

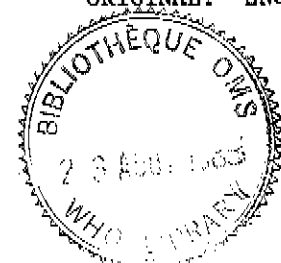
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ORIGINAL: ENGLISH

DATA SHEET ON PESTICIDES

No. 71

THIRAM



CLASSIFICATION:

Primary use: Fungicide

Secondary use: Repellent and bactericide

Chemical group: Dithiocarbamate

1. GENERAL INFORMATION

1.1 COMMON NAME: Thiram (ISO, BSI; exception USSR (TMTD) and JMAF (thiuram))

1.1.1 Identity:

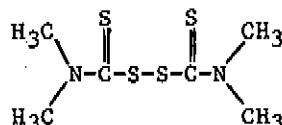
IUPAC: Tetramethylthiuram disulfide

CAS: Tetramethylthioperoxydicarbonic diamide

CAS Reg. No.: 137-26-8

Molecular formula: C₆H₁₂N₂S₄ Molecular weight: 240.4

Structural formula:



1.1.2 Synonyms: Accelerator thiuram^R; Aceto TETD^R; Arasan^R; Cyuram^R; ENT 987; Ekagom^R; Faltitram^R; Fernacol^R; Fernasan^R; Fernide^R; Hermal^R; Hermat TMT^R; Heryl^R; Kregasan^R; Mercuram^R; Methyl thiuram; Methyl tuads; Nobecutan^R; Nomersan^R; Normersan^R; Panoram^R; Polyram ultra^R; Pomarsol^R; Pomasol^R; Puralin^R; Rezifilm^R; Royal TMTD^R; Sadoplon^R; Spotrete^R; SQ1489^R; Tersan^R; Thillate^R; Thiosan^R; Thiotex^R; Thiramid^R; Thirame^R; Thirasan^R; Thiurad^R; Thiuram; Thiuramyl^R; Thylate^R; Thirampa^R; Tiuram; Tiuramyl^R; TMTD; Trametan^R; Tripomol^R; TTD^R; Tuads^R; Tulisan^R; USAF B-30; USAF EK-2089; USAF P-5; Vancide^R; Vuagr^R; Vulcafor^R; Vulkacit MTIC^R.

1.2 SYNOPSIS: Thiram is a dithiocarbamate; a fungicide with good avian and mammalian repellent properties; and a metabolic poison of low acute toxicity to mammals and a skin irritant. It also causes alcohol intolerance. It is also used as a promoter of vulcanization in the rubber industry, an activator in plastics manufacturing and as a chemosterilant in plastic film dry wound dressing. It is not phytotoxic when used as directed.

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1.3 SELECTED PROPERTIES

- 1.3.1 Physical characteristics - Thiram is a colourless, odourless crystalline compound which melts at 155-156°C. It has a density (d^{20}) of 1.29. It is non-corrosive.
- 1.3.2 Solubility - In water, 30 mg/l at room temperature. It is slightly soluble in ethanol and diethyl ether and soluble in acetone, chloroform, benzene and carbon disulfide.
- 1.3.3 Stability - Thiram readily decomposes under acidic and alkaline conditions and under prolonged exposure to air, heat or moisture. It supports combustion if ignited but is non-explosive.
- 1.3.4 Vapour pressure - Negligible at room temperature.

1.4 AGRICULTURE, HORTICULTURE AND FORESTRY

- 1.4.1 Common formulations - These include a wettable powder, 30-900 g a.i./kg; a colloidal suspension, 500 g/l; a dust seed treatment, 600 g a.i./kg; foliar dusts, 10-700 g a.i./kg; granule preparations, 22.5-50 g/kg; and a 10 g a.i./l paint-on preparation. It is also available in combination with phenylmercury dimethyldithiocarbamate, malachite green, phenylmercury acetate, gamma BHC, thiophanate and zineb at various concentrations. Mercury-containing formulations are no longer cleared for use in many countries.
- 1.4.2 Pests controlled - May be used as a repellent against rabbits, mice, deer, birds, chipmunks, moles and squirrels and as a fungicide in the control of several plant diseases.
- 1.4.3 Use pattern - As an animal repellent it may be applied undiluted with a brush to the lower trunks of trees and ornamentals; diluted as a spray on forest nursery stock and ornamentals; and diluted as a dip for bundles of forest, fruit and ornamental planting stock. When used as a dip, root contact must be avoided. Hang bundles to dry topside down. Dry thoroughly before planting. Do not use on those parts of the plant that are to be used as food when used as a repellent agent.

