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PESTICIDE MANUAL

PART II: BASIC INFORMATION ON THIRTY-FIVE PESTICIDE CHEMICALS

R. VON RUMKER

F. HORAY

DEPARTMENT OF STATE

AGENCY FOR INTERNATIONAL DEVELOPMENT

P E S T I C I D E M A N U A L

PART I : SAFE HANDLING AND USE OF PESTICIDES

PART II : BASIC INFORMATION ON THIRTY-FIVE PESTICIDE CHEMICALS

PART III : SPECIFICATIONS

By

R. von Rümker

and

F. Horay

RvR CONSULTANTS
P. O. B. 553
Shawnee Mission, Kansas 66201

August, 1972

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PREFACE.

This Manual was prepared under the auspices of the University of California/AID Pest Management and Related Environmental Protection Project, Contract No. AID/csd 3296, Dr. Ray F. Smith, Project Director. The Project's Panel on Pesticides under the Chairmanship of Dr. Gordon E. Guyer provided the outline for the Manual, supervised its preparation, reviewed the draft, and furnished important data, literature references and other inputs. The authors gratefully acknowledge these contributions, and the guidance and encouragement received from Dr.'s Gordon E. Guyer, Ray F. Smith, David E. Schlegel, John E. Davies, Virgil H. Freed, James G. Horsfall, Allen B. Lemmon, and from Dr. W. H. Garman, AID.

Appreciation is also expressed to the pesticide manufacturers who contributed data and information on their products.

We are grateful to Dr. R. de B. Ashworth, Chairman of CIPAC, Harpenden, Herts., Great Britain, and to Dr. A. V. Adam, Pesticides Officer, FAO, Rome, Italy for their assistance in regard to Part III (Specifications) of the Manual.

Rosmarie von Rümker

Fred Horay

Shawnee Mission, Kansas

August, 1972

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PART III: SPECIFICATIONS

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PART II : BASIC INFORMATION ON THIRTY-FIVE PESTICIDE CHEMICALS

INTRODUCTION.

This section of the Pesticide Manual provides the following basic data on thirty-five pesticide chemicals: Identity, including common name(s), tradenames and chemical description; physical and chemical properties; analytical methods; hazards to humans, including acute and chronic toxicity data, allowable daily dietary intake, and residue tolerances; hazards to the environment; pesticidal effectiveness, and an effectiveness profile.

A considerable number of publications deal with the properties and effects of pesticide chemicals. Most of these discuss one specific aspect of many pesticides, such as their chemistry, mode of action, formulation, toxicology, analysis, application, disposal, effects on non-target organisms, or biological efficacy and uses. No single publication in the current literature covers all of these aspects.

On the other hand, pesticide manufacturers publish information bulletins in which many of the foregoing aspects are summarized for one or more of their own

pesticides. This proprietary literature is a very useful source of information, but its basic purpose is, of course, to promote sales of the product. This type of literature is, therefore, often written in a very positive vein and will usually not stress unknowns or problem areas beyond the extent legally required. Furthermore, each company has its own format and standards for presenting technical information on its products. Therefore, it is difficult to make meaningful comparisons between different manufacturers' products on the basis of company literature.

Both the general and the proprietary published literature reflect the fact that concern for the environmental effects of pesticides is of such recent origin that at the present time, many questions in this regard remain to be answered.

Thus, it is quite difficult even for persons with access to good technical libraries to obtain up-to-date information on all important aspects of pesticides in a manner which permits comparisons. This is an even greater problem for persons who do not have such library facilities available.

Part II of the Pesticide Manual will help to alleviate this problem. For each of the products covered, data are presented in a uniform and concise format.

This information was assembled from several sources, including data supplied by the basic manufacturers of most of the products concerned, and extensive study of recent literature on the properties and effects of pesticides. Dr. V. H. Freed, Oregon State University, Corvallis, Oregon, provided the volatilization and leaching indices.

The following explanations are important to the proper interpretation and use of the detailed data on each product.

Identity.

In describing the identity of a pesticide chemical, we have endeavored to list all common names and the most important trade names under which the product is known. A number of products are sold under so many different tradenames that it was not possible to list all of them. An alphabetical index of all tradenames and common names is provided, see pages 356ff.

For "chemical names", we have generally preferred the terminology accepted by the American Chemical Society.

Physical and chemical properties.

These data are given for the active ingredient of each pesticide. With some chemicals, there are considerable differences between the pure and the technical active

ingredient. Where physical or chemical properties are given for the technical active ingredient, this is so stated.

Analytical methods.

In this category, our basic assumption is that the "Handbook on Analysis of Technical and Formulated Pesticides" (Ref. 9), published by CIPAC (Collaborative International Pesticides Analytical Council Limited) is currently the best and internationally most widely available compendium of pesticide quality control methods. It is further assumed that laboratories performing analyses of pesticides, including those in developing countries, will have this handbook available as one of their indispensable resources. The Handbook of Analytical Methods of the Association of Official Analytical Chemists of the U. S. (AOAC) was considered to be the second most important collection of pesticide quality control analysis methods. Accordingly, we included for each product information on whether or not methods for its analysis are included in the CIPAC or AOAC Handbooks. In the case of products for which neither the CIPAC nor the AOAC Handbook contain analytical methods, analysts are referred to the manufacturer.

Hazards to humans.

Entries in this section are given for the active ingredient of each pesticide, not for a formulation. The entries for "precautions" (last item in this section) refer to the table entitled "Toxicity and Precaution Categories" (page 66). This table summarizes the main toxicity parameters which determine whether a pesticide product is considered "highly toxic", "moderately toxic", "slightly toxic", or "relatively non-toxic".

The "signal words required on label" are those required by U. S. federal laws and regulations to be included in the labels of registered pesticides.

The concentration of active ingredient in a pesticide formulation has, of course, an effect on the toxicity of the formulation. Thus, a low-concentrate dust or granular formulation of a pesticide whose active ingredient is in the "highly toxic" category might be only "moderately toxic" or "slightly toxic". Conversely, some relatively non-toxic pesticide active ingredients are formulated with solvents or other adjuvants which are more toxic than the active ingredient, resulting in a formulated pesticide whose mammalian toxicity is greater than that of the active ingredient.

Formulation often alters the oral, dermal and/or inhalation toxicity of an active ingredient in different degrees. For example, some active ingredients have a relatively much higher dermal toxicity when formulated as an emulsifiable spray concentrate as compared to the technical active ingredient or dry formulations because the solvent system in the liquid formulation promotes skin penetration and systemic absorption.

Thus, the mammalian toxicity of pesticide formulations is not simply a function of the concentration of active ingredient contained, but has to be experimentally determined for each formulation as a basis for appropriate warning and precaution statements on the product label.

There are considerable variations between data on the acute toxicity of pesticides to laboratory animals reported by different laboratories, especially in the case of less toxic chemicals. This is not surprising because so many different factors affect the outcome of such tests, including the strain, age, sex and general condition of the animals used; whether or not animals were fasted prior to administration of the toxicant; the time of day when the toxicant was administered; the form (solvent, particle size, etc.) in which it was administered; and the mode of administration. In the interest of allowing meaningful comparisons

between products as much as possible, we have relied on the "Clinical Handbook on Economic Poisons" by W. J. Hayes (U. S. Department of Health, Education and Welfare, Atlanta, Georgia, 1963) as the prime source of acute oral and dermal toxicity data, since it represents the largest collection of such data obtained in one laboratory under standardized conditions.

"Specific antidote(s)" refers to those antidotes which are specific in their action to remove or counteract the effects of the pesticide concerned, as opposed to "symptomatic treatment" of the symptoms of poisoning which is the only treatment possible if a specific antidote is not available. In the pesticide field, a classical example of a "specific antidote" is atropine sulfate, which specifically counteracts the effects of cholinesterase inhibition. (Cholinesterase is a vital body enzyme which is inhibited by organic phospate and carbamate insecticides.) Another example is pralidoxime chloride (2-PAM), a drug capable of reactivating inhibited cholinesterase.

In all pesticide poisoning cases, regardless of whether or not specific antidotes are available, stopping further exposure of the victim to the toxicant must be the first treatment step. If poisoning was by oral ingestion, induction of vomiting or gastric lavage are indicated in most

cases. If eyes or body surfaces were exposed, they must be thoroughly rinsed or washed. If poisoning resulted from inhalation, the patient must be moved to fresh air.

Beyond these obvious steps, symptomatic treatment of the poisoning symptoms is the only course of action available in cases of poisoning by a pesticide for which no specific antidote is known. The label of the product used must be consulted for appropriate procedures, especially also for information on measures or drugs which may be contraindicated. Steps to be taken and steps to be avoided depend not only on the properties of the active ingredient, but also on those of the formulation ingredients. For this reason, "symptomatic treatment" instructions cannot be given in a single statement for all formulations of a given pesticide chemical and are therefore not included in this Manual.

Hazards to the environment.

The data for this section have been particularly difficult to obtain, especially in the case of older products which were researched, developed and registered long before present concerns about the environmental effects of pesticides came into being. Accordingly, the largest number of "not known", "no data" and similar entries are found in this section. Very few precise and quantitative answers to

questions on the fate and effects of pesticides in the environment are available to date.

The categories of toxicity to fishes, lower aquatic organisms, birds, wild mammals, and soil organisms are not as clearly defined as the categories of toxicity to laboratory animals discussed in the preceding section. The following general guidelines have been employed in assigning toxicity ratings:

-- "Highly toxic" means that severe losses may occur if the pesticide is used in or over a habitat containing the animals or organisms specified. "Use" of the pesticide in this context means use at recommended dosage levels, including such overuse as may be expected in normal operations from overlapping swaths, inadvertant double treatment and/or miscalibration.

-- "Moderately toxic" means that moderate losses of the animals or organisms may occur under the operating conditions outlined in the preceding subparagraph.

-- "Slightly toxic" means that slight losses or injury to non-target animals or organisms may occur.

-- "Relatively non-toxic" means that no losses or injury to non-target species are likely to occur, allowing for a considerable margin of overuse, misapplication and/or miscalibration.

For a number of products, different publications list different levels of toxicity to non-target species. In other instances, information supplied by the manufacturer was at variance with published data, or data supplied by different manufacturers of the same product did not agree. Whenever such conflicting data required a judgment decision, first preference was given to the most authoritative data source, with the general proviso that unavoidable errors should be on the conservative side.

"Build-up in food chains" is a phenomenon which has been studied for DDT more than for any other pesticide. Chemicals which combine high lipid solubility with high chemical stability show this tendency. For most products other than DDT, data on biological concentration are available only for a few links in a food chain, rather than for entire food chains or webs. Accordingly, answers to this question are not precise for most products.

The entries under "likelihood of movement away from treated fields" pertain to the transport mechanisms by which pesticides and/or their degradation products may move away from the target site after application. The behavior of chemicals in this regard is a function of their physical and chemical properties including their volatility, water solubility, sorption on organic and inorganic soil particles,

biota, etc., and the manifold interactions between these and the soil, its moisture content, the temperature and other factors.

The volatilization and leaching index numbers were estimated uniformly for all products for which they are given, for loam soil at 25°C at an annual rainfall of 150 cm (59 inches).

Volatilization of pesticides under these conditions, i.e., from a porous, sorptive medium (loam soil) in a non-equilibrium situation, is different from volatilization from an inert surface or from the chemical's own surface. Thus, the environmental volatilization indices may or may not parallel a chemical's vapor pressure.

The volatilization index numbers relate to estimated losses from treated areas as follows:

1 = vapor loss of less than 0.1 kg/hectare (ha)/yr.

2 = median vapor loss of 2.0 kg/ha/yr.

3 = median vapor loss of 5.0 kg/ha/yr.

4 = vapor loss of more than 10 kg/ha/yr.

The leaching index numbers indicate the approximate distance that the chemical would move through the loam soil profile under an annual rainfall of 150 cm. Index numbers relate to that distance as follows (1 inch = 2.54 cm):

1 = movement of less than 10 cm

2 = movement of 10 - 20 cm

3 = movement of 20 - 50 cm

4 = movement of more than 50 cm

The remaining entries for most products in the section "hazards to the environment" leave much to be desired in regard to precision and completeness. Nevertheless, this section is a very important part of the total profile of a pesticide product, and important differences between products are apparent even from the incomplete data currently available.

Pesticidal effectiveness.

This section is designed to give a concise, but general description of the toxic action and spectrum of effectiveness of each pesticide, not specific use recommendations. Most entries in this section are very self-explanatory.

The pesticidal efficacy of each product is further defined in terms of an "effectiveness profile" in grid form. This profile provides a quick overview of the crops and pests on which the product is useful. "Effectiveness" is interpreted in a broad sense for purpose of this profile, not limited to uses registered in the United States.

Again, this "effectiveness profile" is not intended to provide detailed directions for use. These have to be obtained from the product label.

Following the individual product profiles, there is a cross-reference index for crops and pesticides, the latter separated into herbicides, organic phosphate and carbamate insecticides, chlorinated hydrocarbon insecticides, and fungicides.

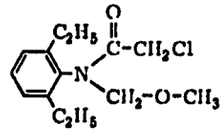
Identity

Common name(s): alachlor, methachlor

Trade name(s) : Lasso, Lazo, Laco

Chemical name : 2-Chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide

Structural formula:



Empirical formula : $C_{14}H_{20}ClNO_2$

Molecular weight : 269.77

Physical and Chemical Properties

Physical state : Yellow solid at room temperature

Specific gravity : 1.1331 at 25°C

Solubility in -

-water at 20°C : 210 ppm; at 30°C: 295 ppm

-organic solvents: Infinitely soluble in all common organic solvents

-lipids, fats : Soluble

Melting point : 35 - 37°C

Boiling point : 135°C at 0.3 mm Hg

Vapor pressure : 0.02 mm Hg at 100°C; 0.3 mm Hg at 135°C

Flammability : Closed cup flash point above 120°C

Stability : Heat evolution rate (cal./min./kg) 1.0 at 150°C; 10.0 at 180°C

Analytical Methods : Not in CIPAC 1 or AOAC Handbook of Methods GLC method available from manufacturer

alachlor

Hazards to Humans

Toxic action	:	Not known.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 3,000 mg/kg
- dermal	:	LD-50 to rabbits 3,500 mg/kg
- inhalation	:	Relatively non-toxic.
Irritating to -		
- eyes	:	Moderately irritating.
- nose & throat	:	Moderately irritating.
- skin	:	Moderately irritating.
Other hazards	:	None known.
Specific antidote(s)	:	None known.
Chronic toxicity	:	Not determined. In a 90 day subacute feeding study, no adverse effects to laboratory animals at 200 ppm in the diet.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	None established.
Residue tolerance(s)	:	0.2 - 0.75 ppm
Precautions	:	Group III (Slightly toxic).

alachlor

Hazards to the Environment

Toxicity to -

- fishes : Relatively non-toxic.
- lower aquatic organisms : Not known.
- birds : Relatively non-toxic.
- wild mammals : Not known.
- soil organisms : Not known.

Build-up in food chains: Not likely.

Likelihood of movement away from treated fields by -

- volatilization : Index = 3
- leaching : Index = 1 - 2
- surface runoff -
  --in water : Minor.
  --on solids : Minor.
- wind erosion : Minor.

Degradation in the environment

Chemical route : Not known.

Major degradation product(s) and their toxicity relative to the parent cpd. : Water soluble conjugates with natural products; not more toxic than parent.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Possible.
--sunlight : Minor.

Overall rate of degradation : Rapid; degrades during growing season of treated crop.

Persistence in soil : Not persistent.

Carry-over to next season : None.

Precautions: Follow label directions.

alachlor

Pesticidal Effectiveness

Toxic action : Pre-emergent, soil-applied, selective herbicide. Toxic to germinating weed seedlings.

Spectrum of effectiveness : Effective against many annual grass weeds and some broadleaf weeds in corn, soybeans, peanuts and cotton. Ineffective against established perennial weeds.

Target pest resistance : None reported.

Toxicity to bees (1) : None.

Toxicity to beneficial insects (predators and parasites) (1): None.

Residual effectiveness : Weed control persists for 10 to 12 weeks.

Minimum interval between last treatment & harvest to prevent unsafe residues: 12 weeks (corn).

Precautions: Do not allow EC formulation to freeze. Follow label directions.

---

(1) At dosage rates recommended for control of target pests.

alachlor

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)								
Rice								
Millet & sorghum								
Corn								
Pulses (2)						X	X	
Oilseeds (3)								
Other fiber crops (4)						*	*	
Cotton								
Sugar beets						X	X	
Sugar cane								
Forage crops (5)								
Potatoes								
Vegetables								
Fruits & nuts:								
Small fruits								
Decid. fruits, nuts								
Grapes								
Citrus fruits								
Bananas								
Pineapples								
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals								
Lawn & turf								

Other Uses : None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

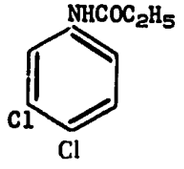
Identity

Common name(s): propanil

Trade name(s) : Rogue, Plus de Riz, Stam, Surcopur, ChemRice

Chemical name : 3,4-Dichloropropionanilide

Structural formula:



Empirical formula : $C_9H_9Cl_2NO$

Molecular weight : 218

Physical and Chemical Properties

Physical state	:	Solid
Specific gravity	:	1.362 at 25°C
Solubility in -		
-water at 20°C	:	140 ppm; at 30°C: 180 ppm
-organic solvents	:	Readily soluble in ketones, alcohols, ether, and chlorinated hydrocarbons; moderately soluble in aromatic solvents
-lipds, fats	:	Slightly soluble
Melting point	:	90°C
Boiling point	:	N.a.
Vapor pressure	:	Less than 0.001 mm Hg at 50°C
Flammability	:	Tag open cup flash point = 205°F
Stability	:	Stable under normal use conditions; hydrolyzes in presence of strong acid or alkali
Analytical Methods:	:	Not in CIPAC 1 or AOAC Handbook of Methods GLC method available from manufacturers

propanil

Hazards to Humans

Toxic action	:	Depression of central nervous system.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 1,384 mg/kg; to dogs 1,217 mg/kg
- dermal	:	LD-50 to rabbits 7080 mg/kg (4lbs. EC)
- inhalation	:	Slightly toxic.
Irritating to -		
- eyes	:	Severely irritating.
- nose & throat	:	Moderately irritating.
- skin	:	Moderately irritating.
Other hazards	:	None known.
Specific antidote(s)	:	None known.
Chronic toxicity	:	No-effect level in the diet was 400 ppm for rats, 600 ppm for dogs in two-year studies.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	None established.
Residue tolerance(s)	:	0.05 (eggs & milk) to 75 ppm (rice straw).
Precautions	:	Group III (Slightly toxic).

propanil

Hazards to the Environment

Toxicity to -

- fishes : Relatively non-toxic.
- lower aquatic organisms : Not known.
- birds : Moderately toxic.
- wild mammals : Not known.
- soil organisms : Not known.

Build-up in food chains: Not likely.

Likelihood of movement away from treated fields by -

- volatilization : Index = 2
- leaching : Index = 1 - 2
- surface runoff -
  --in water : Negligible.
  --on solids : Negligible.
- wind erosion : Negligible.

Degradation in the environment

Chemical route : Not known.

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Possible.
--sunlight : Minor.

Overall rate of degradation: Very rapid; 1 - 2 days.

Persistence in soil : Not persistent.

Carry-over to next season : None.

Precautions: Follow label directions.

propanil

Pesticidal Effectiveness

Toxic action : Post-emergent selective herbicide for use on rice. Controls weeds by contact action.

Spectrum of effectiveness : Effective against a fairly borad spectrum of annual grasses and some broadleaf weeds infesting rice. Ineffective against certain aquatic weeds, perennial grasses, cattail and sedges.

Target pest resistance : None reported.

Toxicity to bees (1): None.

Toxicity to beneficial insects (predators and parasites) (1): None.

Residual effectiveness : Contact action, no residual activity.

Minimum interval between last treatment & harvest to prevent unsafe residues: None established. Used early in growing season.

Precautions: Do not apply propanil within 14 days before or after insecticide applications because serious damage to rice may occur. Plum trees are especially sensitive to exposure to propanil. Follow label directions.

---

(1) At dosage rates recommended for control of target pests.

propanil

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)								
Rice						X	X	
Millet & sorghum								
Corn								
Pulses (2)								
Oilseeds (3)								
Other fiber crops (4)								
Cotton								
Sugar beets								
Sugar cane								
Forage crops (5)								
Potatoes								
Vegetables								
Fruits & nuts:								
Small fruits								
Decid. fruits, nuts								
Grapes								
Citrus fruits								
Bananas								
Pineapples								
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals								
Lawn & turf								

Other Uses : None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

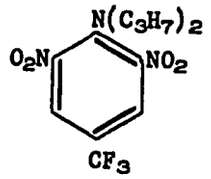
Identity

Common name(s) : trifluralin

Trade name(s) : Treflan, Elancolan, Trefanocide

Chemical name : 2,2,2-Trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine

Structural formula:



Empirical formula : $C_{13}H_{16}O_4F_3N_3$

Molecular weight : 335.28

Physical and Chemical Properties

Physical state : Yellow-orange crystals

Specific gravity : 1.29 at 25°C

Solubility in -

-water at 27°C : Less than 1 ppm

-organic solvents: Readily soluble in acetone, xylene, and aromatic naphthas

-lipids, fats : Soluble

Melting point : 48.5 - 49°C

Boiling point : 96 - 97°C at 0.18 mm Hg
139 - 140°C at 4.2 mm Hg

Vapor pressure : 1.99×10^{-4} mm Hg at 29.5°C

Flammability : Active ingredient not flammable

Stability : Susceptible to decomposition by ultraviolet irradiation

Analytical Methods : Not in CIPAC 1 or AOAC Handbook of Methods
GLC method available from manufacturer

trifluralin

Hazards to Humans

Toxic action	:	Mammalian toxicity low. Mechanism of action not known.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats greater than 10,000 mg/kg
- dermal	:	LD-50 to rats greater than 5,000 mg/kg
- inhalation	:	Relatively non-toxic.

