
NPIC Technical Fact Sheets are designed to provide information that is technical in nature for individuals with a scientific background or familiarity with the regulation of pesticides by the U.S. Environmental Protection Agency (U.S. EPA). This document is intended to be helpful to professionals and to the general public for making decisions about pesticide use.

National
Pesticide
Information
Center

Malathion

(General Fact Sheet)

Please refer to the **Technical Fact Sheet** for more technical information.

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 potential hazard.

CAUTION - low toxicity

WARNING - moderate toxicity

DANGER - high toxicity

What is malathion?

- Malathion is an insecticide that was registered for use in the United States in 1956 (1).
- Malathion belongs to a class of insecticides known as organophosphates (OPs) (2).
- Malathion is a yellow to brown liquid with a skunk- or garlic-like odor. It dissolves slightly in water and does not readily evaporate into the air. It may damage metal and some forms of plastic and rubber (3).
- Malathion products are used to control a variety of insects outdoors and are sold in the form of dusts, liquids, aerosols, and wettable powders (4).
- Signal words for products containing malathion range from Caution to Danger (5). The signal word reflects the combined toxicity of malathion and other ingredients in each product. See the **Pesticide Label** box above.

How does malathion work?

- Malathion kills insects by disrupting the nervous system (4). It does this by inhibiting an enzyme called cholinesterase (4, 6, 7).
- Malathion affects the nervous systems of insects and humans. Insects are more susceptible to it than mammals (4).

What types of products contain malathion?

- Agricultural insecticides for food and non-food crops
- Home-use products for vegetable gardens, ornamental plants, and lawns
- Mosquito control insecticides
- Insecticides used in the Cotton Boll Weevil and Mediterranean Fruit Fly (Medfly) Eradication Programs

NOTE: Some head lice products contain malathion – these are regulated by the U.S. Food and Drug Administration (FDA) (4). This fact sheet **does not** address head lice products.

How toxic is malathion?

Animals

- Malathion is very low in toxicity when ingested by rats (4, 8). See boxes on **Laboratory Testing**, **Toxicity Category**, and **LD50/LC50**.
- Malathion is very low in toxicity when inhaled by rats (4, 8).
- Malathion is low in toxicity when applied to the skin of rats (4, 8).
- Impurities in malathion products can increase the toxicity of malathion to rats (6, 7). These impurities may result from manufacturing or storage (6). Malathion impurities may be toxic themselves or may increase the toxicity of malathion (9).
- In a skin irritation study, malathion caused slight skin irritation to rabbits. The EPA classifies malathion as very low in toxicity for skin effects (4).
- In studies with guinea pigs, malathion did not cause skin sensitivity (4).
- In a study with rabbits, malathion caused slight eye irritation (4). Malathion caused no eye effects in a study with rats (10). The U.S. EPA classifies malathion as low in toxicity for eye effects (4).
- Scientists exposed the skin of rabbits to malathion for three weeks and noted cholinesterase inhibition at the two highest doses tested. One rabbit died at the highest dose in the study (11).

Exposure: Effects of malathion on human health and the environment depend on how much malathion is present and the length and frequency of exposure. Effects also depend on the health of a person and/or certain environmental factors.

Laboratory Testing: Before pesticides are registered by the U.S. EPA, they must undergo laboratory testing for short-term (acute) and long-term (chronic) health effects. Laboratory animals are purposely fed high enough 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 the label directions, toxic effects are not likely to occur because the amount of pesticide that people and pets may be exposed to is low compared to the doses fed to laboratory animals.

Toxicity Category (Signal Word) (12)

	High Toxicity (Danger)	Moderate Toxicity (Warning)	Low Toxicity (Caution)	Very Low Toxicity (Caution)
Oral LD50	Less than 50 mg/kg	50 - 500 mg/kg	500 - 5000 mg/kg	Greater than 5000 mg/kg
Dermal LD50	Less than 200 mg/kg	200 - 2000 mg/kg	2000 - 5000 mg/kg	Greater than 5000 mg/kg
Inhalation LC50	Less than 0.05 mg/l	0.05 - 0.5 mg/l	0.5 - 2 mg/l	Greater than 2 mg/l
Eye Effects	Corrosive	Irritation persisting for 7 days	Irritation reversible within 7 days	Minimal effects, gone within 24 hrs
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation

