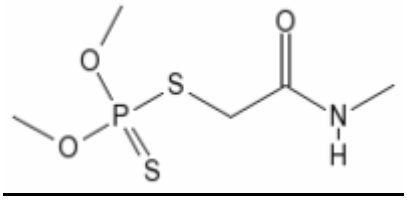
Dimethoate



Chemical name: dimethoate
Other names: O,O-dimethyl *S*-[2-(methylamino)-2-oxoethyl] dithiophosphate
O,O-dimethyl *S*-methylcarbamoylmethyl phosphorodithioate
Phosphorodithioic acid,
O,O-Dimethyl *S*-(2-(methylamino)-2-oxoethylyl)ester
Compound: $C_5H_{12}NO_3PS_2$
CAS Number: 60-51-5
Pesticide type: insecticide

Characteristics

An organophosphate insecticide, first patented and introduced in the 1950s by American Cyanamid. Like other organophosphates, it is an anticholinesterase which disables cholinesterase, an enzyme essential for central nervous system function. Dimethoate is a colorless crystalline solid with a camphor-like (mercaptan) odor. It is one of the most widely-used insecticides in the world produced by 39 companies. In 1998, there were 16250 metric tonnes of sales globally, with a value of 180 million USD.

Use

It kills mites and insects systemically and on contact. It is used against a wide range of insects, including aphids, thrips and whiteflies on ornamental plants, alfalfa, apples, corn, cotton, grapefruit, grapes, lemons, melons, oranges, pears, pecans, safflower, sorghum, soybeans, tobacco, tomatoes, watermelons, wheat and other vegetables. It is also used as a residual wall spray in farm buildings for house flies. Dimethoate has been administered to livestock for control of botflies. It is available in aerosol spray, dust, emulsifiable concentrate, and ULV concentrate formulations.
Trade names include Cekuthoate, Chimigor 40, Cygon 400, Daphene, De-Fend, Demos NF, Devigon, Dimate 267, Dimet, Dimethoat Tech 95%, Dimethopgen, Ferkethion, Fostion MM, Perfekthion, Rogodan, Rogodial, Rogor, Roxion, Sevigor, Trimetion.
Target pests in agricultural applications: aphids, leaf hoppers, bugs, mites; say stink bugs and sweet clover weevils.

Possible hazards and regulation

Dimethoate is moderately toxic by ingestion, inhalation and dermal absorption. As with all organophosphates, dimethoate is readily absorbed through the skin. The first effects are usually respiratory and may include bloody or runny nose, coughing, chest discomfort, difficult or short breath. Skin contact with organophosphates may cause localized sweating and involuntary muscle contractions. Eye contact will cause pain, bleeding, tears, pupil constriction, and blurred vision. Within 12 hours, nausea, vomiting, diarrhea, abdominal cramps, headache, dizziness, eye pain, blurred vision, constriction or dilation of the eye pupils, tears, salivation, sweating, and confusion appear. Severe poisoning will affect the central nervous system, producing incoordination, slurred speech, loss of reflexes, weakness,

fatigue, involuntary muscle contractions, twitching, tremors of the tongue or eyelids, and eventually paralysis of the body extremities and the respiratory muscles. In severe cases there may also be involuntary defecation or urination, psychosis, irregular heart beats, unconsciousness, convulsions and coma. Death may be caused by respiratory failure or cardiac arrest. Some problems may remain for months, some last forever. [1]
The population as a whole is not generally subject to exposure to dimethoate from air, water or food, but occupational exposure may occur during manufacture, formulation and use. Dimethoate is rapidly metabolized by mammals. Rats excreted about 60% of a dose in urine and expired air within 24 hours. Human volunteers excreted 76 to 100% of administered dimethoate within 24 hours.
PAN Bad Actor Chemical. On EU list of possible endocrine disruptors. In the UK it has been practically banned since April 2010 on certain crops like broccoli and sprouts.
WHO – II moderately hazardous

Toxicity
Acutely toxic. Toxic by ingestion, inhalation and dermal absorption (rapidly absorbed through the skin and easily absorbed through the lungs).

Toxicity to humans
There was no cholinesterase inhibition in a human who ingested 18 mg (about 0.26 mg/kg/day) for 21 days. No toxic effects and no cholinesterase inhibition were observed in individuals who ingested 2.5 mg/day (about 0.04 mg/kg/day) for 4 weeks. In another study with humans given oral doses of 5, 15, 30, 45 or 60 mg/day for 57 days, cholinesterase inhibition was observed only in the 30 mg/day or higher groups.
Dimethoate is possibly a human teratogen. It was teratogenic in cats and rats. A dosage of 12 mg/kg/day given to pregnant cats increased the incidence of extra toes on kittens. In 1994, BASF rejected claims of a link between high levels of genetic defects among babies born in the fruit-growing region in Chile with the usage of dimethoate saying there was no clear evidence.

Acute toxicity limits
The oral LD50 in rats is 60 to 387 mg/kg, 60 mg/kg in mice (other source 150), 400 mg/kg in dogs, 200 mg/kg in hamsters, 300 mg/kg in rabbits, 350 mg/kg in guinea pigs, and 100 mg/kg in cats. The dermal LD50 in rabbits is 1,000 mg/kg, and 353 mg/kg in rats (other source: more than 7000 mg/kg?). The probable oral lethal dose in humans is between 50-500 mg/kg, or between 1 teaspoon and 1 ounce for a 70kg person.