The solvent system is more toxic than trifluralin active ingredient.

Irritating to -		
-eyes	:	No.
- nose & throat	:	No.
- skin	:	No.
Other hazards	:	None known.
Specific antidote(s)	:	None known.
Chronic toxicity	:	No-effect level in the diet was 2,000 for rats in a two-year study; 400 ppm for dogs in a three-year study.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	None established.
Residue tolerance(s)	:	0.05 to 2.0 ppm
Precautions	:	Group III (Slightly toxic).

trifluralin

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Toxic.
- birds : Relatively non-toxic.
- wild mammals : Relatively non-toxic.
- soil organisms : Not known.

Build-up in food chains: Not likely.

Likelihood of movement away from treated fields by -

- volatilization : Index = 2
- leaching : Index = 1 - 2
- surface runoff -
  --in water : No.
  --on solids : Low.
- wind erosion : Low.

Degradation in the environment

Chemical route : Dealkylation and reduction.

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Yes.
--sunlight : Yes.

Overall rate of degradation: Moderate; 80 - 90% of applied rate degrades during growing season.

Persistence in soil : Moderately persistent.

Carry-over to next season : May occur.

Precautions: Follow label directions. Trifluralin is surprisingly toxic to fish.

trifluralin

Pesticidal Effectiveness

Toxic action : Pre-emergent, selective, soil-incorporated herbicide. Toxic to germinating weed seedlings.

Spectrum of effectiveness : Effective against many grasses and a number of broadleaf weeds in many field and horticultural crops. Ineffective against established weeds, certain broadleaf weeds and nutgrass.

Target pest resistance : None reported.

Toxicity to bees (1) : None.

Toxicity to beneficial insects (predators and parasites) (1): None.

Residual effectiveness : Weed control persists for 8 to 12 weeks.

Minimum interval between last treatment & harvest to prevent unsafe residues: None established; application no later than early post-emergence.

Precautions: Safety margin narrow. Follow all label directions carefully. Do not expose E.C. formulation to temperatures below 40°F.

---

(1) At dosage rates recommended for control of target pests.

trifluralin

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)						*	*	
Rice								
Millet & sorghum								
Corn								
Pulses (2)						X	X	
Oilseeds (3)						X	X	
Other fiber crops (4)						*	*	
Cotton						X	X	
Sugar beets						X	X	
Sugar cane						X	X	
Forage crops (5)						X	X	
Potatoes						X	X	
Vegetables						X	X	
Fruits & nuts:								
Small fruits								
Decid. fruits, nuts						X	X	
Grapes						X	X	
Citrus fruits						X	X	
Bananas								
Pineapples						X	X	
Stimulant crops (6)						*	*	
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals						X	X	
Lawn & turf								

Other Uses : None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

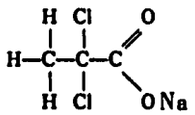
Identity

Common name(s) : dalapon-Na

Trade name(s) : Ded-Weed, Dowpon, Gramevin, Radapon, Unipon, Basfapon, and others

Chemical name : 2,2-Dichloropropionic acid, sodium salt

Structural formula:



Empirical formula : $C_3H_3O_2Cl_2Na$

Molecular weight : 165

Physical and Chemical Properties

Physical state : White powder

Specific gravity : Density 25 - 30 lbs./cu. ft.

Solubility in -

-water at 25°C : 50 grams/100 ml

-organic solvents: Readily soluble in methanol; slightly soluble in acetone and ether

Melting point : Decomposes at 166.5°C before melting.

Boiling point : N.a.

Vapor pressure : Not known

Flammability : Not flammable

Stability : Stable to heat. Aqueous solution hydrolyzes above 70°C; corrosive to iron

Analytical Methods: CIPAC Handbook 1
AOAC Handbook of Methods

dalapon-Na

Hazards to Humans

Toxic action	:	Not known.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 5,660 mg/kg; to rabbits 2,830 mg/kg
- dermal	:	Not absorbed in toxic amounts.
- inhalation	:	Relatively non-toxic.
Irritating to -		
- eyes	:	Moderately irritating.
- nose & throat	:	Moderately irritating.
- skin	:	Moderately irritating.
Other hazards	:	None known.
Specific antidote(s)	:	None known.
Chronic toxicity	:	No-effect level 15 to 50 mg/kg/day for rats and dogs.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	None established.
Residue tolerance(s)	:	1 - 75 ppm; 5 - 15 ppm on most crops.
Precautions	:	Group III (Slightly toxic).

dalapon-Na

Hazards to the Environment

Toxicity to -

- fishes : Relatively non-toxic.
- lower aquatic organisms : Moderately toxic.
- birds : Slightly toxic.
- wild mammals : Slightly toxic.
- soil organisms : Slightly toxic.

Build-up in food chains: No.

Likelihood of movement away from treated fields by -

- volatilization : Index = 1
- leaching : Index = 4
- surface runoff -
  --in water : May be substantial.
  --on solids : Possible.
- wind erosion : Not likely.

Degradation in the environment

Chemical route : Hydrolysis to CO_2, H_2O, Cl^-, Na^+.

Major degradation product(s) and their toxicity relative to the parent cpd. : Non-toxic.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Yes.
--sunlight : Yes.

Overall rate of degradation: Rapid; degrades within about 60 days.

Persistence in soil : Not persistent.

Carry-over to next season : No.

Precautions: Follow label directions.

Pesticidal Effectiveness

Toxic action	Systemic, selective herbicide, toxic to actively growing grasses following absorption through foliage or roots.
Spectrum of effectiveness	: Effective against a broad spectrum of grass weeds, including perennials.
Target pest resistance	: None reported.
Toxicity to bees (1)	: Relatively non-toxic.
Toxicity to beneficial insects (predators and parasites) (1)	: None.
Residual effectiveness	: Normally applied as a foliage spray and as such will control germinating grasses for 2 - 3 weeks.
Minimum interval between last treatment & harvest to prevent unsafe residues:	Usually 30 days.

Precautions: Follow label directions.

---

(1) At dosage rates recommended for control of target pests.

dalapon-Na

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)								
Rice								
Millet & sorghum								
Corn								
Pulses (2)						X		
Oilseeds (3)								
Other fiber crops (4)						X		
Cotton						X		
Sugar beets						X		
Sugar cane						X		
Forage crops (5)						X		
Potatoes								
Vegetables						X		
Fruits & nuts:						X		
Small fruits								
Decid. fruits, nuts								
Grapes						X		
Citrus fruits						X		
Bananas						X		
Pineapples						X		
Stimulant crops (6)						X		
Tree oil crops (7)						X		
Rubber trees						X		
Forest trees						X		
Ornamentals						X		
Lawn & turf								

Other Uses : None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

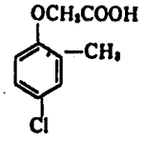
Identity

Common name(s) : MCPA

Trade name(s) : Agroxone, Chiptox, Hormotuho, Kilsem, Mephanac, MCP, Metaxon, Methoxone, Rhonox Rhomene, and others

Chemical name : 2-Methyl-4-chlorophenoxyacetic acid

Structural formula:



Empirical formula : $C_9H_9ClO_3$

Molecular weight : 200.6

Physical and Chemical Properties

Physical state : Light brown solid

Specific gravity : Not given

Solubility in -

-water at 15°C : 825 ppm; at 30°C: N.a.

-organic solvents: Slightly soluble in aromatic solvents; readily soluble in ether and alcohols

-lipids, fats : Not known

Melting point : 118 - 119°C (pure); 99 to 107°C (technical)

Boiling point : Not known

Vapor pressure : Not known

Flammability : Not known

Stability : Quite stable

Analytical Methods : CIPAC Handbook 1

MCPA

Hazards to Humans

Toxic action	:	Not known.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 700 mg/kg
- dermal	:	LD-50 to rats greater than 1,000 mg/kg
- inhalation	:	Slightly toxic.
Irritating to -		
- eyes	:	Moderately irritating.
- nose & throat	:	Moderately irritating.
- skin	:	Moderately irritating.
Other hazards	:	None known.
Specific antidote(s)	:	None known.
Chronic toxicity	:	No data.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	None established.
Residue tolerance(s)	:	None established.
Precautions	:	Group III (Slightly toxic).

MCPA

Hazards to the Environment

Toxicity to -

- fishes : Moderately toxic.
- lower aquatic organisms : Not known.
- birds : Slightly toxic.
- wild mammals : Slightly toxic.
- soil organisms : Relatively non-toxic.

Build-up in food chains: No.

Likelihood of movement away from treated fields by -

- volatilization : Index = 1 (acid)) May be different for acid derivatives.
- leaching : Index = 2 (acid))
- surface runoff -
  --in water : Possible
  --on solids : Possible.
- wind erosion : Not likely.

Degradation in the environment

Chemical route : Hydrolysis, oxidation.

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms : Yes.
--non-biological factors : Yes.
--sunlight : Yes.

Overall rate of degradation: Rapid.

Persistence in soil : Not more than 4 - 6 weeks.

Carry-over to next season : None.

Precautions: Follow label directions. Avoid drift.
Do not burn emptied containers.

MCPA

Pesticidal Effectiveness

Toxic action : Systemic, selective herbicide, plant growth regulant action.

Spectrum of effectiveness : Effective against many broadleaf weeds; most effective when plants are actively growing. Less effective on maturing plants.

Target pest resistance : None reported.

Toxicity to bees (1): Relatively non-toxic.

Toxicity to beneficial insects (predators and parasites) (1): None.

Residual effectiveness : One to four weeks, depending on weather.

Minimum interval between last treatment & harvest to prevent unsafe residues: None established. Usually applied early in the growing season.

Precautions: Avoid drift to susceptible crops or other desirable plants. MCPA esters, amines and salts and their formulations vary considerable in their volatility, flammability and in other properties. Follow label directions carefully.

---

(1) At dosage rates recommended for control of target pests.

MCPA

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)							X	
Rice							X	
Millet & sorghum								
Corn								
Pulses (2)								
Oilseeds (3)								
Other fiber crops (4)							X	
Cotton								
Sugar beets								
Sugar cane								
Forage crops (5)								
Potatoes								
Vegetables								
Fruits & nuts:								
Small fruits								
Decid. fruits, nuts								
Grapes								
Citrus fruits								
Bananas								
Pineapples								
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals								
Lawn & turf							X	

Other Uses : None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

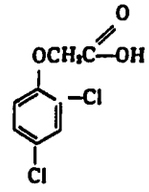
Identity

Common name(s) : 2,4-D

Trade name(s) : Chloroxone, Crop Rider, Ded-Weed, Weed-B-Gone, Weedar 64, Amoxone, Dacamine, Esteron, Salvo, and others

Chemical name : 2,4-Dichlorophenoxyacetic acid

Structural formula:



Empirical formula : $C_8H_6Cl_2O_3$

Molecular weight : 221.0

Physical and Chemical Properties

Physical state : White crystalline powder

Specific gravity : 1.565

Solubility in -

-water at 20°C : 620 ppm; at 30°C: N.a.

-organic solvents: Readily soluble in alcohol, ether, and alkaline solutions, insoluble in petroleum oils

-lipids, fats : Not known

Melting point : 135 - 138°C

Boiling point : 160°C at 0.4 mm Hg

Vapor pressure : Extremely low at 20°C
0.4 mm Hg at 160°C

Flammability : Not Flammable

Stability : Not stable to heat up to 260°C
Decomposes at higher temperature

Analytical Methods : CIPAC Handbook 1
AOAC Handbook of Methods

2,4-D

Hazards to Humans

Toxic action	:	Not known.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 375 mg/kg; to dogs 100 mg/kg
- dermal	:	LD-50 to rats 1,500 mg/kg
- inhalation	:	Slightly toxic.
Irritating to -		
- eyes	:	Moderately irritating.
- nose & throat	:	Moderately irritating.
- skin	:	Moderately irritating.
Other hazards	:	None known.
Specific antidote(s)	:	None known.
Chronic toxicity	:	No-effect level in the diet of rats and dogs 500 to 1,250 ppm.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	None established.
Residue tolerance(s)	:	0.5 - 20 ppm; 5 ppm on many crops.
Precautions	:	Group II (Moderately toxic).

2,4-D

Hazards to the Environment

Toxicity to -

- fishes : Moderately toxic.
- lower aquatic organisms : Slightly toxic.
- birds : Slightly toxic.
- wild mammals : Slightly toxic.
- soil organisms : Relatively non-toxic.

Build-up in food chains: No.

Likelihood of movement away from treated fields by -

- volatilization : Index = 1 (acid)) May be different for acid derivatives.
- leaching : Index = 2 (acid))
- surface runoff-
  --in water : Possible.
  --on solids : possible.
- wind erosion : Possible.

Degradation in the environment

Chemical route : Hydrolysis, oxidation.

Major degradation product(s) and their toxicity relative to the parent cpd. : CO_2, H_2O, Cl^-; non-toxic.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Yes.
--sunlight : Yes.

Overall rate of degradation : Rapid.

Persistence in soil : Not more than four weeks.

Carry-over to next season : None.

Precautions: Follow label directions. Avoid drift.
Do not burn emptied containers.

2,4-D

Pesticidal Effectiveness

Toxic action	:	Systemic, selective herbicide, plant growth regulant action.
Spectrum of effectiveness	:	Effective against a broad spectrum of broadleaf weeds and some woody plants. Most effective when plants are actively growing. Less effective on maturing plants.
Target pest resistance	:	None reported.
Toxicity to bees (1)	:	Relatively non-toxic.
Toxicity to beneficial insects (predators and parasites) (1)	:	None.
Residual effectiveness	:	One to four weeks, depending on weather.
Minimum interval between last treatment & harvest to prevent unsafe residues:		7 days for pasture and grazing, 14 days or more for other crops.

Precautions: Avoid drift to susceptible crops or other desirable plants. 2,4-D esters, amines and salts and their formulations vary considerably in their volatility, flammability, and in other properties. Follow label directions carefully.

---

(1) At dosage rates recommended for control of target pests.

2,4-D

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)							X	
Rice							X	
Millet & sorghum							X	
Corn							X	
Pulses (2)								
Oilseeds (3)								
Other fiber crops (4)								
Cotton								
Sugar beets								
Sugar cane							X	
Forage crops (5)							X	
Potatoes								
Vegetables							X	
Fruits & nuts:								
Small fruits							X	
Decid. fruits, nuts								
Grapes								
Citrus fruits								
Bananas								
Pineapples								
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees							X	
Ornamentals							X	
Lawn & turf							X	

Other Uses : Brush control; weed and brush control on rangeland and pastures.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

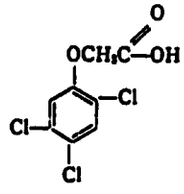
Identity

Common name(s) : 2,4,5-T

Trade name(s) : Ded-Weed Brush Killer, Esteron 245, Fence Rider, Inverton, Line Rider, Reddon, Forron, Tributon, Weedar 2,4,5-T, Weedone 2,4,5-T, and others

Chemical name : 2,4,5-Trichlorophenoxyacetic acid

Structural formula:



Empirical formula : $C_8H_5Cl_3O_3$

Molecular weight : 255.5

Physical and Chemical Properties

Physical state : White crystalline powder

Specific gravity : 1.662

Solubility in -

-water at 25°C : 278 ppm; at 30°C: N.a.

-organic solvents: Soluble in acetone, ethanol, ether and alkaline solutions

-lipids, fats : Not known

Melting point : 156.6°C (pure acid)

Boiling point : Decomposes before boiling

Vapor pressure : Very low at room temperature

Flammability : Not flammable

Stability : Very stable

Analytical Methods : CIPAC Handbook 1

2,4,5-T

Hazards to Humans

Toxic action	:	Not known.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 500 mg/kg
- dermal	:	Not known.
- inhalation	:	Slightly toxic.
Irritating to -		
- eyes	:	Strongly irritating.
- nose & throat	:	Moderately irritating.
- skin	:	Moderately irritating
Other hazards	:	None known.
Specific antidote(s)	:	None known.
Chronic toxicity	:	Not known. In subacute 90 day feeding studies, the no-effect level to rats and dogs was 10 - 30 mg/kg/day.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	None established.
Precautions	:	Group III (Slightly toxic).

Technical 2,4,5-T which has not been carefully produced may contain an extremely toxic impurity, 2,3,7,8-tetrachlorodibenzo-p-dioxin. The oral acute LD-50 of this compound is 0.022 - 0.045 mg/kg of body weight to the rat, 0.0006 mg/kg to the guinea pig. It is also a powerful teratogen, that is a substance capable of producing embryo malformations.

2,4,5-T

Hazards to the Environment

Toxicity to -

- fishes : Moderately toxic.
- lower aquatic organisms : Slightly toxic.
- birds : Slightly toxic.
- wild mammals : Slightly toxic.
- soil organisms : Relatively non-toxic.

Build-up in food chains: No.

Likelihood of movement away from treated fields by -

- volatilization : Index = 1 (acid)) May be different for acid derivatives.
- leaching : Index = 2 (acid))
- surface runoff -
  --in water : Possible.
  --on solids : Possible.
- wind erosion : Possible.

Degradation in the environment

Chemical route : Hydrolysis, oxidation.

Major degradation product(s) and their toxicity relative to the parent cpd. : CO_2, H_2O, Cl^-; non-toxic.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Yes.
--sunlight : Yes.

Overall rate of degradation : Fairly rapid.

Persistence in soil : Up to 3 months.

Carry-over to next season : None at recommended rates.

Precautions: Follow label directions. Avoid drift. Do not burn emptied containers.

2,4,5-T

Pesticidal Effectiveness

Toxic action : Systemic, selective herbicide, plant growth regulant action.

Spectrum of effectiveness : Effective against many broadleaf weeds and woody plants.

Target pest resistance : None reported.

Toxicity to bees (1) : Relatively non-toxic.

Toxicity to beneficial insects (predators and parasites) (1): None.

Residual effectiveness : One to four weeks.

Minimum interval between last treatment & harvest to prevent unsafe residues: None established. Not recommended for use on food crops in the U.S. Grazing of dairy animals not permitted within 6 weeks after application.

Precautions: Avoid drift to susceptible crops or other desirable plants. 2,4,5-T derivatives and their formulations vary considerably in their volatility, flammability, and in other properties. Follow label directions carefully.

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(1) At dosage rates recommended for control of target pests.

2,4,5-T

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)							X	
Rice								
Millet & sorghum								
Corn								
Pulses (2)								
Oilseeds (3)								
Other fiber crops (4)								
Cotton								
Sugar beets								
Sugar cane								
Forage crops (5)							X	
Potatoes								
Vegetables								
Fruits & nuts:								
Small fruits								
Decid. fruits, nuts								
Grapes								
Citrus fruits								
Bananas								
Pineapples								
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals								
Lawn & turf								

Other Uses : Brush control; weed and brush control on rangeland and pastures.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

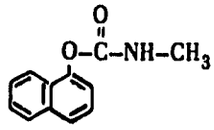
Identity

Common name(s) : carbaryl

Trade name(s) : Hexavin, Karbaspray, Ravyon, Sevin, Sevimol, Sevidol, Septene, Tricarnam

Chemical name : 1-Naphthyl methylcarbamate

Structural formula:



Empirical formula : $C_{12}H_{11}O_2N$

Molecular weight : 201.2

Physical and Chemical Properties

Physical state : White crystalline solid

Specific gravity : 1.232 at 20°C

Solubility in -

-water at 20°C : N.a.; at 30°C: 40 ppm

-organic solvents: Soluble in most polar organic solvents including dimethyl formamide and dimethyl sulfoxide, slightly soluble in xylene

-lipids, fats : Not known

Melting point : 142°C

Boiling point : Decomposes above 70°C

Vapor pressure : Less than 0.005 mm Hg at 26°C

Flammability : Flash point (open cup) 193°C

Stability : Stable to light, including ultraviolet; to heat up to 70°C; and under prolonged storage; rapidly hydrolysed to 1-naphthol in strong alkaline solutions

Analytical Methods : CIPAC Handbook 1
AOAC Handbook of Methods

carbaryl

Hazards to Humans

Toxic action : Reversible cholinesterase inhibitor.

Acute toxicity to laboratory animals -

- oral : LD-50 to rats 850 mg/kg (males).
- dermal : LD-50 to rats greater than 4,000 mg/kg (males).
- inhalation : LC-50 to guinea pigs greater than 0.390 mg/l

Irritating to -

- eyes : No.
- nose & throat : No.
- skin : No.

Other hazards : None known.

Specific antidote(s): Atropine sulfate. Do not use 2 - PAM, opiates or cholinesterase inhibiting drugs.

Chronic toxicity : No-effect level was 200 ppm in the diet of rats in a two-year study; 400 ppm in the diet of dogs in a one year test.

Cumulative toxic effects : None.

Allowable daily intake (FAO/WHO): 0.01 mg/kg (temporary).

Residue tolerance(s): 1 - 100 ppm; 5 to 10 ppm for most common commodities.

Precautions : Group III (Slightly toxic).

carbaryl

Hazards to the Environment

Toxicity to -

- fishes : Slightly toxic.
- lower aquatic organisms : Moderately toxic.
- birds : Relatively non-toxic.
- wild mammals : Relatively non-toxic.
- soil organisms : Relatively non-toxic.

Build-up in food chains: No.

