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# 2,4-D

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** 2,4-D

**CHEMICAL NAME:** 2,4-dichlorophenoxyacetic acid, including, but not limited to:

Acids and Salts:

Cas Nos. 2008-39-1, 1929-73-3, 5742-19-8, 2702-72-9, 32341-80-3,  
1048373-72-3

Esters:

Cas Nos. 1928-43-4, 25168-26-7, 94-11-1

**CHEMICAL TYPE:** Chlorinated phenoxy compound

**PESTICIDE CLASSIFICATION:** Herbicide

**REGISTERED USE STATUS:** General Use Pesticide. Restricted Use in Washington for Some Locations. Date and Elevation Restrictions for Aerial Applications in Idaho.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, the United States Environmental Protection Agency (USEPA) announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. USEPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the 2,4-D formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

**RESIDUE ANALYTICAL METHODS:** EPA Method 600/4-88-039 515.1; 515.2; 555.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** 2,4-D is registered for use in crop and non-crop sites for selective and total weed control. For terrestrial and aquatic uses.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** 2,4-D is used for control of grasses, broadleaf weeds, and woody plants.

**MODE OF ACTION:** Plant growth regulator (synthetic auxin herbicide).

**METHOD OF APPLICATION AND RATES:** Aerial and ground broadcast, spot and localized applications. Rates depend on formulation.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**RESTRICTIONS/WARNINGS/LIMITATIONS:** Do not apply through any type of irrigation system. Groundwater advisory. Various state use restrictions.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of 2,4-D acid ranges from 1.1 to 42.5 days with a median half-life of 6.1 days.

**ADSORPTION:** The  $K_{(oc)}$  of 2,4-D is 20 to 600 depending on formulation.

**PERSISTENCE AND AGENTS OF DEGRADATION:** 2,4-D acid can be moderately persistent in the plant and soils. The primary route of degradation is microbial activity in the terrestrial environment and photodegradation in water.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** 2,4-D acid degrades to many less toxic chemicals. Three major degradates were identified in the submitted environmental fate studies for 2,4-D: 1,2,4-benzenetriol (maximum formed = 37%); 2,4-dichlorophenol (2,4-DCP) (maximum formed = 32.6%); and chlorohydroquinone (CHQ) (maximum formed = 16%).

### WATER:

**SOLUBILITY:** The solubility of 2,4-D acid 569 mg/l in water (20° C). Other formulations range from practically insoluble to 806,000 mg/l.

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** 2,4-D is moderately persistent with a low soil adsorption coefficient. There is a moderate potential for 2,4-D to leach into groundwater.

**AIR:**

**VOLATILIZATION:** Low ( $1.4 \times 10^{-7}$  mm Hg at 25° C).

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

## **IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES**

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**MICROORGANISMS:**

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

**AQUATIC VERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) 1.1 - >240 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) 0.9 - >524 mg/l

**OVERALL TOXICITY: Highly Toxic - Practically Non-Toxic** (Depending on Formulation)

**AQUATIC FRESHWATER INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (*Daphnia magna* 48-hour) 5.8 - >184 mg/l

**OVERALL TOXICITY: Moderately Toxic - Practically Non-Toxic** (Depending on Formulation)

**AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (Dungeness crab 96-hour) >10.0 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (brown shrimp 96-hour) >2.0 mg/l

**OVERALL TOXICITY: Moderately Toxic - Slightly Toxic** (Depending on Formulation)

**TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (various birds) 219 - >2000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (various birds) >1000 mg/kg

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (various mammals) >100 - >5000 mg/kg

**OVERALL TOXICITY: Moderately Toxic to Practically Non-Toxic** (Depending on Formulation)

**BIOACCUMULATION POTENTIAL: Low Potential**

**THREATENED AND ENDANGERED SPECIES:** All federally listed terrestrial and aquatic species may be adversely affected if certain formulated products are applied directly or indirectly to the species or habitat.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >50 - >5000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2000 -20,000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Slight - Non-Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Severe Irritant - Slight Irritant

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >1.0 - >100.0 mg/l

**OVERALL TOXICITY:** Category 1 – Highly Toxic to Practically Non-Toxic (Depending on Formulation)

### CHRONIC TOXICITY:

**CARCINOGENICITY:** IARC Group 2B - Possible human carcinogen. EPA Group D - Not Classifiable As To Human Carcinogenicity.

**DEVELOPMENTAL/REPRODUCTIVE:** Animal studies indicate limited ability to cause birth defects. Evidence suggests adverse reproductive effects at moderate doses.

**MUTAGENICITY:** Evidence suggests adverse effects on human chromosomes.

**HAZARD:** The end-use product labels for the 2,4-D formulations vary considerably between the *Caution* and *Danger* signal words due to various effects.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** Nervous system from skin absorption. Dizziness, irritation and coughing from inhalation. Ingestion of large amounts of 2,4-D has caused death within 1 to 2 days. Ingestion of lower doses has resulted in neuromuscular problems. Existing medical conditions may be aggravated by exposure to 2,4-D.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** Liver, kidney, digestive, muscular and nervous system damage.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** See above.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** See above.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** Past reports of dioxin contamination. Recent testing has shown 2,4-D manufactured in the U.S. to be relatively free of dioxin. Minor traces found do not have biological significance.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

*Most Acid and Salt Formulations:*

2,4-D - **DANGER** - CAUSES IRREVERSIBLE EYE DAMAGE. HARMFUL IF SWALLOWED OR ABSORBED THROUGH SKIN. AVOID BREATHING SPRAY MIST. DO NOT GET IN EYES, ON SKIN OR CLOTHING.

*Most Esters:*

2,4-D - **CAUTION** – HARMFUL IF SWALLOWED, ABSORBED THROUGH THE SKIN OR INHALED. AVOID BREATHING VAPORS AND SPRAY MIST. AVOID CONTACT WITH EYES, SKIN OR CLOTHING.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks, and protective eyewear where appropriate.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Imperative to flush eyes with water for a minimum of 15 minutes. Call physician immediately.

**SKIN:** Wash all exposed areas with soap and water. Call physician if irritation persists.

**INGESTION:** Rinse mouth thoroughly with water. Promptly drink a large quantity of milk, egg whites, gelatin or water. Do not induce vomiting. Call physician immediately.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act  
**formulation** – the form in which the pesticide is supplied by the manufacturer for use  
**half-life** – the time required for half the amount of a substance to be reduced by natural processes  
**herbicide** – a substance used to destroy plants or to slow down their growth  
**Hg** – chemical symbol for mercury  
**IARC** – International Agency for Research on Cancer  
**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$   
**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects  
**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects  
**leach** – to dissolve out by the action of water  
**mg/kg** – weight ratio expressed as milligrams per kilogram  
**mg/l** – weight-to-liquid ratio expressed as milligrams per liter  
**microorganisms** – living things too small to be seen without a microscope  
**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa – Pascal (unit of pressure)**  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.



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# Aminocyclopyrachlor

## HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

**COMMON NAME:** Method 240SL

**CHEMICAL NAME:** [6-amino-5-chloro-2-cyclopropyl-4-pyrimidinecarboxylic acid]

CAS No. 858956-08-8

**CHEMICAL TYPE:** pyrimidine carboxylic acids class within the family of synthetic auxins

**PESTICIDE CLASSIFICATION:** Herbicide

**REGISTERED USE STATUS:** General Use Pesticide.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal and no concern were placed on List 4A and 4B, respectively.

The contents of the aminocyclopyrachlor formulation for Method<sup>®</sup> 240SL herbicide are listed below:

Method <sup>®</sup> 240SL Herbicide (Bayer Environmental Science)			No inert ingredients listed.
Active Ingredient	Potassium salt of aminocyclopyrachlor	25.0 %	
Inert Ingredients		75.0 %	
Acid Equivalent	Aminocyclopyrachlor	21.1%	2 pounds acid per gallon

**RESIDUE ANALYTICAL METHODS:** Standard herbicide screening analysis.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Aminocyclopyrachlor is registered for control of broadleaf weeds, woody species, vines, and grasses in non-crop areas [private, public, and military lands: uncultivated non-agricultural areas (such as airports, highway, railroad and utility rights-of-way, sewage disposal areas), uncultivated non-crop agricultural areas (such as farmyards, fuel storage areas, fence rows, non-irrigation ditchbanks, barrier strips), outdoor industrial sites (such as lumberyards, pipeline, and tank farms), natural areas (such as wildlife management areas, wildlife openings, wildlife habitats, recreation areas, campgrounds, trailheads, and trails)], turf/lawns (residential, industrial, and institutional), golf courses, parks, cemeteries, athletic fields, and sod farms.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Preemergence and/or postemergence control of the broadleaf weeds, vines, and brush species.

**MODE OF ACTION:** Synthetic auxin-type herbicide causing disorganized plant growth (pyrimidine carboxylic acid).

**METHOD OF APPLICATION AND RATES:** Soluble liquid that is mixed in water and applied as a spray at rates of 4-18 fluid ounces per acre per year (0.063-0.28 lb ae/A/year). When applied at lower rates, Method 240SL herbicide provides short-term control of weeds; when applied at higher rates, weed control spectrum is broadened and extended.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Apply in the fall, before the soil freezes, or in the spring after the soil thaws. Applications can be made anytime of the year except when snow or water prevents treating to the ground line.

**DRIFT CONTROL:** Avoid spraying to the point of excessive runoff as injury to desirable species or ground cover may occur. Apply only using nozzles which deliver coarse or greater (VMD >350 microns) droplets as defined by ASABE S572 standard. Do not apply with a nozzle height greater than 4 feet above the ground or canopy unless necessitated by the application equipment. Apply with the spray boom or nozzle height as low as possible. Do not apply when wind speed is greater than 10 mph. Use spray pressures no greater than are required to obtain adequate coverage. The use of drift control additives, shielded sprayers, or other drift control systems can help minimize spray drift. Do not apply during a temperature inversion.

### Restrictions/Warnings/Limitations:

Do not use plant material treated with Method 240SL herbicide for mulch or compost.

Do not apply within the root zone of desirable trees and/or shrubs unless injury or loss can be tolerated. Root zones of desirable trees/shrubs may extend beyond the tree canopy.

Do not apply this product if site-specific characteristics and conditions exist that could contribute to movement and unintended root zone exposure to desirable trees or vegetation, unless injury or loss can be tolerated.

Do not make applications when circumstances favor movement from treatment site.

Do not apply to highways/roadsides or other non-crop areas during periods of intense rainfall or where prevailing soils are either saturated with water or of a type through which rainfall will not readily penetrate, as this may result in off-site movement.

Do not apply or otherwise permit this product or sprays containing this product to come into contact with any non-target crop or desirable vegetation.

Do not apply in or on dry or water containing irrigation ditches or canals including their outer banks.

Do not apply through any type of irrigation system.

Do not contaminate water intended for irrigation. To avoid injury to crops or other desirable vegetation, do not treat or allow spray drift or run-off to fall onto banks or bottoms or irrigation ditches, either dry or containing water, or other channels that carry water that may be used for irrigation purposes.

Do not apply when powdery dry soil or light or sandy soils are known to be prevalent in the area to be treated. Treatment of powdery dry soil and light sandy soils, when there is little likelihood of rainfall soon after treatment, may result in off target movement and possible damage to susceptible crops and desirable vegetation when soil particles are moved by wind or water. Injury to crops or desirable vegetation may result if treated soil is washed, blown, or moved onto land used to produce crops or land containing desirable vegetation.

Do not apply when soil is frozen or covered with snow.

Do not use on lawns, walks, paved driveways, tennis courts, or similar areas.

Do not apply more than 18 fluid ounces (0.28 pound ae) per acre per year.

Do not graze or feed forage, hay, or straw from treated areas to livestock.

Do not use plant material treated with this product for mulch or compost.

Do not plant the treated sites for at least one year after the application if non-crop sites treated are to be converted to a food, feed, or fiber agricultural crop, or to a horticultural crop. A field bioassay must then be completed before planting the desired crop.

Certain species, in particular, may be sensitive to low levels of Method 240SL including but not limited to conifers (such as Douglas fir, Norway spruce, ponderosa pine, and white pine), deciduous trees (such as aspen, Chinese tallow, cottonwood, honey locust, magnolia, poplar species, redbud, silver maple, and willow species), and ornamental shrubs (such as arborvitae, burning bush, crape myrtle, forsythia, hydrangea, ice plant, magnolia, purple plum, and yew).

Injury or loss of desirable trees may result if applied on or near desirable trees or vegetation, on areas where their roots extend, or in locations where the treated soil may be washed or moved into contact with their roots. Consider site-specific characteristics and conditions that could contribute to unintended root zone exposure to desirable trees or vegetation. Root zone areas of desirable trees or vegetation are affected by local conditions and can extend beyond the tree canopy. If further information is needed regarding root zone area, consult appropriate state extension service, professional consultant, or other qualified authority.

Injury to or loss of desirable trees or vegetation may result if equipment is drained or flushed on or near these trees or vegetation or on areas where their roots may extend, or in locations where the chemical may be washed or moved into contact with their roots.

In non-crop areas adjacent to desirable vegetation, avoid overlapping spray applications and shut off spray to the spray boom while starting, turning, slowing, or stopping to avoid injury to desirable vegetation.

Applications made where runoff water flows onto agricultural land may injure or kill crops such as, but not limited to, sugar beets, potatoes, tomatoes, tobacco, soybeans, field beans, alfalfa, grapes, peaches, almonds, and vegetables.

Applications should be made only when there is little or no hazard from spray drift. Very small quantities of spray, which may not be visible, may seriously injure susceptible plants.

Exposure may injure or kill most crops and may injure or kill desirable vegetation. Injury may be more severe when the crops or desirable vegetation are irrigated.

Caution is advised when using this product in areas where loss of desirable conifer or deciduous trees and/or shrubs, as well as other broadleaf plants, including but not limited to legumes and wildflowers, cannot be tolerated. Without prior experience, it is necessary that small areas containing these plants be tested for tolerance and its soil residues before any large-scale spraying occurs.

Low rates can injure or severely injure most crops. Following an application, the use of spray equipment to apply other pesticides to crops on which Method 240SL herbicide is not registered may result in their damage. The most effective way to reduce this crop damage potential is to use dedicated mixing and application equipment.

Leave treated soil undisturbed to reduce the potential for movement by soil erosion due to wind or water.

In the case of suspected off-site movement to cropland, soil samples should be quantitatively analyzed for Method 240SL herbicide, or any other herbicide which could be having an adverse effect on the crop, in addition to conducting the field bioassay.

May suppress or severely injure certain established grasses, such as some bromegrass and wheatgrass species, especially when the grass plants are stressed by adverse environmental conditions. Areas that contain these grass plants should recover as environmental conditions for good grass growth occur.

Keep out of reach of children.

Hazards to humans and domestic animals.

Caution. Causes moderate eye irritation. Avoid contact with eyes or clothing. Mixers, loaders, and applicators must wear long-sleeved shirt and long pants, shoes plus socks. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

Environmental hazards. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high-water mark. Do not contaminate water when disposing of equipment washwaters or rinsate.

Surface water advisory. This product may impact surface water quality due to runoff of rainwater. This is especially true for poorly draining soils and soils with shallow ground water. This product is classified as having high potential for reaching surface water via runoff for several months after application. A level, well-maintained vegetative buffer strip between areas to which this product is applied and surface water features such as ponds, streams, and springs will reduce the potential loading of aminocyclopyrachlor from runoff water and sediment. Runoff of this product will be reduced by avoiding applications when rainfall is forecasted to occur within 48 hours.

Ground water advisory. Aminocyclopyrachlor has properties and characteristics associated with chemicals detected in ground water. This chemical may leach into ground water if used in areas where soils are permeable, particularly where the water table is shallow.

### III. ENVIRONMENTAL EFFECTS/FATE

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**SOLUBILITY:** 4,200 mg/l in water (pH 7 at 20° C).

**VAPOR PRESSURE:**  $3.7 \times 10^{-8}$  torr at 25° C.

**HYDROLYSIS:** Stable at pH 4, 7, and 9.

**PHOTOLYSIS IN WATER:** 1.2 days in natural water, pH 6.2, at 20° C.

**PHOTOLYSIS ON SOIL:** 129 days at 20° C.

**AEROBIC SOIL METABOLISM: AVERAGE:** 224 days.

**ANAEROBIC SOIL METABOLISM:** 6,932 days.

**K<sub>oc</sub>:** 2.0-26 depending on soil. Average 11.68.

**PERSISTENCE AND AGENTS OF DEGRADATION/DISSIPATION:** Aminocyclopyrachlor is a persistent compound that will degrade primarily via photolysis post application. It slowly degrades by aerobic microbial metabolism with half-lives ranging from 114-433 days in different soils. It is stable to degradation via other pathways. It is expected to be highly mobile in the environment. The reported Terrestrial Field Dissipation half-lives are likely more a result of transport losses from runoff and leaching rather than degradation.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** IN-LXT69, 5-chloro-2-cyclopropyl-pyrimidin-4-ylamine; IN-QFH57, 4-cyano-2-cyclopropyl-aH-imidazole-5-carboxylic acid; IN-Q3007, cyclopropanecarboxamide; IN-V0977, cyclopropanecarboxylic acid; IN-YY905, cyclopropanecarbamidine. The metabolites are not expected to occur in environmentally relevant concentrations.

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** This product is classified as having high potential for reaching surface water via runoff for several months after application. This chemical may leach into groundwater if used in areas where soils are permeable, particularly where the water table is shallow.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### TERRESTRIAL:

<b>AVIAN ACUTE ORAL TOXICITY:</b>	LD <sub>50</sub> (bobwhite quail) >2075 mg/kg
<b>AVIAN SUBACUTE DIETARY TOXICITY:</b>	LC <sub>50</sub> (mallard duck) >5290 mg/kg LC <sub>50</sub> (bobwhite quail) >5290 mg/kg
<b>HONEY BEE</b>	LC <sub>50</sub> >100 µg/bee (acute contact) and 112.03 µg/bee (oral)
<b>EARTHWORM</b>	LOAEC and NOAEC 334 mg/kg soil DW and 203 mg/kg soil DW, respectively.

**SMALL MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**OVERALL TERRESTRIAL TOXICITY: Practically Non-Toxic**

**PLANTS:** Highly toxic. Dicots are much more sensitive than monocots.

**FRESHWATER AQUATIC SPECIES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) 122 mg/l (practically non-toxic)

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) 120 mg/l (practically non-toxic)

**ACUTE TOXICITY:** EC<sub>50</sub> (Daphnia 48-hour) 39.7 mg/l (slightly toxic)

**OVERALL FRESHWATER AQUATIC TOXICITY: Practically Non-Toxic to Slightly Toxic**

**ESTUARINE/MARINE AQUATIC SPECIES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (sheepshead minnow 96-hour) 129 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (mysid shrimp 96-hour) 122 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (eastern oyster 96-hour) 118 mg/l

**OVERALL ESTUARINE/MARINE TOXICITY: Practically Non-Toxic**

**BIOACCUMULATION POTENTIAL:** Low tendency.

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to plants and surface water.

## V. TOXICOLOGICAL DATA

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**ACUTE TOXICITY:**

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE INHALATION:** LC<sub>50</sub> (rat 4-hour) >5.4 mg/l

**OVERALL TOXICITY: Category IV – Practically Non-Toxic**

**CHRONIC TOXICITY:**

**CARCINOGENICITY:** Not likely to be Carcinogenic to Humans.

**DEVELOPMENTAL/REPRODUCTIVE:** There is low concern for reproductive, developmental, or neurotoxicity for aminocyclopyrachlor.

**MUTAGENICITY:** Negative.

**HAZARD:** The end-use product labels for the aminocyclopyrachlor formulation Method® 240SL herbicide carries the *Caution!* signal word due to moderate eye irritation and need to avoid contact with eyes.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

### CHRONIC TOXICITY:

REPORTED EFFECTS: Decreased body weights, body weight gains, food consumption, and food efficiency in both sexes of rats were observed at the LOAEL of 1044.6/1424.9 mg/kg/day.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

AMINOCYCLOPYRACHLOR (*METHOD® 240SL Herbicide*) - **Caution!** – MODERATE EYE IRRITATION. AVOID CONTACT WITH EYES.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear all PPE with long-sleeved shirt and long pants, shoes plus socks and gloves.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a physician or poison control center immediately.

**SKIN:** Take off contaminated clothing and shoes immediately. Wash off immediately with plenty of water for at least 15 minutes. Call a physician or poison control center immediately.

**INGESTION:** Call a physician or poison control center immediately. Rinse out mouth and give water in small sips to drink. DO NOT induce vomiting unless directed to do so by a physician or poison control center. Never give anything by mouth to an unconscious person. Do not leave victim unattended.



**INHALATION:** Move to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. Call a physician or poison control center immediately

**HANDLING, STORAGE AND DISPOSAL:** *Handle and open container in a manner as to prevent spillage. Use only in area provided with appropriate exhaust ventilation. Wash hands thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, using the toilet or applying cosmetics. Remove Personal Protective Equipment (PPE) immediately after handling this product. Before removing gloves clean them with soap and water. Remove soiled clothing immediately and clean thoroughly before using again. Wash thoroughly and put on clean clothing.*

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Collect and transfer the product into a properly labelled and tightly closed container. Clean contaminated floors and objects thoroughly, observing environmental regulations. Do not allow to enter soil, waterways or waste water canal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**LOEC** – lowest observed effect concentration

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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Bayer Environmental Science, Method® 240SL, Package Label, 84099295

Bayer Environmental Science, Method® 240SL, Safety Data Sheet, SDS Number 102000030323, Version 2.0, September 2, 2015

New York State Department of Environmental Conservation, Registration of DuPont Method 240SL Herbicide (EPA Reg. No. 352-786) and DuPont Method 50SG Herbicide (EPA Reg. No. 352-787) Containing the New Active Ingredient Aminocyclopyrachlor, March 7, 2013

Syracuse Environmental Research Associates, Inc., Submitted to USDA Forest Service, Aminocyclopyrachlor Human Health and Ecological Risk Assessment FINAL REPORT, September 27, 2012

USEPA, Registration of the New Active Ingredient Aminocyclopyrachlor for Use on Non-Crop Areas, Sod Farms, Turf, and Residential Lawns, August 24, 2010

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20,000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

**Disclaimers and Other Legal Information:**

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees, and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

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# Aminopyralid

## HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

**COMMON NAME:** aminopyralid

**CHEMICAL NAME:** 4-amino-3,6-dichloro-2-pyridinecarboxylic acid,

Cas No. 150114-71-9

**CHEMICAL TYPE:** pyridine carboxylic acid

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** General Use Pesticide.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal and no concern were placed on List 4A and 4B, respectively.

The contents of the aminopyralid formulation for Milestone<sup>®</sup> / Milestone<sup>®</sup> VM are listed below:

Milestone <sup>®</sup> and/or Milestone <sup>®</sup> VM Herbicide			No listed inerts.
Active Ingredient	aminopyralid	40.6 %	
Inert Ingredients		59.4 %	

**RESIDUE ANALYTICAL METHODS:** No information available.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Aminopyralid is registered for use in non-crop sites including industrial sites, rights-of-way, non-irrigation ditches, rangeland, natural areas, wildlife openings, wildlife habitats, recreation areas, campgrounds, trailheads, and grazed areas in and around these sites. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Systemic post-emergence broad-spectrum herbicide for control of broadleaf weeds with residual action

**MODE OF ACTION:**

**METHOD OF APPLICATION AND RATES:** Ground broadcast spray, spot and localized spray applications. Rates adjustable not to exceed 7 fluid ounces per acre per growing season.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant and desired results. Total vegetation management is best obtained with early spring applications coupled with later summer treatment for residual control.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger. Tank or hose pressure should not exceed 25 psi.

### Restrictions/Warnings/Limitations:

T&E toxicity warning for ALL plants.

Do not use the product to treat irrigation ditches or other channels used for either agricultural or domestic purposes

Do not apply to residential or commercial lawns

Do not apply this product where loss of desirable broadleaf plants (including legumes) cannot be tolerated

Do not apply this herbicide via any type of irrigation system.

### III. ENVIRONMENTAL EFFECTS/FATE

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**SOLUBILITY:** 205 g/l in water (pH 7 at 25° C).

**HYDROLYSIS:** Stable.

**PHOTOLYSIS IN WATER:** Extremely susceptible.

**PHOTOLYSIS ON SOIL:** 72 days.

**AEROBIC SOIL METABOLISM: AVERAGE:** 103.5 days.

**ANAEROBIC SOIL METABOLISM:** 20 to 32 days.

**K<sub>OC</sub>:** 1 TO 24 DEPENDING ON SOIL.

**MOBILITY-UNAGED LEACHING:** Relatively immobile.

**MOBILITY-AGED LEACHING:** Non-Persistent.

**PERSISTENCE AND AGENTS OF DEGRADATION/DISSIPATION:** The primary route of dissipation is photolysis. Carbon dioxide and oxamic and malonic acid has been identified as major degradates.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** None

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Little potential due to non-persistent and relatively immobile characteristics.

**VOLATILIZATION:**  $7.14 \times 10^{-11}$  mm Hg at 20° C.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### TERRESTRIAL:

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >2250 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >5556 mg/kg  
LC<sub>50</sub> (mallard duck) >5496 mg/kg

**AVIAN REPRODUCTION:** LOEC (bobwhite quail) 640 mg/kg

**SMALL MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.



## **FRESHWATER AQUATIC SPECIES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) >100 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) >100 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (northern leopard frog 96-hour) >95.2 mg/l

**ACUTE TOXICITY:** EC<sub>50</sub> (Daphnia 48-hour) >98.6 mg/l

**OVERALL FRESHWATER AQUATIC TOXICITY: Practically Non-Toxic**

## **ESTUARINE/MARINE AQUATIC SPECIES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (sheepshead minnow 96-hour) >120 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (eastern oyster 96-hour) >89 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (mysid shrimp 96-hour) >100 mg/l

**OVERALL ESTUARINE/MARINE AQUATIC FRESHWATER TOXICITY: Slightly Toxic**

**BIOACCUMULATION POTENTIAL:** Not expected to bioaccumulate in fish tissue.

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## **V. TOXICOLOGICAL DATA**

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### **ACUTE TOXICITY:**

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >5.79 mg/l

**OVERALL TOXICITY: Category III – Slightly Toxic**

### **CHRONIC TOXICITY:**

**CARCINOGENICITY:** No evidence of carcinogenicity in test animals.

**DEVELOPMENTAL/REPRODUCTIVE:** Some effects at highest dose levels.

**MUTAGENICITY:** Negative.

**HAZARD:** The end-use product labels for the aminopyralid formulation Milestone® carries the *Caution* signal word due to moderate eye irritation.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

### CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

AMINOPYRALID (*Milestone*<sup>®</sup>) - **CAUTION** –CAUSES MODERATE EYE IRRITATION

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Flush eyes with water for 15 to 20 minutes. Call physician.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation is present.

**INGESTION:** Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**LOEC** – lowest observed effect concentration

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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Dow AgroSciences, Milestone<sup>®</sup> Specialty Herbicide, Specimen Product Label, Label Code: D02-879-001, August 29, 2005

Dow AgroSciences, Milestone<sup>®</sup> Specialty Herbicide, Material Safety Data Sheet, MSDS: 007887, May 18, 2004

Dow AgroSciences, Milestone<sup>®</sup> VM Specialty Herbicide, Specimen Product Label, Label Code: D02-880-001, November 4, 2005

Dow AgroSciences, Milestone<sup>®</sup> VM Specialty Herbicide, Material Safety Data Sheet, MSDS: 007887, January 3, 2006

USEPA, Pesticide Fact Sheet, Aminopyralid, Conditional Registration of a New Chemical, August 10, 2005

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2006.**

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# Bromacil

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** bromacil\*

**CHEMICAL NAME:** 5-bromo-3-sec-butyl-6-methyluracil, CAS No. 314-40-9  
5-bromo-3-sec-butyl-6-methyluracil, lithium salt, CAS No. 53404-19-6

\* According to EPA, bromacil and bromacil lithium salt are toxicologically similar. This Fact Sheet applies to both active ingredients.

**CHEMICAL TYPE:** uracil class of herbicide

**PESTICIDE CLASSIFICATION:** systemic, broad-spectrum herbicide to controls weeds and brush

**REGISTERED USE STATUS:** General Use Pesticide. Restricted Use Pesticide in Washington.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the dicamba formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the bromacil formulation is listed below:

Hyvar™ X (Wettable Powder)

Bromacil	80 %
Inert	20 %

Hyvar™ X-L (Water Soluble Liquid)

Bromacil Lithium Salt	21.9 %
Inert	78.1 %

**RESIDUE ANALYTICAL METHODS:** EPA METHOD 632

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Bromacil as Hyvar™ is registered for use in non-agricultural and agricultural areas for the control of weeds, grasses, and as a total vegetation management tool for bare-ground treatment. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Bromacil is a non-selective herbicide for annual and perennial weeds and brush, woody plants and, vines.

**MODE OF ACTION:** Bromacil enters the plant through the root zone and moves throughout the plant inhibiting photosynthesis.

