



Dicamba

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

Dicamba is a benzoic acid herbicide used to control noxious and nuisance weeds and brush. It mimics a plant growth hormone, causing uncontrolled and disorganized plant growth that leads to plant death. Dicamba is the only active ingredient (41.8%) in the herbicide **Vanquish**. Dicamba and the active ingredient 2,4-D are in the herbicide products **Veteran 720**, **Escalade** and **Weedmaster**. The Washington State Department of Transportation (WSDOT) uses all of these products for selective noxious and nuisance weed and brush control. Dicamba also has agricultural and urban uses.

WSDOT assessed the potential risks to humans, wildlife, and aquatic animals exposed to dicamba 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 for Vanquish range from 8 to 32 ounces of product—or a maximum of about 1 pound of the active ingredient dicamba—per acre. Escalade is applied at 16 to 80 ounces or a maximum of 2.75 pounds per acre.. Veteran 720 and Weedmaster are applied at 48 to 96 ounces of product—or a maximum of about 0.56 pounds of dicamba—per acre. Because applications are directed only onto target vegetation, the total amounts applied in any given acre are far less than these maximums. Applicators use truck-mounted handguns, hose reels, or side booms to apply Veteran 720, Escalade, and Weedmaster year round and Vanquish from April to September. WSDOT workers applied an average of 5,340 pounds of dicamba per year, statewide between 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 **Veteran 720**, **Escalade**, and **Weedmaster** as toxicity class III (low toxicity) with the signal word CAUTION.

Acute toxicity: Dicamba has low toxicity if individuals accidentally eat, touch, or inhale residues. Data submitted to U.S. EPA in support of pesticide petition filing indicate variously that dicamba is not a primary skin irritant to a mild skin irritant, is mildly to extremely irritating and corrosive to the eyes, and has no to moderate potential to cause skin sensitization.

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 dicamba use cited in this fact sheet.

Chronic toxicity: Dicamba caused some enlargement of the adrenal gland and lesions in the liver when fed to rats at high doses for two years. Dogs and mice fed dicamba for one to two years showed no effects except for a decrease in body weight.

Reproductive effects: Dicamba did not affect the reproduction, growth, or survivability of the offspring when fed to rats over three generations. In a two-generation study in rats, offspring of parents fed very high doses of dicamba showed a slower growth rate, increased liver weights, and decreased food consumption. The offspring of laboratory rats exposed to dicamba during pregnancy showed no birth defects. In rabbits at high doses, dicamba caused increased fetal loss, reduced body weight, and decreased motor activity.

Carcinogenic effects: Rats and mice fed dicamba fed moderate to high doses of dicamba for 2 years showed no increased incidence of tumors. Studies of dicamba show no evidence that it causes mutations. The EPA lists dicamba as a Group D human carcinogen (not classifiable as to carcinogenicity).

Fate in humans and animals: Rats rapidly excrete dicamba in the urine, with trace amounts in the feces. Mice, rats, rabbits, and dogs fed dicamba excreted the majority of the dose within 48 hours. Dicamba does not bioaccumulate (build up) in animals.

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: Dicamba is slightly toxic to mammals. (See LD50/LC50 text box and Wildlife Toxicity Category table). The LD50 for rats fed dicamba ranges from greater than 757 milligrams per kilogram (mg/kg) to 1,707 mg/kg. The LD50 for rabbits exposed by skin contact is greater than 2,000 mg/kg. Breathing dicamba is the most sensitive route of exposure with a rat inhalation LC50 of greater than 200 mg/kg. Dicamba did not cause chronic toxicity in rats when exposed to concentrations ranging from 0.5 to 25 mg/kg/day.

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 ²
Slightly toxic	501-2,000 ¹	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 dicamba use cited in this fact sheet.

²The toxicity of dicamba to fish and aquatic insects varies depending on specific fish or insect species that is exposed.

Effects on birds: Dicamba is practically nontoxic to birds, with an LD50 of 2,009 mg/kg for mallard ducks. The 8-day dietary LD50 is greater than 10,000 mg/kg for bobwhite quail.

Effects on fish: Dicamba is slightly to practically nontoxic to fish. Dicamba appears to be more toxic to sensitive species such as rainbow trout than to carp, although LC50 values in the scientific literature vary. Dicamba does not bioaccumulate (build up) in fish.

Effects on aquatic insects: Dicamba is practically nontoxic to aquatic (water) insects.

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

The half-life of dicamba in soils ranges from 1 to 4 weeks, with a typical time of 2 weeks. (See Half-life text box). Microbes and sunlight break it down. Dicamba is highly mobile in the environment and has the potential to leach through soils and contaminate groundwater. It does not bioconcentrate (build up) through the food chain.

Plants rapidly take up dicamba through the leaves and roots. Dicamba is readily translocated (move throughout) to other plant parts. In some plant species it accumulates in the tips of mature leaves. Dicamba can harm broadleaf plants such as fruit trees and tomatoes during stages of growth and development.

Human Health Risk Assessment

WSDOT evaluated several human exposure scenarios, including adults and children eating drift-contaminated garden vegetables or children directly touching drift-contaminated berries or sprayed vegetation. For each exposure scenario, WSDOT evaluated conditions of average exposure and extremely conservative conditions of maximum exposure. (See Human Cancer/Non-cancer text box and Human Risk Classification under Conditions of Average Exposure table). Dicamba poses a negligible risk of adverse non-cancer effects to WSDOT workers and the public under all average exposure scenarios. Dicamba poses a potential low risk of adverse non-cancer effects to the public under the maximum exposure scenarios for adults and children who eat drift-contaminated garden vegetables. Workers making broadcast spray applications face potentially low risks under the maximum exposure scenarios.

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 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 dicamba.

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 pesticide residues with their skin or eyes or when they inhale vapors or particulates. Estimated dietary doses for rats, mice, and meadow voles are approximately 230 to 2,000 times lower than the rats LD50 of 2,740 mg/kg. Because of the higher risk seen in mice, WSDOT's current use of dicamba poses a low risk to mammals using habitats found along roadway corridors. Estimated dietary doses for bobwhite quail, marsh wrens, and American robins are approximately 25 to 290 times lower than the pheasant LD50 of 637 mg/kg and approximately 80 to 900 times lower than the mallard LD50 of 2,000 mg/kg. Based on the more toxic pheasant LD50, 2,4-D poses a low risk to quail and a high risk to marsh wrens and American robins. Based on the less toxic mallard LD50, 2,4-D poses a low risk to quail and marsh wrens and a moderate risk to American robins. Because of the higher risk seen in marsh wrens and American robins when using the more sensitive LD50 for pheasants, the use of dicamba poses a low risk to bird species using habitat found along roadway corridors.

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 dicamba occurs primarily through direct contact with contaminated surface waters. Dicamba does not bioaccumulate (build up) in aquatic animals. WSDOT's current application rates and use patterns for dicamba pose 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)