Likelihood of movement away from treated fields by -

- volatilization : Index = 3 - 4
- leaching : Index = 2
- surface runoff -
  --in water : Low.
  --on solids : Low.
- wind erosion : Slight.

Degradation in the environment

Chemical route: Hydrolysis to naphthol, conjugation to sulfates or glucuronides; oxidation to ring-hydroxylated carbamate metabolites.

Major degradation product(s) and their toxicity relative to the parent cpd. : Methylol carbaryl, 1-naphthol, hydroxy carbaryls; all less toxic than parent.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Yes.
--sunlight : Yes, but slowly.

Overall rate of degradation: Moderate to rapid.

Persistence in soil : Not persistent, half life in soil 7 to 10 days.

Carry-over to next season : None.

Precautions: Follow label directions.

carbaryl

Pesticidal Effectiveness

Toxic action	:	Contact and stomach poison. No systemic action.
Spectrum of effectiveness	:	Effective against a broad spectrum of sucking and chewing insects affecting many crops, poultry and pets.
Target pest resistance	:	Occasional; certain leafhoppers, noctuids.
Toxicity to bees (1)	:	Highly toxic.
Toxicity to beneficial insects (predators and parasites) (1)	:	Highly toxic to ladybird beetles and Hymenoptera; less toxic to Tachinids and lacewings.
Residual effectiveness	:	Generally 3 to 10 days on plants; 3 - 4 months on protected inert surfaces; 3 weeks in soil.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	0 - 21 days; 1 to 3 days on most important crops.

Precautions: Highly toxic to bees. To avoid fruit thinning on apples, do not apply until 25 days after full bloom. Follow label directions.

---

(1) At dosage rates recommended for control of target pests.

carbaryl

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)	X							
Rice	X							
Millet & sorghum	X							
Corn	X							
Pulses (2)	X							
Oilseeds (3)	X							
Other fiber crops (4)	X							
Cotton	X							
Sugar beets	X							
Sugar cane	X							
Forage crops (5)	X							
Potatoes	X							
Vegetables	X	X						
Fruits & nuts:								
Small fruits	X							
Decid. fruits, nuts	X							X
Grapes	X							
Citrus fruits	X							
Bananas	X							
Pineapples								
Stimulant crops (6)	X							
Tree oil crops (7)	*							
Rubber trees								
Forest trees	X							
Ornamentals	X							
Lawn & turf	X							

Other Uses: Fruit thinning on apples. Control of ectoparasites on livestock, poultry and pets. Control of household and stored products insects.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

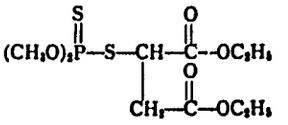
Identity

Common name(s) : malathion, mercaptothion (South Africa), carbofos (U.S.S.R.), maldison (Australia)

Trade name(s) : Cythion, Emmatos, Fyfanon, Karbofos, Kop-Thion, Kypfos, Malamar, Malaspray, Malathion, Malathon, Malatol, Zithiol, others

Chemical name: O,O-Dimethyl-S-(1,2-dicarbethoxyethyl) phosphorodithioate

Structural formula:



Empirical formula: $C_{10}H_{19}O_6PS_2$

Molecular weight : 330.4

Physical and Chemical Properties

Physical state : Clear, amber liquid

Specific gravity : 1.2315 at 25°C

Solubility in -

-water at 20°C : 120 ppm; at 30°C: 300 ppm

-organic solvents: Completely soluble in most alcohols, esters and ketones, aromatic and chlorinated hydrocarbons; poorly soluble in aliphatic hydrocarbons

-lipids, fats : Moderately soluble

Melting point : 2.85°C

Boiling point : 156 - 157°C at 0.7 mm Hg (slight decomposition)

Vapor pressure : 4×10^{-5} mm Hg at 30°C

Flammability : Flash point (open cup) greater than 120°C

Stability: Decomposes under alkaline conditions, at high temperatures, and at pH below 5. Relatively stable to light and under mildly acid conditions

Analytical Methods: CIPAC Handbook 1
AOAC Handbook of Methods

malathion

Hazards to Humans

Toxic action : Cholinesterase inhibition, stimulation of the nervous system.

Acute toxicity to laboratory animals -

- oral : LD-50 to rats 1,375 mg/kg (males); 1,000 mg/kg (females).
- dermal : LD-50 to rats greater than 4,444 mg/kg (males and females).
- inhalation : No LC-50 achieved in inhalation tests.

Irritating to -

- eyes : No.
- nose & throat: No.
- skin : May be slightly irritating to sensitive persons.

Other hazards : None known.

Specific antidote(s): Atropine sulfate alone or in conjunction with pralidoxime chloride (2-PAM).

Chronix toxicity : No-effect level in the diet of rats was 100 ppm, equivalent to 5 mg/kg/day.

Cumulative toxic effects : None known.

Allowable daily intake (FAO/WHO): 0.02 mg/kg

Residue tolerance(s): 1-135 ppm; 8 ppm on most crops.

Precautions : Group III (Slightly toxic).

malathion

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Moderately toxic.
- birds : Moderately toxic.
- wild mammals : Relatively non-toxic.
- soil organisms : Toxic to insects. Relatively non-toxic to other soil organisms.

Build-up in food chains: No.

Likelihood of movement away from treated fields by -

- volatilization : Index = 2
- leaching : Index = 2 - 3
- surface runoff -
  --in water : Minor.
  --on solids : Possible, but probably negligible.
- wind erosion : Possible, but probably negligible.

Degradation in the environment

Chemical route : Hydrolysis at carboxylic ester groups and at the phosphorus linkage.

Major degradation product(s) and their toxicity relative to the parent cpd. : Malaoxon more toxic, but transitory; thiophosphoric acid and carboxylic acids relatively non-toxic.

Degradable by -
--biological organisms: Yes.
--non-biological factors: Yes.
--sunlight : Yes.

Overall rate of degradation: Rapid
Persistence in soil : Not persistent, breaks down in less than 2 weeks.
Carry-over to next season : None.

Precautions: Follow label directions.

malathion

Pesticidal Effectiveness

Toxic action	:	Contact and stomach poison. Inhibits cholinesterase.
Spectrum of effectiveness	:	Effective against a broad spectrum of insects and mites om many crops, and against insects affecting man, animals or stored products.
Target pest resistance	:	Some strains of aphids, mites, houseflies and mosquitoes.
Toxicity to bees (1)	:	Highly toxic on direct contact, but toxicity of plant residues dissipates rapidly.
Toxicity to beneficial insects (predators and parasites) (1)	:	Highly toxic on direct contact.
Residual effectiveness	:	1 - 3 days on most treated crops; 2 - 4 weeks on indoor surfaces; 3 - 12 months in stored products.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	0 - 21 days, 3 - 7 days for most crops.
Precautions	:	Follow label directions.

---

(1) At dosage rates recommended for control of target pests.

malathion

Effectiveness profile

Plants / Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)	X							
Rice	X							
Millet & sorghum	X							
Corn	X							
Pulses (2)	*							
Oilseeds (3)	*							
Other fiber crops (4)	*							
Cotton	X							
Sugar beets	X							
Sugar cane	X							
Forage crops (5)	X							
Potatoes	X							
Vegetables	X							
Fruits & nuts:								
Small fruits	X							
Decid. fruits, nuts	X							
Grapes	X							
Citrus fruits	X							
Bananas	X							
Pineapples	X							
Stimulant crops (6)	X							
Tree oil crops (7)	X							
Rubber trees	X							
Forest trees	X							
Ornamentals	X							
Lawn & turf	X							

Other Uses : Control of insects on rangelands and pastures; control of insects on livestock, poultry and pest; control of mosquitoes, houseflies, household insects, stored products insects, human lice, bedbugs, etc.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

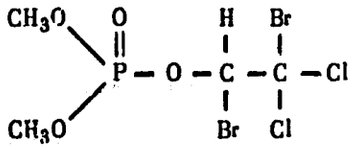
Identity

Common name(s) : naled

Trade name(s) : Dibrom

Chemical name: 1,2-Dibromo-2,2-dichloroethyl dimethyl phosphate

Structural formula:



Empirical formula : $C_4H_7O_4Br_2Cl_2P$

Molecular weight : 381

Physical and Chemical Properties

Physical state : Pure material solid below 26°C; technical is straw-colored liquid

Specific gravity : 1.97 at 20°C

Solubility in -

-water at 23°C : 0.2%

-organic solvents: Miscible with aromatic solvents; slightly soluble in aliphatics. Highly soluble in alcohols and ketones, with slow decomposition in some

-lipids, fats : Not known

Melting point : 27°C

Boiling point : 110°C at 0.5 mm Hg

Vapor pressure : 0.0002 mm Hg at 20°C

Flammability : Relatively non-flammable

Stability : Unstable under alkaline conditions, in sunlight, and in presence of iron. Hydrolyzes slowly at neutral or slightly acid pH

Analytical Methods : Not in CIPAC Handbook 1 or AOAC Handbook of Methods
GLC method available from manufacturer

naled

Hazards to Humans

Toxic action	:	Cholinesterase inhibition, stimulation of the nervous system.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 430 mg/kg
- dermal	:	LD-50 to rabbits 1,100 mg/kg
- inhalation	:	No mortality in rats, mice or guinea pigs after exposure to 1.52 mg/l/6 hrs.
Irritating to -		
- eyes	:	Yes. Concentrates severely irritating.
- nose & throat	:	Yes. Concentrates severely irritating.
- skin	:	Yes. Concentrates may cause skin damage.
Other hazards	:	None known.
Specific antidote(s)	:	Atropine sulfate.
Chronic toxicity	:	No gross or histopathologic effects on rats fed 100 ppm in the diet for two years, on dogs given 7.5 mg/kg/day for two years. Cholinesterase determinations not given.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	None established.
Residue tolerance(s)	:	0.5 - 3 ppm; 0.5 - 1 ppm on most crops.
Precautions	:	Group II (Moderately toxic).

naled

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Moderately toxic.
- birds : Moderately toxic.
- wild mammals : Slightly toxic.
- soil organisms : Relatively non-toxic due to rapid breakdown.

Build-up in food chains: No.

Likelihood of movement away from treated fields by -

- volatilization : Index = 4
- leaching : Index = 3
- surface runoff -
  --in water : Possible.
  --on solids : Low.
- wind erosion : Not likely.

Degradation in the environment

Chemical route : Hydrolysis, exact pathway not known.

Major degradation product(s) and their toxicity relative to the parent cpd. : DDVP, more toxic than parent, but not persistent.

Degradable by -
--biological organisms : Not known.
--non-biological factors: Yes.
--sunlight : Yes.

Overall rate of degradation: Very rapid breakdown in soil, water and on plants.

Persistence in soil : Not persistent, half-life in soil 4 hours or less

Carry-over to next season : None.

Precautions: Follow label directions.

naled

Pesticidal Effectiveness

Toxic action : Contact and stomach poison, non-systemic. Inhibits cholinesterase. Short residual.

Spectrum of effectiveness : Effective against a broad spectrum of chewing and sucking insects, and against some mites.

Target pest resistance : Not a major factor yet.

Toxicity to bees (1): Highly toxic.

Toxicity to beneficial insects (predators and parasites) (1): Highly toxic on direct contact, but plant residues dissipate rapidly.

Residual effectiveness : 1 - 3 days on plant surfaces; 1 to several weeks on protected inert surfaces.

Minimum interval between last treatment & harvest to prevent unsafe residues: 1 - 4 days.

Precautions: : Follow label directions.

---

(1) At dosage rates recommended for control of target pests.

naled

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)	*							
Rice	X							
Millet & sorghum								
Corn								
Pulses (2)	*							
Oilseeds (3)	*							
Other fiber crops (4)								
Cotton	X							
Sugar beets	X							
Sugar cane	X							
Forage crops (5)	*							
Potatoes	X							
Vegetables	X							
Fruits & nuts:								
Small fruits	X							
Decid. fruits, nuts	X							
Grapes	X							
Citrus fruits	X							
Bananas								
Pineapples								
Stimulant crops (6)	*							
Tree oil crops (7)								
Rubber trees								
Forest trees	X							
Ornamentals	X							
Lawn & turf								

Other Uses : Control of insects in or around animal holding facilities. Control of houseflies, mosquitoes, other household insects, and other nuisance insects indoors and outdoors.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

Identity

Common name(s) : dimethoate

Trade name(s) : Cygon, Daphene, De-Fend, Fostion, Le-Kuo, Perfekthion, Rogor, Roxion, Trimetion, Dimethogen

Chemical name : O,O-Dimethyl S-(N-methylcarbamoylmethyl) phosphorodithioate

Structural formula: $(CH_3O)_2\overset{S}{\overset{\|}{P}}-S-CH_2CONHCH_3$

Empirical formula : $C_5H_{12}O_3NPS$

Molecular weight : 229.3

Physical and Chemical Properties

Physical state : White crystalline solid

Specific gravity : 1.35 at 20°C

Solubility in

-water at 20°C : 3%; at 30°C: 5%

-Organic solvents: Soluble in aromatic petroleum distillates, lower alkanols, esters, ketones, ether and chloroform; slightly soluble in aliphatic hydrocarbons

-lipids, fats : Moderately soluble.

Melting point : 42° - 46°C

Boiling point : Not known

Vapor pressure : 0.025 mm Hg at 25°C

Flammability : Flash point 130°C. Combustible.

Stability : Relatively stable in dilute acid; hydrolyses rapidly in alkaline media and at pH below 4. Poor thermal stability.

Analytical Methods: Not in CIPAC Handbook 1 or AOAC Handbook of Methods. GLC method available from manufacturer.

dimethoate

Hazards to Humans

Toxic action : Cholinesterase inhibition, stimulation of the nervous system.

Acute toxicity to laboratory animals-

- oral : LD-50 to rats 215 mg/kg (males).
- dermal : LD-50 to rats 400 mg/kg (males).
- inhalation : No data.

Irritating to -

- eyes : No for technical; yes for liquid formulations.
- nose & throat: No for technical; yes for liquid formulations.
- skin : No for technical, yes for liquid formulations.

Other hazards : Readily absorbed through the skin.

Specific antidote(s): Atropine sulfate alone or with pralidoxime chloride (2 - PAM).

Chronic toxicity : No complete data. In 90 day subacute studies, no-effect level to dogs was 9 ppm in the diet. In a ome year study on rats, no-effect level was 32 ppm in the diet. No effects on man from 0.2 mg/kg/day for 4 weeks.

Cumulative toxic effects : None known.

Allowable daily intake (FAO/WHO): 0.02 mg/kg.

Residue tolerance(s): 0.002 - 2 ppm; 2 ppm on most crops.

Precautions : Group II (Moderately toxic).

dimethoate

Hazards to the Environment

Toxicity to

- fishes : Moderately toxic.
- lower aquatic organisms : Relatively non-toxic.
- birds : Moderately toxic.
- wild mammals : Moderately toxic.
- soil organisms : Toxic to insects. Toxicity to other soil organisms not known.

Build-up in food chains: Not likely.

Likelihood of movement away from treated fields by -

- volatilization : Index = 2
- leaching : Index = 2 - 3
- surface runoff -
  --in water : May be substantial.
  --on solids : May occur.
- wind erosion : Not known but may occur.

Degradation in the Environment

Chemical route : Oxidation, then hydrolysis.

Major degradation product(s) and their toxicity relative to the parent cpd. : Dimethoxon, more toxic (3-4 times) than parent. Others are esters of thio- and dithiophosporic acid, all less toxic than parent.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Yes.
--sunlight : Not known. Probably minor.

Overall rate of degradation: Fairly rapid on plants; relatively slow in water.

Persistence in soil : Not persistent; half-life in soil 3 - 4 days.

Carry-over to next season : None.

Precautions: Follow label directions. Keep out of any body of water.

dimethoate

Pesticidal Effectiveness

Toxic action	:	Contact and stomach poison. Contact and systemic activity on plants. Inhibits cholinesterase.
Spectrum of effectiveness	:	Broad spectrum, effective against many sucking and chewing insects and against mites on many crops.
Target pest resistance	:	Some strains of houseflies.
Toxicity to bees (1)	:	Highly toxic.
Toxicity to beneficial insects (predators and parasites) (1)	:	Highly toxic.
Residual effectiveness	:	7 - 14 days.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	0 - 28 days; 7 - 15 days on most crops.
Precautions	:	Follow label directions.

---

(1) At dosage rates recommended for control of target pests.

dimethoate

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)	*							
Rice								
Millet & sorghum	X							
Corn								
Pulses (2)	X							
Oilseeds (3)	*							
Other fiber crops (4)								
Cotton	X							
Sugar beets								
Sugar cane								
Forage crops (5)	X							
Potatoes	X							
Vegetables	X							
Fruits & nuts:								
Small fruits								
Decid. fruits, nuts	X							
Grapes								
Citrus fruits	X							
Bananas								
Pineapples								
Stimulant crops (6)	*							
Tree oil crops (7)	X							
Rubber trees								
Forest trees	X							
Ornamentals	X							
Lawn & turf								

Other Uses : Control of houseflies in and around livestock barns, pens, etc., except milk processing or storage areas.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

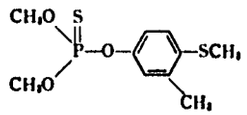
Identity

Common name(s) : fenthion

Trade name(s) : Baytex, Entex, Lebaycid, Mercaptophos, Tiguvon, Queletox, and others

Chemical name : O,O-Dimethyl O-4(methylthio)-m-tolyl phosphorothioate

Structural formula:



Empirical formula : $C_{10}H_{15}O_3PS_2$

Molecular weight : 278.3

Physical and Chemical Properties

Physical state : Brown liquid

Specific gravity : 1.245 at 20°C

Solubility in -

-water at 25°C : ca. 55 ppm

-organic solvents: Readily soluble in most organic solvents. Limited solubility in aliphatics.

-lipids, fats : Not known

Melting point : Lower than -25°C

Boiling point : 87°C at 0.01 mm Hg

Vapor pressure : 3×10^{-5} mm Hg at 20°C
8×10^{-5} mm Hg at 30°C

Flammability : Above 82°C

Stability : Subject to hydrolysis, especially under alkaline conditions. Thermally stable at 210°C

Analytical Methods : Not in CIPAC Handbook 1 or AOAC Handbook of Methods
Method available from manufacturer

fenthion

Hazards to Humans

Toxic action : Cholinesterase inhibition, stimulation of the nervous system.

Acute toxicity to laboratory animals-

- oral : LD-50 to rats 215 mg/kg (males); 245 mg/kg (females)
- dermal : LD-50 to rats 330 mg/kg (males and females)
- inhalation (LC_{50}): LC-50 to rats 2.4 mg/l/60 min.

Irritating to -

- eyes : No.
- nose & throat : No.
- skin : No.

Other hazards : None known.

Specific antidote(s): Atropine sulfate.

Chronic toxicity : Cholinesterase no-effect level in the diet is 3 ppm in rats, 2 ppm in dogs.

Cumulative toxic effects : Yes.

Allowable daily intake (FAO/WHO): None established.

Residue tolerance(s): 0.01 - 18 ppm; 0.01 ppm in milk; all tolerances associated with use against mosquitoes and livestock insects.

Precautions : Group II (Moderately toxic)

fenthion

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Highly toxic.
- birds : Highly toxic.
- wild mammals : Not known.
- soil organisms : Not known.

Build-up in food chains: Not reported.

Likelihood of movement away from treated fields by -

- volatilization : Index = 2
- leaching : Index = 2
- surface runoff -
  --in water : Low.
  --on solids : Possible
- wind erosion : Possible.

Degradation in the environment

Chemical route : Oxidation and hydrolysis.

Major degradation product(s) and their toxicity relative to the parent cpd. : Some oxidation products more toxic than parent.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Yes.
--sunlight : Yes.

Overall rate of degradation: Moderate.

Persistence in soil : Not persistent. Soil-applied product no longer detectable after 4 months.

Carry-over to next season : None.

Precautions: Follow label directions.

fenthion

Pesticidal Effectiveness

Toxic action : Contact and stomach poison. Inhibits cholinesterase. Systemic action when applied to mammals orally or dermally.

Spectrum of effectiveness : Effective against a broad spectrum of sucking and chewing insects, including insects affecting man and animals.

Target pest resistance : Some strains of mosquitoes and houseflies.

Toxicity to bees (1): Highly toxic.

Toxicity to beneficial insects (predators and parasites) (1): Highly toxic when used as a foliar insecticide. Not a factor when used against insects affecting man or animals.

Residual effectiveness : On indoor surfaces 8 - 12 weeks; on outdoor inert surfaces (patio areas, farm buildings, etc.) 7 - 8 weeks.

Minimum interval between last treatment & harvest to prevent unsafe residues: None established for U.S. crops; 10 - 20 days in other countries. Treated meat animals may not be slaughtered within 35 days of treatment.

Precautions: : Follow label directions.

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(1) At dosage rates recommended for control of target pests.

fenthion

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)								
Rice	X							
Millet & sorghum								
Corn								
Pulses (2)								
Oilseeds (3)								
Other fiber crops (4)								
Cotton								
Sugar beets	X							
Sugar cane								
Forage crops (5)								
Potatoes								
Vegetables								
Fruits & nuts:								
Small fruits								
Decid. fruits, nuts								
Grapes								
Citrus fruits								
Bananas								
Pineapples								
Stimulant crops (6)	*							
Tree oil crops (7)	*							
Rubber trees								
Forest trees	X							
Ornamentals	X							
Lawn & turf								

Other Uses : Control of insects in or on livestock. Control of mosquitoes and household insects.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

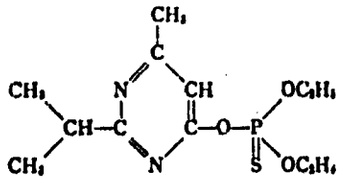
Identity

Common name(s) : diazinon

Trade name(s) : Basudin, Dazzel, Diazajet, Diazide, Diazinon, Diazol, Sarolex, Spectracide

Chemical name: O,O-Diethyl-O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothiate

Structural formula:



Empirical formula : $C_{12}H_{21}O_3N_2PS$

Molecular weight : 304.35

Physical and Chemical Properties

Physical state : Light amber to dark brown liquid

Specific gravity : 1.116 to 1.118

Solubility in -

-water at 20°C : 0.004%; at 30°C: Not known

-organic solvents: Readily soluble in aliphatic and aromatic solvents, alcohols, and ketones

-lipids,fats : Not known

Melting point : N.a.

