



Imazapyr

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

Imazapyr is an imidazolinone herbicide used to control grasses, broadleaves, vines, brambles, brush, and trees. Imazapyr disrupts an enzyme (found only in plants) necessary for protein synthesis, and interferes with cell growth and DNA synthesis in plants. The isopropylamine salt of imazapyr is the only active ingredient (28.7%) in the herbicides **Arsenal** and **Habitat**. According to the product labels, Arsenal and Habitat also contain 71.3% other ingredients (unspecified). Arsenal is typically tank mixed with 0.25% of a nonionic surfactant. Habitat is labeled for use in aquatic environments. The Washington State Department of Transportation (WSDOT) is considering the future use of Arsenal for non-selective weed and brush control and Habitat for non-selective control of weeds growing near surface water.

WSDOT assessed the potential risks to human, wildlife, and aquatic animals exposed to imazapyr 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

WSDOT is currently evaluating the use of Arsenal and Habitat for maintenance of a bare ground strip at the edge of pavement. Arsenal and Habitat are typically applied at 3.5 to 5.2 pounds of product—or a maximum of about 1.5 pounds of imazapyr—per acre. Applicators use truck mounted booms placed 18" above the ground to make a single application of imazapyr in the spring. In 2005 WSDOT applied 35 pounds of imazapyr statewide.

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 Arsenal and Habitat as category III (Low Toxicity)

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 imazapyr cited in this fact sheet.

with a signal word of CAUTION (see “Toxicity Category and Signal Word” table).

Acute toxicity: Imazapyr has low toxicity if individuals get residues on their skin, and very low toxicity if it is eaten or inhaled. Imazapyr was not irritating to rabbit eyes, but was mildly irritating when applied to the skin. Imazapyr did not produce sensitization in guinea pigs.

Chronic toxicity: Mice fed imazapyr for two years developed fluid accumulation in the lungs and increased incidence of kidney cysts. Rats fed imazapyr for two years developed abnormal blood formation in the spleen, increased blood pooling in the liver, an increase in thyroid cysts, and a decrease in food efficiency. Most of these data were not considered significant by U.S. EPA. There was no information on either study describing exposure dose.

Reproductive effects: In a 2-generation reproductive study conducted in rats, no treatment-related effects were seen in parents or offspring at any of the doses tested. In other studies, there were no maternal, reproductive, or developmental effects in rats and rabbits exposed to imazapyr during pregnancy.

Carcinogenic effects: Imazapyr is considered not likely to be a human carcinogen by U.S. EPA.

Fate in humans and animals: Rats rapidly excrete imazapyr unchanged in urine and feces. Imazapyr does not bioaccumulate (build up) in mammals.

Wildlife and Aquatic Effects

Effects on mammals: Imazapyr is practically non-toxic to mammals based on an acute oral LD₅₀ of >5,000 mg/kg in rats. Acute dermal toxicity of >2,000 mg/kg was reported in rabbits.

Effects on birds: Imazapyr is practically non-toxic to birds. Oral LD₅₀ values of >2,150 were reported for both quail and duck.

Effects on fish: The reported acute toxicity LC₅₀ concentration for rainbow trout, bluegill sunfish, and channel catfish is >100 mg/L based on product registrant studies with technical grade imazapyr using standard 96-hr exposure studies. Tests were also conducted with the Atlantic silverside to address the potential toxicity of imazapyr to marine fish. In those tests the highest concentration tested was 184 mg/L, which yielded no significant toxicity (mortality). A summary report by USDA reported an LC₅₀ of <100 mg/L for fish. On these bases, imazapyr would be characterized as practically non-toxic to slightly toxic to fish.

Effects on aquatic insects: Imazapyr would be considered slightly toxic to practically non-toxic to invertebrates based on the results from a range of invertebrate species. The reported acute toxicity LC₅₀ concentration for the water flea *Daphnia magna* is >100 mg/L. One study where Arsenal was applied with a surfactant (not defined) with *Daphnia magna* yielded a 48-hr LC₅₀ of 350 mg-Arsenal/L.

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

¹Highlighted categories specify the range for imazapyr cited in this fact sheet. The toxicity of imazapyr to wildlife receptors varies by species.

Environmental Fate

A typical half-life for imazapyr in soils is 10 days (see “Half-life” text box). Microbes and sunlight break down imazapyr in the environment. Imazapyr’s potential to leach to groundwater is high; surface runoff potential is high, and potential for loss on eroded soil is intermediate. Imazapyr has low volatility and the potential for loss to the atmosphere is low. Imazapyr does not bioconcentrate (build up) through the food chain. Plants take up imazapyr through the leaves and roots. Imazapyr is translocated (moved throughout) to other plant parts.

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.

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).

Imazapyr is expected to pose negligible potential risks of adverse non-cancer effects to WSDOT workers and the public under conditions of average and maximum exposure. All hazard quotients are below 1. Imazapyr 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 proposed application rates and use patterns for imazapyr would be 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 3,600, 420 and 550-fold lower, respectively, than the acute dietary LD50 for imazapyr. The estimated dietary exposures of imazapyr to quail, marsh wren, and American robin from WSDOT’s proposed application practices would be 970, 110, and 85-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.

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

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 imazapyr.

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 imazapyr occurs primarily through direct contact with contaminated surface waters and sediment. Imazapyr is highly persistent in soil but breaks down relatively quickly in water. The estimated risks to fish and aquatic invertebrates from imazapyr applied at levels established by WSDOT is low in the Columbia Plateau and Blue Mountain regions and slight in the other six regions of the state.

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)