As a fungicide, it may be used as a dust or a slurry for treatment of seeds of a large variety of food crops, apply after the seeds have cured (for peanuts apply immediately after shelling); as a foliar-spray treatment of apple, banana and peach trees and on celery, tomato, strawberry and turf plants. For foliar treatment a spreader-sticker additive is recommended and it may be applied to bulbs and tubers of several ornamental and food plants.

Thiram is compatible with common insecticides and fungicides.

- 1.4.4 Unintended effects - Thiram is not phytotoxic.
- 1.5 PUBLIC HEALTH USE - Thiram is a chemosterilant used in the manufacture of plastic dry-wound dressings and vulcanized rubber and plastic medical devices. It was also used as an ingredient in antiseptic sprays, soaps, etc.
- 1.6 HOUSEHOLD USE - Thiram is one of a broad spectrum of fungicides available for home-garden use and as an animal repellent.

2. TOXICOLOGY AND RISKS

2.1 TOXICOLOGY - MAMMAL

- 2.1.1 Absorption route - Thiram is rapidly absorbed from the gastrointestinal tract, through the intact skin, and by inhalation of spray mist and dust.
- 2.1.2 Mode of action - Thiram and other dithiocarbamates are metabolic poisons. Their acute toxic effects are largely similar to those of carbon disulfide, supporting the conclusion that the common metabolite of these compounds is responsible for their toxicity. This conclusion is supported by the findings that most dithiocarbamates of very low toxicity are poorly absorbed and that a large portion of an oral dose is

excreted in the faeces unchanged. The exact mode of action is unclear; it involves intracellular action of metabolites of carbon disulfide, causing microsome injury and cytochrome P-450 injury accompanied by increased heme-oxygenase activity. A wide variety of factors including monoamine-oxidase inhibition, abnormal vitamin B₆ and tryptophan metabolisms, and cellular deprivation of zinc and copper have been cited as causes of the subcellular injuries.

In contrast to carbon disulfide, thiram also causes thyroid dysfunctions in vertebrates. This effect is thought to be a result of metabolic release of atomic sulfur in the follicular cells, causing inhibition of tyrosine iodination and ultimately hormone synthesis. A single dose of thiram causes a transient dysfunction; repeated doses can cause goitres. Other cellular enzymes may be similarly affected.

Thiram induces an alcohol intolerance similar to that of Antabuse (disulfiram) either by inhibiting acetaldehyde dehydrogenase or through the formation of a quaternary compound with the ethanol.

- 2.1.3 Excretion products - The metabolism and excretion of thiram has not been extensively studied; insight can be gained from pooled information of other dithiocarbamate studies, especially disulfiram. The initial degradation probably occurs in the gastrointestinal tract where the parent compound is reduced to dimethyldithiocarbamic acid which is rapidly absorbed and further metabolized by hepatic enzymes. A portion of the acid will be excreted unchanged as a glucuronide. Further metabolism may also yield dimethylamine and carbon disulfide residues. Only a small portion of the peroral dose has been found as carbon disulfide in the blood of rats (0.003%). Clearly a high portion of the parent compound may be metabolized to carbon disulfide, whereas the small portion recovered in the blood represents only that portion of the dose not lost through the pulmonary route nor involved in tissue reactions.

Dimethyldithiocarbamate may also be degraded to dimethylthiocarbamate, sulfate ion and formaldehyde following methylation and oxidation reactions in body tissues in general. Dimethylthiocarbamic acid is excreted as a glucuronide.

2.1.4 Toxicity, single dose:

Oral LD₅₀:

Rat (M, F)	560 mg/kg bw
Rat (M, F)	630 mg/kg bw (as a 20% suspension in propylene glycol)
Mouse	1350 mg/kg bw
Rabbit	210 mg/kg bw
Sheep	225 mg/kg bw

Animals killed with a single oral dose showed hyperaemia and focal ulcerations of the gastrointestinal tract; focal necrosis of the liver and the renal tubules; patchy demyelination and ascending flaccid paralysis. Poisoning is characterized by eosinopenia, depression, adynamia and convulsions of the clonic type.

