Developed and designed by Thanal Conservation Action Information and Trading Network Private Limited

A project of Savitri

Technical support by PAN India

HIGHLY HAZARDOUS PESTICIDES

CYPERMETHRIN

(Insecticide/acaricide)

It is a broad-spectrum insecticide/acaricide used to control the pests like lepidopterans, aphids, weevils, yellow cereal fly, flea beetles and midges on cereals, vegetables, and fruits. It is known to cause acute and chronic toxic effects (neurotoxic and carcinogenic effects) in animals and humans.

IUPAC Name - [cyano-(3-phenoxyphenyl) methyl] 3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropane-1-carboxylate

CAS NO: 52315-077-8

Substance group- Pyrethroid insecticide

Trade names - Cymbush (Syngenta), Cyrux (UPL), Colt (PI Ind.), Super Killer 25 (Dhanuka), Super Fighter (IIL), Jackpot-25 (Crystal), Cyperkill (Coromandel), Auzar 25EC (BioStadt), Cyper- 25 (National Pesticide and chemicals), Sakthi (Unikil pesticides), Striker 10(Indo Biochem), Cyperfill (Agrofill industries)

Classification - WHO- Class II (Moderately hazardous)

US EPA- Group C- Possible Human Carcinogens

Bans- It is banned in 29 countries of European Union.

Mode of action- non-systemic. Contact and stomach action. It is involved in sodium channel modulation.

General properties

Cypermethrin has a chemical structure which is based on pyrethrin, an insecticidal compound found in chrysanthemum flowers

It exists as an odourless crystal or yellow-brown viscous semisolid at ambient temperatures (technical grade). It is both a stomach poison and a contact insecticide. It has a low aqueous solubility and is volatile

Formulations- 6 Formulations; Alphacypermethrin 0.1 %, RTU Alphacypermethrin 0.5% Chalk, Alphacypermethrin 0.667 % LLIN, Alphacypermethrin 05 % WP, Alphacypermethrin 10.00% EC, Alphacypermethrin 10.00% SC

GHS Hazard Statements-

GHS Signal Word: Warning

H302: Harmful if swallowed [Warning Acute toxicity, oral]

H332: Harmful if inhaled (Acute toxicity, inhalation)

H335: May cause respiratory irritation (Specific target organ toxicity, single exposure; Respiratory tract irritation)

H400: Very toxic to aquatic life (Acute hazardous to the aquatic environment)

H410: Very toxic to aquatic life with long lasting effects (Long-term hazardous to the aquatic environment)

Exposure root- Exposure may occur through inhalation or by ingestion.

Residues- In samples of rice, spices, and vegetables collected from local markets and monitored for the presence of pesticide residues from different states, cypermethrin was found above MRL (Annual project report of All India Network Project on Pesticide Residues, Indian Agricultural Research Institute 2018-19)

Quinalphos and Chlorpyrifos were found in higher concentrations at four locations near the freshwater resource in Kashmir Valley.

The Maximum Residue Limit (MRL) prescribed for Cypermethrin according to Food Safety and Standards (Contaminants, toxins, and residues) Regulations, 2011 is given in mg/kg.

Rice	-2.0
Brinjal	-0.2
Cotton seed oil	-0.01
Meat	-2.0
Milk	-0.05
Cabbage	-2.0
Okra	-0.5

Regulatory status:

International regulation: It is not approved by COPR regulatory status and EC regulation 1107/2009 status

Products containing the pesticide, Cypermethrin are classified as Restricted Use Pesticides (RUP) by EPA.

In 1981, the JMPR established an acceptable daily intake (ADI) for cypermethrin of 0-0.05 mg/kg body weight.

WHO has classified cypermethrin as an "irritant to eyes and sensitizer of skin" in the list of "technical products unlikely to present an acute hazard in normal use" (WHO, 1986).

Federal Register of the US has set a tolerance limit for cypermethrin for commodities/vegetables which are involved in trade under WTO**.**

The cypermethrin alpha, beta, theta and zeta are banned in 29, 30, 1 and 28 countries respectively. It is considered a Highly Hazardous Pesticide (HHP) by PAN International. Products containing the pesticide are classified Restricted Use Pesticides (RUP) by EPA

National regulation: Cypermethrin is toxic-labelled blue colour (Moderately Hazardous)

In India, Cypermethrin 3 % Smoke Generator, is to be used only through Pest Control Operators and not allowed to be used by the General Public.