**METHOD OF APPLICATION AND RATES:** Broadcast, band and basal application at 2 to 12 pounds of formulated product per acre. Aerial application is prohibited.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** For woody plants and brush, Bromacil is applied in the spring and summer. Weeds are controlled by applying Bromacil prior to or after emergence. As bromacil must move to the root zone to be effective, adequate soil moisture is necessary.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**Restrictions/Warnings/Limitations:** Do not enter or allow others to enter the treated area until sprays have dried. Not for use in recreation or residential areas. Do not apply through any type of irrigation system. Do not apply more than 12 pounds/acre/year for any treated site. Do not apply when ground is frozen. Do not apply directly to water or areas where surface water is present, or to intertidal areas below the mean high water mark. Do not apply to irrigation banks or other ditch banks. Do not graze animals in treated areas. Will harm non-target plants.



### III. ENVIRONMENTAL EFFECTS/FATE

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#### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of bromacil is 275 days.

**ADSORPTION:** The  $K(oc)$  of bromacil is 32.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Bromacil is persistent with no major (>10%) degradates.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** The primary metabolites of bromacil are carbon dioxide, 5-bromo-6-methyluracil, 5-bromo-3-(alpha-hydroxymethylpropyl)-6-methyluracil, 5-bromo-3-sec-butyl-6-hydroxymethyluracil, 5-bromo-3-(2-hydroxy-1-methylpropyl)-6-methyluracil, and 3-sec-butyl-6-methyluracil. These metabolites are not of toxicological concern to EPA.

#### WATER:

**SOLUBILITY:** 700 mg/kg in water.

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Bromacil is persistent and highly mobile. Bromacil is known to leach into ground water and has high potential to enter surface waters.

#### AIR:

**VOLATILIZATION:** Very low.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### MICROORGANISMS:

**ACUTE ORAL TOXICITY:**  $LD_{50}$  (honey bee 48-hour) >193.3  $\mu\text{g}/\text{bee}$

**ACUTE CONTACT TOXICITY:**  $LD_{50}$  (honey bee 48-hour) >100  $\mu\text{g}/\text{bee}$

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target brush/woody plants.

#### AQUATIC VERTEBRATES:

**ACUTE TOXICITY:**  $LC_{50}$  (rainbow trout 96-hour) 36 mg/l

**ACUTE TOXICITY:**  $LC_{50}$  (bluegill sunfish 96-hour) 127 mg/l

**OVERALL TOXICITY: Slightly Toxic**

#### AQUATIC FRESHWATER INVERTEBRATES:

**ACUTE TOXICITY:**  $EC_{50}$  (*Daphnia magna* 48-hour) 121 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

#### **AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (Eastern oyster larvae 48-hour) 130 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (mysid 48-hour) 12.9 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (sheepshead minnow 48-hour) 1620 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

#### **TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >2250 mg/kg

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) 3998 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >10,000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >10,000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

#### **BIOACCUMULATION POTENTIAL: Low potential**

**THREATENED AND ENDANGERED SPECIES:** Federally listed plants may be adversely affected if the product is applied directly to the plants.

## **V. TOXICOLOGICAL DATA**

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#### **ACUTE TOXICITY:**

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) 5126 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >5000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Not an Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Slight Irritant

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >14.4 mg/l

**OVERALL TOXICITY:** Category III – Caution

#### **CHRONIC TOXICITY:**

**CARCINOGENICITY:** Classified by EPA as Group C - possible human carcinogen.

**DEVELOPMENTAL/REPRODUCTIVE:** No effects reported.

**MUTAGENICITY:** Not a mutagenic.

**HAZARD:** The end-use product label for Hyvar™ carries the *Caution* signal word due to eye irritation, potential exposure to mixers/applicators, and PPE requirements.

## VI. HUMAN HEALTH EFFECTS

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### **ACUTE TOXICITY (POISONING):**

REPORTED EFFECTS: Low Risk.

### **CHRONIC TOXICITY:**

REPORTED EFFECTS: None reported.

### **POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

### **POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** Information not available.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** Mild, temporary skin and eye irritation.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

BROMACIL - **CAUTION** – HARMFUL IF SWALLOWED. CAUSES MODERATE EYE IRRITATION. AVOID CONTACT WITH EYES OR CLOTHING

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks, and waterproof gloves.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water; call physician if irritation persists.

**SKIN:** Wash all exposed areas with soap and water; call physician if irritation persists.

**INGESTION:** Induce vomiting and call physician or Poison Control Center.

**INHALATION:** None.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly. Liquid formulation is combustible. Do not use or store near heat or open flame. Keep container closed when not in use.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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Du Pont Agricultural Products, Hyvar<sup>®</sup> X Herbicide, Specimen Product Label H-637906, 1999

Du Pont Agricultural Products, Hyvar<sup>®</sup> X Herbicide, Material Safety Data Sheet M0000018, December 12, 1996

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Spray Drift Task Force, A Summary of Ground Application Studies, 1997  
<http://www.agdrift.com/publications/Body.htm>

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<http://www.epa.gov/oppsrrd1/REDs/>

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
<b>I (Highly Toxic)</b>	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
<b>II (Moderately Toxic)</b>	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
<b>III (Slightly Toxic)</b>	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
<b>IV (Practically Non-toxic)</b>	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**





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# Chlorsulfuron

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** chlorsulfuron

**CHEMICAL NAME:** 2-Chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl] benzenesulfonamide

Cas No. 64902-72-3

**CHEMICAL TYPE:** sulfonylurea herbicide

**PESTICIDE CLASSIFICATION:** systemic, selective pre- and post-emergent herbicide

**REGISTERED USE STATUS:** "General Use Pesticide."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of these formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the chlorsulfuron formulation are listed below:

Telar<sup>®</sup> DF

Chlorsulfuron	75 %
Inert	25 %

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Chlorsulfuron as Telar® is registered for use in non-agricultural areas for the control of weeds, grasses, and as a total vegetation management tool for bareground treatment. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Chlorsulfuron is a selective herbicide for pre- and post-emergent control of annual, biennial, and perennial broadleaf weeds.

**MODE OF ACTION:** Chlorsulfuron enters the plant through the root zone and foliage inhibiting the synthesis of key amino acids.

**METHOD OF APPLICATION AND RATES:** Broadcast and spot spray applications a t1/4 to 3 ounces of formulated product per acre. Ground application only.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Weeds are controlled by applying Chlorsulfuron prior to or after emergence. As chlorsulfuron must move to the root zone to be effective for pre-emergent control, adequate soil moisture is necessary.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**Restrictions/Warnings/Limitations** Do not enter or allow others to enter the treated area until sprays have dried. Do not apply through any type of irrigation system. Do not apply directly to water or areas where surface water is present, or to intertidal areas below the mean high water mark. Do not apply to irrigation banks or other ditch banks. Do not use on lawns. Do not use on walks, driveways, tennis courts, or other impermeable areas. Do not apply to frozen ground. Treated soil should remain undisturbed. Will harm non-target plants.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of chlorsulfuron is 28 to 42 days.

**ADSORPTION:** The K(oc) of chlorsulfuron is 33.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Chlorsulfuron is persistent with no major (>10%) degradates.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Chlorsulfuron degrades to nonphytotoxic, low-molecular-weight compounds.

### WATER:

**SOLUBILITY:** 31,800 mg/l in water (pH 7).

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Chlorsulfuron is moderately persistent and highly mobile and has potential to enter surface waters from runoff. The very low application rate and microbial breakdown suggest that chlorsulfuron has little potential to enter ground water.

**AIR:**

**VOLATILIZATION:** Nonvolatile

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

## **IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES**

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**MICROORGANISMS:**

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee contact) >25 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

**AQUATIC VERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) >250 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) >300 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

**AQUATIC FRESHWATER INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (*Daphnia magna* 48-hour) 370.9 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

**AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

**ACUTE TOXICITY:** EC<sub>50</sub> (Eastern oyster larvae 48-hour) 385 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (sheepshead minnow 96-hour) >980

**OVERALL TOXICITY: Practically Non-Toxic**

**TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >5000 mg/kg

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (mallard duck) >5000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >5620 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >5000 mg/kg

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

**BIOACCUMULATION POTENTIAL: No Potential**

**THREATENED AND ENDANGERED SPECIES:** Federally listed plants may be adversely affected if the product is applied directly to the plants.

**V. TOXICOLOGICAL DATA**

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**ACUTE TOXICITY:**

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Not an Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Moderate Irritant

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >5.9 mg/l

**OVERALL TOXICITY:** Category III – Caution

**CHRONIC TOXICITY:**

**CARCINOGENICITY:** No effects reported.

**DEVELOPMENTAL/REPRODUCTIVE:** No effects reported.

**MUTAGENICITY:** Not a mutagenic.

**HAZARD:** The end-use product label for Telar<sup>®</sup> carries the *Caution* signal word due to eye, nose, throat or skin irritation.

**VI. HUMAN HEALTH EFFECTS**

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**ACUTE TOXICITY (POISONING):**

**REPORTED EFFECTS:** None.

**CHRONIC TOXICITY:**

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** Mild, temporary skin and eye irritation.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

CHLORSULFURON - **CAUTION** – MAY IRRITATE EYES, NOSE, THROAT OR SKIN

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water; call physician if irritation persists.

**SKIN:** Wash all exposed areas with soap and water; call physician if irritation persists.

**INGESTION:** Induce vomiting and call physician or Poison Control Center.

**INHALATION:** Remove to fresh air.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects  
**leach** – to dissolve out by the action of water  
**mg/kg** – weight ratio expressed as milligrams per kilogram  
**mg/l** – weight-to-liquid ratio expressed as milligrams per liter  
**microorganisms** – living things too small to be seen without a microscope  
**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa – Pascal (unit of pressure)**  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## **IX. INFORMATION SOURCES**

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Du Pont Agricultural Products, Escort<sup>®</sup>, Oust<sup>®</sup>, Telar<sup>®</sup> Herbicides, Product Information Bulletin, H-66607, June 1996

Du Pont Agricultural Products, Noxious/Selective Weed Control, Escort<sup>®</sup> and Telar<sup>®</sup> Herbicides, Product Information Bulletin, H-87254, January 2000

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EPRI, Determination of the Effectiveness of Herbicide Buffer Zones in Protecting Water Quality, EPRI Final Report TR-113160, 1999

Extension Toxicology Network, Toxicology Information Briefs: Bioaccumulation, Revised 1993, <http://ace.orst.edu/info/extoxnet/tibs/bioaccum.htm>

Spray Drift Task Force, A Summary of Ground Application Studies, 1997 <http://www.agdrift.com/publications/Body.htm>

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
<b>I (Highly Toxic)</b>	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
<b>II (Moderately Toxic)</b>	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
<b>III (Slightly Toxic)</b>	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
<b>IV (Practically Non-toxic)</b>	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**



# Clethodim

## HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

**COMMON NAME:** clethodim

**CHEMICAL NAME:** (±)-2-[(E)-3-chloroallyloxyimino]propyl]-5-(2-ethylthiopropyl) -3-hydroxycyclohex-2-enone (IUPAC)

Cas No. 36734-19-7

**CHEMICAL TYPE:** cyclohexanediones

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** General Use Pesticide.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal and no concern were placed on List 4A and 4B, respectively.

The contents of the clethodim formulation for Select<sup>®</sup> 2 EC Herbicide are listed below:

Select <sup>®</sup> 2 EC Herbicide			Inert/Other Ingredients
Active Ingredient	clethodim	26.4 %	*CERCLA RQ 179.7 lbs (product) *IARC Group 2B carcinogen *RCRA Waste Code U165 *EPA Inert List 3
Inert/Other Ingredients			
	Naphthalene *	5-7 %	
	trimethylbenzene **	2-3 %	
	total hydrocarbons ***	65-71%	**EPA Inert List 3  ***EPA Inert List 2

**RESIDUE ANALYTICAL METHODS:** LC/ES/MS for water.

## **II. HERBICIDE USES**

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Clethodim is registered for use in crop and non-crop sites. For terrestrial use only.

### **OPERATIONAL DETAILS:**

**TARGET PLANTS:** Selective post-emergence herbicide for control of annual and perennial grasses. This herbicide will not control broadleaf weeds or sedges.

**MODE OF ACTION:** Lipid inhibitor.

**METHOD OF APPLICATION AND RATES:** Ground broadcast spray, spot and localized spray applications. Rates adjustable between 8 and 32 fl oz per acre.

### **SPECIAL PRECAUTIONS:**

**TIMING OF APPLICATION:** Timing is dependent on the target plant and desired results. For grasses, best results are obtained if grass is cut.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger. Tank or hose pressure should not exceed 25 psi.

### **Restrictions/Warnings/Limitations:**

T&E toxicity warning for ALL plants.

Do not apply if rain is expected within 1 hour of application.

Do not apply if grasses are under stress, i.e. not growing.

Do not apply a post-emergence broadleaf within 1 day of Select 2 EC application.

Select 2 EC is subject to Clean Water Act regulations for spills/drifts into US waters.

Do not apply to any waters.

Select 2 EC is a combustible liquid. Do not store or use near heat or open flame.

DOT regulations apply when transporting >119 gallons.

### III. ENVIRONMENTAL EFFECTS/FATE

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**SOLUBILITY:** 5400 g/l in water (pH 7 at 25° C).

**HYDROLYSIS:** 25 to greater than 300 days.

**PHOTOLYSIS IN WATER:** 128 days.

**PHOTOLYSIS ON SOIL:** 3 days.

**AEROBIC SOIL METABOLISM: AVERAGE:** 3 days.

**ANAEROBIC SOIL METABOLISM:** 177 days.

**K<sub>p</sub>:** 1 to 2 depending on soil.

**MOBILITY-UNAGED LEACHING:** Relatively immobile.

**MOBILITY-AGED LEACHING:** Non-Persistent.

**PERSISTENCE AND AGENTS OF DEGRADATION/DISSIPATION:** The primary route of dissipation is photolysis.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** None

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Little potential due to non-persistent and relatively immobile characteristics.

**VOLATILIZATION:**  $7.14 \times 10^{-11}$  mm Hg at 20° C.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### TERRESTRIAL:

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >2000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >6000 mg/kg

**AVIAN REPRODUCTION:** NOEL (bobwhite quail) 300 mg/kg

**HONEY BEES (ORAL)** LD<sub>50</sub> >100 ug/bee

**HONEY BEES (DERMAL)** LD<sub>50</sub> >100 ug/bee

**EARTHWORM ACUTE TOXICITY** LD<sub>50</sub> 454 mg/kg soil

**SMALL MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >2920 mg/kg

**OVERALL TERRESTRIAL TOXICITY: Slightly Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

## FRESHWATER AQUATIC SPECIES:

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) 16 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) 13 mg/l

ACUTE TOXICITY: EC<sub>50</sub> (Daphnia 48-hour) >120 mg/l

**OVERALL FRESHWATER AQUATIC TOXICITY: Slightly Toxic**

**BIOACCUMULATION POTENTIAL:** Not expected to bioaccumulate in fish tissue.

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants, and, aquatic species may be adversely affected if the product is applied directly to the plants, fish, water and/or indirectly as the result of drift or leaching.

## TOXICITY OF INERT/OTHER INGREDIENTS

### Naphthalene

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) 1.8 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (coho salmon 96-hour) 2.1 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (pink salmon 96-hour) 1.2 mg/l

**OVERALL FRESHWATER AQUATIC TOXICITY FOR NAPHTHALENE: Moderately Toxic**

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) >2920 mg/kg

ACUTE DERMAL TOXICITY: LD<sub>50</sub> (rat) >5000 mg/kg

ACUTE INHALATION: LC<sub>50</sub> (rat) 3.9 mg/l

**OVERALL TOXICITY: Category III – Slightly Toxic**

### CHRONIC TOXICITY:

**CARCINOGENICITY:** No evidence of carcinogenicity in test animals.

**DEVELOPMENTAL/REPRODUCTIVE:** None.

**MUTAGENICITY:** Negative.

**HAZARD:** The end-use product labels for the clethodim formulation Select<sup>®</sup> 2 EC carries the *Warning* signal word due to moderate eye irritation.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

### CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

### POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None.

### POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:

This product contains a solvent mixture. Solvents, when inhaled, can cause nasal and respiratory irritation and central nervous system effects including dizziness, weakness, fatigue, nausea, headache, and possible unconsciousness and even death. Ingestion of solvents can cause gastrointestinal irritation, nausea, vomiting and diarrhea. Prolonged or repeated dermal exposures may cause drying, scaling, and even blistering of the skin. Aspiration of low viscosity products can cause chemical pneumonitis which can be fatal.

Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage.

Acute exposure to naphthalene by inhalation, ingestion, and dermal contact has been associated with hemolytic anemia, damage to the kidneys, cataracts, and, in infants, brain damage. There is limited evidence of fetal and maternal toxicity from exposure to naphthalene.

Trimethylbenzene may affect the liver and may cause changes in the blood cells and affect the blood's clotting ability. Trimethylbenzene can irritate the lungs. Repeated exposures may cause bronchitis to develop.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** See above.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

CLETHODIM (*Select*<sup>®</sup> 2 EC) - **WARNING** –CAUSES SUBSTANTIAL BUT TEMPORARY EYE IRRITATION

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks, and chemical-resistant gloves.

**MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water for 15 to 20 minutes. Call physician.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation is present.

**INGESTION:** Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Combustible liquid do not store near heat or open flame. Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly. DOT regulations apply.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Clean Water Act regulations apply. Notification to federal and state authorities may be required. Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

---

**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**LOEC** – lowest observed effect concentration

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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EXTOXNET, Pesticide Information Profiles, Clethodim, July 1995

International Atomic Energy Agency, INFOCRIS, Chemical Entity Record, clethodim, January 14, 2006

USEPA, Pesticide Fate Database <http://cfpub.epa.gov/pfate/home.cfm>, March 2006

Ministry of Agriculture, Food and Fisheries, Pesticide Info, clethodim, February 2004

Valent USA Corporation, Select<sup>®</sup> 2 EC Herbicide, Specimen Product Label, Label Code: 2002-SEL-00002, October 2002

Valent USA Corporation, Select<sup>®</sup> 2 EC Herbicide, Material Safety Data Sheet, Label Code: 2002-SEL-00002, October 2002



## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20,000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2006.**

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# Clopyralid

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

---

**COMMON NAME:** clopyralid

**CHEMICAL NAME:** 3,6-dichloro-2-pyridinecarboxylic acid, monoethanolamine salt

Cas No. 1702-17-6

**CHEMICAL TYPE:** pyridine-carboxylic acid

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the clopyralid formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the clopyralid formulation are listed below:

Transline® Specialty Herbicide

Clopyralid	40.9 %
Inert	59.1 %

**RESIDUE ANALYTICAL METHODS:** Gas/liquid chromatography.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Clopyralid is registered for use in crop and non-crop sites for selective post-emergent weed control. For terrestrial use only.

**OPERATIONAL DETAILS:**

**TARGET PLANTS:** Selective, broad leaf weeds.

**MODE OF ACTION:** Clopyralid is an auxin growth regulator absorbed by the leaves.

**METHOD OF APPLICATION AND RATES:** Aerial (helicopter only) and ground broadcast, spot and localized applications. One-third to 1 1/3 pints per acre.

**SPECIAL PRECAUTIONS:**

**TIMING OF APPLICATION:** Timing is dependent on emergence of the target plant. As clopyralid must be absorbed through the leaves, timing is limited to emerged plants.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**Restrictions/Warnings/Limitations:** Groundwater advisory. Do not contaminate irrigation ditches or water used for irrigation or domestic purposes. T&E warning for plants.

## III. ENVIRONMENTAL EFFECTS/FATE

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**SOIL:**

**RESIDUAL SOIL ACTIVITY:** The half-life of clopyralid is 40 days.

**ADSORPTION:** The K(oc) of clopyralid is 6.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Clopyralid is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Clopyralid degrades to carbon dioxide and other unidentified products.

**WATER:**

**SOLUBILITY:** 300,000 mg/l in water (pH 7 at 25° C).

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Clopyralid is moderately persistent with a very low soil adsorption coefficient. There is a high potential for clopyralid to leach into groundwater when applied over shallow aquifers or to soils having high permeability.

**AIR:**

**VOLATILIZATION:** Not volatile.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

## **IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES**

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**MICROORGANISMS:**

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

**AQUATIC VERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) >100 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) >100 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

**AQUATIC FRESHWATER INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (*Daphnia magna* 48-hour) >100 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

**AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (fiddler crab 96-hour) No information

**ACUTE TOXICITY:** LC<sub>50</sub> (grass shrimp 96-hour) No information

**OVERALL TOXICITY: Practically Non-Toxic**

**TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) <2000 mg/kg

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (mallard duck) <2000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) <5000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) <5000 mg/kg

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >4000 mg/kg

**OVERALL TOXICITY: Slightly Toxic**

**BIOACCUMULATION POTENTIAL: Little or No Potential**

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >5000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Moderate Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Slight Irritant

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >3.0 mg/l

**OVERALL TOXICITY:** Category III – Slightly Toxic

### CHRONIC TOXICITY:

**CARCINOGENICITY:** No evidence of carcinogenicity in test animals.

**DEVELOPMENTAL/REPRODUCTIVE:** Some effects at highest dose levels.

**MUTAGENICITY:** No effects.

**HAZARD:** The end-use product labels for clopyralid formulations carry the *Caution* signal word due to potential eye, skin and inhalation hazards.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** None reported.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** EPA reports no toxicological endpoints of concern..

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

CLOPYRALID - **CAUTION** – CAUSES EYE INJURY. HARMFUL IF INHALED OR ABSORBED THROUGH THE SKIN

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Flush eyes with water.

**SKIN:** Wash all exposed areas with soap and water; call physician if irritation persists.

**INGESTION:** Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram  
**mg/l** – weight-to-liquid ratio expressed as milligrams per liter  
**microorganisms** – living things too small to be seen without a microscope  
**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa – Pascal (unit of pressure)**  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## **IX. INFORMATION SOURCES**

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<http://www.agdrift.com/publications/Body.htm>

USDA Forest Service, Pesticide Fact Sheet, Clopyralid, November 1995  
<http://www.fs.fed.us/foresthealth/pesticide/index.html>



## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**

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# Dicamba

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

---

**COMMON NAME:** dicamba

**CHEMICAL NAME:** 3,6-dichloro-o-anisic acid

Cas No. 1918-00-9

**CHEMICAL TYPE:** benzoic acid compound

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** General Use Pesticide. Date and Elevation Restrictions for Aerial Applications in Idaho.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the dicamba formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the dicamba formulation are listed below:

Banvel® Herbicide	
Dicamba	48.2 %
Inert	51.8 %
Vanquish®	
Dicamba	56.8 %
Inert	43.2 %

**RESIDUE ANALYTICAL METHODS:** Gas/liquid chromatography.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Dicamba is registered for use in crop and non-crop sites for selective pre- and post-emergent weed and brush control. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Selective, pre- and post-emergent herbicide for control of annual and perennial broadleaf weeds and brush.

**MODE OF ACTION:** Absorbed by root and shoot tissue causing rapid, abnormal cell growth leading to disruption of the phloem system and normal auxin balance.

**METHOD OF APPLICATION AND RATES:** Aerial and ground broadcast, spot and localized applications. One-half to four pints per acre.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**Restrictions/Warnings/Limitations:** Do not exceed 4 pints per/acre/year. Groundwater advisory. Do not apply within 50 feet of wells or other waters. Do not apply in situations favorable to runoff. Do not apply to impervious surfaces. Do not contaminate irrigation ditches or water used for irrigation or domestic purposes. T&E warning for plants.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of dicamba is 90 days.

**ADSORPTION:** The K(oc) of dicamba is 2.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Dicamba is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Dicamba degrades to carbon dioxide and other unidentified products.

**WATER:**

**SOLUBILITY:** 400,000 mg/l in water (pH 7 at 25° C).

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Dicamba is moderately persistent with a very low soil adsorption coefficient. There is a high potential for dicamba to leach into groundwater or surface water when applied over shallow aquifers or to soils having high permeability, and to impervious surfaces

**AIR:**

**VOLATILIZATION:** Moderately volatile.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

## **IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES**

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**MICROORGANISMS:**

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

**AQUATIC VERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) >100 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) >100 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

**AQUATIC FRESHWATER INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (*Daphnia magna* 48-hour) 38 mg/l

**OVERALL TOXICITY: Slightly Toxic**

**AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (fiddler crab 96-hour) >180 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (grass shrimp 96-hour) >100 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

## TERRESTRIAL ANIMALS:

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (mallard duck) >2000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >10,000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >10,000 mg/kg

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >500 mg/kg

**OVERALL TOXICITY: Slightly Toxic**

## BIOACCUMULATION POTENTIAL: Slight Potential

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) 3512 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Non-Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Moderate Irritant

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >5.3 mg/l

**OVERALL TOXICITY:** Category III – Slightly Toxic

### CHRONIC TOXICITY:

**CARCINOGENICITY:** No evidence of carcinogenicity in test animals.

**DEVELOPMENTAL/REPRODUCTIVE:** Some effects at highest dose levels.

**MUTAGENICITY:** No effects.

**HAZARD:** The end-use product labels for the dicamba formulation Vanquish® carries the *Caution* signal word due to potential eye and skin hazards.

The end-use product labels for the dicamba formulation Banvel® carries the *Warning* signal word due to potential eye hazards.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** None reported.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** EPA reports no toxicological endpoints of concern..

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

DICAMBA (*Vanquish*<sup>®</sup>) - **CAUTION** – AVOID CONTACT WITH SKIN, EYES OR CLOTHING. HARMFUL IF SWALLOWED.

DICAMBA (*Banvel*<sup>®</sup>) - **WARNING** – CAUSES EYE IRRITATION. DO NOT GET IN EYES, ON SKIN OR ON CLOTHING. HARMFUL IF SWALLOWED.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation persists.

**INGESTION:** Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

---

**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center  
**dermal** – of, or related to, the skin  
**EC<sub>50</sub>** - median effective concentration during a bioassay  
**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment  
**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act  
**formulation** – the form in which the pesticide is supplied by the manufacturer for use  
**half-life** – the time required for half the amount of a substance to be reduced by natural processes  
**herbicide** – a substance used to destroy plants or to slow down their growth  
**Hg** – chemical symbol for mercury  
**IARC** – International Agency for Research on Cancer  
**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$   
**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects  
**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects  
**leach** – to dissolve out by the action of water  
**mg/kg** – weight ratio expressed as milligrams per kilogram  
**mg/l** – weight-to-liquid ratio expressed as milligrams per liter  
**microorganisms** – living things too small to be seen without a microscope  
**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa – Pascal (unit of pressure)**  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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BASF Corporation, Banvel® Herbicide, Specimen Product Label, NVA 97-4-63-0099, 1997

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<http://www.agdrift.com/publications/Body.htm>

USDA Forest Service, Pesticide Fact Sheet, Dicamba, November 1995 <http://www.infoventures.com/e-hlth/pesticide/pest-fac.html>

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
<b>I (Highly Toxic)</b>	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
<b>II (Moderately Toxic)</b>	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
<b>III (Slightly Toxic)</b>	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
<b>IV (Practically Non-toxic)</b>	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

**TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)**

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**

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# Dichlobenil

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

---

**COMMON NAME:** dichlobenil

**CHEMICAL NAME:** 2,6-dichlorobenzonitrile

Cas No. 1194-65-6

**CHEMICAL TYPE:** benzonitrile

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the dichlobenil formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the dichlobenil formulation are listed below:

Casoron® Herbicide

Dichlobenil	4.0 %
Inert	96.0 %

**RESIDUE ANALYTICAL METHODS:** Gas chromatography with electron capture.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Dichlobenil is registered for use in crop and non-crop sites for selective and total weed control. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Dichlobenil is used for control of annual and perennial grasses, broadleaf weeds, and woody plants.

**MODE OF ACTION:** Acts on growing points and root tips, dichlobenil inhibits germination of actively dividing meristems.

**METHOD OF APPLICATION AND RATES:** Ground broadcast, spot and localized applications. One hundred to five hundred pounds per acre depending on target species.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**Restrictions/Warnings/Limitations:** Do not plant or transplant into treated soil. Do not graze livestock in treated areas.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of dichlobenil is 60 days.

**ADSORPTION:** The  $K(oc)$  of dichlobenil is 400.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Dichlobenil is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Dichlobenil degrades to 2,6-dichlorobenzamide (BAM) and 2,6-dichlorobenzoic acid. BAM is the primary metabolite produced by soil microbes.

### WATER:

**SOLUBILITY:** 21.2 mg/l in water (pH 7 at 25° C).

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Dichlobenil is moderately persistent with a very high soil adsorption coefficient. There is a moderate potential for dichlobenil to leach into groundwater and a high potential for surface water runoff.

### AIR:

**VOLATILIZATION:** 0.088 Pa at 20° C.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

## V. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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### MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD<sub>50</sub> (honey bee contact) >120 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

### AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) 6.26 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) 6.72 mg/l

**OVERALL TOXICITY: Moderately Toxic**

### AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (*Daphnia magna* 48-hour) 5.8 mg/l

**OVERALL TOXICITY: Moderately Toxic**

### AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (sheepshead minnow 96-hour) >12.7 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (grass shrimp 96-hour) >1.0 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (eastern oyster 96-hour) >1.63 mg/l

**OVERALL TOXICITY: Moderately Toxic**

### TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (bobwhite quail) 683 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (mallard duck) >2000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (bobwhite quail) 5200 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (mallard duck) >5200 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) 4250 mg/kg

**OVERALL TOXICITY: Slightly Toxic**

### BIOACCUMULATION POTENTIAL: Slight Potential

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) 4250 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Non-Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Non-Irritant

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >3.3 mg/l

**OVERALL TOXICITY:** Category III – Slightly Toxic

### CHRONIC TOXICITY:

**CARCINOGENICITY:** EPA Group C - possible human carcinogen.

**DEVELOPMENTAL/REPRODUCTIVE:** No adverse effects.

**MUTAGENICITY:** No adverse effects.

**HAZARD:** The end-use product labels for the dichlobenil formulation Casoron® carries the *Caution* signal word due to potential eye and skin irritation.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** None reported.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

DICHLORBENIL - **CAUTION** – HARMFUL IF SWALLOWED. AVOID BREATHING DUST. AVOID CONTACT WITH SKIN AND EYES.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Flush eyes with water.