Dermal: Single applications of 1000-2000 mg/kg bw to rats and 500-1000 mg/kg bw to rabbits did not produce skin irritation or other toxic effects. In guinea-pigs thiram was found to be a primary skin irritant. See section 2.1.7 "Sensitization".

Intraperitoneal LD₅₀:

Mouse	2.50 mg/kg bw
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The most susceptible species is probably the rabbit.

2.1.5 Toxicity, repeated dose:

Oral: See sections 2.1.6 (Dietary studies) and 2.1.7 (Carcinogenicity).

Dermal: Repeated dermal application, 50 mg/kg bw, to rabbits did not prove irritating.

Cumulation of compound: Thiram has significant cumulation properties. At 0.1-0.005 x LD₅₀ the cumulation coefficient is 2.1-2.85.

2.1.6 Dietary studies

Short-term: In an 80-day feeding study in rats 5.0 mg/kg bw per day in males and 6.0 mg/kg bw in females were found to be the no-effect levels. Patchy alopecia was observed in some males and females at dosage levels of 20 mg/kg bw per day and over. Paralysis and atrophy of the hind legs of females was observed at 67 mg/kg bw per day. In a 13-week dietary study male rats were fed thiram at dosage levels of 30, 58 and 132 mg/kg bw per day. Dose-dependent reductions in body weight and food consumption were observed. At the highest dose there was an increase in BUN, SGOT and SGPT values, evidence of testicular damage and atypical spermiogenesis were observed; five of the 20 animals in this dose group died within 13 weeks. At 58 mg/kg bw per day only BUN increases were observed.

In an 80-week study male rats were found to consume 5, 20 and 52 mg of thiram/kg bw per day, and females 6, 26 or 67 mg/kg bw per day. Dose-dependent decreases in body weight and food consumption were observed in males starting at 5 mg/kg bw and in females starting at 26 mg/kg bw.

There were no treatment-related mortalities and moderate to severe clinical signs of toxicity were observed only among the females in the highest dosage group. There were no other adverse effects. In a one-year diet study in dogs the no-effect level was found to be 4.0 mg/kg bw per day.

Long-term: In a two-year dietary study in rats the no-effect level was found to be approximately 4.9 mg/kg bw per day. At 2500 ppm there was 100% mortality within 17 weeks. General weakness, ataxia and occasional paralysis were observed at 300 and 1000 ppm but there was no treatment-related mortality. Thiram caused an increase in squamous epithelial metaplasia in the thyroid and fatty infiltration in males. There was a reduction in incidences of spontaneous nephritis in both sexes.

2.1.7 Supplementary studies of toxicity

Carcinogenicity: Thiram is classified as an equivocal tumorigen with no known carcinogenic effect. It did not alter the incidence or latent period of spontaneous tumours also seen in the control rats in the several dietary studies described above. Also, no clear carcinogenic effect was demonstrated in several studies of mice (C57 BL) given the highest tolerated doses in a 77-week intubation-dietary study, a five-week intubation study and after a single subcutaneous injection (4.6 mg/kg bw).

N-nitrosodimethylamine, a known carcinogen (in mice, rats, rabbits, hamsters and guinea-pigs), was produced from thiram under simulated stomach conditions in the presence of nitrite. The possibility of this transformation of carcinogenic potential occurring in vivo under normal dietary conditions is unknown.

Mutagenicity: Thiram was mutagenically active on base-substitution sensitive S. typhimurium strains TA1535 and TA100, the effect was abolished in the presence of rat liver microsomes, L-cysteine and glutathion; in TA1538 and TA98 strains following metabolic activation only; in mitotic recombination assays with B. subtilis; and in mice given 100 mg/kg bw p.o. causing an increase in chromosomal aberrations in bone marrow cells.

