E X T O X N E T

Extension Toxicology Network

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Pesticide
Information
Profile

Malathion

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TRADE OR OTHER NAME

Malathion is also known as carbophos, maldison and mercaptothion. Trade names for products containing malathion include Celthion, Cythion, Dielathion, Karbofos, Maltox, El 4049, Emmaton, Fyfanon and Exathion among many others. Malathion may also be found in formulations with many other pesticides.

INTRODUCTION

Malathion is a non-systemic, wide spectrum insecticide. It was one of the earliest organophosphate insecticides developed (introduced in 1950). Malathion is suited for the control of sucking and chewing insects on fruits and vegetables. Malathion is also used to control mosquitoes, flies, household insects, animal parasites (ectoparasites) and head and body lice.

Malathion is a general use pesticide.

TOXICOLOGICAL EFFECTS

ACUTE TOXICITY

Malathion is classified as slightly toxic and carries the signal word CAUTION on the label. The acute effects of malathion depend on product purity and the vehicle of administration (5). Thus the LD50 for rats ranges from 480 to 10,700 mg/kg and from 775 to 3,321 mg/kg for mice. Several other factors also affect the toxicity of the pesticide. For example, the toxicity of malathion appeared to be strongly linked to the amount of protein in the diet of laboratory rats (13). As protein intake decreased, malathion was increasingly toxic to the rats. Malathion has been shown to have different toxicities in male and female rats (12) and humans due to metabolism,

storage and excretion differences between the sexes. For humans, the lowest dose at which lethal effects have been observed was nearly three times higher for males than for females. Acute symptoms in humans include nausea, headache, tightness in the chest, and other symptoms typical of acetyl- cholinesterase inhibition. Unconsciousness, convulsions, and a "prolonged worsening illness" are also typical of malathion poisoning at high doses (14).

There is one reported case of malathion poisoning of an infant who exhibited severe signs of cholinesterase inhibition after exposure to an aerosol bomb containing 0.5% malathion (3). Numerous other malathion intoxication incidents have occurred among pesticide workers and with small children through accidental exposure. Human exposures can occur through ingestion, inhalation, and absorption through the skin.

As with many other organophosphate insecticides, malathion, at relatively high doses (near the LC50) can act to suppress the immune system in some animal species (16).

CHRONIC TOXICITY

Human volunteers fed very low doses of malathion for one and a half months showed no significant effects on blood cholinesterase activity. Rats fed diets containing 100-1,500 ppm of malathion in their food for two years showed no symptoms apart from depressed cholinesterase activity. When small amounts of the compound were administered for eight weeks, rats showed no adverse effects on whole-blood cholinesterase activity. Weanling male rats were twice as susceptible to malathion as adults.

Reproductive and Teratogenic Effects

Several studies have documented developmental and reproductive effects due to high doses of malathion in test animals (14). However, malathion fed to rats at a low dosages caused no reproductive effects.

Malathion and its metabolites can cross the placenta of the goat and depress cholinesterase activity of the fetus (6). Rats fed high doses (240 mg/kg) showed no teratogenic effects, but similar doses (300 mg/kg) administered by stomach tube during pregnancy caused an increased rate of newborn mortality. Chickens fed diets at low doses for two years showed no adverse effects on egg hatching. There is no direct evidence that malathion is teratogenic in mammals.

Mutagenic Effects

Malathion produced detectable mutations in three different types of cultured human cells, including white blood cells and lymph cells. It is possible that malathion could pose a mutagenic risk to humans chronically exposed.

Carcinogenic Effects

Female mice fed approximately 1% diets of malathion for over three years showed no significant increased tumor incidence. Female rats on diets containing high concentrations of malathion for two years did not develop tumors. Adrenal tumors developed in the males at low doses, but not at the high doses (2), suggesting that malathion may not have been the cause. Three of five studies that have investigated the carcinogenicity of malathion have found that the compound does not produce tumors in the test animals. The two other studies have been determined to be unacceptible studies and the results discounted. Additional studies are being requested by the EPA (17). While it seems unlikely that the compound would pose a significant cancer risk to humans exposed at low levels there is not enough data to draw definitive conclusions.

Organ Toxicity

The pesticide has been shown to affect both the adrenal glands and the liver of rats. It also has effects on blood clotting time in test animals.