**SKIN:** Wash all exposed areas with soap and water; call physician if irritation persists.

**INGESTION:** Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram  
**mg/l** – weight-to-liquid ratio expressed as milligrams per liter  
**microorganisms** – living things too small to be seen without a microscope  
**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa – Pascal (unit of pressure)**  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD <sub>50</sub> (mg/kg)	Avian Acute Oral LD <sub>50</sub> (mg/kg)	Avian Acute Dietary LC <sub>50</sub> (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC <sub>50</sub> (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

**Disclaimers and Other Legal Information:**

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**

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# Diuron

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** diuron

**CHEMICAL NAME:** N-(3,4-dichlorophenyl)-N,N-dimethyl urea

Cas No. 330-54-1

**CHEMICAL TYPE:** substituted urea

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** General Use Pesticide. Restricted Use Pesticide in Washington.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the diuron formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the diuron formulation are listed below:

Diuron® 4L Herbicide

Diuron	40.0 %
Inert	60.0 %

Diuron® 80 DF Herbicide

Diuron	80.0 %
Inert	20.0 %

Karmex® DF Herbicide

Diuron	80.0 %
Inert	20.0 %

**RESIDUE ANALYTICAL METHODS:** EPA Method 632.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Diuron is registered for use in crop and non-crop sites for selective and total weed control. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Diuron is used for pre- and post-emergent control of annual and perennial grasses and broadleaf weeds.

**MODE OF ACTION:** Diuron is absorbed through the root system, inhibiting photosynthesis.

**METHOD OF APPLICATION AND RATES:** Aerial and ground broadcast, spot, and localized applications. Fifteen to forty-eight pounds per acre on non-crop target species.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant. Rainfall is required to activate migration to root zone.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**Restrictions/Warnings/Limitations:** Do not plant or transplant into treated soil. Do not graze livestock in treated areas. Do not apply to impervious surfaces.

### III. ENVIRONMENTAL EFFECTS/FATE

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#### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of diuron is 90 days.

**ADSORPTION:** The K(oc) of diuron is 480.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Diuron is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** No information.

#### WATER:

**SOLUBILITY:** 42.0 mg/l in water (pH 7 at 25° C).

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Diuron is moderately persistent, with a very high soil adsorption coefficient. There is a moderate potential for diuron to leach into groundwater and a high potential for surface water runoff.

#### AIR:

**VOLATILIZATION:** 0.41 mPa at 50° C.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### MICROORGANISMS:

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

#### AQUATIC VERTEBRATES:

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) 3.5 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) 42 mg/l

**OVERALL TOXICITY: Moderately Toxic**

#### AQUATIC FRESHWATER INVERTEBRATES:

**ACUTE TOXICITY:** LC<sub>50</sub> (*Daphnia magna* 48-hour) 1.0 mg/l

**OVERALL TOXICITY: Highly Toxic**

## **AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (sheepshead minnow 96-hour)

**ACUTE TOXICITY:** LC<sub>50</sub> (grass shrimp 96-hour)

**ACUTE TOXICITY:** LC<sub>50</sub> (eastern oyster 96-hour)

**OVERALL TOXICITY: Moderately Toxic**

## **TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >2000 mg/kg

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (mallard duck) >2000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >1730 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >1730 mg/kg

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) 3400 mg/kg

**OVERALL TOXICITY: Slightly Toxic**

## **BIOACCUMULATION POTENTIAL: Slight Potential**

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## **V. TOXICOLOGICAL DATA**

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### **ACUTE TOXICITY:**

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) 3500 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Mild Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Mild Irritant

**ACUTE INHALATION:** LC<sub>50</sub> (rat) <2.5 mg/l

**OVERALL TOXICITY:** Category III – Slightly Toxic

### **CHRONIC TOXICITY:**

**CARCINOGENICITY:** Proposed revised EPA guidelines as a Known/Likely Carcinogen..

**DEVELOPMENTAL/REPRODUCTIVE:** Teratogenic in mice at high dose levels. Significant decrease in offspring weights at highest dose levels.

**MUTAGENICITY:** No adverse effects.

**HAZARD:** The end-use product labels for the diuron formulation Casoron® carries the *Caution* signal word due to potential eye and skin irritation.

## VI. HUMAN HEALTH EFFECTS

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### **ACUTE TOXICITY (POISONING):**

**REPORTED EFFECTS:** May cause cyanosis, depression, watering eyes, liver enlargement.

### **CHRONIC TOXICITY:**

**REPORTED EFFECTS:** Skin and eye irritant. Short exposure may cause blood effects, spleen effects, thyroid effects, and other nonspecific effects.

### **POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

### **POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** Dust from granular product may be an irritant.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

**DIURON - CAUTION** – CAUSES EYE IRRITATION. MAY IRRITATE NOSE, THROAT AND SKIN. AVOID BREATHING DUST OR SPRAY MIST. AVOID CONTACT WITH SKIN, EYES AND CLOTHING.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water.

**SKIN:** Wash all exposed areas with soap and water; call physician if irritation persists.

**INGESTION:** Drink 1 to 2 glasses of water and induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures



## IX. INFORMATION SOURCES

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<http://www.agdrift.com/publications/Body.htm>

## X. TOXICITY CATEGORY TABLES

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TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER</b> (poison)	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

**TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)**

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

**Disclaimers and Other Legal Information:**

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**

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# Florpyrauxifen-benzyl

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** Florpyrauxifen-benzyl

**CHEMICAL NAME:** 2-pyridinecarboxylic acid, 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxy-phenyl)-5-fluoro-, phenyl methyl ester

Cas No. 1390661-72-9

**CHEMICAL TYPE:** Arylpicolinate (class of synthetic auxin)

**PESTICIDE CLASSIFICATION:** Herbicide

**REGISTERED USE STATUS:** General Use Pesticide

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, the United States Environmental Protection Agency (USEPA) announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. USEPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of mixtures containing florpyrauxifen-benzyl are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

**Note:** BPA would use florpyrauxifen-benzyl only as a component of a terrestrially-applied pre-formulated herbicide mixture with other approved active ingredients, e.g. with aminopyralid in TerraVue® herbicide.

The contents of ProcellaCOR™SC are listed below:

Florpyrauxifen-benzyl: 2-pyridinecarboxylic acid, 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxy-phenyl)-5-fluoro-, phenyl methyl ester.....	26.5%
Other Ingredients .....	73.5%
Total.....	100.00%

The contents of ProcellaCOR™EC are listed below:

Florpyrauxifen-benzyl: 2-pyridinecarboxylic acid, 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxy-phenyl)-5-fluoro-, phenyl methyl ester.....	2.7%
Other Ingredients .....	97.3%
Total.....	100.00%

The contents of TerraVue® are listed below:

Aminopyralid: 2-pyridinecarboxylic acid, 4-amino-3,6-dichloro-, potassium salt.....	71.01%
Florpyrauxifen-benzyl: 2-pyridinecarboxylic acid, 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxy-phenyl)-5-fluoro-, phenyl methyl ester.....	6.00%
Other Ingredients .....	22.99%
Total.....	100.00%

## II. HERBICIDE USES

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### PROCELLACOR™SC AND EC (FLORPYRAUXIFEN-BENZYL):

**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** No. ProcellaCOR™SC and EC are selective systemic herbicides for management of freshwater aquatic vegetation in slow-moving/quiescent waters with little or no continuous outflow: ponds, lakes, reservoirs, freshwater marshes, wetlands, bayous, drainage ditches, and non-irrigation canals, including shoreline and riparian areas in or adjacent to these sites. Also for management of invasive freshwater aquatic vegetation in slow-moving/quiescent areas of rivers (coves, oxbows or similar sites).

### OPERATIONAL DETAILS:

**TARGET PLANTS:** ProcellaCOR™SC and EC are used to control aquatic plants and weeds.

**MODE OF ACTION:** ProcellaCOR™SC and EC are absorbed by aquatic vascular plants through emergent or floating leaves and from water through submersed plant shoots and leaves where it is translocated to fast-growing plant tissues and deregulates plant growth metabolic pathways, resulting in death of susceptible species.

### METHOD OF APPLICATION AND RATES:

ProcellaCOR™SC: Aerial and ground broadcast, spot, and localized applications not to exceed 0.052 lbs/acre per application, or 0.104 lbs/acre per year.

ProcellaCOR™EC: Aerial and ground broadcast, spot, and localized applications not to exceed 0.052 lbs/acre per application, or 0.104 lbs/acre per year.

## FOR TERRAVUE® (AMINOPYRALID + FLORPYRAUXIFEN-BENZYL):

**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** TerraVue® is registered for use in non-crop sites for control of annual and perennial broadleaf weeds including invasive and noxious weeds, certain annual grasses, and certain woody plants and vines. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** TerraVue® is used to control annual and perennial broadleaf weeds including invasive and noxious weeds, certain annual grasses, and certain woody plants and vines.

**MODE OF ACTION:** TerraVue® is absorbed by the foliage and roots, and is translocated to fast-growing plant tissues where it deregulates plant growth metabolic pathways, resulting in death of susceptible species.

**METHOD OF APPLICATION AND RATES:** Ground broadcast, spot, or repeat applications not to exceed a total of 5.7 oz per acre of TerraVue (0.252 lbs aminopyralid and 0.0213 lbs florpyrauxifen-benzyl) per year as a result of broadcast, spot, or repeat applications.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Apply when vegetation is actively growing and not stressed by drought or other conditions. Increase herbicide rate within the labeled rate range as the season progresses and plants become more mature. Higher application rates will produce an increase in residual suppression.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions.

**RESTRICTIONS/WARNINGS/LIMITATIONS:** Restrictions in Hay or Manure Use. Do not reformulate or repackage this product into other end-use products. Do not treat frozen soil where runoff could damage sensitive plants. Use 2 or more gallons of spray solution per acre. Do not make more than two applications per year. Do not apply within 30 days of previous application. Do not contaminate water intended for irrigation or domestic purposes. Do not apply through any type of irrigation system. Non-target plant advisory. See label for more information.

## III. ENVIRONMENTAL EFFECTS/FATE

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### FLORPYRAUXIFEN-BENZYL:

**HALF-LIFE IN ATMOSPHERE:** 1.12 days.

**SOLUBILITY:** Florpyrauxifen-benzyl: 15 µg/l in water (pH 7).

**VAPOR PRESSURE:**  $4.6 \times 10^{-5}$  Pa ( $3.5 \times 10^{-7}$  Torr) at 25°C, Classified as "Non-volatile under field conditions."

**HALF-LIFE IN WATER:** Aerobic: 4-6 days;  
Anaerobic: 2 days.

**HALF-LIFE VIA HYDROLYSIS:** 111 days (pH=7); Stable (pH=4); 1.23 days (pH=9)

**PHOTOLYSIS IN WATER:** 0.16 days.

**PERSISTENCE IN WATER:** DT<sub>50</sub> value 1.4 to 6.4 days

**HALF-LIFE IN SOIL (20°C):** Aerobic: 55.3 days;  
Anaerobic: 41.5 days.

**HALF-LIFE IN SEDIMENT:** Aerobic: 8.36 days;  
Anaerobic: 2.65 days.

**K<sub>oc</sub>:** 32,280 L/kg<sub>oc</sub>.

**PERSISTENCE AND AGENTS OF DEGRADATION/DISSIPATION:** Florpyrauxifen-benzyl degrades rapidly in atmosphere. In water, Florpyrauxifen-benzyl is expected to dissipate quickly from water, due to its rapid photolysis and low persistence. In soils, it is moderately persistent, and shows low mobility.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Florpyrauxifen-benzyl transforms into several degradates that are expected to have the same or lesser toxicity and hazard concern than the parent; however, they are shown to be moderately to highly persistent in water, soils, and sediments.

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Florpyrauxifen-benzyl has a low potential to leach into groundwater and a high potential for surface water runoff.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available.

## IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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### FLORPYRAUXIFEN-BENZYL:

#### TERRESTRIAL:

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >2,250 mg AI/kg

**AVIAN ACUTE DIETARY:** LC<sub>50</sub> (mallard duck) >5,640 mg AI/kg diet

**HONEY BEE:** LD<sub>50</sub> >40 µg/bee (acute contact) and 105.4 µg/bee (oral)

**SMALL MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg AI/kg

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact may injure or kill target and non-target plants.

#### AQUATIC:

**ACUTE TOXICITY:** LC<sub>50</sub> (freshwater, rainbow trout, 96-hr.) >49 µg AI/L

**ACUTE TOXICITY:** LC<sub>50</sub> (estuarine/marine, sheepshead minnow, 96-hr.) >40.3 µg AI/L

**ACUTE TOXICITY:** LC<sub>50</sub> (freshwater, scud, 96-hr.) >41.9 µg AI/L

**ACUTE TOXICITY:** EC<sub>50</sub> (marine, eastern oyster, 96 hour) >270 µg AI/L

**OVERALL FRESHWATER AQUATIC TOXICITY: Practically Non-Toxic**

**BIOACCUMULATION POTENTIAL:** Florpyrauxifen-benzyl is not expected to bioaccumulate in aquatic organisms due application rates that do not approach concentrations of concern, and because the chemical and degradation products would be metabolized by these organisms.

**THREATENED AND ENDANGERED SPECIES:** Application of Florpyrauxifen-benzyl may result in lethal or sub-lethal effects to federally listed terrestrial and aquatic plants, especially if the product is applied directly to the plants. Application may result in sub-lethal effects to fish, macroinvertebrates and other organisms.

## V. TOXICOLOGICAL DATA

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### FLORPYRAUXIFEN-BENZYL:

#### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg.

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Non-Irritating

**PRIMARY EYE IRRITATION:** Rabbit – Non-Irritating

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >5.66 mg/l

**OVERALL TOXICITY:** Category IV – Practically Non-Toxic

#### CHRONIC TOXICITY:

**CARCINOGENIC POTENTIAL:** Not Likely To Be Carcinogenic To Humans

**TERATOGENIC POTENTIAL:** Florpyrauxifen-benzyl did not cause birth defects or any other fetal effects in laboratory animals.

**REPRODUCTIVE TOXICITY:** Florpyrauxifen-benzyl did not interfere with reproduction in laboratory animals.

**MUTAGENICITY:** In vitro genetic toxicity studies were negative.

**HAZARD:** The end-use product labels for Florpyrauxifen-benzyl formulations ProcellaCOR™ and TerraVue® carry the *Caution* signal word due to moderate eye irritation hazard.

## VI. Human Health Effects

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**FLORPYRAUXIFEN-BENZYL:** No adverse acute or chronic effects, carcinogenicity, or mutagenicity were observed in toxicological studies, thus EPA concluded there were no risks of concern to human health. EPA also concluded that drinking water exposures to florpyrauxifen-benzyl do not pose a significant human health risk.

## VII. SAFETY PRECAUTIONS

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### PROCELLACOR™SC AND EC (FLORPYRAUXIFEN-BENZYL):

#### SIGNAL WORD AND DEFINITION:

**CAUTION** – Causes moderate eye irritation.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear protective eyewear, long-sleeved shirt and long pants, shoes plus socks, and waterproof gloves.

**MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Hold eyes open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eyes. Call a poison control center or doctor for treatment advice.

**SKIN:** Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

**INGESTION:** Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. Never give anything by mouth to an unconscious person.

**INHALATION:** Move person to fresh air. If person is not breathing, call an emergency responder or ambulance, then give artificial respiration; if by mouth to mouth use rescuer protection (pocket mask etc). Call a poison control center or doctor for treatment advice.

**HANDLING:** Keep out of reach of children. Do not swallow. Avoid contact with eyes, skin, and clothing. Avoid breathing vapor or mist. Wash thoroughly after handling. Keep container closed. Use with adequate ventilation.

**STORAGE:** Store in a dry place. Store in original container. Keep container tightly closed when not in use. Do not store near food, foodstuffs, drugs or potable water supplies.

**DISPOSAL:** If wastes and/or containers cannot be disposed of according to the product label directions, disposal of this material must be in accordance with your local or area regulatory authorities. This information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations. If the material as supplied becomes a waste, follow all applicable regional, national and local laws.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. Spills or discharge to natural waterways is likely to kill aquatic organisms. Contain spilled material if possible. Small spills: Absorb with materials such as: Clay. Dirt. Sand. Sweep up. Collect in suitable and properly labeled containers. Large spills: Contact manufacturer for clean-up assistance.



## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**DT<sub>50</sub>** – (Disappearance time 50): The time within which the initial concentration of the test substance is reduced by 50 percent.

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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USEPA. 2021. Office of Pesticide Programs. Chemicals Evaluated for Carcinogenic Potential Annual Cancer Report 2021. [http://npic.orst.edu/chemicals\\_evaluated.pdf](http://npic.orst.edu/chemicals_evaluated.pdf). Accessed February 22, 2022.

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20,000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2022.**

# Flumioxazin

## HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

**COMMON NAME:** flumioxazin

**CHEMICAL NAME:** (2-[7-fluoro-3,4-dihydro-3-oxo-4-(2-propynyl)-2*H*-1,4-benzoxazin-6-yl]-4,5,6,7-tetrahydro-1*H*-isoindole-1,3(2*H*)-dione

Cas No. 103361-09-7

**CHEMICAL TYPE:** N-phenylphthalimide

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** General Use Pesticide.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal and no concern were placed on List 4A and 4B, respectively.

The contents of the flumioxazin formulation Payload<sup>®</sup> are listed below:

Payload <sup>®</sup> Herbicide		
Active Ingredient	flumioxazin	51.0 %
Inert	kaolin clay*	16.0 %
	titanium oxide**	<1.0 %
	silica, crystalline***	<1.0 %
	other	32.0 %

\* List 4A  
\*\* List 4B  
\*\*\* CA Prop 65, IARC Group 1

**RESIDUE ANALYTICAL METHODS:** Foods: Valent Method RM-30A-1.

## **II. HERBICIDE USES**

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Flumioxazin is registered for use in crop and non-crop sites for selective pre- and post-emergent weed control. For terrestrial use only.

### **OPERATIONAL DETAILS:**

**TARGET PLANTS:** Selective, pre- and post-emergent herbicide for control of annual and perennial weeds.

**MODE OF ACTION:** Inhibits protoporphyrinogen oxidase required for chlorophyll biosynthesis. (Sunlight activates this process after being absorbed by the plant.)

**METHOD OF APPLICATION AND RATES:** Ground broadcast spray, spot and localized spray applications. Eight to twelve ounces per acre.

### **SPECIAL PRECAUTIONS:**

**TIMING OF APPLICATION:** Timing is dependent on the target plant.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

#### **Restrictions/Warnings/Limitations:**

Do not apply more than 12 oz per acre per application.

Do not apply more than 24 oz per acre per year.

Do not apply to wet or moist plant foliage.

Do not incorporate into soil.

Do not apply this herbicide via any type of irrigation system.

Groundwater/Surface Water Advisory.

Do not apply within 50 feet of wells or other surface waters.

Do not apply in situations or soils favorable to runoff.

Do not contaminate irrigation ditches or water used for irrigation or domestic purposes.

Do not graze treated areas.

T&E toxicity warning for ALL plants.

T&E toxicity warning for aquatic species.

### III. ENVIRONMENTAL EFFECTS/FATE

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**SOLUBILITY:** 1.79 mg/l in water (pH 7 at 25° C).

**HYDROLYSIS:** 4.2 days at pH 5; 1 day at pH 7; 0.01 days at pH 9.

**PHOTOLYSIS IN WATER:** 1 day at pH 5.

**PHOTOLYSIS ON SOIL:** Average 5.8 days.

**AEROBIC SOIL METABOLISM: AVERAGE:** 14.7 days

**ANAEROBIC AQUATIC METABOLISM:** 0.2 days

**MOBILITY-UNAGED LEACHING:** Moderately mobile

**MOBILITY-AGED LEACHING:** Generally not found below 3 inches of soil depth.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Flumioxazin is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Flumioxazin degrades to 6-Amino-7-fluoro-4-(2-propynyl)-1,4-benzoxazin-3(2H)-one (APF) and 3,4,5,6-tetrahydrophthalic acid (THPA). The toxicity of these metabolites is not described but appear to be more soluble and persistent in water. APF and THPA were very minor degradates from fate processes in soil.

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** There is a low potential for flumioxazin to leach into groundwater when applied as directed. The potential for degradation products APF and THPA to leach into groundwater is high. Flumioxazin could potentially reach surface waters via spray drift and/or runoff when certain conditions exist.

**VOLATILIZATION:**  $2.41 \times 10^{-6}$  mm Hg.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### TERRESTRIAL:

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >2250 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >5620 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >5620 mg/kg

**SMALL MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee contact) >105 g/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

## FRESHWATER AQUATIC SPECIES:

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) 2.3 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) >21 mg/l

ACUTE TOXICITY: EC<sub>50</sub> (*Daphnia pulex* 48-hour) 5.5 mg/l

**OVERALL TOXICITY: Moderately Toxic**

## ESTUARINE/MARINE AQUATIC SPECIES:

ACUTE TOXICITY: LC<sub>50</sub> (sheepshead minnow 96-hour) >4.7 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (eastern oyster 96-hour) >2.4 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (mysid shrimp 96-hour) >0.23 mg/l

**OVERALL TOXICITY: Highly Toxic**

## BIOACCUMULATION POTENTIAL: Slight Potential

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) >5000 mg/kg

ACUTE DERMAL TOXICITY: LD<sub>50</sub> (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit – Minor Irritant

PRIMARY EYE IRRITATION: Rabbit – Slight Irritant

ACUTE INHALATION: LC<sub>50</sub> (rat) >0.969 mg/l

**OVERALL TOXICITY: Category III – Slightly Toxic**

### CHRONIC TOXICITY:

CARCINOGENICITY: No evidence of carcinogenicity in test animals.

DEVELOPMENTAL/REPRODUCTIVE: Some effects at highest dose levels.

MUTAGENICITY: No effects.

**HAZARD:** The end-use product labels for the flumioxazin formulation Payload<sup>®</sup> carries the *Caution* signal word due to potential eye, skin, and inhalation hazards.



## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

### CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

### POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:

EPA reports no toxicological endpoints of concern..

### POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:

This product contains crystalline silica. Repeated inhalation of the dust may cause insidious lung injury and possibly silicosis. The signs and symptoms may include cough, shortness of breath, difficulty in breathing, and loss of weight. IARC classifies crystalline silica as a probable human carcinogen. The California Proposition 65 list of known carcinogens includes crystalline silica.

Users of this product should confirm that their operating, storage, and distribution facilities comply with OSHA 29CFR1910.1200 for all material containing over 0.1 percent crystalline silica. Employee exposures to airborne crystalline silica should be controlled to below the OSHA 8-hour PEL of (250)/(%SiO<sub>2</sub> + 5) mppcf (respirable); (10 mg/m<sup>3</sup>)/(%SiO<sub>2</sub> + 2) (respirable); (30 mg/m<sup>3</sup>)/(%SiO<sub>2</sub> + 2) (total dust).

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

FLUMIOXAZIN (*Payload*<sup>®</sup>) - **CAUTION** – HARMFUL IF INHALED OR ABSORBED THROUGH THE SKIN. CAUSES MODERATE EYE IRRITATION. AVOID BREATHING DUST AND SPRAY MIST. AVOID CONTACT WITH SKIN, EYES, AND CLOTHING.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear chemical-resistant gloves, long-sleeved shirt and long pants, shoes plus socks.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Flush eyes with water. Call physician.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation persists.

**INGESTION:** Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa** – Pascal (unit of pressure)

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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California, State Department of Pesticide Regulation, Public Report 2003-6, Flumioxazin, Tracking ID Number 191861 N, post 2001

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USEPA, Pesticide Fact Sheet, Flumioxazin Conditional Registration, April 12, 2001

Valent USA Corporation, Payload<sup>®</sup> Herbicide, Specimen Product Label, 2004-PAY-0001 11/03 AV mf, 2004

Valent USA Corporation, Payload<sup>®</sup> Herbicide, Material Safety Data Sheet, 0228, Revision 3, November 13, 2003

## X. TOXICITY CATEGORY TABLES

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TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
<b>I (Highly Toxic)</b>	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
<b>II (Moderately Toxic)</b>	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
<b>III (Slightly Toxic)</b>	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
<b>IV (Practically Non-toxic)</b>	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

**TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)**

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, December 2004.**

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# Fosamine Ammonium

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** fosamine ammonium

**CHEMICAL NAME:** ammonium salt of fosamine; [ethyl hydrogen (aminocarbonyl) phosphonate]

CAS No. 25954-13-6

**CHEMICAL TYPE:** organophosphonate subclass of organophosphate

**PESTICIDE CLASSIFICATION:** herbicidal brush control agent; plant growth regulator

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the fosamine ammonium formulation, Krenite™, are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the fosamine ammonium formulation is listed below:

Fosamine ammonium	41.5 %
Inert	58.5 %

**RESIDUE ANALYTICAL METHODS:** EPA 614, 8141A.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Fosamine ammonium as Krenite™ is registered for use in non-agricultural, uncultivated areas and non-agricultural rights-of-ways for the control of woody plants. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Fosamine ammonium is a selective, post-emergent herbicide for control of woody/brush and herbaceous plants, including, but not limited to: maple, birch, alder, blackberry, hawthorn, vine maple, ash, and oak.

**MODE OF ACTION:** Inhibits bud and leaf formation.

**METHOD OF APPLICATION AND RATES:** Foliar application by open pour, mix/load, high pressure hand wand, backpack, aerial and ultra low-volume equipment at rates of 6 to 24 pounds of active ingredient per acre.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** The Krenite formulation is applied any time from full leaf in the spring to first fall coloration.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions.

**Restrictions/Warnings/Limitations:** Do not apply directly to water or areas where surface water is present, or to intertidal areas below the mean high water mark. May harm non-target plants. Not for use on crops. Do not plant crops or graze livestock within one year of application. Do not apply through irrigation systems. Do not cut treated brush until stems are dead, or sprouting may occur. Not registered for use in California or Arizona.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of fosamine ammonium is 8 days.

**ADSORPTION:** The K(oc) of fosamine ammonium is 8 to 150 depending on soil pH and soil types.

**PERSISTENCE AND AGENTS OF DEGRADATION:** The field half-life of fosamine ammonium is 0.5 to 5 days and is dependent on rapid-microbial mediated dissipation.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Fosamine ammonium degrades to carbamoylphosphonic acid (CPA), carboxylphosphonic acid (ING-3003), and carbon dioxide. No fate data is available for CPA and ING-3003.

### WATER:

**SOLUBILITY:** Completely miscible in water.

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** The product has low potential to leach into surface and ground water due to rapid field and soil dissipation.

**AIR:**

**VOLATILIZATION:**  $4 \times 10^{-6}$  mm Hg at 25° C.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Carbon dioxide may be formed.

## **IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES**

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**MICROORGANISMS:**

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee 48-hour) >200 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target brush/woody plants.

**AQUATIC VERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) 377 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) 590 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (coho salmon 96-hour) >200 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

**AQUATIC INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (*Daphnia magna* 48-hour) 1524 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

**TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >5000 mg/kg

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (mallard duck) >5000 mg/kg

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >24,400 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >5620 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >5620 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

**BIOACCUMULATION POTENTIAL: Slight Potential**

**THREATENED AND ENDANGERED SPECIES:** Federally listed plants may be adversely affected if the product is applied directly to the plants during budding and leafing until fall coloration.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) 24,400 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >1682 mg/kg

LD<sub>50</sub> (rabbit) >5000 mg/kg (Krenite™)

**PRIMARY SKIN IRRITATION:** Rabbit - Low Potential

**PRIMARY EYE IRRITATION:** Rabbit – Low to Moderate Potential

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >56.6 mg/l (male)

LC<sub>50</sub> (rat) >42 mg/l (female)

**OVERALL TOXICITY: Category III – Caution – Causes Moderate Eye Irritation**

### CHRONIC TOXICITY:

**CARCINOGENICITY:** Not listed or classified by EPA or CAEPA as a carcinogen.

**DEVELOPMENTAL/REPRODUCTIVE:** No effects reported.

**MUTAGENICITY:** Krenite™ was clastogenic both with and without metabolic activation. Chromosome breakage was observed at final concentrations.

**HAZARD:** The end-use product label for Krenite™ carries the *Caution* signal word due to moderate eye irritation.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** None reported.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** Information not available.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** Mild, temporary skin and eye irritation.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.



## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

FOSAMINE AMMONIUM - **CAUTION** – CAUSES MODERATE EYE IRRITATION. AVOID CONTACT WITH EYES OR CLOTHING. WASH THOROUGHLY WITH SOAP AND WATER AFTER HANDLING.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** None.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Flush eyes with water; call physician if irritation persists.