Boiling point : 83° - 84°C at 0.002 mm Hg

Vapor pressure : 1.4 at 10^{-4} mm Hg at 20°C

Flammability : 105°F

Stability : Stable in mildly alkaline media; reacts with acid and strong alkali

Analytical Methods: CIPAC Handbook 1; GLC method available from manufacturer

diazinon

Hazards to Humans

Toxic action	:	Cholinesterase inhibitor; stimulates the nervous system.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 108 mg/kg (males); 76 mg/kg (females).
- dermal	:	LD-50 to rats 900 mg/kg (males); 455 mg/kg (females).
- inhalation	:	No data.
Irritating to -		
- eyes	:	Moderately irritating.
- nose & throat	:	Moderately irritating.
- skin	:	Mildly irritating.
Other hazards	:	None known.
Specific antidote(s)	:	Atropine sulfate and pralidoxime chloride (2 - PAM).
Chronic toxicity	:	No gross effects in rats fed 100 ppm in the diet for two years, nor in dogs fed 4.3 - 5.3 mg/kg/day for 43 days. Cholinesterase inhibition in both groups.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	0.002 ppm
Residue tolerance(s)	:	0.01 - 60 ppm; 0.75 ppm for most fruits and vegetables.
Precautions	:	Group II (Moderately toxic).

diazinon

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Highly toxic
- birds : Highly toxic.
- wild mammals : Slightly toxic.
- soil organisms : Toxic to soil insects; relatively non-toxic to other soil organisms.

Build-up in food chains: Not likely.

Likelihood of movement away from treated fields by -

- volatilization : Index = 3
- leaching : Index = 2
- surface runoff -
  --in water : Possible.
  --on solids : Possible.
- wind erosion : Possible.

Degradation in the environment

Chemical route : Hydrolysis at the heterocyclic phosphate bond; cyclic moiety eventually reduced to CO_2.

Major degradation product(s) and their toxicity relative to the parent cpd. : Several; those which have been identified are less toxic than parent.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Yes.
--sunlight : No data.

Overall rate of degradation: Moderately rapid.

Persistence in soil : Not persistent; half-life 4 to 6 weeks.

Carry-over to next season : None.

Precautions: Follow label directions.

diazinon

Pesticidal Effectiveness

Toxic action : Contact, stomach and vapor action. Inhibits cholinesterase.

Spectrum of effectiveness : Broad spectrum insecticide, effective against many sucking, chewing, and biting insects on plants. Also effective against a number of soil insects, and household and stored products insects.

Target pest resistance : Some strains of houseflies, ticks and sheep blowfly (in Australia).

Toxicity to bees (1): Highly toxic.

Toxicity to beneficial insects (predators and parasites) (1): Toxic.

Residual effectiveness : Foliage 7 to 10 days; indoor inert surfaces 4 to 6 weeks; soil 2 to 4 months.

Minimum interval between last treatment & harvest to prevent unsafe residues: 0 - 35 days; generally 3 to 10 days.

Precautions : Follow label directions.

---

(1) At dosage rates recommended for control of target pests.

diazinon **Effectiveness profile**

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)								
Rice								
Millet & sorghum	X	X						
Corn	X	X						
Pulses (2)	*	*						
Oilseeds (3)		*						
Other fiber crops (4)								
Cotton								
Sugar beets								
Sugar cane								
Forage crops (5)	X							
Potatoes	X	X						
Vegetables	X	X						
Fruits & nuts:								
Small fruits	X							
Decid. fruits, nuts	X							
Grapes	X							
Citrus fruits	X							
Bananas	X							
Pineapples	X							
Stimulant crops (6)	*							
Tree oil crops (7)	*							
Rubber trees								
Forest trees	X							
Ornamentals	X							
Lawn & turf	X	X						

Other Uses : Control of ectoparasites on sheep.
Control of household and stored products insects.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

Identity

Common name(s) : ethion; diethion (France, So. Africa)

Trade name(s) : Ethion, Nialate

Chemical name : O,O,O,O-Tetraethyl S,S-methylene bis-phosphorodithioate

Structural formula: $(C_2H_5O)_2\overset{S}{\overset{\|}{P}}-S-CH_2-S-\overset{S}{\overset{\|}{P}}(OC_2H_5)_2$

Empirical formula : $C_9H_{22}O_4P_2S_4$

Molecular weight : 384.48

Physical and Chemical Properties

Physical state : Amber liquid

Specific gravity: 1.220 at 20°C (purified)
1.215 - 1.230 at 20°C (technical)

Solubility in -

-water at 22°C : 2 ppm

-organic solvents: Miscible in xylene, kerosene, acetone, chloroform and methylated naphthalene

-lipids, fats : No data

Melting point : -7 to -9°C (purified); -12 to -15°C (tech.)

Boiling point : Decomposes above 150°C

Vapor pressure : 1.5×10^{-6} mm Hg at 25°C

Flammability : Not flammable

Stability : Subject to acid and alkaline hydrolysis; slowly oxidizes in air

Analytical Methods: Not in CIPAC Handbook 1 or AOAC Handbook of Methods; GLC method available from manufacturer

ethion

Hazards to Humans

Toxic action	:	Cholinesterase inhibitor, stimulates the nervous system.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 65 mg/kg (males); 27 mg/kg (females)
- dermal	:	LD-50 to rats 245 mg/kg (males); 62mg/kg (females)
- inhalation	:	No data.
Irritating to -		
- eyes	:	No.
- nose & throat	:	No.
- skin	:	No.
Other hazards	:	None known.
Specific antidote(s)	:	Atropine sulfate.
Chronic toxicity	:	No data. In 90 day subacute studies, no effect levels were 3 ppm in the diet in rats (= 0.15 mg/kg/day); 0.125 mg/kg/day in dogs. In a 3 week study, no-effect level in man was 0.05 mg/kg/day.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	0.00125 mg/kg
Residue tolerance(s)	:	0.1 - 14 ppm, most important commodities 2 ppm.
Precautions	:	Group II (Moderately toxic).

ethion

Hazards to the Environment

Toxicity to -

- fishes	:	Highly toxic.
- lower aquatic organisms	:	Highly toxic
- birds	:	Toxic.
- wild mammals	:	Not known.
- soil organisms	:	Toxic to insects. Relatively non-toxic to other soil organisms.

Build-up in food chains: Not likely.

Likelihood of movement away from treated fields by -

-volatilization	:	Index = 1 - 2
-leaching	:	Index = 1 - 2
-surface runoff -		
--in water	:	Low.
--on solids	:	Possible.
-wind erosion	:	Possible.

Degradation in the environment

Chemical route	:	Oxidation and hydrolysis; exact route not known.
Major degradation product(s) and their toxicity relative to the parent cpd.	:	Oxidation products more toxic than parent.

Degradable by -

--biological organisms	:	Not known.
--non-biological factors	:	Not known.
--sunlight	:	Not known.
Overall rate of degradation	:	Rapid in soil; moderate on plants; relatively slow in water.
Persistence in soil	:	Not persistent; 90% degraded in 30 days.
Carry-over to next season	:	Negligible.

Precautions: Follow label directions. Keep out of any body of water.

ethion

Pesticidal Effectiveness

Toxic action : Contact and stomach poison; inhibits cholinesterase.

Spectrum of effectiveness : Broad spectrum; effective against many species of chewing and sucking insects and mites, incl. Eriophyid mites, on a large number of crops.

Target pest resistance : Some strains of spider mites.

Toxicity to bees (1): Moderately toxic.

Toxicity to beneficial insects (predators and parasites) (1): Moderately toxic.

Residual effectiveness : 30 days on plants, 60 days on unexposed surfaces. Quite stable in water.

Minimum interval between last treatment & harvest to prevent unsafe residues: 0 - 60 days; 7 days on vegetables, 20 - 40 days on most fruits.

Precautions : Follow label directions.

---

(1) At dosage rates recommended for control of target pests.

ethion

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals: Small grains (1)								
Rice								
Millet & sorghum	x							
Corn	x							
Pulses (2)								
Oilseeds (3)								
Other fiber crops (4)								
Cotton	X							
Sugar beets								
Sugar cane								
Forage crops (5)	X							
Potatoes								
Vegetables	X							
Fruits & nuts: Small fruits	X							
Decid. fruits, nuts	X							
Grapes	X							
Citrus fruits	X							
Bananas								
Pineapples								
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals	X							
Lawn & turf	X							

Other Uses : None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

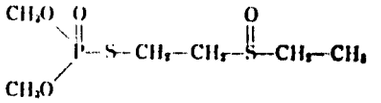
Identity

Common name(s) : oxydemeton-methyl; demeton-S-methyl sulfoxide (Germany)

Trade name(s) : Metasystemox, Meta-Systox-R

Chemical name : O,O-Dimethyl S-2-(ethylsulfinyl) ethyl phosphorothioate

Structural formula:



Empirical formula : $C_6H_{15}O_4PS_2$

Molecular weight : 246

Physical and Chemical Properties

Physical state : Clear amber liquid

Specific gravity : 1.29 at 20°C

Solubility in -

-water at 20°C : Infinitely; at 30°C: Infinitely

-organic solvents: Readily soluble in most organic solvents; insoluble in aliphatics

-lipids, fats : Not known

Melting point : Lower than -10°C

Boiling point : 106°C at 0.01 mm Hg

Vapor pressure : Not known

Flammability : Not known

Stability : Subject to hydrolysis. Not stable in alkaline media or at elevated temperatures.

Analytical Methods : Not in CIPAC Handbook 1 or AOAC Handbook of Methods. Method available from manufacturer

oxydemeton-methyl

Hazards to Humans

Toxic action	:	Cholinesterase inhibition, stimulation of the nervous system.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 65 mg/kg (males); 56 mg/kg (females).
- dermal	:	LD-50 to rats 250 mg/kg
- inhalation	:	LC-50 to rats 1.5 mg/l/60 min.
Irritating to -		
- eyes	:	No.
- nose & throat	:	No.
- skin	:	No.
Other hazards	:	None known.
Specific antidote(s)	:	Atropine sulfate alone or with pralidoxime chloride (2 - PAM).
Chronic toxicity	:	Cholinesterase no-effect level in the diet is 1 ppm in rats; 2 ppm in dogs.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	None established.
Residue tolerance(s)	:	None established.
Precautions	:	Group I (Highly toxic).

oxydemeton-methyl

Hazards to the Environment

Toxicity to -

- fishes : Moderately toxic.
- lower aquatic organisms : Moderately toxic.
- birds : Moderately toxic.
- wild mammals : Not known.
- soil organisms : Not known.

Build-up in food chains: Not likely.

Likelihood of movement away from treated fields by -

- volatilization : Index = 3
- leaching : Index = 3 - 4
- surface runoff -
  --in water : May be substantial.
  --on solids : Possible.
- wind erosion : Not known.

Degradation in the environment

Chemical route : Hydrolytic cleavage of P - S bond. Further pathways of degradation not known.

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms: Not known.
--non-biological factors: Yes.
--sunlight : Not known.

Overall rate of degradation: Fairly rapid.

Persistence in soil : Not persistent. Half-life in soil less than 30 days.

Carry-over to next season: None.

Precautions: Follow label directions.

oxydemeton-methyl

Pesticidal Effectiveness

Toxic action	:	Systemic insecticide, rapidly absorbed through foliage, stems and roots of plants and translocated within plants. Also has contact activity. Inhibits cholinesterase.
Spectrum of effectiveness	:	Effective against aphids, mites, thrips, and other sucking insects on vegetable, fruit, and field crops and on ornamentals.
Target pest resistance	:	Some aphid and mite strains.
Toxicity to bees (1)	:	Moderately toxic.
Toxicity to beneficial insects (predators and parasites) (1)	:	Highly toxic to predators and parasites on direct contact. Treated plants become safe soon after application due to rapid absorption of the product.
Risidual effectiveness	:	One to two weeks from foliar applications. Soil drenches give much longer residual.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	7 - 30 days; 14 to 30 days for most crops.
Precautions	:	Follow label directions.

(1) At dosage rates recommended for control of target pests.

oxydemeton-methyl Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)								
Rice								
Millet & sorghum								
Corn	X							
Pulses (2)								
Oilseeds (3)								
Other fiber crops (4)								
Cotton	X							
Sugar beets	X							
Sugar cane								
Forage crops (5)	X							
Potatoes	X							
Vegetables	X							
Fruits & nuts:								
Small fruits	X							
Decid. fruits, nuts	X							
Grapes								
Citrus fruits								
Bananas								
Pineapples								
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals	X							
Lawn & turf								

Other Uses : None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

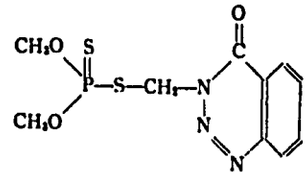
Identity

Common name(s) : azinphos-methyl

Trade name(s) : Carfene, Cotnion, Gusathion, Guthion

Chemical name : O,O-Dimethyl S-[4-oxo-1,2,3-benzotriazin-3-(4H)-ylmethyl]phosphorodithioate

Structural formula:



Empirical formula: $C_{10}H_{12}O_3N_3PS_2$

Molecular weight : 317

Physical and Chemical properties

Physical state : White crystalline solid. Technical brown waxy solid.

Specific gravity : 1.44 at 20°C

Solubility in -

-water at 20°C : ca.17 ppm; at 30°C: ca.25 ppm

-organic solvents: Soluble in most organic solvents except aliphatics

-lipids, fats : Not known

Melting point : 73° - 74°C

Boiling point : Not known; decomposes

Vapor pressure : Practically immeasurable at 20°C

Flammability : Not flammable up to 200°C

Stability : Rapidly hydrolyzed by acid and alkali. Decomposes at elevated temperatures with gas evolution

Analytical Methods: CIPAC Handbook 1

azinphos-methyl

Hazards to Humans

Toxic action : Cholinesterase inhibition, stimulation of the nervous system.

Acute toxicity to laboratory animals -

- oral : LD-50 to rats 13 mg/kg (males; 11 mg/kg (females).
- dermal : LD-50 to rats 220 mg/kg (males and females).
- inhalation LC_{50}): 0.106 mg/l/60 min.

Irritating to -

- eyes : No.
- nose & throat : No.
- skin : No.

Other hazards : None known.

Specific antidote(s): Atropine sulfate alone or with pralidoxime chloride (2 - PAM).

Chronic toxicity : Cholinesterase no-effect level in the diet is 5 ppm in rats and dogs.

Cumulative toxic effects : None known.

Allowable daily intake (FAO/WHO) : 0.0025 mg/kg

Residue tolernace(s): 0.2 - 7.5 ppm; 2 ppm for many crops.

Precautions : Group I (Highly toxic).

azinphos-methyl

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Highly toxic.
- birds : Moderately toxic.
- wild mammals : Not known.
- soil organisms : Not known.

Build-up in the food chains: Not likely.

Likelihood of movement away from treated fields by -

- volatilization : Not known.
- leaching : Index = 1 - 2
- surface runoff -
  --in water : Not likely.
  --on solids : Possible, but probably minor.
- wind erosion : Not known.

Degradation in the environment

Chemical route : Hydrolytic cleavage of phosphate ester, further steps not known.

Major degradation product(s) and their toxicity relative to the parent cpd. : Benzazimide, anthranilic acid, both less toxic than parent.

Degradable by -
--biological organisms: Not known.
--non-biological factors: Yes.
--sunlight : Yes.
Overall rate of degradation: Fairly rapid.
Persistence in soil : Varies with soil, pH and temperature, generally not persistent.

Carry-over to next season : Minor. Less than 10% of material applied to soil found after one year.

Precautions: Follow label directions.

azinphos-methyl

Pesticidal Effectiveness

Toxic action	:	Contact and stomach poison. Inhibits cholinesterase. No significant systemic activity.
Spectrum of effectiveness	:	Broad-spectrum insecticide, effective against many sucking and chewing insects and some mite species, used on many different crops.
Target pest resistance	:	Some aphid and mite strains.
Toxicity to bees (1)	:	Highly toxic.
Toxicity to beneficial insects (predators and parasites) (1)	:	Toxic to many; less toxic to some predatory mites.
Residual effectiveness	:	One to three weeks, depending on crop and weather.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	1 - 60 days; 14 - 21 days for many crops.
Precautions:	:	Follow label directions.

(1) At dosage rates recommended for control of target pests.

azinphos-methyl Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)	x							
Rice								
Millet & sorghum								
Corn								
Pulses (2)	*							
Oilseeds (3)	x							
Other fiber crops (4)								
Cotton	x							
Sugar beets								
Sugar cane	x							
Forage crops (5)	x							
Potatoes	x							
Vegetables	x							
Fruits & nuts:								
Small fruits	x							
Decid. fruits, nuts	x							
Grapes	x							
Citrus fruits	x							
Bananas								
Pineapples								
Stimulant crops (6)	*							
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals	x							
Lawn & turf								

Other Uses : None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

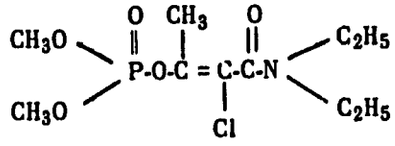
Identity

Common name(s) : phosphamidon

Trade name(s) : Dimecron, Dimicron, Phosphamidon

Chemical name: 2-Chloro-2-diethylcarbamoyl-1-methylvinyl dimethyl phosphate

Structural formula:



Empirical formula : $C_{10}H_{19}O_5ClNP$

Molecular weight : 299.7

Physical and Chemical Properties

Physical state : Colorless oil

Specific gravity : 1.2132 at 25°C

Solubility in -

-water at 20°C : Miscible; at 30°C: Miscible

-organic solvents: Miscible with all organic solvents except saturated hydrocarbons; slightly soluble in saturated hydrocarbons

-lipids, fats : No data.

Melting point : N.a.

Boiling point : 94°C at 0.04 mm Hg; 150°C at 1 mm Hg

Vapor pressure : 2.5×10^{-5} mm Hg at 20°C
2.6×10^{-4} mm Hg at 40°C

Flammability : Flammable

Stability : Technical product stable. Hydrolyzes slowly in neutral or acid, rapidly in basic solutions

Analytical Methods: Not in CIPAC Handbook 1 or AOAC Handbook of Methods. Several methods available from manufacturer, and described in other literature

phosphamidon

Hazards to Humans

Toxic action	:	Cholinesterase inhibition, stimulation of the nervous system.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 23.5 mg/kg (males & females)
- dermal	:	LD-50 to rats 143 mg/kg (males); 107 mg/kg (females)
- inhalation	:	Highly toxic.
Irritating to -		
- eyes	:	No data.
- nose & throat	:	No data.
- skin	:	No data.
other hazards	:	None known.
Specific antidote(s)	:	Atropine sulfate; pralidoxime chloride (2 - PAM)
Chronic toxicity	:	No-effect level to dogs in a two-year study was 0.1 mg/kg/day (capsule); no-effect level to rats in a 13 months test was 0.5 ppm in the diet.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	0.001 mg/kg
Residue tolerance(s)	:	0.1 - 1 ppm; 0.5 - 0.75 ppm for most crops.
Precautions	:	Group I (Highly toxic).

phosphamidon

Hazards to the Environment

Toxicity to -

- fishes : Moderately toxic.
- lower aquatic organisms : Highly toxic.
- birds : Highly toxic.
- wild mammals : Moderately toxic.
- soil organisms : Not known.

Build-up in the food chains: No data.

Likelihood of movement away from treated fields by -

- volatilization : Index = 2 - 3
- leaching : Index = 3 - 4
- surface runoff -
  --in water : May be substantial.
  --on solids : Possible.
- wind erosion : Possible.

Degradation in the environment

Chemical route : Not known

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms: Not known.
--non-biological factors: Not known.
--sunlight : Not known.

Overall rate of degradation: Not known.
Persistence in soil : Not known.

Carry-over to next season : Not likely.

Precautions: Follow label directions.

phosphamidon

Pesticidal Effectiveness

Toxic action	:	Contact and stomach poison; contact and systemic activity on plants. Inhibits cholinesterase.
Spectrum of effectiveness	:	Effective against sucking and chewing insects, and against mites. Especially active against aphids.
Target pest resistance	:	Some strains of mites, pear psylla.
Toxicity to bees (1)	:	Highly toxic.
Toxicity to beneficial insects (predators and parasites)(1)	:	Highly toxic.
Residual effectiveness	:	10 - 14 days.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	1 - 30 days; 7 - 15 days for most crops.
Precautions	:	Follow label directions.

