United States
Department of
Agriculture

Forest Service
Pacific Northwest Region

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Triclopyr

Herbicide Information Profile

This information profile is produced by the USDA Forest Service, Pacific Northwest Region, for employees, forest workers, and for the public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions for the herbicide triclopyr and its formulations. A list of definitions is included in Section VIII of the information profile. For general information on herbicide use by the Forest Service, refer to the PNW Region Treatment Methods Profile for Herbicides.

The PNW Region Final Environmental Impact Statement (FEIS) for Managing Competing and Unwanted Vegetation; Forest Service "Herbicide Background Statement: Triclopyr;" and product labels and Material Safety Data Sheets are the principal sources of information and conclusions in this profile. Information from other sources is specifically referenced in the profile.

I. Basic Information

Common Name: Triclopyr

Chemical Name: [(3,5,6-trichloro-2-pyridinyl)oxy]-acetic acid

Product Names: Garlon 3A®; Garlon 4®; Pathfinder II®

Registered Use Status: "General Use"

Formulations: Formulated triclopyr products contain one or more substances besides triclopyr itself. These substances are called inert ingredients, because they do not kill plants by themselves. The identities of inert ingredients are not usually listed on the label.

DowElanco manufactures all the products discussed in this profile. The manufacturer revealed the identity of all inerts to U.S. Environmental Protection Agency (EPA). The Forest Service has asked the manufacturer to identify inert ingredients for public disclosure in this profile. The manufacturer did not reveal the identity of inert ingredients listed as "surfactants," and "emulsifiers" in Garlon® formulations (DowElanco a 1992). The inert ingredients in Pathfinder II® are described as a single solvent that is a naturally-derived, nonpetroleum oil (DowElanco f 1996). This solvent is classified by EPA on Inert List #4, which is described as slightly toxic or non-toxic (DowElanco g 1995). Where the identity of inerts is not available, this profile may not fully characterize possible hazards to human health and the environment associated with the triclopyr formulation.

Garlon 3A®

Triclopyr, as the triethylamine salt	44.4%
Inert ingredients:	55.6%
Water	
Surfactants	
Ethanol	

Garlon 4®

Triclopyr, as the butoxyethyl ester	61.6%
Inert ingredients:	38.4%
Kerosene	
Emulsifiers	

Pathfinder II®

Triclopyr, as the butoxyethyl ester	13.6%
Inert ingredients:	86.4%
Nonpetroleum natural oil solvent	

Tests reported for triclopyr involve the acid form of the herbicide. Other tests used triclopyr amine, which is found in Garlon 3A®, or triclopyr butoxyethyl ester, found in Garlon 4®, and Pathfinder II®.

The results of formulation tests reported in this profile apply only to Garlon 3A®, Garlon 4®, and Pathfinder II®. Other formulated products contain both triclopyr and another herbicide. Information in this profile does not address possible effects of these formulated herbicide mixtures.

Residue Assay Methods: Gas/liquid chromatography methods are available for residue assay. The manufacturer cites these detection limits for the methods it has developed and shared with other analytical laboratories:

Water	1 ppb
Soil	10 ppb
Plants	50 ppb

(DowElanco d Undated.)

II. Herbicide Uses

Registered Forestry, Rangeland, Right-of-Way Uses: Control of woody plants and broadleaf weeds on right-of-way, non-crop areas, non-irrigation ditch banks, forests, wildlife openings, rangeland, and permanent grass pastures.

Operational Details:

Target Plants: Triclopyr is used to control woody plants and broadleaf weeds. Triclopyr does not injure grasses at recommended rates.

Mode of Action: Plants respond to triclopyr as if it were a growth hormone; triclopyr interferes with normal plant growth processes. It is absorbed by green bark, leaves, roots, and cut stem surfaces and moves throughout the plant. Triclopyr accumulates in the meristem (growth region) of the plant.

Method of Application: Ground or aerial foliage spray, basal bark and stem treatment, cut surface treatment, tree injection. Pathfinder II® is purchased as a ready-to-use product; no further additives or mixing are required. Additional oil, water, and/or surfactants must be mixed with the other triclopyr herbicides before use.

Use Rates: 0.25 to 9 pounds acid equivalent per acre.

