Washington State Department of Transportation

Pyraflufen

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

Pyraflufen is a pyrazolylphenyl herbicide used for selective control of broadleaf weeds. Pyraflufen inhibits the plant enzyme protoporphyrinogen oxidase. Pyraflufen-ethyl is the only active ingredient (2.5%) in the herbicide **Edict**. According to the product label, **Edict** also contains 97.5% other ingredients (unspecified.) The Washington State Department of Transportation (WSDOT) is considering the use of **Edict** for selective broadleaf weed control. Pyraflufen also has agricultural uses.

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

If used by WSDOT in the future, **Edict** would be applied at 0.16 pounds of product—or a maximum of about 0.004 pounds of the active ingredient pyraflufen—per acre. Applicators would use truck-mounted hand-guns, hose reels, or backpack sprayers to make a single application of pyraflufen in the spring or summer. Most applications are directed onto individual target plants. In some cases when applied over wide-spread infestations applications may be made through truck- or tractor-mounted booms.

Human Health Effects

The U.S. Environmental Protection Agency (EPA) classifies **Edict** as category I (High Toxicity) with a signal word of DANGER because of irreversible damage to the eyes and harm if swallowed or absorbed through the skin (see "Toxicity Category and Signal Word" table).

Acute toxicity: Pyraflufen has low toxicity if it gets on the skin, and very low toxicity if it is eaten or inhaled. Pyraflufen causes irreversible eye damage and can cause moderate skin irritation, but does not cause skin sensitization.

Chronic toxicity: Rats administered high doses of pyraflufen in the diet for 104 weeks had liver and kidney abnormalities. Dogs fed pyrafluen for 52 weeks had no treatment-related effects, even at high doses. Mice fed pyraflufen for 78 weeks had liver abnormalities at moderate to high doses.

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 pyraflufen cited in this fact sheet.

Reproductive effects: Rabbits exposed to pyraflufen during pregnancy showed increased maternal mortality at moderate doses and increased abortion at high doses. In a 2-generation rat study, no reproductive effects were observed at high doses of pyraflufen. In a separate rat study in which pyraflufen was administered during pregnancy, no adverse maternal or developmental effects were noted.

Carcinogenic effects: Mice fed pyraflufen for 78 weeks had increased liver tumors. Pyraflufen is considered by U.S. EPA to be a likely human carcinogen.

Fate in humans and animals: Rats rapidly excrete pyraflufen unchanged and as metabolites in urine and feces. Pyraflufen 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: A summary report presented by the European Commission indicates that Pyraflufen is practically non-toxic to mammals based on an acute oral LD50 value of >5,000 mg/kg in rats. A dermal LD50 of >2,000 mg/kg was reported for rats. Via the inhalation route, the LD50 for rats was >5,030 mg/m^3 (298 ppm).

Effects on birds: Pyraflufen is practically non-toxic to birds according to a European Union summary that reported an acute LD50 of >2,000 mg/kg for birds. Dietary toxicity to birds was reported as an LC50 > 5,000 mg/kg food. The species tested in these studies were not provided.

Effects on fish: Findings from acute toxicity tests ranged widely from highly toxic to practically non-toxic for 96-hour acute toxicity studies reviewed by the European Commission. The LC50 for rainbow trout ranged from >0.1 to <60 mg/L, while for bluegill sunfish an LC50 >100 mg/L was reported.

Effects on aquatic insects: Findings from acute toxicity tests ranged widely from highly toxic to practically non-toxic for 48-hour acute toxicity studies of *Daphnia magna*.

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	501-2,00	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 pyraflufen cited in this fact sheet. The toxicity of pyraflufen to wildlife receptors varies by species.

Environmental Fate

A typical half-life for pyraflufen in soils is 7 days (see "Half-life" text box). Microbes and sunlight break down pyraflufen in the environment. Pyraflufen's potential to leach to groundwater is low; surface runoff potential is intermediate, and potential for loss on eroded soil is intermediate. Pyraflufen has low volatility and the potential for loss to the atmosphere is low. Pyraflufen does not bioconcentrate (build up) through the food chain. Pyraflufen is adsorbed through the leaves and stems, and is translocated (move 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).

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

Pyraflufen is expected to pose negligible potential risks of cancer and adverse non-cancer effects to WSDOT workers and the public under conditions of average and maximum exposure. All cancer risk levels are below 1 x 10^{-5} (1 in 100,000) and all hazard quotients are below 1.

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 pyraflufen would be expected to pose an insignificant risk to mammals. The estimated dietary exposures to rats, mice, and meadow vole from the maximum label application rate would be 890,000, 100,000, and 140,000-fold lower, respectively, than the acute dietary LD50 for pyraflufen. The estimated dietary exposures of pyraflufen to quail, marsh wren, and American robin from the maximum label

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 pyraflufen.

application rate would be 230,000, 25,000 and 20,000-fold lower, respectively, than the acute dietary LD50 for bobwhite quail. These estimated exposures result in risks from pyraflufen that are considered insignificant for each of these species.

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 pyraflufen occurs primarily through direct contact with contaminated surface waters and sediment. Primarily because of its low application rate, the estimated risk to fish and aquatic invertebrates from using pyraflufen at levels established by WSDOT were slight in all physiographic provinces of the state examined, except in the Columbia Plateau and Blue Mountain regions, where the risks would be characterized as low.

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)