(1) At dosage rates recommended for control of target pests.

phosphamidon

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)	*							
Rice								
Millet & sorghum								
Corn								
Pulses (2)	*							
Oilseeds (3)								
Other fiber crops (4)								
Cotton	X							
Sugar beets	X							
Sugar cane								
Forage crops (5)	X							
Potatoes	X							
Vegetables	X							
Fruits & nuts:								
Small fruits								
Decid. fruits, nuts	X							
Grapes								
Citrus fruits	X							
Bananas								
Pineapples								
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals								
Lawn & turf								

Other Uses : None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

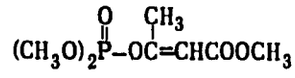
Identity

Common name(s) : mevinphos

Trade name(s) : Menite, Phosdrin, Phosfene

Chemical name: 2-Carbomethoxy-1-methylvinyl dimethyl phosphate

Structural formula:



Empirical formula : $C_7H_{13}O_6P$

Molecular weight : 224

Physical and Chemical Properties

Physical state : Liquid at 25°C

Specific gravity : 1.24; density 10.3 lbs/gal at 68°F

Solubility in -

-water at 20°C : Miscible; at 30°C: Miscible

-organic solvents: Miscible with most alcohols, ketones, chlorinated hydrocarbons, aromatic hydrocarbons. Slightly soluble in aliphatic hydrocarbons

-lipids, fats : Soluble

Melting point : -56°C

Boiling point : 99 - 103.5°C at 0.03 mm Hg; 325°C at 760 mm Hg

Vapor pressure : 2.9×10^{-3} at 21.1°C; 5.7×10^{-3} at 29°C

Flammability : Not flammable

Stability : Corrosive to many metals. In aqueous solution rapidly hydrolyzed under alkaline conditions, stable in acid range

Analytical Methods: Not in CIPAC Handbook 1 or AOAC Handbook of Methods. IR and GLC methods available from manufacturer

mevinphos

Hazards to Humans

Toxic action	:	Cholinesterase inhibition, stimulation of the nervous system.
Acute toxicity to laboratory animals -		
- oral	:	LD-50 to rats 6.1 mg/kg (males); 3.7 mg/kg (females).
- dermal	:	LD-50 to rabbits 16 - 34 mg/kg
- inhalation	:	Saturated vapor exposure for 4 hours not lethal to rats.
Irritating to -		
- eyes	:	Rapid systemic absorption and severe poisoning can result from direct contact.
- nose & throat	:	Non-irritating.
- skin	:	Non-irritating; however, systemic absorption and poisoning can result from skin contact.
Other hazards	:	None known.
Specific antidote(s)	:	Atropine alone or in conjunction with pralidoxime chloride (2 - PAM).
Chronic toxicity	:	No-effect level in rats 0.5 ppm in diet; in dogs 0.025 mg/kg/day (equivalent to 0.5 ppm in diet).
Cumulative toxic effects	:	None known aside from irreversible inhibition of cholinesterase. Progressive upon repeated exposure.
Allowable daily intake (FAO/WHO)	:	None established.
Residue tolerance(s)	:	0.25 - 4 ppm; 0.25 - 1 ppm on most crops.
Precautions	:	Group I (Highly toxic).

mevinphos

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Highly toxic.
- birds : Highly toxic.
- wild mammals : Highly toxic.
- soil organisms : Toxic to soil insects. Relatively non-toxic to other soil organisms.

Build-up in food chains: Not reported.

Likelihood of movement away from treated fields by -

- volatilization : Index = 3 - 4
- leaching : Index = 3 - 4
- surface runoff -
  --in water : May be substantial.
  --on solids : Not likely.
- wind erosion : Not likely.

Degradation in the environment

Chemical route : Not known.

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms: Yes.
--non-biological factors: Yes.
--sunlight : No data.

Overall rate of degradation: Rapid.

Persistence in soil : Not persistent. Half-life in soil 3 - 12 hours.

Carry-over to next season: None.

Precautions: Follow label directions.

mevinphos

Pesticidal Effectiveness

Toxic action	: Contact, stomach, fumigant and systemic activity. Inhibits cholinesterase.
Spectrum of effectiveness	: Effective against a broad spectrum of foliage pests, including sucking and chewing insects and mites.
Target pest resistance	: Some aphid and mite strains.
Toxicity to bees (1)	: Highly toxic, but relatively short residual activity.
Toxicity to beneficial insects (predators and parasites) (1)	: Extremely toxic to many beneficial insects at time of application. Plants sprayed become safe within 12 hours of application because of short residual.
Residual effectiveness	: Biological effectiveness generally lasts less than one day.
Minimum interval between last treatment & harvest to prevent unsafe residues	: Generally 1 to 7 days, depending on crop and dosage. For most crops at average dosages 1 to 2 days.
Precautions	: Follow label directions.

(1) At dosage rates recommended for control of target pests.

mevinphos Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)	X							
Rice	X							
Millet & sorghum	X							
Corn	X							
Pulses (2)	*							
Oilseeds (3)	*							
Other fiber crops (4)								
Cotton	X							
Sugar beets	X							
Sugar cane								
Forage crops (5)	X							
Potatoes	X							
Vegetables	X							
Fruits & nuts:								
Small fruits	X							
Decid. fruits, nuts	X							
Grapes	X							
Citrus fruits	X							
Bananas								
Pineapples								
Stimulant crops (6)	*							
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals	X							
Lawn & turf								

Other Uses : Insect control in greenhouses.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

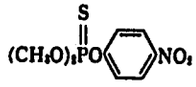
x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

Identity

Common name(s) : methyl parathion; parathion-methyl; metaphos (USSR)

Trade name(s) : Dalf, Folidol M, Metron, Nitrox, Partron, Tekwaisa, Wofatox

Chemical name: O,O-Dimethyl O-p-nitrophenyl phosphorothioate

Structural formula: 

Empirical formula : $C_8H_{10}O_5NPS$

Molecular weight : 263.2

Physical and Chemical Properties

Physical state : White solid (pure)
amber liquid (technical)

Specific gravity : 1.358 at 20°C (pure)

Solubility in -

-water at 20°C : 25 ppm; at 40°C: 77 ppm

-organic solvents: Slightly soluble in light petroleum and mineral oils; readily soluble in most organic solvents

-lipids, fats : Slightly soluble

Melting point : 37°C (pure); 29° (technical)

Boiling point : Thermally unstable

Vapor pressure : 0.97×10^{-5} mm Hg at 20°C

Flammability : Flash point (open cup) 115°F

Stability : May explode at 120°C, should not be heated above 55°C (131°F). Rapidly hydrolyzed in alkaline media; hydrolyzes slowly at pH 7 and below

Analytical Methods: CIPAC Handbook 1, AOAC Handbook of Methods

methyl parathion

Hazards to Humans

Toxic action	:	Powerful cholinesterase inhibitor affecting the nervous system.
Acute toxicity to laboratory animals -		
- oral	:	LD-50 to rats 14 mg/kg (males); 24 mg/kg (females).
- dermal	:	LD-50 to rats 67 mg/kg (males & females).
- inhalation	:	No data.
Irritating to -		
- eyes	:	Not irritating, but single drop in eye could be fatal.
- nose & throat	:	Not irritating, but highly poisonous when inhaled.
- skin	:	Not irritating, but rapidly absorbed through intact skin.
Other hazards	:	None known.
Specific antidote(s)	:	Atropine sulfate, alone or with pralidoxime chloride (2-PAM).
Chronic toxicity	:	No data available.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	0.001 mg/kg (temporary)
Residue tolerance(s)	:	0.1 to 5 ppm; 1 ppm for most crops.
Precautions	:	Group I (Highly toxic). May explode in excessive heat (above 55°C = 131°F).

methyl parathion

Hazards to the Environment

Toxicity to -

- fishes : Moderately toxic.
- lower aquatic organisms : Highly toxic.
- birds : Highly toxic.
- wild mammals : Highly toxic.
- soil organisms : Toxic to soil insects. Relatively non-toxic to other soil organisms.

Build-up in food chains: No.

Likelihood of movement away from treated fields by -

- volatilization : Index = 3
- leaching : Index = 2
- surface runoff -
  --in water : Low.
  --on solids : Low.
- wind erosion : Low.

Degradation in the environment

Chemical route : Hydrolysis, oxidation, reduction, dealkylation.

Major degradation product(s) and their toxicity relative to the parent cpd. : Most degradation products less toxic than parent.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Yes.
--sunlight : Yes.

Overall rate of degradation: Very rapid.

Persistence in soil : Not persistent.

Carry-over to next season : None.

Precautions: Follow label directions.

methyl parathion

Pesticidal Effectiveness

Toxic action	:	Contact, stomach and inhalation poison, not a systemic.
Spectrum of effectiveness	:	Effective against a broad spectrum of insects and some mites attacking many crops.
Target pest resistance	:	Strains of cotton bollworm, tobacco budworm, cabbage looper, housefly, mosquitoes and mites.
Toxicity to bees (1)	:	Highly toxic.
Toxicity to beneficial insects (predators and parasites) (1)	:	Highly toxic.
Residual effectiveness	:	Very short, 1 - 2 days or less.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	5 - 21 days; about 14 days for most crops.
Precautions:	:	Follow label directions.

(1) At dosage rates recommended for control of target pests.

methyl parathion Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)	X							
Rice	X							
Millet & sorghum	X							
Corn	X							
Pulses (2)	X							
Oilseeds (3)	X							
Other fiber crops (4)								
Cotton	X							
Sugar beets	X							
Sugar cane	X							
Forage crops (5)	X							
Potatoes	X							
Vegetables	X							
Fruits & nuts:								
Small fruits	X							
Decid. fruits, nuts	X							
Grapes	X							
Citrus fruits								
Bananas								
Pineapples								
Stimulant crops (6)	X	X						
Tree oil crops (7)								
Rubber trees								
Forest trees	X							
Ornamentals								
Lawn & turf								

Other Uses : Control of mosquito larvae in public health programs.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

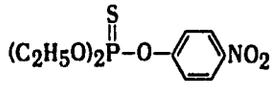
Identity

Common name(s) : parathion; thiophos (USSR)

Trade name(s) : Ethyl Parathion, AAT, Alkron, Alleron, Aphamite, Corothion, Etilon, Folidol, Niran, Orthophos, Panthion, Paramar, Paraphos, Parathene, Parawet, Phoskil, Rhodiatox, Soprathion, Stathion, others

Chemical name: O,O-Diethyl O-p-nitrophenyl phosphorothioate

Structural formula:



Empirical formula: $C_{10}H_{14}O_5NPS$

Molecular weight : 291.27

Physical and Chemical Properties

Physical state : Brown liquid

Specific gravity : 1.265 at 25°C

Solubility in -

-water at 20°C : 9 ppm; at 40°C: 11 ppm

-organic solvents: Miscible with acetone, benzene, chlorofrom, ethanol and xylene; slightly soluble in heptane and petroleum oils

-lipids, fats : Slightly soluble

Melting point : 6.1°C

Boiling point : 157 to 162°C at 0.6 mm Hg (thermally unstable)

Vapor pressure : 0.57×10^{-5} mm Hg at 20°C

Flammability : Flash point (open cup) 200°C

Stability : Unstable above 100°C; hydrolyses rapidly in alkali, very slowly at pH 7 and below

Analytical Methods: CIPAC Handbook I
AOAC Handbook of Methods

parathion

Hazards to Humans

Toxic action	:	Powerful cholinesterase inhibitor affecting the nervous system.
Acute toxicity to laboratory animals -		
- oral	:	LD-50 to rats 13 mg/kg (males); 3.6 mg/kg (females).
- dermal	:	LD-50 to rats 21 mg/kg (males); 6.8 mg/kg (females).
- inhalation	:	No data.
Irritating to -		
- eyes	:	Not irritating, but single drop in eye could be fatal.
- nose & throat	:	Not irritating, but highly poisonous when inhaled.
- skin	:	Not irritating, but rapidly absorbed through intact skin.
Other hazards	:	None known.
Specific antidote(s)	:	Atropine sulfate, alone or with pralidoxime chloride (2-PAM).
Chronic toxicity	:	No-effect level (cholinesterase inhibition) for rats was 1 ppm in the diet (= 0.05 mg/kg/day) in a two year study. The same rate was the no-effect level for man in a shorter study.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	0.005 mg/kg
Residue tolerance(s)	:	0.1 - 5 ppm; 1 ppm for most crops.
Precautions	:	Group I (Highly toxic). Handle with extreme care. Parathion is one of the most dangerous pesticides. Observe all safety precautions.

parathion

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Highly toxic.
- birds : Highly toxic.
- wild mammals : Highly toxic.
- soil organisms : Highly toxic to soil insects and earthworms.

Build-up in food chains: No.

Likelihood of movement away from treated fields by -

- volatilization : Index = 3
- leaching : Index = 2
- surface runoff -
  --in water : Low.
  --on solids : Possible
- wind erosion : Possible.

Degradation in the environment

Chemical route : Oxidation to paraoxon; hydrolysis to p-nitrophenol and diethyl thiophosphoric acid; reduction to amino parathion.

Major degradation product(s) and their toxicity relative to the parent cpd. : Most less toxic, paraoxon more toxic but less stable.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Yes.
--sunlight : Yes.

Overall rate of degradation : Moderate.

Persistence in soil : Varies greatly, depending on soil, pH and temperature. Generally not persistent.

Carry-over to next season: Minor to none.

Precautions: Parathion is a highly dangerous poison and has a great potential for harm to non-target species including man. Follow label directions carefully.

parathion

Pesticidal Effectiveness

Toxic action	:	Contact, stomach and inhalation poison, no strong systemic action.
Spectrum of effectiveness	:	Effective against a very broad spectrum of insects and mites attacking many crops.
Target pest resistance	:	Several strains of mites and insects.
Toxicity to bees (1)	:	Highly toxic.
Toxicity to beneficial insects (predators and parasites) (1)	:	Highly toxic.
Residual effectiveness	:	On exposed plant surfaces one to several days, on protected surfaces (bark) one month.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	7 - 30 days, around 14 days for most crops.
Precautions	:	Follow label directions carefully.

(1) At dosage rates recommended for control of target pests.

parathion

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)	X	X						
Rice	X	X						
Millet & sorghum	X							
Corn	X	X						
Pulses (2)	X	X						
Oilseeds (3)	X	X						
Other fiber crops (4)								
Cotton	X	X						
Sugar beets	X	X						
Sugar cane	X	X						
Forage crops (5)	X	X						
Potatoes	X	X						
Vegetables	X	X						
Fruits & nuts:								
Small fruits	X							
Decid. fruits, nuts	X							
Grapes	X							
Citrus fruits	X							
Bananas								
Pineapples	X	X						
Stimulant crops (6)	X	X						
Tree oil crops (7)	X							
Rubber trees								
Forest trees	X							
Ornamentals	X							
Lawn & turf		X						

Other Uses: None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

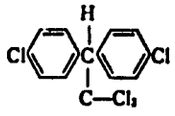
x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

Identity

Common name(s) : DDT

Trade name(s) : Anofex, Chlorophenotane, Dedelo, Dicophane, Genitox, Gesapon, Gesarex, Gesarol, Gyron, Ixodex, Kopsol, Neocid, Pentachlorin, Rukseam, Zerdane

Chemical name : Dichloro-diphenyl-trichloroethane

Structural formula: 

Empirical formula : $C_{14}H_9Cl_5$

Molecular weight : 354.3

Physical and Chemical Properties

Physical state : White crystalline solid

Specific gravity : 1.38 (tech. grade); 1.6 (pp'-isomer)

Solubility in -

-water at 20°C : Insoluble; at 30°C: Insoluble

-organic solvents: Readily soluble in most aromatic and chlorinated solvents; moderately soluble in hydrophilic and polar solvents and in petroleum oils

-lipids, fats : Very soluble

Melting point : 108.5°C (pp'- DDT)

Boiling point : Decomposes at 110°C

Vapor pressure : 1.9×10^{-7} mm Hg at 20°C (pp'- DDT)

Flammability : Not flammable

Stability : Very stable. Decomposes above 110°C, evolving HCl

Analytical Methods: CIPAC Handbook 1
AOAC Handbook of Methods

DDT

Hazards to Humans

Toxic action	:	Stimulation of the central nervous system.
Acute toxicity to laboratory animals -		
- oral	:	LD-50 to rats 113 mg/kg (males) 118 mg/kg (females).
- dermal	:	LD-50 to rats 2,510 mg/kg (females).
- inhalation	:	Relatively non-toxic.
Irritating to -		
- eyes	:	No.
- nose & throat	:	No.
- skin	:	No.
Other hazards	:	None known.
Specific antidote(s)	:	Phenobarbital.
Chronic toxicity	:	No-effect level for dogs 10 mg/kg/day. (Humans much more sensitive).
Cumulative toxic effects	:	Liver changes.
Allowable daily intake (FAO/WHO)	:	0.005 mg/kg
Residue tolerance(s)	:	Up to 7 ppm
Precautions	:	Group II (Moderately toxic).

DDT

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Toxic.
- birds : Moderately toxic.
- wild mammals : Moderately toxic.
- soil organisms : Slightly toxic.

Build-up in food chains: Yes.

Likelihood of movement away from treated fields by -

- volatilization : Index = 1
- leaching : Index = 1
- surface runoff -
  --in water : Low.
  --on solids : May be substantial.
- wind erosion : Substantial.

Degradation in the environment

Chemical route : Complex; degradation products include DDE, DDA, TDE, DME and others.

Major degradation product(s) and their toxicity relative to the parent cpd. : Less toxic.

Degradable by -
--biological organisms: Yes.
--non-biological factors: Yes.
--sunlight : Yes.

Overall rate of degradation: Very slow.

Persistence in soil : Very persistent.

Carry-over to next season : Substantial if applied to the soil.

Precautions: DDT is very persistent, accumulates and biomagnifies in food chains, and has caused widespread environmental contamination. Its use may be restricted or prohibited by local laws or regulations.

DDT

Pesticidal Effectiveness

Toxic action	:	Contact and stomach poison.
Spectrum of effectiveness	:	Controls a very broad spectrum of insects.
Target pest resistance	:	Very substantial; many strains of many insect species completely resistant.
Toxicity to bees (1)	:	Moderately toxic.
Toxicity to benefical insects (predators and parasites) (1)	:	Toxic
Residual effectiveness	:	12 - 16 days on plants; much longer (up to one year and more) on inert, unexposed surfaces.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	7 - 90 days.
Precautions	:	Follow label directions.

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(1) At dosage rates recommended for control of target pests.

DDT Effectiveness profile

Plants / Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)								
Rice								
Millet & sorghum								
Corn	x							
Pulses (2)	x							
Oilseeds (3)	x	x						
Other fiber crops (4)	x	x						
Cotton	x	x						
Sugar beets								
Sugar cane								
Forage crops (5)	x	x						
Potatoes		x						
Vegetables	x	x						
Fruits & nuts:								
Small fruits	x							
Decid. fruits, nuts	x							
Grapes	x							
Citrus fruits	x							
Bananas								
Pineapples								
Stimulant crops (6)	x							
Tree oil crops (7)								
Rubber trees								
Forest trees	x							
Ornamentals	x							
Lawn & turf	x							

Other Uses: Public health; DDT is effective against the insect vectors of some 30 vector-borne diseases. Structural pest control, control of stored products insects, and control of insects on pets and poultry. Control of house mice.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

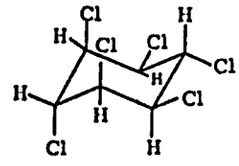
Identity

Common name(s) : BHC, HCH (Europe)

Trade name(s) : Benzahex, Benzex, Dol, Dolmix, FBHC, HCCH, Hexafor, Hexyclan, Soprocide, others

Chemical name : benzene hexachloride; hexachlorocyclohexane (mixed isomers)

Structural formula:



Empirical formula : $C_6H_6Cl_6$

Molecular weight : 290.9

Physical and Chemical Properties

Physical state : Off-white to brown powdery solid

Specific gravity : 1.89

Solubility in -

-water at 20°C : 10 ppm; at 30°C: Not known

-organic solvents: Soluble in benzene, chloroform and acetone; slightly soluble in alcohol

-lipids, fats : Not known

Melting point : 112.9°C (gamma-isomer)

Boiling point : Decomposes at 288°C

Vapor pressure : 0.02 mm Hg at 20°C
0.06 mm Hg at 40°C

Flammability : Not flammable

Stability : Stable to light, air, heat, and strong acids. Dehydrochlorinates in presence of alkali or on prolonged exposure to heat, forming HCl and trichlorobenzenes

Analytical Methods: CIPAC Handbook 1
AOAC Handbook of Methods

BHC

Hazards to Humans

Toxic action	:	Gamma and alpha isomers stimulate the central nervous system, while the beta and delta isomers are CNS depressants.
Acute toxicity to laboratory animals -		
- oral	:	LD-50 to rats 88 mg/kg (males); 91 mg/kg (females)
- dermal	:	LD-50 to rats 1,000 mg/kg (males); 900 mg/kg (females).
- inhalation	:	No data.
Irritating to -		
- eyes	:	Irritating.
- nose & throat	:	Irritating.
- skin	:	Irritating.
Other hazards	:	None known.
Specific antidote(s)	:	None known.
Chronic toxicity	:	No-effect level to rats less than 100 ppm tech.BHC in the diet (this level produced increase in liver size).
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	None established.
Residue tolerance(s)	:	1 ppm on many crops.
Precautions	:	Group II (Moderately toxic).

BHC

Hazards to the Environment

Toxicity to

- fishes : Highly toxic.
- lower aquatic organisms : Highly toxic.
- birds : Slightly toxic.
- wild mammals : Moderately toxic.
- soil organisms : Slightly to relatively non-toxic.

Build-up in food chains: No data.

Likelihood of movement away from treated fields by -

- volatilization : Index = 3
- leaching : Index = 1
- surface runoff -
  --in water : No.
  --on solids : Minor.
- wind erosion : Minor.

Degradation in the Environment

Chemical route : Not known.

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms : Not known.
--non-biological factors: Not known.
--sunlight : Not known.
Overall rate of degradation: Very slow.
Persistence in soil : Very persistent.
Carry-over to next season : Yes.

