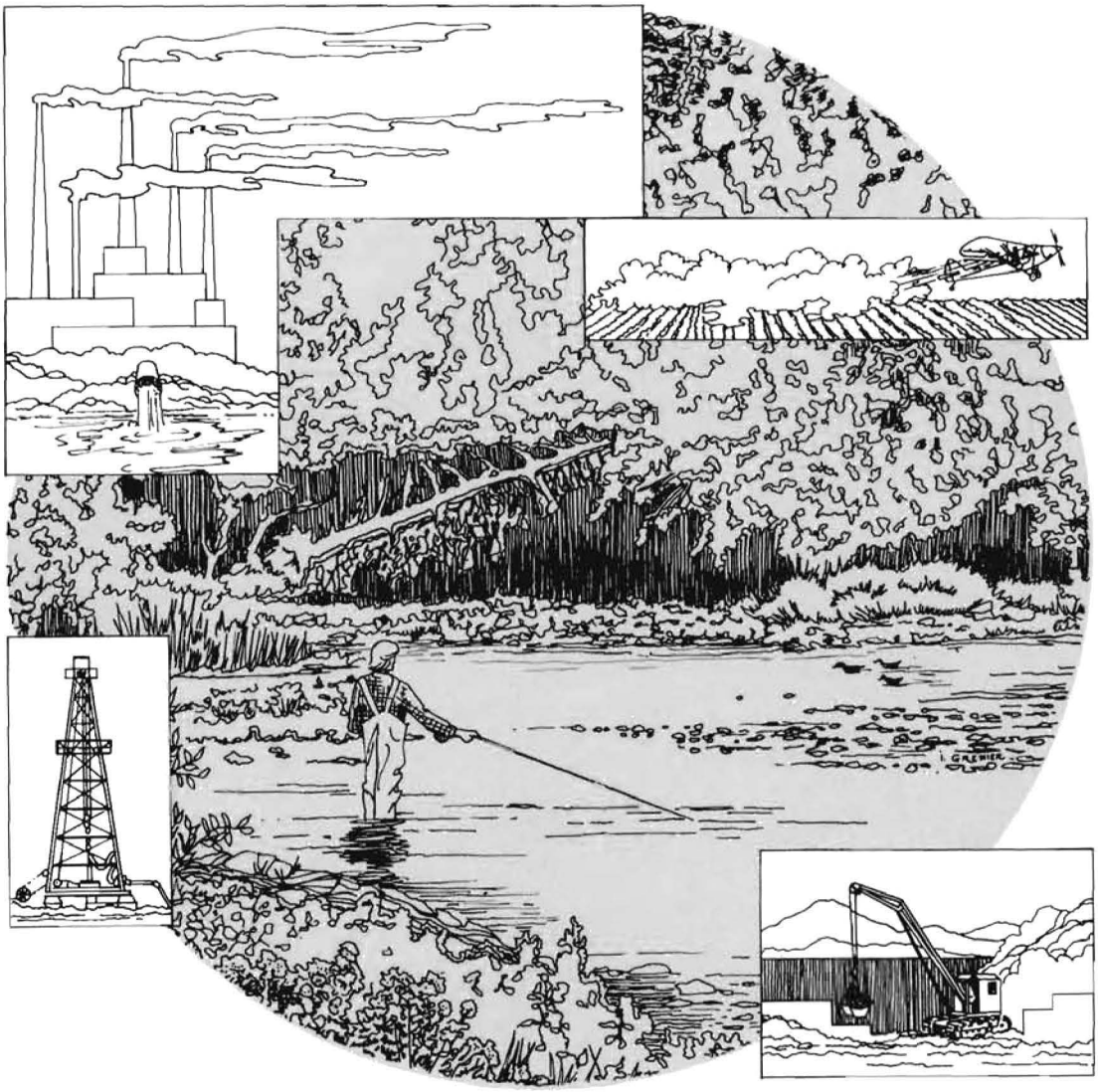
HANDBOOK OF ACUTE TOXICITY OF CHEMICALS TO FISH AND AQUATIC INVERTEBRATES



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE / RESOURCE PUBLICATION 137

Library of Congress Cataloging in Publication Data

Johnson, Waynon W
Handbook of acute toxicity of chemicals to fish and aquatic invertebrates.

(Resource publication—United States, Fish and Wildlife Service ; 137)
Bibliography: p.
Includes index.
Supt. of Docs. no.: I 49.66:137
1. Fishes—Effect of water pollution on—Handbooks, manuals, etc. 2. Water—Pollution—Toxicology—Handbooks, manuals, etc. 3. Toxicity testing—Handbooks, manuals, etc. 4. Aquatic invertebrates—Effect of water pollution on—Handbooks, manuals, etc. I. Finley, Mack T., joint author. II. Columbia National Fisheries Research Laboratory. III. Title. IV. Series: United States. Fish and Wildlife Service. Resource publication—United States, Fish and Wildlife Service ; 137.

S914.A3 no. 137 [SH174] 333.95'4s [591.2'4] 80-607122

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
STOCK NO. 024-010-00586-9

HANDBOOK OF ACUTE TOXICITY OF CHEMICALS TO FISH AND AQUATIC INVERTEBRATES

Summaries of Toxicity Tests Conducted at Columbia National Fisheries Research Laboratory, 1965-78

By
Waynon W. Johnson
Mack T. Finley

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE / RESOURCE PUBLICATION 137
WASHINGTON, D.C. / 1980

Contents

	Page
Preface	iii
Acknowledgments	v
Introduction	1
Arrangement of Data	2
Toxicological Data	8
References	86
Appendix I. Glossary	87
Appendix II. Cross-index to Chemical Equivalent Names	88
Appendix III. Publications of the Columbia National Fisheries Research Laboratory containing toxicity data on chemicals included in this Handbook	96

Preface

This Handbook is a compilation of results of toxicity tests on fish and aquatic invertebrates conducted at the Columbia National Fisheries Research Laboratory in 1965-78. These studies, which were initiated under former Laboratory Director Oliver B. Cope, include 1,587 acute toxicity tests on 271 chemicals against 28 species of fish and 30 species of invertebrates. Many scientists and technicians have contributed significantly in one way or another to the Handbook. However, the authors deserve the major credit. Their work spanned several years and included countless evenings of meticulous effort in reviewing and recalculating raw data, judging the quality of findings, editing and compiling summary tables, and preparing the manuscript. Although a number of acute toxicity tests were judged inadequate for inclusion in the Handbook, results of more intensive research were summarized and added for selected chemicals.

The Handbook was produced as (1) a reference source for scientists and resource managers and (2) a contribution to the data base essential to establishing water quality criteria and to estimating potential environmental impacts of chemicals.

To better understand the relative value and use of acute toxicity data, one can group problem chemical contaminants of the Nation into the following three categories: (1) potential future contaminants accompanying development, such as new pesticides, new industrial chemicals, new processes, energy extraction and processing, changing land uses, and population changes; (2) contaminants that exist in aquatic habitats, but are as yet unidentified or are poorly characterized; and (3) the general assemblage of contaminants that have been known to exist in aquatic environments for some time. Laboratory toxicological assessments, including acute toxicity measurements at an early stage, are most appropriate for chemical contaminants in the first two categories. Toxicologists are well aware of the virtues and limitations inherent in the use of the acute toxicity measure, yet there are probably few measurements that have been as misunderstood in evaluating hazard or safety of a chemical to aquatic life as the LC50 (concentration lethal to 50% of the test organisms during a specified exposure period). Users of this Handbook, or users of any acute toxicity data, must bear in mind that the LC50 measures only one biological response—death. Its main value is to provide a relative starting point for evaluation, along with other measurements (e.g., water solubility of the chemical, its partition coefficient, and its degradation rate) of the environmental hazard. In addition, the acute toxicity test provides a rapid, cost efficient way to measure the relative toxicity of different forms and formulations of a chemical in different types of water (acidic, basic, hard, cold, warm) and to organisms representing different trophic levels.

In the early stages of evaluation, where acute measurements are most useful, the LC50 has little more than academic value unless scientists or resource managers can estimate the expected environmental concentration (EEC). At present, procedures for making such estimates are far from precise, and range from "armchair" calculations (based on estimates of volumes or flow rates of water, discharges, application rates, etc.) to estimates based on physical-chemical properties of the chemical and actual analyses of chemical residues present in the abiotic environment.

In general, comparisons of several LC50 values for fish and other aquatic organisms with the EEC should be viewed as a "first cut" in assessing the potential threat of new or little known chemical contaminants. When LC50's are three to four orders of magnitude above the EEC, the long-term effect of a chemical on aquatic life is likely to be small. However, that generalization may not hold for a nontoxic material that physically disrupts, modifies, or destroys aquatic habitat or causes behavioral changes. As the difference between LC50 and EEC declines, consideration must be given to more definitive investigations of bioaccumulation and degradation rates and products, to long-term toxicologic tests, or to integrated laboratory and field ecological studies.

Although the acute toxicity test has been rightly criticized for a variety of technical reasons that are beyond the scope of the present discussion, the principal criticism probably stems from inferential uses of acute toxicity data beyond their limitations, and out of context from other measures necessary for hazard evaluation. Unfortunately, that is the way things are in the real world, because acute toxicity measurements may be the only aquatic effects data available for many chemicals, and then for only a fraction of the thousands of chemicals that have been identified as having potential for escape into the environment. Ideally, evaluators of potential chemical hazards to the environment would prefer a plethora of additional measurements concerning possible effects on growth, reproduction, pathology, biochemistry, populations of aquatic organisms, and ecological relationships. Frankly, the U.S. scientific community does not have the time, research facilities, trained personnel, experimental animals, nor financial resources to provide the additional data needed for "comfortable" predictions of the possible environmental effects of a broad spectrum of chemical contaminants. What is needed is a strategy for concentrating limited scientific resources on those chemicals most likely to have adverse impacts on aquatic systems. Similarly, a chemical-analytical strategy is needed for a more comprehensive approach to the detection, identification, and analysis of a broader spectrum of chemicals in selected environmental compartments. Such strategies would probably not be foolproof and would be different for aquatic ecosystems than for terrestrial ecosystems.

On the brighter side, where rationales exist for targeting research priorities on specific chemicals, toxicological evaluations beyond the acute test are being emphasized. Strategies are being developed to improve quality control in test methods, and to develop schemes for deciding depth of environmental effects testing, particularly under the aegis of the American Society of Testing and Materials and the American Institute of Biological Sciences. It is interesting to note, however, that nearly all such strategies and methods include acute toxicity measurements in the early phases of evaluating effects of pesticides and other potentially toxic materials on aquatic organisms. Unless other techniques can be shown to be equally or more meaningful to aquatic toxicologists, the acute toxicity test is here to stay. For a broader discussion of the methods, uses, and limitations of acute toxicity tests and data, the reader is advised to examine three review papers by Sprague (1969, 1970, 1971), and documents prepared by two groups: the Committee on Methods for Toxicity Tests with Aquatic Organisms (1975); and the Aquatic Hazards of Pesticides Task Group (American Institute of Biological Sciences 1978*b*).

Richard A. Schoettger, *Director*
Columbia National Fisheries
Research Laboratory

Acknowledgments

Numerous scientists and technicians have made major contributions to this Handbook. Under the former Director, Oliver B. Cope, and the present Director, Richard A. Schoettger, funds were provided to support the acute toxicity testing program. Appreciation goes to F. L. Mayer, Jr., for suggestions regarding the selection of chemicals for testing, design of the Handbook format, and for critical review of the manuscript. D. L. Livingston and J. L. Brauhn provided the high-quality organisms needed for testing. Other Federal and State agencies also provided test organisms. Special thanks go to the many chemical companies who provided the compounds for testing.

