

---

# Azafenidin

## 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:** azafenidin

**CHEMICAL NAME:** 2-[2,4-dichloro-5-(2-propynyloxy)phenyl]-5,6,7,8-tetrahydro-1,2,4-triazolo[4,3-a]pyridin-3(2H)-one

CAS No. 68049-83-2

**CHEMICAL TYPE:** triazolone class of herbicides

**PESTICIDE CLASSIFICATION:** selective pre- and postemergent herbicide for broad leaf weeds and grasses.

**REGISTERED USE STATUS:** "Registration Pending."

**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 azafenidin formulation are not classified by EPA as inert ingredients of toxicological concern to humans or the environment.

The contents of the azafenidin formulation is listed below:

Azafenidin	80 %
Inert	20 %

#### **RESIDUE ANALYTICAL METHODS:**

## **II. HERBICIDE USES**

---

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

#### **OPERATIONAL DETAILS:**

**TARGET PLANTS:** Azafenidin is a selective pre- and post-emergent herbicide for control of broadleaf weeds and grasses, including, but not limited to the following: bluegrass, bermudagrass, crabgrass, chickweed, knotweed, milkweed, nettle, nutsedges, ragweed, and Russian thistle.

**MODE OF ACTION:** Inhibits the porphyrin biosynthetic pathway at a site that causes the accumulation of a photodynamic porphyrin intermediate, protoporphyrin IX, resulting in cell membrane disruption.

**METHOD OF APPLICATION AND RATES:** Pre- or post-treatment by a variety of spray application methods, with application rates of 8 to 16 ounces of active ingredient per acre.

#### **SPECIAL PRECAUTIONS:**

**TIMING OF APPLICATION:** Approximately one-half inch of rain is necessary for activation. The Milestone formulation is applied any time but is most effective for pre-emergent treatment. The timing will depend on the 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. Spray droplet size should be 150 microns or larger.

**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.

## **III. ENVIRONMENTAL EFFECTS/FATE**

---

#### **SOIL:**

**RESIDUAL SOIL ACTIVITY:** The half-life of azafenidin is 4 to 129 days.

**ADSORPTION:** The K(oc) of azafenidin is 186 to 579 depending on soil pH and soil types.

**PERSISTENCE AND AGENTS OF DEGRADATION:** Not known.

**METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS:** Not known.

#### **WATER:**

**SOLUBILITY:** 18 mg/kg in water.

**POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER:** The product has low potential to leach into surface and ground water due to low solubility, high K(oc) and relatively rapid field and soil dissipation.

**AIR:**

**VOLATILIZATION:**  $2.1 \times 10^{-10}$  mm Hg at 25° C

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

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

---

**MICROORGANISMS:**

**ACUTE ORAL TOXICITY:** LD<sub>50</sub> (honey bee 48-hour) >20 µg/bee

**ACUTE CONTACT TOXICITY:** LD<sub>50</sub> (honey bee 48-hour) >100 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) 33 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (bluegill sunfish 96-hour) 48 mg/l

**ACUTE TOXICITY:** LC<sub>50</sub> (sheepshead minnow 96-hour) >25 mg/l

**OVERALL TOXICITY: Slightly Toxic**

**AQUATIC INVERTEBRATES:**

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

**OVERALL TOXICITY: Slightly Toxic**

**TERRESTRIAL ANIMALS:**

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

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

**MAMMAL ACUTE ORAL TOXICITY:** LD<sub>50</sub> (rat) >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) >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.

## V. TOXICOLOGICAL DATA

---

### ACUTE TOXICITY:

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

LD<sub>50</sub> (rat) >5000 mg/kg (Milestone™)

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

LD<sub>50</sub> (rabbit) >5000 mg/kg (Milestone™)

**PRIMARY SKIN IRRITATION:** Rabbit - Not an Irritant (Technical and Milestone™)

**PRIMARY EYE IRRITATION:** Rabbit – Not an Irritant (Technical and Milestone™)

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

LC<sub>50</sub> (rat) >5.5 mg/l (Milestone™)

**OVERALL TOXICITY:** Awaiting final registration by EPA.

### CHRONIC TOXICITY:

**CARCINOGENICITY:** Not listed or classified by EPA or CAEPA as a carcinogen.

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

**MUTAGENICITY:** No effects reported.

**HAZARD:** Awaiting final registration by EPA.

## VI. HUMAN HEALTH EFFECTS

---

### ACUTE TOXICITY (POISONING):

**REPORTED EFFECTS:** Ingestion may cause liver toxicity and anemia.

### 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

---

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

AZAFENIDIN - **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**

---

Du Pont Agricultural Products, Milestone® Herbicide, Material Safety Data Sheet M0000386, January 22, 1998

Du Pont Agricultural Products, Milestone® Herbicide Technical Bulletin H-76229, October 1997

Du Pont Agricultural Products, Milestone® Herbicide Technical Bulletin H-81910, March 1999

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.

**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.

This document is copyrighted by the USDOE-BPA. USDOE-BPA retains all rights under all conventions, but permits free reproduction by all providing that full credit is given to USDOE-BPA in citing this publication, sources and date of publication, and, that such reproduction is not distributed or redistributed for profit.

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