

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[®] 2 EC Herbicide are listed below:

Select [®] 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

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

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_o: 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: 7.14×10^{-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

TERRESTRIAL:

AVIAN ACUTE ORAL TOXICITY: LD₅₀ (bobwhite quail) >2000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC₅₀ (bobwhite quail) >6000 mg/kg

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

HONEY BEES (ORAL) LD₅₀ >100 ug/bee

HONEY BEES (DERMAL) LD₅₀ >100 ug/bee

EARTHWORM ACUTE TOXICITY LD₅₀ 454 mg/kg soil

SMALL MAMMAL ACUTE ORAL TOXICITY: LD₅₀ (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: LC₅₀ (rainbow trout 96-hour) 16 mg/l

ACUTE TOXICITY: LC₅₀ (bluegill sunfish 96-hour) 13 mg/l

ACUTE TOXICITY: EC₅₀ (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: LC₅₀ (rainbow trout 96-hour) 1.8 mg/l

ACUTE TOXICITY: LC₅₀ (coho salmon 96-hour) 2.1 mg/l

ACUTE TOXICITY: LC₅₀ (pink salmon 96-hour) 1.2 mg/l

OVERALL FRESHWATER AQUATIC TOXICITY FOR NAPHTHALENE: Moderately Toxic

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD₅₀ (rat) >2920 mg/kg

ACUTE DERMAL TOXICITY: LD₅₀ (rat) >5000 mg/kg

ACUTE INHALATION: LC₅₀ (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[®] 2 EC carries the *Warning* signal word due to moderate eye irritation.

VI. HUMAN HEALTH EFFECTS

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

SIGNAL WORD AND DEFINITION:

CLETHODIM (*Select*[®] 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

EC₅₀ - 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: $K(oc) = \text{conc. adsorbed}/\text{conc. dissolved}/\% \text{ organic carbon in soil}$

LC₅₀ – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD₅₀ – 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

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[®] 2 EC Herbicide, Specimen Product Label, Label Code: 2002-SEL-00002, October 2002

Valent USA Corporation, Select[®] 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 ₅₀ (mg/kg)	Acute Dermal LD ₅₀ (mg/kg)	Acute Inhalation LC ₅₀ (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 ₅₀ (mg/kg)	Acute Oral LD ₅₀ (mg/kg)	Acute Dietary LC ₅₀ (mg/kg)	Acute Concentration LC ₅₀ (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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