Assistance in compiling summary tables and reviewing and performing data computations was provided by C. Cotant, T. F. King, M. J. Nevins, and D. Whitener. Special appreciation goes to H. O. Sanders for contributions regarding invertebrate toxicity data and for reviewing the manuscript. We also thank D. F. Woodward and W. L. Mauck for contributions to the Laboratory's toxicity file and for reviewing the manuscript. Other biologists contributing to this Handbook include L. C. Folmar, A. M. Julin, and D. V. Swedberg. J. D. Petty critically reviewed the chemical nomenclature for the manuscript. For their excellent technical assistance, we thank B. Barnum, B. W. Faerber, D. A. Johnson, R. L. Knowlton, G. L. Mossing, D. U. Palawski, D. W. Short, J. H. Steinmetz, and J. R. Wencker. Lastly, we are grateful to J. L. Henry and B. Q. Lauxen for typing drafts of the manuscript.

Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates

Summaries of toxicity tests conducted at Columbia National Fisheries Research Laboratory, 1965-78

By

Waynon W. Johnson[1] and Mack T. Finley

U.S. Fish and Wildlife Service
Columbia National Fisheries Research Laboratory
Columbia, Missouri 65201

Introduction

Acute toxicity is a major subject of research at Columbia National Fisheries Research Laboratory for evaluating the impact of toxic chemicals on fishery resources. The Laboratory has played a leading role in developing research technology for toxicity testing and data interpretation. In 1965-78, more than 400 chemicals were tested against a variety of invertebrates and fish species representative of both cold- and warm-water habitats.

The use of acute toxicity tests for assessing the potential hazard of chemical contaminants to aquatic organisms is well documented (Boyd 1957; Henderson et al. 1960; Sanders and Cope 1966; Macek and McAllister 1970). Static acute toxicity tests provide rapid and (within limits) reproducible concentration-response curves for estimating toxic effects of chemicals on aquatic organisms. These tests provide a data base for determining relative toxicity of a large number of chemicals to a variety of species and for estimating acute effects of chemical spills on natural aquatic systems; they also assist in determining priority and design of additional toxicity studies.

Acute toxicity tests usually provide estimates of the exposure concentration causing 50% mortality (LC50) to test organisms during a specified period of time. For certain invertebrates, the effective concentration is based on immobilization, or some other identifiable endpoint, rather than on lethality. The application of the LC50 has gained acceptance among toxicologists and is generally the most highly rated test for assessing potential adverse effects of chemical contaminants to aquatic life (Brungs and Mount 1978; American Institute for Biological Sciences 1978*a*).

The literature contains numerous papers dealing with the acute toxicity of chemicals to freshwater organisms. However, there is a tremendous need for a concise compendium of toxicity data covering a large variety of chemicals and test species. This Handbook is a compilation of a large volume of acute toxicity data from the Columbia Laboratory and its field laboratories. It presents definitive acute toxicity data on 271 chemicals tested against a variety of freshwater invertebrates and fishes. The chemicals represent all major groups of pesticides, as well as numerous industrial chemicals. This compilation should serve as a useful data base for the many agencies and organizations dealing with research and management programs concerned with the impact of chemicals on aquatic resources.

The Columbia Laboratory has played a major role in developing currently used standard methodology for static acute toxicity testing. The use of standardized methodology greatly reduces variation in results. The data presented here have been carefully scrutinized to eliminate tests that failed to follow acceptable procedures. Handling of test organisms and procedures for static toxicity tests followed those described by Lennon and Walker (1964) and Macek and McAllister (1970), and conform well with those recommended by Brauhn and Schoettger (1975) and the Committee on Methods for Toxicity Tests with Aquatic Organisms (1975).

The species of fish and invertebrates that were tested are listed in phylogenetic order in Tables 1 and 2. Fish were obtained from Federal and State hatcheries as either eggs or fry. Original stocks of invertebrates were collected and cultured from wild populations with no known source of contamination; these populations were replenished regularly. The invertebrates were cultured in the Laboratory by methods similar to those described by Sanders and Cope (1966).

Test chemicals usually consisted of technical or analytical grade samples of known purity. Formulations

[1]Present address: Office of Environment (AE/ECE), U.S. Fish and Wildlife Service, P.O. Box 95067, Atlanta, Georgia 30347.

of the chemicals were also tested when available. When purity of test chemicals was known, all calculated concentrations were based on percent active ingredients. Stock solutions were prepared immediately before each test, with commercial grade acetone as the carrier solvent. Occasionally, ethanol or dimethylformamide was substituted. Solvent concentrations did not exceed 0.5 mL/L in final dilution water.

Test water (dilution water) was reconstituted from deionized water of at least 10^6 ohms resistivity by the addition of appropriate reagent grade chemicals (Marking 1969). Water was buffered to maintain a pH of 7.2 to 7.5, an alkalinity of 30 to 35 mg/L, and a hardness of 40 to 50 mg/L as $CaCO_3$. Test water was mixed thoroughly and aerated before transfer into test chambers. Fish were acclimated to dilution water by gradually changing the water in acclimation tanks from 100% well water to 100% reconstituted water over a 1- to 3-day period at the desired testing temperature. Invertebrates were acclimated from well water to dilution water over a 4- to 6-h period. Toxicity tests were conducted under static conditions without aeration, and the organisms were not fed during acclimation or testing. Temperature of test solutions was maintained within $\pm 1\,°C$ of that required for a given test.

Toxicity tests with fish were conducted in 18.9-liter (5-gal) wide-mouthed jars containing 15 liters of test solution. Fingerling fish weighing 0.2 to 1.5 g were tested at each concentration. Caution was taken not to exceed 0.8 g of test organisms per liter of solution. Duplicate test chambers were used to accommodate larger fish. Test chambers varied in size for invertebrates, depending on the species used; volume of test solution ranged from 0.25 to 4 liters. At least 10 organisms were exposed to each concentration for all definitive tests. At least six concentrations were used per toxicity test.

The tests began upon initial exposure to the toxicant and continued for 96 h. Immobilization tests with invertebrates were conducted for only 48 h. The number of dead or affected organisms in each test chamber was recorded and the dead organisms were removed every 24 h; general observations on the condition of test organisms were also recorded at these times.

Toxicity data were analyzed by a statistical method described by Litchfield and Wilcoxon (1949) to determine LC50 (theoretical estimate of the concentration lethal to 50% of the test animals) and 95% confidence intervals. This method is recommended by the American Public Health Association (1971) and by Sprague (1969) for determining median lethal concentrations. The procedure is easily modified for computing a single LC50 when replicate tests are performed.

Arrangement of Data

In the section on toxicological data, acute toxicity data are summarized separately for each of the 197 chemicals arranged alphabetically by common name in Table 3. Results of tests with an additional group of 74 chemicals, for which only limited data were available, are summarized in Table 4 (p. 81).

The EC50 and LC50 values and their 95% confidence intervals are expressed as either mg/L (ppm) or μg/L (ppb). The standard 96-h LC50 is presented for fish and most invertebrates; 48-h EC50 values are given for daphnids and midges. Exceptions to this form of data presentation fall into one of three categories: (1) when confidence intervals could not be calculated, only the LC50 is reported; (2) when the LC50 could not be calculated because of heterogeneity of the data, range values are presented, usually at 0.5 to 1.0 logarithmic interval; (3) when the LC50 was not calculated but was outside the limits of the test concentrations the values are expressed as "greater than" (>) or "less than" (<).

For many of the chemicals tested, a NOTE section following the summary of acute toxicity highlights additional toxicity data, when available. Results are given for acute toxicity tests in which different pH's, temperatures, or hardnesses, or aged test solutions (chemical deactivation) were used. Also, variations in sensitivity due to size or developmental life stage of the test organisms are included. Time-independent LC50 (TILC50) values—mathematically derived toxicant concentrations at which 50% of the test animals would be expected to survive indefinitely—are summarized for some chemicals. Organisms are exposed to toxicants under flow-through conditions for up to 30 days, and the TILC50's are calculated by the method of Green (1965), as modified by the additional requirements recommended by Johnson and Julin (1980). The cumulative action of a test chemical can be estimated by computing the ratio of the 96-h LC50 to the TILC50. This ratio or the "cumulative toxicity index" serves as an estimate of the cumulative action of a toxicant (Hayes 1967; Tucker and Crabtree 1970). Chemicals with an index of less than 11 are not considered highly cumulative. We have also added summaries of the results from chronic toxicity studies concerning effects on survival, growth, reproduction, residue dynamics, physiology and biochemistry, or histopathology.

A glossary of terms is given in Appendix I, a cross-index of chemical equivalent names in Appendix II, and a list of publications originating from the Columbia Laboratory that contain toxicity data on any chemicals covered in this Handbook, in Appendix III.

Table 1. *Common and scientific names of invertebrates used for acute toxicity testing.*[a]

Order, genus, and species	Common name
Anostraca	Fairy shrimps
Streptocephalus seali	
Cladocera	Daphnids
Simocephalus serrulatus	
Daphnia magna	
Daphnia pulex	
Ostracoda	Seed shrimps
Cypridopsis vidua	
Isopoda	Sowbugs
Asellus brevicaudus	
Amphipoda	Scuds
Gammarus pseudolimnaeus	
Gammarus lacustris	
Gammarus fasciatus	
Decapoda	
Orconectes nais	Crayfish
Procambarus sp.	Crayfish
Palaemonetes kadiakensis	Glass shrimp
Plecoptera	Stoneflies
Pteronarcella badia	
Pteronarcys californica	
Acroneuria sp.	
Claassenia sabulosa	
Isoperla sp.	
Skwala sp.	
Ephemeroptera	Mayflies
Hexagenia bilineata	
Baetis sp.	
Odonata	
Macromia sp.	Dragonflies
Ischnura venticalis	Damselfly
Lestes congener	Damselfly
Trichoptera	Caddisflies
Hydropsyche sp.	
Limnephilus sp.	
Diptera	
Tipula sp.	Crane flies
Chaoborus sp.	Phantom midges
Pentaneura sp.	Midges
Chironomus plumosus	Midge
Atherix variegata	Snipe fly

[a]The following life stages of invertebrates were tested: daphnids—first instar; crayfish—early instar; stonefly—first year class (1-20 mm long), second year class (20-40 mm long); and midge—fourth instar. All other invertebrates were designated as naiad, juvenile, or mature.

