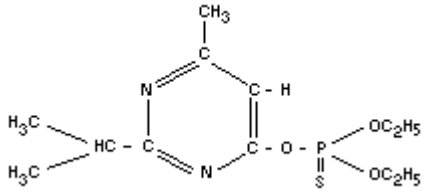
Diazinone



Chemical name: O,O-diethyl O-2-isopropyl-6-methylpyrimidin-4-yl phosphorothioate
Other names: dimpylate, diazide, G.24480, Basudin, Kayazinon, Necidol/Nucidol
Compound: C_{12} H $_{21}N_2$ O_3 PS
CAS Number: 000333-41-5
Pesticide type: insecticide and acaricide

Characteristics

First synthesized in 1951, development prompted by the appearance of DDT resistance in flies and mosquitoes. First registered for use in the United States in 1956. Pesticide used to control pest insects in soil, on ornamental plants and on fruit and vegetable field crops. It is a synthetic chemical and does not occur naturally in the environment. Pure diazinone is colorless and practically odorless oil. Most is used in liquid form, it does not dissolve easily in water and does not burn easily. Diazinone poisons humans and insects through its effect on nerve enzymes. It combines with the acetylcholinesterase enzyme and inactivates it. This enzyme is essential for the control of nerve impulse transmission. Its loss allows the accumulation of acetylcholine, the substance secreted by nerves that activates muscles and glands. This causes muscle contractions or twitching.

Use

Formerly an active ingredient in household and garden products used to control pests such as flies, fleas and cocroaches, used in pet collars as well. Used on ranges, pastures, grasslands, and ornamentals. Other uses include applications as a topically applied pesticide agent on non-lactating livestock. It replaced many of the organochlorine pesticides such as chlordane.
It is sold under trade names Alfatox, Basudin, AG500, Dazzel, Gardentox, and Knoxout.
In 1990, only in the US, 4,67 million kg of diazinone were produced. Due tu emerging health and ecological risks (uses on golf courses suspended already in 1980s after deaths occurred in migratory waterfowl), manufacturing of indoor use products discontinued on June 30, 2001 and prodution of non-agricultural outdoor use products containing diazinone discontinued on June 30, 2003. Since 2004, sales of diazinone-containing products for residential use discontinued. Other restrictions to be implemented: cancellation of all granular registrations, deletion of aerial applications, deletion of foliar application on all vegetables etc. The FAO advises against using WHO class II pesticides like diazinone in developing countries, yet it is widely used in for example Senegal and Indonesia.

Possible hazards and regulation

2007 CERCLA Priority List of Hazardous Substances – diazinone occupies 56th position. It was also included in the PAN Bad Actor chemical list.
The substance is mildly irritating to the eyes and the skin. Low level exposure may result in acetylcholinesterase inhibition in the absence of signs of toxicity. Short exposure to high levels can affect the nervous system with symptoms including headache, dizziness, weakness, feelings of anxiety, not being able to see clearly. Exposure to very high levels causes nausea, vomiting, abdominal cramps, slow pulse, difficulty breathing and coma, insomnia, nightmares, and a form of toxic psychosis resulting in bizarre behaviour. Effects may be delayed (usually minutes to hours).
The US Poison Control Centre analyzed its operations for the years 1985 to 1992 – there were a total of 20565 diazinone cases, of these, 749 were occupational exposure, total of 10079 non-

occupational exposure. The California Pesticide Illness Surveillance Program reported 521 cases of adverse effects and diazinone was ranked 5th as a cause of systemic poisoning in California from 1990 to 1994. The manufacturers are not supporting diazinone at the European Union level and it may be withdrawn soon.

WHO II - Moderately Hazardous (1996)

Toxicity

Absorbed from the gastrointestinal system, it is poorly absorbed through the skin. It is readily absorbed through the lungs and distributed throughout the body, without accumulating in body tissues. It is rapidly metabolised by oxidation, hydrolysis and deoxygenation to other metabolites which are excreted in the urine. Because diazinone is fat soluble, there is potential for delayed toxicity if significant amounts of diazinone are stored in fatty tissues.

Toxicity to humans

Little potenial for high level exposure because home and garden uses for diazinone have been cancelled. Oral exposure possible by drinking contaminated water or eating foods containing residues. Studies of the U.S. Food and Drug Administration have found that the levels in food are far below the level that might cause harmful health effects. There are no reports of deaths in humans or animals exposed by inhalation to diazinone alone.
It is included in the draft list of initial chemicals for screening under the U.S. EPA Endocrine Disrupter Screening Program (EDSP).

Acute toxicity limits

ATSDR (Agency for Toxic Substances and Disease Registry) MRL (2009): inhalation 0,01 mg/m3, oral acute 0,006 mg/kg/day.
Rats: acute oral LD50 1250 mg/kg (other source 2700 mg/kg ?)
Other LD50 values (in mg/kg): 80 – 135 mice, 250 – 355 guinea pigs, 130 rabbits, 8 hens, 3 pheasants, 3,5 ducks, 100 pigs

Chronic toxicity:

oral chronic 0,0007 mg/kg/day
In pigs, mortality evident at 2,5 mg/kg/day and above. In dogs, above 10mg/kg/day.