LD50/LC50: A common measure of acute toxicity is the lethal dose (LD50) or lethal concentration (LC50) that causes death (resulting from a single or limited exposure) in 50 percent of the treated animals. LD50 is generally expressed as the dose in milligrams (mg) of chemical per kilogram (kg) of body weight. LC50 is often expressed as mg of chemical per volume (e.g., liter (L)) of medium (i.e., air or water) the organism is exposed to. Chemicals are considered highly toxic when the LD50/LC50 is small and practically non-toxic when the value is large. However, the LD50/LC50 does not reflect any effects from long-term exposure (i.e., cancer, birth defects, or reproductive toxicity) that may occur at levels below those that cause death.

- Male and female rats inhaling malathion for three months displayed cholinesterase inhibition at all doses tested. Researchers also noted respiratory system effects (11).
- Researchers fed dogs malathion for 1 year, and cholinesterase activity decreased at all doses for the animals. Researchers did not detect any signs of toxicity (8, 11).

Humans (See box on **Human Studies**)

- Volunteers ingested malathion for 47 days and displayed no significant cholinesterase activity effects. Volunteers eating malathion for 56 days had reduced cholinesterase activity three weeks after the dosing period in the study. This made the relationship of cholinesterase inhibition to malathion exposure uncertain (6).
- Volunteers who inhaled malathion products for 42 days showed no cholinesterase activity effects and no signs of poisoning (6).
- Volunteers exposed to malathion dust on their skin and clothes for 8 or more weeks complained of skin irritation and odor. Scientists noted cholinesterase inhibition at the highest dose but did not consider it significant (6).
- Researchers conducted a study evaluating the health effects associated with people living in areas treated with malathion by ground and air applications. The applications, which occurred from April 1998 to September 1998, generated 230 reports of pesticide-related illness. Of these, 123 reports were listed as probable or possible cases. The most-commonly reported signs and symptoms were associated with the respiratory, gastrointestinal, and nervous systems (13).
- In a separate study, air applications of malathion from December 1989 to June 1990 generated 1,874 reports of pesticide-related illness. The majority of complaints (1,575), dealt with respiratory tract irritation, headaches, gastrointestinal tract symptoms, and fatigue. The other 299 complaints dealt with skin rashes (14).
- Researches associated a human outbreak of malathion poisoning in 1976 with product impurities (6). The U.S. EPA concludes that current impurities in malathion products do not pose a health concern (4).
- Signs and symptoms associated with malathion poisoning may include headaches, nausea, vomiting, dizziness, muscle weakness, sluggishness, and nervousness. In severe or life-threatening poisonings, breathing problems, diarrhea, tremors, confusion, seizures, and coma may occur. Signs relatively specific to organophosphate poisoning include pinpoint pupils, eye tearing, increased sweating and salivation, and localized muscle contractions (15).

Human Studies: Results from human studies are presented for information purposes only. The U.S. EPA presently does not use data from human studies in its risk assessments (EPA has asked the National Academy of Sciences to make “recommendations regarding the particular factors and criteria EPA should consider to determine the potential acceptability ...”) of data from human studies. “... During the Academy’s consideration of the issues and until a policy is in place, the Agency will not consider or rely on any such human studies in its regulatory decision making, whether previously or newly submitted. ...” – **Quotes from:** Environmental News R-246, U.S. EPA, December 14, 2001.

Does malathion break down and leave the body?

Animals

- Rats exposed to malathion excreted the majority of the chemical in the urine within the first day. Malathion did not accumulate in the exposed rats (4, 8).

Humans

- Volunteers absorbed small amounts of malathion applied to their skin. Maximum malathion excretion occurred within the first day (16).

Does malathion cause reproductive or birth defects?

Animals

- Two generations of rats that were fed malathion in their food exhibited no adverse effects on their fertility. The offspring had lower body weights at the two highest doses, while adult rats displayed lower body weights only at the highest dose (11).
- Pregnant rats fed malathion during pregnancy had offspring with no birth defects. Mother rats ate less and had lower weight gains at the highest dose tested (8, 11).
- Rabbits fed malathion during pregnancy had mothers with lower body weight gains and offspring with developmental effects at the two highest doses tested (8, 11).