Table 2. *Common and scientific names of fish used for acute toxicity testing.*

Family, genus, and species	Common name
Polyodontidae	
Polyodon spathula	Paddlefish
Salmonidae	
Oncorhynchus kisutch	Coho salmon
Oncorhynchus tshawytscha	Chinook salmon
Salmo clarki	Cutthroat trout
Salmo gairdneri	Rainbow (steelhead) trout
Salmo salar	Atlantic salmon
Salmo trutta	Brown trout
Salvelinus fontinalis	Brook trout
Salvelinus namaycush	Lake trout
Esocidae	
Esox lucius	Northern pike
Cyprinidae	
Carassius auratus	Goldfish
Cyprinus carpio	Carp
Pimephales promelas	Fathead minnow
Catostomidae	
Catostomus catostomus	Longnose sucker
Catostomus commersoni	White sucker
Ictaluridae	
Ictalurus melas	Black bullhead
Ictalurus punctatus	Channel catfish
Clariidae	
Clarias batrachus	Walking catfish
Poeciliidae	
Gambusia affinis	Mosquitofish
Centrarchidae	
Lepomis cyanellus	Green sunfish
Lepomis macrochirus	Bluegill
Lepomis microlophus	Redear sunfish
Micropterus dolomieui	Smallmouth bass
Micropterus salmoides	Largemouth bass
Pomoxis annularis	White crappie
Pomoxis nigromaculatus	Black crappie
Percidae	
Perca flavescens	Yellow perch
Stizostedion vitreum vitreum	Walleye

Table 3. *List of chemicals included in this handbook.*[a]

Common name	Chemical name
Acephate	0,S-dimethyl N-acetylphosphoramidothioate
Acetone*	2-propanone
Akton	0,0-diethyl 0-[2-chloro-1-(2,5-dichlorophenyl)] vinyl phosphorothioate
Alachlor	2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide
Aldicarb*	2-methyl-2-(methylthio) propionaldehyde-0-(methylcarbamoyl) oxime
Aldrin	1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4-endo-exo-5,8-dimethanonaphthalene
Allethrin	d1-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one ester of d1 cis/trans-2,2-dimethyl-3-(2-methyl-propenyl)-cyclopropanecarboxylic acid
Ametryn*	2-(ethylamino)-4-(isopropylamino)-6(methylthio)-1,3,5-triazine
Aminocarb	4-(dimethylamino)-m-tolyl methylcarbamate
Amitrol*	3-amino-s-triazole
Antimycin A	Antimycin antibiotic (isolated from *Streptomyces*)
Aramite	2-(p-tert-butylphenoxy)-1-methylethyl-2-chloroethyl sulfite
Azide	potassium or sodium azide
Azinphos ethyl	0,0-diethyl S-[(4-oxo-1,2,3-benzotriazin-3(4H)-yl)methyl] phosphorodithioate
Azinphos methyl	0,0-dimethyl S-[(4-oxo-1,2,3-benzotriazin-3(4H)-yl)methyl] phosphorodithioate
Azodrin	dimethyl phosphate of 3-hydroxy-N-methyl-cis-crotonamide
Bayluscide	2',5-dichloro-4'-nitrosalicylamide, 2-aminoethanolsalt
Benefin*	N-butyl-N-ethyl-α,α,α-trifluoro-2,6-dinitro-p-toluidine
Benomyl	methyl 1-(butyl carbamoyl)-2-benzimidazolecarbamate
Bensulide*	0,0-diisopropyl phosphorodithioate S-ester of N-(2-mercaptoethyl) benzenesulfonamide
Benzene*	benzene (C_6H_6)
Benzene hexachloride	1,2,3,4,5,6-hexachlorocyclohexane
Binapacryl	2-sec-butyl-4,6,-dinitrophenyl-3-methyl-2-butenoate
Bufencarb*	m-(1-ethylpropyl) phenyl methylcarbamate and m-(1-methylbutyl) phenyl methylcarbamate mixture
Butylate*	S-ethyl-N,N-diisobutylthiocarbamate
Captafol	cis-N-(1,1,2,2-tetrachloroethylthio)-4-cyclohexene-1,2-dicarboximide
Captan	N-(trichloromethylthio)-4-cyclohexene-1,2-dicarboximide
Carbaryl	1-napthyl N-methylcarbamate
Carbofuran	2,3-dihydro-2,2-dimethyl-7-benzofuranyl methyl carbamate
Carbophenothion	S-(p-chlorophenyl methylthio)0,0-diethyl phosphorodithioate
Chlorbromuron*	3-(4-bromo-3-chlorophenyl)-1-methoxy-1-methylurea
Chlordane	1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene
Chlordane HCS-3260	1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene
Chlordimeform*	N'-(4-chloro-o-tolyl)-N,N-dimethylforamidine
Chlorendate	dibutyl and dimethyl esters of 1,4,5,6,7,7-hexachloro-(2.2.1)-bicyclo-5-heptene-2,3-dicarboxylic acid
Chlorfenethol*	1,1-bis(4-chlorophenyl) ethanol
Chlorobenzilate*	ethyl-4,4'-dichlorobenzilate
Chloronitropropane*	1-chloro-2-nitropropane
Chlorowax	chlorinated n-paraffin of C_{10}-C_{30}
Chloroxuron*	3-[p-(p-chlorophenoxy)phenyl]-1,1-dimethylurea
Chlorpyrifos	0,0-diethyl 0-(3,5,6-trichloro-2-pyridyl) phosphorothioate
Copper count	copper ammonium sulfate
Copper sulfate	copper sulfate pentahydrate
Coumaphos	0,0-diethyl 0-(3-chloro-4-methyl-2-oxy(2H)1-benzopyran-7-yl) phosphorothioate
Crotoxyphos	dimethyl cis-1-methyl-2-(1-phenylethoxycarbonyl) vinyl phosphate
Crufomate*	4-tert-butyl-2-chlorophenyl methyl methylphosphoramidate
Cryolite	sodium fluoaluminate
Cyanazine	2-[[4-chloro-6-(ethylamino)-S-triazin-2-yl]amino]-2-methyl-propionitrile
Cyclohexamide*	3-[2-(3,5-dimethyl-2-oxycyclohexyl)-2-hydroxyethyl]glutarimide
Cycocel*	(2-chloroethyl)trimethyl ammonium chloride
Cytrol amitrole-T	mixture of aminotriazole and ammonium thiocyanate
Dalapon	2,2-dichloropropionic acid
D-D soil fumigant	mixture of 1,3-dichloropane, 1,3-dichloropene, and related C_3 compounds
DDD	dichloro diphenyl dichloroethane
DDE	dichloro diphenyl dichloroethylene

Table 3. Continued

Common name	Chemical name
DDT	dichloro diphenyl trichloroethane
Deet*	N,N-diethyl-meta-toluamide
DEF	S,S,S-tributyl phosphorotrithioate
Demeton	0,0-diethyl 0-[2-(ethylthio)ethyl] phosphorothioate and 0,0-diethyl S-[2-(ethylthio)ethyl] phosphorothioate
Diazinon	0,0-diethyl 0-(2-isopropyl-6-methyl-4-pryimidinyl) phosphorothioate
Dicambia	2-methoxy-3,6-dichlorobenzoic acid
Dichlobenil	2,6-dichlorobenzonitrile
Dichlofenthion	0,0-diethyl 0-(2,4-dichlorophenyl) phosphorothioate
Dichlormate*	mixture of 3,4- and 2,3-dichlorobenzyl N-methylcarbamate
Dichloropropene	1,3-dichloropropene
Dichlorvos	2,2-dichlorovinyl dimethyl phosphate
Dicofol	1,1-bis (4-chlorophenyl)-2,2,2-trichloroethanol
Dicrotophos	dimethyl cis-2-dimethyl-carbamoyl-1-methylvinyl phosphate
Dieldrin	1,2,3,4,10,10-hexachloro-exo-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo-exo-5,8-dimethanonaphthalene
Diflubenzuron	N-[[(4-chlorophenyl)amino]carbonyl]-2,6-difluorobenzamide
Dilan*	mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis (p-chlorophenyl)-2-nitrobutane
Dimethoate	0,0-dimethyl S-(N-methylcarbamoylmethyl) phosphorodithioate
Dimethrin	2,4-dimethylbenzyl-2,2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate
Dimethylformamide*	N,N-dimethylformamide
Dimethyl sulfoxide*	dimethyl sulfoxide
Dinitramine	N^3,N^3-diethyl-2,4-dinitro-6-(trifluoromethyl)-1,3-phenylenediamine
Dinitrocresol	4,6-dinitro-o-cresol
Dinocap	2,4-dinitro-6-octyl phenyl crotonate (reaction mixture)
Dinoseb	2-(sec-butyl)-4,6-dinitrophenol
Dioxathion	2,3-p-dioxanedithiol S,S-bis (0,0-diethyl phosphorodithioate)
Diphenamid	N,N-dimethyl-2,2-diphenylacetamide
Diquat	6,7-dihydrodipyrido [1,2-a:2',1'-c] pyrazinediium dibromide, monohydrate
Disulfoton	0,0-diethyl S-[2-(ethylthio)ethyl] phosphorodithioate
Diuron	3-(3,4-dichlorophenyl)-1,1-dimethylurea
Dodine*	n-dodecylguanidine acetate
d-trans Allethrin	d1-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one ester of *d*-trans chrysanthemum monocarboxylic acid
Du-ter	triphenyltin hydroxide
Dyrene	2,4-dichloro-6-(o-chloroanilino)-s-triazine
Emcol AD-410*	calcium salt of dodecyl benzene sulfonic acid and polyoxyethylene ethers
Endosulfan	6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3-oxide
Endothall	7-oxabyclo(2.2.1) heptane-2,3-dicarboxylic acid
Endrin	1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo, endo-5,8-dimethanonaphthalene
EPN	0-ethyl-0-(p-nitrophenyl) phenyl phosphonothioate
EPTC	S-ethyl dipropylthiocarbamate
Ethanol*	ethyl alcohol
Ethion	0,0,0',0'-tetraethyl S,S'-methylene bisphosphorodithioate
Ethofumesate	2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate
Ethyl benzene*	ethyl benzene
Ethylene dichloride*	1,2-dichloroethane
Ethylene glycol*	1,2-ethanediol
Monomethyl ether*	2-methoxyethanol
Fenac	2,3,6-trichlorophenyl acetic acid
Fenaminosulf	p-(dimethylamino) benzenediazo sodium sulfonate
Fenitrothion	0,0-dimethyl 0-(4-nitro-m-tolyl) phosphorothioate
Fenson*	p-chlorophenyl benzenesulfonate
Fensulfothion*	0,0-diethyl 0-[p-(methylsulfinyl) phenyl] phosphorothioate
Fenthion	0,0-dimethyl 0-[4-(methylthio)-m-tolyl] phosphorothioate
Fire-Trol 100	ammonium sulfate plus, additives
Fire-Trol 931	ammonium polyphosphate, plus additives

