

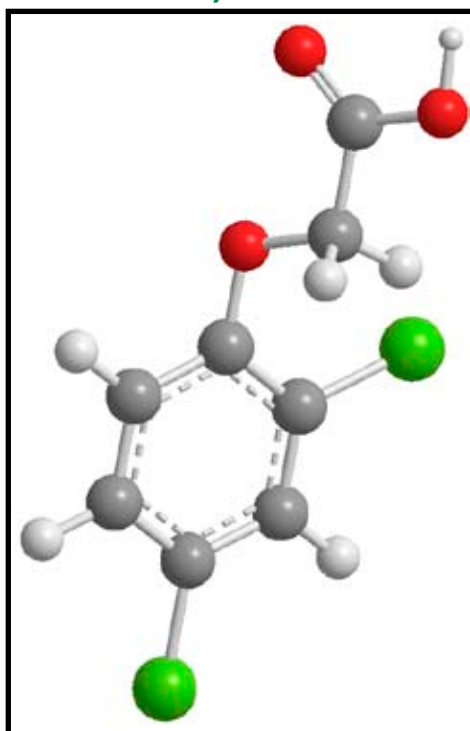
Thank you for visiting the National Pesticide Information Center's fact sheets.

Some of the information in the following fact sheet (scroll down) is out-of-date. NPIC has started a *NEW* set of fact sheets, and 2,4-D is high on our list of priorities. If you would like to be notified when NPIC releases new publications, send an email to npicupdates@ace.orst.edu with "subscribe" in the subject line.

Check out our new technical fact sheet on [resmethrin!](#)

Please call NPIC with any questions you have about pesticides at **1-800-858-PEST (7378)**.

Molecular Structure - 2,4-D



NPTN fact sheets are designed to answer questions that are commonly asked by the general public about pesticides that are regulated by the U.S. Environmental Protection Agency (US EPA). This document is intended to be educational in nature and helpful to consumers for making decisions about pesticide use.

National Pesticide Telecommunications Network

2,4-D

The Pesticide Label: Labels provide directions for the proper use of a pesticide product. *Be sure to read the entire label before using any product.* A signal word, on each product label, indicates the product's short-term toxicity.

CAUTION- low toxicity

WARNING- moderate toxicity

DANGER- high toxicity

What is 2,4-D?

- 2,4-D (short for 2, 4-dichlorophenoxyacetic acid) is the most widely used herbicide (kills or controls weeds) worldwide and has been used for over 50 years.
- 2,4-D is used to kill broadleaf weeds, often in grass crops. **See herbicide selectivity box.** This chemical has many registered uses and is sometimes mixed with other pesticides and fertilizers.
- 2,4-D comes in three formulations: salt, amine, and ester. Each has slightly different properties.

Herbicide selectivity: Some herbicides have the ability to kill certain plants without harming others. These are called selective herbicides. Resistant plants can survive by detoxifying the herbicide or not absorbing it. Often, a crop plant will be more tolerant of a herbicide than the weeds around it. This is the case for 2,4-D where the grass crop (for example: bermudagrass lawns or wheat crops) survives and broadleaf plants (dandelion, thistles, etc.) die.

How does 2,4-D work?

- 2,4-D is a plant hormone (auxin) mimic. It poisons the plant by causing rapid cell division and abnormal growth.
- It is unclear why 2,4-D kills broadleaf plants while grasses survive. **See herbicide selectivity box.**

- Symptoms of injury in susceptible plants include: cupping and curling of stems and leaves, stunting of growth, and production of ethylene (1).
- 2,4-D is a systemic herbicide (dispersed throughout the plant) and can be absorbed through the roots, although it is most often applied to foliage (1).

What products contain 2,4-D?

- Many lawn care products
- Wheat, corn, and other monocot (grass family) crop herbicides
- Products used in forestry
- Some non-crop land herbicides, including treatments for roadsides and rights-of-way
- Orchard crop weed control products
- Aquatic weed control products

What is the toxicity of 2,4-D?

Animals

- The amount of 2,4-D that would poison rats depends on formulation type (acid, amine or ester). Overall, 2,4-D is slightly toxic to rats (1) **See laboratory testing box.** *Note: pesticide products containing 2,4-D range in signal word from Caution to Danger. This reflects the combined toxicity of 2,4-D and other ingredients in each product.*
- Long term toxicity in animals has been thoroughly studied. Recent studies show that when dogs and rats were fed low levels of 2,4-D daily in the diet, no long term health effects were seen. When high amounts were administered daily in the diet, 2,4-D

caused a reduction in weight gain and changes in blood chemistry (2, 3).

Laboratory Testing: Before pesticides are registered by the U.S. EPA, they must undergo laboratory testing for short-term and long-term health effects. In these tests, laboratory animals are purposely fed a pesticide at high doses to cause toxic effects. These tests help scientists judge how these chemicals might affect humans, domestic animals, and wildlife in cases of overexposure. When pesticide products are used according to label directions, toxic effects are not likely to occur because the amount of pesticide that people and animals may be exposed to is low compared to the doses fed to laboratory animals

Humans:

- 2,4-D has low to moderate toxicity to humans for short-term exposures (4).
- Excessive doses of 2,4-D can affect the nervous system and digestive system (4).
- Symptoms of over-exposure include: muscle weakness, loss of reflexes, nausea, vomiting, sweating, headaches, dizziness, and brief lowering of blood pressure (4).
- 2,4-D can cause temporary skin and mucous membrane irritation although these symptoms are not common in humans (4).