Precautions: BHC soil residues are very persistent and will impart undesirable odors or off-flavors especially to root crops growing in contaminated soil.
Follow label directions.

BHC

Pesticidal Effectiveness

Toxic action : Contact and stomach poison. Also has fumigant action.

Spectrum of effectiveness : Broad spectrum, effective on many foliar and soil insects. Use on food crops limited because BHC gives bad odor and off-flavor to treated crops.

Target pest resistance : No data.

Toxicity to bees (1): Highly toxic on contact. Not a factor when used as soil or seed treatment.

Toxicity to beneficial insects (predators and parasites) (1): Highly toxic.

Residual effectiveness : Persistent on foliage, very persistent in soil.

Minimum interval between last treatment & harvest to prevent unsafe residues: On most crops, no applications after seedling stage permitted. Uses on crops used for food or feed severely restricted in U.S.

Precautions : Odor and off-flavor problems limit usefulness of BHC on crops used for food or feed. Follow label directions.

---

(1) At dosage rates recommended for control of target pests.

BHC

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)		X						
Rice		X						
Millet & sorghum		X						
Corn		X						
Pulses (2)		X						
Oilseeds (3)								
Other fiber crops (4)								
Cotton	X							
Sugar beets		X						
Sugar cane								
Forage crops (5)	X	X						
Potatoes								
Vegetables	X	X						
Fruits & nuts:								
Small fruits								
Decid. fruits, nuts	X							
Grapes	X							
Citrus fruits								
Bananas								
Pineapples								
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals								
Lawn & turf		X						

Other Uses : Control of ticks, chiggers, etc., on uncultivated land.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

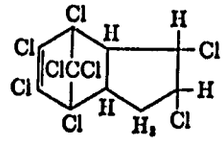
Identity

Common name(s) : chlordane

Trade name(s) : Chlordane, Belt, Chlor Kil, Corodane, Kypchlor, Octachlor, Ortho-Klor, Synklor, Topiclor 20

Chemical name: 1,2,4,5,6,7,8,8,-octachloro-4,7,-methano-3a,4,7,7a-tetrahydroindane

Structural formula:



Empirical formula : $C_{10}H_6Cl_8$

Molecular weight : 409.8

Physical and Chemical Properties

Physical state : Amber, viscous liquid

Specific gravity : 1.59 to 1.63 at 25°C

Solubility in -

-water at 20°C : Insoluble; at 30°C: Insoluble

-organic solvents: Soluble in most organic solvents

-lipids, fats : Soluble

Melting point : 175°C at 22 mm Hg

Boiling point : 118°C at 0.06 mm Hg

Vapor pressure : 1×10^{-5} mm Hg at 25°C

Flammability : Not flammable

Stability : Stable to acid and alkaline conditions encountered in normal use. Dehydrohalogenates in presence of stronger alkali

Analytical Methods: CIPAC Handbook I
AOAC Handbook of Methods

chlordane

Hazards to Humans

Toxic action	:	Stimulation of the central nervous system.
Acute toxicity to laboratory animals -		
- oral	:	LD-50 to rats 335 mg/kg (males; 430 mg/kg (females).
- dermal	:	LD-50 to rats 840 mg/kg (males); 690 mg/kg (females).
- inhalation	:	Moderately toxic.
Irritating to -		
- eyes	:	Moderately irritating.
- nose & throat	:	Slightly irritating.
- skin	:	Slightly irritating.
Other hazards	:	None known.
Specific antidote(s)	:	None known.
Chronic toxicity	:	No-effect level in laboratory animals between 3 and 15 ppm in the diet.
Cumulative toxic effects	:	Similar to accute symptoms, slowly progressive. In addition, loss of appetite, loss of weight and headaches may be present.
Allowable daily intake (FAO/WHO)	:	0.001 mg/kg
Residue tolerance(s)	:	0.3 ppm
Precautions	:	Group II (Moderately toxic).

chlordane

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Not known.
- birds : Slightly toxic.
- wild mammals : Moderately toxic.
- soil organisms : Toxic to soil insects, moderately toxic to some soil bacteria and to earthworms.

Build-up in food chains: Yes.

Likelihood of movement away from treated fields by -

- volatilization : Index = 2
- leaching : Index = 1
- surface runoff -
  --in water : Negligible
  --on solids : Not known.
- wind erosion : Not known.

Degradation in the environment

Chemical route : To hydrophilic products such as chlorohydrin and glycols

Major degradation product(s) and their toxicity relative to the parent cpd. : Less toxic than chlordane.

Degradable by -
--biological organisms: Yes.
--non-biological factors: Yes.
--sunlight : Negligible

Overall rate of degradation: Slow.

Persistence in soil : Half-life about one year.

Carry-over to next season : Yes.

Precautions: Chlordane is a persistent chlorinated hydrocarbon insecticide. Follow label directions.

chlordane

Pesticidal Effectiveness

Toxic action	:	Contact and stomach poison.
Spectrum of effectiveness	:	Controls a wide variety of foliar and soil insects.
Target pest resistance	:	German cockroach; sod webworm.
Toxicity to bees (1)	:	Highly toxic in foliar applications, no danger to bees from soil application.
Toxicity to beneficial insects (predators and parasites) (1)	:	Toxic when applied to foliage.
Residual effectiveness	:	Moderate when applied to foliage, more prolonged following soil application.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	30 days for many crops.
Precautions	:	Follow label directions.

(1) At dosage rates recommended for control of target pests.

chlordane

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)		X						
Rice								
Millet & sorghum		X						
Corn		X						
Pulses (2)		X						
Oilseeds (3)		X						
Other fiber crops (4)		X						
Cotton	X	X						
Sugar beets		X						
Sugar cane		X						
Forage crops (5)								
Potatoes		X						
Vegetables		X						
Fruits & nuts:								
Small fruits		X						
Decid. fruits, nuts		X						
Grapes		X						
Citrus fruits		X						
Bananas		X						
Pineapples								
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees	X							
Ornamentals	X							
Lawn & turf		X						

Other Uses : Control of stored products insects; structural pest control.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

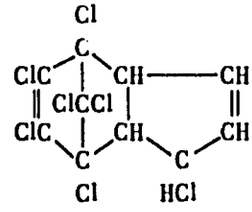
Identity

Common name(s) : heptachlor

Trade name(s) : Heptachlor, Heptamul, Drinox, Heptagran, Heptavel, Clorahep

Chemical name: 1,4,5,6,7,8,8-heptachloro3a,4,7,7a-tetrahydro-4,7-methanoindene

Structural formula:



Empirical formula : $C_{10}H_5Cl_7$

Molecular weight : 373.5

Physical and Chemical Properties

Physical state : White crystalline solid

Specific gravity : 1.65 to 1.67

Solubility in -

-water at 20°C : 0.01 ppm; at 30°C: Not known

-organic solvents: Soluble in most organic solvents

-lipids, fats : Insoluble

Melting point : 95° to 96°C

Boiling point : None at 760 mm

Vapor pressure : 1.5×10^{-2} mm at 65°C
3.75×10^{-3} mm at 50°C

Flammability : Not flammable

Stability : Stable to light, moisture, air and moderate heat

Analytical Methods: CIPAC Handbook I
AOAC Handbook of Methods

heptachlor

Hazards to Humans

Toxic action	:	Stimulation of the central nervous system.
Acute toxicity to laboratory animals -		
- oral	:	LD-50 to rats 100 mg/kg (males); 162 mg/kg (females).
- dermal	:	LD-50 to rats 195 mg/kg (males); 250 mg/kg (females).
- inhalation	:	Moderately toxic.
Irritating to -		
- eyes	:	Slightly irritating.
- nose & throat	:	Slightly irritating.
- skin	:	No.
Other hazards	:	None known.
Specific antidote(s)	:	None known.
Chronic toxicity	:	No-effect level in laboratory animals 1 ppm in the diet.
Cumulative toxic effects	:	Similar to acute symptoms, slowly progressive. In addition, loss of appetite, loss of weight and headaches may be present.
Allowable daily intake (FAO/WHO)	:	0.0005 mg/kg
Residue tolerance(s)	:	0.01 - 0.1 ppm
Precautions	:	Group II (Moderately toxic).

heptachlor

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Toxic.
- birds : Toxic.
- wild mammals : Toxic.
- soil organisms : Toxic to soil insects and earthworms.

Build-up in food chains: Yes.

Likelihood of movement away from treated fields by -

- volatilization : Index = 3
- leaching : Index = 1
- surface runoff -
  --in water : Negligible.
  --on solids : Not known.
- wind erosion : Not known.

Degradation in the environment

Chemical route : 1-hydroxy-chlordene; 1-hydroxy-2, 3-epoxy-chlordene; heptachlor epoxide

Major degradation product(s) and their toxicity relative to the parent cpd. : Heptachlor epoxide more toxic, other metabolites less toxic to mammals than parent cpd.

Degradable by -
--biological organisms : Yes.
--non-biological factors : Yes.
--sunlight : Negligible.

Overall rate of degradation : Slow.
Persistence in soil : Half-life about one year.
Carry-over to next season : Yes.

Precautions: Heptachlor is one of the more persistent chlorinated hydrocarbon insecticides. Its use may be restricted or prohibited by local laws or regulations.

heptachlor

Pesticidal Effectiveness

Toxic action	:	Contact and stomach poison.
Spectrum of effectiveness	:	Broad spectrum soil insecticide.
Target pest resistance	:	Corn rootworms.
Toxicity to bees (1)	:	Highly toxic.
Toxicity to beneficial insects (predators and parasites) (1)	:	Not studied.
Residual effectiveness	:	Prolonged, up to several years after soil application.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	Pre-plant application recommended for most uses.
Precautions	:	Follow label directions.

(1) At dosage rates recommended for control of target pests.

heptachlor

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)		X						
Rice								
Millet & sorghum								
Corn		X						
Pulses (2)		X						
Oilseeds (3)		X						
Other fiber crops (4)								
Cotton		X						
Sugar beets		X						
Sugar cane		X						
Forage crops (5)								
Potatoes		X						
Vegetables		X						
Fruits & nuts:								
Small fruits								
Decid. fruits, nuts								
Grapes								
Citrus fruits		X						
Bananas								
Pineapples		X						
Stimulant crops (6)		X						
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals								
Lawn & turf		X						

Other Uses : Structural pest control.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

Identity

Common name(s) : toxaphene (U.S. only), camphechlor (FAO), polychlorocamphene (USSR)

Trade name(s) : Toxaphene, Alltox, Phenacide, ClorChem, Phenatox, Strobane-T, Toxakil

Chemical name: Chlorinated camphene containing 67 - 69% chlorine

Structural formula: Exact structure not known

Empirical formula : $C_{10}H_{10}Cl_8$

Molecular weight : 414

Physical and Chemical Properties

Physical state : Waxy solid

Specific gravity : 1.65 at 25°C

Solubility in -

-water at 25°C : 0.4 ppm

-organic solvents: Readily soluble in most organic solvents, including petroleum oils

-lipids, fats : Soluble

Melting point : Not sharp. Softening point 70°C minimum

Boiling point : Decomposes

Vapor pressure : 0.17 - 0.40 mm Hg at 25°C
3.0 - 4.0 mm Hg at 90°C

Flammability : Not flammable

Stability : Very stable; dehydrochlorinated by heat, strong sunlight and by certain catalysts such as iron

Analytical Methods: CIPAC Handbook I

toxaphene

Hazards to Humans

Toxic action	:	Stimulation of the central nervous system.
Acute toxicity to laboratory animals -		
- oral	:	LD-50 to rats 90 mg/kg (males); 80 mg/kg (females).
- dermal	:	LD-50 to rats 1,075 mg/kg (males); 780 mg/kg (females).
- inhalation	:	Moderately toxic.
Irritating to -		
- eyes	:	No.
- nose & throat	:	No.
- skin	:	No.
Other hazards	:	None known.
Specific antidote(s)	:	Pentobarbital or phenobarbital parenterally.
Chronic toxicity	:	No-effect levels: 25 ppm rat; 20 ppm dog; 0.7 mg/kg/day monkey.
Cumulative toxic effects	:	Microscopic liver changes including centrilobular hypertrophy and liposphere infiltration.
Allowable daily intake (FAO/WHO)	:	None established.
Residue tolerance(s)	:	2 - 7 ppm; 7 ppm on grains, fruit, nuts, fat of animals.
Precautions	:	Group II (Moderately toxic).

toxaphene

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- Lower aquatic organisms : Toxic.
- birds : Moderately toxic.
- wild mammals : Moderately toxic.
- soil organisms : Not known.

Build-up in food chains: Yes.

Likelihood of movement away from treated fields by -

- volatilization : Index = 4
- leaching : Index = 1
- surface runoff -
  --in water : Negligible.
  --on solids : Possible.
- wind erosion : Possible.

Degradation in the environment

Chemical route : Not known

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Not demonstrated.
--sunlight : Not demonstrated.

Overall rate of degradation: Slow.

Persistence in soil : Very persistent, but generally not applied to the soil.

Carry-over to next season : Possible.

Precautions: Toxaphene is a fairly persistent chlorinated hydrocarbon insecticide. Extremely toxic to fish. Follow label directions.

toxaphene

Pesticidal Effectiveness

Toxic action	:	Contact and stomach poison.
Spectrum of effectiveness	:	Broad spectrum. Controls many chewing and sucking insects.
Target pest resistance	:	A number of insects can no longer be controlled by toxaphene alone, but toxaphene mixtures with other insecticides have shown a degree of synergism and can be used successfully.
Toxicity to bees (1)	:	Moderately toxic.
Toxicity to beneficial insects (predators and parasites) (1)	:	Moderately toxic.
Residual effectiveness	:	5 - 14 days on treated plants.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	2 - 35 days, depending on formulation and crop. 28 - 30 days on meat animals.
Precautions	:	Follow label directions.

---

(1) At dosage rates recommended for control of target pests.

toxaphene

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)	x							
Rice	x							
Millet & sorghum	x							
Corn	x							
Pulses (2)		*						
Oilseeds (3)		*						
Other fiber crops (4)								
Cotton	x							
Sugar beets	x							
Sugar cane								
Forage crops (5)	x							
Potatoes								
Vegetables								
Fruits & nuts:								
Small fruits	x							
Decid. fruits, nuts	x							
Grapes								
Citrus fruits	x							
Bananas	x							
Pineapples	x							
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals	x							
Lawn & turf	x	x						

Other Uses : Structural pest control; control of insects and ticks on livestock, and of scabies on sheeps and goats.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

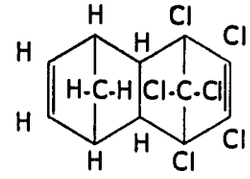
Identity

Common name(s) : aldrin (ISO name for technical material containing not less than 95% of HHDN)

Trade name(s) : Aldrin, Aldrosol, Aldrite, Drinox, Octalene, Seedrin

Chemical name: Hexachlorohexahydro-endo,exo-dimethanonaphthalene (HHDN)

Structural formula:



Empirical formula: $C_{12}H_8Cl_6$

Molecular weight : 364.93

Physical and Chemical Properties

Physical state : Solid (at 25°C)

Specific gravity : n. a.

Solubility in -

-water at 20°C : 11 ppb; at 30°C: not known

-organic solvents: At 25°C moderately soluble in paraffins, aromatics, halogenated solvents, esters and ketones; sparingly soluble in alcohols

-lipids, fats : Soluble

Melting point : Setting range 130 - 150°F

Boiling point : [illegible]°C at 1 x 10^{-5} mm Hg

Vapor pressure : [illegible] x 10^{-6} mm Hg at 25°C

Flammability : Not flammable

Stability : Slowly forms hydrochloric acid on storage and may, therefore, be corrosive to metal containers. Stable to heat, alkali and dilute acids; reacts with acid oxidizing agents, strong acids, phenols and active metals

Analytical Methods: CIPAC Handbook I
AOAC Handbook of Methods

aldrin

Hazards to Humans

Toxic action	:	Stimulation of the central nervous system.
Acute toxicity to laboratory animals -		
- oral	:	LD-50 to rats 39 mg/kg (males); 60 mg/kg (females).
- dermal	:	LD-50 to rats 98 mg/kg (males & females)
- inhalation	:	Highly toxic.
Irritating to -		
- eyes	:	Mildly irritating.
- nose & throat	:	Non-irritating.
- skin	:	Mildly irritating.
Other hazards	:	None known.
Specific antidote(s)	:	Barbiturate hypnotics.
Chronic toxicity	:	Minimal effect level in rats is 0.5 ppm in the diet; in dogs 0.05 mg/kg/day (equivalent to 1.0 ppm in the diet).
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	0.0001 mg/kg
Residue tolerance(s)	:	0.1 to 0.02 ppm
Precautions	:	Group I (Highly toxic).

aldrin

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Highly toxic.
- birds : Highly toxic.
- wild mammals : Highly toxic.
- soil organisms : Highly toxic to soil insects, relatively non-toxic to other soil organisms.

Build-up in food chains: Yes (dieldrin, principal metabolite of aldrin).

Likelihood of movement away from treated fields by -

- volatilization : Index = 1
- leaching : Index = 1
- surface runoff -
  --in water : No.
  --on solids : Substantial.
- wind erosion : Possible.

Degradation in the environment

Chemical route : Epoxidation to dieldrin, not known beyond.

Major degradation product(s) and their toxicity relative to the parent cpd. Dieldrin, toxicity similar to aldrin.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Possible, but not confirmed.
--sunlight : Negligible.

Overall rate of degradation: Slow.

Persistence in soil : Very persistent.

Carry-over to next season: Substantial.

Precautions: The principal metabolite of aldrin is dieldrin, one of the most persistent pesticides. Thus, aldrin residues following soil application are quite persistent and may contaminate the environment beyond the target area through sediment transport. Its use may be restricted or prohibited by local laws or regulations.

aldrin

Pesticidal Effectiveness

Toxic action	:	Contact and stomach poison.
Spectrum of effectiveness	:	Effective against a wide range of soil insects attacking horticultural, farm and plantation crops. Also effective against some foliar insects, and many livestock pests.
Target pest resistance	:	Corn rootworms in many areas in the U.S.; seed corn beetle, seed corn maggot, wireworms, rice water weevil.
Toxicity to bees (1)	:	Highly toxic on direct contact, but no danger to bees when aldrin is incorporated into the soil.
Toxicity to beneficial insects (predators and parasites) (1)	:	Toxic when applied to foliage. No reports of detrimental effects on beneficial soil organisms.
Residual effectiveness	:	Short when applied to foliage. Prolonged when incorporated into the soil (may extend for two or more years).
Minimum interval between last treatment & harvest to prevent unsafe residues	:	Up to 30 days, depending on crop.
Precautions	:	Follow label directions.

(1) At dosage rates recommended for control of target pests.

aldrin

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)		X						
Rice		X						
Millet & sorghum		X						
Corn		X						
Pulses (2)		X						
Oilseeds (3)		*						
Other fiber crops (4)		*						
Cotton		X						
Sugar beets								
Sugar cane		X						
Forage crops (5)								
Potatoes	X	X						
Vegetables	X	X						
Fruits & nuts:								
Small fruits	X							
Decid. fruits, nuts	X	X						
Grapes	X	X						
Citrus fruits		X						
Bananas		X						
Pineapples	X	X						
Stimulant crops (6)	*	*						
Tree oil crops (7)								
Rubber trees		X						
Forest trees		X						
Ornamentals		X						
Lawn & turf		X						

Other Uses: Seed dressings; ant baits; greenhouse uses; structural pest control; termite control; wood preservation.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

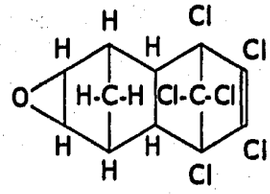
Identity

Common name(s) : dieldrin (ISO name for technical material containing not less than 85% of HEOD)

Trade name(s) : Dieldrin, Alvit, Dieldrite, Octalox, Panoram D-31, Quintox

Chemical name: Hexachloroepoxyoctahydro-endo,exo-dimethanonaphthalene (HEOD)

Structural formula:



Empirical formula : $C_{12}H_8Cl_6O$

Molecular weight : 380.93

Physical and Chemical Properties (technical dieldrin)

Physical state : Solid (at 25°C)

Specific gravity : N.a.

Solubility in -
- -water at 20°C : 110 ppb; at 30°C: not known
- -organic solvents: At 25°C moderately soluble in aromatics, halogenated solvents, esters and ketones, slightly soluble in aliphatic hydrocarbons and alcohols
- -lipids, fats : Soluble

Melting point : 95°C

Boiling point : 83.5°C at 1×10^{-5} mm Hg

Vapor pressure : 1.8×10^{-7} mm Hg at 25°C

Flammability : Not flammable

Stability : Stable to alkali, mild acidity and to light. Reacts with acid oxidizing agents, strong acids, phenols and active metals

Analytical Methods: CIPAC Handbook I
AOAC Handbook of Methods

dieldrin

Hazards to Humans

Toxic action	:	Stimulation of the central nervous system.
Acute toxicity to laboratory animals -		
- oral	:	LD-50 to rats 46 mg/kg (males & females).
- dermal	:	LD-50 to rats 90 mg/kg (males); 60 mg/kg (females).
- inhalation	:	Highly toxic.
Irritating to -		
- eyes	:	Mildly irritating.
- nose & throat	:	Non-irritating.
- skin	:	Mildly irritating.
Other hazards	:	None known.
Specific antidote(s)	:	Barbiturate hypnotics.
Chronic toxicity	:	No-effect level in rats is 0.1 ppm in the diet, in dogs 0.005 mg/kg/day(equivalent to 0.1 ppm in diet).
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	0.0001 mg/kg
Residue tolerance(s)	:	0.1 to 0.02 ppm
Precautions	:	Group I (Highly toxic).

dieldrin

Hazards to the Environment

Toxicity to -

- fishes : Highly toxic.
- lower aquatic organisms : Highly toxic.
- birds : Highly toxic.
- wild mammals : Highly toxic.
- soil organisms : Highly toxic to soil insects, relatively non-toxic to other soil organisms.