Humans

- Data are not available from work-related exposures, accidental poisonings, or other human studies regarding the reproductive and developmental toxicity of malathion.

Does malathion cause cancer?

Animals

- Female rats fed malathion in their diet for 2 years had a higher number of liver tumors. Male rats did not. The U.S. EPA concluded that liver tumors in female rats only occurred at excessively high doses (11).
- Male and female mice fed malathion in their diet for 1.5 years had a higher number of liver tumors. The U.S. EPA concluded that liver tumors in the mice only occurred at excessively high doses (11).
- Researchers often test chemicals for their ability to change the genetic material of an organism as an indication of their potential to cause cancer. Evidence exists that malathion may change genetic material, but the U.S. EPA concludes that malathion is not a significant mutagenic hazard (4, 8, 17).

Humans

- The U.S. EPA classifies malathion as containing “suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential” (11). See box on **Cancer**.
- In a study of workers exposed to malathion, researchers did not detect an increased risk of genetic change. The small sample size in the study prevented definitive conclusions (18).
- Eight human studies concluded an increased risk for genetic changes with malathion exposure. Study interpretation is limited because researchers did not consider other contributing factors (17).

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 at large doses, then the EPA considers it unlikely the pesticide will cause cancer in humans. Cancer tests are not conducted on human subjects.

What happens to malathion in the environment?

- Malathion does not degrade readily by sunlight. It does break down in water under certain conditions (9).
- Malathion does not degrade readily by sunlight. It does break down in water under certain conditions (9).
- Malathion can move through soil, but it breaks down quickly. Malathion does not pose a great risk to ground water (9, 19).
- Malathion does not readily enter air from bodies of water (20)
- On plant surfaces, the time required for half of the malathion to disappear ranges from less than 1 day to about 1 week (9, 21). See box on **Half-life**.
- In the environment, microbes and water often degrade malathion into compounds of lower toxicity. However, malathion may be converted into more toxic substances under some conditions (9, 22).

Half-life is the time required for half of the compound to degrade.

1 half-life = 50% degraded
2 half-lives = 75% degraded
3 half-lives = 88% degraded
4 half-lives = 94% degraded
5 half-lives = 97% degraded

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

What effects does malathion have on wildlife?

- Malathion is slightly to moderately toxic to various bird species (9).
- Malathion is considered moderate to very high in toxicity to fish and other water organisms (9).
- Malathion is not expected to build up in fish and other water organisms (20).
- Malathion is highly toxic to bees (9).

Date reviewed: February, 2001

For more information contact: NPIC

Oregon State University, 333 Weniger Hall, Corvallis, Oregon 97331-6502.

Phone: 1-800-858-7378 Fax: 1-541-737-0761 Email: npic@ace.orst.edu

NPIC at <http://npic.orst.edu/> EXTOKNET at <http://ace.orst.edu/info/extoknet/>

References

1. *Pesticide Fact Sheet Number 152: Malathion*; U.S. Environmental Protection Agency, Office of Pesticide Programs, U.S. Government Printing Office: Washington, DC, 1988.
2. Chamber, H. W. Organophosphorus Compounds: An Overview. In *Organophosphates: Chemistry, Fate, and Effects*; Chambers, J. E., Levi, P. E., Eds.; Academic: San Diego, CA, 1992; pp 3-17.
3. Malathion. In *Hazardous Substances Data Bank (HSDB)* [CD-ROM]; U.S. National Library of Medicine: Bethesda, MD, March 2000.
4. U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC. Malathion Preliminary Risk Assessments: Health Effects. <http://www.epa.gov/pesticides/op/malathion.htm> (accessed Nov 2000).
5. *Pest-Bank Pesticide Product Data* [CD-ROM]; Purdue Research Foundation: West Lafayette, IN, 2000.

