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

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HIGHLY HAZARDOUS PESTICIDES

PROFENOFOS

(Insecticide)

It is a non-systemic organic thiophosphate insecticide used for the control of Bollworm, Jassids, Aphids, Thrips, Whiteflies, Semi looper in soybean and cotton. It is known to cause acute and chronic toxic effects (neurotoxic and reproductive effects) in animals and humans

IUPAC Name- 4-bromo-2-chloro-1-[ethoxy(propylsulfanyl)phosphoryl] oxybenzene

CAS NO: 41198-08-7

Substance Group- Organophosphate insecticide

Trade names -Curacron (Syngenta), Celcron (Excel), Jashn (TATA), Kriphos (KR), Proven (MIL), Carina (PI Ind.), Devi-soldier (Devidayal), Profenofos 50 EC (GAICL), Banjo (IIL), Maxcron (Vimax), Jashn (TATA), Tagpro (Tropical), Aurifos (Cheminova), Sucron (SuperCSL), Kilcron (Crystal), Ajanta (Coromandel), Hilfos (HIL), Kombat (PCCPL), Profex (Nagarjuna), Orax (Atul), Prahar & Prudent (BioStadt), Profax (AOL)

Classification- (WHO) - Class II- Moderately hazardous

Bans: Profenofos is banned in 34 countries including Indonesia, Saudi Arabia and Switzerland

Mode of action- Profenofos inhibits the enzyme acetylcholinesterase (AChE) which leads to the accumulation of acetylcholine in neural junction resulting in neurotoxicity in the central and peripheral nervous system, where the parent compound itself is the inhibitor and no intermediates like oxons are required.

General Properties

It is a trans-laminar pesticide, where it moves into deeper layers of plant tissues and affects foliar-feeding insects.

It is a Cholinesterase inhibitor and shows higher rates of RBC AChE inhibition than brain AChE inhibition

It exists at room temperature as a pale-yellow liquid with a pungent odour.

It is a non-systemic insecticide derived from 4-bromo-2-chlorophenol, which is soluble in organic solvents and mildly soluble in polar solvents

Formulations - 1 (Profenofos 50 % EC)

GHS Hazard Statements-

GHS signal word: WARNING

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

H312: Harmful in contact with skin [Warning Acute toxicity, dermal]

H332: Harmful if inhaled [Warning Acute toxicity, inhalation]

H400- Very Very toxic to aquatic life (Hazardous to the aquatic environment, acute hazard)

Exposure root- The substance can be absorbed into the body by inhalation, ingestion and dermal absorption

Residues: Profenofos has a maximum residue limit of 0.01 mg/kg in fruits and nuts as of 14/08/2022(European Commission)

Non-approved use of profenofos was noted in vegetable samples collected from multiple states in

India in All India Network Project on Pesticide Residues, Indian Agricultural Research Institute 2018-19

The JMPR meeting in 2008 estimated a maximum residue level of 0.05mg/kg in poultry meat and edible offal, and 0.02 mg/kg in eggs

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

Cotton seed oil	-3.0
Soybean	-0.01
Meat	-0.05

Regulatory status:

International regulation: It is not approved by U.K COPR regulation and EU regulation (1107/2009)

EPA has assessed the risks of profenofos and reached an Interim Reregistration Eligibility Decision (IRED) where it stated that its risks are within acceptable levels. Profenofos was made eligible for reregistration (EPA Profenofos facts, July 2000)

The estimate of acceptable daily intake for humans 0–0.03 mg/kg bw was re-evaluated by the periodic review programme of the Codex Committee on Pesticide Residues (CCPR) (2000)

National regulation: Profenofos is toxic-labelled yellow colour

It has a volume consumption of 486.4 metric tons in the year 2021 in India

It is approved for 2 crops nationally which are cotton and soybean and is used to control pests like Bollworm, Jassids, Aphids, Thrips, Whiteflies, Semi looper and Girdle beetle

Health Hazards

Acute toxicity: Acute risks are of concern for fishes, birds, and honeybees (PPDB). Large-scale fish kills were observed due to overexposure to profenofos. Thirteen such fish kills occurred in Louisiana and Mississippi during 1994-1996.