Table 3. Continued

Common name	Chemical name
Fluometuron*	1,1-dimethyl-3-3-(trifluoromethylphenyl) urea
Folpet	N-(trichloromethylthio) phthalimide
Fonofos*	0-ethyl-S-phenylethyl phosphonodithioate
Garlon 3A*	3,5,6-trichloro-2-pyridinyloxyacetic acid
Geranol*	4-ethylphenyl-6,7-epoxygeranyl ether
Glycerol*	1,2,3-propanetriol
Glyphosate	N-(phosphonomethyl) glycine
Gophacide*	0,0-bis(p-chlorophenyl) acetimidoylphosphoramidothioate
Halowax 1099*	mixture of trichloro- and tetrachloronaphthalene
Heptachlor	1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene
Hexachlorobenzene	hexachlorobenzene
Houghto-Safe 1120	mixture of tri-aryl phosphate esters
Jodfenphos*	0,0-dimethyl-0-(2,5-dichloro-4-idodophenyl phosphorothioate
Kepone	decachlorooctahydro-1,3,4-metheno-2H-cyclobuta [cd]pentalen-2-one
Kling-Tite 800*	potassium 1-naphthaleneacetate
Landrin*	mixture of 3,4,5-methylphenyl and 2,3,5-methylphenyl methylcarbamate
Lead arsenate*	diplumbic hydrogen arsenate
Leptophos	0-(4-bromo-2,5-dichlorophenyl) 0-methylphenylphosphonothioate
Lethane 384*	2-(2-butoxyethoxy)ethyl thiocyanate
Lignasan	methyl 2-benzimidazolecarbamate phosphate
Lime sulfur	calcium polysulfide
Lindane	gamma isomer of 1,2,3,4,5,6-hexachlorocyclohexane
Malathion	0,0-dimethyl S-(1,2-dicarbethoxyethyl) phosphorodithioate
Merphos*	tributyl phosphorotrithioite
Methanol*	methyl alcohol
Methidathion*	0,0-dimethyl phosphorodithioate, S-ester with 4-(mercaptomethyl)-2-methoxy-1,3,4-thiadiazolin-5-one
Methiocarb*	4-(methylthio)-3,5-xylyl methylcarbamate
Methomyl	S-methyl-N-[(methylcarbamoyl)oxy]thioacetimidate
Methoprene	isopropyl (2E,4E)-11-methoxy-3,7,11-trimethyl-2,4-dodecadienoate
Methoprotryne*	2-(isopropylamino)-4-[(3-methylpropyl)amino]-6-(methylthio)-s-triazine
Methoxychlor	2,2-bis(p-methoxyphenyl)-1,1-trichloroethane
Methyl-Demeton*	0,0-dimethyl S(and 0)-[2-(ethylthio)ethyl] phosphorothioate
Methyl trithion	S-(((p-chlorophenyl)thio)methyl) 0,0-dimethyl phosphorodithioate
Mevinphos	dimethyl phosphate of methyl-3-hydroxy-cis-crotonate
Mexacarbate	4-(dimethylamino)-3,5-xylyl methylcarbamate
Mirex	dodecachloroctahydro-1,3,4-metheno-2H-cyclobuta(cd)pentalene
Molinate	S-ethyl hexahydro-1 H-azepine-1-carbothioate
MON-0818	unknown
Monoethanolamine*	2-aminoethanol
Morsodren*	cyano(methylmercuri)guanidine
MSMA	monosodium methanearsonate
Naled	1,2-dibromo-2,2-dichloroethyl dimethyl phosphate
Niclosamide*	5-chloro-N(2-chloro-4-nitrophenyl)-2-hydroxybenzamide 2-amino ethanol salt
Nitralin	4-(methylsulfonyl)-2,6-dinitro-N N-dipropylaniline
Nitrofen*	2,4-dichlorophenyl-p-nitrophenyl ether
Norea*	3-(hexahydro-4,7-methanoindan-5-yl)-1,1-dimethylurea
N-Serve*	2-chloro-6-(trichloromethyl)pyridine
Ortho-11775	3-(2-butyl)phenyl-N-methyl-N-(phenylsulfenyl) carbamate
Oryzalin*	3,5-dinitro-N⁴,N⁴-dipropylsulfanilamide
Oxydemeton-methyl	S-[2-(ethylsulfinyl)ethyl] 0,0-dimethyl phosphorothioate
Paraquat	1,1-demethyl-4,4 -bipyridinium ion (dichloride and bis (methylsulfate) salt
Parathion ethyl	0,0-diethyl 0-p-nitrophenyl phosphorothioate
Parathion methyl	0,0-dimethyl-0-p-nitrophenyl phosphorothioate
Pentachlorophenol	pentachlorophenol
Sodium salt	sodium pentachlorophenate
Permethrin	3-(phenoxyphenyl)methyl(1)-cis,trans-3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropane-carboxylate

Table 3. Continued

Common name	Chemical name
Perthane*	1,1-dichloro-2,2-bis(4-ethylphenyl)ethane
Phenoxy herbicides	
2,4-D's	2,4-dichlorophenoxyacetic acid
2,4,5-T's	2,4,5-trichlorophenoxyacetic acid
2,4-D/2,4,5-T	mixtures of derivatives of 2,4-D and 2,4,5-T
Phorate	0,0-diethyl S-[(ethylthio)methyl] phosphorodithioate
Phosalone	0,0-diethyl S-[6-chloro-3-(mercaptomethyl)-2-benzoxazolinone] phosphorodithioate
Phos-Chek	diammonium phosphate, plus additives
Phosmet	N-(mercaptomethyl)phthalimide S-(0,0-dimethyl phosphorodithioate)
Phosphamidon	2-chloro-N,N-diethyl-3-(dimethyoxyphosphinyloxy) crotonamide
Phoxim	phenylglyoxylonitrile oxime 0,0-diethyl phosphorothioate
Phthalic acid esters	
DBP	n-butyl ester of phthalic acid
DEHP	di-2-ethylhexyl ester of phthalic acid
Phygon XL	2,3-dichloro-1,4-naphthoquinone
Phytar 560	sodium salt of cacodylic acid
Picloram	4-amino-3,5,6-trichloropicolinic acid
Piperonyl butoxide	*a*-[2-(2-butoxyethoxy)ethoxyl]-4,5-metholenedioxy-2-propyltoluene
Pipron*	3-(2-methylpiperidino)propyl-3,4-dichlorobenzoate
Plictran	tricyclohexyltin hydroxide
Polychlorinated phenyls	
biphenyls	1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, 1268
terphenyls	4465, 5442, 5460
Propanil*	3',4'-dichlorophenylpropionanilide
Propham	isopropyl N-phenylcarbamate
Propoxur	0-isopropoxyphenyl N-methylcarbamate
Purifloc C-31	synthetic organic polyelectrolyte
Pydraul 50E	mixture of tri-aryl phosphate esters
Pydraul 115E	mixture of tri-aryl phosphate esters
Pyrethrum	mixture of natural pyrethrins
Reldan*	0,0-dimethyl 0-(3,5,6-trichloro-2-pyridyl)phosphorothioate
Resmethrin	(5-benzyl-3-furyl)methyl 2,2-dimethyl-3-(2-methyl propenyl) cyclopropanecarboxylate
Roccal*	alkyl dimethyl benzylammonium chloride
Ronnel	0,0-dimethyl 0-(2,4,5-trichlorophenyl) phosphorothioate
Rotenone	1,2,12,12a-tetrahydro-2-isopropenyl-8,9-dimethyoxy[1] benzopyrano[3,4-b]furo[2,3-b][1]benzopyran-6(6aH)-one
RU-11679	(5-benzyl-3-furyl) methyl 1R, 2R-2-(cyclopentylidene) methyl]-3,3-dimethylcyclopropane carboxylate
Ryania	powdered stemwood of *Ryania speciosa*
S-bioallethrin	*d*-trans-chrysanthemum monocarboxylic acid ester of *d*-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one
SD-14114	distannoxane, hexakis (beta,beta-dimethyl-phenethyl)
SD-17250	N-[(methylcarbamoyl)oxy]thioacetimidic acid ester with 3-mercaptopropionitrile
Simazine	2-chloro-4,6-bis(ethylamino)-s-triazine
Sodium arsenite	sodium arsenite
Stabilene*	polypropylene glycol monobutylether
Stirofos*	2-chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl phosphate
Strobane	polychlorinates of camphene, pinene, and related terpenes
Suffix	ethyl N-benzoyl-N-(3,4-dichlorophenyl)-2-aminopropionate
2,3,6-TBA*	2,3,6-trichlorobenzoic acid
Temephos	0,0,0',0'-tetramethyl 0,0'-(thiodi-p-phenylene) phosphorothioate
Tepa*	tris(1-aziridinyl)phosphine oxide
TEPP	tetraethyl diphosphate
Terbutryn*	2-(tert-butylamino)-4-(ethylamino)-6-(methylthio)-s-triazine
Tetradifon	4-chlorophenyl 2,4,5-trichlorophenyl sulfone, (2,4,5,4'-tetrachlorodiphenyl sulfone)
Tetramine	tetramethylene disulfotetramine
TFM	3-trifluoromethyl-4-nitrophenol, sodium salt
Thanite	isobornyl thiocyanoacetate

Table 3. Continued

Common name	Chemical name
Thiobencarb	5-(4-chlorobenzyl)N,N-diethylthiolcarbamate
Thynon	5,10-dihydro-5,10-dioxonaphtho(2,3b)-p-dithiin-2,3-dicarbonitrile
Toluene*	toluene
Toxaphene	chlorinated camphene (67-69% chlorine) mixture
Tranid*	exo-3-chloro-endo-6-cyano-2-norbornanone 0-(methylcarbamoyl)oxime
Trefmid*	mixture of diphenamid and trifluralin
Tretolite	unknown
Trichlorfon	dimethyl(2,2,2-trichloro-1-hydroxyethyl) phosphonate
Trichloronat*	0-ethyl 0-(2,4,5-trichlorophenyl)ethyl phosphonothioate
Tricresyl phosphate	tricresyl phosphate
Trifluralin	*a,a,a*-trifluoro-2,6-dinitro-N,N-dipropyl-*p*-toludine
Ureabor	mixture of sodium metaborate tetrahydrate, sodium chlorate, and bromacil
Velpar*	3-cyclohexyl-6-(dimethylamino)-1-methyl-S-triazine-2,4(1H,3H)-dione
Vernolate	S-propyl N,N-dipropylthiocarbamate
Warfarin*	3(*a*-acetonylbenzyl)-4-hydroxycoumarin
Xylene*	dimethyl benzene

[a]Chemicals are listed alphabetically by common or generic names proposed by organizations such as the Weed Science Society of America and the Entomological Society of America. Common names followed by an asterisk designate chemicals subjected to limited toxicity testing, which are summarized in Table 4 (p. 81).

Toxicological Data

Summary tables of toxicity data are arranged separately for each chemical tested. Chemicals are arranged alphabetically by common name, along with the generic chemical name, any known trade names and synonyms, principal use, and purity of test samples. In chemical names occupying two or more lines, an equal sign (=) at the end of a line indicates that the name is continuous (to be written solid, not spaced or hyphenated). If the chemical name is not shown, the chemical composition of the commercial compound has not been made available by the manufacturer. If no principal use is given, none is known. Where the sample description includes more than one formulation, each is followed by a superscript number that identifies (by the same superscript number) the organisms in the table against which the formulation was tested. Toxicity data for technical grade material are listed first, followed by data for different formulations. Species tested are listed phylogenetically for each formulation. Included with all toxicity values are the weights or development stages of the test organisms and the testing temperature. Except where otherwise indicated, toxicity values are expressed as either mg/L (ppm) or μg/L (ppb).

The following abbreviations are used throughout the summary tables: Fish—YSF = yolk sac fry; SUF=swim-up fry; J=juvenile; F=fingerling. Invertebrates—*G*=*Gammarus*; I_1=first instar; I_E=early instar; I_4=fourth instar; YC_1=first year class; YC_2=second year class; N=naiad; J=juvenile; and M=mature.

ACEPHATE

Chemical Name: 0,S-Dimethyl N-acetylphos=phoramidothioate

Alternate Names: ENT-27822, Orthene, Ortho 12420, Ortran, RE 12420

Principal Use: Herbicide

Sample Description: Technical material, 94%[1]; soluble powder, 75%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. pseudolimnaeus[1]	M	12	>50
Pteronarcella[1]	N	12	9.5 7.3-12.3
Skwala[1]	N	7	12 8.7-16
Chironomus[1]	I_4	20	>1,000
Cutthroat trout[1]	0.7	12	>100
Rainbow trout[1]	1.5	10	1,100 775-1,561
Brook trout[1]	0.2	12	>100

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Fathead minnow[1]	1.0	20	>1,000
Channel catfish[1]	2.0	22	>1,000
Bluegill[1]	0.4	20	>1,000
Yellow perch[1]	2.0	12	>50
Skwala[2]	N	7	12 8.0-18
Cutthroat trout[2]	0.9	12	>100
Rainbow trout[2]	1.2	10	730 580-920
Fathead minnow[2]	1.0	20	>1,000
Channel catfish[2]	0.5	22	560-1,000
Bluegill[2]	0.4	20	>1,000
Yellow perch[2]	1.8	12	>100

NOTE: Alterations in temperature (7°-20°C), pH (6.5-9.5), and hardness (12-300 ppm) did not alter toxicity to trout, bluegills, or yellow perch. An increase in pH from 6.5 to 8.5 increased 96-h LC50's in stonefly naiads (*Pteronarcella*) from 6.4 to 21 mg/L. Aging of test solutions for 7 days did not alter the toxicity to midge larvae (*Chironomus*).