Special Precautions:

Always read all of the information on the product label before using any pesticide. Read the label for application restrictions.

Use Restrictions: For triclopyr products discussed in this profile, livestock grazing and hay production are restricted in treated areas. These restrictions are intended to prevent residues of triclopyr in meat and milk that may exceed EPA standards. Time limits and application rates vary among products. Consult the product label for exact restrictions when planning for or applying triclopyr products where grazing occurs.

Timing of Application: For foliar treatment, apply triclopyr during active plant growth. Basal bark and cut surface treatments can be applied at any time of the year. Dormant stem application can only be done when trees and brush are dormant.

Drift Control: Apply triclopyr only when there is little or no hazard of spray drift. Do not allow spray to come in contact with broadleaf crops. Spray only when wind speed is low. Avoid fine spray, which may drift.

III. Environmental Effects/Fate

Soil:

Residual Soil Activity: Triclopyr is absorbed by plant roots, but it is not considered effective as a soil-applied herbicide. When soil from a recent clearcut was treated with Garlon 4®, the germination of soil-stored seed was inhibited at tricolpyr concentrations of 50 mg/kg and completely stopped at concentrations of 500 mg/kg (SERA, Inc. 1996a). These concentrations represent approximately 10 and 100 times respectively the soil concentrations of triclopyr actually measured after forestry applications (SERA, Inc. 1996b).

Adsorption: Triclopyr is adsorbed primarily to organic matter particles in soil. The organic matter content is the primary factor in the degree of soil adsorption. Adsorption of triclopyr is generally characterized as "not strong."

Persistence and Agents of Degradation: Microorganisms degrade triclopyr readily. It degrades more rapidly under warm, moist conditions which favor microbial activity. Persistence varies widely, depending on soil type and climate. Half-lives for triclopyr in western Oregon soils have been reported from 75 to 81 days (Norris 1987). This study found detectable triclopyr residues in soil 477 days after treatment.

Metabolites/Degradation Products and Potential Environmental Effects: TCP (3,5,6-Trichloro-2-pyridinol) is the major initial product of degradation. TCP is also a major degradation product of chlorpyrifos, an insecticide. Reported half-lives for TCP range from 8 to 279 days in tests on 15 soil types. TMP is another degradate; it is found less often, and in smaller amounts. Reported half-lives for TMP range from 50 to 300 days in three soils. Carbon dioxide has been identified as one final degradation product; other degradates were not identified.

Water:

Solubility: Triclopyr solubility was recently reported to be 430-440 ppm. The PNW Region FEIS rating would be "Low" solubility. Garlon 4® and Pathfinder II® (esters) are not soluble in water; Garlon 3A® (amine) is highly soluble.

Potential for Leaching into Ground-Water: The potential for triclopyr leaching increases as soil organic matter decreases, and as climatic conditions reduce soil microbial activity. Triclopyr has some characteristics conducive to leaching behavior. It is not strongly adsorbed to soil particles, and adsorbed molecules may later detach into water moving through the soil. Triclopyr exceeds the threshold for solubility used by EPA (30 ppm) when evaluating potential for leaching into groundwater (U.S. EPA 1986). Long-term forest and pasture field studies found very little indication that triclopyr will leach substantially either horizontally or vertically in loamy soils (SERA, Inc. 1996c).

A trace amount of the metabolite TCP was detected in groundwater at a golf course site. Chlorpyrifos, but not triclopyr, was also detected (Dupuy 1986). In soil leaching tests, little or no triclopyr has been found below surface layers. The metabolites of triclopyr were less mobile than triclopyr itself. Triclopyr contamination of groundwater has not been reported.

Surface Waters: Sunlight rapidly breaks down triclopyr in water. The half-life of triclopyr in water exposed to sunlight ranged from 3 hours to 4.3 days under field conditions (SERA, Inc. 1996d). In western Oregon, triclopyr was detected in runoff nine months after application. Researchers concluded that the triclopyr did not come from upslope sprayed areas. The triclopyr had been sprayed directly onto dry streambeds, which became flowing streams during the rainy season, and carried the triclopyr downstream (Norris 1987).

Air:

Volatilization: Very low. In monitoring of southern Oregon airsheds, trace amounts of triclopyr were detected in less than ten percent of all samples (Bentson and Norris 1989).