Teratogenicity: Thiram p.o. was shown to be teratogenic, at high doses causing adult injury, in rats (400 mg/kg bw on days 6-15 of gestation); in mice (250 mg/kg bw on days 6-15 of gestation); and in hamsters at 250 mg/kg bw on days 7 or 8 of gestation. The pattern of foetal defects was not well defined; many changes are suspected to result from retardation of growth. In hamsters the combined effects of thiram and the solvent DMSO were possibly synergistic. In mice simultaneous administration of L-cysteine and thiram tended to abolish the teratogenic effect of thiram.

Reproduction: Thiram was found to have adverse effects on reproduction and to be embryotoxic in mice, rats and hamsters at high dosage levels toxic to the adults. In a three-generation dietary study in rats 100 mg/kg bw per day had no adverse effects on reproduction or foetal development. In a single generation study in rats, 50 mg/kg bw per day, from gestation day 16 to post-partum day 21, caused reduced pup growth and survival. These effects were prevented when the pups were transferred to untreated lactating dams. In an inhalation study in rats 3.8 mg/m³ of air for 6 hours per day, 5 days per week for 4.5 months, caused reproductive malfunction: prolonged oestrus cycles, decreased conception rates, decreased fertility and reduced foetal weights. In mice 132 mg/kg bw p.o. per day for 13 weeks caused male infertility; 96 mg/kg bw for 14 days delayed oestrous cycles. These adverse effects were reversed when treatment ceased.

Neurotoxicity: Animals killed by single oral doses of thiram showed patchy demyelination in the central nervous system, initially in the cerebellum and medulla. Rats fed 300 mg/kg bw per day had clonic-tonic convulsions and showed calcification in the cerebellum, hypothalamus and medulla oblongata. In another study eight out of 24 female rats fed 67 mg/kg bw per day for 80 weeks developed severe signs of neurotoxicity including ataxia and ascending paralysis; degeneration of axis cylinders and presence of macrophages in the bundle of the sciatic nerve were observed.

Metabolism: Thiram has been shown to be an inhibitor of many enzymes. It induces accumulation of acetaldehyde in the bloodstream following ethanol or paraldehyde treatment. It inhibits the *in vitro* conversion of dopamine to noradrenalin in cardiac and adrenal medulla preparations. It depresses some hepatic microsomal demethylation reactions, microsomal cytochrome P-450 content and the synthesis of phospholipids. Thiram has also been shown to have moderate inhibiting action on decarboxylases and, in fish, muscle acetylcholinesterases.

Sensitization: Thiram was found to be a primary skin irritant with a threshold limit value of 5% in a 24-hour occluded patch test in guinea-pigs and it was also shown to have moderate contact hypersensitivity potency in a guinea-pig maximization test.

- 2.1.8 **Modification of toxicity** - In mammals the teratogenic and embryotoxic effects of thiram are at least partly overcome by simultaneous treatment with L-cysteine or glutathione. Potentiation of the teratogenic effect occurs with the solvent DMSO.

2.2 TOXICOLOGY - MAN

- 2.2.1 **Absorption** - Thiram can be absorbed from the gastrointestinal tract, through the intact skin and by inhalation of dust and fine spray mist.

- 2.2.2 **Dangerous doses** - There is no information on doses leading to illness.

Single: Thiram has been given a toxicity rating of 4 (Gosselin), the probable oral lethal dose for humans is 50-500 mg/kg bw. Alcohol, regardless of the route of absorption of thiram, increases thiram toxicity and is probably the cause of most systemic poisonings involving thiram.

Repeated: No information is available. Since thiram is cumulative the repeated dangerous dose is likely to be much smaller than the single dose.

- 2.2.3 **Observations on occupationally exposed workers** - Numerous studies of industrial and agricultural workers have been published. There have been very few cases of thiram systemic poisoning leading to death without known alcohol involvement. Increased skin sensitivity unrelated to alcohol use, once thought to be uncommon, is becoming increasingly more common, especially in tropical countries, in association with thiram use.

In one industrial study of men and women between 20 and 50 years of age, who had been exposed to TMD for several years, ocular manifestations were common. The initial symptoms, lachrymation and photophobia, were temporary and were followed by chronic conjunctivitis in 14% of those examined, enlargement of retinal blood vessels (in 34%), reduced visual acuity, delayed dark adaptation and reduced corneal sensitivity.