**SKIN:** Wash all exposed areas with soap and water.

**INGESTION:** None.

**INHALATION:** None.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food or feed by storage or disposal.

## VIII. DEFINITIONS

---

**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram  
**mg/l** – weight-to-liquid ratio expressed as milligrams per liter  
**microorganisms** – living things too small to be seen without a microscope  
**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa – Pascal (unit of pressure)**  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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Du Pont Agricultural Products, Krenite<sup>®</sup> S Brush Control Agent, Specimen Product Label, H-63354, December 9, 1997

Du Pont Agricultural Products, Krenite<sup>®</sup> S Brush Control Agent, Material Safety Data Sheet M000022, March 7, 1997

Du Pont Agricultural Products, Krenite<sup>®</sup> UT Brush Control Agent, Specimen Product Label, H-63353, December 9, 1997

Du Pont Agricultural Products, Krenite<sup>®</sup> UT Brush Control Agent, Material Safety Data Sheet M000096, March 7, 1997

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USEPA, Office of Pesticide Programs, Reregistration Eligibility Decision, Fosamine ammonium, EPA-738-R-95-004, January 1995, <http://www.epa.gov/oppsrrd1/REDs/>

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
<b>I (Highly Toxic)</b>	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
<b>II (Moderately Toxic)</b>	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
<b>III (Slightly Toxic)</b>	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
<b>IV (Practically Non-toxic)</b>	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**

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# Glyphosate

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** glyphosate

**CHEMICAL NAME:** N-(phosphonomethyl)glycine

Cas No. 38641-94-0

**CHEMICAL TYPE:** phosphanoglycine

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the glyphosate formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

There are many formulations of glyphosate, including:

Accord<sup>®</sup> Herbicide (Terrestrial/Aquatic Uses)

Glyphosate	41.5 %
Inert	58.5 %

Accord<sup>®</sup> Site Prep (Terrestrial Uses)

Glyphosate	41 %
Inert	59 %

Glypro<sup>®</sup> Specialty Herbicide (Terrestrial/Aquatic Uses)

Glyphosate	53.8 %
Inert	46.2 %

Glypro<sup>®</sup> Plus (Terrestrial Uses)

Glyphosate	41 %
Inert	59 %

Glyphomax<sup>®</sup> Herbicide (Terrestrial Uses)

Glyphosate	41 %
Inert	59 %

Glyphos<sup>®</sup> Herbicide (Terrestrial Uses)

Glyphosate	41 %
Inert	59 % (Ethoxylated Tallowamines)

Glypro<sup>®</sup> Plus (Terrestrial Uses)

Glyphosate	41 %
Inert	59 %

Honcho<sup>®</sup> Herbicide (Terrestrial Uses)

Glyphosate	41 %
Inert	59 % (Ethoxylated Tallowamines)

Rodeo<sup>®</sup> Emerged Aquatic Weed and Brush Herbicide (Terrestrial/Aquatic Uses)

Glyphosate	53.8 %
Inert	46.2 %

Roundup Ultra<sup>®</sup> Herbicide (Terrestrial Uses)

Glyphosate	41 %
Inert	59 %

**RESIDUE ANALYTICAL METHODS:** EPA Method 547.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Glyphosate is registered for use in crop and non-crop sites, including aquatic sites, for post-emergent weed and woody plant control. For terrestrial and aquatic use.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Broad spectrum, non-selective for grasses, weeds and woody plants.

**MODE OF ACTION:** Glyphosate is absorbed by the leaves preventing the plant from producing an essential amino acid.

**METHOD OF APPLICATION AND RATES:** Aerial and ground broadcast, spot and localized applications. Application rates vary.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant. As glyphosate must be absorbed through the leaves, timing is limited to emerged plants.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**Restrictions/Warnings/Limitations:** Non-selective herbicide—apply to target plants only. Unless labeled for aquatic use, do not apply directly to water or to areas where surface water is present. Corrosive to unlined and galvanized steel. T&E warning for plants.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of glyphosate is 47 days.

**ADSORPTION:** The K(oc) of glyphosate is 24,000.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Glyphosate is moderately persistent in the plant. The primary route of degradation is microbial activity.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** The primary metabolite of glyphosate is aminomethylphosphonic acid. Environmental effects similar to parent chemical.

### WATER:

**SOLUBILITY:** 11,600 mg/l in water (pH 7 at 25° C).

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Glyphosate is moderately persistent with a very high soil adsorption coefficient. It is not expected to leach or otherwise migrate from the site of application.

### AIR:

**VOLATILIZATION:** Very low.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: None.

#### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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*For Glyphosate Formulations Labeled for Terrestrial Uses*

##### **MICROORGANISMS:**

ACUTE CONTACT TOXICITY: LD<sub>50</sub> (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

##### **AQUATIC VERTEBRATES:**

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) 8.2 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) 5.8 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (chinook salmon 96-hour) 20 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (coho salmon 96-hour) 22 mg/l

**OVERALL TOXICITY: Moderately Toxic**

##### **AQUATIC FRESHWATER INVERTEBRATES:**

ACUTE TOXICITY: LC<sub>50</sub> (*Daphnia magna* 48-hour) 24 mg/l

**OVERALL TOXICITY: Slightly Toxic**

##### **AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

ACUTE TOXICITY: LC<sub>50</sub> (fiddler crab 96-hour) 934 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (grass shrimp 96-hour) 281 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

##### **TERRESTRIAL ANIMALS:**

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (bobwhite quail) >2000 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (mallard duck) >2251 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (bobwhite quail) >6300 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (mallard duck) >6300 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD<sub>50</sub> (goat) >5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

**BIOACCUMULATION POTENTIAL: Little or No Potential**



*For Glyphosate Formulations Labeled for Aquatic/Terrestrial Uses*

**MICROORGANISMS:**

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

**AQUATIC VERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) >1000 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) >1000 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

**AQUATIC FRESHWATER INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (*Daphnia magna* 48-hour) 930 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

**AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (Eastern oyster larvae 48-hour) >10 mg/l

**ACUTE TOXICITY :** LC<sub>50</sub> (fiddler crab 96-hour) 934 mg/l

**ACUTE TOXICITY:** TL<sub>50</sub> (grass shrimp 96-hour) >281 mg/l

**OVERALL TOXICITY: Slightly Toxic**

**TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >2000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >4640 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >4640 mg/kg

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (goat) >5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

**BIOACCUMULATION POTENTIAL: Little or No Potential**

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >4320 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Slight Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Mild Irritant

**ACUTE INHALATION:** Not required by EPA.

**OVERALL TOXICITY:** Category III – Slightly Toxic

### CHRONIC TOXICITY:

**CARCINOGENICITY:** Classified as a Group E chemical: Evidence of non-carcinogenicity for humans.

**DEVELOPMENTAL/REPRODUCTIVE:** Some effects at highest dose levels.

**MUTAGENICITY:** No effects.

**HAZARD:** The end-use product labels for glyphosate formulations without ethoxylated tallowamines carry the *Caution* signal word due to potential eye irritation.

The end-use product labels for glyphosate formulations with ethoxylated tallowamines carry the *Warning* signal word by causing substantial but temporary eye injury.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** Glyphosate formulations will cause reversible eye injury. Will cause hypotension and lung edema if ingested in large quantities.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** Decreased body weight, decreased food consumption, increased white blood cells, decreased liver weight and increased relative brain weights were observed in test animals.

### POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:

EPA reports no toxicological endpoints of concern..

### POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:

None reported.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** The results of a single exposure (acute) toxicity studies conducted on formulations containing ethoxylated tallowamines indicate that these materials are no more than moderately toxic in rats after ingestion or in rabbits after skin application. The formulation is severely irritating to corrosive to rabbit eyes and can be irritating to rabbit skin.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

GLYPHOSATE - **CAUTION** – CAUSES EYE IRRITATION

GLYPHOSATE WITH ETHOXYLATED TALLOWAMINES - **WARNING** - CAUSES SUBSTANTIAL BUT TEMPORARY EYE INJURY

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks; for the ethoxylated tallowamine formulations, the user must also wear protective eyewear.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water for 15 minutes and call physician.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation persists.

**INGESTION:** Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

**INHALATION:** None normally needed.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury  
**IARC** – International Agency for Research on Cancer  
**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$   
**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects  
**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects  
**leach** – to dissolve out by the action of water  
**mg/kg** – weight ratio expressed as milligrams per kilogram  
**mg/l** – weight-to-liquid ratio expressed as milligrams per liter  
**microorganisms** – living things too small to be seen without a microscope  
**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa – Pascal (unit of pressure)**  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## **IX. INFORMATION SOURCES**

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<http://ace.orst.edu/info/extoxnet/pips/ghindex.html>

Extension Toxicology Network, Toxicology Information Briefs: Bioaccumulation, Revised 1993,  
<http://ace.orst.edu/info/extoxnet/tibs/bioaccum.htm>

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Monsanto Company, Accord Site Prep™ Herbicide, Specimen Product Label, 1999-1 21166W1-1/CG, 1999

Monsanto Company, Accord Site Prep™ Herbicide, Material Safety Data Sheet, MSDS Number: S00013288, January 5, 2000

Monsanto Company, Honcho® Herbicide, Specimen Product Label, 1997-1 21152V1-3/CG, 1997

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Monsanto Company, Roundup ULTRA® Herbicide, Specimen Product Label, 1999-1 21137X5-2/CG, 1999

Monsanto Company, Roundup ULTRA® Herbicide, Material Safety Data Sheet, MSDS Number: S00012770, May 26, 1999

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<http://www.fs.fed.us/foresthealth/pesticide/index.html>

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USEPA, Office of Pesticide Programs, R.E.D. Facts, Glyphosate, EPA-738-F-93-011, October 1998  
<http://www.epa.gov/oppsrrd1/REDs/>

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

**Disclaimers and Other Legal Information:**

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees, and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**





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# Halosulfuron-methyl

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** halosulfuron-methyl

**CHEMICAL NAME:** Methyl 5-[[[(4,6-dimethoxy-2pyrimidinyl)amino]carbonylamino]sulfonyl]-3-chloro-1-methyl-1H-pyrazole-4-carboxylate

CAS No. 100784-20-1

**CHEMICAL TYPE:** Sulfonyl Urea

**PESTICIDE CLASSIFICATION:** Herbicide

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the Manage<sup>®</sup> formulation are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the halosulfuron-methyl formulation is listed below:

Manage <sup>®</sup> Turf Herbicide	
Halosulfuron-methyl	75%
Inert	25%

**RESIDUE ANALYTICAL METHODS:** Analytical Method AG-500B

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Manage<sup>®</sup> is registered for commercial and non-commercial application to established lawns, ornamental turfgrass, and established woody ornamentals in numerous places, including public areas.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Halosulfuron-methyl is a selective herbicide for post-emergence control of sedges and other weeds in turf.

**MODE OF ACTION:** Halosulfuron-methyl interferes with acetolactate synthase enzyme, resulting in a rapid cessation of cell division and plant growth in both roots and shoots.

**METHOD OF APPLICATION:** Halosulfuron-methyl (as Manage<sup>®</sup>) is applied (ground methods only) to established turf grasses, etc., at an application rate of 0.66 to 1.66 ounces per acre. A second treatment may be necessary.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Halosulfuron-methyl is a post-emergence weed herbicide and is applied after emergence of target weeds.

**DRIFT CONTROL:** Halosulfuron-methyl is applied mixed with water/surfactant. Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by following label and sprayer instructions.

**RESTRICTIONS/WARNINGS/LIMITATIONS:** Groundwater advisory. Do not apply within 4 hours of precipitation. Do not apply through any irrigation system. Do not apply by air.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of halosulfuron-methyl is 55 days.

**ADSORPTION:** The K(oc) of halosulfuron-methyl is 75.

**PERSISTENCE AND AGENTS OF DEGRADATION:** The manufacturer has not conducted environmental toxicity studies with this product.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** The manufacturer has not conducted environmental toxicity studies with this product.

### WATER:

**SOLUBILITY:** 15 ppm at pH 5; 1630 ppm at pH 7

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** The product has high potential to leach into surface and ground water when applied to normal to basic soils (greater than pH 7).

### AIR:

**VOLATILIZATION:** Halosulfuron-methyl is slightly volatile.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** No information is available.

## **IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES**

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### **MICROORGANISMS:**

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

### **AQUATIC VERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) >131 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) >118 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

### **AQUATIC FRESHWATER INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (*Daphnia magna* 48-hour) >107 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

### **AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

**ACUTE TOXICITY:** EC<sub>50</sub> (Eastern oyster larvae 48-hour)

**ACUTE TOXICITY:** LC<sub>50</sub> (grass shrimp 96-hour)

**OVERALL TOXICITY:**

### **TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail)

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (mallard duck)

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail)

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck)

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) 1287 mg/kg

**OVERALL TOXICITY: Slightly Toxic**

### **BIOACCUMULATION POTENTIAL: Slight Potential**

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >1287 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit – Slightly Irritating

**PRIMARY EYE IRRITATION:** Rabbit – Moderately Irritating

**ACUTE INHALATION:** LC<sub>50</sub> (rat 4 hour) >5.7 mg/l.

**OVERALL TOXICITY: Category III – Caution – Slightly Toxic**

### CHRONIC TOXICITY:

**CARCINOGENICITY:** No effects.

**DEVELOPMENTAL:** Slight developmental toxicity.

**REPRODUCTIVE:** No effects.

**MUTAGENICITY:** No effects.

**HAZARD:** EPA has concluded that potential levels of halosulfuron-methyl or metabolites in soil and water do not appear to have significant toxicological effects on humans or animals and presents a negligible risk [63FR29401].

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** In sulfite-sensitive individuals, skin reactions have been reported following dermal exposure.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** Inhalation of both silica gel and kaolin dust may cause coughing, sneezing and nasal irritation.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** There have been no reported effects on workers manufacturing the products.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

**HEALTH RISK MANAGEMENT PROCEDURES:** See Section VII.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

HALOSULFURON-METHYL - **CAUTION** – AVOID CONTACT WITH EYES AND CLOTHING. HARMFUL IF SWALLOWED.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Wear eye protection. Wear long-sleeved shirt, long pants, shoes and socks.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water; call physician.

**SKIN:** Wash all exposed areas with soap and water. Wash all contaminated clothing prior to reuse. Call a physician if irritation develops.

**INGESTION:** Remove visible particles from mouth and rinse with water. Swallow water to dilute. Immediately transport to a medical care facility.

**INHALATION:** Remove individual to fresh air. If breathing difficulty occurs, provide CPR assistance and seek immediate medical attention.

**HANDLING, STORAGE AND DISPOSAL:** Keep dry (below 120° F) and store away from food, feed or other material to be used or consumed by humans or animals. Do not contaminate water. Dispose of only in accordance with local, state, and federal regulations.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Large spills should be reported to CHEMTREC (800-424-9300) for assistance. Prevent runoff. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer  
**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$   
**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects  
**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects  
**leach** – to dissolve out by the action of water  
**mg/kg** – weight ratio expressed as milligrams per kilogram  
**mg/l** – weight-to-liquid ratio expressed as milligrams per liter  
**microorganisms** – living things too small to be seen without a microscope  
**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa – Pascal (unit of pressure)**  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## **IX. INFORMATION SOURCES**

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Oregon State University, et al., Pacific Northwest Weed Control Handbook, 1998

Spray Drift Task Force, A Summary of Ground Application Studies, 1997  
<http://www.agdrift.com/publications/Body.htm>

USEPA, Notice, Monsanto Company; Pesticide Tolerance Petitions Filing, 63FR29401, May 29, 1998

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
<b>I (Highly Toxic)</b>	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
<b>II (Moderately Toxic)</b>	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
<b>III (Slightly Toxic)</b>	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
<b>IV (Practically Non-toxic)</b>	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals (Acute Oral LD <sub>50</sub> mg/kg)	Avian (Acute Oral LD <sub>50</sub> mg/kg)	Avian LC <sub>50</sub> (mg/kg)	Fish or Aquatic Invertebrates LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

**Disclaimers and Other Legal Information:**

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**



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# Hexazinone

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** hexazinone

**CHEMICAL NAME:** [3-cyclohexyl-6-(dimethylamino)-1-methyl-S-triazine-2,4-(1H,3H)-dione]

Cas No. 51235-04-2

**CHEMICAL TYPE:** triazine-dione herbicide

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** General Use Pesticide. Restricted Use Pesticide in Washington.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the Velpar<sup>®</sup> formulation are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the hexazinone formulation are listed below:

Velpar<sup>®</sup> Herbicide (soluble powder)

Hexazinone	90 %
Inert	10 %

Velpar<sup>®</sup> DF (dispersible granules)

Hexazinone	75 %
Inert	25 %

Velpar<sup>®</sup> L (water dispersible liquid)

Hexazinone	25 %
Inert	75 % (includes 45% ethanol - CAS 64-17-5)

Velpar<sup>®</sup> ULW (soluble granules)

Hexazinone	75 %
Inert	25 %

Velpar<sup>®</sup> ULW DF (soluble granules)

Hexazinone	75 %
Inert	25 %

**RESIDUE ANALYTICAL METHODS:** EPA Method 633.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Hexazinone as Velpar<sup>®</sup> is registered for use in agriculture and forestry for selective weed control, and in non-agricultural areas as a non-selective general weed and woody plants control herbicide. For terrestrial use only.

**OPERATIONAL DETAILS:**

**TARGET PLANTS:** Broad-spectrum annual, biennial, and perennial weeds including woody plants.

**MODE OF ACTION:** Hexazinone inhibits photosynthesis.

**METHOD OF APPLICATION AND RATES:** Broadcast and spot spray applications at 1/4 ounce to 8 ounces of formulated product per acre. Ground or aerial (helicopter only) application. Do not apply more than 8 ounces/acre/year.

**SPECIAL PRECAUTIONS:**

**TIMING OF APPLICATION:** Timing is dependent on the target plant. Application may be made at any time the ground is not frozen. As hexazinone must move to the root zone to be effective for pre-emergent control, adequate soil moisture is necessary.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**Restrictions/Warnings/Limitations:** Do not apply through any type of irrigation system. Do not apply to frozen ground. Do not apply 30 to 60 days before grazing, harvest, or feeding. Non-target plants may be adversely effected from drift and run-off.

### III. ENVIRONMENTAL EFFECTS/FATE

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#### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of hexazinone is 175 days.

**ADSORPTION:** The  $K(oc)$  of hexazinone is 40.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Hexazinone is persistent and is known to leach into groundwater. Hexazinone is degraded by soil microorganisms and sunlight.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Hexazinone degrades to carbon dioxide; many degradates have similar or identical characteristics to the parent material.

#### WATER:

**SOLUBILITY:** 33,000 mg/l in water (pH 7).

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Hexazinone is persistent and is known to leach into groundwater under favorable soil conditions and high water tables.

#### AIR:

**VOLATILIZATION:** 0.03 Pa at 25° C.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** None.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### MICROORGANISMS:

**ACUTE CONTACT TOXICITY:**  $LD_{50}$  (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

#### AQUATIC VERTEBRATES:

**ACUTE TOXICITY:**  $LC_{50}$  (rainbow trout 96-hour) >320 mg/l

**ACUTE TOXICITY:**  $LC_{50}$  (bluegill sunfish 96-hour) >370 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

#### **AQUATIC FRESHWATER INVERTEBRATES:**

ACUTE TOXICITY: LC<sub>50</sub> (*Daphnia magna* 48-hour) 151.6 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

#### **AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

ACUTE TOXICITY: EC<sub>50</sub> (Eastern oyster larvae 48-hour) >320 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (grass shrimp 96-hour) >78 mg/l

**OVERALL TOXICITY: Slightly Toxic**

#### **TERRESTRIAL ANIMALS:**

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (bobwhite quail) >2251 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (mallard duck) >2251 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (bobwhite quail) >5000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (mallard duck) >10,000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) >1100 mg/kg

**OVERALL TOXICITY: Slightly Toxic**

#### **BIOACCUMULATION POTENTIAL: Slight Potential**

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## **V. TOXICOLOGICAL DATA**

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#### **ACUTE TOXICITY:**

ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) >1200 mg/kg

ACUTE DERMAL TOXICITY: LD<sub>50</sub> (rabbit) >5278 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Slight Irritant

PRIMARY EYE IRRITATION: Rabbit – Severe Irritant

ACUTE INHALATION: LC<sub>50</sub> (rat) >3.94 mg/l

**OVERALL TOXICITY: Category I – Danger**

#### **CHRONIC TOXICITY:**

**CARCINOGENICITY:** Classified as a Group D chemical: Not classifiable as a human carcinogen.

**DEVELOPMENTAL/REPRODUCTIVE:** Some effects at mid- to high dose levels.

**MUTAGENICITY:** Positive in one study and negative in another. Suggests slight to no mutagenic effects.

**HAZARD:** The end-use product label for Velpar® carries the *Danger* signal word due to irreversible eye damage.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** Hexazinone formulations will cause irreversible eye damage.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** Decreased body weight, decreased food consumption, increased white blood cells, decreased liver weight and increased relative brain weights were observed in test animals..

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** EPA reports no toxicological endpoints of concern.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** Severe eye irritation.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

HEXAZINONE - **DANGER** – CORROSIVE, CAUSES IRREVERSIBLE EYE DAMAGE

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks, and protective eyewear.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Flush eyes with water for 15 minutes and call physician.

**SKIN:** Wash all exposed areas with soap and water; call physician if irritation persists.

**INGESTION:** Do not induce vomiting. Promptly drink a large quantity of milk, egg whites, gelatin solution, or if these are not available, drink large quantities of water. Avoid alcohol. Call a physician.

**INHALATION:** Remove to fresh air.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

---

**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa** – Pascal (unit of pressure)

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## **IX. INFORMATION SOURCES**

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## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	DANGER (poison)	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	WARNING	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	CAUTION	>500-5000	>2000-20,000	>2-20	no corneal opacity; irritation reversible within 7 days	Moderate irritation at 72 hours
IV (Practically Non-toxic)	NONE	>5000	>20,000	>20	no irritation	Moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.



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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**



# Imazapic

## HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

**COMMON NAME:** imazapic

**CHEMICAL NAME:** ( $\pm$ )-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid

Cas No. 104098-48-8

**CHEMICAL TYPE:** Imidazolinone

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** General Use Pesticide.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal and no concern were placed on List 4A and 4B, respectively.

The contents of the imazapic formulation for Plateau<sup>®</sup> DG herbicide are listed below:

Plateau <sup>®</sup> DG Herbicide			No listed inerts.
Active Ingredient	imazapic	70 %	
Inert Ingredients		30 %	

**RESIDUE ANALYTICAL METHODS:** No information available.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Imazapic is registered for weed control use in native grass establishment and other non-crop areas. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Systemic pre- and post-emergence broad-spectrum herbicide for control of broadleaf weeds

**MODE OF ACTION:** Inhibits enzyme synthesis.

**METHOD OF APPLICATION AND RATES:** Ground broadcast spray, spot and localized spray applications. Rates adjustable between 1.44 (1 packet) and 4.32 (3 packets) ounces per acre on an annual, biennial and or perennial basis not to exceed 4.32 (3 packets) ounces per year per acre.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant and desired results. Weed management is best obtained with early spring applications coupled with later summer treatment for residual control.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger. Tank or hose pressure should not exceed 25 psi.

### Restrictions/Warnings/Limitations:

T&E toxicity warning for ALL plants.

Groundwater warning.

Do not use on food or feed crops.

Do not use on areas to be grazed or cut for hay.

Do not use the product to treat irrigation ditches or other channels used for either agricultural or domestic purposes

Do not apply this herbicide via any type of irrigation system.

Do not apply to residential or commercial lawns

Do not apply to the foliage of desirable trees or ornamental plants.

### III. ENVIRONMENTAL EFFECTS/FATE

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**SOLUBILITY:** 36,000 mg/l in water (pH 7 at 25° C).

**HYDROLYSIS:** Stable.

**PHOTOLYSIS IN WATER:** 1 – 2 days.

**PHOTOLYSIS ON SOIL:** 106 days.

**AEROBIC SOIL METABOLISM: AVERAGE:** 113 days.

**ANAEROBIC SOIL METABOLISM:** 2440 days.

**K<sub>OC</sub>:** 7 TO 8140 Depending on soil

**PERSISTENCE AND AGENTS OF DEGRADATION/DISSIPATION:** The primary route of dissipation is photolysis.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** None

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Low to high dependent on soil type and organic content.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### TERRESTRIAL:

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >15,000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >2500 mg/kg

**HONEY BEE** LD<sub>50</sub> >100 ug/bee

**SMALL MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

## FRESHWATER AQUATIC SPECIES:

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) >100 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) >100 mg/l

ACUTE TOXICITY: EC<sub>50</sub> (Daphnia 48-hour) >96 mg/l

**OVERALL FRESHWATER AQUATIC TOXICITY: Slightly Toxic**

**BIOACCUMULATION POTENTIAL:** 0.11 Low potential.

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) >5000 mg/kg

ACUTE DERMAL TOXICITY: LD<sub>50</sub> (rat) >5000 mg/kg

ACUTE INHALATION: LC<sub>50</sub> (rat 4-hour) >2.38 mg/l

**OVERALL TOXICITY: Category III – Slightly Toxic**

### CHRONIC TOXICITY:

**CARCINOGENICITY:** No evidence of carcinogenicity in test animals.

**DEVELOPMENTAL/REPRODUCTIVE:** Negative.

**MUTAGENICITY:** Negative.

**HAZARD:** The end-use product labels for the aminopyralid formulation Plateau<sup>®</sup> DG herbicide carries the *Caution* signal word due to moderate eye and skin irritation.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

### CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## **VII. SAFETY PRECAUTIONS**

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### **SIGNAL WORD AND DEFINITION:**

IMAZAPIC (*Plateau<sup>®</sup> DG Herbicide*) - **CAUTION** – HARMFUL IF ABSORBED THROUGH THE SKIN, CAUSES MODERATE EYE IRRITATION

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks and gloves.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water for 15 to 20 minutes. Call physician.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation is present.

**INGESTION:** Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

---

**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**LOEC** – lowest observed effect concentration

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures



## **IX. INFORMATION SOURCES**

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BASF Corporation, Plateau DG<sup>®</sup> Herbicide, Material Safety Data Sheet, 30128284/MDS\_CPA\_USS/EN, February 16, 2006

Nature Conservancy (The), Weed Control Methods Handbook, Tu, et al, April 2001

USDA-Forest Service, Imazapic Human Health and Ecological Risk Assessment – Final Report, December 23, 2004

USDOI – Bureau of Land Management, Reno, Nevada, Imazapic Ecological Risk Assessment – Final Report, November 2005

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2006.**

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# Imazapyr

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** imazapyr

**CHEMICAL NAME:** 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1-H-imidazol-2-yl]-3-pyridinecarboxylic acid

Cas No. 81334-34-1

**CHEMICAL TYPE:** imidazolinone

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the imazapyr formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the imazapyr formulation are listed below:

Arsenal® Herbicide		
Imazapyr		28.7 %
Inert		71.3 %
Arsenal® Applicators Concentrate Herbicide		
Imazapyr		53.1 %
Inert		46.9 %
Arsenal® Railroad Herbicide		
Imazapyr		27.6 %
Inert		72.4 %
Chopper® Herbicide		
Imazapyr		27.6 %
Inert		72.4 %

**RESIDUE ANALYTICAL METHODS:** Capillary Electrophoresis Method 2657.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Imazapyr is registered for use in non-crop sites for selective and total weed control. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Imazapyr is used for pre- and post-emergent control of annual and perennial grasses and broadleaf weeds, brush, vines, and many deciduous trees.

**MODE OF ACTION:** Imazapyr is absorbed by the leaves and through the root system, disrupting protein synthesis.

**METHOD OF APPLICATION AND RATES** Aerial and ground broadcast, spot and localized applications at 2 to 6 pints per acre.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**RESTRICTIONS/WARNINGS/LIMITATIONS:** Do not use on food or feed crops. Do not treat irrigation ditches or water used for irrigating crops.

### III. ENVIRONMENTAL EFFECTS/FATE

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#### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of imazapyr is 90 days.

**ADSORPTION:** The  $K(oc)$  of imazapyr is 100.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Imazapyr is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** No information.

#### WATER:

**SOLUBILITY:** 1.0 mg/l in water (pH 7 at 25° C).

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Imazapyr is moderately persistent with a moderate soil adsorption coefficient. There is a moderate potential for imazapyr to leach into groundwater and a high potential for surface water runoff.

#### AIR:

**VOLATILIZATION:** No information.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### MICROORGANISMS:

**ACUTE CONTACT TOXICITY:**  $LD_{50}$  (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

#### AQUATIC VERTEBRATES:

**ACUTE TOXICITY:**  $LC_{50}$  (rainbow trout 96-hour) >100 mg/l

**ACUTE TOXICITY:**  $LC_{50}$  (bluegill sunfish 96-hour) >100 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

#### AQUATIC FRESHWATER INVERTEBRATES:

**ACUTE TOXICITY:**  $LC_{50}$  (*Daphnia magna* 48-hour) >100 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

#### AQUATIC ESTUARINE/MARINE INVERTEBRATES:

**ACUTE TOXICITY:**  $LC_{50}$  (sheepshead minnow 96-hour)

**ACUTE TOXICITY:** LC<sub>50</sub> (grass shrimp 96-hour)

**ACUTE TOXICITY:** LC<sub>50</sub> (eastern oyster 96-hour)

**OVERALL TOXICITY: Practically Non-Toxic** (Based on freshwater data, imazapyr is not expected to be toxic to estuarine invertebrates.)

