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

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HIGHLY HAZARDOUS PESTICIDES

FIPRONIL
(Insecticide)

It is a broad-spectrum contact insecticide used for the control of Leaf folder, Diamondback moth, shoot borer, Thrips, Stem borer, Brown plant hopper etc in rice, wheat, sugarcane etc. It is known to cause acute and chronic toxic effects (neurotoxic and reproductive effects) in animals and humans and has no specific antidote.

IUPAC Name- 5-amino-1-(2,6-dichloro-α, α, α-trifluoro-p-tolyl)-4-trifluoromethylsulfinylpyrazole-3-carbonitrile

CAS NO: 120068-37-3

Substance Group- Pyrazole insecticide

Trade names -: Regent (BASF) Gr, Agadi-G (HPM Chemicals) Jump 80 WG (Bayer), Blitz, Icon Termidor Ceasefire (Aventis CropScience) Over and Out, Termidor. Chipco, Choice Top Choice (BASF)

Classification-

WHO- Class II- Moderately hazardous

Banned countries- Fipronil is banned in 38 countries including UK, Turkey, and Senegal.

Mode of action- It affects the gamma-aminobutyric acid neurotransmission system by interfering with the passage of chloride. Disruption of the GABAA receptors by fipronil prevents the uptake of chloride ions resulting in excess neuronal stimulation and death of the target insect

General properties:
Fipronil is a phenyl pyrazole insecticide, whereas the technical grade fipronil is a white powder with a mouldy odour.

It was first introduced to the U.S. in 1996 for commercial turf and indoor pest control.

It has contact and stomach action

Fipronil on photodegradation converts into Fipronil-di sulfonyl whose toxicity is greater than that of the parent molecule, fipronil

It acts as a GABA-gated chloride channel antagonist.

It has low aqueous solubility and volatility

Formulations - 8 (Fipronil 00.03 % & 0.5 % Gel, Fipronil 00.05 % GEL, Fipronil 00.30 % GR Fipronil 00.60 % w/w GR, Fipronil 02.92 % EC , Fipronil 05 % SC , Fipronil 18.87 % w/w SC , Fipronil 80 % WG)

GHS Hazard Statements-

GHS SIGNAL WORD: DANGER

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]

H360: May damage fertility; Suspected of damaging the unborn child [Danger Reproductive toxicity]

H373: Causes damage to organs through prolonged or repeated exposure [Warning Specific target organ toxicity, repeated exposure]

H410- Very toxic to aquatic life with long-lasting effects [Warning

Hazardous to the aquatic environment, long-term hazard]

Exposure root- Occupational exposure may occur through inhalation and ingestion

Residues: The maximum residue limit proposed by the European Commission for Fipronil in fruits (Fresh and frozen) and nuts is 0.05 mg/kg (applicable from 18/05/2020)

The European Commission has set a maximum residue limit (MRL) for the sum of fipronil and fipronil sulfone in eggs and poultry meat as 0.005 mg/kg (Commission Regulation 396/2005 as of 19/09/2022)

0.08 ppm Fipronil which exceeds FSSAI MRL limit of 0.01 was found in Fruit samples collected from New Delhi, in the Annual project report of All India Network Project on Pesticide Residues, Indian Agricultural Research Institute 2018-19.

A Joint Meeting of FAO Panel of Experts on Pesticide Residues in Food and the Environment and WHO Core Assessment Group on Pesticide Residues (JMPR) concluded that long-term dietary exposure to residues of fipronil from uses considered in the Meeting may present a public health concern. Residues of the sum of fipronil and fipronil-sulfone were found to be 14× higher in milk fat compared to whole milk from the same JMPR meeting

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

Rice	-0.01
Cabbage	-0.02
Cotton seed oil	-0.01
Tea	-0.01
Chilli/sugarcane	-0.01
Milk	-0.02
Meat	-0.01
Onion	-0.04

Regulatory status:

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

Fipronil is severely restricted within the European Union in the use category 'pesticides' and should be added to the lists of chemicals in Parts 1 and 2 of Annex I to Regulation (EU) No 649/2012.

In 2017, due to the detection of fipronil, millions of eggs were taken off the European market. This was done after notifications in the Rapid Alert System for Food and Feed (RASFF) of the European Commission.

Fipronil was reviewed for toxicity after finding significant effects in bees. EU report in 2013 stated that, the risk to bees cannot be excluded except by imposing further restrictions on the use of plant protection products containing fipronil as laid down in Regulation (EU) No 781/2013.

It is an HHP according to JMPM criteria.