AKTON

Chemical Name: 0,0-Diethyl 0-[2-chloro-1-(2,5-dichlorophenyl)] vinyl phosphorothioate

Alternate Names: Axiom, CAS-1757-18-2, ENT-27102, SD-9098

Principal Use: Non-systemic soil insecticide

Sample Description: Technical material, 80%[1]; emulsifiable concentrate, 2 lb/gal[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Channel catfish[1]	0.7	18	400 295-542
Bluegill[1]	1.1	18	0.17 0.10-0.27
Redear sunfish[1]	2.5	18	0.38 0.17-0.85
Rainbow trout[2]	1.2	12	1,200 1,080-1,370
Fathead minnow[2]	—	12	270

ALACLOR

Chemical Name: 2-Chloro-2'6'-diethyl-N-methoxy=methyl) acetanilide

Alternate Names: Lasso, WSSA, MAF, CP50144, Lazo

Principal Use: Herbicide

Sample Description: Technical material, 100%[1]; liquid, 43%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Rainbow trout[1]	0.8	12	2.4 1.8-3.1
Bluegill[1]	1.0	22	4.3 3.5-5.5
Rainbow trout[2]	0.8	12	1.4 1.1-1.8
Bluegill[2]	1.0	22	3.2 2.3-4.5

ALDRIN

Chemical name: 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4-endo-exo-5,8-dimethanonaphthalene

Alternate Names: Aldrine, Aldrite, Aldrosol, CAS-309-00-2, Compound 118, ENT-15949, HHDN, Octalene, Seedrin

Principal Use: Insecticide

Sample Description: Technical material, 90%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	15	23[a] 17-30
Simocephalus	I_1	21	32[a] 22-36
Daphnia pulex	I_1	15	28[a] 20-39
Cypridopsis	M	21	18[a] 15-21
G. fasciatus	M	21	4,300 3,500-5,300
Palaemonetes	M	21	50 38-65
Pteronarcys	YC_2	15	1.3 0.8-2.2
Chinook salmon	0.8	15	14.3
Rainbow trout	0.6	13	2.6 2.3-2.9
Fathead minnow	0.6	18	8.2
Black bullhead	1.5	24	19
Channel catfish	5.2	18	53
Bluegill	0.7	18	6.2 5.2-7.7
Largemouth bass	2.5	18	5

[a]48-h EC50.

NOTE: Toxicity to fish was not appreciably changed by variations in temperature or water hardness. Temperature variations from 2° to 18°C gave a 96-h LC50 range of 3.4 to 2.6 μg/L for rainbow trout and a variation of 7° to 24°C gave a range of 9.7 to 5.6 μg/L for bluegills. Variations in hardness from 40 to 135 ppm did not change LC50 values for rainbow trout or bluegills. Invertebrates accumulated significant residues when exposed to C^{14}-labeled aldrin. In *Daphnia magna*, exposure for 3 days to a water concentration of 16 ng/L resulted in a 100,000-fold bioaccumulation. Similarly, *Hexagenia bilineata* and *Chironomus* sp. accumulated residues of 34,000- and 22,800-fold, respectively, when exposed to concentrations of 21 ng/L.

ALLETHRIN

Chemical Name: d1-2-Allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one ester of d1 cis/trans 2,2-dimethyl-3-(2-methylpropenyl)-cyclopropanecarboxylic acid

Alternate Names: Allyl hemolog of cinerin I, CAS-MX8018-12-0, cinerin, cinerolone, ENT-17510, Pallethrine, Pynamin, Pyresyn, Pyrocide, Synthetic Pyrethrin

Principal Use: Insecticide

Sample Description: Technical material, 90%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	15	56.0[a] 40.0-78.0
Daphnia pulex	I_1	15	21.0[a] 19.0-35.0
G. fasciatus	M	21	11.0 8.0-15.0
Pteronarcys	YC_2	15	5.6 4.9-6.4
Rainbow trout	0.9	13	19.0
Bluegill	0.9	24	56.0

[a]48-h EC50.

AMINOCARB

Chemical Name: 4-(Dimethylamino)-m-tolyl methyl= carbamate

Alternate Names: A-363, Aminocarbe, Bay 44646, CAS-2032-59-9, ENT-25784, Matacil, Metacil

Principal Use: Insecticide

Sample Description: Technical material, 98%[1]; liquid formulation, 17%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. fasciatus[1]	M	21	12 8.2-18

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Cutthroat trout[1]	0.8	10	31,000[b] 18,000-52,400
Rainbow trout[1]	1.5	12	13,500 11,300-16,200
Atlantic salmon[1]	0.4	12	7,600 5,880-9,820
Brown trout[1]	0.5	12	15,000 11,500-19,500
Brook trout[1]	1.0	12	16,000 12,700-20,100
Fathead minnow[1]	0.7	20	8,500 6,500-11,100
Channel catfish[1]	0.6	20	10,000 6,970-14,330
Bluegill[1]	0.6	20	3,100 1,900-5,100
Largemouth bass[1]	0.7	18	3,150[b] 2,840-3,490[b]
Yellow perch[1]	0.6	12	6,400[b] 5,300-7,730
Walleye[1]	0.8	18	880 755-1,030
Daphnia magna[2]	I_1	21	10-100[a]
G. pseudolimnaeus[2]	M	10	> 50[b]
Chironomus[2]	I_4	20	270[a] 187-389
Cutthroat trout[2]	1.0	10	64[b] 31-134
Rainbow trout[2]	1.5	10	130 103-164
Fathead minnow[2]	0.7	20	75 63-90
Channel catfish[2]	4.5	20	130 105-160
Bluegill[2]	0.6	20	100 68-148

[a]48-h EC50.
[b]Tested in hard water.

NOTE: Eyed rainbow trout eggs were not sensitive to the 17% formulation of aminocarb; the 96-h LC50 exceeded 32,000 μg/L. A 1.5- to 3.5-fold increase in toxicity was noted when test temperatures were raised from 7° to 17°C for trout and 12° to 27°C for bluegills. A 5- to 15-fold increase in the toxicity of technical aminocarb to fish was noted when the pH was increased from 6.5 to 9.5. Most of the change occurred between pH 8.5 and 9.5; the increase was only twofold or less when variations ranged from 6.5 to 8.5. Aging of test solutions for 4 weeks appeared to have little effect on the toxicity to fish. Brown trout showed a twofold increase in toxicity after 1 week of aging but no further change occurred after 2 additional weeks. Time-independent LC50's for rainbow trout and bluegills were 22 and 41 μg/L, respectively. Little cumulative toxicity was indicated; cumulative toxicity indices were 2.5 and 2.4, respectively.

ANTIMYCIN A

Chemical Name: Antibiotic isolated from the bacterium *Streptomyces*

Alternate Names: Antimycin, Fintrol

Principal Use: Piscicide

Sample Description: Technical material, 95.5%

SUMMARY OF ACUTE TOXICITY[a]

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (ng/l)
Daphnia magna	I_1	21	5,000-10,000[b]
Asellus	M	15	> 1,000
G. fasciatus	M	15	8.0 5.8-11
Palaemonetes	M	21	3,000-6,000
Paddlefish	YSF	15	1.0 0.4-3.0
Coho salmon	0.9	12	18 12-28
Cutthroat trout	1.1	9	78 60-99
Rainbow trout	1.3	13	12 7-23
Lake trout	F	12	53[c] 45-63

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (ng/L)
Goldfish	0.9	18	180 99-348
Fathead minnow	0.5	17	40 21-77
Black bullhead	1.2	18	7,500 4,300-13,100
Channel catfish	2.3	17	4,230 2,830-6,340
Walking catfish	3.8	25	15,000
Mosquitofish	0.6	17	192 114-324
Green sunfish	1.1	18	220 128-416
Bluegill	1.2	17	38 19-75
Largemouth bass	0.6	17	237 159-354
White crappie	1.5	17	340 273-424
Yellow perch	0.7	12	40 31-52

[a]LC50 and EC50 values are presented as ng/L (nanograms per liter).
[b]48-h EC50.
[c]24-h LC50.

ARAMITE

Chemical Name: 2-(p-tert-Butylphenoxy)-1-methylethyl-2-chloroethyl sulfite

Alternate Names: Aracide, CAS-140-57-8, ENT-16519, Niagaramite, 88-R

Principal Use: Acaricide

Sample Description: Technical material, 90%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Simocephalus	I_1	15	230[a] 140-390
Daphnia magna	I_1	15	160[a] 113-225
G. fasciatus	M	21	60 43-84
Pteronarcys	YC_2	15	>1,000
Rainbow trout	0.9	13	320 265-387
Bluegill	0.7	24	350

[a]48-h EC50.

AZIDE

Chemical Name: Potassium or sodium azide

Alternate Names: CAS-12136-44-6, Kazoe, Smite

Principal Use: Herbicide

Sample Description: Technical material: potassium azide, 98%[1]; sodium azide, 98%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Simocephalus[1]	I_1	15	8.4[a] 6.1-12.2
Daphnia pulex[1]	I_1	15	7.5[a] 6.3-9.1
G. fasciatus[1]	M	21	6.4 4.6-8.9
Pteronarcys[1]	YC_2	15	8.0 5.7-11.0
Rainbow trout[1]	1.4	13	1.6
Bluegill[1]	0.4	18	0.8
Simocephalus[2]	I_1	15	6.4[a] 4.6-8.9
Daphnia pulex[2]	I_1	15	4.2[a] 2.8-6.2
G. fasciatus[2]	I_1	21	5.0 3.7-6.8

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Pteronarcys[a]	YC_2	15	9.0 6.4-13
Rainbow trout[a]	1.4	13	0.8
Bluegill[a]	0.6	18	0.7

[a]48-h EC50.

AZINPHOS ETHYL

Chemical Name: 0,0-Diethyl S-[(4-oxo-1,2,3-benzo=triazin-3(4H)-yl) methyl] phosphorodithioate

Alternate Names: Bay 16259, CAS-2642-71-9, Cotnion-Ethyl, ENT-22014, Ethyl Guthion, Gusathion A, R-1513, Triazotion

Principal Use: Insecticide

Sample Description: Technical material, 88%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	15	4.2[a] 2.9-6.1
Daphnia pulex	I_1	15	3.2[a] 1.8-5.8
Pteronarcys	YC_2	15	1.5 0.8-2.7
Rainbow trout	1.4	13	20 17-22
Bluegill	0.8	24	1.1 0.9-1.2

[a]48-h EC50.