Omethoate: A metabolite that is considerably more toxic than dimethoate; however, the levels of residues of omethoate resulting from the use of dimethoate on crops are likely to be low. The oral LD_{50} of omethoate in rats was approximately 25 mg/kg.

Chronic toxicity limits
Repeated oral, rat NOAEL = 0.04 mg/kg per day.
12-month study in dogs at doses of 0, 5, 20, or 125 ppm was 5 ppm, equal to 0.2 mg/kg bw per day; in rats the NOAEL in a life-span study at doses of 0, 1, 5, 25, or 100 ppm was 1 ppm, equal to 0.04 mg/kg per day.

Reproductive effects:
When mice were given dimethoate, there was decreased reproduction, pup survival, and growth rates of surviving pups. Once in the bloodstream, dimethoate may cross the placenta.

ADI: 0.02 mg/kg/day
0.001 mg/kg bw/day [2]

Ecological effects
Dimethoate is very toxic to birds. Birds are not able to metabolize dimethoate quickly like mammals. 7 mg/kg of dimethoate will kill one-half of the wild birds exposed (LC50). The LC50 for birds in general is 22 mg/kg of dimethoate. The oral LD50 for mallard ducks is 41.7 mg/kg. Dimethoate is highly toxic to fish and to aquatic invertebrates. The 96-hour LC50 for dimethoate in rainbow trout is 6.2 ug/. The LC50 in mosquito fish is 40 to 60 mg/l. Dimethoate is highly toxic to honey bees. The 24-hour topical LD50 for dimethoate in bees is 0.12 ug/bee. It is very toxic to livestock and other wildlife. Oral LD50's range from 30 mg/kg (humans) to 400 mg/kg (dogs). Dimethoate is 300 times more toxic to insects (house flies) than to mice. [3]

Carcinogenity
Dimethoate is possibly carcinogenic. An increase in malignant tumors was reported in rats given oral doses of 5, 15 or 30 mg/kg dimethoate for 511 to 627 days.

Mutagenity: it is a possible mutagen. *in-vitro* studies indicate that dimethoate has mutagenic potential, this potential does not appear to be expressed *in vivo.*In 1989, the WHO concluded that it was found to be mutagenic, still no consensus.
Bioaccumulation: no accumulation in fat tissue
Mobility: mobile, yet relatively non-persistent

Persistence and degradability in environment
Somewhat persistent. Dimethoate is biodegradable. It undergoes rapid degradation in the environment and in sewage treatment plants. It may be subject to considerable leaching and to degradation by hydrolysis, especially in alkaline soils, and to evaporation from dry soil surfaces. Dimethoate does not persist. Soil half-lives of 4 to 16 days, or as high as 122 days. It is rapidly broken down by most soil microorganisms. In water, dimethoate is not expected to adsorb to sediments or suspended particles, nor to bioaccumulate in aquatic organisms.[4]
Dimethoate is not toxic to plants.

Limits
Codex Alimentarius MRL in eggs, milk, meat, wheat: 0,05 mg/kg, citrus fruit: 5 mg/kg, celery, olives: 0,5 mg/kg
Czech Republic (mg/kg): celery 0,1, tea 2, cabbage 1, nuts 0,05, wheat 0,3

Hazard Symbol : Xn - harmful
N – dangerous for the environment

Risk Phrases :
R22 Harmful if swallowed
R50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment

Safety Phrases :
S2 Keep out of reach of children
S24/25 Avoid contact with skin and eyes

S60 This material and its container must be disposed of as hazardous waste
S61 Avoid release to the environment. Refer to special instructions/safety data sheet

References

[1] Occupational Health Services, Inc. 1991 (Sept. 16). MSDS for Dimethoate. OHS Inc., Secaucus, NJ.
[2] Review report for the active substance dimethoate finalised in the Standing Committee on the Food Chain and Animal Health at its meeting on24 November 2006in view of the inclusion of dimethoate in Annex I of Directive 91/414/EEC.
[3] Cheminova Agro A/S. 1991 (June 11). Material Safety Data Sheet : Dimethoate. Cheminova, Lemvig, Denmark
[4]Howard, P.H. (ed.). 1989. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Vol. III: Pesticides. Lewis Publishers, Chelsea, MI.

Links

http://pmep.cce.cornell.edu/profiles/extoxnet/dienochlor-glyphosate/dimethoate-ext.html
http://www.pesticideinfo.org/Detail_Chemical.jsp?Rec_Id=PC33349
http://www.codexalimentarius.net/pestres/data/pesticides/details.html?id=27
http://toxipedia.org/display/toxipedia/Dimethoate
http://www.furs.si/law/EU/ffs/eng/annexI/direktive/RR/dimethoate.pdf
http://www.inchem.org/documents/jmpr/jmpmono/v96pr05.htm
http://www.fao.org/docrep/w3727e/w3727e0g.htm
http://www.pan-uk.org/pestnews/Actives/dimethoa.htm

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