Fate in Humans and Animals

Malathion is rapidly and effectively absorbed by practically all routes including the gastrointestinal tract, skin, mucous membranes, and lungs.

In rats, 44% was excreted in the urine in eight hours and 83% after 24 hours. Of the remainder 6% appeared in feces, 3% was in expired air and 8% remained in the gastrointestinal tract. Cows excreted malathion less rapidly with 69% in the urine in four days, 8% in the feces and 0.2% in the milk.

Autopsy samples from one individual who had ingested large amounts of malathion showed a substantial portion in the stomach and intestines, a small amount in fat tissue and no detectable levels in the liver. Malathion requires conversion to malaoxon to become an active anticholinesterase agent. Most of the occupational evidence indicates a low chronic toxicity for malathion. One important exception to this was traced to impurities in the formulation of the pesticide (14).

ECOLOGICAL EFFECTS

Malathion is moderately toxic to birds and highly toxic to aquatic invertebrates, the aquatic stages of amphibians and to honey bees. Mallards have an LD50 of 1,485 mg/kg and chickens a LD50 of 948 mg/kg. Bobwhite quail had an oral LC50 of 3,497 ppm and pheasants 2,639 ppm. Ninety percent of the dose to birds was metabolized and excreted in 24 hours via urine (5).

Fish have a wide range of toxicities to malathion, extending from very highly toxic for the walleye (96-hour LC50 64 ppb) to highly toxic for brown trout (101 ppb) and the cutthroat trout (280 ppb), moderately toxic for fathead minnows (8.6 ppm) and slightly toxic for goldfish (10.7 ppm). Various aquatic invertebrates are sensitive, with EC50's in the 1ppb to 1 ppm. Whole body analysis of pinfish showed the presence of malathion, mono- and di-carboxylic acids but no malaoxon (7).

ENVIRONMENTAL FATE

Degradation in soil is rapid and related to the degree of soil binding. Breakdown occurs by a combination of biological and non- biological reaction with water. The average half-life for the compound is six days (15). In raw river water, the half-life is less than one week, whereas malathion remained stable in distilled water for three weeks. Applied at 1 to 6 pounds/acre in log ponds for mosquito control, it was effective for 2.5 to 6 weeks. In sterile seawater, the degradation increases with increased salinity. The breakdown products in water are mono- and di-carboxylic acids.

A field of kale was sprayed at 2.5 pounds per acre. After two days, 18 ppm of the compound and its breakdown products were present. After 15 days, only 1.2 ppm remained. If released to the atmosphere, malathion will break down rapidly in sunlight. The half-life in air is about 1.5 days (15). Malathion has been found in small concentrations in several wells in California.

Residues were found mainly associated with areas of high lipid content in the plant. Increased moisture content increased degradation. The FDA Market Basket Survey (1965-1969) showed an average malathion concentration in representative foods of 0.00013 ppm (5). The tolerance on most food crops is 8 ppm.

Because of its very short half-life, malathion is not expected to bioconcentrate in aquatic organisms (15). However, the brown shrimp showed an average concentration of 869 and 959 times the ambient water concentration in two separate samples.

Exposure Guidelines:

NOEL:	rat: 5 mg/kg/day, based on erythrocyle cholinesterase rat: 25 mg/kg/day, based on whole blood cholinesterase human: 25 mg/kg/day, based on cholinesterase
DWEL:	0.8 mg/l
HA:	0.2 mg/l lifetime
TLV-TWA:	15 mg/m3
(NIOSH):	10 mg/m3 (ACGIH)
ADI:	0.2 mg/kg/day (WHO)
LEL:	0.34 mg/kg/day (human)

Physical Properties:

CAS #:	121-75-5
Chemical name:	diethyl (dimethoxy phosphinothioyl) thiobutanedioate
Chemical class/use:	organophosphate insecticide
Solubility in water:	130 mg/l
Solubility in other solvents:	light petroleum 35 g/100 g; miscible in most organic solvents
Melting Point:	2.8-3.7 degrees C
Vapor Pressure:	8 x 10 to the minus 6 power mm Hg
Partition Coefficient:	2.89 (log)

BASIC MANUFACTURER

Cheminova Agro A/S
Lemvig, Denmark

American Cyanamid Co.
One Cyanamid Plaza
Wayne, NJ 07470
Telephone: 201-831-3521

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