Profenofos is classified as acutely toxic via the oral (Toxicity Category II) and dermal routes (Toxicity Category I or II) and classified as having low acute toxicity via the inhalation route (Toxicity Category IV).

Signs of oral toxicity include impaired respiration, ataxia, reflexes, and tremors (US EPA). It was also found to be a dermal sensitizer. It was found to be a minimal eye irritant and a moderate dermal irritant (Toxicity Category III).

Chronic toxicity: Profenofos can cause cholinesterase inhibition in humans where it can overstimulate the nervous system resulting in nausea, dizziness, confusion, and at very high exposures and respiratory paralysis and death in severe cases (national technical resource library)

Profenofos is labelled as, Aquatic chronic 1(H410) hazardous to the aquatic environment (GHS)

Carcinogenicity: Profenofos is classified as a "Group E Chemical – evidence of non-carcinogenicity for humans" based on the lack of evidence of carcinogenicity in rats and mice.

Histopathological studies in rats showed a dose-dependent induction of hyperplasia when given profenofos added corn food through a stomach tube (Sarah G et al,2011)

Neurotoxicity: Neurotoxicant (GHS)

Inhibition of acetylcholine esterase activity was observed in the study on euryhaline fish, *Oreochromis mossambicus* (Venkateswara Rao J et al,2002)

AChE activity was significantly inhibited when earthworm, *Eisenia foetida* was exposed to profenofos at 3.55 mg/cm2 for 48 h (N. Chakra Reddy and J. Venkateswara Rao,2007)

Cytotoxicity: Profenofos induces mortality and considerable changes in haemoglobin content in fish, *Labio rohita* (Sadhna Kesharwani et al, 2017)

Cytotoxic damage and genotoxic damage exerted by profenofos in an invitro sample of human peripheral blood lymphocytes were also observed (G. Prabhavathy Das et al, 2006)

Endocrine disruption: Not suspected (GHS, US EPA)

Profenofos-treated embryos of Zebra fish showed increased malformations in organogenesis (Zakia sultana et al, 2021)

Oral and dermal exposure to profenofos exerts disruption in the male reproductive organs of male rats (Moustafa G.G et al,2007)

Similar results were seen where profenofos induced disruption of

testicular tissues (Leydig cells) in rabbits (S. A. Memon et al, 2014)

Genotoxicity: No reported genotoxicity (GHS)

Studies on In Vivo Genotoxicity of Profenofos to Chinese Native Amphibian, *Rana spinosa* tadpoles exhibited higher DNA damage in gel electrophoresis and micronuclear assay (Xianbin Li et al,2010)

Profenofos can induce genotoxicity in the marine fish *T. jarbua* even in low concentrations where DNA damage was noted using comet assays (V. Janaki Devi et al,2012)

Poisoning Data

Two people were poisoned by Profenofos during the infamous Warangal poisoning, 2002.

Following severe poisoning in the Yavatmal district of Maharashtra, Profenofos was banned in 2017.

Antidote- Administration of Atropine sulfate (1 mg) for organophosphate toxicosis is the recommended antidote.

Environmental fate and effects: Aerobic soil degradation values denote its non-persistent nature in soil

It has a BCF value of 1186/kg, which is a threshold for concern

Ecotoxicity

Mammals- Moderate acute toxicity

Birds- High acute toxicity

Earthworms- High acute toxicity

Honeybees- High acute toxicity

Fish - High acute toxicity

Aquatic invertebrates-Moderate acute toxicity

Aquatic crustaceans- High acute toxicity

Alternate Pest management

Sustainable ecological solutions to replace chemical Pesticides include the use of bio-pesticides 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.

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