In another study, in addition to ocular manifestations, tachycardia, thoracic pain and coughing, epistaxis, dermal lesions, myocardial dystrophy, liver dysfunction, astenia and goitre have been found. A single case of thyroidal adenocarcinoma in a person exposed to thiram has been reported. Many cases of poisoning have involved alcohol interaction with thiram, especially in agricultural workers and formulators. The symptoms of this poisoning include gastric pain, nausea, vomiting, hypertension and hyper-irritability, fine tremors, fever and moderate lymphopenia.

- 2.2.4 Observations on exposure of the general population - The use of thiram in the manufacture of many rubber and plastic products (e.g., shoes) and as a fungicide in recreational areas (e.g., golf courses and bowling greens) presents considerable opportunity for exposure of sensitive individuals to the compound. Thiram is considered to be a borderline allergen requiring several exposures to produce sensitization. For further details see section 4.1.5.
- 2.2.5 Observations of volunteers - Thiram has been used in several medicinal products and soaps. Systemic poisonings and contact dermatitis have not been commonly seen in these studies (see section 4.1.5 for more details). Oral doses of 0.5-1.5 g per person per day for several weeks have been tolerated without ill-effect provided alcohol was avoided.
- 2.2.6 Reported mishaps - There is no published information available on intentional poisoning involving thiram. Most accidental systemic poisonings due to thiram have also included alcohol consumption. In most cases, though the symptoms were severe enough to warrant hospitalization, the recovery was uneventful and complete in three to four days. In one incident, a fatality occurred following the mixing of seed and thiram with a spade. The worker, who was exposed for approximately 10 hours, fell ill and though treated in hospital he died four days later.

2.3 TOXICITY TO NON-MAMMALIAN SPECIES

2.3.1 Fish - No information available.

2.3.2 Birds - Thiram is moderately toxic to most birds; the acute and chronic toxic effects are similar to those found in mammals. It has been shown to be teratogenic and to interfere in normal reproductive physiology and behaviour in domestic fowl. The effect in the young birds appears to be more severe than in older birds.

Oral LD50:

Mallards	2800 mg/kg bw
Pheasants	673 mg/kg bw
Red wing blackbird	300 mg/kg bw
Domestic sparrow	100 mg/kg bw
Common grackle	100 mg/kg bw

2.3.3 Other species - No information available.

3. FOR REGULATORY AUTHORITIES - RECOMMENDATIONS ON REGULATION OF COMPOUND

3.1 RECOMMENDED RESTRICTIONS ON AVAILABILITY

(For definition of categories, see the Introduction to Data Sheets)

All liquid formulations over 28%, Category 3.

All other liquid formulations, Category 4.

All solid formulations over 11%, Category 4.

All other solid formulations, Category 5.

3.2 TRANSPORTATION AND STORAGE

Formulations in categories 3 and 4 - Should be transported or stored in clearly labelled rigid and leakproof containers and away from containers of food and drink. Storage should be under lock and key and secure from access by unauthorized persons and children.

Formulations in Category 5 - Should be transported or stored in clearly labelled leakproof containers out of reach of children and away from food and drink.

3.3 HANDLING

Formulations in categories 3 and 4 - Protective clothing (see part 4) should be provided for those handling concentrates. Adequate washing facilities should be available close at hand. Eating, drinking and smoking should be prohibited during handling and before washing after handling. Adequate ventilation must be maintained.

Formulations in Category 5 - No special facilities other than those for handling of any chemical need be required. Adequate ventilation must be maintained.

- 3.4 DISPOSAL AND/OR DECONTAMINATION OF CONTAINER - If not decontaminated container must either be burned or crushed and buried below topsoil. Care must be taken to avoid subsequent contamination of water sources. Container may be decontaminated (for method see paragraph 4.3 and part 4). Decontaminated containers should not be used for any other purpose.

3.5 SELECTION, TRAINING AND MEDICAL SUPERVISION OF WORKERS

Formulations in categories 3 and 4 - Pre-employment medical examination for workers desirable. Workers suffering from active hepatic or renal disease should be excluded from contact. Pre-employment and periodic cholinesterase tests for workers desirable. Training of workers in techniques to avoid contact and the need for strict abstention from alcohol use prior to and after thiram use are essential.

Formulations in Category 5 - Warning of workers to minimize contact and about the dangers of alcohol use prior to and after thiram use is essential.