6. Gallo, M. A.; Lawryk, N. J. Organic Phosphorus Pesticides. In *Handbook of Pesticide Toxicology*; Hayes, W. J., Laws, E. R., Eds.; Academic: San Diego, CA, 1991; Vol. 2, pp 917-1123.
7. World Health Organization. *Organophosphorus Insecticides: A General Introduction*, Environmental Health Criteria, 63, Geneva, Switzerland, 1986.
8. Marrs, T. C. Malathion. In *Pesticide residues in food, Joint FAO/WHO Meeting on Pesticide Residues, Evaluations 1997: Part II - Toxicological and Environmental*; International Programme on Chemical Safety, World Health Organization: Geneva, Switzerland, 1998; pp 189-219.
9. U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC. Malathion Preliminary Risk Assessments: Environmental Fate and Effects. <http://www.epa.gov/pesticides/op/malathion.htm> (accessed Nov 2000).
10. Boyes, W. K.; Hunter, E.; Gary, C.; Jensen, K.; Peiffer, R. L. Topical Exposure of the Eyes to the Organophosphorus Insecticide Malathion: Lack of Visual Effects. *J. Appl. Toxicol.* **1999**, *19*, 473-483.
11. U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC. Malathion Preliminary Risk Assessments: Toxicology Chapter. <http://www.epa.gov/pesticides/op/malathion.htm> (accessed Nov 2000).
12. U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC. Label Review Manual. <http://www.epa.gov/oppfod01/labeling/lrm/chap-08.htm> (accessed Nov 2000).
13. Shafey, O.; Sekereke, H. J.; Hughes, B. J.; Heber, S.; Hunter, R. G.; Brooks, R. G. Surveillance for Acute Pesticide-Related Illness During the Medfly Eradication Program-Florida. *MMWR* **1999**, *282*, 1015-1027.
14. Schanker, H. M.; Rachelefsky, G.; Siegel, S.; Katz, R.; Spector, S.; Rohr, A.; Rodriquez, C.; Woloshin, K.; Papanek, P. J. Jr. Immediate and delayed type hypersensitivity to malathion. *Ann. Allergy* **1992**, *69*, 526-528.
15. U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC. Malathion Preliminary Risk Assessments: Review of Malathion Incident Reports. <http://www.epa.gov/pesticides/op/malathion.htm> (accessed Oct 2000).
16. Wester, R. C.; Maibach, H. I.; Bucks, D. A.; Guy, R. H. Malathion Percutaneous Absorption after Repeated Administration to Man. *Toxicol. Appl. Pharmacol.* **1983**, *68*, 116-119.
17. Flessel, P.; Quintana, P. J. E.; Hooper, K. Genetic Toxicity of Malathion: A Review. *Environ. Mol. Mutagen.* **1993**, *22*, 7-17.
18. Windham, G. C.; Titenko-Holland, N.; Osorio, A. M.; Gettner, S.; Reinisch, F.; Haas, R.; Smith, M. Genetic Monitoring of Malathion-Exposed Agricultural Workers. *Am. J. Ind. Med.* **1998**, *33*, 164-174.
19. Hornsby, A. G.; Wauchope, D. R.; Herner, A. E. *Pesticide Properties in the Environment*; Springer: New York, 1999; p 134.
20. Howard, P. H. *Handbook of Environmental Fate and Exposure Data for Organic Compounds*. Lewis: Chelsea, MI, 1991; pp 474-485.
21. Bradman, M. A.; Harnly, M. E.; Goldman, L. R.; Marty, M. A.; Dawson, S. V.; Dibartolomeis, M. J. Malathion and Malaoxon Environmental Levels Used for Exposure Assessment and Risk Characterization of Aerial Applications to Residential Areas of Southern California. *J. Expos. Anal. Environ. Epidemiol.* **1994**, *4*, 49-63.
22. Brown, M. A.; Petreas, M. X.; Okamoto, H. S.; Mischke, T. M.; Stephens, R. D. Monitoring of Malathion and Its Impurities and Environmental Transformation Products on Surfaces and in Air Following an Aerial Application. *Environ. Sci. Technol.* **1993**, *27*, 388-397.

NPIC is sponsored cooperatively by Oregon State University and the U.S. Environmental Protection Agency. Data presented through NPIC documents are based on selected authoritative and peer-reviewed literature. The information in this profile does not in any way replace or supersede the restrictions, precautions, directions or other information on the pesticide label/ing or other regulatory requirements.