AZINPHOS METHYL

Chemical Name: 0,0-Dimethyl S-[(4-oxo-1,2,3-benzo=triazin-3(4H)-yl) methyl] phosphorodithioate

Alternate Names: Bay 9027, Bay 17147, Carfene, CAS 85-50-0, Cotnion-Methyl, DBD, ENT-23233, Gusa=thion M, Guthion, Metiltriazotion, R-1582

Principal Use: Insecticide

Sample Description: Technical material, 88-100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Asellus	M	15	21 15-28
G. fasciatus	M	21	0.15 0.11-0.20
Procambarus	M	12	56 41-77
Palaemonetes	M	21	0.13[a] 0.11-0.16
Pteronarcys	YC_2	15	1.9 1.5-2.4
Coho salmon	0.7	12	6.1 5.0-7.4
Rainbow trout	1.0	12	4.3 3.0-6.4
Atlantic salmon	0.5	12	2.1 1.7-2.6
Brown trout	1.5	12	4.6 3.5-6.1
Northern pike	YSF	12	0.36 0.27-0.48
Goldfish	0.9	18	4,270 3,030-6,010
Carp	0.6	18	695 410-1,280
Fathead minnows	1.2	18	235 135-410
Black bullhead	1.2	18	3,500 2,920-4,950
Channel catfish	1.5	18	3,290 2,490-4,340
Green sunfish	1.1	18	52 28-94
Bluegill	1.5	18	22 20-25

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Largemouth bass	0.9	18	4.8 3.1-7.4
Black crappie	1.0	18	3.0 2.3-3.8
Yellow perch	1.4	18	15 11-19

[a]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Variations in test temperatures from 2° to 18°C for rainbow trout and 12° to 22°C for bluegills produced no change in toxicity at the lower temperatures and a twofold increase at the highest temperature. Yellow perch became substantially more susceptible with an increase in temperature; 96-h LC50's decreased from 40 to 2.4 μg/L when temperature was increased from 7° to 22°C. Variations in water hardness from 12 to 300 ppm produced no change in toxicity to scuds or fish. Alkaline solutions (pH 8.5 to 9.0) were slightly less toxic to fish than more acidic solutions (pH 6.5 to 7.5). One to 3 weeks of aqueous degradation produced a 1.3- to 2-fold increase in 96-h LC50's for Atlantic salmon and yellow perch. Atlantic salmon eggs were highly tolerant to poisoning (11-day LC50 greater than 50 mg/L). Susceptibility of yolk-sac fry equaled that of fingerlings. Time-independent LC50's were 0.23, 0.29, and 0.32 μg/L for Atlantic salmon, bluegill, and yellow perch, respectively. Cumulative toxicity indices varied from 10.9 to 20.5, indicating a moderate to high degree of cumulative action (for an organophosphate).

AZODRIN

Chemical Name: Dimethyl phosphate of 3-hydroxy-N-methyl-cis-crotonamide

Alternate Names: CAS-141-66-2, Ciba 1414, ENT-27129, Monocron, Monocrotophos, Nuracron, SD-9129

Principal Use: Insecticide

Sample Description: Technical material, 100%[1]; dispersible liquid, 3.2 lb/gal[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/l)
G. fasciatus[1]	M	15	0.3
Fathead minnow[1]	0.9	18	>50
Bluegill[1]	1.0	18	12.1 7.2-10.1
Rainbow trout[2]	0.5	13	5.2
Channel catfish[2]	1.4	18	4.93 2.58-9.43

BAYLUSCIDE

Chemical Name: 2',5-Dichloro-4'-nitrosalicylamide, 2-aminoethanolsalt

Alternate Names: Bay 73, Bay 25648, Bayer 73, CAS 1420-04-8, Clonitralid

Principal Use: Molluscicide

Sample Description: Wettable powder, 70%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Daphnia magna	I_1	21	190[ab] 140-270
G. pseudolimnaeus	M	21	2,400[b] 1,800-3,100
Orconectes	I_E	21	25,000[b] 19,000-33,000
Palaemonetes	M	21	10,000[b] 7,000-15,000
Pteronarcys	YC_2	15	200 130-300
Chironomus	I_4	21	1,600[ab] 1,100-2,200
Rainbow trout	1.4	13	340 289-399

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Whole body residues were low in invertebrates exposed to C^{14}-Bayluscide (1 μg/L). Within 48 h, invertebrates (daphnids, sowbugs, scuds, glass shrimp,

crayfish, damselfly larvae, and midge larvae) reached plateaus which were 4 to 87 times that of the concentration to which they were exposed. A 50% reduction in these residues occurred within 24 h after the organisms were transferred to fresh water. In flow-through tests, daphnids showed a 21-day LC50 of 0.65 mg/L, and a concentration of 0.38 mg/L caused a 50% decrease in reproduction.

BENOMYL

Chemical Name: Methyl 1-(butyl carbamoyl)-2-benzimidazolecarbamate

Alternate Names: Benlate, Tersan

Principal Use: Fungicide

Sample Description: Technical material, 99%[1]; wettable powder, 50%[2]; methyl-2-benzimidazole=carbamate, 99% (MBC metabolite)[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Rainbow trout[1]	1.2	12	170 120-230
Fathead minnow[1]	0.9	22	2,200 1,590-3,040
Channel catfish[1]	1.2	22	29 22-37
Bluegill[1]	0.9	22	850 550-1,300
Rainbow trout[2]	1.0	12	310 250-390
Fathead minnow[2]	0.5	22	1,900 1,430-2,530
Channel catfish[2]	1.2	22	28 21-34
Bluegill[2]	0.6	22	1,200 900-1,590
Rainbow trout[3]	0.2	12	370 268-510
Channel catfish[3]	0.8	22	16 11-23

NOTE: The toxicity of benomyl was altered by water hardness and pH and by life stage of the fish tested. Temperature had no appreciable effect on toxicity. Variations in pH altered toxicity more than any other test condition. Benomyl was about 5 times more toxic to rainbow trout and bluegills at pH's 6.5 or 7.5 than at 8.5. Benomyl was equally toxic to all life stages of rainbow trout; 96-h LC50's ranged from 120 to 280 μg/L. However, fry of channel catfish were considerably more sensitive to benomyl than were fingerlings. The 96-h LC50's for yolk-sac fry, swim-up fry, and fingerlings were 5.6, 12, and 29 μg/L, respectively. Toxicity of the MBC metabolite was very similar to that of technical grade benomyl for all life stages of rainbow trout and channel catfish tested.

BENZENE HEXACHLORIDE

Chemical Name: 1,2,3,4,5,6-hexachlorocyclohexane

Alternate Names: Benzahex, Benzex, BHC, Dol, Dolmix, FBHC, HCCH, HCH, Hexachlor, Hexachloran, Hexafor, Hexaclan, Soprocide

Principal Use: Insecticide

Sample Description: Technical material, 41.5%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Daphnia pulex	I_1	16	680[a]
G. lacustris	M	21	78 54-113
Pteronarcys	YC_2	15	<18
Cutthroat trout	1.0	13	9 8-10
Rainbow trout	1.0	13	18 15-20
Goldfish	1.0	18	348 261-466
Fathead minnow	1.0	18	125 96-164
Channel catfish	1.1	18	105 85-129
Bluegill	1.5	18	67 51-96
Largemouth bass	0.8	18	41 36-47

[a]48-h EC50.

BINAPACRYL

Chemical Name: 2-sec-Butyl-4,6-dinitrophenyl-3-methyl-2-butenoate

Alternate Names: Acricid, Ambox, CAS 485-31-4, Dinoseb methacrylate, Endosan, ENT-25793, FMC 9044, Hoe 2784, Morocide, NIA 9044

Principal Use: Acaricide

Sample Description: Technical material, 99.9%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Asellus	M	16	29
Rainbow trout	1.1	13	50 46-55
Channel catfish	1.4	18	15
Green sunfish	0.8	18	43 37-50
Bluegill	1.3	18	40 34-47

CAPTAFOL

Chemical Name: cis-N-(1,1,2,2-Tetrachloroethylthio)-4-cyclohexene-1,2-dicarboximide

Alternate Names: CAS 2425-06-1, Difolatan, Folcid, Sanspor, Sulfenimide

Principal Use: Fungicide

Sample Description: Wettable powder, 80%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. lacustris	M	21	800 500-1,300
Pteronarcys	YC_2	15	40 20-60
Rainbow trout	1.0	13	21 13-32
Goldfish	0.9	18	178 146-217
Channel catfish	1.0	18	28
Bluegill	1.1	18	59 49-70

NOTE: The toxicity of captafol to rainbow trout, goldfish, and bluegills was reduced about 50% in tests conducted in hard water (272 ppm $CaCO_3$).

CAPTAN

Chemical Name: N-(Trichloromethylthio)4-cyclo=hexene-1,2-dicarboximide

Alternate Names: Captane, CAS 133-06-2, Merpan, Orthocide, Vondcaptan

Principal Use: Fungicide

Sample Description: Technical material, 90-100%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Coho salmon	0.8	12	138 118-161
Chinook salmon	F	12	56.5 52.3-61.0
Cutthroat trout	0.4	12	56.4 42.2-75.4
Rainbow trout	1.0	12	73.2 66.6-80.4
Brown trout	0.7	12	80.0 63.8-100
Lake trout	0.4	12	49.0 40.1-59.9
Fathead minnow	0.3	12	200 168-238
Channel catfish	1.2	20	77.5 70.5-85.2

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Bluegill	1.1	17	141 119-167
Yellow perch	1.0	17	120[a] 97-147

[a]Flow-through toxicity test.

CARBARYL

Chemical Name: 1-Naphthyl N-methylcarbamate

Alternate Names: Carpolin, CAS 63-25-2, Cenapon, Dicarbam, ENT-23969, Hexavin, Karbaspray, Nac, Ravion, Ravyon, Septene, Sevin, SOK, Tricarnam

Principal Use: Insecticide

Sample Description: Technical material, 99.5%[1]; Oil dispersion, 49%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus[1]	I_1	16	7.6[a] 6.2-9.3
Daphnia pulex[1]	I_1	16	6.4[a] 4.5-8.9
Cypridopsis[1]	M	21	115[a] 74-179
Asellus[1]	M	18	280 214-367
G. lacustris[1]	M	21	22 16-30
G. fasciatus[1]	M	21	26 16-39
Procambarus[1]	I_E	12	1,900 1,160-3,110
Palaemonetes[1]	M	21	5.6 3.6-8.3
Pteronarcella[1]	N	16	1.7 1.4-2.4
Pteronarcys[1]	YC_2	16	4.8 3.0-7.7
Claassenia[1]	YC_2	16	5.6 3.9-8.1
Skwala[1]	N	12	3.6 2.4-5.5
Coho salmon[1]	1.0	13	4,340 3,310-5,690
Chinook salmon[1]	F	12	2,400[b] 1,620-3,550
Cutthroat trout[1]	0.5	12	7,100 5,240-9,620
Rainbow trout[1]	1.5	12	1,950 1,450-2,630
Atlantic salmon[1]	0.4	12	4,500 3,820-5,310
Brown trout[1]	0.6	12	6,300 5,520-7,190
Brook trout[1]	0.8	12	2,100 1,680-2,620
Lake trout[1]	1.7	12	690 520-910
Goldfish[1]	0.9	18	13,200 8,310-20,800
Carp[1]	0.6	18	5,280 4,620-6,050
Fathead minnow[1]	0.8	18	14,600 11,700-19,800
Black bullhead[1]	1.2	18	20,000 18,000-24,000
Channel catfish[1]	1.5	18	15,800 13,900-18,000
Green sunfish[1]	1.1	18	11,200 8,140-15,500
Bluegill[1]	1.2	18	6,760 5,220-8,760
Largemouth bass[1]	0.9	18	6,400 4,400-9,200
Black crappie[1]	1.0	18	2,600 1,180-5,700

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Yellow perch[1]	0.6	12	5,100 4,520-5,760
Skwala[2]	YC_1	7	9.2 7.4-12.0
Brook trout[2]	1.3	12	4,500 3,948-5,066
Bluegill[2]	0.7	17	39,000 29,732-51,157

[a]48-h EC50.
[b]Flow-through test.

NOTE: Little or no alteration in toxicity resulted when temperatures were increased from 10° to 21°C for daphnids or from 7° to 17°C for cutthroat trout and Atlantic salmon. Conversely, toxicity to brook trout and yellow perch was significantly increased (4- to 11-fold) by similar temperature increases. Increases in the pH of test solutions from 6.5 to 8.5 decreased toxicity to stoneflies by one-half. However, alkaline test solutions (pH 8.5 to 9.0) were 1.4 to 11.4 times more toxic to trout, salmon, and yellow perch than were test solutions with lower pH (6.5 to 7.5). Variations in hardness (12 to 300 ppm) did not appreciably alter toxicity to scuds, trout, or yellow perch. Test solutions aged for 3 weeks were less toxic to stonefly naiads, yet more toxic to cutthroat trout. Exposures of channel catfish for 28 days to ^{14}C-labeled carbaryl in the diet (2.8 mg/kg) or by bath (0.25 mg/L) produced whole body residues of 9 and 11 ng/g, respectively. Within 28 days, 78% of these residues were eliminated by the diet-exposed fish but only 11% by the bath-exposed fish.