#### **TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >2150 mg/kg

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (mallard duck) >2150 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >5000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >5000 mg/kg

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

#### **BIOACCUMULATION POTENTIAL: Little Potential**

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## **V. TOXICOLOGICAL DATA**

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#### **ACUTE TOXICITY:**

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Slight Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Moderate Irritant

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >1.3 mg/l

**OVERALL TOXICITY:** Category III – Slightly Toxic

#### **CHRONIC TOXICITY:**

**CARCINOGENICITY:** EPA Group E - No evidence of human carcinogenicity.

**DEVELOPMENTAL/REPRODUCTIVE:** No adverse effects.

**MUTAGENICITY:** No adverse effects.

**HAZARD:** The end-use product labels for the imazapyr formulations carry the *Caution* signal word due to potential eye and skin irritation.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None.

### CHRONIC TOXICITY:

REPORTED EFFECTS: None.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** Dermal sensitizer in some applicators after prolonged and repeated contact with formulated products.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

IMAZAPYR - **CAUTION** – HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. AVOID BREATHING SPRAY MIST. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. PROLONGED OR FREQUENT EXPOSURE TO SKIN MAY CAUSE ALLERGIC REACTIONS IN SOME INDIVIDUALS.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Flush eyes with water.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation persists.

**INGESTION:** Drink 1 to 2 glasses of water and induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.



## VIII. DEFINITIONS

---

**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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USDA Forest Service, Pesticide Fact Sheet, Imazapyr, November 1995  
<http://www.fs.fed.us/foresthealth/pesticide/index.html>

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	DANGER (poison)	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	WARNING	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	CAUTION	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	NONE	>5000	>20,000	>20	no irritation	Moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**



# Indaziflam

## HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

**COMMON NAME:** Indaziflam, Alion Herbicide, Esplanade 200 SC, Rejuvra, and Marengo

**CHEMICAL NAME:** N-[(1R,2S)-2,3-dihydro-2,6-dimethyl-1H-inden-1-yl]-6-(1-fluoroethyl)-1,3,5-triazine-2,4-diamine

CAS No. 950782-86-2

**CHEMICAL TYPE:** Alkylazine

**PESTICIDE CLASSIFICATION:** Herbicide

**REGISTERED USE STATUS:** General Use Pesticide.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal and no concern were placed on List 4A and 4B, respectively.

The contents of the Indaziflam formulation for Esplanade® 200 SC herbicide are listed below:

Esplanade® 200 SC Herbicide			No inert ingredients listed.
Active Ingredient	Indaziflam	19.05 %	
Inert Ingredients		80.95 %	

**RESIDUE ANALYTICAL METHODS:** Standard herbicide screening analysis.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Indaziflam is registered for application to residential and commercial areas (lawns, ornamentals, and hardscapes including patios, walkways, etc.), turf (parks, cemeteries, golf courses, sod farms, sports fields, and commercial lawns), field grown ornamentals and Christmas trees, commercial nursery and landscape plantings, and forestry sites. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Pre-emergent control of annual grasses and broadleaf weeds.

**MODE OF ACTION:** Inhibits cellulose biosynthesis (CB Inhibitor).

**METHOD OF APPLICATION AND RATES:** Spot, localized, broadcast, and aerial spray applications. The application rate is 3.5-7 fl oz per acre. Not to exceed 7 fl oz for a single application and must not exceed 10 fl oz per acre in a 12-month period. For aerial application (helicopter and fixed wing aircraft), use 5-30 gallons of spray volume per acre.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant and desired results. Apply Esplanade 200 SC prior to weed seed germination as it does not generally control weeds that have emerged. For maximum weed control, Esplanade 200 SC needs to reach the soil surface and be activated by rainfall or adequate soil moisture. Apply Esplanade 200 SC in the spring for control of spring and summer germinating weeds and apply in the fall for control of winter weeds. For late fall applications, apply prior to when the ground freezes.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. To reduce the potential for drift, the ground application equipment must be set to apply coarse or greater droplets (i.e., ASABE Standard 572.1) with corresponding spray pressure. Use high flow rate nozzles to apply the highest practical spray volume. With most nozzle types, narrower spray angles produce larger droplets. Follow the nozzle manufacturer's directions on pressure, orientation, spray volume, etc., in order to minimize drift and optimize coverage and control. For aerial applications the distance of the outer most nozzles on the boom must not exceed  $\frac{3}{4}$  the length of the wingspan or rotor, and nozzles must always point backward, parallel with the air stream and never be pointed downwards more than 45 degrees. All aerial and ground application equipment must be properly maintained and calibrated using appropriate carriers.

### Restrictions/Warnings/Limitations:

Do not apply to frozen or snow covered ground.

Do not graze or feed forage, hay, or straw from treated areas to livestock.

Do not apply directly to water or to soil where standing water is present.

Do not apply in or on irrigation ditches/canals including the outer banks.

Do not contaminate water intended for irrigation and domestic use.

Do not treat or allow spray drift or runoff to fall into irrigation ditches/canals or other channels that carry water that may be used for irrigation purposes.

Do not exceed 7 fl oz per acre in a single application.

Do not exceed 10 fl oz per acre within a calendar year or in a 12-month period from previous application.

Do not apply to newly seeded turf.

Do not apply through an irrigation or chemigation system.

Aerial applications are only allowed to release or re-establish desirable vegetation in non-crop areas such as parks and open space, wildlife management areas, recreational areas, fire rehabilitation areas, prairies, and fire breaks.

Do not apply or otherwise permit this product or sprays containing this product to come into contact with any non-target crop or desirable plants.

Do not make applications when circumstances favor movement from treatment sites.

Do not use on residential lawns or commercial lawns, golf courses, sod farms, or production and landscape ornamentals.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

Applications to hardscapes (e.g. patios, paved parking lots, and walkways) may be made by spot application only.

Applications made to areas where runoff water flows onto agricultural land may injure crops.

Applications made during periods of intense rainfall, to soils saturated with water, or soils through which rainfall will not readily penetrate may result in runoff and movement of herbicide.

Treated soil should be left undisturbed to reduce the potential for herbicide movement by soil erosion, by wind, or water.

Applications should be made only when there is little or no risk of spray drift or movement of applied product into sensitive areas. Sensitive areas are defined as bodies of water (ponds, lakes, rivers, and streams), habitats of endangered species and non-labeled agricultural crop areas.

Avoid application to powdery, dry, light or sandy soil when there is little likelihood of rainfall soon after application. Injury to crops or desirable vegetation may result if treated soil is washed, blown, or moved into these areas.

If planning to plant desirable species in the treated area, avoid planting for at least eight months after application.



### III. ENVIRONMENTAL EFFECTS/FATE

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**SOLUBILITY:** pH 4: 0.0044 g/L at 20°C; pH 9: 0.0028 g/L at 20°C; Distilled water (pH 6.6-6.9): 0.0028 g/L at 20°C.

**VAPOR PRESSURE:** 2.5 x 10<sup>-8</sup> PA at 20°C or 1.875 x 10<sup>-10</sup> mm Hg; 6.8 x 10<sup>-8</sup> PA at 25°C or 5.1 x 10<sup>-10</sup> mm Hg; 6.9 x 10<sup>-6</sup> PA at 50°C or 5.2 x 10<sup>-8</sup> mm Hg.

**HYDROLYSIS:** Stable.

**PHOTOLYSIS IN WATER:** T<sub>1/2</sub> of 3.7 days.

**PHOTOLYSIS ON SOIL:** T<sub>1/2</sub> of 40.8 days.

**AEROBIC SOIL METABOLISM: AVERAGE:** T<sub>1/2</sub> range from 35 to 178 days.

**ANAEROBIC SOIL METABOLISM:** T<sub>1/2</sub> of >180 days.

**K<sub>oc</sub>:** 496.

**PERSISTENCE AND AGENTS OF DEGRADATION/DISSIPATION:** The primary route of degradation is aerobic soil metabolism, aerobic aquatic metabolism, and aquatic photolysis.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:**

Degradation results in the production of metabolites: triazine-indanone (aerobic soil and aerobic aquatic metabolism), indaziflam-carboxylic acid (aerobic soil and aerobic aquatic metabolism), indaziflam-hydroxyethyl (aquatic photolysis), indaziflam-olefin (aquatic photolysis), fluoroethyl diamino triazine (FDAT; aerobic soil and aerobic aquatic metabolism), and fluoroethyl-triazinanedione (aerobic soil metabolism). Metabolites are only toxicologically significant in regards to impacts on non-target aquatic macrophytes.

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Moderately mobile to mobile in soil and likely that runoff events could move indaziflam off treated areas and into adjacent waterbodies. Metabolites are more mobile than the parent. The degradate FDAT is mobile to highly mobile and has the potential to leach to the ground water.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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**TERRESTRIAL:**

<b>AVIAN ACUTE ORAL TOXICITY:</b>	LD <sub>50</sub> (bobwhite quail) >2000 mg AI/kg
<b>AVAIN SUBACUTE DIETARY</b>	LC <sub>50</sub> (mallard duck/bobwhite quail) >2000 mg AI/kg
<b>HONEY BEE</b>	LC <sub>50</sub> >100 µg/bee (acute contact) and 120 µg/bee (oral)
<b>EARTHWORM</b> soil DW, respectively (No significant toxicity).	LOAEC and NOAEC 60.3 mg/kg soil DW and 34 mg/kg
<b>SMALL MAMMAL ACUTE ORAL TOXICITY:</b>	LD <sub>50</sub> (rat) >=5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact may injure or kill target and non-target plants.

## FRESHWATER AQUATIC SPECIES:

**ACUTE TOXICITY:** LC<sub>50</sub> (freshwater fish) 0.32 – 0.57 mg/L

**ACUTE TOXICITY:** LC<sub>50</sub> (marine/estuarine fish) 0.96 mg/L

**ACUTE TOXICITY:** EC<sub>50</sub> (Daphnia 48 hour) 9.88 mg/L

**ACUTE TOXICITY:** EC<sub>50</sub> (marine/estuarine invertebrates 96 hour) ~1 mg/L

**OVERALL FRESHWATER AQUATIC TOXICITY: Highly Toxic**

**BIOACCUMULATION POTENTIAL:** Does not bioaccumulate.

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants and fish may be adversely affected if the product is applied directly to the plants, or indirectly to water as the result of drift or leaching.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >=5000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rat) >2000 mg/kg

**ACUTE INHALATION:** LC<sub>50</sub> (rabbit 4-hour) >3.624 mg/L

**OVERALL TOXICITY: Category III – Slightly Toxic**

### CHRONIC TOXICITY:

**CARCINOGENICITY:** Not likely to be carcinogenic to humans.

**DEVELOPMENTAL/REPRODUCTIVE:** Some developmental and maternal toxicity in the offspring of pregnant rats, but not rabbits, characterized by decreased fetal and maternal body weights at 200 mg/kg/day.

**MUTAGENICITY:** No concerns for mutagenicity.

**HAZARD:** The end-use product labels for the indaziflam formulation Esplanade® 200 SC herbicide carries the *Caution* signal word due to harm if swallowed, inhaled, or absorbed through the skin. Avoid contact with skin, eyes, and clothing. Avoid breathing spray mist.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** No symptoms known or expected.

### CHRONIC TOXICITY:

REPORTED EFFECTS: No symptoms known or expected.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

Indaziflam (*Esplanade<sup>®</sup> 200 SC Herbicide*) – **CAUTION!** – HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH THE SKIN OR INHALED.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks and chemical-resistant gloves.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a physician or poison control center immediately.

**SKIN:** Take off contaminated clothing and shoes immediately. Wash off immediately with plenty of water for at least 15 minutes. Call a physician or poison control center immediately.

**INGESTION:** Call a physician or poison control center immediately. Rinse out mouth and give water in small sips to drink. DO NOT induce vomiting unless directed to do so by a physician or poison control center. Never give anything by mouth to an unconscious person. Do not leave victim unattended.

**INHALATION:** Move to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth if possible. Call a physician or poison control center immediately.

**GENERAL ADVICE:** When possible, have the product container or label with you when calling a poison control center or doctor or going for treatment.

**HANDLING, STORAGE AND DISPOSAL:** Handle and open container in a manner as to prevent spillage. Maintain exposure levels below the exposure limit through the use of general and local exhaust ventilation. Store in a cool, dry place and in such a manner as to prevent cross contamination with other crop protection products, fertilizers, food, and feed. Store in original container and out of the reach of children, preferably in a locked storage area. Protect from freezing. Do not reuse or refill this container. Triple rinse or pressure rinse container promptly after emptying. Offer for recycling, if available, or puncture and dispose of in a sanitary landfill.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Collect and transfer the product into a properly labelled and tightly closed container. Clean contaminated floors and objects thoroughly, observing environmental regulations.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**LOEC** – lowest observed effect concentration

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa** – Pascal (unit of pressure)

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## **IX. INFORMATION SOURCES**

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Bayer Environmental Science, Esplanade® 200 SC, Package Label, 80878486

Bayer Environmental Science, Esplanade® 200 SC, Safety Data Sheet, SDS Number 102000023686, Version 2.1, June 14, 2016

New York State, Department of Environmental Conservation, Registration of the New Active Ingredient Indaziflam as Contained in Alion Herbicide (EPA Reg. No. 264-1106), Esplanade 200 SC (EPA Reg. No. 432-1516), and Marengo (EPA Reg. No. 432-1518) and the Withdrawal of Specticle 20 WSP (EPA Reg. No. 432-1499), October 05, 2012

USEPA, Pesticide Fact Sheet, Conditional Registration, July 26, 2010

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
<b>I (Highly Toxic)</b>	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
<b>II (Moderately Toxic)</b>	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
<b>III (Slightly Toxic)</b>	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
<b>IV (Practically Non-toxic)</b>	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD <sub>50</sub> (mg/kg)	Avian Acute Oral LD <sub>50</sub> (mg/kg)	Avian Acute Dietary LC <sub>50</sub> (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, February 2020.**



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# Isoxaben

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** isoxaben

**CHEMICAL NAME:** N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6dimethoxybenzamide and isomers

CAS No. 82558-50-7

**CHEMICAL TYPE:** benzamide family

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the *Federal Register* on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the imazapyr formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the isoxaben formulation are listed below:

Gallery 75 DF®	Isoxaben	75%
	Inert	25%

**RESIDUE ANALYTICAL METHODS:** Information not available.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Industrial sites, utility substations, highways.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Isoxaben is used for pre-emergence control of certain broadleaf weeds in non-cropland areas. Does not control established weeds.

**MODE OF ACTION:** Isoxaben inhibits cell wall biosynthesis. Susceptible plants are killed prior to emergence.

**METHOD OF APPLICATION:** Isoxaben, a pre-emergence herbicide, is applied during planting and in established turf grasses/ open areas at an application rate of 0.66 to 1.66 pounds per acre.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Isoxaben, a pre-emergent weed herbicide, is applied during germination of the target plant. Isoxaben is also registered for use in established turf grasses to prevent growth of unwanted weeds.

**DRIFT CONTROL:** Isoxaben is mixed with water and applied using low-pressure sprayers. Isoxaben can be applied to dry soil, as water does not affect the effectiveness of the herbicide. Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** Isoxaben residual activity is reported not to exceed 6 months under normal application rates.

**ADSORPTION:** Isoxaben has a K(oc) of 1400 and is moderately adsorbed onto soils.

**PERSISTENCE AND AGENTS OF DEGRADATION:** The half-life of isoxaben in the soil is 100 days.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Information not available.

### WATER:

**SOLUBILITY:** Less than 1.0 mg/l water.

**POTENTIAL FOR LEACHING INTO SURFACE OR GROUND WATER:** There is a low potential for leaching into surface and groundwater.

### AIR:

**VOLATILIZATION:** Isoxaben is slightly volatile at  $<3.9 \times 10^{-7}$  mm Hg at 77° F.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information is not available; however, the formulated product will emit toxic vapors as it burns.

## IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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### MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD<sub>50</sub> (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

### AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) 1.1 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) 1.1 mg/l

**OVERALL TOXICITY: Moderately Toxic**

### AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (*Daphnia magna* 48-hour) >100 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

### AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (sheepshead minnow 96-hour)

ACUTE TOXICITY: LC<sub>50</sub> (grass shrimp 96-hour)

ACUTE TOXICITY: LC<sub>50</sub> (eastern oyster 96-hour)

**OVERALL TOXICITY: Practically Non-Toxic** (Based on freshwater data, imazapyr is not expected to be toxic to estuarine invertebrates.)

### TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (bobwhite quail)

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (mallard duck)

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (bobwhite quail) >5000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (mallard duck) >5000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) >5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

**BIOACCUMULATION POTENTIAL: Little Potential**

**THREATENED AND ENDANGERED SPECIES:** Isoxaben may be a hazard if applied to pre-emerging endangered plants and if applied directly to waters containing endangered aquatic plant life. There is an indication that isoxaben may interfere with reproduction and may cause birth defects in animals.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2000 mg/kg

**PRIMARY IRRITATION SCORE:** Slight

**PRIMARY EYE IRRITATION:** Moderate. The formulated product may cause moderate eye irritation, which may be slow to heal. May cause slight temporary corneal injury.

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >2.68 mg/l

**OVERALL TOXICITY:** Category III – Caution – Slightly Toxic

### CHRONIC TOXICITY:

**CARCINOGENICITY:** Isoxaben is considered slightly oncogenic. In addition, the formulated product contains crystalline silica (in kaolin), which is listed as a known carcinogen.

**DEVELOPMENTAL:** Unknown effects.

**REPRODUCTIVE:** Has been shown to interfere with reproduction in animals.

**MUTAGENICITY:** Isoxaben has caused birth defects in laboratory animals at doses toxic to the mother.

**HAZARD:** Based on the results of animal studies, isoxaben causes genetic damage and birth defects. There are data that support the finding that isoxaben has potential to have cancer-causing effects on animals.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** None reported.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** Slight skin and eye irritation caused by clay (Kaolin) binding agents. Crystalline silica (in Kaolin) is listed as a carcinogen for hazard communication purposes under 29 CFR 1910.1200.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** There have been no reported effects on workers manufacturing the products.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

**HEALTH RISK MANAGEMENT PROCEDURES:** See Section VII.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

ISOXABEN - **CAUTION** – CAUSES EYE IRRITATION AND HARMFUL IF INHALED.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Use safety glasses. Use impervious gloves when prolonged or frequently repeated contact could occur. In enclosed spaces, use NIOSH-approved dust respirator. Long-sleeved shirt, long pants, shoes, and socks are required for workers.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water; call physician if irritation develops.

**SKIN:** Wash all exposed areas with soap and water. Wash all contaminated clothing prior to reuse. Call a physician if irritation develops.

**INGESTION:** Call a physician or Poison Control Center. Immediately transport to a medical care facility.

**INHALATION:** Remove individual to fresh air. If breathing difficulty occurs, provide CPR assistance and seek immediate medical attention.

**HANDLING, STORAGE AND DISPOSAL:** Keep dry (below 120° F) and store away from food, feed, or other material to be used or consumed by humans or animals. Do not contaminate water. Dispose only in accordance with local, state and federal regulations.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Large spills should be reported to CHEMTREC (800-424-9300) for assistance. Prevent runoff. Do not contaminate water, food or feed by storage or disposal.

## VIII. DEFINITIONS

---

**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth  
**Hg** – chemical symbol for mercury  
**IARC** – International Agency for Research on Cancer  
**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$   
**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects  
**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects  
**leach** – to dissolve out by the action of water  
**mg/kg** – weight ratio expressed as milligrams per kilogram  
**mg/l** – weight-to-liquid ratio expressed as milligrams per liter  
**microorganisms** – living things too small to be seen without a microscope  
**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa – Pascal (unit of pressure)**  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	DANGER (poison)	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	WARNING	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	CAUTION	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	NONE	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals (Acute Oral LD <sub>50</sub> mg/kg)	Avian (Acute Oral LD <sub>50</sub> mg/kg)	Avian LC <sub>50</sub> (mg/kg)	Fish or Aquatic Invertebrates LC <sub>50</sub> (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**



# Mefluidide

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

---

**COMMON NAME:** mefluidide

**CHEMICAL NAME:** N-[2,4-dimethyl-5-[[trifluoromethyl)sulfonyl]amino]phenyl] acetamide

CAS No. 53780-34-0

**CHEMICAL TYPE:** acetamide compound

**PESTICIDE CLASSIFICATION:** plant growth regulator

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the *Federal Register* on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the Embark<sup>®</sup> formulation are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the mefluidide formulations are listed below:

Embark <sup>®</sup>	Mefluidide	3.20%
	Inert	96.80%

**RESIDUE ANALYTICAL METHODS:** Following extraction, mefluidide is derivatized with diazomethane and analyzed by gas chromatography using flame ionization detection.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Embark® is registered as a plant growth regulator to suppress seedhead formation and to regulate the vegetative growth of various turfgrass species and woody ornamentals in commercial, residential, public, and non-cropland areas.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Many, mainly turfgrasses and weeds such as Johnsongrass, shattercane, volunteer corn, and volunteer sorghum.

**MODE OF ACTION:** Mefluidide inhibits the growth and development of the meristematic regions of the affected plants.

**METHOD OF APPLICATION:** Conventional power spray equipment using a non-ionic surfactant. Manufacturer recommends use of colorant to control even application.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Mefluidide must be applied before emergence of seedheads.

**DRIFT CONTROL:** Apply only when conditions will prevent drift to non-target areas and surface waters.

**RESTRICTIONS/WARNINGS/LIMITATIONS:** Do not apply through any type of irrigation system. Do not allow animals to graze treated areas.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** Mefluidide residual activity is reported not to exceed 3 hours after application.

**ADSORPTION:** Mefluidide has a K(oc) of 200. Adsorption of mefluidide after 3 hours, however, is insignificant.

**PERSISTENCE AND AGENTS OF DEGRADATION:** The half-life of mefluidide is 4 days.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Information not available.

### WATER:

**SOLUBILITY:** 180 mg/l water at 23° C (Pure Compound)

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Mefluidide is weakly adsorbed onto soil and organic particles but is not persistent in soils or plants. Leaching into groundwater should be minimal or nonexistent if application methods are followed.

**SURFACE WATERS:** See above.

### AIR:

**VOLATILIZATION:** <13 mPa at 25° C (Pure Compound).

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available.

## IV. ECOLOGICAL TOXICITY EFFECTS TO NON-TARGET SPECIES

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### MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD<sub>50</sub> (honey bee contact) >25 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact may injure or kill target and non-target plants.

### AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) <100 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) <100 mg/l

**OVERALL TOXICITY: Slightly Toxic**

### AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (*Daphnia magna* 48-hour) No information.

**OVERALL TOXICITY: [Not available.]**

### AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC<sub>50</sub> (Eastern oyster larvae 48-hour) No information.

ACUTE TOXICITY: LC<sub>50</sub> (sheepshead minnow 96-hour) No information.

**OVERALL TOXICITY: [Not available.]**

### TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (mallard duck) >4640 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (bobwhite quail) >10,000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (mallard duck) >10,000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) >4000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

### BIOACCUMULATION POTENTIAL: No Potential

**THREATENED AND ENDANGERED SPECIES:** Mefluidide may be a hazard if applied to pre-emerging endangered plants and if applied directly to waters containing endangered aquatic life. It probably would not be a hazard to most endangered terrestrial animals, due to its low toxicity.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

#### ACUTE ORAL TOXICITY

LD<sub>50</sub> (rat) >4000 mg/kg

LD<sub>50</sub> (mice) >1920 mg/kg

#### ACUTE DERMAL TOXICITY:

Rabbit LD<sub>50</sub> >4,000 mg/kg

**PRIMARY IRRITATION SCORE:** none

**PRIMARY EYE IRRITATION:** Mild irritation to rabbits

**ACUTE INHALATION:** LC<sub>50</sub> (rat, 4-hour) >8.5 mg/l.

**OVERALL TOXICITY: Category III – Caution – Slightly Toxic**

### CHRONIC TOXICITY:

**CARCINOGENICITY:** No data.

**DEVELOPMENTAL:** No effects.

**REPRODUCTIVE:** No effects.

**MUTAGENICITY:** No effects.

**HAZARD:** Based on the results of animal studies, mefluidide does not cause genetic damage or birth defects and has little or no effect on fertility, reproduction or development of offspring. There are no data on the potential cancer-causing effects of mefluidide.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** None reported.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** No information available.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** There have been no reported effects on workers manufacturing the products.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

**HEALTH RISK MANAGEMENT PROCEDURES:** See Section VII.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

**MEFLUIDIDE - CAUTION** – HARMFUL IF SWALLOWED OR ABSORBED THROUGH THE SKIN. AVOID BREATHING SPRAY MIST. AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. WEAR PROTECTIVE CLOTHING INCLUDING RUBBER GLOVES WHEN HANDLING.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Use safety glasses. Use impervious gloves when prolonged or frequently repeated contact could occur. Long-sleeved shirt, long pants, shoes, and socks are recommended.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water; call physician if irritation develops.

**SKIN:** Wash all exposed areas with soap and water. Wash all contaminated clothing prior to reuse. Call a physician if irritation develops.

**INGESTION:** Do not induce vomiting. Call a physician or Poison Control Center. Do not wait for symptoms to appear. Immediately transport to a medical care facility.

**INHALATION:** Remove individual to fresh air. If breathing difficulty occurs, provide CPR assistance and seek immediate medical attention.

**HANDLING, STORAGE AND DISPOSAL:** Keep dry and store away from food, feed, or other material to be used or consumed by humans or animals. Do not contaminate water. Dispose only in accordance with local, state and federal regulations.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Large spills should be reported to CHEMTREC (800-424-9300) for assistance. Prevent runoff. Do not contaminate water, food or feed by storage or disposal.

## VIII. DEFINITIONS

---

**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
<b>I (Highly Toxic)</b>	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
<b>II (Moderately Toxic)</b>	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
<b>III (Slightly Toxic)</b>	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
<b>IV (Practically Non-toxic)</b>	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

**TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)**

<b>Risk Category</b>	<b>Mammals (Acute Oral LD<sub>50</sub> mg/kg)</b>	<b>Avian (Acute Oral LD<sub>50</sub> mg/kg)</b>	<b>Avian LC<sub>50</sub> (mg/kg)</b>	<b>Fish or Aquatic Invertebrates LC<sub>50</sub> (mg/l)</b>
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**



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# Metsulfuron-methyl

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

---

**COMMON NAME:** metsulfuron-methyl

**CHEMICAL NAME:** methyl 2-[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]-  
carbonyl]amino]sulfonyl]benzoate

Cas No. 74223-64-6

**CHEMICAL TYPE:** sulfonylurea herbicide

**PESTICIDE CLASSIFICATION:** systemic, selective pre- and post-emergent herbicide

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the Escort® formulation are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the metsulfuron-methyl formulation are listed below:

Escort®

Metsulfuron-methyl	60 %
Inert	40 %

**RESIDUE ANALYTICAL METHODS:** EPA Method 632.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Metsulfuron-methyl as Escort® is registered for use in non-agricultural areas as a general weed and brush control herbicide. For terrestrial use only, however, Escort® is registered for use in floodplains where surface water is not present and in terrestrial areas of deltas and low-lying areas.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Metsulfuron-methyl is a selective herbicide primarily for post-emergent control of annual, biennial, and perennial broadleaf weeds and brush. Escort® does have pre-emergent activity.

**MODE OF ACTION:** Metsulfuron-methyl enters the plant through the root zone and foliage, inhibiting the synthesis of key amino acids.

**METHOD OF APPLICATION AND RATES:** Broadcast and spot spray applications at 1/4 to 4 ounces of formulated product per acre. Ground and aerial application. Do not apply more than 4 ounces/acre/year.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant; however, application may be made at any time the ground is not frozen. As metsulfuron-methyl must move to the root zone to be effective for pre-emergent control, adequate soil moisture is necessary.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**RESTRICTIONS/WARNINGS/LIMITATIONS:** Do not enter or allow others to enter the treated area until sprays have dried. Do not apply through any type of irrigation system. Do not apply directly to water or areas where surface water is present, or to intertidal areas below the mean high water mark. Do not apply to irrigation banks or other ditch banks. Do not use on lawns. Do not use on walks, driveways, tennis courts, or other impermeable areas. Do not apply to frozen ground. Treated soil should remain undisturbed. Grazing and cut forage restrictions of 3 days post-application at rates of 1-2/3 to 3-1/3 ounces per acre. This herbicide is injurious to plants at extremely low concentrations. Non-target plants may be adversely affected from drift and run-off. Not for use in California.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of metsulfuron-methyl is 120 days.

**ADSORPTION:** The K(oc) of metsulfuron-methyl is 35.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Metsulfuron-methyl is persistent with no major (>10%) degradates.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Metsulfuron-methyl degrades to nonphytotoxic, low-molecular-weight compounds.

## **WATER:**

**SOLUBILITY:** 2790 mg/l in water (pH 7).

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Metsulfuron-methyl is moderately persistent and highly mobile and has potential to enter surface waters from runoff. The very low application rate and microbial breakdown suggest that metsulfuron-methyl has little potential to enter or ground water.

