective clothing to prevent prolonged skin contact (3).

Exposure Guidelines:

No occupational exposure limits have been established for abamectin by OSHA, NIOSH or ACGIH (3).

Physical Properties:

CAS #:	Avermectin B1a - 65195-55-3; Avermectin B1b - 65195-56-4
Chemical name:	avermectin B1a
Chemical Class/Use:	avermectin acaricide/insecticide; macrocyclic lactone disaccharide isolated from the soil bacterium Streptomyces avermitilis.
Density:	1.16 at 21 degrees C (7)
H20 solubility:	practically insoluble; 7.8 ppb (6)
Solubility in other solvents:	soluble in acetone, methanol, isopropanol and toluene (4, 8)
Melting point:	155-157 degrees C (4)
Vapor pressure:	negligible (4); 1.5 x 10 to the minus 9 torr (7)
Koc:	4,000 (6)

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Review by Basic Manufacturer:

Comments solicited: April, 1993
Comments received: July, 1993

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