Effects of 2,4-D on human health and the environment depend on how much 2,4-D is present and the length and frequency of exposure. Effects also depend on the health of a person and/or certain environmental factors.

Does 2,4-D break down and leave the body?

Animals

- After high doses, rats excrete 50% of 2,4-D in 53 hours. **See half-life box.** Lower doses are eliminated even quicker. When sheep are given small doses, almost all 2,4-D is excreted within 96 hours. The elimination time differs slightly with 2,4-D formulation (4).
- In the acid or amine formulation, 2,4-D is excreted from the body so quickly that it is not broken down. The ester formulation of 2,4-D is converted to the acid form in the body prior to excretion (4).

Half-life is the time required for half of the compound to degrade or be eliminated from the body.

1 half-life	=	50% remaining
2 half-lives	=	25% remaining
3 half-lives	=	12% remaining
4 half-lives	=	6% remaining
5 half-lives	=	3% remaining

Remember that the amount of chemical remaining after a half-life will always depend on the amount of the chemical originally applied.

Humans

- When 2,4-D was injected into two human volunteers, 100% was eliminated from their bodies at a rate of about 3% and 5% per hour. Based on this information and animal studies, 2,4-D is not expected to accumulate in the body (4).

Is 2,4-D likely to cause cancer?

Animals

- Although a few older animal studies suggested a correlation between 2,4-D ingestion and tumor formation, recent animal studies suggest no link between 2,4-D and cancer (2, 3). **See cancer box.**

Humans

- Studies of agricultural workers exposed to 2,4-D over many years show little evidence that 2,4-D is carcinogenic. However, a potential relationship between 2,4-D exposure and non-Hodgkins lymphoma has been suggested (5).
- U.S. EPA has classified 2,4-D as a group D carcinogen (not classifiable as to human carcinogenicity) (6).

Does 2,4-D cause developmental or birth defects?

Animals

- 2,4-D does not cause birth defects in rats (4).
- Rats and rabbits suffered no adverse birth complications except when fed high doses of 2,4-D. Mothers fed high daily doses experienced reduced weight gain and smaller litters (4).

Cancer: The U.S. EPA has strict guidelines that require testing of pesticides for their potential to cause cancer. These studies involve feeding laboratory animals large daily doses of the pesticide over most of the lifetime of the animal. Based on these tests, and any other available information, EPA gives the pesticide a rating for its potential to cause cancer in humans. For example, if a pesticide does not cause cancer in animal tests, then the EPA considers it unlikely the pesticide will cause cancer in humans. Testing for cancer has not been done on human subjects.

Humans

- Scientists have gathered no evidence that indicates 2,4-D causes harmful reproductive effects to the general public or to professional applicators.

What happens to 2,4-D in the environment?

- For all formulations, typical half-life in the soil environment is 10 days. **See box on half-life.** 2,4-D usually remains active against susceptible plants for 1 to 4 weeks (7).
- Although it has potential to leach through soil, 2,4-D is unlikely to contaminate groundwater because it is rapidly degraded in most soil types (1).
- In plants, 2,4-D is absorbed through roots and foliage and tends to accumulate in growing tips. Metabolism in plants is generally slow, but varies among species (1).

What effect does 2,4-D have on wildlife?

- Some formulations of 2,4-D are toxic to some forms of aquatic life while other 2,4-D formulations are very low in aquatic toxicity. For all formulations, concentrations in lakes and streams resulting from proper applications pose little risk for most species (8).
- In general, 2,4-D is low in toxicity to insects. Ester formulations are generally less toxic to insects than acid formulations (8).

- Birds (including ducks and quail) are resistant to 2,4-D toxicity. Eggs are not affected by high doses of 2,4-D (8).

Selected References:

- (1) *Herbicide Handbook Seventh Edition.* (1994). Champaign, IL: Weed Science Society of America.
- (2) Charles, J. M., Bond, D. M., Jeffries, T. K., Yano, B. L., & Stott, W. T. (1996). Chronic Dietary Toxicity Oncogenicity Studies on 2,4-Dichlorophenoxyacetic Acid in Rodents. *Fundamental and Applied Toxicology*, 33, 166-172.
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- (4) Hayes, W. J. & E. R. Laws. *Handbook of Pesticide Toxicology: Volume 3.* (1991). San Diego, CA: Academic Press.
- (5) U.S. Department of Agriculture. (1996) *Biologic and Economic Assessment of Benefits from the Use of Phenoxy Herbicides in the United States.* (NAPIAP Report No. 1-PA-96) Washington DC: Author.
- (6) U. S. Environmental Protection Agency, Health Effects Division, Carcinogenicity Peer Review Committee. (1997). *Review of 2,4-D.* Washington, DC: U. S. Environmental Protection Agency.
- (7) Wilson, R. D., Geronimo J., & Armbruster J. A. (1997). 2,4-D Dissipation in Field Soils after Application of 2,4-D Dimethylamine Salt and 2,4-D 2-ethylhexyl Ester. *Environmental Toxicology and Chemistry*, 16(6), 1239-1246.
- (8) World Health Organization, International Programme on Chemical Safety. (1989). *Environmental Health Criteria 84. 2,4-Dichlorophenoxyacetic acid-Environmental Aspects.* Geneva, Switzerland: World Health Organization.

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