The monitoring data submitted to FAO WHO Joint Meeting of Pesticide Residues (JMPR) by Codex Alimentarius Commission (CAC) has set an MRL of 3 ppm for cypermethrin in cardamom

Health Hazards

Acute toxicity: Cypermethrin is reported to cause human health issues like eye and respiratory tract irritations. Acute exposure is associated with symptoms of burning sensation, cough, dizziness, headache, nausea, muscle twitching, seizures, itching and shortness of breath.

cypermethrin is classified among the Type II compounds, which cause toxic signs of choreoathetosis with salivation (CS-syndrome) in the rat (Verschoyle & Aldridge, 1980)

The oral LD_{50} for the rat ranged from 200-4000 mg/kg body weight.

Chronic toxicity: It is a potent endocrine disruptor and a possible liver and kidney toxicant. Cypermethrin is reported to cross the blood-brain barrier and induce neurotoxicity (Kumar et al, 2012).

Chronic studies in dogs have shown an increased incidence of gastrointestinal symptoms including the elevated incidence of fluid faeces and vomiting at 5 mg/kg for a year (USEPA)

Slight to severe skin irritation, decreased food consumption, body weight and absolute and relative gonad weights have been observed in rabbits treated with cypermethrin (Handerson and Parkinson, 1981)

Neurotoxicity: Cockroach brain cells exposed to very small doses (0.02 µg/ gram of brain wt) of cypermethrin exhibited nervous system responses like restlessness, incoordination, prostration, and paralysis (Gammon. D.W et al, 1981)

Endocrine Toxicity: Cypermethrin induced endocrine disruption in adolescents including the antiandrogenic effect on male Wistar rats (Jin Y Wang et al, 2011, Shepelska. N. R et al, 2021)

Reproductive toxicity: Decreased number of implantation sites and the number of viable foetuses was seen in rabbits treated with cypermethrin (Elbetieha et al., 2001).

Exposure of male and female Wistar Han rats to alpha-cypermethrin at doses of 0.2–3.0 mg/kg during gametogenesis had a toxic effect on the reproductive system characterized by impaired gonadal and reproductive functions (Shepelska. N. R et al, 2021)

Carcinogenic effect: Cypermethrin induced tumour formation in male and female rats at all doses, when tested for complete carcinogenic activity (Shukla, Y et al, 2002)

Metabolic effects: Cypermethrin affects the crucial pathways of carbohydrate metabolism by affecting certain hormone functions. The homeostatic mechanism existing between glucose, glycogen, lactic acid, and pyruvic acid is impaired in fishes which affects their survival (Ansari, B. A et al, 1988)

Poisoning Data

Cypermethrin was responsible for 4 deaths and 58 admissions to hospital in 2002, Warangal poisoning

Following Yavatmal Poisoning in 2017, Maharashtra government banned Cypermethrin in 2017.

A case report of a 30-year-old following suicidal ingestion of 10% Cypermethrin exhibited severe hypoxia, recurrent vomiting, epigastric and throat pain and dyspnea.

Antidotes - No specific antidote

Environmental fate and effects:

It is a moderately persistent insecticide with low leachability. The soil half-life of cypermethrin is 8-16 days. It has an extremely low potential to move in the soil and is unlikely to contaminate groundwater because it binds tightly to soil particles. Cypermethrin is stable in sunlight. The average half-life of cypermethrin on foliage is 5 days

Ecotoxicity

Mammals- Moderate acute toxicity

Birds - Low acute toxicity

Earthworms- Moderate acute toxicity

Honeybees - High Contact and Oral acute LD50

Fish - Fish acute toxicity

Aquatic invertebrates -High acute toxicity

Alternate pest management

Sustainable ecological solutions to replace chemical Pesticides include the use of biopesticides and numerous cultural, mechanical and biological solutions to pest control, as well as natural sprays that can be used depending on the pest and the situation that relies on the utilization of agroecological practices.

Notes on HHPs

Highly Hazardous pesticides or HHPs are a group of pesticides, that can pose serious risks to humans and cause irreversible damage to the environment. They are listed in international conventions and are banned in many countries. The handling and use of these HHPs are beyond the safety level of PPE as stated by SAICM.