CARBOFURAN

Chemical Name: 2,3-Dihydro-2,2-dimethyl-7-benzofuranyl methyl carbamate

Alternate Names: Bay 70142, CAS 1563-66-2, Curaterr, D-1221, ENT-27164, FMC 10242, Furadan, NIA-10242

Principal Use: Insecticide

Sample Description: Technical material, 99%[1]; wettable powder, 50%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Coho salmon[1]	0.6	12	530 432-650
Rainbow trout[1]	1.5	12	380 272-531
Brown trout[1]	0.5	12	560 475-660
Lake trout[1]	0.5	12	164[a] 119-226
Fathead minnow[1]	1.3	17	872 479-1,590
Channel catfish[1]	1.0	20	248 94-649
Yellow perch[1]	0.6	12	147 115-188
Bluegill[2]	0.8	18	240 186-310

[a]Flow-through toxicity test.

CARBOPHENOTHION

Chemical Name: S-(p-Chlorophenyl) methylthio 0,0-diethyl phosphorodithioate

Alternate Names: Acarithion, CAS 786-19-6, Dagadip, ENT-23709, Garrathion, Lethox, Nephocarp, R-1303, Trithion

Principal Use: Insecticide

Sample Description: Technical material, 95.3%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
G. lacustris	M	21	5.2 4.1-6.5
G. fasciatus	M	16	10-100
Palaemonetes	M	21	1.2 0.8-1.4
Channel catfish	1.1	18	6,000 5,740-6,270

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Green sunfish	0.8	18	280 186-422
Bluegill	1.1	18	13 10-16

CHLORDANE

Chemical Name: 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene

Alternate Names: Aspon, Belt, CAS 57-75-9, Chlor=dan, Chlor-Kill, Corodane, ENT-9932, Krypclor, Octachlor, Ortho-Klor, Synklor, Topiclor 20, Velsicol 1068

Principal Use: Insecticide

Sample Description: Technical material, 100% (contains 60% chlordane isomers and 40% related compounds)

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	15	20[a] 12-32
Daphnia pulex	I_1	15	24[a] 20-28
G. fasciatus	M	21	40 21-60
Pteronarcys	YC_2	15	15 9-24
Coho salmon	0.6	12	14 11-17
Cutthroat trout	1.0	12	27 24-31
Rainbow trout	1.0	12	42 37-48
Brown trout	0.6	12	11.1 9.3-13.1
Fathead minnow	0.7	17	115 62-214
Channel catfish	1.9	17	6.7 3.1-14.5
Bluegill	1.4	17	57 40-81
Largemouth bass	0.1	17	3.0 2.2-4.2

[a]48-h EC50.

NOTE: In flow-through tests, crayfish (*Orconectes*) were the least sensitive invertebrate; the 96-h LC50 was 50 μg/L and the 35-day LC50 was 31.6 μg/L. Diet quality was found to significantly alter toxicity for rainbow trout; 96-h LC50's ranged from 8.2 to 47 μg/L in fish fed different commercial and synthetic diets. Bluegills were slightly more sensitive at 13°C than at 24°C; 96-h LC50's were 83 and 93 μg/L, respectively. Toxicity of *cis*-chlordane to bluegills was about 8 times that of *trans*-chlordane; 96-h LC50 values were 7.1 and 50.5 μg/L, respectively. Residues of *cis*-chlordane were preferentially stored and magnified over *trans*-chlordane by bluegills and invertebrates in ponds treated with technical chlordane at concentrations ranging from 0.37 to 1.14 μg/L. The *cis* isomer, with a residue half-life estimated to be 46 days, persisted longer after treatment than did the *trans* isomer. The *trans* isomer was not detectable after 56 days. Invertebrate populations were significantly depressed in treated ponds—mayflies the most and midges the least.

CHLORDANE HCS-3260

Chemical Name: 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene

Alternate Names: Experimental chlordane, HCS-3260

Principal Use: Insecticide

Sample Description: Technical material, 100%[1a]; emulsifiable concentrate, 45%[2]; granular, 33.3%[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Rainbow trout[1]	1.5	12	24.9 16.1-38.5
Fathead minnow[1]	0.7	17	24.8

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Channel catfish[1]	1.8	17	45.8
Bluegill[1]	1.3	17	29.3
Rainbow trout[2]	1.5	12	24.9 16.1-38.5
Bluegill[2]	1.5	17	23.4
Rainbow trout[3]	1.5	12	20.0
Bluegill[3]	1.5	17	19.1

[a]Technical material contains 95% chlordane isomers and 5% related compounds.

CHLORENDATE

Chemical Name: Dibutyl and dimethyl esters of 1,4,5,6,7,7-hexachloro-(2.2.1)-bicyclo-5-heptene-2,3-dicarboxylic acid

Alternate Names: Not known

Principal Use: Industrial chemical: plasticizer

Sample Description: Commercial formulation, 100%: Dibutyl chlorendate[1], Dimethyl chlorendate[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Rainbow trout[1]	1.0	6	170 132-210
Fathead minnows[1]	0.7	20	>100
Channel catfish[1]	1.0	20	>100
Bluegill[1]	1.4	20	>100
Rainbow trout[2]	1.0	11	1.4 1.0-1.9
Fathead minnow[2]	1.0	20	1.7 1.3-2.3
Channel catfish[2]	1.0	20	2.0 1.6-2.5
Bluegill[2]	1.4	20	2.2 1.8-2.7

NOTE: The toxicity of dimethyl chlorendate to rainbow trout was not altered by temperature variations between 6° and 16°C. Time-independent LC50's for the four species ranged from 0.2 to 1.3 mg/L and cumulative toxicity indices were from 1.8 to 2.6, indicating a low degree of accumulative action. Flow-through tests produced a sharp increase in toxicity for dibutyl chlorendate, yielding a 30-day LC50 of 6 μg/L for rainbow trout. Although mortality did not reach time-independence during this period, a high degree of accumulative action is indicated.

CHLOROWAX

Chemical Name: Chlorinated n-paraffin of C_{10}-C_{30} chain length and average chlorine content of 35-65%

Alternate Names: Chlorinated paraffin

Principal Use: Industrial chemical: plasticizer, oil additive, flame retardant

Sample Description: Commercial formulations, 100%; Chlorowax 40[1], Chlorowax 50[2], Chlorowax 70[3], Chlorowax 500C[4], Chlorowax LV[5]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Rainbow trout[1]	0.7	10	>300
Bluegill[1]	0.5	20	>300
Rainbow trout[2]	0.7	10	>300
Bluegill[2]	0.5	20	>300
Rainbow trout[3]	0.7	10	>300
Bluegill[3]	0.5	20	>300
Rainbow trout[4]	0.5	10	>300
Fathead minnow[4]	0.8	20	>100
Channel catfish[4]	1.1	20	>300
Bluegill[4]	0.7	20	>300
Rainbow trout[5]	0.7	10	>300
Bluegill[5]	0.5	20	>300

NOTE: Variations in test temperature between 5° and 25°C did not reduce the static toxicity of Chlorowax 500C below a 96-h LC50 value of 300 mg/L. Sublethal effects were noted in flow-through tests with rainbow

trout in concentrations as low as 40 μg/L. These effects primarily involved a progressive loss of motor function to the point of immobilization after 15 and 20 days of exposure. Death, when it occurred, resulted from debilitation and other secondary effects. These sublethal effects were not present or only slightly expressed in bluegills and channel catfish. Tests with rainbow trout revealed no significant differences in susceptibility among yolk-sac fry, swim-up fry, and fingerlings. Fingerling rainbow trout fed a diet fortified with 10 ppm chlorowax 500C for 82 days showed no gross pathological effects, although they accumulated a whole body residue level of 1.1 ppm. However, growth of the treated fish was reduced.

CHLORPYRIFOS

Chemical Name: 0,0-Diethyl 0-(3,5,6-trichloro-2-pyridyl) phosphorothioate

Alternate Names: CAS 2921-88-2, Dowco 179, Dursban, Lorsban

Principal Use: Insecticide

Sample Description: Technical material, 97%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. lacustris	M	20	0.11 0.07-0.17
Pteronarcys	YC_2	15	10 7-13
Claassenia	YC_2	15	0.57 0.40-0.80
Cutthroat trout	1.4	10	18 16-22
Rainbow trout	1.4	13	7.1 6.0-8.4
Lake trout	2.3	12	98 54-180
Channel catfish	0.8	18	280 206-381
Bluegill	0.6	18	2.4 1.1-5.1

NOTE: Variations in temperature from 2° to 18°C for rainbow trout and 13° to 29°C for bluegills increased the toxicity by 2- to 15-fold. Toxicity to cutthroat trout was increased threefold when the pH was increased from 7.5 to 9.0. A similar effect was not noted in lake trout, which were much less sensitive to chlorpyrifos than were other species of fish. The TILC50 for lake trout was 45μg/L and the cumulative toxicity index was 5.5, indicating only slight cumulative toxic action.

COPPER COUNT

Chemical Name: Copper ammonium sulfate with and without sulfur

Alternate Names: Oxy-Cop-8L, Oxy-Cop-8LS

Principal Use: Fungicide

Sample Description: Spray concentrate: Copper Count S, 13%[1]; Copper Count N, 8%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Rainbow trout[1]	1.0	12	121 90-164
Fathead minnow[1]	1.1	17	154 92-255
Bluegill[1]	1.2	17	13,700 9,360-20,400
Rainbow trout[2]	1.0	12	20.4 14.8-28.2
Fathead minnow[2]	1.0	17	35.9 26.3-48.9
Bluegill[2]	1.2	17	3,280 1,860-5,750

COPPER SULFATE

Chemical Name: Copper sulfate pentahydrate

Alternate Names: Blue copperas, Bluestone, Blue vitriol, CAS 1344-73-6

Principal Use: Algicide, fungicide

Sample Description: Technical material, 100% (about 25% elemental copper)

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Rainbow trout	1.6	13	135
Goldfish	0.9	18	1,380[a] 989-1,930
Fathead minnow	1.2	18	838[a] 623-1,000
Green sunfish	1.1	18	3,510 2,570-4,800
Bluegill	1.5	18	884 707-1,100

[a]Tested in hard water, 272 ppm $CaCO_3$.

COUMAPHOS

Chemical Name: 0,0-Diethyl 0-(3-chloro-4-methyl-2-oxy(2H)1-benzopyran-7-yl) phosphorothioate

Alternate Names: Asuntol, Bay 21/199, Baymix, CAS 6012-87-9, Co-Ral, ENT-17957, Meldane, Muscatox, Rasitox

Principal Use: Insecticide

Sample Description: Technical material, 95-97%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	15	0.10[a]
G. fasciatus	M	21	0.074 0.059-0.092
Cutthroat trout	0.3	12	862 645-1,150
Rainbow trout	1.2	12	890
Lake trout	2.1	12	593 416-846
Channel catfish	1.0	18	840 620-1,140
Largemouth bass	0.9	18	1,100 1,000-1,200
Bluegill	1.3	18	340
Walleye	0.8	18	780 645-943

[a]48-h EC50.