3.6 ADDITIONAL REGULATIONS RECOMMENDED IF DISTRIBUTED BY AIRCRAFT

All formulations - Pilot and loaders should have special training in application methods and early symptoms of poisoning. Flagmen, if used, should wear a broad brimmed hat, a facial mask and coveralls, and be located well away from the dropping zone.

3.7 LABELLING

Formulations in categories 3 and 4 - Minimum cautionary statement - "WARNING - POISON" (skull and cross-bones insignia). Thiram is a dithiocarbamate; a metabolic poison of slight acute toxicity and has potential long-term toxic effects. A primary irritant, avoid contact with skin and eyes. Inhalation of dust or spray, or swallowing may be fatal. Wear protective gloves, clean protective clothing, and a particle respirator (3 micron capability) type when handling this material. Bathe immediately after work. Ensure that containers are closed and stored under lock and key. Empty containers must be disposed of in such a way as to prevent all possibility of accidental contact with them. Keep the material out of reach of children and well away from foodstuffs, animal feed and their containers.

Maintain adequate ventilation during use. In case of contact immediately remove contaminated clothing and wash the skin thoroughly with soap and water; for eyes, flush with water for 15 minutes. If poisoning occurs, call a physician. Avoid alcohol use for at least 10 days. There is no specific antidote, treatment must be symptomatic.

Formulations in Category 5 - Minimum cautionary statement - This formulation contains thiram, it is poisonous if swallowed. Keep the material out of reach of children and well away from foodstuffs, animal feed and food containers. Maintain adequate ventilation during use. Avoid alcohol use prior to and after thiram use.

3.8 RESIDUES IN FOOD

Maximum residue levels - Maximum residue levels have been recommended by the Joint FAO/WHO Meeting on Pesticide Residues.

4. PREVENTION OF POISONING IN MAN AND EMERGENCY AID

4.1 PRECAUTIONS IN USE

4.1.1 General - Thiram is a dithiocarbamate of slight acute toxicity and potential long-term toxic effects. In addition to its inherent toxicity it induces an alcohol intolerance similar to that of Antabuse (disulfiram), a related dithiocarbamate. It may be absorbed from the gastrointestinal tract; by inhalation of spray mist or dust; and through the intact skin. A primary irritant, avoid contact to skin and eyes; spills must be washed immediately from the skin and eyes. Adequate ventilation is essential.

4.1.2 Manufacture and formulation - TLV - 5 mg/m³, ACGIH. Formulation should not be attempted without advice from the manufacturer. Although volatility is low vapour and dusts should be controlled preferably by mechanical means. Protective equipment for the skin and self-contained respiratory protection is essential. Adequate ventilation is also essential.

4.1.3 Mixers and applicators - When opening the container and when mixing, care should be taken to avoid contact with the mouth and eyes. Maintain adequate ventilation during handling; a self-contained breathing apparatus, coveralls and gloves should be worn. Mixing, if not mechanical, should always be carried out with a paddle of appropriate length. The applicator should avoid working in spray mists and avoid contact with the mouth. Splashes must be washed immediately from the skin or eyes with large quantities of water. Before eating, drinking or smoking, hands and other exposed skin should be washed.

4.1.4 Other associated workers (including flagmen in aerial operations) - Persons exposed to thiram and associated with its application should observe the precautions described in section 4.1.3 under "Mixers and applicators".

4.1.5 Other populations likely to be affected - With correct application and appropriate warnings of use the general public should not be exposed to hazardous amounts of thiram. Warnings of use are essential; there are reports of contact poisoning in sensitive persons following exposure after correct horticultural applications and after continuous use of vulcanized rubber or plastic products contaminated with thiram during their manufacture.

4.2 ENTRY OF PERSONS INTO TREATED AREAS - Unprotected persons should be kept out of treated areas until the spray solution is dry.

4.3 DECONTAMINATION OF SPILLAGE AND CONTAINERS - Residues in containers should be dissolved in a combustible solvent (alcohol, benzene, etc.) and burned in a furnace. The empty containers may be decontaminated by rinsing two or three times with a combustible solvent, the rinse burned. An additional rinse should be carried out with 15% calcium hypochlorite solution which should remain in the container overnight; neutralize and dispose of the rinse in a deep pit or into a sewer with abundant water. Impermeable gauntlets should be worn during this work and a soakage pit should be provided for the rinsings. Decontaminated containers should not be used for any other purpose. Spillage of thiram and its formulations should be removed by washing with 15% calcium hypochlorite solution and then rinsing with large quantities of water. Neutralize the rinse fluid and drain into a deep pit or sewer with abundant water.

