

Isoxaben

Roadside Vegetation Management Herbicide Fact Sheet



This fact sheet was developed by Oregon State University and Intertox, Inc. to assist interested parties in understanding the risks associated with pesticide use in Washington State Department of Transportation's (WSDOT) Integrated Vegetation Management program.

Introduction

Isoxaben is a benzamizole herbicide with broad spectrum pre-emergent activity for broadleaf weeds, grasses, vines, for use around ornamental trees and shrubs. Isoxaben disrupts an enzyme (found only in plants) necessary for protein synthesis. Isoxaben is the only active ingredient (75%) in the herbicide **Gallery DF**. According to the product label, Gallery 75DF also contains 25% other ingredients (unspecified). The Washington State Department of Transportation (WSDOT) uses Gallery DF for pre-emergent weed control in ground cover beds. Gallery DF is also used in agriculture and urban settings.

WSDOT assessed the potential risks to human, wildlife, and aquatic animals exposed to isoxaben in their Integrated Vegetation Management (IVM) program. Evaluating potential risks takes into account both the toxicity of a pesticide and the characteristics of possible exposure.

WSDOT Application Rates and Use Patterns on Highway Rights-of-Way

Gallery is applied at a rate of 1.33 pounds of product—or about 1.0 pound of isoxaben—per acre. Gallery DF is applied once a year as needed in the spring or fall, as a broadcast treatment over ornamental ground cover and shrub beds through truck-mounted hand-guns, hose reels, or backpack sprayers. WSDOT workers applied an average of 150 pounds of isoxaben per year statewide during 2004 and 2005.

Laboratory Testing: Before pesticides are registered by the U.S. Environmental Protection Agency (EPA), they must undergo laboratory testing for short-term (acute) and long-term (chronic) health effects. Laboratory animals are purposely fed doses high enough to cause toxic effects. These tests help scientists determine how chemicals might affect humans, domestic animals, or wildlife in cases of overexposure. Pesticide products used according to label directions are unlikely to cause toxic effects. The amount of pesticide that people and pets may be exposed to is low compared to the doses fed to laboratory animals.

Human Health Effects

The U.S. Environmental Protection Agency (EPA) classifies Gallery DF as category III (Low Toxicity) with a signal word of CAUTION because it causes eye irritation and is harmful if inhaled (see "Toxicity Category and Signal Word

Toxicity Category and Signal Word

	High Toxicity (<i>Danger</i>)	Moderate Toxicity (<i>Warning</i>)	Low Toxicity (<i>Caution</i>)	Very Low Toxicity (<i>Caution</i>)
Oral LD50	Less than 50 mg/kg	50-500 mg/kg	500-5000 mg/kg	Greater than 5000 mg/kg
Dermal LD50	Less than 200 mg/kg	200-2000 mg/kg	2000-5000 mg/kg	Greater than 5000 mg/kg
Inhalation LC50	Less than 0.05 mg/l	0.05-0.5 mg/l	0.5-2.0 mg/l	Greater than 2.0 mg/l
Eye Effects	Corrosive	Irritation persisting for 7 days	Irritation reversible in 7 days	Minimal effects, gone in 24 hrs
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation

Note: Highlighted categories specify the range for isoxaben cited in this fact sheet.

Signal Word" table).

Acute toxicity: Isoxaben has moderate toxicity if it gets on the skin, and very low toxicity if eaten or inhaled.

Chronic toxicity: Rats fed isoxaben in the diet for two years showed blood chemistry changes, body weight changes, and increased organ weights at moderate and high doses.

Reproductive effects: In a 3-generation rat reproductive study, decreased body weight was observed in the mother at high doses, and the number of viable pups was decreased in subsequent generations. An additional study in rats found maternal and reproductive effects at high doses. No systemic, developmental or reproductive effect was seen in rabbits administered high doses of isoxaben.

Carcinogenic effects: Studies in rats and mice have provided evidence of increased tumors from exposure to isoxaben. Isoxaben was negative in mutagenicity studies. Isoxaben is considered a possible human carcinogen by U.S. EPA.

Fate in humans and animals: Rats rapidly excrete isoxaben unchanged, primarily in feces. Isoxaben does not bioaccumulate (build up) in mammals.

Wildlife and Aquatic Effects

Effects on mammals: Isoxaben is practically non-toxic to mammals based on an acute oral LD50 of >10,000 mg/kg in rats and mice. Via the dermal route, an LD50 of >200 mg/kg was reported in rabbits (moderately toxic). Via inhalation, an LD50 >1,990 mg/m³ (146 ppm) was reported in rats.

Effects on birds: Isoxaben is practically non-toxic to birds based on an acute oral LD50 of >2,000 mg/kg reported in quail.

Effects on fish: It was not possible to evaluate the toxicity of isoxaben in fish because adequate data were not identified. The bioconcentration potential of isoxaben is reportedly low with a bioconcentration factor (BCF) <100.

Effects on aquatic insects: Toxicity of isoxaben for aquatic invertebrates was not evaluated due to a lack of information identified.

Environmental Fate

A typical half-life for isoxaben in soils is 100 days (see "Half-life" text box). Microbes and sunlight break down isoxaben in

LD50/LC50: Acute toxicity is commonly measured by the lethal dose (LD) or lethal concentration (LC) that causes death in 50 percent of treated laboratory animals. LD50 indicates the dose of a chemical per unit body weight of an animal and is expressed as milligrams per kilogram (mg/kg). LC50 is the concentration of a chemical per volume of air or water and is expressed as milligrams per liter (mg/L). Chemicals are highly toxic when the LD50 or LC50 value is small and practically nontoxic when the value is large. However, the LD50 and LC50 do not reflect potential health effects such as cancer, birth defects, or reproductive toxicity that may occur at levels of exposure below those that cause death.