Potential for By-Products from Burning of Treated Vegetation: DowElanco reports irritat-

ing vapors from burning Garlon 3A®; nitrogen oxides, hydrogen chloride, and phosgene from Garlon 4®. Pathfinder II® produces fumes, smoke, carbon monoxide, and aldehydes, and additionally, the same gases reported for Garlon 4® (DowElanco c 1990).

Triclopyr was not detected in monitoring of prescribed burns for air pollution and worker exposure after herbicide treatment. Triclopyr was almost completely consumed when burning treated wood under natural fire conditions. Under smoldering conditions, however, 68% of triclopyr was recovered intact in smoke (McMahon and Bush 1990); (Bush, et al. 1987).

IV. Ecological Effects

Please refer to Section X for definitions of ecotoxicological categories.

Non-Target Toxicity:

Soil Microorganisms: Triclopyr did not affect the growth of soil microorganisms up to 500 parts per million (Forest Service 1984). No studies of effects of these triclopyr formulations have been reported.

Plants: Triclopyr is toxic to many broadleaf plants. Even very small amounts of spray may injure some plants.

No effects were noted in aquatic algae from triclopyr concentrations up to 2.6 mg/l (SERA, Inc. 1996e).

Triclopyr residue may be found in edible plant parts; the maximum residue level in berries was reported at 2.4 ppm when harvested six days after treatment (Forest Service 1984). TCP residues have been detected in root crops following application of chlorpyrifos which also degrades to TCP (Chapman 1980).

Aquatic Animals: Triclopyr and its formulations have been tested for acute and subacute toxic effects in fish and invertebrates. Triclopyr is slightly toxic to fish, and from slightly toxic to practically non-toxic to daphnia, an invertebrate. Tested aquatic invertebrates were somewhat less sensitive to triclopyr than were fish (SERA, Inc. 1996f).

Garlon 3A® was consistently less toxic to aquatic animals than triclopyr. Garlon 4® was consistently more toxic; however Garlon 4® rapidly changes to triclopyr in surface waters.

Acute toxic level:

Species	Triclopyr LC50	Garlon 3A® LC50	Garlon 4® LC50
frog (tadpole)			>1.2 ppm[a]
trout	117 ppm[d] 8.4 ppm[b]	420 ppm[b]	2.7 ppm[b]
salmon	7.8 ppm[b]	275 ppm[b]	1.4 ppm[b]
bluegill	148 ppm[d]		
daphnia	133 ppm[d]		1.2 ppm[c] (EC50)

(a: Berrill 1994; b: Wan 1987; c: Servizi 1987; d: DowElanco d undated. All are 96-hour exposures except a: 48 hours.)

Tests of Garlon 3A® reproductive/developmental effects in minnows and Daphnia showed no effects from long-term exposure (DowElanco d undated).

Garlon 4® has been observed to cause behavioral (neurological) changes that may affect survivability in frog tadpoles (Berrill 1994) and in salmon fry when exposed to 1/4 to 1/2 of lethal levels. Triclopyr acid accumulated in fish tissues during the exposure. Reversibility was not studied, but associated behavioral effects were reversible in uncontaminated water (Morgan 1991); (Johansen 1990). Physiological stress was not observed during other tests of long-term exposure of salmon fry to Garlon 3A® and Garlon 4® (Janz 1990).

Terrestrial Animals: Triclopyr is slightly toxic to mammals and to birds. Triclopyr is practically non-toxic to bees. Acute toxic level of triclopyr:

Species	LD50
mammals	310-713 mg/kg
ducks	1,698 mg/kg

48-hour contact toxicity to bees = >60 micrograms/bee.

In eight day dietary studies in birds, the LC50 for triclopyr ranged from 2,935 ppm to greater than 5,000 ppm. The formulations were less toxic than triclopyr itself to birds in both acute toxic and dietary studies .

No tests of formulations for acute toxicity to wildlife mammals have been reported. Triclopyr and its formulations have not been tested for chronic effects in wildlife mammals.

Populations of several native mammals and birds were studied for several years following triclopyr, prescribed burning, and combination treatments in oak-savanna woodlands. Populations for all species showed either no change or increase following treatments. The one statistically significant physiological effect was an increase in thymus gland weight. A direct correlation to effects of triclopyr is not possible because weight increases were also observed for burned areas where herbicide was not applied (SERA, Inc. 1996g).