Build-up in food chains: Yes.

Likelihood of movement away from treated fields by -

- volatilization : Index = 1
- leaching : Index = 1
- surface runoff -
  --in water : No.
  --on solids : Substantial.
- wind erosion : Possible.

Degradation in the environment

Chemical route : Not known.

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms : Yes.
--non-biological factors : Possible, but not confirmed.
--sunlight : Not proved under field conditions.

Overall rate of degradation: Slow

Persistence in soil : Very persistent.

Carry-over to next season : Substantial.

Precautions: Dieldrin is one of the most persistent pesticides. Dieldrin residues, unless deeply incorporated into the soil, may contaminate the environment, especially water, through transport on sediment. Its use may be restricted or prohibited by local laws or regulations.

dieldrin

Pesticidal Effectiveness

Toxic action	:	Contact and stomach poison.
Spectrum of effectiveness	:	Effective against many foliar and soil insects, including subterranean termites.
Target pest resistance	:	Corn rootworms in many areas in the U.S.; seed corn beetle, seed corn maggot, wire worms.
Toxicity to bees (1)	:	Highly toxic on direct contact, but no danger to bees when dieldrin is incorporated into the soil.
Toxicity to beneficial insects (predators and parasites)(1)	:	Toxic if applied to foliage.
Residual effectiveness	:	Short (2 - 4 weeks) when applied to foliage. Several years of residual effect following soil incorporation.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	Up to 45 days, depending on crop.
Precautions:	:	Follow label directions.

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(1) At dosage rates recommended for control of target pests.

dieldrin

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)	X	X						
Rice	X							
Millet & sorghum		X						
Corn	X	X						
Pulses (2)	X	*						
Oilseeds (3)	*	*						
Other fiber crops (4)	*							
Cotton	X	X						
Sugar beets	X							
Sugar cane	X							
Forage crops (5)	X							
Potatoes	X							
Vegetables	X	X						
Fruits & nuts:								
Small fruits	X	X						
Decid. fruits, nuts	X	X						
Grapes	X							
Citrus fruits	X	X						
Bananas	X	X						
Pineapples	X							
Stimulant crops (6)	*	*						
Tree oil crops (7)	X							
Rubber trees	X							
Forest trees	X							
Ornamentals	X	X						
Lawn & turf	X	X						

Other Uses : Seed dressings; greenhouse uses; termite control; wood preservation; structural pest control; moth-proofing of fabrics; control of household insects, insects of public health importance, and of locusts.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

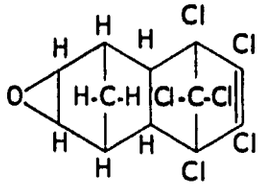
Identity

Common name(s) : endrin (mendrin in India & So. Africa)

Trade name(s) : Endrin, Hexadrin

Chemical name: Hexachloroepoxyoctahydro-endo,endo-dimethanonaphthalene

Structural formula:



Empirical formula : $C_{12}H_8Cl_6O$

Molecular weight : 380.92

Physical and Chemical Properties (technical endrin)

Physical state : Solid (at 25°C)

Specific gravity : 1.645 at 25°C

Solubility in -

-water at 23°C : 160 ppb; at 30°C: Not known

-organic solvents: Moderately soluble in benzene and acetone; sparingly soluble in alcohols, paraffins and xylene

-lipids, fats : Soluble

Melting point : 235°C (with decomposition); rearranges exothermally when heated above 200°C

Boiling point : --

Vapor pressure : 2×10^{-7} mm Hg at 25°C

Flammability : Not flammable

Stability : Stable to alkali. Acids, certain metal salts, catalytically active carriers and heat above 200°C cause rearrangement to insecticidally less active derivatives

Analytical Methods: CIPAC Handbook I
AOAC Handbook of Methods

endrin

Hazards to Humans

Toxic action	:	Stimulation of the central nervous system.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 17.8 mg/kg (males); 7.5 mg/kg (females).
- dermal	:	LD-50 to rats 15 mg/kg (females).
- inhalation	:	Highly toxic.
Irritating to -		
- eyes	:	Moderately irritating.
- nose & throat	:	Moderately irritating.
- skin	:	Moderately irritating.
Other hazards	:	None known.
Specific antidote(s)	:	Barbiturate hypnotics.
Chronic toxicity	:	No-effect level in both rats and dogs 1.0 ppm in the diet.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	0.0002 mg/kg.
Residue tolerance(s)	:	0.1 to 0.02 ppm (FAO/WHO)
Precautions	:	Group I (Highly toxic).

endrin

Hazards to the Environment

Toxicity to

- fishes : Highly toxic.
- lower aquatic organisms : Highly toxic.
- birds : Highly toxic.
- wild mammals : Highly toxic.
- soil organisms : Slightly toxic.

Build-up in food chains: Probable.

Likelihood of movement away from treated fields by

- volatilization : Index = 1
- leaching : Index = 1
- surface runoff -
  --in water : No.
  --on solids : Low.
- wind erosion : Low.

Degradation in the environment

Chemical route : Not known.

Major degradation product(s) and their toxicity relative to the parent cpd. Hydrophilic compounds, less toxic than endrin.

Degradable by -
--biological organisms : Yes.
--non-biological factors : Possible, but not confirmed.
--sunlight : Not known.

Overall rate of degradation: Slow.

Persistence in soil : Persistent (but not applied directly to soil).

Carry-over to next season : Substantial <u>if</u> applied to soil (not recommended).

Precautions: Endrin is a broad spectrum, highly toxic, rather stable insecticide which has a great potential for damage to non-target organisms. Its use may be restricted or prohibited by local laws or regulations.

endrin

Pesticidal Effectiveness

Toxic action	:	Contact and stomach poison.
Spectrum of effectiveness	:	Effective against most lepidopterous insects, many beetles, leafminers, spittle bugs, thrips, sawflies and aphids. Broad spectrum. Also effective against orchard and field rodents.
Target pest resistance	:	Pink bollworm. Some mice.
Toxicity to bees (1)	:	Moderately toxic.
Toxicity to beneficial insects (predators and parasites) (1)	:	Moderately to highly toxic to many predators and parasites. Non-toxic to soil organisms.
Residual effectiveness	:	Usually biologically effective for 10 to 12 days.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	45 days for most crops.
Precautions	:	Follow label directions.

(1) At dosage rates recommended for control of target pests.

endrin

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)	X							
Rice	X							
Millet & sorghum	X							
Corn	X							
Pulses (2)								
Oilseeds (3)	*							
Other fiber crops (4)	*							
Cotton	X							
Sugar beets	X							
Sugar cane	X							
Forage crops (5)	X							
Potatoes	X							
Vegetables	X							
Fruits & nuts:								
Small fruits	X							
Decid. fruits, nuts	X							
Grapes								
Citrus fruits	X							
Bananas								
Pineapples								
Stimulant crops (6)	*							
Tree oil crops (7)								
Rubber trees								
Forest trees	X							
Ornamentals	X							
Lawn & turf								

Other Uses : Rodent control in orchards.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

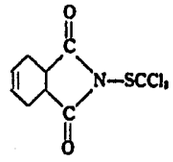
Identity

Common name(s) : captan

Trade name(s) : Captan, Orthocide, Merpan

Chemical name : N-[(trichloromethyl)thio]-4-cyclohexene-1,2-dicarboximide

Structural formula :



Empirical formula : $C_9H_8Cl_3NO_2S$

Molecular weight : 300.6

Physical and Chemical Properties

Physical state : White to light beige crystalline solid

Specific gravity : 1.73 at 20°C (technical)

Solubility in -

-water at 25°C : 3.3 ppm; at 30°C : N.a.

-organic solvents: Slightly soluble in xylene, chloroform, cyclohexanone, acetone; insoluble in petroleum oils

lipids, fats : Not known

Melting point : 160-170°C (technical)

Boiling point : Decomposes before boiling

Vapor pressure : Less than 1×10^{-5} mm Hg at 25°C

Flammability : Flash point greater than 320°F

Stability : Stable under normal storage conditions, unstable under alkaline conditions, or to heat above 100°C

Analytical Methods : CIPAC Handbook 1

captan

Hazards to Humans

Toxic action	:	Local irritant. Toxicity very low.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 9,000 mg/kg (males).
- dermal	:	Not systemically toxic via dermal route.
- inhalation	:	Relatively non-toxic.
Irritating to -		
- eyes	:	Strongly irritating.
- nose & throat	:	Moderately irritating.
- skin	:	Slightly irritating.
Other hazards	:	None known.
Specific antidote(s)	:	None known.
Chronic toxicity	:	No-effect level in the diet of rats 1,000 ppm.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	0.125 mg/kg ("temporary").
Residue tolerance(s)	:	2 - 100 ppm; 25 ppm for most crops.
Precautions	:	Group IV (Relatively non-toxic).

captan

Hazards to the Environment

Toxicity to -

- fishes : Moderately toxic.
- lower aquatic organisms : Not known.
- birds : Relatively non-toxic.
- wild mammals : Relatively non-toxic.
- soil organisms : Toxic to some soil fungi. Relatively non-toxic to other soil organisms.

Build-up in food chains: Not likely.

Likelihood of movement away from treated fields by -

- volatilization : Index = 2
- leaching : Index = 1
- surface runoff -
  --in water : Low.
  --on solids : Not known.
- wind erosion : Not known.

Degradation in the environment

Chemical route : Not known.

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Yes.
--sunlight : Not known.

Overall rate of degradation: Rapidly degraded in water, soil, biota, and under alkaline conditions.

Persistence in soil : Not persistent; half-life in soil about 2 weeks.

Carry-over to next season : None.

Precautions: Follow label directions.

captan

Pesticidal Effectiveness

Toxic action	:	Non-systemic fungicide, inhibits mycelial growth from germinating spores by fungistatic action.
Spectrum of effectiveness	:	Effective against a wide spectrum of foliar and soil-borne pathogenic fungi affecting many different crops. Ineffective against rusts and powdery mildew.
Target pest resistance	:	None reported.
Toxicity to bees (1)	:	Relatively non-toxic.
Toxicity to beneficial insects (predators and parasites) (1)	:	Not toxic to insects.
Residual effectiveness	:	3 - 7 days. Applications in spray programs have to be repeated every 7 - 14 days during high infection periods.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	None required for most crops.

Precautions: Follow label directions.

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(1) At dosage rates recommended for control of target pests.

captan

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)					X			
Rice					X			
Millet & sorghum					X			
Corn				X	X			
Pulses (2)				X	X			
Oilseeds (3)					X			
Other fiber crops (4)								
Cotton					X			
Sugar beets					X			
Sugar cane								
Forage crops (5)					X			
Potatoes				X	X			
Vegetables				X	X			
Fruits & nuts:								
Small fruits				X				
Decid. fruits, nuts				X				
Grapes				X				
Citrus fruits				X				
Bananas								
Pineapples				X				
Stimulant crops (6)				X				
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals				X	X			
Lawn & turf				X	X			

Other Uses : Control of ringworm (girth itch), caused by Trychophyton spp. or Microsporium spp., on horses, dogs and cats.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

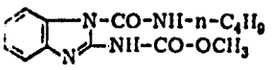
x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

Identity

Common name(s): benomyl

Trade name(s) : Benlate

Chemical name : Methyl 1-(butylcarbamoyl)-2-benzimidazole-carbamate

Structural formula: 

Empirical formula : $C_{14}H_{18}N_4O_3$

Molecular weight : 290.3

Physical and Chemical Properties

Physical state : White crystalline solid

Specific gravity : Density 18 - 25 lbs./cu.ft.

Solubility in -

-water at 20°C : nil at 30°C: nil

-organic solvents : Generally low. Slightly soluble in chloroform and dimethyl formamide, sparingly in acetone and xylene

-lipids, fats : Slight

Melting point : Decomposes without melting

Boiling point : N.a.

Vapor pressure : Negligible

Flammability : Not flammable

Stability : Decomposes in storage and in the soil in the presence of moisture.

Analytical Methods : Not in CIPAC 1 or AOAC Handbook of Methods. Method available from manufacturer.

benomyl

Hazards to Humans

Toxic action	:	Not known. Toxicity very low.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats greater than 10,000 mg/kg (males & females)
- dermal	:	LD-50 to rabbits greater than 10,000 mg/kg
- inhalation	:	LC-50 to rats greater than 2 mg/liter
Irritating to -		
- eyes	:	Slightly irritating.
- nose & throat	:	Slightly irritating.
- skin	:	Slightly irritating.
Other hazards	:	None known.
Specific antidote(s)	:	None known.
Chronic toxicity	:	Low order of toxicity to rats and dogs in two-year feeding tests.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	None established.
Residue tolerance(s)	:	0.2 - 15 ppm; 15 ppm on most crops.
Precautions:	:	Group IV (Relatively non-toxic).

benomyl

Hazards to the Environment

Toxicity to -

- fishes : Not known.
- lower aquatic organisms : Not known.
- birds : Not known.
- wild mammals : Not known.
- soil organisms : Not known.

Build-up in food chains: Not likely.

Likelihood of movement away from treated fields by -

- volatilization : Index = 3
- leaching : Index = 2 - 3
- surface runoff -
  --in water : No.
  --on solids : Not likely.
- wind erosion : Not likely.

Degradation in the environment

Chemical route : Not known.

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms : Not known.
--non-biological factors : Not known.
--sunlight : Not known.

Overall rate of degradation: Not known.

Persistence in soil : Not known.

Carry-over to next season : Not known.

Precautions: Follow label directions.

benomyl

Pesticidal Effectiveness

Toxic action	:	Contact and systemic fungicide with protective and curative action.
Spectrum of effectiveness	:	Effective against a broad range of pathogenic fungi, except Phycomycetes.
Target pest resistance	:	None reported from the field. Can be induced by strain selection in vitro and in greenhouse studies (primarily powdery mildew of cucumbers).
Toxicity to bees (1)	:	Relatively non-toxic.
Toxicity to beneficial insects (predators and parasites) (1)	:	Negligible.
Residual effectiveness	:	Prolonged; for instance, 14 - 21 days against apple scab. May be longer in many crops, depending on infection cycle of fungi.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	None required; may be used up to harvest and as post-harvest dip in many fruit crops.

Precautions: Follow label directions.

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(1) At dosage rates recommended for control of target pests.

benomyl — Effectiveness profile

Plants / Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)				X	X			
Rice				X	X			
Millet & sorghum					X			
Corn								
Pulses (2)				*	*			
Oilseeds (3)				*				
Other fiber crops (4)								
Cotton				X	X			
Sugar beets				X				
Sugar cane				X	X			
Forage crops (5)				X				
Potatoes					X			
Vegetables				X	X			
Fruits & nuts:								
Small fruits				X				
Decid. fruits, nuts				X				
Grapes				X				
Citrus fruits				X				
Bananas				X				
Pineapples				X				
Stimulant crops (6)				*				
Tree oil crops (7)								
Rubber trees				X				
Forest trees								
Ornamentals				X	X			
Lawn & turf				X	X			

Other Uses : None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

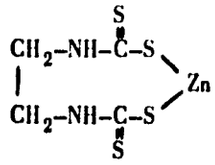
Identity

Common name(s) : zineb

Trade name(s) : Aspor, Dithane Z-78, Hexathane, Kypzin, Lonacol, Parzate C, Zebtox, Zinosan, others

Chemical name : Zinc ethylene bisdithiocarbamate

Structural formula:



Empirical formula : $C_4H_6N_2S_4Zn$

Molecular weight : 275.8

Physical and Chemical Properties

Physical state : Off-white solid

Specific gravity : No data

Solubility in -

-water at 20°C : Very slight; at 30°C: Very slight

-organic solvents : Soluble in pyridine

-lipids, fats : Negligible

Melting point : Decomposes before melting

Boiling point : N.a.

Vapor pressure : Negligible at 15°C

Flammability : Flash point (open cup) between 280 and 290°F

Stability : Decomposes gradually, accelerated by exposure to moisture, heat or air

Analytical Methods : CIPAC Handbook 1
AOAC Handbook of Methods (dithiocarbamate method)

zineb

Hazards to Humans

Toxic action	:	Not known.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats greater than 5,200 ppm
- dermal	:	No data.
- inhalation	:	No data.
Irritating to -		
- eyes	:	Slightly irritating.
- nose & throat	:	Slightly irritating.
- skin	:	Slightly irritating.
Other hazards	:	Ethylene thiourea (ETU) is a metabolite of zineb.
Specific antidote(s)	:	None known.
Chronic toxicity	:	In a two-year test on rats, 5,000 ppm in the diet reduced the growth rate.
Cumulative toxic effects	:	None reported.
Allowable daily intake (FAO/WHO)	:	0.025 mg/kg (temporary).
Residue tolerance(s)	:	2 - 4 ppm for most crops.
Precautions	:	Group IV (Relatively non-toxic).

zineb

Hazards to the Environment

Toxicity to -

- fishes : Moderately toxic.
- lower aquatic organisms : Not known.
- birds : Relatively non-toxic.
- wild mammals : Relatively non-toxic.
- soil organisms : Not known.

Build-up in food chains: Not likely.

Likelihood of movement away from treated fields by -

- volatilization : Index = 1
- leaching : Index = 2
- surface runoff -
  --in water : Low.
  --on solids : Slight.
- wind erosion : Slight.

Degradation in the environment

Chemical route : Not known

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms : Not known.
--non-biological factors: Yes.
--sunlight : Not known.

Overall rate of degradation: Rapid

Persistence in soil : Not persistent.

Carry-over to next season : None.

Precautions: Follow label directions.

zineb

Pesticidal Effectiveness

Toxic action	:	Non-systemic fungicide, mechanism of action not fully clarified. A metabolite, ethylene thiuram monosulphide is believed to be the agent toxic to fungi.
Spectrum of effectiveness	:	Protective action against a broad spectrum of pathogenic fungi, especially those causing foliar and fruit diseases on crops.
Target pest resistance	:	None reported.
Toxicity to bees (1)	:	Negligible.
Toxicity to beneficial insects (predators and parasites) (1)	:	Negligible to most; may be toxic to predatory mites.
Residual effectiveness	:	Moderate.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	0 - 40 days; 7 days for many crops.

Precautions: Follow label directions. Shelf life limited. Flammable derivatives may be formed on decomposition.

---

(1) At dosage rates recommended for control of target pests.

zineb

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)				X				
Rice								
Millet & sorghum								
Corn				X				
Pulses (2)								
Oilseeds (3)								
Other fiber crops (4)								
Cotton								
Sugar beets								
Sugar cane								
Forage crops (5)								
Potatoes				X				
Vegetables				X				
Fruits & nuts:								
Small fruits				X				
Decid. fruits, nuts				X				
Grapes				X				
Citrus fruits				X				
Bananas								
Pineapples								
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals				X				
Lawn & turf								

Other Uses: None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

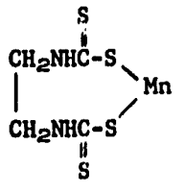
Identity

Common name(s) : maneb

Trade name(s) : Manzate, Dithane M-22, Maneba, Manesan, Sopranebe, Trimangol, Trimanzone, others

Chemical name: Manganese ethylene-1,2-bisdithiocarbamate

Structural formula :



Empirical formula : $C_4H_6MnN_2S_4$

Molecular weight : 265.3

Physical and Chemical Properties

Physical state : Yellow crystalline solid

Specific gravity : 1.92

Solubility in -

-water at 20°C : Very slight; at 30°C: Very slight

-organic solvents: Insoluble in most organic solvents

-lipids, fats : Negligible

Melting point : Decomposes before melting

Boiling point : N.a.

Vapor pressure : Negligible

Flammability : Flash point (open cup) 295°F

Stability : Decomposes gradually, especially in presence of moisture, acidity or elevated temperatures

Analytical Methods : CIPAC Handbook I
AOAC Handbook of Methods

maneb

Hazards to Humans

Toxic action	:	Not known.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats 6,750 mg/kg
- dermal	:	No data.
- inhalation	:	No data.
Irritating to -		
- eyes	:	Slightly irritating.
- nose & throat	:	Slightly irritating.
- skin	:	Slightly irritating.
Other hazards	:	Ethylene thiourea (ETU) is a metabolite of maneb.
Specific antidote(s)	:	None known.
Chronic toxicity	:	No-effect level in the diet to rats was 250 ppm in a two year study; to dogs 80 ppm in a one year study.
Cumulative toxic effects	:	None reported.
Allowable daily intake (FAO/WHO)	:	0.025 mg/kg (temporary).
Residue tolerance(s)	:	4 - 5 ppm for most crops.
Precautions	:	Group IV (Relatively non-toxic).

maneb

Hazards to the Environment

Toxicity to -

- fishes : Moderately toxic.
- lower aquatic organisms : Not known.
- birds : Relatively non-toxic
- wild mammals : Relatively non-toxic.
- soil organisms : Not known.

Build-up in food chains: Not likely.

Likelihood of movement away from treated fields by -

- volatilization : Index = 1
- leaching : Index = 2
- surface runoff -
  --in water : Low.
  --on solids : Slight.
- wind erosion : Slight.

Degradation in the environment

Chemical route : Not known.

Major degradation product(s) and their toxicity relative to the parent cpd. : Not known.

Degradable by -
--biological organisms : Not known.
--non-biological factors: Yes.
--sunlight : Not known.