National regulation: Fipronil is Toxic-labelled yellow colour (Highly Toxic)

It is recommended for 8 crops nationally which are rice, cabbage, chilli, sugar cane, wheat, grapes, onion, and cotton against insect pests like Leaf folder, Diamondback moth, shoot borer, Thrips, Stem borer, Brown plant hopper, green leaf hopper, Rice leaf hopper, Rice gall midge, Whorl maggot, etc.

It has a volume consumption of 256.83 metric ton units in India in the year 2021

Health Hazards

Acute toxicity: Fipronil is moderately toxic via ingestion, inhalation, and skin absorption (GHS)

It is of moderate dermal toxicity to rabbits and is less toxic to mammals than to fish, some birds, and invertebrates (NCAMP Factsheet)

Toxicology Characteristics of Technical Grade Fipronil (USEPA)

- Acute oral (Rat): LD50 97 mg/kg; Tox Category II
- Acute dermal (Rabbit): LD50 354 mg/kg; Tox Category II
- Acute dermal (Rat): LD50 > 2000 mg/kg; Tox Category III
- Acute inhalation (Rat): LC50 0.39mg/L; Tox Category II

Acute toxic effects include dizziness, headache, paresthesia, seizure, confusion, slurred speech, nausea, vomiting, diarrhoea, abdominal pain and tachycardia. Other symptoms include upper respiratory pain, rash, and painful eyes.

According to the U.S. Environmental Protection Agency (EPA) studies, pets treated with fipronil flea products have developed skin irritation, lethargy, incoordination, dilated pupils, facial swelling, and convulsions.

Chronic toxicity: Fipronil is a suspected carcinogen, has targeted effects on the central nervous system, cardiovascular system, and reproductive system and is a thyroid, kidney and liver toxicant. It is a skin, eye irritant and a potential neurotoxicant.

In an acceptable chronic rat feeding study; seizures, decreased body weight gain, decreased food consumption and food conversion efficiency, decreased haematology parameters, alterations in clinical chemistry (cholesterol, calcium, and protein), alterations in thyroid hormones, alterations in urine chemistry, changes on gross necropsy, increase in liver and thyroid weights, and progressive senile nephropathy (kidney effects) was observed (Fipronil. May 1996. New Pesticide Fact Sheet. US EPA Office of Prevention, Pesticides and Toxic Substances)

Carcinogenicity: Fipronil is classified as Group C 'Possible human carcinogen' by US EPA

Fipronil is carcinogenic to rats at doses of 300 ppm, causing thyroid cancer - thyroid follicular cell tumours. Based on this study EPA has classified it as a possible human carcinogen.

Reproductive Toxicity: Reproductive toxicity study in rats showed that fipronil is associated with altered reproductive behaviours (Fipronil. May 1996. New Pesticide Fact Sheet. US EPA Office of Prevention, Pesticides and Toxic Substances). According to USEPA,

- NOEL for parental toxicity - 3 ppm
- LOEL for parental toxicity - 30 ppm.
- NOEL for reproductive toxicity - 30 ppm
- LOEL for reproductive toxicity - 300 ppm

Neurotoxicity: Fipronil has demonstrated neurotoxicity in acute and sub chronic rat studies, as well as in the rat chronic/oncogenicity and chronic dog studies

Fipronil inhibited DNA and protein synthesis in undifferentiated neuronotypic cells and induced oxidative stress, resulting in reduced cell numbers. These studies also concluded that fipronil is inherently a more potent disruptor of neuronal cell development than chlorpyrifos (Lassiter T.L et al,2009)

Endocrine Disruption: Fipronil is anti-androgenic in action.

Fipronil can disrupt thyroid function – which is responsible for the regulation of cell metabolism by decreasing plasma concentrations of total thyroxine (T4) likely through increased T4 clearance (Leghait J et al,2009)

Poisoning Data

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

Antidote- No specific antidote is available

Environmental fate and effects: Fipronil is a persistent pesticide with a soil half-life of over 210 days.

Fipronil is relatively immobile (mean KO, 727 ml/ g) in terrestrial environments. Biodegradation is considered the primary process of dissipation. In aquatic systems, it is expected to adsorb to suspended solids and sediments.

It gets accumulated in fish and arthropods. It induces swimming impairments and developmental neurotoxicity in fish. This pesticide is extremely toxic to aquatic invertebrates and highly toxic to birds (PANAP FACT SHEET)

Fipronil appears to bioaccumulate in fish when exposed to treated water at a concentration of about 900 nanograms for 35 days (Fipronil. May 1996. New Pesticide Fact Sheet. US EPA Office of Prevention, Pesticides and Toxic Substances)

Ecotoxicity

Mammals- High acute toxicity

Birds- High acute toxicity

Earthworms- Moderate acute toxicity

Honeybees- High acute toxicity

Fish - Moderate 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 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.

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