In mammals, most triclopyr is excreted, unchanged, in the urine. Triclopyr has been observed to concentrate slightly in ovaries of laboratory animals given repeated doses. No accumulation was observed in other tissues. The authors concluded that triclopyr and its metabolites are likely to have a low potential to accumulate upon repeated exposure (Timchalk et al. 1990).

Threatened and Endangered Species: Triclopyr may be a hazard to endangered plant species if it is used in areas where they live. EPA has not determined whether triclopyr could be a hazard to endangered animal species.

V. Health Effects Testing

The data are results of laboratory animal studies. These data have been evaluated by the Forest Service and are used to make inferences relative to human health.

For triclopyr and DowElanco formulations containing triclopyr as the only active ingredient (Garlon 3A®, Garlon 4®, and Pathfinder II®), findings are from studies conducted by the manufacturer. These studies have been presented to EPA to support product registration, but may not be available to the public.

Formulation tests are noted for each category of acute toxicity. Numerical results are only noted for tests of formulations which showed significantly greater toxicity than triclopyr alone.

Acute Toxicity:

Acute Oral Toxicity: In tests in rats, the acute oral median lethal dose was 630 to 729 mg/kg. Slightly Toxic (Category III).

All formulations listed in this profile have been tested and found to be less toxic than triclopyr itself.

Acute Dermal Toxicity: Median Lethal Dose in rabbits:

Triclopyr >2,000 mg/kg
Slightly Toxic (Category III).

All listed formulations have been tested and found to be no more toxic than triclopyr itself.

Primary Eye Irritation: tests in rabbits:

Triclopyr
Slight to moderate irritant (Toxicity Category III to IV).

All formulations may cause skin irritation from prolonged or repeated exposure. Garlon 3A® may cause a burn. Garlon 4® and Pathfinder II® are considered potential skin sensitizers (DowElanco c 1990).

Primary Eye Irritation: tests in rabbits:

Triclopyr
Slight eye irritant (Category III).

Garlon 4® and Pathfinder II® are slightly irritating to eyes. Undiluted Garlon 3A® is severely irritating and injurious to eyes (Category I).

Acute Inhalation: In tests in rats, exposure to 5.34 ppm of triclopyr for one hour caused no adverse effects (Toxicity Category III).

Garlon 4® caused nasal irritation but no deaths in rats exposed to 0.82 mg/l concentration for four hours.

CHRONIC TOXICITY:

These data are also based on tests in laboratory animals. EPA requires these tests only for the active ingredient triclopyr. No tests of formulations for chronic toxicity have been reported. Please refer to Section X for an explanation of how NOEL (No Observable Effects Level) is calculated.

The Pacific Northwest Region FEIS risk assessment evaluated the quality of the testing that had been done on triclopyr up to 1988. Quality considerations for individual studies included: ranges of doses and species that were tested; length of test; identification of the most sensitive effect. Additionally, the degree of quantitative agreement among all tests for an effect was considered. Please refer to Section X for an explanation of qualitative ratings in this section.

SYSTEMIC TOXICITY:

NOEL for triclopyr: 0.5 mg/kg/day (dog tests) (SERA, Inc. 1996h).

Toxic effects have been observed on liver and kidney functions.

The PNW Region FEIS rated the quality of testing as Marginal-Inadequate.

The NOEL listed in this Profile was reported and accepted by EPA after the FEIS risk analysis.

CARCINOGENICITY/MUTAGENICITY:

Carcinogenicity: Laboratory tests in mice and rats fed up to 30 mg/kg per day for 2 years did not show any evidence of carcinogenicity.

Mutagenicity: Triclopyr was negative in several laboratory tests for mutagenicity (the ability to cause genetic damage), but was weakly positive in one test in rats. Recent tests accepted by EPA were negative for all tested mutagenic effects (SERA, Inc. 1996i).

The PNW Region FEIS rated the quality of testing as Marginally Adequate for these effects.

REPRODUCTION/DEVELOPMENTAL:

Reproduction: A three-generation reproduction study in rats did not show any adverse effects on fertility or reproduction at doses up to 30 mg/kg per day.