## **AIR:**

**VOLATILIZATION:** Nonvolatile

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

## **IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES**

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### **MICROORGANISMS:**

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee contact) >25 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

### **AQUATIC VERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) >150 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) >150 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

### **AQUATIC FRESHWATER INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (*Daphnia magna* 48-hour) >150 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

### **AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

**ACUTE TOXICITY:** EC<sub>50</sub> (Eastern oyster larvae 48-hour)

**ACUTE TOXICITY:** LC<sub>50</sub> (sheepshead minnow 96-hour)

**OVERALL TOXICITY: Practically Non-Toxic**

### **TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail)

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (mallard duck) >2510 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >5620 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >5620 mg/kg

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

**BIOACCUMULATION POTENTIAL: No Potential**

**THREATENED AND ENDANGERED SPECIES:** Federally listed plants may be adversely affected if the product is applied directly to the plants.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >5000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Mild Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Moderate Irritant

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >5.3 mg/l

**OVERALL TOXICITY:** Category III – Caution

### CHRONIC TOXICITY:

**CARCINOGENICITY:** No effects reported.

**DEVELOPMENTAL/REPRODUCTIVE:** No effects reported.

**MUTAGENICITY:** Not a mutagenic.

**HAZARD:** The end-use product label for Escort<sup>®</sup> carries the *Caution* signal word due to eye irritation.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** None.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None reported..

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** Mild, temporary skin and eye irritation.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

METSULFURON-METHYL - **CAUTION** – CAUSES EYE IRRITATION

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, and shoes plus socks.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water; call physician if irritation persists.

**SKIN:** Wash all exposed areas with soap and water; call physician if irritation persists.

**INGESTION:** No specific intervention is indicated as compound is not likely to be hazardous by ingestion. Consult a physician if necessary.

**INHALATION:** Remove to fresh air.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use  
**half-life** – the time required for half the amount of a substance to be reduced by natural processes  
**herbicide** – a substance used to destroy plants or to slow down their growth  
**Hg** – chemical symbol for mercury  
**IARC** – International Agency for Research on Cancer  
**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$   
**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects  
**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects  
**leach** – to dissolve out by the action of water  
**mg/kg** – weight ratio expressed as milligrams per kilogram  
**mg/l** – weight-to-liquid ratio expressed as milligrams per liter  
**microorganisms** – living things too small to be seen without a microscope  
**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa – Pascal (unit of pressure)**  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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<http://www.infoventures.com/e-hlth/pesticide/pest-fac.html>

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
<b>I (Highly Toxic)</b>	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
<b>II (Moderately Toxic)</b>	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
<b>III (Slightly Toxic)</b>	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
<b>IV (Practically Non-toxic)</b>	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

**TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)**

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**



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# Oryzalin

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** oryzalin

**CHEMICAL NAME:** 3,5-dinitro-N4,N4-dipropylsulfanilamide

CAS No. 019044-88-3

**CHEMICAL TYPE:** 2,6-dinitroaniline

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the oryzalin formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the oryzalin formulation is listed below:

Surflan Herbicide (both formulations)

Oryzalin	40.4%
Inert	59.6%

**RESIDUE ANALYTICAL METHODS:** Pesticide Analytical Method Volume I FDA Multiresidue Protocols D and E.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Oryzalin is registered for commercial and non-commercial application to established lawns, ornamental/shade trees, nonagricultural rights-of-way, power stations, and industrial and paved areas.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Oryzalin is a non-selective, post-emergent herbicide for control of annual grasses, broadleaf weeds, herbaceous plants, woody shrubs and vines.

**MODE OF ACTION:** Oryzalin inhibits cell division.

**METHOD OF APPLICATION:** Oryzalin is applied at an application rate of 0.75 to 6.0 pounds per acre depending on use, formulation and application method.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Oryzalin is a post-emergence herbicide and is applied anytime after emergence of target plants.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Aerial application is not allowed (see below).

**RESTRICTIONS/WARNINGS:** Oryzalin is NOT registered for use on residential lawns. Aerial application is RESTRICTED throughout the U.S., except for agricultural use in California. This herbicide is TOXIC to fish. DO NOT graze or feed forage to livestock in treated areas.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of oryzalin is 20 days.

**ADSORPTION:** The K(oc) of oryzalin is 75.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Degradates of oryzalin have not been monitored.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** The manufacturer has not conducted environmental toxicity studies with the degradates of this product.

### WATER:

**SOLUBILITY:** 2.5 mg/kg at 25 C.

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** The product has low potential to leach into surface and ground water.

### AIR:

**VOLATILIZATION:** Oryzalin is not volatile.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Nitrogen oxides and other toxic gasses may be formed.

## **IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES**

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### **MICROORGANISMS:**

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee 48-hour) >11 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

### **AQUATIC VERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) 3.26 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) 2.88 mg/l

**OVERALL TOXICITY: Moderately Toxic**

### **AQUATIC INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (*Daphnia Magna* 48-hour) 1.4 mg/l

**OVERALL TOXICITY: Moderately Toxic**

**AQUATIC ESTUARINE/MARINE INVERTEBRATES:** Studies not required by EPA. EPA calculates toxicity will be similar to freshwater invertebrates.

### **TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) 506.7 mg/kg

**AVIAN DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >5000 mg/kg

**SMALL MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> >10,000 mg/kg

**OVERALL TOXICITY: Slightly to Practically Non-Toxic**

**BIOACCUMULATION POTENTIAL: LOW POTENTIAL**

**THREATENED AND ENDANGERED SPECIES:** Federally listed aquatic organisms may be at risk in shallow water adjacent to treated areas. In addition, oryzalin may adversely affect federally listed plants.

## **V. TOXICOLOGICAL DATA**

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### **ACUTE TOXICITY:**

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >10,000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2000 mg/kg

**PRIMARY SKIN IRRITATION:** No information available

**PRIMARY EYE IRRITATION:** Rabbit – Slightly Irritating

**ACUTE INHALATION:** LC<sub>50</sub> (rat 4-hour) >3.17 mg/l.

**OVERALL TOXICITY: Category III – Caution – Slightly Toxic**

**CHRONIC TOXICITY:**

**CARCINOGENICITY:** Classified by EPA as a Group C possible human carcinogen based on mammary gland tumors.

**DEVELOPMENTAL:** Reduced maternal and fetal body weight and increased runts and bone development effects at high dose levels.

**REPRODUCTIVE:** Increase in liver and kidney weights and decreased food consumption and body weight gain at high dose levels.

**MUTAGENICITY:** No adverse effects.

**HAZARD:** Sufficient cancer risk is present to require PPE in all application methods, and extended reentry intervals.

## **VI. HUMAN HEALTH EFFECTS**

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**ACUTE TOXICITY (POISONING):**

**REPORTED EFFECTS:** None reported.

**CHRONIC TOXICITY:**

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** Repeated excessive ingestion of propylene glycol may cause central nervous system effects.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** Temporary eye irritation. Prolonged or repeated exposure may cause allergic skin reactions.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

**HEALTH RISK MANAGEMENT PROCEDURES:** See Section VII.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

ORYZALIN - **CAUTION** – AVOID CONTACT WITH EYES SKIN AND CLOTHING. HARMFUL IF SWALLOWED, INHALE, OR ABSORBED THROUGH THE SKIN

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Wear eye protection. Wear long-sleeved shirt, long pants, shoes and socks, and waterproof gloves.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Flush eyes with water; call physician.

**SKIN:** Wash all exposed areas with soap and water. Wash all contaminated clothing prior to reuse. Call a physician if irritation develops.

**INGESTION:** Do not induce vomiting. Call a physician or Poison Control Center. If available, administer activated charcoal (6-8 heaping teaspoonfuls) with a large quantity of water. Do not give by mouth to an unconscious person. Immediately transport to a medical care facility.

**INHALATION:** Remove individual to fresh air. If breathing difficulty occurs, provide CPR assistance and seek immediate medical attention.

**HANDLING, STORAGE AND DISPOSAL:** Keep dry (below 120° F) and store away from food, feed, or other material to be used or consumed by humans or animals. Do not contaminate water. Dispose of only in accordance with local, state and federal regulations.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Large spills should be reported to CHEMTREC (800-424-9300) for assistance. Prevent runoff. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\%$  organic carbon in soil

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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<http://www.epa.gov/oppsrrd1/REDs/>

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER</b> (poison)	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

**TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)**

<b>Risk Category</b>	<b>Mammals (Acute Oral LD<sub>50</sub> mg/kg)</b>	<b>Avian (Acute Oral LD<sub>50</sub> mg/kg)</b>	<b>Avian LC<sub>50</sub> (mg/kg)</b>	<b>Fish or Aquatic Invertebrates LC<sub>50</sub> (mg/l)</b>
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**





## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Oxadiazon is registered for weed control by commercial nursery, turf, and landscape personnel only. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** selective pre-emergent herbicide for control of annual grasses, broadleaf weeds, vines, and brambles.

**MODE OF ACTION:** Inhibits enzyme protoporphyrinogen oxidase.

**METHOD OF APPLICATION AND RATES:** Ground application via granular applicator. Rates adjustable between 2.25 lb and 4.5 lb per 1000 sq ft..

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant and desired results. Weed management is best obtained with late summer to early spring applications.

**DRIFT CONTROL:** Care should be exercised not to over-apply or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and granulator applicator instructions.

#### **Restrictions/Warnings/Limitations:**

T&E toxicity warning for ALL plants.

T&E toxicity warning for aquatic species.

Surface water warning.

Do not use on food or feed crops.

Do not use on areas to be grazed or cut for hay.

Do not use the product to treat irrigation ditches or other channels used for either agricultural or domestic purposes

Do not apply this herbicide via any type of irrigation system.

Do not apply to the foliage of desirable trees or ornamental plants.

### III. ENVIRONMENTAL EFFECTS/FATE

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**SOLUBILITY:** 0.7 mg/l in water (pH 7 at 20° C).

**VAPOR PRESSURE:**  $7.76 \times 10^{-7}$  mm Hg.

**HYDROLYSIS:** Stable.

**PHOTOLYSIS IN WATER:** 3 days.

**PHOTOLYSIS ON SOIL:** NA.

**AEROBIC SOIL METABOLISM: AVERAGE:** 60 days.

**ANAEROBIC SOIL METABOLISM:** Information not available.

**K<sub>OC</sub>:** 1409-3268 depending on soil

**PERSISTENCE AND AGENTS OF DEGRADATION/DISSIPATION:** The primary route of dissipation is photolysis.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** None

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** There is moderate potential for surface water leaching due to the high KOC and moderate half-life. There is low potential to leach into ground water for the same reasons.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### TERRESTRIAL:

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (mallard duck) >1040 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >5000 mg/kg  
LD<sub>50</sub> (bobwhite quail) >5000 mg/kg

**SMALL MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) 3500 to >5000 mg/kg

**OVERALL TERRESTRIAL TOXICITY: Slightly Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

#### **FRESHWATER AQUATIC SPECIES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) 0.88 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) 0.88mg/l

**ACUTE TOXICITY:** EC<sub>50</sub> (Daphnia 48-hour) 2.2 mg/l

**OVERALL FRESHWATER AQUATIC TOXICITY: Highly Toxic**

#### **ESTUARINE/MARINE AQUATIC SPECIES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (sheepshead minnow 96-hour) 1.5 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (mysid shrimp 96-hour) 2.7 mg/l

**OVERALL ESTUARINE/MARINE TOXICITY: Moderately Toxic**

**BIOACCUMULATION POTENTIAL:** Very low to none.

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants, as well as, freshwater and marine aquatic species may be adversely affected if the product is applied directly to plants and surface water.

## **V. TOXICOLOGICAL DATA**

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#### **ACUTE TOXICITY:**

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2000 mg/kg

**ACUTE INHALATION:** LC<sub>50</sub> (rat 4-hour) >2000 mg/l

**OVERALL TOXICITY: Category III – Slightly Toxic**

#### **CHRONIC TOXICITY:**

**CARCINOGENICITY:** Positive (CA Prop 65 List).

**DEVELOPMENTAL/REPRODUCTIVE:** Positive (CA Prop 65 List).

**MUTAGENICITY:** Negative.

**HAZARD:** The end-use product labels for the oxadiazon formulation Ronstar<sup>®</sup> AC and Ronstar<sup>®</sup> G herbicide carries the *Warning* signal word due to moderate eye and skin irritation.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

### CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** Listed on CA Prop 65 List for carcinogenic and developmental toxicity.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** Listed on CA Prop 65 List for carcinogenic and developmental toxicity.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

OXADIAZON (*Ronstar<sup>®</sup> AC and G Herbicide*) - **Warning** – HARMFUL IF INHALED, CAUSES SKIN AND EYE IRRITATION

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks and gloves.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Flush eyes with water for 15 to 20 minutes. Call physician.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation is present.

**INGESTION:** Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly. Do not store at home. Do not store around food or feed.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**LOEC** – lowest observed effect concentration

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## **IX. INFORMATION SOURCES**

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Bayer Environmental Science, Ronstar® G Herbicide, Specimen Product Label, Ron G-SL-081303B, July 1998

Bayer Environmental Science, Ronstar® G Herbicide, Material Safety Data Sheet, MSDS Number 181, Version 2.2, December 2002

California State, Environmental Protection Agency, Chemicals Known to the State to Cause Cancer or Reproductive Toxicity, August 11, 2006

United States, Environmental Protection Agency, Reregistration Eligibility Decision for Oxadiazon, EPA 738-R-04-003, September 2003

Washington State, Department of Transportation, Oxadiazon Roadside Vegetation Management Herbicide Fact Sheet, February 2006

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20,000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.



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**This fact sheet was prepared by USDOE-Bonneville Power Administration, August 2006.**

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# Paclobutrazol

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** paclobutrazol

**CHEMICAL NAME:** (R\*,R\*)-(±)-β-[(4-chlorophenyl)methyl]-α-(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol

CAS No. 76738-62-2

**CHEMICAL TYPE:** Information not available.

**PESTICIDE CLASSIFICATION:** Plant Growth Regulator

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the paclobutrazol formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the paclobutrazol formulation is listed below:

Profile® 2SC Tree Growth Regulator

Paclobutrazol	21.8%
Inert	78.2%

**RESIDUE ANALYTICAL METHODS:** Information not available.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Paclobutrazol is registered for the reduction of terminal growth and pruning volume in trees not used for food production on sites such as utility rights-of-way, urban environments, and residential and non-crop areas.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Paclobutrazol is a non-selective, post-emergent herbicide for control of annual grasses, broadleaf weeds, herbaceous plants, woody shrubs and vines.

**MODE OF ACTION:** Paclobutrazol is a xylem plant growth regulator that slows vegetative growth by inhibiting gibberellin biosynthesis.

**METHOD OF APPLICATION:** Paclobutrazol (as Profile<sup>®</sup>) is applied as a basal soil drench or by soil injection.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Paclobutrazol is a post-emergence growth regulator and is applied anytime after emergence of target plants. Effects may not be noticeable for up to eighteen months.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions.

**RESTRICTIONS/WARNINGS:** Do not apply this product through any type of irrigation system.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of paclobutrazol is 200 days, depending on soil type.

**ADSORPTION:** The K(oc) of paclobutrazol is 400.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Information not available.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:**  
Information not available.

### WATER:

**SOLUBILITY:** 35 mg/l at 25 C

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** The product has high potential to leach into surface and ground water.

### AIR:

**VOLATILIZATION:** Paclobutrazol is slightly volatile.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available.

## IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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### MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD<sub>50</sub> (honey bee contact) >100 µg/bee

OVERALL TOXICITY: **Practically Non-Toxic**

PLANTS: Contact will slow the growth of target and non-target trees.

### AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) 27.8 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) 23.6 mg/l

OVERALL TOXICITY: **Slightly Toxic**

### AQUATIC INVERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (*Daphnia Magna* 48-hour) 33.2 mg/l

OVERALL TOXICITY: **Slightly Toxic**

**AQUATIC ESTUARINE/MARINE INVERTEBRATES:** Studies not required by EPA. EPA calculates toxicity will be similar to freshwater invertebrates.

### TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (mallard duck) 7913 mg/kg

AVIAN DIETARY TOXICITY: LC<sub>50</sub> (mallard duck) >20,000 mg/kg

AVIAN DIETARY TOXICITY: LC<sub>50</sub> (bobwhite quail) >5000 mg/kg

SMALL MAMMAL ACUTE ORAL TOXICITY: LD<sub>50</sub> >2140 mg/kg

OVERALL TOXICITY: **Practically Non-Toxic**

### BIOACCUMULATION POTENTIAL: LOW POTENTIAL

**THREATENED AND ENDANGERED SPECIES:** Due to the low toxicity and method of application, paclobutrazol is not expected to cause adverse effects to federally listed species.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat, female) 1330 mg/kg

ACUTE DERMAL TOXICITY: LD<sub>50</sub> (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Slightly irritating

PRIMARY EYE IRRITATION: Rabbit - Moderately irritating

**ACUTE INHALATION:** LC<sub>50</sub> (rat 4-hour) >250 mg/l.

**OVERALL TOXICITY: Category III – Caution – Slightly Toxic**

**CHRONIC TOXICITY:**

**CARCINOGENICITY:** No adverse effects.

**DEVELOPMENTAL:** Caused birth defects in lab animals at doses toxic to the mother.

**REPRODUCTIVE:** No adverse effects.

**MUTAGENICITY:** No adverse effects.

**HAZARD:** Harmful if swallowed or absorbed through the skin.

## **VI. HUMAN HEALTH EFFECTS**

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**ACUTE TOXICITY (POISONING):**

**REPORTED EFFECTS:** None reported.

**CHRONIC TOXICITY:**

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** Repeated excessive ingestion of propylene glycol may cause central nervous system effects. Commercial bentonite may contain silica gel, which is listed as a potential carcinogen by IARC.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** Temporary eye irritation. Prolonged or repeated exposure may cause allergic skin reactions and lung effects.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

**HEALTH RISK MANAGEMENT PROCEDURES:** See Section VII.

## **VII. SAFETY PRECAUTIONS**

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**SIGNAL WORD AND DEFINITION:**

Paclobutrazol - **CAUTION** – AVOID CONTACT WITH EYES SKIN AND CLOTHING. HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH THE SKIN

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Wear eye protection. Wear long-sleeved shirt, long pants, shoes, socks, and waterproof gloves.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water; call physician.

**SKIN:** Wash all exposed areas in flowing water or shower. Wash all contaminated clothing prior to reuse. Call a physician if irritation develops.

**INGESTION:** Do not induce vomiting. Call a physician or Poison Control Center. Immediately transport to a medical care facility.

**INHALATION:** Remove individual to fresh air. If breathing difficulty occurs, provide CPR assistance and seek immediate medical attention.

**HANDLING, STORAGE AND DISPOSAL:** Keep dry (below 120° F) and store away from food, feed or other material to be used or consumed by humans or animals. Do not contaminate water. Dispose of only in accordance with local, state and federal regulations.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Large spills should be reported to CHEMTREC (800-424-9300) for assistance. Prevent runoff. Do not contaminate water, food, or feed by storage or disposal.

## **VIII. DEFINITIONS**

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa** – Pascal (unit of pressure)  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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Cornell University, Pesticide Management Program, Chemical Fact Sheet No. 62: Paclobutrazol, August 14, 1985

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Dow AgroSciences, Profile® 2SC Specialty Growth Regulator, Material Safety Data Sheet, MSDS: 004433, January 1, 1998

EPRI, Determination of the Effectiveness of Herbicide Buffer Zones in Protecting Water Quality, EPRI Final Report TR-113160, 1999

Extension Toxicology Network, Toxicology Information Briefs: Bioaccumulation, Revised 1993, <http://ace.orst.edu/info/extoxnet/tibs/bioaccum.htm>

Spray Drift Task Force, A Summary of Ground Application Studies, 1997  
<http://www.agdrift.com/publications/Body.htm>

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	DANGER (poison)	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	WARNING	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	CAUTION	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	NONE	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals (Acute Oral LD <sub>50</sub> mg/kg)	Avian (Acute Oral LD <sub>50</sub> mg/kg)	Avian LC <sub>50</sub> (mg/kg)	Fish or Aquatic Invertebrates LC <sub>50</sub> (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.



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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**

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# Picloram

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

---

**COMMON NAME:** picloram (potassium salt)

**CHEMICAL NAME:** 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1-H-imidazol-2-yl]-3-pyridinecarboxylic acid

Cas No. 2545-60-0

**CHEMICAL TYPE:** pyridinecarboxylic acid

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** Restricted Use Pesticide in All States.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the picloram formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the picloram formulation are listed below:

Tordon® 22K Herbicide

Picloram	28.7 %
Inert	71.3 %

**RESIDUE ANALYTICAL METHODS:** EPA Method 600/4-88-039 515.1; 515.2;555.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Picloram is registered for use in non-crop sites for selective and total plant control. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Picloram is used for control woody plants on rights-of-ways and for the control of noxious weeds on rangeland.

**MODE OF ACTION:** Picloram is absorbed by the leaves, bark and roots, interfering with the plant's ability to produce proteins and nucleic acids.

**METHOD OF APPLICATION AND RATES:** Aerial and ground broadcast, spot, and localized applications at 1/4 pint to 1 quart per acre, not to exceed 2 quarts/acre/year (Tordon<sup>®</sup> 22K).

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** For weeds, best results are achieved when the plants are small and actively growing.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**RESTRICTIONS/WARNINGS/LIMITATIONS:** Do not enter the treated area until the spray has dried. Do not apply through any type of irrigation system. Do not graze or feed forage from treated areas for 2 weeks after treatment. Groundwater advisory. Surface water and drift advisory. Non-target plant advisory.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of picloram is 90 days.

**ADSORPTION:** The K(oc) of picloram is 16.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Picloram is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Breaks down into carbon dioxide, oxalic acid, 4-amino-2,3,5-trichloropyridine and 4-amino-3,5-dichloro-6-hydroxypicolinic acid.

### WATER:

**SOLUBILITY:** 200,000 mg/l in water (pH 7 at 25° C).

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Picloram is moderately persistent with a moderate soil adsorption coefficient. There is a very high potential for picloram to leach into groundwater and a high potential for surface water runoff.

### AIR:

**VOLATILIZATION:** No information.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

## IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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### MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD<sub>50</sub> (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

### AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) 13 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) 24 mg/l

**OVERALL TOXICITY: Slightly Toxic**

### AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (*Daphnia magna* 48-hour) 68.3 mg/l

**OVERALL TOXICITY: Slightly Toxic**

### AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC<sub>50</sub> (grass shrimp 96-hour) 306 mg/l

ACUTE TOXICITY: EC<sub>50</sub> (eastern oyster 96-hour) 18 mg/l

**OVERALL TOXICITY: Slightly Toxic**

### TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (mallard duck) >2250 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (bobwhite quail) >2250 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (bobwhite quail) >10,000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (mallard duck) >10,000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) >5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

### BIOACCUMULATION POTENTIAL: Little Potential

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Non-Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Moderate Irritant

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >8.11 mg/l

**OVERALL TOXICITY:** Category III – Slightly Toxic

### CHRONIC TOXICITY:

**CARCINOGENICITY:** EPA Group E - No evidence of human carcinogenicity.

**DEVELOPMENTAL/REPRODUCTIVE:** Body weight gains/losses, abortions, excess salivation.

**MUTAGENICITY:** No adverse effects.

**HAZARD:** The end-use product labels for the picloram formulations carry the *Caution* signal word due to potential eye irritation.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** Damage to central nervous system, weakness, diarrhea and weight loss.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** Liver damage.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** See effects reported under acute toxicity.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported .

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

PICLORAM - **CAUTION** – CAUSES MODERATE EYE IRRITATION.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Flush eyes with water for 15 minutes. Call physician.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation persists.

**INGESTION:** Call physician. Do not induce vomiting.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food or feed by storage or disposal.

## VIII. DEFINITIONS

---

**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram  
**mg/l** – weight-to-liquid ratio expressed as milligrams per liter  
**microorganisms** – living things too small to be seen without a microscope  
**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa – Pascal (unit of pressure)**  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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Dow AgroSciences, Tordon® 22K Specialty Herbicide, Specimen Product Label, Label Code: D02-111-008, February 22, 1999

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<http://www.agdrift.com/publications/Body.htm>

USDA Forest Service, Pesticide Fact Sheet, Picloram, November 1995  
<http://www.fs.fed.us/foresthealth/pesticide/index.html>

USEPA, Office of Pesticide Programs, Reregistration Eligibility Decision, Picloram, EPA-738-R-95-019, August 1995  
<http://www.epa.gov/oppsrrd1/REDs/>

USEPA, Office of Pesticide Programs, R.E.D. Facts, Picloram, EPA-738-F-95-018, August 1995

## X. TOXICITY CATEGORY TABLES

**TABLE I: HUMAN HAZARDS**

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
<b>I (Highly Toxic)</b>	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
<b>II (Moderately Toxic)</b>	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
<b>III (Slightly Toxic)</b>	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
<b>IV (Practically Non-toxic)</b>	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

**TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)**

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.



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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**

# Prodiamine

## HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

**COMMON NAME:** prodiamine

**CHEMICAL NAME:** N3,N3-Di-n-propyl-2,4-dinitro-6-(trifluoromethyl)-m-phenylenediamine

Cas No. 29091-21-2

**CHEMICAL TYPE:** dinitroaniline

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** General Use Pesticide.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal and no concern were placed on List 4A and 4B, respectively.

The contents of the prodiamine formulation for Barricade® 65WG herbicide are listed below:

Barricade® 65WG Herbicide			
Active Ingredient	prodiamine	65.0 %	Inert ingredients include kaolin clay and a dispersing agent listed as either non-hazardous or proprietary.
Inert Ingredients		35.0 %	

**RESIDUE ANALYTICAL METHODS:** Standard herbicide screening analysis.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Prodiamine is registered for weed control for commercial nurseries, landscaping, Christmas tree farms, turf farms, golf courses, etc. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Pre-emergent control of grasses and broadleaf weeds.

**MODE OF ACTION:** Inhibits mitotic processes.

**METHOD OF APPLICATION AND RATES:** Ground broadcast spray, spot and localized spray applications. The application rate is 0.4 oz per 100 sq ft.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant and desired results. Barricade may be applied as necessary to control target weeds.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger. Tank or hose pressure should not exceed 25 psi.

### Restrictions/Warnings/Limitations:

T&E toxicity warning for ALL plants.

T&E toxicity warning for aquatic species.

Groundwater and surface water warning.

Do not use on food or feed crops.

Do not use on areas to be grazed or cut for hay.

Do not use the product to treat irrigation ditches or other channels used for either agricultural or domestic purposes

Do not apply this herbicide via any type of irrigation system.

Do not apply aurally.

### III. ENVIRONMENTAL EFFECTS/FATE

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**SOLUBILITY:** 0.013 ppm in water at 25° C.

**VAPOR PRESSURE:**  $5.6 \times 10^{-6}$  mm Hg.

**HYDROLYSIS:** Stable.

**PHOTOLYSIS IN WATER:** 30 days.

**PHOTOLYSIS ON SOIL:** 106 days.

**AEROBIC SOIL METABOLISM: AVERAGE:** 106 days.

**ANAEROBIC SOIL METABOLISM:** 19 days.

**K<sub>OC</sub>:** 273.9

**PERSISTENCE AND AGENTS OF DEGRADATION/DISSIPATION:** The primary route of dissipation is photolysis.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** None

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** High dependent on soil type and organic content.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### TERRESTRIAL:

<b>AVIAN ACUTE ORAL TOXICITY:</b>	LD <sub>50</sub> (bobwhite quail) >2250 mg/kg
<b>AVAIN 8-DAY DIETARY</b>	LC <sub>50</sub> (mallard duck) >10,000 mg/kg
<b>HONEY BEE</b>	LC <sub>50</sub> /EC <sub>50</sub> >100 ug/bee
<b>EARTHWORM</b>	Less than 25% mortality (No significant toxicity).
<b>SMALL MAMMAL ACUTE ORAL TOXICITY:</b>	LD <sub>50</sub> (rat) >5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact may injure or kill target and non-target plants.

## FRESHWATER AQUATIC SPECIES:

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) 0.83 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) 0.55mg/l

ACUTE TOXICITY: EC<sub>50</sub> (Daphnia 48-hour) 0.66 mg/l

**OVERALL FRESHWATER AQUATIC TOXICITY: Highly Toxic**

**BIOACCUMULATION POTENTIAL:** Low to no potential.

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants and fish may be adversely affected if the product is applied directly to the plants, or indirectly to water as the result of drift or leaching.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) >5000 mg/kg

ACUTE DERMAL TOXICITY: LD<sub>50</sub> (rat) >2000 mg/kg

ACUTE INHALATION: LC<sub>50</sub> (rat 4-hour) >1.81 mg/l

**OVERALL TOXICITY: Category III – Slightly Toxic**

### CHRONIC TOXICITY:

**CARCINOGENICITY:** Not listed, however, benign thyroid tumors have been reported in rats but not mice.

**DEVELOPMENTAL/REPRODUCTIVE:** Fetal toxicity at high does and developmental and maternal toxicity observed at 1 g/kg/day.

**MUTAGENICITY:** Information not available.

**HAZARD:** The end-use product labels for the prodiamine formulation Barricade® 65WG herbicide carries the *Caution* signal word due to inhalation and skin absorption potential.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

### CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

PRODIAMINE (*Barricade*<sup>®</sup> 65WG Herbicide) - **CAUTION** – HARMFUL IF INHALED OR ABSORBED THROUGH THE SKIN.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks and chemical-resistant gloves.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water for 15 to 20 minutes. Call physician.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation is present.