Persistence in soil : Not persistent. Half-life 1 - 2 weeks.

Carry-over to next season: None.

Precautions: Follow label directions.

maneb

Pesticidal Effectiveness

Toxic action	:	Non-systemic fungicide, mechanism of action not fully clarified. A metabolite, ethylene thiuram monosulphide, is believed to be the agent toxic to fungi.
Spectrum of effectiveness	:	Protective action against a broad spectrum of pathogenic fungi, especially Ascomycetes and Phycomycetes. Used for control of early and late blights on potatoes and tomatoes and many other crop diseases.
Target pest resistance	:	None reported.
Toxicity to bees (1)	:	Negligible.
Toxicity to beneficial insects (predators and parasites) (1)	:	Negligible to most; may be toxic to predatory mites.
Residual effectiveness	:	Moderate; 7 - 14 day spray intervals recommended for most crops.
Minimum interval between last treatment & harvest to prevent unsafe residues	:	0 - 30 days, 7 days for many crops.

Precautions: Follow label directions. Shelf life limited. Spontaneous combustion of maneb has been known to occur. Flammable products may be formed on decomposition.

---

(1) At dosage rates recommended for control of target pests.

maneb

Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)				X	X			
Rice				X	X			
Millet & sorghum					X			
Corn				X	X			
Pulses (2)				X	X			
Oilseeds (3)				*				
Other fiber crops (4)								
Cotton				X	X			
Sugar beets				X	X			
Sugar cane					X			
Forage crops (5)				X	X			
Potatoes				X	X			
Vegetables				X	X			
Fruits & nuts:								
Small fruits				X				
Decid. fruits, nuts				X				
Grapes				X				
Citrus fruits				X				
Bananas				X				
Pineapples				X	X			
Stimulant crops (6)				*				
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals				X				
Lawn & turf								

Other Uses : None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

Identity

Common name(s) : Mancozeb

Trade name(s) : Dithane M45, Fore

Chemical name : Coordination product of zinc ion and manganese ethylene bisdithiocarbamate

Structural formula: Exact structure not known

Empirical formula : Not known

Physical and Chemical Properties

Physical state : Yellowish powder

Specific gravity : Bulk density 0.55 grams per ml

Solubility in -

-water at 20°C : Very slight; at 30°C: Very slight

-organic solvents: Insoluble

-lipids, fats : Negligible

Melting point : Decomposes before melting

Boiling point : N.a.

Vapor pressure : No data

Flammability : Flash point (open cup) 280°F

Stability : Stable under normal storage conditions. Decomposes at elevated temperatures and when exposed to moisture or acidity

Analytical Methods : AOAC Official Methods, Pesticides

mancozeb

Hazards to Humans

Toxic action	:	Not known.
Acute toxicity to laboratory animals-		
- oral	:	LD-50 to rats greater than 8,000 mg/kg
- dermal	:	No data.
- inhalation	:	No data.
Irritating to -		
- eyes	:	Slightly irritating.
- nose & throat	:	Slightly irritating.
- skin	:	Slightly irritating.
Other hazards	:	Ethylene thiourea (ETU) is a metabolite of mancozeb.
Specific antidote(s)	:	None known.
Chronic toxicity	:	No-effect level in the diet in two-year studies was 100 ppm to rats, 1,000 ppm to dogs.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	0.025 mg/kg (temporary).
Residue tolerance(s)	:	4 - 7 ppm for most crops.
Precautions	:	Group IV (Relatively non-toxic).

mancozeb

Hazards to the Environment

Toxicity to -

- fishes : Moderately toxic.
- lower aquatic organisms : Not known.
- birds : Relatively non-toxic.
- wild mammals : Not known.
- soil organisms : Moderately toxic.

Build-up in food chains: No.

Likelihood of movement away from treated fields by

- volatilization : Index = 1
- leaching : Index = 1
- surface runoff -
  --in water : No.
  --on solids : Possible.
- wind erosion : Possible.

Degradation in the environment

Chemical route : Not known.

Major degradation product(s) and their toxicity relative to the parent cpd. : Metallic cations, inorganic materials, ethylene diamine.

Degradable by -
--biological organisms : Yes.
--non-biological factors: Not known.
--sunlight : Not known.

Overall rate of degradation: Rapid

Persistence in soil : Not persistent.

Carry-over to next season : None

Precautions: Follow label directions.

mancozeb

Pesticidal Effectiveness

Toxic action	:	Non-systemic fungicide, mechanism of action not clarified. A metabolite, ethylene thiuram monosulphide, is believed to be the agent toxic to fungi.
Spectrum of effectiveness	:	Protective action against many pathogenic fungi affecting vegetables, field and fruit crops. Also used as soil and seed treatment.
Target pest resistance	:	None reported.
Toxicity to bees (1)	:	Negligible.
Toxicity to beneficial insects (predators and parasites) (1)	:	Negligible to most; may be toxic to predatory mites.
Residual effectiveness	:	Moderate (30 days).
Minimum interval between last treatment & harvest to prevent unsafe residues	:	0 - 66 days; 7 - 15 days for many crops.
Precautions	:	Follow label directions. Shelf life limited. Flammable derivatives may be formed on decomposition.

---

(1) At dosage rates recommended for control of target pests.

mancozeb — Effectiveness profile

Plants / Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)				x	x			
Rice				x	x			
Millet & sorghum					x			
Corn				x	x			
Pulses (2)								
Oilseeds (3)				x	x			
Other fiber crops (4)								
Cotton				x	x			
Sugar beets				x	x			
Sugar cane								
Forage crops (5)				x	x			
Potatoes				x	x			
Vegetables				x	x			
Fruits & nuts:								
Small fruits				x				
Decid. fruits, nuts				x				
Grapes				x				
Citrus fruits				x				
Bananas				x				
Pineapples				x	x			
Stimulant crops (6)				x	x			
Tree oil crops (7)								
Rubber trees				x				
Forest trees				x				
Ornamentals				x				
Lawn & turf				x	x			

Other Uses : None

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

Identity

Common name(s) : methyl bromide

Trade name(s) : Brom-O-Gas, Dowfume, Meth-O-Gas, Profume

Chemical name : Bromomethane

Structural formula: CH_3Br

Empirical formula : CH_3Br

Molecular weight : 94.95

Physical and Chemical Properties

Physical state : Colorless volatile liquid or gas

Specific gravity : 1.746 at -5°C

Solubility in -

-water at 20°C : Slightly soluble; at 30°C: Slightly soluble

-organic solvents: Freely soluble in alcohols, chloroform, acetone, benzene, ether and carbon tetrachloride

-lipids, fats : No data

Melting point : - 94°C

Boiling point : 3.6°C

Vapor pressure : 1,400 mm Hg at 20°C
2,600 mm Hg at 40°C

Flammability : Non-flammable in concentrated form. 10 to 15% in air will form flammable mixture

Stability : Stable under normal conditions. Do not use with aluminum or magnesium pumps or containers

Analytical Methods: Not in CIPAC 1 Handbook
GLC method available

methyl bromide

Hazards to Humans

Toxic action : Poison. Respiratory embarrassment, cardiac arrest, central nervous system irritation.

Acute toxicity to laboratory animals-

- oral : Gas. Not applicable.
- dermal : Not defined. Skin contact causes severe burns.
- inhalation : Acute vapor toxicity 200 ppm.

Irritating to -

- eyes : Severely irritating.
- nose & throat: Severely irritating.
- skin : Severely irritating; skin burns.

Other hazards : Poisonous gas, poison label required.

Specific antidote(s): None known.

Chronic toxicity : No data.

Cumulative toxic effects : Repeated exposures are cumulative, causing severe lung irritation and damage to kidneys and the nervous system.

Allowable daily intake (FAO/WHO): 1 mg/kg (as inorganic bromides).

Residue tolerance(s): 5 - 400 ppm; 20 - 50 ppm for many commodities.

Precautions : Group I (Highly toxic). For use only by trained professional operators. Handling by inexperienced persons may have disastrous results.

methyl bromide

Hazards to the Environment

Toxicity to -

- fishes : N.a.
- lower aquatic organisms : N.a.
- birds : Highly toxic, but birds will not ordinarily come in contact with product.
- wild mammals : Highly toxic, but wild mammals will not ordinarily come in contact with product.
- soil organisms : Moderately toxic, affects nitrifying bacteria temporarily. At high dosages controls pathogens.

Build-up in food chains: No.

Likelihood of movement away from treated fields by -

- volatilization : Product applied as a gas; disperses quickly in atmosphere.
- leaching : No.
- surface runoff-
  - --in water : No.
  - --on solids : No.
- wind erosion : No.

Degradation in the environment

Chemical route : Hydrolyzes in soil water.

Major degradation product(s) and their toxicity relative to the parent cpd. : Methanol and hydrogen bromide, eventually CO_2 and H_2O.

Degradable by -
--biological organisms : No.
--non-biological factors: Yes.
--sunlight : Slight.
Overall rate of degradation: Half-life in water about 55 days.
Persistence in soil : Inorganic bromides can build up.
Carry-over to next season : None.

Precautions: Follow label directions.

methyl bromide

Pesticidal Effectiveness

Toxic action : Fumigant.

Spectrum of effectiveness : General biocide; destroys insects, nematodes, weed seeds, rodents, soil pathogens. Used in mills, warehouses, grain elevators, vaults, ships, freight cars, greenhouses, and as a soil fumigant.

Target pest resistance : None reported.

Toxicity to bees (1) : Highly toxic, but bees will not be exposed.

Toxicity to beneficial insects (predators and parasites) (1): Highly toxic.

Residual effectiveness : None.

Minimum interval between last treatment & harvest to prevent unsafe residues: N.a.

Precautions: Follow label directions.
Handle with extreme care.

---

(1) At dosage rates recommended for control of target pests.

methyl bromide — Effectiveness profile

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)								
Rice								
Millet & sorghum								
Corn								
Pulses (2)								
Oilseeds (3)								
Other fiber crops (4)								
Cotton								
Sugar beets								
Sugar cane								
Forage crops (5)								
Potatoes								
Vegetables			X		X	X	X	
Fruits & nuts:								
Small fruits			X		X	X	X	
Decid. fruits, nuts			X		X	X	X	
Grapes								
Citrus fruits								
Bananas								
Pineapples								
Stimulant crops (6)			*		*	*	*	
Tree oil crops (7)								
Rubber trees								
Forest trees			X		X	X	X	
Ornamentals			X		X	X	X	
Lawn & turf			X		X	X	X	

Other Uses: Control of soil-borne insects, nematodes, pathogens and weed seeds in seed beds. Control of insects and rodents in structures, stored products, etc.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

Identity

Common name(s) : zinc phosphide

Trade name(s) : None given

Chemical name : zinc phosphide

Structural formula: Zn_3P_2

Empirical formula : Zn_3P_2

Molecular weight : 258.1

Physical and Chemical Properties

Physical state : Grey - black powder or crystals

Specific gravity : 4.55

Solubility in -

-water at 20°C : Insoluble; at 30°C: Insoluble

-organic solvents: Soluble in carbon disulfide and benzene; unsoluble in ethanol

-lipids, fats : Not known

Melting point : Above 420°C

Boiling point : Sublimes at 1,100°C

Vapor pressure : N.a.

Flammability : Zinc phosphide generates phosphine which is spontaneously flammable and highly toxic

Stability : Stable in dry air; decomposes slowly in presence of water, generating phosphine. Can react violently with water or acids, giving off phosphine. Corrosive to metals.

Analytical Methods: CIPAC Handbook 1

zinc phosphide

Hazards to Humans

Toxic action	:	Zinc phosphide in presence of water generates phosphine, a colorless, flammable, highly toxic gas which is a depressant of the central nervous system.
Acute toxicity to laboratory animals -		
- oral	:	LD-50 to rats 40 - 50 mg/kg
- dermal	:	N.a. (not readily absorbed through the skin).
- inhalation	:	N.a.
Irritating to -		
- eyes	:	Extremely irritating.
- nose & throat	:	Extremely irritating.
- skin	:	Extremely irritating.
Other hazards	:	Phosphine gas autoignites at 40 - 65°C and is a serious fire hazard in concentrations above 1%
Specific antidote(s)	:	None known.
Chronic toxicity	:	No data.
Cumulative toxic effects	:	None known.
Allowable daily intake (FAO/WHO)	:	None established or required.
Residue tolerance(s)	:	None established or required.
Precautions	:	Group I (Highly toxic).

zinc phosphide

Hazards to the Environment

Toxicity to -

- fishes : Not known.
- lower aquatic organisms : Not known.
- birds : Highly toxic.
- wild mammals : Highly toxic.
- soil organisms : Not known.

Build-up in food chains: Not known, not likely.

Likelihood of movement away from treated fields by -

- volatilization :
- leaching :
- surface runoff -
  --in water :
  --on solids :
- wind erosion :

Zinc phosphide is used in the form of dilute baits (usually 1% by weight) for control of rats and mice and therefore not likely to be exposed to these environmental transport mechanisms.

Degradation in the environment

Chemical route : Zn_3P_2 to PH_3, ZnO, P-oxides

Major degradation product(s) and their toxicity relative to the parent cpd. : Phosphine gas, PH_3, is highly toxic.

Degradable by -
--biological organisms : Not known.
--non-biological factors: Yes.
--sunlight : Not known.
Overall rate of degradation: Rapid.
Persistence in soil : Not persistent.
Carry-over to next season: None.

Precautions: Due to its properties and use patterns, zinc phosphide is very hazardous to persons and animals exposed to it, but its use does not entail a general environmental hazard.

zinc phosphide

Pesticidal Effectiveness

Toxic action : Zinc phosphide generates phosphine, a highly toxic gas.

Spectrum of effectiveness : Rodenticide, control of rats and mice indoors and outdoors, mostly by baits containing about 1% of active ingredient.

Target pest resistance : Exposure to sublethal dosages may result in development of tolerance in rodents. Bait shyness may also develop.

Toxicity to bees (1) : Not known; bees not exposed in normal use of product.

Toxicity to beneficial insects (predators and parasites) (1): Not known; not a problem.

Residual effectiveness : Short

Minimum interval between last treatment & harvest to prevent unsafe residues: Not applicable.

Precautions: Zinc phosphide should be used only by trained and experienced professionals, and only as a single-dose, corrective measure when less hazardous materials are not available or will not be effective. Zinc phosphide should not be used as a maintenance rodenticide. Follow label directions.

---

(1) At dosage rates recommended for control of target pests.

zinc phosphide

Plants Plant Pests	Foilar insects	Soil insects	Nema-todes	Foilar diseases	Soil-borne diseases	Grassy weeds	Broadleaf weeds	Other pests
Cereals:								
Small grains (1)								
Rice								
Millet & sorghum								
Corn								
Pulses (2)								
Oilseeds (3)								
Other fiber crops (4)								
Cotton								
Sugar beets								
Sugar cane								
Forage crops (5)								
Potatoes								
Vegetables								
Fruits & nuts:								
Small fruits								
Decid. fruits, nuts								
Grapes								
Citrus fruits								
Bananas								
Pineapples								
Stimulant crops (6)								
Tree oil crops (7)								
Rubber trees								
Forest trees								
Ornamentals								
Lawn & turf								

Other Uses : Rodenticide, used mainly as a bait for the control of rats and mice indoors and outdoors.

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

x Effective on all crops where more than one in the group.
* Effective only on the crop(s) underlined in the footnote section.

PLANTS - PESTICIDES CROSS-REFERENCE INDEX.

The following four grid forms provide a cross-reference index between crops and pesticides, the latter divided into herbicides, organic phosphate and carbamate insecticides, chlorinated hydrocarbon insecticides, and fungicides. For each of these four groups, the crops on which the respective pesticides are effective in controlling one or more pests can be seen at a glance. For more detailed information on individual pesticides, the reader is referred to the individual product and effectiveness profiles.

Cross-Reference Index Plants/Herbicides

Herbicides / Plants	alachlor	propanil	trifluralin	dalapon-Na	MCPA	2,4-D	2,4,5-T
Cereals:							
Small grains (1)			X		X	X	X
Rice		X			X	X	
Millet & sorghum						X	
Corn	X			X		X	
Pulses (2)			X				
Oilseeds (3)	X		X	X			
Other fiber crops (4)			X	X	X		
Cotton	X		X	X			
Sugar beets			X	X			
Sugar cane			X	X		X	
Forage crops (5)			X			X	X
Potatoes			X	X			
Vegetables			X	X		X	
Fruits & nuts:							
Small fruits						X	
Decid. fruits, nuts			X	X			
Grapes			X	X			
Citrus fruits			X	X			
Bananas				X			
Pineapples			X	X			
Stimulant crops (6)			X	X			
Tree oil crops (7)				X			
Rubber trees				X			
Forest trees				X		X	
Ornamentals			X			X	
Lawn & turf					X	X	
Other Uses :						X	X

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
(5) Including alfalfa.
(6) Coffee, cocoa, tea, tobacco, hops.
(7) Olives, palms.

Cross-Reference Index Plants/Organic Phosphate and Carbamate Insecticides

Organic phosphate and carbamate insecticides / Plants	carbaryl	malathion	naled	dimethoate	fenthion	diazinon	ethion	oxydemeton-me	azinphos-me	phosphamidon	mevinphos	me-parathion	parathion
Cereals:													
Small grains (1)	X	X	X	X					X	X	X	X	X
Rice	X	X	X		X						X	X	X
Millet & sorghum	X	X		X		X	X				X	X	X
Corn	X	X				X	X	X			X	X	X
Pulses (2)	X	X	X	X		X			X	X	X	X	X
Oilseeds (3)	X	X	X	X		X			X		X	X	X
Other fiber crops (4)	X	X											
Cotton	X	X	X	X			X	X	X	X	X	X	X
Sugar beets	X	X	X		X			X		X	X	X	X
Sugar cane	X	X	X						X			X	X
Forage crops (5)	X	X	X	X		X	X	X	X	X	X	X	X
Potatoes	X	X	X	X		X		X	X	X	X	X	X
Vegetables	X	X	X	X		X	X	X	X	X	X	X	X
Fruits & nuts:													
Small fruits	X	X	X			X	X	X	X		X	X	X
Decid. fruits, nuts	X	X	X	X		X	X	X	X	X	X	X	X
Grapes	X	X	X			X	X		X		X	X	X
Citrus fruits	X	X	X	X		X	X		X	X	X		X
Bananas	X	X				X							
Pineapples		X				X							X
Stimulant crops (6)	X	X	X	X	X	X			X		X	X	X
Tree oil crops (7)	X	X		X	X	X							X
Rubber trees		X											
Forest trees	X	X	X	X	X	X						X	X
Ornamentals	X	X	X	X	X	X	X	X	X		X		X
Lawn & turf	X	X				X	X						X
Other Uses :	X	X	X	X	X	X					X	X	

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
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(7) Olives, palms.

Cross-Reference Index

Plants/Chlorinated Hydrocarbon Insecticides

Chlorinated hydrocarbon insecticides / Plants	DDT	BHC	chlordane	heptachlor	toxaphene	aldrin	dieldrin	endrin
Cereals:								
Small grains (1)		X	X	X	X	X	X	X
Rice		X			X	X	X	X
Millet & sorghum		X	X		X	X	X	X
Corn	X	X	X	X	X	X	X	X
Pulses (2)	X	X	X	X	X	X	X	
Oilseeds (3)	X		X	X	X	X	X	X
Other fiber crops (4)	X		X			X	X	X
Cotton	X	X	X	X	X	X	X	X
Sugar beets		X	X	X	X		X	X
Sugar cane			X	X		X	X	X
Forage crops (5)	X	X			X		X	X
Potatoes	X		X	X		X	X	X
Vegetables	X	X	X	X		X	X	X
Fruits & nuts:								
Small fruits	X		X		X	X	X	X
Decid. fruits, nuts	X	X	X		X	X	X	X
Grapes	X	X	X			X	X	
Citrus fruits	X		X	X	X	X	X	X
Bananas			X		X	X	X	
Pineapples				X	X	X	X	
Stimulant crops (6)	X			X		X	X	X
Tree oil crops (7)							X	
Rubber trees						X	X	
Forest trees	X		X			X	X	X
Ornamentals	X		X		X	X	X	X
Lawn & turf	X	X	X	X	X	X	X	
Other Uses :	X	X	X	X	X	X	X	X

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
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Cross-Reference Index Plants/Fungicides

Fungicides / Plants	captan	benomyl	zineb	maneb	mancozeb
Cereals:					
Small grains (1)	X	X	X	X	X
Rice	X	X		X	X
Millet & sorghum	X	X		X	X
Corn	X		X	X	X
Pulses (2)	X	X		X	
Oilseeds (3)	X	X		X	X
Other fiber crops (4)					
Cotton	X	X		X	X
Sugar beets	X	X		X	X
Sugar cane		X		X	
Forage crops (5)	X	X		X	X
Potatoes	X	X	X	X	X
Vegetables	X	X	X	X	X
Fruits & nuts:					
Small fruits	X	X	X	X	X
Decid. fruits, nuts	X	X	X	X	X
Grapes	X	X	X	X	X
Citrus fruits	X	X	X	X	X
Bananas		X		X	X
Pineapples	X	X		X	X
Stimulant crops (6)	X	X		X	X
Tree oil crops (7)					
Rubber trees		X			X
Forest trees					X
Ornamentals	X	X	X	X	X
Lawn & turf	X	X			X
Other Uses :	X				

(1) Wheat, oats, barley, rye, etc.
(2) Dry beans, dry peas, lentils, vetch, lupins, etc.
(3) Soybeans, peanuts, linseed, rapeseed, sesame seed, etc.
(4) Flax, hemp, jute, sisal, etc.
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