Developmental: Laboratory studies with triclopyr acid in pregnant rats (at dose levels up to 200 mg/kg per day) and rabbits (at dose levels up to 100 mg/kg per day) indicated no evidence of teratology (birth defects). In pregnant rats at the 200 mg/kg per day dose level, there were signs of mild toxicity to the fetus.

Doses of 100 to 300 mg/kg/day of ester and amine formulations of triclopyr produced toxic effects in both the mother and fetus (SERA, Inc. 1996j).

The PNW Region FEIS evaluated the testing as Marginally Adequate for these effects.

OTHER POSSIBLE HEALTH EFFECTS

There was insufficient information available to evaluate the potential for effect to the nervous or immune systems. Long-term feeding studies to evaluate systemic toxic effects did not observe signs of nervous system toxicity at the levels at which other toxic effects were noted (SERA, Inc. 1996k). The metabolite TCP was not shown to be neurotoxic, carcinogenic, mutagenic, or to cause birth defects in studies of chlorpyrifos reviewed by EPA in 1984 (for chlorpyrifos) (EPA 1984).

VI. HUMAN HEALTH EFFECTS

FOREST SERVICE EVALUATION OF HUMAN HEALTH RISKS

The Pacific Northwest Region evaluated a range of triclopyr health effects data, including laboratory studies cited in Section V. Both quantitative (numerical) estimates of toxicity, and the quality of data used to make numerical estimates were evaluated.

The FEIS Quantitative Risk Assessment predicts the amount of human exposure—both to project workers and to the public—from typical forestry operations, and also from a large accidental spill. The Risk Assessment used this information to assess health risks from typical uses. These risks were compared to EPA standards of acceptable risk for human health effects. The FEIS risk assessment identified as "Moderate" or "High" any predicted risks from Forest Service operations that were greater than EPA standards. Specific mitigation measures were designed to reduce human exposure from these operations; they are mandatory for every applicable project on National Forest lands.

The complete set of risk ratings is displayed in Section X.

The quality of the existing data affects the reliability of these risk ratings. The FEIS judged the overall quality of available data on triclopyr toxicity to be "Marginal to Inadequate." There were some studies of marginal quality that provided useful information, but studies were inconsistent and some contained flaws. New studies are cited throughout this Profile that add to or change estimates of effects from those used in the FEIS. It is very likely that new studies would change some FEIS estimates of health effects. Very cautious assumptions were made in characterizing risk.

Potential for Health Effects to the Public

Forest visitors and nearby residents could be exposed to herbicide drift, to vegetation with herbicide residues, and to accidental spraying. They also could eat food or drink water containing herbicide residues. No studies of public exposure were available; public doses were estimated based on the behavior of the herbicide in the environment. The "Routine Application" situation estimates maximum possible public exposure under normal operating conditions. The "Large Spill" situation models the highest doses that could be reasonably be expected to occur. Typical public exposures and risks would be much lower than either situation.

Mitigating Measures to Reduce Triclopyr Risks to Public

Consider potential for public exposure when designing contact procedures, posting and signing needs in the Herbicide Application Plan.

"Moderate" risk of general health effects, and of reproductive health effects for people who receive multiple exposures from a large (400 acre) aerial application project. "Low" risk for smaller (40 acre) aerial projects, and for all ground-based applications.

Prevent all public contact with accidental spills (emergency spill notification system, restrict public access to spill site).

"High" risk of general health effects, and "High" risk of reproductive effects if exposed to concentrated triclopyr from a large spill.

Probability of a Worker Receiving a Dose Which Affects General Health or Reproduction

Worker exposure and dose are estimated for typical forestry applications. Studies have measured actual worker doses of herbicide formulations in typical forestry applications using varying levels of applicator protection (Middendorf 1991). In contrast, the worker doses used in the FEIS and this Profile do not account for any reduction in exposure from following safety precautions or mitigating measures (such as wearing protective clothing).

Mitigating Measures to Reduce Identified Triclopyr Risks to Workers

The probability of worker exposure to a toxic concentration for either general health or reproductive effects was rated "Low" or "Negligible" for all application methods except for backpack sprayers, for which risk was rated "Moderate."