**INGESTION:** Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**UNUSUAL HAZARD:** *This product is considered electrically conductive. Static electricity, mechanical sparks, open flames, and certain hot surfaces (greater than 680 degree F can serve as ignition sources for this material.*

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**LOEC** – lowest observed effect concentration

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## **IX. INFORMATION SOURCES**

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Syngenta Crop Protection, Inc., Barricade® 65WG Herbicide, Specimen Product Label, SCP 834A-M4C 0504, 2004

Syngenta Crop Protection, Inc., Barricade® 65WG Herbicide, Material Safety Data Sheet, SCP-955-834A-00145P, December 2004



## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20,000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, August 2006.**

# Sethoxydim

## HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

**COMMON NAME:** sethoxydim

**CHEMICAL NAME:** 2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one

Cas No. 74051-80-2

**CHEMICAL TYPE:** cyclohexanedione

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** General Use Pesticide.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal and no concern were placed on List 4A and 4B, respectively.

The contents of the sethoxydim formulation for Poast<sup>®</sup> are listed below:

Poast <sup>®</sup> Herbicide		Inert/Other Ingredients
Active Ingredient	sethoxydim	18 %
Inert/Other Ingredients		
Other		8 %
Naphthalene *		7 %
Petroleum solvent **		74 %

\*CERCLA RQ 179.7 lbs (product)  
 \*IARC Group 2B carcinogen  
 \*RCRA Waste Code U165  
 \*EPA Inert List 3

\*\*EPA Inert List 2

**RESIDUE ANALYTICAL METHODS:** No information available.

## **II. HERBICIDE USES**

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Sethoxydim is registered for use in non-crop sites including industrial sites, rights-of-way, substations, natural areas, wildlife openings, recreation areas, campgrounds, etc. For terrestrial use only.

### **OPERATIONAL DETAILS:**

**TARGET PLANTS:** Selective post-emergence herbicide for control of annual and perennial grasses. This herbicide will not control broadleaf weeds or sedges.

**MODE OF ACTION:** Lipid inhibitor.

**METHOD OF APPLICATION AND RATES:** Ground broadcast spray, spot and localized spray applications. Rates adjustable between 16 and 32 fl oz per acre..

### **SPECIAL PRECAUTIONS:**

**TIMING OF APPLICATION:** Timing is dependent on the target plant and desired results. Total vegetation management is best obtained with early spring applications coupled with later summer treatment for residual control.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger. Tank or hose pressure should not exceed 25 psi.

### **Restrictions/Warnings/Limitations:**

T&E toxicity warning for ALL plants.

T&E toxicity warning for all aquatic species.

Do not apply to any waters.

Do not apply if rain is expected within 1 hour of application.

Do not apply if grasses are under stress, i.e. not growing.

Poast is subject to Clean Water Act regulations for spills/drifts into US waters.

Do not apply to any waters.

Poast is a combustible liquid. Do not store or use near heat or open flame.

DOT regulations apply when transporting 120 gallons or more.

### III. ENVIRONMENTAL EFFECTS/FATE

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**SOLUBILITY:** 4700 mg/l in water (pH 7 at 25° C).

**HYDROLYSIS:** Stable.

**PHOTOLYSIS IN WATER:** 1 hour.

**PHOTOLYSIS ON SOIL:** 4 hours.

**K<sub>OC</sub>:** 100

**MOBILITY-UNAGED LEACHING:** Low.

**MOBILITY-AGED LEACHING:** Non-Persistent.

**PERSISTENCE AND AGENTS OF DEGRADATION/DISSIPATION:** The primary route of dissipation is photolysis.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** None

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Little potential due to non-persistent and relatively immobile characteristics.

**VOLATILIZATION:** Information not available.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### TERRESTRIAL:

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (mallard duck) >2510 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >>5620 mg/kg  
LC<sub>50</sub> (mallard duck) >5620 mg/kg

**SMALL MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >2676 mg/kg

**HONEY BEES (ORAL)** LD<sub>50</sub> >100 ug/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

## FRESHWATER AQUATIC SPECIES:

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) 1.2 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) 100 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (carp 96-hour) 1.6 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (Daphnia 48-hour) >2.6 mg/l

**OVERALL FRESHWATER AQUATIC TOXICITY: Moderately Toxic**

**BIOACCUMULATION POTENTIAL:** Not expected to bioaccumulate in fish tissue.

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants, and, aquatic species may be adversely affected if the product is applied directly to the plants, fish, water and/or indirectly as the result of drift or leaching.

## TOXICITY OF INERT/OTHER INGREDIENTS

### Naphthalene

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) 1.8 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (coho salmon 96-hour) 2.1 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (pink salmon 96-hour) 1.2 mg/l

**OVERALL FRESHWATER AQUATIC TOXICITY FOR NAPHTHALENE: Moderately Toxic**

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) >2676 mg/kg

ACUTE DERMAL TOXICITY: LD<sub>50</sub> (rat) >5000 mg/kg

ACUTE INHALATION: LC<sub>50</sub> (rat) >6.3 mg/l

**OVERALL TOXICITY: Category III – Slightly Toxic**

### CHRONIC TOXICITY:

**CARCINOGENICITY:** No evidence of carcinogenicity in test animals.

**DEVELOPMENTAL/REPRODUCTIVE:** None.

**MUTAGENICITY:** Negative.

**HAZARD:** The end-use product labels for the sethoxydim formulation Poast<sup>®</sup> carries the *Warning* signal word due to moderate eye irritation.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

### CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

### POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None.

### POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:

This product contains a solvent mixture. Solvents, when inhaled, can cause nasal and respiratory irritation and central nervous system effects including dizziness, weakness, fatigue, nausea, headache, and possible unconsciousness and even death. Ingestion of solvents can cause gastrointestinal irritation, nausea, vomiting and diarrhea. Prolonged or repeated dermal exposures may cause drying, scaling, and even blistering of the skin. Aspiration of low viscosity products can cause chemical pneumonitis which can be fatal.

Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage.

Acute exposure to naphthalene by inhalation, ingestion, and dermal contact has been associated with hemolytic anemia, damage to the kidneys, cataracts, and, in infants, brain damage. There is limited evidence of fetal and maternal toxicity from exposure to naphthalene.

Trimethylbenzene may affect the liver and may cause changes in the blood cells and affect the blood's clotting ability. Trimethylbenzene can irritate the lungs. Repeated exposures may cause bronchitis to develop.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** See above.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

SETHOXYDIM (*Poast*<sup>®</sup>) - **WARNING** –CAUSES SUBSTANTIAL BUT TEMPORARY EYE IRRITATION

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks, and chemical-resistant gloves.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Flush eyes with water for 15 to 20 minutes. Call physician.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation is present.

**INGESTION:** Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Combustible liquid do not store near heat or open flame. Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly. DOT regulations apply.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Clean Water Act regulations apply. Notification to federal and state authorities may be required. Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.



## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**LOEC** – lowest observed effect concentration

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## **IX. INFORMATION SOURCES**

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EXTOXNET, Pesticide Information Profiles, Sethoxydim, June 1996

Nature Conservancy, The, Weed Control Methods Handbook, Tu, et al, April 2001

Micro Flo Company, Poast Herbicide, Specimen Product Label, Label Code AD120299, October 2002

Micro Flo Company, Poast Herbicide, Material Safety Data Sheet, Poast Herbicide, October 2002

USDA-Forest Service, Sethoxydim Human Health and Ecological Risk Assessment – Final Report, October 31, 2001

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20,000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

**Disclaimers and Other Legal Information:**

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees, and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2006.**

# Sulfentrazone

## HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

**COMMON NAME:** sulfentrazone

**CHEMICAL NAME:** N-[2,4-dichloro-5-[4-(difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl]phenyl]methanesulfonamide

Cas No. 122836-35-5

**CHEMICAL TYPE:** aryl triazolinone

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** General Use Pesticide.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal and no concern were placed on List 4A and 4B, respectively.

The contents of the sulfentrazone formulation for Portfolio<sup>®</sup> / Authority<sup>®</sup> are listed below:

Portfolio <sup>®</sup> and/or Authority <sup>®</sup> Herbicide		
Active Ingredient	sulfentrazone	75.0 %
Inert Ingredients		32.0 %
The above total contains:		
Surfactant Blend		<12.3 %
Toluene (CAS 108-88-3)*		<2.4 %

\*Toluene:  
EPA Inert List 2  
CA Prop 65  
IARC Group 3  
CERCLA 313 RQ 1000 lb Technical  
RCRA Regulated (Code U220)

**RESIDUE ANALYTICAL METHODS:** No information available.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Sulfentrazone is registered for use in crop and non-crop sites for selective pre- and early post-emergent weed control. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Selective, pre- and early post-emergent herbicide for control of broadleaf weeds, grasses and sedges.

**MODE OF ACTION:** Sulfentrazone control weeds by process of protoporphyrinogen oxidase inhibition (membrane disruption), a mode-of-action commonly referred to as PPO inhibition. Sulfentrazone is primarily taken up by the roots of treated plants. Plants emerging from treated soil turn necrotic and die after exposure to light. Foliar contact causes rapid desiccation and necrosis of exposed plant tissue. Shoot-root soil placement studies indicate that sulfentrazone is primarily absorbed by the roots of the plant following soil applications

**METHOD OF APPLICATION AND RATES:** Ground broadcast spray, spot and localized spray applications. Rates adjustable from 5.33 to 8 ounces per acre.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant and desired results. Total vegetation management is best obtained with early spring applications coupled with later summer treatment for residual control. Rainfall is required to activate this product.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger. Tank or hose pressure should not exceed 25 psi.

### Restrictions/Warnings/Limitations:

T&E toxicity warning for aquatic species (invertebrates).

T&E toxicity warning for ALL plants.

Groundwater/Surface Water Advisory.

Do not apply within 50 feet of wells, other surface waters, or where surface water is, or likely to be, seasonally present.

Do not apply to soils with particles classified as sands or larger with less than 1 % organic matter.

Do not apply this herbicide via any type of irrigation system.

Do not apply by aerial application.

Do not graze or crop treated areas.

### III. ENVIRONMENTAL EFFECTS/FATE

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**SOLUBILITY:**  $7.8 \times 10^2$  mg/l in water (pH 7 at 25° C).

**HYDROLYSIS:** Stable.

**PHOTOLYSIS IN WATER:** Extremely susceptible.

**PHOTOLYSIS ON SOIL:** Stable.

**AEROBIC SOIL METABOLISM: AVERAGE:** 1.5 years

**ANAEROBIC SOIL METABOLISM:** 9 years.

**K<sub>OC</sub>:** 43

**MOBILITY-UNAGED LEACHING:** Very high.

**MOBILITY-AGED LEACHING:** Persistent. The product will partition in the water column and remain very mobile in the soil and water columns.

**PERSISTENCE AND AGENTS OF DEGRADATION/DISSIPATION:** Sulfentrazone is persistent in the plant, soil and water. The primary routes of dissipation are aqueous photolysis and leaching. This product does not degrade through biodegradation

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:**  
Information not available.

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** There is a very high potential for sulfentrazone to leach into groundwater when applied as directed. Sulfentrazone could potentially reach surface waters via spray drift and/or runoff when certain conditions exist.

**VOLATILIZATION:**  $1.0 \times 10^{-9}$  mm Hg.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### TERRESTRIAL:

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> >2250 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> >5620 mg/kg

**SMALL MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> <2000 mg/kg

**OVERALL TOXICITY: Slightly Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

## FRESHWATER AQUATIC SPECIES:

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) >120 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) 93.8 mg/l

ACUTE TOXICITY: EC<sub>50</sub> (Daphnia 48-hour) 0.51 mg/l

**OVERALL TOXICITY: Highly Toxic**

**BIOACCUMULATION POTENTIAL:** Information not available.

**THREATENED AND ENDANGERED SPECIES:** Federally listed freshwater and marine species may be adversely affected if the product is applied directly to water, or indirectly to water as the result of drift or leaching.

Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) 2416 mg/kg

ACUTE DERMAL TOXICITY: LD<sub>50</sub> (rat) >5000 mg/kg

ACUTE INHALATION: LC<sub>50</sub> (rat) >3.6 mg/l

**OVERALL TOXICITY: Category II – Moderately Toxic**

### CHRONIC TOXICITY:

CARCINOGENICITY: No evidence of carcinogenicity in test animals.

DEVELOPMENTAL/REPRODUCTIVE: Some effects at highest dose levels.

MUTAGENICITY: No information available.

**HAZARD:** The end-use product labels for the sulfentrazone formulation Portfolio<sup>®</sup> carries the *Caution* signal word due to potential eye, skin, and inhalation hazards.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

### CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** Information not available.



**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** This product contains toluene.

Inhalation exposure to Toluene may cause irritation of the nose and throat with sneezing, sore throat or runny nose; headache, nausea and weakness; and central nervous system depression with dizziness, confusion, incoordination drowsiness or unconsciousness.

Ingestion of Toluene may cause irritation of the digestive tract with stomach pain, heartburn, nausea, vomiting or diarrhea; however there may be no symptoms at all.

Repeated and/or prolonged inhalation or ingestion exposure to Toluene may cause abnormal liver or kidney function with altered results on blood tests; irregular heart beat with a strange sensation in the chest, "heart thumping", apprehension, lightheadedness, feeling of fainting, dizziness, weakness, sometimes progressing to loss of consciousness and death; or low blood pressure.

Increased susceptibility to the effects of Toluene may be observed in persons with pre-existing disease of the central nervous system. Chromosomal changes in the circulating blood of exposed workers have been reported. The significance of these reports is unclear because of exposure to other substances. Epidemiology studies suggest that overexposure to Toluene may be associated with an increased incidence of neurological effects.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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**SIGNAL WORD AND DEFINITION:**

SULFENTRAZONE (*Portfolio*<sup>®</sup>) - **CAUTION** – HARMFUL IF INHALED OR ABSORBED THROUGH THE SKIN. CAUSES MODERATE EYE IRRITATION. AVOID BREATHING DUST AND SPRAY MIST. AVOID CONTACT WITH SKIN, EYES, AND CLOTHING.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear waterproof gloves, long-sleeved shirt and long pants, shoes plus socks.

**MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water. Call physician.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation persists.

**INGESTION:** Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

---

**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## **IX. INFORMATION SOURCES**

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Du Pont and Company, Authority<sup>®</sup> Herbicide, Specimen Product Label, SL-797 101501, May 21, 2002

Du Pont and Company, Authority<sup>®</sup> Herbicide, Material Safety Data Sheet M0000414, Revised November 4, 2002

USEPA, Pesticide Fact Sheet, Sulfentrazone, Registration of a New Chemical, February 27, 1997

Wilbur-Ellis Company, Portfolio<sup>®</sup> Herbicide, Specimen Product Label, F-010705, January 7, 2005

Wilbur-Ellis Company, Portfolio<sup>®</sup> Herbicide, Material Safety Data Sheet, January 7, 2005

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD <sub>50</sub> mg/kg)	Avian Acute Oral LD <sub>50</sub> (mg/kg)	Avian Acute Dietary LC <sub>50</sub> (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, December 2004.**

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# Sulfometuron-methyl

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

---

**COMMON NAME:** sulfometuron-methyl

**CHEMICAL NAME:** {Methyl 2-[[[(4,6-dimethyl-2-pyrimidinyl)amino]-carbonyl]amino]sulfonyl]benzoate}

Cas No. 74222-97-2

**CHEMICAL TYPE:** sulfonyleurea herbicide

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the Oust<sup>®</sup> formulation are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the sulfometuron-methyl formulation are listed below:

Oust<sup>®</sup>

Sulfometuron-methyl	75 %
Inert	25 %

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Sulfometuron-methyl as Oust<sup>®</sup> is registered for use in non-agricultural areas as a general weed and brush control herbicide. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Sulfometuron-methyl is a selective herbicide primarily for post-emergent control of annual, biennial, and perennial broadleaf weeds and brush. Oust<sup>®</sup> does have pre-emergent activity.

**MODE OF ACTION:** Sulfometuron-methyl enters the plant through the root zone and foliage, inhibiting the synthesis of key amino acids.

**METHOD OF APPLICATION AND RATES:** Broadcast and spot spray applications at 1/4 ounce to 8 ounces of formulated product per acre. Ground or aerial (helicopter only) application. Do not apply more than 8 ounces/acre/year.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Timing is dependent on the target plant. Application may be made at any time the ground is not frozen. As sulfometuron-methyl must move to the root zone to be effective for pre-emergent control, adequate soil moisture is necessary.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**RESTRICTIONS/WARNINGS/LIMITATIONS:** Do not enter or allow others to enter the treated area until sprays have dried. Do not apply through any type of irrigation system. Do not apply directly to water or areas where surface water is present, or to intertidal areas below the mean high water mark. Do not apply to irrigation banks or other ditch banks. Do not use on lawns. Do not use on walks, driveways, tennis courts, or other impermeable areas. Do not apply to frozen ground. Treated soil should remain undisturbed. Grazing and cut forage restrictions of 12 months post-application apply. This herbicide is injurious to plants at extremely low concentrations. Non-target plants may be adversely affected from drift and run-off. Not for use in California.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of sulfometuron-methyl is 20 days.

**ADSORPTION:** The K(oc) of sulfometuron-methyl is 78.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Sulfometuron-methyl is slightly persistent with no major (>10%) degradates.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Sulfometuron-methyl degrades to nonphytotoxic, low-molecular-weight compounds and carbon dioxide.

## **WATER:**

**SOLUBILITY:** 244 mg/l in water (pH 7).

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Sulfometuron-methyl is slightly persistent and slightly mobile and has low potential to enter surface waters from runoff. The very low application rate and microbial breakdown suggest that sulfometuron-methyl has little potential to enter ground water.

## **AIR:**

**VOLATILIZATION:** Nonvolatile.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

## **IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES**

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### **MICROORGANISMS:**

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

### **AQUATIC VERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) >148 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) >150 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

### **AQUATIC FRESHWATER INVERTEBRATES:**

**ACUTE TOXICITY:** LC<sub>50</sub> (*Daphnia magna* 48-hour) >150 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

### **AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

**ACUTE TOXICITY:** EC<sub>50</sub> (Eastern oyster larvae 48-hour)

**ACUTE TOXICITY:** LC<sub>50</sub> (sheepshead minnow 96-hour) >45 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

### **TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >5000 mg/kg

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (mallard duck) >5000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >5620 mg/kg



**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >5000 mg/kg

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

**BIOACCUMULATION POTENTIAL: No Potential**

**THREATENED AND ENDANGERED SPECIES:** Federally listed plants may be adversely affected if the product is applied directly to the plants.

## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5000 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2000 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Slight Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Moderate Irritant

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >5.1 mg/l

**OVERALL TOXICITY:** Category III – Caution

### CHRONIC TOXICITY:

**CARCINOGENICITY:** No effects reported.

**DEVELOPMENTAL/REPRODUCTIVE:** No effects reported.

**MUTAGENICITY:** Not a mutagenic.

**HAZARD:** The end-use product label for Oust<sup>®</sup> carries the *Caution* signal word due to eye irritation.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** Ingestion of large amounts of sulfometuron may cause red cell destruction.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** Reduced red cell count, increased liver weights, increased white cell count, and anemia reported in test animals at highest doses.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported and none expected at application rates.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None reported.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** Mild, temporary skin and eye irritation.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### **SIGNAL WORD AND DEFINITION:**

**SULFOMETURON-METHYL - CAUTION** – CAUSES MODERATE EYE IRRITATION

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water; call physician if irritation persists.

**SKIN:** Wash all exposed areas with soap and water; call physician if irritation persists.

**INGESTION:** Immediately give 2 glasses of water and induce vomiting. Call a physician.

**INHALATION:** Remove to fresh air.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer  
**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$   
**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects  
**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects  
**leach** – to dissolve out by the action of water  
**mg/kg** – weight ratio expressed as milligrams per kilogram  
**mg/l** – weight-to-liquid ratio expressed as milligrams per liter  
**microorganisms** – living things too small to be seen without a microscope  
**mPa** – milli-Pascal (unit of pressure)  
**mutagenicity** – ability to cause genetic changes  
**NFPA** – National Fire Protection Association  
**NIOSH** - National Institute for Occupational Safety and Health  
**NOEL** - no observable effect level  
**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control  
**OSHA** - Occupational Safety and Health Administration  
**Pa – Pascal (unit of pressure)**  
**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied  
**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA  
**PPE** – personal protective equipment  
**ppm** – weight ratio expressed as parts per million  
**residual activity** – the remaining amount of activity as a pesticide  
**T&E** – Threatened and Endangered Species (from the Endangered Species Act)  
**µg** – micrograms  
**volatility** – the tendency to become a vapor at standard temperatures and pressures

## **IX. INFORMATION SOURCES**

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Du Pont Agricultural Products, Escort<sup>®</sup>, Oust<sup>®</sup>, Telar<sup>®</sup> Herbicides, Product Information Bulletin, H-66607, June 1996

Du Pont Agricultural Products, Oust<sup>®</sup> Herbicide, Specimen Product Label, H-63401, March 27, 1998

Du Pont Agricultural Products, Oust<sup>®</sup> Herbicide, Specimen Special Local Need 24© Labeling, H-63740, July 2, 1999

Du Pont Agricultural Products, Oust<sup>®</sup> Herbicide, Material Safety Data Sheet M0000028, May 13, 1998

EPRI, Determination of the Effectiveness of Herbicide Buffer Zones in Protecting Water Quality, EPRI Final Report TR-113160, 1999

Extension Toxicology Network, Pesticide Information Profile, Sulfometuron-methyl, Revised June 1996  
<http://ace.orst.edu/info/extoxnet/pips/ghindex.html>

Extension Toxicology Network, Toxicology Information Briefs: Bioaccumulation, Revised 1993,  
<http://ace.orst.edu/info/extoxnet/tibs/bioaccum.htm>

## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
<b>I (Highly Toxic)</b>	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
<b>II (Moderately Toxic)</b>	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
<b>III (Slightly Toxic)</b>	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
<b>IV (Practically Non-toxic)</b>	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD <sub>50</sub> (mg/kg)	Avian Acute Oral LD <sub>50</sub> (mg/kg)	Avian Acute Dietary LC <sub>50</sub> (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.**

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# Tebuthiuron

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** tebuthiuron

**CHEMICAL NAME:** N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N,N'-dimethylurea

Cas No. 34014-18-1

**CHEMICAL TYPE:** substituted urea

**PESTICIDE CLASSIFICATION:** herbicide

**REGISTERED USE STATUS:** General Use Pesticide. Restricted Use Pesticide in Washington.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the tebuthiuron formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the tebuthiuron formulations are listed below:

Spike <sup>®</sup> 20 P Herbicide	
Tebuthiuron	20 %
Inert	80 %
Spike <sup>®</sup> 80 DF Herbicide	
Tebuthiuron	80 %
Inert	20 %
Spike <sup>®</sup> 80 W Herbicide	
Tebuthiuron	80 %
Inert	20 %

**RESIDUE ANALYTICAL METHODS:** EPA Method 632.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Tebuthiuron is registered for use in non-crop sites for selective and total plant control. For terrestrial use only.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Tebuthiuron is a pre- and post-emergent total herbicidal control for weeds and brush.

**MODE OF ACTION:** Tebuthiuron is absorbed by the roots inhibiting photosynthesis.

**METHOD OF APPLICATION AND RATES:** Aerial and ground broadcast, spot and localized applications at 0.2 to 2.5 lbs./acre.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Just before or during active plant growth.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

**RESTRICTIONS/WARNINGS/LIMITATIONS:** Do not apply more than 1.25 lb./acre of any Spike formulation in areas with less than 20 inches of annual rainfall. Do not apply more than 2.5 lb./acre of any Spike formulation in areas with more than 20 inches of annual rainfall. Do not enter the treated area until the spray has dried. Do not apply through any type of irrigation system. Do not graze or feed forage from treated areas for 2 weeks after treatment. Groundwater advisory. Do not apply within areas identified as groundwater protection zones. Surface water and drift advisory. Non-target plant advisory.

### III. ENVIRONMENTAL EFFECTS/FATE

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#### SOIL:

**RESIDUAL SOIL ACTIVITY:** The half-life of tebuthiuron is 360 days.

**ADSORPTION:** The K(oc) of tebuthiuron is 80.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Tebuthiuron is highly persistent in the plant and soils. The primary route of degradation is microbial activity.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Breakdown products are found in very low concentrations and should be relatively non-toxic.

#### WATER:

**SOLUBILITY:** 2500 mg/l in water (pH 7 at 25° C).

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Tebuthiuron is moderately persistent with a moderate soil adsorption coefficient. There is a very high potential for tebuthiuron to leach into groundwater and a high potential for surface water runoff.

#### AIR:

**VOLATILIZATION:** 0.27 mPa at 25° C.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

### IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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#### MICROORGANISMS:

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee contact) 30 ug/bee

**OVERALL TOXICITY: Slightly Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

#### AQUATIC VERTEBRATES:

**ACUTE TOXICITY:** LC<sub>50</sub> (rainbow trout 96-hour) 87 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) 87 mg/l

**OVERALL TOXICITY: Slightly Toxic**

#### AQUATIC FRESHWATER INVERTEBRATES:

**ACUTE TOXICITY:** LC<sub>50</sub> (*Daphnia magna* 48-hour) 225 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**



## **AQUATIC ESTUARINE/MARINE INVERTEBRATES:**

**ACUTE TOXICITY:** EC<sub>50</sub> (pink shrimp 96-hour) 48 mg/l

**ACUTE TOXICITY:** EC<sub>50</sub> (fiddler crab 96-hour) 320 mg/l

**OVERALL TOXICITY: Slightly Toxic**

## **TERRESTRIAL ANIMALS:**

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (mallard duck) >2500 mg/kg

**AVIAN ACUTE ORAL TOXICITY:** LD<sub>50</sub> (bobwhite quail) >2500 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (bobwhite quail) >5000 mg/kg

**AVIAN SUBACUTE DIETARY TOXICITY:** LC<sub>50</sub> (mallard duck) >5000 mg/kg

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) 644 mg/kg

**OVERALL TOXICITY: Slightly Toxic**

## **BIOACCUMULATION POTENTIAL: Little Potential**

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

## **V. TOXICOLOGICAL DATA**

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### **ACUTE TOXICITY:**

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) 644 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >200 mg/kg

**PRIMARY SKIN IRRITATION:** Rabbit - Slight Irritant

**PRIMARY EYE IRRITATION:** Rabbit – Slight Irritant

**ACUTE INHALATION:** LC<sub>50</sub> (rat) 3.7 mg/l

**OVERALL TOXICITY:** Category III – Slightly Toxic

### **CHRONIC TOXICITY:**

**CARCINOGENICITY:** EPA Group E - Not classifiable as a human carcinogen.

**DEVELOPMENTAL/REPRODUCTIVE:** No adverse effects.

**MUTAGENICITY:** No adverse effects.

**HAZARD:** The end-use product labels for the tebuthiuron formulations carry the *Caution* signal word due to potential eye skin and inhalation hazards.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** Eye irritation, skin irritation, nausea, vomiting, dizziness, sweating, headache and sore throat have been reported.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** See effects reported under acute toxicity.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** None.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** Both Spike 20P and 80W contain kaolin. Kaolin, or crystalline silica, is listed as a carcinogen.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

**TEBUTHIURON - CAUTION** – CAUSES EYE IRRITATION. HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH THE SKIN.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Flush eyes with water for 15 minutes. Call physician.

**SKIN:** Wash all exposed areas with soap and water, call physician if irritation persists.

**INGESTION:** Call physician. Do not induce vomiting.

**INHALATION:** Remove to fresh air. Call a physician if breathing difficulty persists.

**HANDLING, STORAGE AND DISPOSAL:** Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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# Triclopyr

## HERBICIDE FACT SHEET

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U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

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This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

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**COMMON NAME:** triclopyr

**CHEMICAL NAME:** 3,5,6-trichloro-2-pyridinyloxyacetic acid

Cas No. 55335-06-3

Of the parent chemical, four forms are used in herbicide formulations:

ACID: 3,5,6-trichloro-2-pyridinyloxyacetic acid, Cas No. 55335-06-3;  
BEE: 3,5,6-trichloro-2-pyridinyloxyacetic acid, butoxyethyl ester, Cas No. 64700-56-7;  
COLN: 2-[(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid, choline salt, Cas No. 104837-85-8; and  
TEA: 2-[(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid, triethylamine salt, Cas No. 57213-69-1.

**CHEMICAL TYPE:** Pyridinyloxyacetic acids

**PESTICIDE CLASSIFICATION:** Herbicide

**REGISTERED USE STATUS:** General Use Pesticide.

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, the United States Environmental Protection Agency (USEPA) announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. USEPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the triclopyr formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of several examples of herbicide products containing triclopyr are listed below:

Trycera® Herbicide		
Triclopyr (ACID)		29.4 %
Inert		70.6 %
Garlon® 4 Herbicide		
Triclopyr (BEE)		61.6 %
Inert		38.4 %
Garlon® XRT Herbicide		
Triclopyr (BEE)		83.9 %
Inert		16.1 %
Pathfinder® II Herbicide		
Triclopyr (BEE)		13.6 %
Inert		86.4 %
Vastlan® Herbicide		
Triclopyr (COLN)		54.7 %
Inert		45.3 %
Garlon® 3A Herbicide		
Triclopyr (TEA)		44.4 %
Inert		55.6 %

**RESIDUE ANALYTICAL METHODS:** Standard herbicide screening analysis.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** All triclopyr formulations are registered for use in non-crop sites for selective control of woody plants and weeds. Triclopyr BEE is for terrestrial use only. Triclopyr ACID, COLN, and TEA formulations are labeled for aquatic use.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Triclopyr is used to control woody plants and weeds.

