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

A project of Savitri

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HIGHLY HAZARDOUS PESTICIDES

ZIRAM

(Fungicide)

It is a broad-spectrum fungicide applied primarily on plant foliage for control of early blight, scab, and seed treatments. It is acutely toxic and is capable of inducing cytotoxic, carcinogenic and reproductive toxic effects in animals. It has no specific antidote.

IUPAC Name- zinc; N, N-dimethylcarbamodithioate

CAS NO: 137-30-4

Substance Group- dithiocarbamate fungicide

Trade names - Cuman L (Syngenta), Ziram (HPM), Zirus (Jai Rasayan), Ziron (Abachem)

Classification-

(WHO)- Class III (Slightly hazardous)

EPA- Toxicity Class III

Banned Countries- Ziram is banned in 3 countries: Canada, UAE, and Brazil.

Mode of Action: It is a broad-spectrum foliar fungicide

General properties

Ziram is a colourless odourless powder at room temperature

Ziram is a dithiocarbamate fungicide used as an insect repellent and used in rubber industry for vulcanization and as an additive in adhesives and latex (USEPA, 2004)

It is a protective fungicide which prevents further diseases but fails to kill established infestations (SRL International report to USEPA,1983)

They are applied to uninfected plants and require frequent application

it is formulated as a rabbit repellent for outdoor foliar applications to ornamentals

It has low solubility in water and high volatility

Formulations: 2 (Ziram 27% SC and Ziram 80% WP).

GHS Hazard Statements-

GHS Signal word: DANGER.

H302: Harmful if swallowed (Acute toxicity, oral)

H317: May cause an allergic skin reaction (Sensitization, Skin)

H318: Causes serious eye damage (Serious eye damage/eye irritation)

H330: Fatal if inhaled (Acute toxicity, inhalation)

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

H373: Causes damage to organs through prolonged or repeated exposure (Specific target organ toxicity, repeated exposure)

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

H410: Very toxic to aquatic life with long-lasting effects (Hazardous to the aquatic environment, long-term hazard)

Exposure Route: Exposure by inhalation and ingestion

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

In 1977, FAO/WHO Expert Committee on Pesticide Residues established an acceptable daily intake for humans of 0.02 mg/kg bw (FAO/WHO, 1978)

Ziram residues in tomatoes should not exceed 3 mg/kg according to FSSAI

Ziram residue levels in apples, pears and wet pomaces were found to be very high and were evaluated at the FAO CCPR periodic review programme, 1996

Regulatory status:

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

Quantitative acute dietary exposure and risk assessments were performed for Ziram, as it indicated the possibility of an effect of concern occurring as a result of a 1-day or single exposure.

The USSR has established a Maximum Air Concentration (MAC) in industrial air of 0.05 mg/m3 and a recommended maximum concentration of 0.01mg/l in water reservoirs used as sources for drinking-water

National regulation: Ziram is Toxic-labelled blue colour (Slightly Hazardous)

It is recommended for 4 crops nationally: grape, apple, tomato, and potato against scabes disease, blight, and anthracnose diseases.

Ziram has 673 metric ton of production in 2022 and 475.54 metric ton of consumption in 2021

It is a deemed to be registered pesticide.

Ziram was included among 66 pesticides reviewed under the Chairmanship of Dr Anupam Verma in 2013.

361st Special Meeting of Registration Committee held on 22nd December, 2015, considered these recommendations, and decided that, 'The Certificate of Registration of technical and its formulation deemed to be invalid w.e.f. from Ist January, 2018 if studies as recommended by the Expert Committee is not submitted by December, 2017'

Health Hazards

Acute toxicity : Acute exposure to Ziram results in irritation of the skin, nose, eyes, and throat

The oral LD50 for ziram is 1400 mg/kg in rats and 480 and 400 mg/kg in mice and rabbits, respectively. Ziram has an LD50 of 100 to 150 mg/kg in guinea pigs (Hazardous Substance Databank)

It is an Eye irritant (Eye Dam. 1 - H318) and skin sensitizer (Skin Sens. 1 - H317)

Chronic toxicity: Ziram may cause damage to organs through prolonged or repeated exposure (STOT RE 2 - H373)

A single oral dose causes neurological impairments (ataxia and slight impaired gait) while repeated short-term exposure results in inhibition of brain cholinesterase and brain neurotoxic esterase in rats (Ziram, Federal Register)

The primary target organ for short- and long-term treatment with ziram were liver, thyroid gland, and testes in rats and dogs. Increased liver weight, degeneration, and focal-cell necrosis (liver), C-cell hyperplasia and carcinomas in thyroid glands, and sterility were noted (Evaluation in CCPR periodic review programme, 1996)

Carcinogenicity: Ziram has shown evidence of carcinogenicity, but not Sufficient to assess Human Carcinogenic Potential (USEPA, 2006)

IARC Group 3: Not classifiable as to its carcinogenicity to humans

Ziram was found to cause Thyroid cancer in male rats upon long-term exposure (National Toxicology Program. Carcinogenesis Bioassay of Ziram, 1983)

Reproductive Toxicity: Reproductive effects of Ziram include adverse effects on body weight, Retarded testicular development and degeneration in seminiferous epithelium of mature fowl (WHO data sheet on Ziram, 1987)

Ziram administration in mice by gastric intubation during the first five days of pregnancy resulted in marked reductions in fertility and foetal weight by day 21 of

gestation in rats (Giavini et al, 1983)

Injection of ziram into the air chamber of eggs prior to incubation was found lethal to chick embryos. (LD50; 2.1 µg/egg) (Gebhardt & Van Logten, 1968)

Genotoxicity: Ziram was found to be genotoxic to the somatic and germ cells of Drosophila melanogaster (Tripathy N K et al, 1989)

Neurotoxicity: In a study on the Induction of Parkinson's disease in zebrafish embryo, Ziram tested positive (Lulla A et al, 2016)

Ziram increased neuronal excitability, the probability of synaptic vesicle release in Drosophila melanogaster (Jenna Harrigan et al, 2020)

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Immunotoxicity: Ziram exposure as little as 125 nm decreased NK cytolytic activity (Wilson et al., 2004).

Ziram was found to induce apoptosis/necrosis in U937 (a human monocyte-like cell line) in a time- and dose-dependent manner (Q. Li et al, 2011)

Developmental Toxicity: Ziram negatively impacts embryonic development (i.e., mortality, hatching, heartbeat and notochord development) of zebrafish, decreases basal respiration of embryos, and alters behavioural responses in larvae (F. Cao et al, 2019)

In Pregnant Sprague Dawley dams ziram administration resulted in biphasic effects on Foetal Leydig cells (FLC) development with a low dose to increase FLC number and function and a high dose to decrease them (J Liu, 2018).

Mutagenicity: Ziram was found to be mutagenic in bacteria. Plate incorporation assay with S. typhimurium demonstrated direct mutagenicity of ziram (Franekic J et al, 1994)

Antidote- No specific antidote is available

Environmental fate and effects:
Ziram is sparingly soluble in aqueous solutions and is highly volatile in nature
It is moderately toxic to mammals and is highly toxic to birds, fish and aquatic invertebrates.

It has a typical half-life of 8 to 9 hours for soil photolysis and it degraded much faster under aerobic than anaerobic conditions
Dithiocarbamates like Ziram binds to various transition metals, forming more lipophilic complexes capable of entering the central nervous system

Ecotoxicity

Mammals- Moderate acute toxicity

Birds- High acute toxicity

Earthworms- Moderate acute toxicity

Honeybees- Low acute toxicity

Fish - Moderate acute toxicity

Aquatic invertebrates- Moderate 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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