4.4 EMERGENCY AID

4.4.1 Early symptoms of poisoning - Early symptoms may include dizziness, confusion, drowsiness, lethargy, ataxia, headaches, or coma; nausea, vomiting, diarrhoea and stomach pains; muscle weakness and paralysis (ascending); respiratory paralysis; and skin rash and eye irritation.

4.4.2 Treatment before person is seen by a physician, if these symptoms appear following exposure - The person should stop work immediately, remove all contaminated clothing, and wash the affected skin or hair with soap and water. Flush contaminated eyes with fresh water for 10-15 minutes. If the compound was ingested and if the victim is alert, induce vomiting if it has not already occurred. Provide artificial respiration if required and preferably by mechanical means. Prevent consumption or other contact with alcohol. Contact a doctor immediately, give supportive care and remove the victim to hospital as quickly as possible.

5. FOR MEDICAL AND LABORATORY PERSONNEL

5.1 MEDICAL DIAGNOSIS AND TREATMENT IN CASES OF POISONING

5.1.1 General information - Thiram is a dithiocarbamate pesticide of slight acute toxicity and some potential long-term effects (e.g., mutagenicity, teratogenicity and tumorigenicity). It is used as an industrial water antifouling agent and in several manufacturing processes. It is absorbed from the gastrointestinal tract; by inhalation of dust or spray mist; and through the intact skin. Thiram induces alcohol intolerance similar to that of Antabuse (disulfiram).

5.1.2 Symptoms and signs - Symptoms of poisoning include nausea, vomiting, abdominal pain, diarrhoea, anorexia and weight loss; headaches, lethargy, dizziness, ataxia, confusion, drowsiness and coma; suppression of tendon reflexes; initial hypotonia progressing to flaccid paralysis (Landry's syndrome); respiratory paralysis; and severe dermatitis and eye inflammation.

5.1.3 Laboratory - Due to rapid metabolism and excretion, detection of thiram in the blood is generally not possible. Detection of thiram metabolites and xanthurenic acid in the urine may confirm absorption but will not necessarily reflect the degree of poisoning. Skin testing may be useful in identifying sensitization to the compound. Treatment should not be deferred pending laboratory results.

5.1.4 Treatment - There is no specific antidote; provide symptomatic and supportive treatment. For contact poisoning remove all contaminated clothing and wash the affected skin and hair with soap and water; flush contaminated eyes with fresh water for 10-15 minutes. If thiram has been ingested, if the patient is alert and if vomiting has not already occurred, induce vomiting preferably with Syrup of Ipecac. Continue to observe patient for signs of depression of consciousness level and/or respiration. If these signs occur, gastric intubation, aspiration and lavage should be performed immediately. Lavage with isotonic saline or sodium bicarbonate solution should be followed by activated charcoal by intubation to limit absorption of any residual thiram in the gastrointestinal tract. If the irritant properties of thiram have not already induced a bowel movement, give a mild cathartic (e.g., magnesium sulfate). Intravenous administration of glucose and ascorbic acid (0.2 g/min up to one gram total) may be useful to accelerate the excretion of unreacted, absorbed thiram. Provide artificial respiration if necessary, preferably by mechanical means. In extreme cases, if the patient is unconscious or in respiratory distress, oxygen should be provided. The patient should avoid fats, oils and lipid solvents which might enhance absorption and prohibit all forms of ethanol consumption for at least three weeks.

5.1.5 Prognosis - If the acute toxic effect is survived the chances of complete recovery are very good.

5.1.6 References to previously reported cases

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5.2 SURVEILLANCE TESTS - There are no readily available techniques to determine the degree of exposure prior to the appearance of symptoms.

5.3 LABORATORY METHODS

5.3.1 Detection and assay of compound

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Butler, L. C. & Staiff, D. C. (1978) J. Agric. Food Chem., 26(11), 295-296

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5.3.2 Other tests in cases of poisoning

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