Washington State
Department of Transportation

# Dichlobenil

## 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

Dichlobenil is an herbicide commonly used to control weeds in gardens, lawns, near ornamental trees, and various other settings. It also controls aquatic (water) weeds such as cattail and purple loosestrife. Dichlobenil stops seed germination, cellulose (cell wall) formation, and growth in plant roots and shoots. It is the active ingredient (4%) in the herbicide products **NOROSAC 4G** and **Casoron** used by the Washington State Department of Transportation (WSDOT) for pre-emergent (before growth begins) control of grass and weeds in ground cover beds. Dichlobenil also has agricultural and forestry uses.

WSDOT assessed the potential risks to humans, wildlife, and aquatic animals exposed to dichlobenil 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 range from 50 to100 pounds of product per acre, or a maximum of about 4 pounds of dichlobenil per acre. Applicators use a belly grinder to apply NOROSAC and Casoron from November to March. WSDOT workers applied 265 pounds of dichlobenil statewide during 2002.

**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 NOROSAC and Casoron as toxicity class III (low toxicity) with a signal word of CAUTION. (See Toxicity Category and Signal Word table).

*Acute toxicity*: Dichlobenil has low acute toxicity if people accidentally eat or inhale residues and moderate toxicity if touched. Dichlobenil does not irritate skin or eyes, and it is not a skin sensitizer. (See Laboratory Testing text box).

*Chronic toxicity*: Dichlobenil caused decreased body weight, increased liver and kidney weights, and blood chemistry changes when fed to rats in moderate doses for 2 years. Dogs fed moderate doses of dichlobenil for 2 years had increased organ weights and liver changes.

**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 |

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

*Reproductive effects*: Dichlobenil caused infertility in some female rats fed moderate doses for two generations. However, this study was unacceptable to the EPA because it did not follow standard testing guidelines. Dichlobenil caused an increase in the number of skeletal changes in the offspring of rats fed high doses during pregnancy.

*Carcinogenic effects*: Rats fed moderate to high doses of dichlobenil for 2 years showed no significant increases in tumors, though another statistical method suggested a possible increase in tumors at the highest dose. U.S. EPA lists dichlobenil as Class C, a possible human carcinogen. Dichlobenil was not mutagenic in multiple studies; however, one study did show a possible increase in mutations.

**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.

*Fate in humans and animals*: Rats fed or injected with dichlobenil excreted 86-96% of the dose in the urine and feces within 7 days. Low doses easily absorb into the body from the gastrointestinal tract. Rats fed high doses of dichlobenil had measurable residues in their livers.

## Wildlife and Aquatic Effects

*Effects on mammals*: Dichlobenil is slightly toxic to mammals with a rat LD50 ranging from 3,160 to 4,250 milligrams per kilogram (mg/kg). The LD50 for rabbits exposed by skin contact is greater than 2,000 mg/kg. (See LD50/LC50 text box and Wildlife Toxicity Category table.)

*Effects on birds*: Dichlobenil is slightly toxic to birds. The acute oral LD50 ranges from 683 mg/kg for bobwhite quail to greater than 2,000 mg/kg for mallard ducks. The LD50 for subacute dietary dichlobenil exposure is 5,200 mg/kg for both species. Researchers find no chronic (long-term) risk assessment for birds.

**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 [1] | 501-2,000 | >10-100 [2] |
| Moderately toxic | 51-500 | 51-500 | >1-10 |
| Highly toxic | 10-50 | 10-50 | 0.1-1 |
| Very highly toxic | <10 | <10 | <0.1 |

[1]Highlighted categories specify the range for dichlobenil use cited in this fact sheet.
[2]The toxicity of dichlobenil to fish and aquatic insects varies depending on the specific fish or insect species that is exposed.

*Effects on fish*: Dichlobenil is slightly to moderately toxic to fish and to other

aquatic insects. From the limited data available, dichlobenil does not bioaccumulate (build up) in fish.

*Effects on aquatic insects*: Dichlobenil is moderately to highly toxic to aquatic 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 dichlobenil in soil is about 60 days. (See Half-life text box). It is moderately mobile in the environment and has the 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 treated 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.

Dichlobenil poses a low adverse non-cancer risk to workers performing broadcast spreader applications. It poses a negligible risk of adverse non-cancer health effects for all of the average case public exposure scenarios evaluated. The hazard quotient for broadcast spray applicators is 1.6. All other hazard quotient values are less than 1 (see Human Cancer/Non-cancer text box and Human Risk Classification under Conditions of Average Exposure Scenarios table).

Under maximum exposure scenarios, dichlobenil poses a negligible risk to adults eating drift-contaminated berries or touching directly treated vegetation. All other exposure scenarios for the public pose a low to moderate adverse non-cancer risk. Values range from 1.1 for adults who touch drift-contaminated berries to 30 for children eating drift-contaminated garden vegetables. The conditions specified for the maximum exposure conditions are worst-case scenarios and are unlikely to occur. Workers making broadcast spray applications are at moderate risk under maximum exposure scenarios with a hazard quotient of 29.

**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 | **Low**[1] |
| 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 risks for specific exposure scenarios involving dichlobenil.
[1]Low potential risks involving dichlobenil 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 pesticide residues with their skin or eyes or when they inhale vapors or particulates. Estimated dietary exposures for rats, mice, and meadow voles are approximately 60 to 560 times lower than the rat LD50 of 4,250 mg/kg. WSDOT's current application rates and use patterns for dichlobenil pose a negligible risk to rats and a low risk to deer mice and meadow voles that use habitat along roadway corridors. Estimated dietary exposures for quail, marsh wrens, and American robins are approximately 15 to 170 times lower than the conservative bobwhite quail and mallard duck LD50 of 1,500 mg/kg. Dichlobenil use poses a low risk to quail and a moderate risk to marsh wrens and American robins that use roadway corridor habitat.

## Aquatic Risk Assessment

WSDOT takes extra precautions applying herbicides near open water, wetlands, and wellhead protection zones. However, contamination may result from rainfall runoff, or residue leaching through the soil into groundwater. Fish and aquatic insect exposure to dichlobenil occurs primarily through direct contact with contaminated surface waters. Dichlobenil does not bioaccumulate (build up) in fish and aquatic insects. The risk to fish and aquatic insects from WSDOT's current application rates and use patterns for dichlobenil is low in all areas of the state except the Puget Trough where the risks to fish are moderate.

## 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)