In the PNW Region FEIS, Mitigating Measure 13 requires workers applying any herbicide to wear protective clothing. Mitigating Measure 23 requires worker exposure monitoring for all herbicide application projects.

The 1992 Amendment to the PNW Record Of Decision requires workers to review this Information Profile before agreeing to apply triclopyr herbicides. The worker may request reassignment without penalty. Additional personal protective equipment must be available at the worksite for workers who want to reduce their exposure to the herbicide.

ACUTE TOXICITY (POISONING)

Reported Effects: Cases of eye and skin irritation have been reported in workers exposed to triclopyr formulations. Absorption and excretion of triclopyr was measured in human volunteers. Both oral and skin exposures were studied. Orally administered triclopyr was rapidly absorbed and rapidly excreted as unchanged triclopyr in the urine. Triclopyr was slowly and poorly absorbed through human skin. The authors concluded that the potential for triclopyr to bioaccumulate, and the potential to be absorbed through skin to acutely toxic levels are both low. Medical examinations of the volunteers after each test found no treatment-related health effects (Carmichael et al. 1989).

Triclopyr was reported to have been detected in the urine of a Forest Service employee who was mixing herbicides. No health effects were reported (Hoglund 1985).

LONG TERM HUMAN HEALTH EFFECTS:

Reported Effects: There are no reported cases of long term health effects in humans due to triclopyr or its formulations.

Potential for Adverse Health Effects from Inert Ingredients Contained in the Formulated Product: The manufacturer has revealed the identity of some inert chemicals in triclopyr formulations; other inerts are not identified. Specific toxicity information is not available for every inert ingredient. Kerosene, an ingredient of Garlon 4®, was categorized by EPA to have suggestion of toxic effects. All other triclopyr inert ingredients were categorized as either: low priority for health effects testing based on absence of data or a chemical structure suspected to cause toxic effects (List 3); or generally recognized to be safe (List 4).

Garlon 3A® contains one percent ethanol (ethyl alcohol). Pure ethanol causes adverse health effects if swallowed, including neurologic effects, liver effects, toxic effects, birth defects, and reduced male fertility. Information is inadequate to determine potential cancer-causing and mutagenic effects. Exposure to ethanol from triclopyr would be very low in typical forestry operations.

Garlon 4® contains between one and six percent kerosene (SERA, Inc. 1996l). Kerosene may cause lung damage or death if inhaled in liquid form. Kerosene vapors may affect the central nervous system (DowElanco c 1990). Kerosene is a skin irritant. It did not damage DNA or chromosomes in tests, or cause cancer in laboratory animals. Kerosene does contain small amounts of other petroleum compounds that are known to cause cancer. The PNW Region FEIS did not find adequate information to evaluate the risk of health effects from kerosene in Garlon 4® in forestry operations.

The inert ingredients in Pathfinder II® are described as a single solvent that is a naturally-derived, non-petroleum oil (DowElanco f 1996). This solvent is classified by EPA on Inert List #4, which is described as slightly toxic or non-toxic (Dow Elanco g 1995). Available data on this inert are inadequate to evaluate carcinogenicity; laboratory tests for cell mutagenicity yield some positive and some negative results (DowElanco c 1994).

Health Effects Associated with Contaminants: No known contaminants. The potential to form a dioxin-related compound during the manufacture or burning of triclopyr has been speculated. DowElanco reports that this compound has not been detected in triclopyr products, and is not produced upon heating of triclopyr (Rohrer 1984). A consortium of state extension services found there is no possibility of dioxin-family contaminants occurring in triclopyr (Extoxnet undated).

Health Effects Associated with Other Formulations: Some formulations contain triclopyr mixed with the herbicides 2,4-D or picloram. The information Profile for Picloram describes its properties and potential effects. A profile for 2,4-D has not been written. No profile fully describes the potential for health or environmental effects from formulations containing multiple herbicides. Additional information on properties and potential effects of these formulations will be prepared before they are used in the PNW Region.

SOCIETAL PERCEPTIONS:

Public opinion about herbicide use in general ranges

from a perception that herbicides are completely safe, to a perception that they are very hazardous. A full range of opinion is available in the FEIS. The PNW Region has contracted to produce a bibliography of recent anecdotal and scientific accounts, and an analysis of reported worker health effects. This information profile will be updated to reflect the results of these reviews as needed.

