



Fosamine

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

Ammonium salt of fosamine (fosamine) is an organophosphate pesticide used to control woody and leafy plants, such as maple, birch, alder, blackberry, vine maple, ash, and oak. Fosamine is a selective, post-emergent (after growth begins) herbicide that prevents dormant plant tissues from growing. It is the active ingredient (41.5%) in the herbicide **Krenite** used by the Washington Department of Transportation (WSDOT) primarily in the control of brush and small undesirable trees. Fosamine also has industrial and forestry uses.

WSDOT assessed the potential risks to humans, wildlife, and aquatic animals exposed to fosamine 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.

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

Typical rights-of-way application rates of Krenite range from 128 to 256 ounces—or a maximum of about 8 pounds of fosamine—per acre. Applicators use truck-mounted handguns or hose reels to apply Krenite from August to September. WSDOT workers applied about 1,596 pounds of fosamine statewide during 2016.

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 Krenite as toxicity class II (moderate toxicity) with a signal word of CAUTION because it can cause moderate eye injury or irritation (see Toxicity Category and Signal Word table).

Acute toxicity: Fosamine has low to very low toxicity if individuals accidentally inhale or eat residues and has moderate toxicity if touched. It is not irritating to the eyes, but it can cause mild to moderate skin irritation. Fosamine is not a skin sensitizer.

Chronic toxicity: No chronic (long-term) studies are available for fosamine.

Sub-chronic toxicity: In one subchronic oral study, the laboratory animals given the highest dose exhibited some statistically significant effects, including effects to the kidneys, bladder and decreases in body weight. In a subchronic neurotoxicity study in rats, no neurotoxic effects were seen.

Reproductive effects: Fosamine did not cause adverse reproductive effects when fed to rats at high doses; however, it did cause kidney enlargement. These results are questionable due to the use of too few animals or poor experimental design.

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

Highlighted categories specify the range for fosamine use cited in this fact sheet.

Carcinogenic effects: Scientists have not tested fosamine ammonium for carcinogenicity. Multiple studies of fosamine produced no evidence of mutations; one study showed chromosome changes.

Fate in humans and animals: Fosamine rapidly passes through the body; elimination is primarily in the feces and less in the urine. It does not bioaccumulate (build up) in mammals.

Wildlife Effects

Effects on Mammals: Fosamine is practically nontoxic to mammals. The LD50 for rats fed fosamine ranges from 5,000 to 24,400 mg/kg (see LD50/LC50 text box and Wildlife Toxicity Category table). If animals are exposed with both skin contact and food exposure, the level rises to slightly toxic.

Effects on birds: Fosamine is practically nontoxic to birds. The LD₅₀ for mallard ducks and bobwhite quail is greater than 5,000 mg/kg. In studies using lower doses, the LD50 for bobwhite quail and mallard ducks fed fosamine is greater than 10,000 mg/kg.

Effects on fish: Fosamine is practically nontoxic to fish. Limited evidence shows that fosamine does not bioaccumulate (build up) in aquatic animals.

Effects on aquatic invertebrates: Fosamine is practically nontoxic to aquatic insects and microorganisms.

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 fosamine use cited in this fact sheet.

Environmental Fate

The typical soil half-life for fosamine is about 8 days. Microbes break down fosamine in soils. Fosamine is mobile in some soils, but because it does not last long in the environment, it has a low potential to contaminate groundwater.

Human Health Risk Assessment

WSDOT evaluated several human exposure scenarios, including workers who prepare, load, and apply the herbicide, and members of the public who may be exposed when they walk, hike, or jog in sprayed vegetation, or who pick or eat drift-contaminated berries or vegetables. For each exposure scenario, WSDOT evaluated conditions of average exposure and extremely conservative conditions of maximum exposure. Based on average exposure scenarios, fosamine poses a negligible risk of adverse non-cancer effects to workers and the public. For maximum exposure scenarios, fosamine poses a potential moderate risk to children who eat drift-contaminated garden vegetables and a negligible to low risk to the public under all other maximum exposure scenarios (see Human Cancer/Non-cancer text box and Human Risk Classifications under Conditions of Average Exposure table). Scientific evidence does not support that fosamine causes cancer.

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, potential non-cancer health effects may be possible. 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 agencies.

Human Risk Classifications under Conditions of Average Exposure

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	Low¹
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 fosamine.

¹Low potential risks involving fosamine are associated with WSDOT workers making broadcast applications.

Wildlife Risk Assessment

Wildlife risk assessment considers pesticide 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 fosamine residues with their skin or eyes or when they inhale fosamine vapors or particulates. WSDOT's current application rates and use patterns for fosamine pose a negligible to low risk to wildlife. Estimated dietary exposures for rats, mice and meadow voles are approximately 50 to 445 times lower than the rat LD50 of 5,000 mg/kg. The risks from WSDOT's current application practices are negligible for rats and low for mice and meadow voles. Estimated dietary exposures for bobwhite quail, marsh wrens, and American robins are approximately 25 to 280 times lower than the bobwhite quail and mallard duck LD50 of 5,000 mg/kg. The risks from WSDOT's current application practices are negligible for bobwhite quail and low for marsh wrens and American robins.

Aquatic Risk Assessment

WSDOT takes extra precautions applying herbicides near open water, wetlands, or wellhead protection zones. However, contamination may result from application drift, rainfall runoff, or residue leaching through the soil into groundwater. Aquatic organism exposure to fosamine occurs primarily through direct contact to contaminated surface waters. Fosamine is practically nontoxic to fish and aquatic insects. Fosamine does not bioaccumulate

(build up) in aquatic organisms (see Wildlife Toxicity Category table). WSDOT's current use of fosamine poses a low risk to fish and aquatic insects in all areas of the state.

Additional Resources

- National Pesticide Information Center 1-800-858-PEST (7378) and <http://npic.orst.edu>
- Extension Toxicology Network (EXTOXNET) <http://extoxnet.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)