2,4-D

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: 2,4-D

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

Acids and Salts

Cas No. 2008-39-1 and 1928-43-4

Esters

Cas No. 25168-26-7

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, 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 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

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.

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

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of 2,4-D is from less than one day to several weeks.

ADSORPTION: The K(oc) of 2,4-D is 19.6 to 109.1.

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

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: 2,4-D degrades to many less toxic chemicals.

WATER:

SOLUBILITY: 3.39×10^{4} mg/l in water (pH 7 at 25° C).

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: 1.4×10^{-7} mm Hg at 25° C.

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

IV. Ecological Toxicity Effects on Non-Target Species

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) 1.1 - >240 mg/l

Acute Toxicity: LC_{50} (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_{50} (*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_{50} (Dungeness crab 96-hour) >10.0 mg/l
Acute Toxicity: LC_{50} (brown shrimp 96-hour) >2.0 mg/l

Overall Toxicity: Moderately Toxic - Slightly Toxic (Depending on Formulation)

Terrestrial Animals:

Avian Acute Oral Toxicity: LD_{50} (various birds) 472 - >2000 mg/kg

Avian Subacute Dietary Toxicity: LC_{50} (various birds) >1000 mg/kg

Mammal Acute Oral Toxicity: LD_{50} (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

Acute Toxicity:

Acute Oral Toxicity: LD_{50} (rat) >50 - >5000 mg/kg

Acute Dermal Toxicity: LD_{50} (rabbit) >2000 -20,000 mg/kg

Primary Skin Irritation: Rabbit - Slight - Non-Irritant

Primary Eye Irritation: Rabbit – Severe Irritant - Slight Irritant

Acute Inhalation: LC_{50} (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.

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

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

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

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_{50} - 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) = conc. adsorbed/conc. dissolved/% organic carbon in soil

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

LD_{50} – 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, Weedmaster® Herbicide, Specimen Product Label, NVA 97-4-69-0117, 1997

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Cornell University, Pesticide Active Ingredient Fact Sheet, 2,4-D, March 11, 1998
http://pmep.cce.cornell.edu/profiles/index.html

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

Rhone-Poulenc Ag Company, WEEDONE® 638 Broadleaf Herbicide, Specimen Product Label, November 4, 1998

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

USDA Forest Service, Pesticide Fact Sheet, 2,4-D, November 1995 http://www.fs.fed.us/foresthealth/pesticide/index.html

Walters, Johanna, California Department of Pesticide Regulation, Environmental Fate of 2,4-Dichlorophenoxyacetic Acid, 1998

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 Acute Oral LD_{50} mg/kg)	Avian Acute Oral LD_{50} (mg/kg)	Avian Acute Dietary LC_{50} (mg/kg)	Fish or Aquatic Invertebrates 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.

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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