VII. Safety Precautions

Signal Word and Definition:

Pathfinder II® and **Garlon 4®** - CAUTION - Harmful if swallowed, inhaled or absorbed through skin.

Garlon 3A® - DANGER - Corrosive. Causes irreversible eye damage. Harmful if swallowed, inhaled, or absorbed through the skin. Prolonged or frequently repeated skin contact with herbicide concentrate may cause an allergic skin reaction in some individuals.

Protective Precautions for Workers: Avoid contact with eyes, skin, or clothing. Avoid contamination of food. Avoid breathing mists or vapors. Wash thoroughly after handling. Remove and wash contaminated clothing before reuse. For Garlon 3A®, wear goggles, face shield, or safety glasses, and rubber gloves when handling.

Medical Treatment Procedures (Antidotes): There is no specific antidote known; treat the symptoms. If swallowed, get medical attention. For exposure to skin, wash with plenty of soap and water. Get medical attention if irritation persists.

For eye exposure to Garlon 3A®, flush with plenty of water for at least 15 minutes. Get medical attention.

For Garlon 3A®, if swallowed, 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. Do not induce vomiting.

In case of emergency, call your local poison control center for advice.

Handling, Storage, and Disposal: Avoid contact with eyes, skin or clothing. Do not ship or store with food, animal feeds, drugs or clothing. Triclopyr formulations are combustible. Do not use or store near heat or open flame. Do not cut or weld container. Triclopyr is stable for at least two years under normal storage conditions. Do not contaminate water by disposal. Dispose of this pesticide according to federal, state, or local procedures.

Emergency (Spill) Hazards and Procedures: Dike large spills. Keep the spill out of streams and water supplies. Absorb small spills with kitty litter or other inert material. Bury material from small spills of Garlon 3A® in non-crop area away from water supplies. For large spills, contact the manufacturer for instructions. Observe all local, state, and federal rules for disposal. In case of a large spill, call CHEMTREC at 1-800-424-9300 for advice.

VIII. Definitions

acute toxicity - the amount of a substance, as a single dose, to cause poisoning in a test animal

adsorption - the process of attaching to a surface

basal treatment - applied to the stem of a plant just above the soil

bioaccumulate - the uptake of a chemical by an organism from its environment.

broadcast application - applied over an entire area

carcinogenicity - ability to cause cancer

chronic toxicity - toxic effect produced in test animals exposed for long periods to a chemical

dermal - of, or related to, the skin

EC50 - the concentration in air or water which will cause a toxic effect in 50% of the subjects

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

half-life - the time required for a chemical to be reduced by natural processes to one half its original amount

herbicide - a substance used to destroy plants or to

slow down their growth

LC50 - the concentration in air or water which will kill 50% of the subjects

LD50 - the dose which will kill 50% of the subjects

leach - to dissolve out by the action of water

mg/kg - milligrams of the substance per kilogram of weight. Equals ppm.

mg/l - milligrams of dissolved substance per liter of water. Equals ppm.

microorganisms - living things too small to be seen without a microscope

mutagenicity - ability to cause genetic changes

non-target - animals or plants other than the ones which the pesticide is intended to kill

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

ppb - parts per billion parts

ppm - parts per million parts. Equal to mg/kg, and mg/l

residual activity - the remaining amount of activity as a pesticide

sensitizer - a delayed allergic response to a substance; symptoms usually resemble an acute toxic response

teratogen - a compound having the property of causing birth defects

volatility - the tendency to become a vapor at relatively low temperature

IX Information Sources:

Pacific Northwest Region, Forest Service, U.S. Department of Agriculture. 1988. ***Final Environmental Impact Statement for Managing Competing and Unwanted Vegetation.***

Chapter IV, Environmental Consequences: Human Health Effects, Characterization and Management of Risk

Appendix C: Herbicide Use and Efficacy

Appendix D: Quantitative Risk Analysis

Appendix H: Qualitative Risk Analysis

Appendix J: Herbicide Review with Wildlife-oriented Effects

Forest Service, U.S. Department of Agriculture. 1984. ***Pesticide Background Statements. Volume 1. Herbicides.*** Agriculture Handbook No. 663.