Wildlife Toxicity Category

Risk Category	Mammals	Birds	Fish or Aquatic Insects
	Acute Oral or Dermal LD ₅₀ (mg/kg)	Acute Oral LD ₅₀ (mg/kg)	Acute LC ₅₀ (mg/L)
Practically nontoxic	>2,000	>2,000	>100
Slightly toxic	501-2,000	501-2,000	>10-100
Moderately toxic	51-500	51-500	>1-10
Highly toxic	10-50	10-50	0.1-1
Very highly toxic	<10	<10	<0.1

Highlighted categories specify the range for isoxaben cited in this fact sheet. The toxicity of isoxaben to wildlife receptors varies by species.

Half-life is the time required for half of the compound to degrade.

- 1 half-life = 50% degraded**
- 2 half-lives = 75% degraded**
- 3 half-lives = 88% degraded**
- 4 half-lives = 94% degraded**
- 5 half-lives = 97% degraded**

Remember: the amount of a chemical remaining after a half-life will always depend on the amount of the chemical originally applied.

the environment. Isoxaben’s potential to leach to groundwater is low; surface runoff potential is high; and potential for loss on eroded soil is high. Isoxaben has moderate volatility and the potential for loss to the atmosphere is moderate. Isoxaben does not bioconcentrate (build up) through the food chain. Plants take up isoxaben primarily through the roots. Isoxaben is translocated (moved throughout) to other plant parts.

Human Health Risk Assessment

WSDOT evaluated several human exposure scenarios, including workers applying herbicides and the public (adults and children) picking and eating drift-contaminated berries, eating drift-contaminated garden vegetables, and walking through sprayed vegetation. For each exposure scenario, WSDOT evaluated conditions of average exposure and extremely conservative conditions of maximum exposure (see “Human Cancer/Non-cancer Risk Classification” text box and “Human Risk Classification for Average Exposure Scenarios” table).

Human Cancer/Non-cancer Risk Classification: Scientists estimate non-cancer health risks by generating a hazard quotient (HQ). This number is the exposure divided by the toxicity. When the HQ is less than 1, exposures are unlikely to cause any adverse health effects. When the HQ is greater than 1, the potential for non-cancer health effects should be considered. Risk assessments for chemicals that cause cancer (carcinogens) estimate the probability of an individual developing cancer over a lifetime. Cancer risks estimated in this way are very conservative, and actual cancer risks are likely to be much lower. Cancer risk estimates of less than 1 in 100,000 are within the range considered negligible by most regulatory

Isoxaben is expected to pose negligible potential risks of adverse non-cancer effects to WSDOT workers and the public under conditions of average exposure. All hazard quotients are below 1. Under conditions of maximum exposure, isoxaben is expected to pose negligible potential risks of adverse non-cancer effects to WSDOT workers and the public in all exposure scenarios except for children coming into dermal contact with directly sprayed vegetation; the HQ for this scenario is 1.1. Isoxaben is not regulated as a carcinogen.

Wildlife Risk Assessment

Wildlife risk assessment considers herbicide behavior in the environment and routes of exposure. Indirect exposure to mammals and birds can occur when they eat contaminated prey or vegetation. Direct exposure can occur when mammals and birds contact herbicide residues with their skin or eyes or when they inhale vapors or particulates. WSDOT’s current application rates and use patterns for isoxaben are expected to pose an insignificant risk to mammals. The estimated dietary exposures to rats, mice, and meadow vole from maximum label application rates would be 7,100, 830 and 1,100-fold lower, respectively, than the acute dietary LD50 for isoxaben. The estimated dietary exposures of isoxaben to quail, marsh wren, and American robin from WSDOT’s current application practices would be 900, 100, and 79-fold lower, respectively, than the acute dietary LD50 for bobwhite quail. These estimated dietary exposures are considered insignificant for quail and low for wren and robin.

Aquatic Risk Assessment

WSDOT takes extra precautions applying herbicides near open water, wetlands, and wellhead protection zones. However, contamination may result from application drift, rainfall runoff, or residue leaching through the soil into groundwater. Fish and aquatic insect exposure to isoxaben occurs primarily through direct contact with contaminated surface waters and sediment. Isoxaben is highly persistent in soil but breaks down relatively

Human Risk Classifications for Average Exposure Scenarios		
Hazard Quotient (Non-cancer Risk)	Cancer Risk	Potential Risks and Management Priority
Less than 1	Less than 1 in 100,000	Negligible
Between 1 and 10	Between 1 in 10,000 and 1 in 100,000	Low
Between 10 and 100	Between 4 in 1,000 and 1 in 10,000	Moderate
Greater than 100	Greater than 4 in 1,000	High

Note: Highlighted categories specify the range of potential risk for specific exposure scenarios involving isoxaben.

quickly in water. Limited persistence of isoxaben in water would likely limit exposure to fish and aquatic invertebrates. However, due to a lack of toxicity data, no risks were calculated for fish and aquatic invertebrates from WSDOT's application of isoxaben.

Additional Resources

- National Pesticide Information Center 1-800-858-PEST (7378) and <http://npic.orst.edu>
- Washington State Department of Transportation, Roadside Maintenance Branch 1-360-705-7865
- Washington Department of Agriculture, Pesticide Management Division 1-877-301-4555 (toll free)