HHPs upon exposure enter the body through food, inhalation, or dermal contact. These pesticides cause lethal effects, especially when exposed for the long term. It includes acute toxicity (Headache, Nausea, Vomiting etc) to Chronic hazards (Gene mutations, Cancer, Reproductive dysfunction etc). Farmers, applicators, and their families are mostly exposed to pesticides. The increased closeness of residents to farming areas worsens the situation and their exposure can occur under deplorable conditions, such as handling, storing, mixing, loading, spraying, disposing, and washing pesticide containers or pesticide-soaked clothes.

Women are the most affected by the ill effects of HHP use, as they have a higher proportion of hormone-sensitive tissues, fats, and primary reproductive tasks. HHPs can cause birth defects, miscarriage, early onset of puberty, sexual maturation, infertility, and abortions in female children. Children are exposed to the HHP-contaminated environment as they consume more air, water and food per unit of body weight. They have a higher metabolism and their immunity and developing functions are compromised at a young age.

REFERENCES

1. Ansari, B. A., & Kumar, K. (1988). Cypermethrin toxicity: effect on the carbohydrate metabolism of the Indian catfish, Heteropneustes fossilis. *Science of the total environment*, *72*, 161-166.
2. Elbetieha, A., S. I. Da'as, W. Khamas and H. Darmani, 2001. Evaluation of the toxic potentials of cypermethrin pesticide on some reproductive and fertility parameters in the male rats. Arch. Environ. Contam. Toxicol., 41(4): 522-528.
3. Environmental Protection Agency. (1989). Cypermethrin Pesticide Fact Sheet. Washington, D.C.
4. Gammon, D. W. et al. (1981). Two classes of pyrethroid action in the cockroach. Pestic. Biochem. Physiol. 15:181-191.
5. Handerson, H. K. and F. N. Parkinson, 1981. Effect of cypermethrin on haematology, clinical chemistry and gonads of male rabbit. Vet. Med. J. (Giza), 31(1): 32-37.
6. Jin, Y., Wang, L., Ruan, M., Liu, J., Yang, Y., Zhou, C., ... & Fu, Z. (2011). Cypermethrin exposure during puberty induces oxidative stress and endocrine disruption in male mice. *Chemosphere*, *84*(1), 124-130.
7. Knisel, W.G. (Ed.). (1993). Groundwater Loading Effects of Agricultural Management Systems. (Version 2.10). [Online]. Tifton, Georgia: United States Department of AgricultureAgricultural Research Service. [Online]. http://www.arsusda.gov/ rsml/ppdb.html
8. Shepelska, N. R., Prodanchuk, M. G., & Kolianchuk, Y. V. (2021). Comparative analysis of two methodological approaches to the study of endocrine disruptor alpha-cypermethrin reproductive toxicity. *Regulatory Mechanisms in Biosystems*, *12*(4), 724-732.
9. Shukla, Y., Yadav, A., & Arora, A. (2002). Carcinogenic and cocarcinogenic potential of cypermethrin on mouse skin. *Cancer Letters*, *182*(1), 33-41.
10. Shukla, Y., Yadav, A., & Arora, A. (2002). Carcinogenic and cocarcinogenic potential of cypermethrin on mouse skin. *Cancer Letters*, *182*(1), 33-41.
11. Ullah, M. S., Ahmad, M., Ahmad, N., Khan, M. Z., & Ahmad, I. (2006). Toxic effects of cypermethrin in female rabbits. *Pakistan veterinary journal*, *26*(4), 193.
12. Umar Singh, A., Nath Tiwari, M., Prakash, O., & Pratap Singh, M. (2012). A current review of cypermethrin-induced neurotoxicity and nigrostriatal dopaminergic neurodegeneration. *Current neuropharmacology*, *10*(1), 64-71.
13. United States Environmental Protection Agency. (1989). Cypermethrin Pesticide Fact Sheet. Washington, D.C.
14. WHO (1986) The WHO recommended classification of pesticides by hazard and guidelines to classification 1986-87. Geneva, World Health Organization (Unpublished WHO document VBC/86.1).
15. WHO/FAO (1975-87) Data sheets on pesticides. (Unpublished WHO documents

Web References

https://agricoop.nic.in/sites/default/files/PPfinal2732015.pdf
Conatminants-Mi020811.pmd (fssai.gov.in)

https://www.fao.org/3/i4854e/i4854e.pdf