U.S. Environmental Protection Agency, Office of Ground-Water Protection. 1986. ***Pesticides in Ground Water: Background Document,*** p. 42.

U.S. Environmental Protection Agency, Office of Pesticide Programs. 1984. ***Guidance for the Reregistration of Pesticide Products Containing Chlorpyrifos as the Active Ingredient***, p. 8.

DowElanco Publications:

a. ***Ingredient Lists for Products Containing Triclopyr***, 1992.

b. ***Product Labels: Garlon 3A®, Garlon 4®, Pathfinder®*** , 1994.

c. ***Material Safety Data Sheets: Garlon 3A®; Garlon 4®; Pathfinder®;*** 1994.

d. ***Triclopyr Technical Information Guide.*** Undated.

e. ***Personal communication***, V. Carrithers—DowElanco Technical Representative, 1992.

f. Edmonson, J., DowElanco Product Development Manager. [Letter to John Borrecco, Forest Service Pesticide Use Specialist]. 23 January 1996.

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For more information on triclopyr, contact your local Forest Service office.

X. Toxicity and Risk Categories

Estimates of Health Risks to the public and to workers from Forest Service Operations

The FEIS predicts levels of human exposure (dose) for project workers and for the public, for both a typical field project and for a large accidental spill. These dose levels are compared to the highest dose level in animal tests that showed no health effect (No Observed Effects Level). The risk is ranked from "Negligible" to "High" based on the margin between the expected human dose and the highest NOEL—"no effect" dose. A "High" risk rating means that the highest NOEL dose is not more than ten times larger than predicted human dose under the specified conditions. A "Moderate" risk rating means that the highest NOEL dose is between 10 and 100 times larger than the expected human dose.

Estimated Health Risks To The Public

Situation	General Health	Reproduction
Routine Large Aerial Application	Moderate	Moderate
Routine Application Other	Low	Low
Large Spill	High	High

Estimated Health Risks To Project Workers

Situation	General Health	Reproduction
Aerial Mixer/Loader	Low	Low
Backpack Sprayer	Moderate	Moderate
Right-of-way Mixer/Loader	Negligible	Negligible
Hack-and-Squirt	Low	Low

Ecotoxological Categories

Mammalian (Acute Oral):	
mg/kg	***Risk Category***
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non toxic

Avian (Acute Oral):	
mg/kg	***Risk Category***
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non toxic

Avian (Dietary):	
ppm	***Risk Category***
<50	very highly toxic
50-500	highly toxic
501-1000	moderately toxic
1001-5000	slightly toxic
>5000	practically non toxic

Aquatic Organisms:	
ppm	***Risk Category***
<0.1	very highly toxic
0.1-1	highly toxic
>1-10	moderately toxic
>10-100	slightly toxic
>100	practically non toxic

TABLE OF CATEGORIES OF TOXICITY

Human Hazards				
		Route of Administration		
Risk Category	**Signal Word**	**Oral (mg/kg)**	**Dermal (mg/kg)**	**Inhalation (mg/kg)**
I	**DANGER--Poison**	0-50	0-200	0-0.2
II	**WARNING**	>50-500	>200-2000	>0.2-2.0
III	**CAUTION**	>500-5000	>2000-20,000	>2.0-20
IV	**NONE**	>5000	>20,000	>20

	Hazard	
Category	**Eye Irritation**	**Skin Irritation**
I	Corrosive: corneal opacity not reversible within 7 days	corrosive
II	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV	no irritation	mild or slight irritation at 72 hours

Categories of Quality of Health Effects Data	
Inadequate:	Inadequate information available for evaluating toxicity. There were too few studies of sufficient quality to yield useful or reliable information.
Marginal-Inadequate:	Some useful information exists for evaluating toxicity. There were studies of marginal quality that provided useful information, but studies were inconsistent and some contained flaws. It is likely that new studies would change estimates of health effects.
Marginal:	Marginal but useful information available for evaluating toxicity. There were studies of adequate quality, and results did not vary greatly, but more information would increase reliability. Although new studies may change estimates of health effects, the results are considered moderately reliable.
Adequate:	Adequate information is available. Studies are of sufficient quality and quantity that estimates of human health are considered reliable. New studies are unlikely to change estimates of health effects.