**MODE OF ACTION:** Triclopyr is a synthetic mimic of the auxin hormone. It is absorbed by the foliage and roots, and is translocated to fast-growing plant tissues where it deregulates plant growth metabolic pathways, resulting in death of susceptible species.

**METHOD OF APPLICATION AND RATES (ALL FORMULATIONS):** Aerial (helicopter only) and ground broadcast, spot, and localized applications in rights-of-way not to exceed 9 lbs a.e./ acre per single application or per year



## SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Apply foliar treatment anytime plant is growing. Bark treatments can be applied any time. Dormant stem applications are made when the plant is dormant.

**DRIFT CONTROL:** Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions.

**RESTRICTIONS/WARNINGS/LIMITATIONS:** Do not apply through any type of irrigation system. Non-target plant advisory. Grazing, haying, and slaughter restrictions (see individual labels).

## III. ENVIRONMENTAL EFFECTS/FATE

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Note: Tank mixes of triclopyr (COLN) and triclopyr (TEA) rapidly or instantaneously dissolve and dissociate into the triclopyr (ACID) form (plus triethylamine and choline portions). Triclopyr (BEE) typically converts to the triclopyr (ACID) form (plus butoxyethanol portion) in less than 1 day via aerobic/anaerobic metabolism in soil and aquatic systems. Triclopyr (ACID) (which forms from triclopyr BEE, COLN, and TEA) is a weak acid that will dissociate into the triclopyr anion at pH values that are typical in the environment. The triclopyr anion is expected to be the predominant portion present in the environment when any of the four forms of triclopyr are used. The environmental effects/fate information below will focus on the triclopyr (ACID) and (BEE) forms.

### SOIL:

#### RESIDUAL SOIL ACTIVITY:

	Triclopyr (ACID) half-life (days)	Triclopyr (BEE) half-life (days)
Soil Photolysis (25°C, pH 7, Loam)	Stable	No data
Aerobic Soil Metabolism (25°C)	13 (clay) to 21 (sandy clay loam)	0.2 (loam) to 0.6 (sandy loam)
Anaerobic Soil Metabolism (25°C)	69 (clay) to 170 (sandy loam)	No data

**ADSORPTION:** The  $K_{(oc)}$  of triclopyr (BEE) is 780. The mean  $K_{(oc)}$  of triclopyr (ACID), and by extension triclopyr (COLN) and triclopyr (TEA), is 59.2, and ranges between 25 and 134 depending on the soil type and soil pH.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Triclopyr (BEE) and (TEA) are moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

#### METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:

Butoxyethanol, trimethylamine and choline are not considered toxicological residues of concern because they rapidly dissociate by microbial degradation. There are two major breakdown products (>10% formation): 3,5,6-trichloro-2-pyridinol (TCP) and 3,6-dichloro-2-pyridinol (3,6-DCP). TCP is a slightly to moderately persistent degradate (estimated half-life of 20 to 70 days) that forms in aerobic/anaerobic soil and aquatic systems. 3,6-DCP is a degradate that forms in some anaerobic soil systems and aerobic aquatic systems. There is evidence that 3,6-DCP is relatively stable in the conditions in which it is present. There are several minor breakdown products that may be formed in very small amounts (<10% formation). 5-Chloropyridin-2-ol (5-CLP) and 6-Chloropyridin-2-ol (6-CLP) are considered minor breakdown products; however, 5-CLP and 6-CLP (combined) were observed as a major degradate in one aerobic aquatic study (Max 26%) and were also shown to be relatively stable.

## **WATER:**

**SOLUBILITY:** Triclopyr (ACID): 440 mg/l (25° C)  
Triclopyr (BEE): 7.4 mg/l (25° C).  
Triclopyr (COLN): Dissolves in seconds  
Triclopyr (TEA): 412,000 mg/l (25° C).

**POTENTIAL FOR GROUNDWATER LEACHING AND SURFACE WATER RUNOFF:** Triclopyr (ACID) , and by extension triclopyr (COLN) and triclopyr (TEA), has a moderate potential to leach into groundwater and a low potential for surface water runoff. Triclopyr (BEE) has a low potential to leach into groundwater and a moderate potential for surface water runoff.

## **AIR:**

**VOLATILIZATION:** Triclopyr ACID, BEE, and TEA are considered non-volatile (vapor pressures from  $3.6 \times 10^{-7}$  to  $3.6 \times 10^{-6}$  torr). There is no data available for triclopyr (COLN).

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Not known.

## **IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES**

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Note: For the reasons described in the environmental effects/fate section above, information below will focus on the triclopyr (ACID) and (BEE) forms, including the TCP degradate, unless otherwise noted.

### *FOR TRICLOPYR ACID AND BEE (INCLUDING TCP DEGRADATE)*

#### **MICROORGANISMS (ACUTE CONTACT TOXICITY):**

##### **HONEY BEE:**

ACID, LD<sub>50</sub>: >100 ug/bee  
BEE (97.7%), LD<sub>50</sub>: >100 ug/bee  
TCP degradate: No Data

##### **OVERALL TOXICITY:**

**ACID: PRACTICALLY NON-TOXIC**  
**BEE: PRACTICALLY NON-TOXIC**  
**TCP DEGRADATE: NO DATA**

#### **PLANTS:**

**CONTACT WILL INJURE OR KILL TARGET AND NON-TARGET PLANTS.**

#### **AQUATIC VERTEBRATES (ACUTE TOXICITY):**

##### **RAINBOW TROUT (96-HR):**

ACID (technical), LC<sub>50</sub>: 117 mg/l  
BEE (96.9%), LC<sub>50</sub>: 0.65 mg/l  
TCP degradate (99.9%), LC<sub>50</sub>: 12.6 mg/l

**BLUEGILL SUNFISH (96-HR):**

ACID (technical), LC<sub>50</sub>: 148 mg/l  
BEE (96.9%), LC<sub>50</sub>: 0.36 mg/l  
TCP degradate (99.9%), LC<sub>50</sub>: 12.5 mg/l

**OVERALL TOXICITY:**

**ACID: PRACTICALLY NON-TOXIC**  
**BEE: HIGHLY TOXIC**  
**TCP DEGRADATE: SLIGHTLY TOXIC**

**AQUATIC FRESHWATER INVERTEBRATES (ACUTE TOXICITY):**

***DAPHNIA MAGNA* (48-HR):**

ACID (technical), EC<sub>50</sub>: 132.9 mg/l  
BEE (96.4%), EC<sub>50</sub>: 12 mg/l  
BEE (96.4%), EC<sub>50</sub>: 1.7 mg/l  
BEE (Garlon 4 Tech., 62.3%), EC<sub>50</sub>: 0.35 mg/l  
TCP degradate (99.9%), EC<sub>50</sub>: 10.4 mg/l

**OVERALL TOXICITY:**

**ACID: PRACTICALLY NON-TOXIC**  
**BEE: SLIGHTLY TOXIC TO HIGHLY TOXIC**  
**TCP DEGRADATE : SLIGHTLY TOXIC**

**AQUATIC ESTUARINE/MARINE INVERTEBRATES (ACUTE TOXICITY):**

**GRASS SHRIMP (96-HR):**

ACID: No Data  
TEA (46.2%) LC<sub>50</sub>: 234 mg/l  
BEE (96.1%), LC<sub>50</sub>: 2.48 mg/l  
BEE (Garlon 4, Tech., 62.4%), LC<sub>50</sub>: 1.7 mg/l  
TCP degradate (99.9%), LC<sub>50</sub>: 83 mg/l

**EASTERN OYSTER 96-HOUR:**

ACID: No Data  
TEA (46.2%), EC<sub>50</sub>: 41.5 mg/l  
BEE (96.1%), EC<sub>50</sub>: 0.46 mg/l  
BEE (Garlon 4 Tech., 62.9%), EC<sub>50</sub>: 0.32 mg/l  
TCP degradate (99.9%), EC<sub>50</sub>: 9.3 mg/l

**OVERALL TOXICITY:**

**ACID: No DATA**  
**TEA: PRACTICALLY NON-TOXIC TO SLIGHTLY TOXIC**  
**BEE: MODERATELY TOXIC TO HIGHLY TOXIC**

**TCP DEGRADATE : SLIGHTLY TOXIC TO MODERATELY TOXIC**

**AVIAN (ACUTE ORAL TOXICITY):**

**MALLARD DUCK:**

ACID (Tech.), LD<sub>50</sub>: 1,698 mg/kg

BEE: No Data

TCP degradate: No Data

**BOBWHITE QUAIL:**

ACID: No Data

BEE (Tech. 96/1%), LD<sub>50</sub>: 735 mg/kg

BEE (Garlon 4, 62.9%), LD<sub>50</sub>: 849.2 mg/kg

TCP degradate (99.9%): LD<sub>50</sub>: >2,000 mg/kg

**OVERALL TOXICITY:**

**ACID: SLIGHTLY TOXIC**

**BEE: SLIGHTLY TOXIC**

**TCP DEGRADATE: PRACTICALLY NON-TOXIC**

**AVIAN (SUBACUTE DIETARY):**

**MALLARD DUCK:**

ACID (Tech., 99.9%), LC<sub>50</sub>: >5,620 mg/kg

BEE (Tech., 93%), LC<sub>50</sub>: >10,000 mg/kg

BEE (96.9%), LC<sub>50</sub>: >5,401 mg/kg

TCP degradate, LC<sub>50</sub>: >5,620 mg/kg

**BOBWHITE QUAIL:**

ACID (Tech.), LC<sub>50</sub>: 2,934 mg/kg

BEE (Tech., 93%), LC<sub>50</sub>: 9,026 mg/kg

BEE (96.9%), LC<sub>50</sub>: 5,401 mg/kg

TCP degradate, LC<sub>50</sub>: No Data

**OVERALL TOXICITY:**

**ACID: PRACTICALLY NON-TOXIC TO SLIGHTLY TOXIC**

**BEE: PRACTICALLY NON-TOXIC**

**TCP DEGRADATE : PRACTICALLY NON-TOXIC**

**BIOACCUMULATION POTENTIAL:**

**ACID: LOW POTENTIAL**

**BEE: HIGH POTENTIAL**

**TCP DEGRADATE: NO DATA**

## V. TOXICOLOGICAL DATA

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### TRICLOPYR (ACID)

#### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (female rats): 1,030 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (female rats): >2,000 mg/kg

**PRIMARY SKIN IRRITATION:** Causes mild skin irritation.

**PRIMARY EYE IRRITATION:** Causes serious eye damage.

**ACUTE INHALATION:** LC<sub>50</sub> (rat): 1.32 mg/l

**OVERALL TOXICITY:** Category I – Highly Toxic

#### CHRONIC TOXICITY:

**CARCINOGENICITY:** EPA Group D - Not classifiable as a human carcinogen.

**DEVELOPMENTAL/REPRODUCTIVE:** Positive for adverse developmental and reproductive effects.

**MUTAGENICITY:** In vitro genetic toxicity studies were negative.

**HAZARD:** The end-use product labels for the triclopyr (ACID) formulations carry the *Danger* signal word due to potential irreversible eye damage.

### TRICLOPYR (BEE)

#### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (female rats): 1,338 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit): >2,000 mg/kg

**PRIMARY SKIN IRRITATION:** Brief contact may cause slight skin irritation with local redness. Repeated contact may cause severe skin irritation with local redness and discomfort.

**PRIMARY EYE IRRITATION:** May cause pain disproportionate to the level of irritation to eye tissues. May cause slight eye irritation. Corneal injury is unlikely.

**ACUTE INHALATION:** LC<sub>50</sub> (rat): >5.2 mg/l

**OVERALL TOXICITY:** Category III – Slightly Toxic

#### CHRONIC TOXICITY:

**CARCINOGENICITY:** EPA Group D - Not classifiable as a human carcinogen.

**DEVELOPMENTAL/REPRODUCTIVE:** In laboratory animal studies, effects on reproduction have been seen only at doses that produced significant toxicity to the parent animals.

**MUTAGENICITY:** In vitro genetic toxicity studies were negative. Animal genetic toxicity studies were negative.

**HAZARD:** The end-use product labels for the triclopyr (BEE) formulations carry the *Caution* signal word due to potential moderate irritation.

### **FOR TRICLOPYR (COLN)**

#### **ACUTE TOXICITY:**

**ACUTE ORAL TOXICITY (FOR SIMILAR MATERIALS):** LD<sub>50</sub> (female rat): 1,000 mg/kg

**ACUTE DERMAL TOXICITY (FOR SIMILAR MATERIALS):** LD<sub>50</sub> (male and female rats): >5,000 mg/kg

**PRIMARY SKIN IRRITATION:** Brief contact is essentially non-irritating to skin.

**PRIMARY EYE IRRITATION:** May cause moderate eye irritation. May cause slight corneal injury.

**ACUTE INHALATION (FOR SIMILAR MATERIALS):** LC<sub>50</sub> (male and female rats): >5.85 mg/l

**OVERALL TOXICITY:** Category II – Moderately Toxic

#### **CHRONIC TOXICITY:**

**CARCINOGENICITY:** EPA Group D - Not classifiable as a human carcinogen.

**DEVELOPMENTAL/REPRODUCTIVE:** In laboratory animal studies, effects on reproduction have been seen only at doses that produced significant toxicity to the parent animals.

**MUTAGENICITY:** In vitro genetic toxicity studies were negative. Animal genetic toxicity studies were negative.

**HAZARD:** The end-use product labels for the triclopyr (COLN) formulations carry the *Warning* signal word due to potential substantial but temporary eye injury.

### **FOR TRICLOPYR (TEA)**

#### **ACUTE TOXICITY:**

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (female rats): 4,100 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (male and female rabbits): >5000 mg/kg

**PRIMARY SKIN IRRITATION:** Brief contact is essentially non-irritating to skin.

**PRIMARY EYE IRRITATION:** May cause moderate eye irritation. May cause moderate corneal injury.

**ACUTE INHALATION:** LC<sub>50</sub> (rat): >5.4 mg/l

**OVERALL TOXICITY:** Category I – Highly Toxic

#### **CHRONIC TOXICITY:**

**CARCINOGENICITY:** EPA Group D - Not classifiable as a human carcinogen.

**DEVELOPMENTAL/REPRODUCTIVE:** In laboratory animal studies, effects on reproduction have been seen only at doses that produced significant toxicity to the parent animals.

**MUTAGENICITY:** In vitro genetic toxicity studies were negative. Animal genetic toxicity studies were negative.

**HAZARD:** The end-use product labels for the triclopyr (TEA) formulations carry the *Danger* signal word due to corrosive potential irreversible eye damage.

## VI. HUMAN HEALTH EFFECTS

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### **ACUTE TOXICITY (POISONING):**

**REPORTED EFFECTS:** Severe eye irritation and skin irritation.

### **CHRONIC TOXICITY:**

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** See effects reported under acute toxicity.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** Kerosene is an ingredient in Triclopyr (BEE). In a lifetime animal dermal carcinogenicity study, an increased incidence of skin tumors was observed when kerosene was applied at doses that also produced skin irritation. This response was similar to that produced in skin by other types of chronic chemical/physical irritation. No increase in tumors was observed when non-irritating dilutions of kerosene were applied at equivalent doses, indicating that kerosene is unlikely to cause skin cancer in the absence of long-term continued skin irritation.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** Triclopyr (ACID) and triclopyr (TEA) are severe eye irritants. Triclopyr (COLN) is a moderate eye irritant.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

## VII. SAFETY PRECAUTIONS

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### SIGNAL WORD AND DEFINITION:

TRICLOPYR (ACID) - **DANGER** – CORROSIVE. CAUSES IRREVERSIBLE EYE DAMAGE. HARMFUL IF SWALLOWED OR ABSORBED THROUGH SKIN. PROLONGED OR FREQUENTLY REPEATED SKIN CONTACT MAY CAUSE ALLERGIC REACTION IN SOME INDIVIDUALS.

TRICLOPYR (BEE) - **CAUTION** – HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH THE SKIN.

TRICLOPYR (COLN) - **WARNING** – MAY BE FATAL IF SWALLOWED. CAUSES SUBSTANTIAL BUT TEMPORARY EYE INJURY. PROLONGED OR FREQUENTLY REPEATED SKIN CONTACT MAY CAUSE ALLERGIC REACTIONS IN SOME INDIVIDUALS.

TRICLOPYR (TEA) - **DANGER** – CORROSIVE. CAUSES IRREVERSIBLE EYE DAMAGE. HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH THE SKIN. PROLONGED OR REPEATED CONTACT WITH THIS HERBICIDE MAY CAUSE ALLERGIC SKIN REACTIONS

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Applicators and other handlers must wear protective eyewear (ACID, COLN, and TEA), protective gloves (chemical resistant), long-sleeved shirt and long pants, shoes and socks.

### MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

**EYES:** Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

**SKIN:** Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

**INGESTION:** Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow (ACID, COLN, and TEA only). Do not induce vomiting unless told to do so by the poison control center or doctor. Never give anything by mouth to an unconscious person.

**INHALATION:** Move person to fresh air. If person is not breathing, call an emergency responder or ambulance, then give artificial respiration; if by mouth to mouth use rescuer protection (pocket mask etc). Call a poison control center or doctor for treatment advice.

**HANDLING:** ALL: Keep away from heat, sparks and flame. Keep out of reach of children. Do not swallow. No smoking, open flames or sources of ignition in handling and storage area. Do not get in eyes. Avoid contact with skin and clothing. Avoid breathing vapor or mist. Use with adequate ventilation. Wash thoroughly after handling. Keep container closed. TEA: Containers, even those that have been emptied, can contain vapors. Do not cut, drill, grind, weld, or perform similar operations on or near empty containers. Electrically ground and bond all equipment. Vapors are heavier than air and may travel a long distance and accumulate in low lying areas. Ignition and/or flash back may occur. Use of non-sparking or explosion-proof equipment may be necessary, depending upon the type of operation.

**STORAGE:** ALL: Store in a dry place. Store in original container. Keep container tightly closed when not in use. Do not store near food, foodstuffs, drugs or potable water supplies. ACID: Store at temperatures above 28 °F. BEE: Avoid temperatures below -10 °C. TEA: Minimize sources of ignition, such as static build-up, heat, spark or flame.



**DISPOSAL:** If wastes and/or containers cannot be disposed of according to the product label directions, disposal of this material must be in accordance with your local or area regulatory authorities. This information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations. If the material as supplied becomes a waste, follow all applicable regional, national and local laws.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. Spills or discharge to natural waterways is likely to kill aquatic organisms. Contain spilled material if possible. Small spills: Absorb with materials such as: Clay. Dirt. Sand. Sweep up. Collect in suitable and properly labeled containers. Large spills: Contact manufacturer for clean-up assistance.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa** – Pascal (unit of pressure)

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

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## X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	<b>DANGER</b> (poison)	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dietary LC <sub>50</sub> (mg/kg)	Acute Concentration LC <sub>50</sub> (mg/l)
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

**Disclaimers and Other Legal Information:**

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees, and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

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**This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000, Updated March 2022.**

# Trinexapac-ethyl

## HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

### I. BASIC INFORMATION

**COMMON NAME:** trinexapac-ethyl

**CHEMICAL NAME:** 4-(cyclopropyl-a-hydroxymethylene)-3,5-dioxo-cyclohexanecarboxylic acid ethylester

CAS No. 95266-40-3

**CHEMICAL TYPE:** Cyclopropyl Derivative of Cyclohexenone

**PESTICIDE CLASSIFICATION:** Plant Growth Retardant

**REGISTERED USE STATUS:** "General Use."

**FORMULATIONS:** Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the trinexapac-ethyl formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the two trinexapac-ethyl formulations are listed below:

Primo WSB <sup>®</sup>	Trinexapac-ethyl	25%
	Inert	75%
Primo Liquid <sup>®</sup>	Trinexapac-ethyl	12%
	Inert	88%

**RESIDUE ANALYTICAL METHODS:** Information not available.

## II. HERBICIDE USES

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**REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES:** Registered as a growth retardant for grasses.

### OPERATIONAL DETAILS:

**TARGET PLANTS:** Trinexapac-ethyl is used to regulate the growth of many types of grasses.

**MODE OF ACTION:** Foliar uptake reduces cell growth.

**METHOD OF APPLICATION:** Low-pressure sprayers at various application rates (see label). Do not apply through any type of irrigation system.

### SPECIAL PRECAUTIONS:

**TIMING OF APPLICATION:** Various (see label), however, as trinexapac-ethyl is a foliar growth retardant, it must be applied to emerged plants to be effective.

**DRIFT CONTROL:** Trinexapac-ethyl is applied mixed with water/surfactant. Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas.

**RESTRICTIONS/WARNINGS/LIMITATIONS:** Do not apply through any type of irrigation system. Do not graze area or feed forage after application.

## III. ENVIRONMENTAL EFFECTS/FATE

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### SOIL:

**RESIDUAL SOIL ACTIVITY:** Information not available.

**ADSORPTION:** Information not available.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Information not available.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:**  
Information not available.

### WATER:

**SOLUBILITY:** 2.11 mg/l at 20° C.

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** Information not available.

### AIR:

**VOLATILIZATION:** 0.003 Pa at 20° C.

**POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION:** Information not available; however, Primo Liquid<sup>®</sup> is a NFPA Class IIIA combustible liquid.

## IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

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### MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD<sub>50</sub> (honey bee contact) >100 µg/bee

**OVERALL TOXICITY: Practically Non-Toxic**

**PLANTS:** Contact will injure or kill target and non-target plants.

### AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC<sub>50</sub> (rainbow trout 96-hour) 68 mg/l

ACUTE TOXICITY: LC<sub>50</sub> (bluegill sunfish 96-hour) >130 mg/l

**OVERALL TOXICITY: Slightly Toxic**

### AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: EC<sub>50</sub> (*Daphnia magna* 48-hour) 142.5 mg/l

**OVERALL TOXICITY: Practically Non-Toxic**

### AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC<sub>50</sub> (grass shrimp 96-hour) No information.

ACUTE TOXICITY: EC<sub>50</sub> (eastern oyster 96-hour) No information.

**OVERALL TOXICITY:**

### TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (mallard duck) >2000 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD<sub>50</sub> (bobwhite quail) >2250 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (bobwhite quail) >5620 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC<sub>50</sub> (mallard duck) >5200 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD<sub>50</sub> (rat) >5000 mg/kg

**OVERALL TOXICITY: Practically Non-Toxic**

### BIOACCUMULATION POTENTIAL: Little Potential

**THREATENED AND ENDANGERED SPECIES:** Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.



## V. TOXICOLOGICAL DATA

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### ACUTE TOXICITY:

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >5050 mg/kg

**ACUTE DERMAL TOXICITY:** LD<sub>50</sub> (rabbit) >2020 mg/kg

**PRIMARY IRRITATION SCORE:** Slight

**PRIMARY EYE IRRITATION:** Moderate

**ACUTE INHALATION:** LC<sub>50</sub> (rat) >2.7 mg/l

**OVERALL TOXICITY: Category III – Caution – Slightly Toxic** (dry formulations)

**OVERALL TOXICITY: Category II – Warning – Moderately Toxic** (liquid formulations)

### CHRONIC TOXICITY:

**CARCINOGENICITY:** Increase in stomach tumors in male mice at 2000-ppm dose rate.

**DEVELOPMENTAL:** None observed.

**REPRODUCTIVE:** None observed.

**MUTAGENICITY:** None observed.

**HAZARD:** Based on the results of animal studies, trinexapac-ethyl may cause an increase in carcinogenicity. Tests on dogs show liver, kidney and brain effects (unspecified) at >5000 ppm doses.

## VI. HUMAN HEALTH EFFECTS

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### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** None reported.

### CHRONIC TOXICITY:

**REPORTED EFFECTS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS:** None reported.

**POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS:** Slight eye irritation caused by clay binding agents.

**HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS:** There have been no reported effects on workers manufacturing the products.

**HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS:** None reported.

**HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS:** None reported.

**HEALTH RISK MANAGEMENT PROCEDURES:** See Section VII.

## **VII. SAFETY PRECAUTIONS**

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### **SIGNAL WORD AND DEFINITION:**

*Dry formulations*

**TRINEXAPAC-ETHYL - CAUTION** – HARMFUL IF ABSORBED THROUGH THE SKIN OR INHALED. CAUSES MODERATE EYE IRRITATION. AVOID CONTACT WITH EYES, SKIN OR CLOTHING AND BREATHING DUST OR SPRAY MIST.

*Liquid formulations*

**TRINEXAPAC-ETHYL - WARNING** – CAUSES EYE IRRITATION. DO NOT GET IN EYES. HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN. AVOID CONTACT WITH SKIN OR CLOTHING. AVOID BREATHING VAPOR OR SPRAY MIST.

**PROTECTIVE PRECAUTIONS FOR WORKERS:** Use safety glasses. Use impervious gloves when prolonged or frequently repeated contact could occur. In enclosed spaces, use NIOSH-approved dust respirator. Long sleeve shirt, long pants, shoes and socks are recommended. Do not enter treated areas without shoes until sprays have dried.

### **MEDICAL TREATMENT PROCEDURES (ANTIDOTES):**

**EYES:** Flush eyes with water; call physician if irritation develops.

**SKIN:** Wash all exposed areas with soap and water. Wash all contaminated clothing prior to reuse. Call a physician if irritation develops.

**INGESTION:** Give large quantity of water and induce vomiting. Call a physician or Poison Control Center. Administer activated charcoal (6-8 teaspoons) with a large amount of water. Immediately transport to a medical care facility.

**INHALATION:** Move to fresh air. Provide artificial respiration if necessary. Call physician if breathing difficulty continues.

**HANDLING, STORAGE AND DISPOSAL:** Keep dry and store away from food, feed or other material to be used or consumed by humans or animals. Do not contaminate water. Dispose of only in accordance with local, state and federal regulations. Primo Liquid® is a NFPA Class IIIA combustible liquid.

**EMERGENCY SPILL PROCEDURES AND HAZARDS:** Contain and sweep up material of small spills and dispose as waste. Large spills should be reported to CHEMTREC (800-424-9300) for assistance. Prevent runoff. Do not contaminate water, food or feed by storage or disposal.

## VIII. DEFINITIONS

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**adsorption** – the process of attaching to a surface

**avian** – of, or related to, birds

**CAEPA** – California Environmental Protection Agency

**carcinogenicity** – ability to cause cancer

**CHEMTREC** – Chemical Transportation Emergency Center

**dermal** – of, or related to, the skin

**EC<sub>50</sub>** - median effective concentration during a bioassay

**ecotoxicological** – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

**FIFRA** – Federal Insecticide, Fungicide and Rodenticide Act

**formulation** – the form in which the pesticide is supplied by the manufacturer for use

**half-life** – the time required for half the amount of a substance to be reduced by natural processes

**herbicide** – a substance used to destroy plants or to slow down their growth

**Hg** – chemical symbol for mercury

**IARC** – International Agency for Research on Cancer

**K(oc)** – the tendency of a chemical to be adsorbed by soil, expressed as:  $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

**LC<sub>50</sub>** – the concentration in air, water, or food that will kill approximately 50% of the subjects

**LD<sub>50</sub>** – the dose that will kill approximately 50% of the subjects

**leach** – to dissolve out by the action of water

**mg/kg** – weight ratio expressed as milligrams per kilogram

**mg/l** – weight-to-liquid ratio expressed as milligrams per liter

**microorganisms** – living things too small to be seen without a microscope

**mPa** – milli-Pascal (unit of pressure)

**mutagenicity** – ability to cause genetic changes

**NFPA** – National Fire Protection Association

**NIOSH** - National Institute for Occupational Safety and Health

**NOEL** - no observable effect level

**non-target** – animals or plants other than the ones that the pesticide is intended to kill or control

**OSHA** - Occupational Safety and Health Administration

**Pa – Pascal (unit of pressure)**

**persistence** – tendency of a pesticide to remain to remain in the environment after it is applied

**pesticides** – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

**PPE** – personal protective equipment

**ppm** – weight ratio expressed as parts per million

**residual activity** – the remaining amount of activity as a pesticide

**T&E** – Threatened and Endangered Species (from the Endangered Species Act)

**µg** – micrograms

**volatility** – the tendency to become a vapor at standard temperatures and pressures

## IX. INFORMATION SOURCES

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## X. TOXICITY CATEGORY TABLES

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TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD <sub>50</sub> (mg/kg)	Acute Dermal LD <sub>50</sub> (mg/kg)	Acute Inhalation LC <sub>50</sub> (mg/l)	Eye irritation	Skin irritation
<b>I (Highly Toxic)</b>	<b>DANGER (poison)</b>	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
<b>II (Moderately Toxic)</b>	<b>WARNING</b>	>50-500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
<b>III (Slightly Toxic)</b>	<b>CAUTION</b>	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
<b>IV (Practically Non-toxic)</b>	<b>NONE</b>	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

**TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)**

<b>Risk Category</b>	<b>Mammals (Acute Oral LD<sub>50</sub> mg/kg)</b>	<b>Avian (Acute Oral LD<sub>50</sub> mg/kg)</b>	<b>Avian LC<sub>50</sub> (mg/kg)</b>	<b>Fish or Aquatic Invertebrates LC<sub>50</sub> (mg/l)</b>
<b>Very Highly Toxic</b>	<10	<10	<50	<0.1
<b>Highly Toxic</b>	10-50	10-50	50-500	0.1 – 1
<b>Moderately Toxic</b>	51-500	51-500	501-1,000	>1 – 10
<b>Slightly Toxic</b>	501-2,000	501-2,000	1,001-5,000	>10 – 100
<b>Practically Non-toxic</b>	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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