Reproductive effects:

One study found neurological and bone effects in young children living in a house where diazinone was misused to control a flea infestation. In animals, levels of exposure high enough to affect the health of pregnant mothers caused developmental effects in their new born babies.

Ecological effects

Birds are quite susceptible to diazinone poisoning. The use of diazinone in open areas poses a "widespread and continuous hazard" to birds. Birds are significantly more susceptible to diazinone than other wildlife (more deaths than with any other pesticide except carbofuran). In one US incident, diazinone applied at two pounds per acre caused death of 85 wigeons after just 30 minutes of feeding. LD50 values for birds range from 2.75 mg/kg to 40.8 mg/kg. The intermediate degradate diazoxon is also very highly toxic to birds, while oxypyrimidine, the terminal degradation product, is practically not-toxic to birds. Diazinone is highly toxic to fish. In rainbow trout, the diazinone LC50 is 2.6 to 3.2 mg/L. Growth of early life stages of fish was inhibited at concentrations between 0,01 and 0,2 mg/litre. There is some evidence that saltwater fish are more susceptible than freshwater fish. Diazinone water concentrations ranging from 0,2 to 5,2 mg/L have been associated with fish kills. Studies show that diazinone does not bioconcentrate significantly in fish. It is highly toxic to bees. The LC50 for the earthworm is 130 mg/kg soil. Diazinone has been

found in rivers across the US and it is one of the most commonly detected insecticides in air, rain and fog.

Carcinogenity

It has not been shown to cause cancer in people or animals. The IARC has not classified it for carcinogenity. EPA classified it as a group E chemical (noncarcinogenic). Governmental Industrial Hygienists (ACGIH, 2007) into category A4 – not a human carcinogen. However, two studies reported weak associations between exposure to diazinone and lung cancer. There are possible links between diazinone exposure and non-Hodgkin´s lymphoma, multiple myeloma and childhood brain cancer - use of diazinon by farmers in Iowa and Minnesota has been linked to increased risk of non-Hodgkins lymphoma (*K.B. Cantor, et. al., Pesticides and other risk factors for non-Hodgkin's Lymphoma among men in Iowa and Minnesota, Cancer Research, 1992, 52, pp2447-2455.).*

Mutagenity: in one test it was considered to have a mutagenic effect on human lymphocytes. However, a test on mice was negative. In vitro tests also negative.
Bioaccumulation: it does not bioaccumulate (once in the body, most of it is eliminated within 12 days)
Mobility: moderately mobile

Persistence and degradability in environment

Diazinone is found in all environmental compartments. It is moderately persistent. In air it is quickly transformed into diazoxon. Released to surface water or soil is subject to volatilization, photolysis, hydrolysis, and biodegradation. The half-life ranges from 70 hours to 12 weeks in water and 10 to 200 days in soil. Has potential to migrate through the soil and into groundwater. Concentrations in outdoor air up to 0,002 ppb, up to 13 ppb in indoor air. Mean soil concentrations of 13 to 268 ppb, up to 38 ppb in sediment. Generally less than 0,02 ppb in surface water, with higher levels near application sites. Not typically detected in drinking water sources, but was found at 0,02 ppm in 5 of 53 drinking wells.[1]

Limits

drinking water: EPA – 20 µg/L for up to 10 days and 1 µg/L during lifetime – safe
food: EPA – 0,1 – 40 ppm
fruits, vegetables (ppm) – 0,75 (Australia, USA), 0,25 (Canada), 0,5 (Germany, Netherlands)
cereals – 0,0 (proposed in India)
olive oil – 2 (Italy), 1 (USA)
The Consumers Union in the US is concerned that tolerance levels for diazinone are too high, especially for children.
ADI: 0,02 mg/kg/day for humans (WHO/FAO)

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] Agency for Toxic Substances and Disease Registry (ATSDR). 2006. Toxicological Profile for Diazinone. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

Links

http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=90
http://www.atsdr.cdc.gov/ToxProfiles/tp86.pdf
http://www.inchem.or/documents/jmpr/jmpmono/v070pr06.htm
http://inchem.org/documents/icsc/icsc/eics0137.htm
http://www.inchem.org/documents/ehc/ehc/ehc198.htm
http://npic.orst.edu/factsheets/diazinonetech.pdf
http://www.pesticideinfo.org/Detail_Chemical.jsp?Rec_Id=PC35079
http://www.pan-uk.org/pestnews/Actives/diazinone.htm

This chemical profile is developed with the financial assistance of the European Union . Its contents are sole responsibility of Arnika Association and Armenian Women for Health and Healthy Environment and can under no circumstances be regarded as reflecting the position of the European Union.