Washington State Department of Transportation

Oxadiazon

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. WSDOT updated in 2017 to reflect current products and usage.

Introduction

Oxadiazon is an oxadiazole herbicide used for pre-emergent control of grasses, broadleaves, vines, brambles, brush, and trees. Oxadiazon inhibits the plant enzyme protoporphyrinogen oxidase. Oxadiazon is the only active ingredient (50%) in the herbicide **Ronstar 50 WSP** and 2% in **Ronstar G**. The Washington State Department of Transportation (WSDOT) uses **Ronstar** for pre-emergent weed control in ground cover beds. **Ronstar** also has agricultural (non-food crops) and urban uses.

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

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.

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

Typical rights-of-way application rates of **Ronstar 50 WSP** range from 4 to 8 pounds of product—or a maximum of about 4 pounds of the active ingredient oxadiazon—per acre. **Ronstar 50** 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 did not apply any Oxadiazon in the year of this update to this report (2016).

Human Health Effects

The U.S. Environmental Protection Agency (EPA) classifies **Ronstar** as category II (Moderate Toxicity) with a signal word of WARNING because it causes substantial but temporary eye injury, causes skin irritation, and is harmful if inhaled or absorbed through skin (see "Toxicity Category and Signal Word" table).

Acute toxicity: Oxadiazon has low toxicity if it individuals inhale it or get it on their skin, and very low toxicity if it is eaten. In rabbits, oxadiazon was negligibly irritating to the skin and mildly irritating to the eyes. Oxadiazon did not cause skin sensitization in guinea pigs.

Chronic toxicity: U.S. EPA reported that in both subchronic and chronic studies, the major target organ of oxadiazon toxicity was the liver. Effects were consistent among the species tested (rat, dog, mouse).

Toxicity Category and Signal Word

	High Toxicity (*Danger*)	Moderate Toxicity (*Warning*)	Low Toxicity (*Caution*)	Very Low Toxicity (*Caution*)
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 oxadiazon cited in this fact sheet.

Reproductive effects: U.S. EPA reported that in reproductive/developmental studies of oxadiazon, there was significant fetal toxicity in rats and rabbits.

Carcinogenic effects: An increase in tumors was seen in rats and mice fed oxadiazon long term. Based on these studies, U.S. EPA classified oxadiazon as likely to be carcinogenic to humans.

Fate in humans and animals: Rats rapidly excrete oxadiazon primarily in urine (93% eliminated in 72 hours.) Oxadiazon does not bioaccumulate (build up) in mammals.

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 and Aquatic Effects

Effects on mammals: Oxadiazon is practically nontoxic to mammals based on studies evaluated by U.S. EPA. LD50s of 3500 and >5,000 mg/kg were reported in oral rat studies. An LD50 of 5,200 mg/kg was reported following dermal exposure in rats. In rabbits, a dermal LD50 of >2,000 mg/kg was reported.

Effects on birds: Oxadiazon is practically non-toxic to slightly toxic to birds. An oral acute LD50 of 1,040 mg/kg was reported for mallard ducks exposed to oxadiazon via acute oral exposure. In another study reviewed by U.S. EPA, LD50 values of >5,000 ppm were reported for quail and mallard ducks following dietary exposure. Elsewhere, an LD50 of 6,000 mg/kg was reported for quail exposed orally to oxadiazon; for ducks, an LD50 of 1,000 mg/kg was reported.

Effects on fish: Oxadiazon is moderately to highly toxic to fish based on acute toxicity tests. In studies evaluated by EPA, an LC50 of 0.88 mg/L was reported for bluegill and rainbow trout. For sheepshead minnow, a marine/estuarine fish, the LC50 was reported as 1.5 mg/L. Elsewhere, the LC50 for oxadiazon was reportedly >2 mg/L for all freshwater species tested.

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 oxadiazon cited in this fact sheet. The toxicity of oxadiazon to wildlife receptors varies by species.

Effects on aquatic insects: Oxadiazon is moderately toxic to aquatic invertebrates based on an LC50 of 2.2 mg/L reported for *Daphnia* (water flea). An LC50 of 0.27 mg/L was reported in Mysid shrimp, suggesting that oxadiazon is highly toxic to estuarine invertebrates.

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.

Environmental Fate

A typical half-life for oxadiazon in soils is 60 days (see "Half-life" text box). Microbes and sunlight break down Oxadiazon in the environment. Oxadiazon's potential to leach to groundwater is low; surface runoff potential is intermediate, and the potential for loss on eroded soil is high. Oxidiazon is moderately volatile, and the potential for loss the atmosphere is moderate. Oxidiazon does not bioconcentrate (build up) through the food chain. Oxadiazon is adsorbed through the shoots and leaves and is translocated (moved throughout) to other plant parts.

Human Health Risk Assessment

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

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).

Under conditions of average exposure, Oxadiazon is expected to pose a low potential risk of adverse non-cancer effects to WSDOT workers; the HQ is 2.0 for broadcast hydraulic spray applications and 1.2 for directed foliar applications. Oxadiazon is expected to pose a negligible potential risk of adverse non-cancer effects to the public. Under conditions of maximum Oxadiazon exposure, the estimated potential risk of adverse non-cancer effects is negligible for adults ingesting drift-contaminated berries; low for WSDOT workers engaged in directed foliar applications, children ingesting drift-contaminated berries, adults and children coming into dermal contact with drift-contaminated berries, and adults and children coming into dermal contact with directly sprayed vegetation; and moderate to WSDOT workers engaged in broadcast hydraulic spray applications and adults and children ingesting drift-contaminated garden vegetables.

Oxadiazon is expected to pose negligible to low potential risks of cancer effects to WSDOT workers under conditions of average exposure based on a cancer risk level of concern of 1×10^{-5} (1 in 100,000). The estimated upper bound cancer risk is 1.2×10^{-5} for broadcast hydraulic spray

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 oxadiazon.

applications and 7.0 x 10^{-6} for directed foliar applications. For the public, the estimated potential risks of cancer are negligible. Under conditions of maximum exposure, Oxadiazon poses a moderate potential risk of cancer to WSDOT workers. The estimated upper bound cancer risk is 4.8 x 10^{-4} for broadcast hydraulic spray applications and 1.1 x 10^{-4} for directed foliar applications. For the public, the estimated potential risks of cancer are negligible for dermal contact with drift-contaminated berries, low for ingestion of drift-contaminated berries and dermal contact with directly sprayed vegetation; and moderate for ingestion of drift-contaminated garden vegetables.

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 oxidiazon 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 1,800, 210 and 270-fold lower, respectively, than the acute dietary LD50 for oxadiazon. The estimated dietary exposures of oxadiazon to quail, marsh wren and American robin from maximum label application rates would be 1,100, 130 and 98-fold lower, respectively, than the acute dietary LD50 value selected to represent avian species. These exposures result in risks that are considered insignificant for quail and low for marsh 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 oxadiazon occurs primarily through direct contact with contaminated surface waters and sediment. Oxadiazon is persistent in soil and water. The relative risks to fish and aquatic invertebrates from application of oxadiazon at levels established by WSDOT were considered moderate for all physiographic provinces.

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)