CROTOXYPHOS

Chemical Name: Dimethyl cis-1-methyl-2-(1-phenyl=ethoxycarbonyl) vinyl phosphate

Alternate Names: CAS 7700-17-6, Ciodrin, ENT-24717, SD-4294

Principal Use: Insecticide

Sample Description: Technical material, 80%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. lacustris	M	15	49.0[a] 36.0-67.0
Pteronarcys	YC_2	15	2.2[b]
Cutthroat trout	1.0	12	51.0 28.0-91.0
Rainbow trout	1.0	17	72.4 60.0-87.4
Fathead minnow	1.0	17	11,900 9,830-14,400
Channel catfish	1.1	18	2,600 2,240-3,020
Largemouth bass	0.7	18	1,100
Bluegill	1.1	17	152 126-183

[a]24-h LC50.
[b]72-h LC50.

CRYOLITE

Chemical Name: Sodium fluoaluminate

Alternate Names: CAS 1344-75-8, ENT-24984, Kryocide

Principal Use: Insecticide

Sample Description: Technical material, 96%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Simocephalus	I_1	15	5.0[a] 3.6-6.8
Daphnia pulex	I_1	15	10.0[a] 7.6-13.0
Rainbow trout	1.8	12	47.0
Bluegill	0.8	24	> 400

[a]48-h EC50.

CYANAZINE

Chemical Name: 2-[[4-Chloro-6-(ethylamino)-S-triazin-2-yl] amino] -2-methyl-propionitrile

Alternate Names: Bladex, Payze, SD 15418, WL 19805

Principal Use: Herbicide

Sample Description: Technical material, 100%[1]; Bladex dispersible liquid, 4 lb/gal[2]; Bladex wettable powder, 80%[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. fasciatus[1]	M	15	2.0
Fathead minnow[1]	0.9	18	16.3 14.2-18.0
Channel catfish[1]	1.6	18	17.4 12.2-24.8
Fathead minnow[2]	1.2	18	17.5 15.7-19.7
Channel catfish[2]	1.6	18	11.3 9.9-12.9
Rainbow trout[3]	1.0	13	9.0 5.6-14.6
Fathead minnow[3]	1.2	18	21.3 16.5-27.4
Channel catfish[3]	1.6	18	10.4 7.7-14.0
Bluegill[3]	1.1	18	22.5

NOTE: Toxicity to fathead minnows and bluegills was not altered by a sixfold increase in water hardness.

CYTROL AMITROLE-T

Chemical Name: Mixture of aminotriazole and ammonium thiocyanate

Alternate Names: Amitril-TL, Amitrole-T

Principal Use: Herbicide

Sample Description: Liquid, 21.1%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Daphnia magna	I_1	21	18.0-56.0[a]
Asellus	M	15	> 100
Channel catfish	1.8	18	> 160
Bluegill	1.1	18	> 280

[a]48-h EC50.

NOTE: Water hardness variations from 44 to 272 ppm did not produce an observable change in toxicity to bluegills or channel catfish.

DALAPON

Chemical Name: 2,2-Dichloropropionic acid

Alternate Names: Basapon, CAS 75-99-0, Ded-Weed, Dowpon, Gramevin, Radapon, Unipon

Principal Use: Herbicide

Sample Description: Technical material, 75.6%[1]; sodium salt formulation, 86.5%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Daphnia pulex[1]	I_1	15	11.0[a] 8.2-14.7
Pteronarcys[1]	YC_1	15	>1,000
Bluegill[1]	1.0	24	105
Simocephalus[2]	I_1	15	16.0[a] 11.4-22.4

[a]48-h EC50.

NOTE: Preliminary data indicate that the LC50 of the sodium salt formulation to bluegills is 500 to 1,000 mg/L. Other tests show that 96-h LC50's for rainbow trout and goldfish exceed 100 mg/L.

D-D SOIL FUMIGANT

Chemical Name: Mixture of 1,3-dichloropane, 1,3-dichloropene, and related C_3 compounds

Alternate Names: CAS 78-87-5, D-D Mixture, Nemafene, Nemax, Vidden D

Principal Use: Nematocide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Cutthroat trout	1.0	12	1.0-10.0
Rainbow trout	1.1	12	5.5 3.6-8.4
Channel catfish	1.1	18	4.4
Largemouth bass	0.9	18	3.4
Bluegill	1.4	18	3.9
Walleye	1.3	18	1.0

DDD

Chemical Name: Dichloro diphenyl dichloroethane

Alternate Names: CAS 72-54-8, ENT-4225, Rothane, TDE

Principal Use: Insecticide

Sample Description: Technical material, 99%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	15	4.5[a] 3.1-6.6
Daphnia pulex	I_1	15	3.2[a] 2.3-4.4
Cyridopsis	M	21	45[a]
Asellus	M	21	16
G. fasciatus	M	21	0.6 0.1-1.2
Palaemonetes	M	21	2.4
Pteronarcys	YC_2	15	380 280-520
Ischnura	J	21	34
Rainbow trout	1.0	12	70 57-87
Fathead minnow	1.0	18	4,400 3,470-5,580
Channel catfish	0.8	18	1,500 1,180-1,910
Largemouth bass	0.7	18	42 34-51
Walleye	1.0	18	14 11-19

[a]48-h EC50.

DDE

Chemical Name: Dichloro diphenyl dichloroethylene

Alternate Names: None known

Principal Use: Insecticide, degradation product of DDT

Sample Description: Technical material, 99%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Rainbow trout	0.8	12	32 26-40
Atlantic salmon	0.5	12	96 52-177
Bluegill	0.9	17	240 201-286

DDT

Chemical Name: Dichloro diphenyl trichloroethane

Alternate Names: Anofax, CAS 50-29-3, Chloro= phenothane, Dedelo, Didimac, ENT-1506, Geritox, Gesapon, Gesarex, Gesarol, Gyron, Ixodex, Kopsol, Neocid, Pentachlorin, Rukseam, Zerdane

Principal Use: Insecticide

Sample Description: Technical material, 99%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Daphnia magna	I_1	15	4.7[a] 2.8-5.6
Cypridopsis	M	21	15[a]
Asellus	M	21	4.0 1.2-6.5
G. lacustris	M	21	1.0 0.7-1.5
Palaemonetes	M	21	2.3 1.3-4.9
Orconectes	J	21	0.18[b] 0.12-0.30
Pteronarcys	YC_2	15	7.0 4.9-9.9
Isoperla	J	15	1.2 0.3-4.9
Pentaneura	J	21	1.5
Chaoborus	J	15	7.4
Coho salmon	1.0	13	4.0 3.0-6.0
Rainbow trout	1.0	13	8.7 6.8-11.4
Northern pike	0.7	18	2.7
Fathead minnow	1.2	18	12.2 10.0-15.4
Black bullhead	1.2	18	4.8 3.4-6.8
Channel catfish	1.5	18	21.5 17.7-26.1
Bluegill	1.5	18	8.6 6.2-12.0
Largemouth bass	0.8	18	1.5 0.9-2.4
Yellow perch	1.4	18	9.0 7.0-11.0
Walleye	1.4	18	2.9 2.4-3.5

[a]48-h EC50.
[b]Tested in well water.

NOTE: The *p,p'*-isomer appears to be more toxic than the *o,p*-isomer to invertebrates. DDE is one of the primary metabolites of DDT in invertebrates and produces biological effects similar to those of the parent compound. DDT rapidly accumulates in invertebrates to several thousand times the exposure level in concentrations as low as 80 ng/L. The residue half-life was 7 days in *Daphnia*. A 60% reproductive impairment was observed in *Daphnia* at 100 μg/L. The 96-h LC50 for 19 species of fish ranged from 1.8 to 22 μg/L. Toxicity to bluegills increased slightly when temperatures were increased from 7° to 29°C. No difference in toxicity was noted between hard and soft water. Continuous exposures for as long as 30 days produced TILC50's of 0.6 μg/L for channel catfish and 0.04 μg/L for bluegills. Cumulative toxicity indices were 90 for channel catfish and 215 for bluegills, indicating a high level of accumulative action. Although isomers tested were toxic to rainbow trout sac fry, the more polar compounds appeared more toxic than the less polar ones. DDT detrimentally altered several physiological characteristics, including normal ratios of serum amino acids, thyroid activity, and the ability to with-

stand stress. Food seems to be more important than water as a source of body residues. Although DDT was not observed to affect gonad maturation, the mortality of fry produced by treated parents was high, especially during the terminal stages of yolk absorption.

DEF

Chemical Name: S,S,S,-Tributyl phosphorotrithioate

Alternate Names: CAS 78-48-8, De-Green, E-Z-OffD, Fos-Fall "A," Ortho Phosphate Defoliant

Principal Use: Defoliant herbicide

Sample Description: Technical material, 95%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
G. fasciatus	M	21	100 68-150
Pteronarcys	YC_2	15	2,100 1,500-2,900
Rainbow trout	0.6	13	660 560-750
Bluegill	0.6	18	620 390-975

DEMETON

Chemical Name: Mixture of 0,0-diethyl 0-[2-(ethyl=thio)ethyl] phosphorothioate and 0,0-diethyl S-[2-ethylthio)ethyl] phosphorothioate

Alternate Names: Systox

Principal Use: Systemic insecticide-acaricide

Sample Description: Technical material, 94%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Daphnia pulex	I_1	15	14.0[a] 10.4-18.7
G. fasciatus	M	15	78 42-140
Rainbow trout	1.4	12	600 483-745
Channel catfish	1.2	18	3,700 3,410-4,020
Largemouth bass	0.7	18	148[b] 136-162
Walleye	1.3	18	230[b] 203-260

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

DIAZINON

Chemical Name: 0,0-Diethyl 0-(2-isopropyl-6-methyl-4-pryimidinyl) phosphorothioate

Alternate Names: AG-500, Alfa-tox, Basudin, CAS 333-41-5, Dazzel, Diazajet, Diazide, Diazol, ENT-19507, Gardentox, Neocidol, Nucidol

Principal Use: Insecticide

Sample Description: Technical material, 89%[1], 92%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Simocephalus[1]	I_1	15	1.4[a] 1.2-1.6
Daphnia pulex[1]	I_1	15	0.8[a] 0.6-1.1
G. fasciatus[1]	M	21	0.20 0.15-0.28
Pteronarcys[1]	YC_2	15	25 20-30
Rainbow trout[1]	1.2	13	90
Cutthroat trout[2]	2.0	12	1,700[b] 1,390-2,090
Lake trout[2]	3.2	12	602[b] 400-906

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Bluegill[2]	1.0	18	168 120-220

[a]48-h EC50.
[b]Tested in hard water, 162 ppm $CaCO_3$.

DICAMBIA

Chemical Name: 2-Methoxy-3,6-dichlorobenzoic acid

Alternate Names: Banex, Banvel, CAS 1918-00-9, Dianet, Mediben

Principal Use: Herbicide

Sample Description: Technical material, 88%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Daphnia magna	I_1	21	>100[a,b]
Asellus	M	15	>100[b]
G. fasciatus	M	15	>100[b]
Palaemonetes	M	21	>56[b]
Rainbow trout	0.8	12	28
Bluegill	0.9	12	>50

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Rainbow trout[1]	1.0	13	6.3 4.7-8.4
Goldfish[1]	0.9	18	7.8 4.8-12.6
Fathead minnow[1]	0.8	18	6.0 4.0-9.1
Green sunfish[1]	1.1	18	5.7 3.6-8.9
Bluegill[1]	1.5	18	8.3 6.0-11.6
Simocephalus[2]	I_1	15	5.8[a] 4.8-8.4
Daphnia pulex[2]	I_1	15	3.7 3.3-4.2
Asellus[2]	M	15	35
G. lacustris[2]	M	21	11 8-15
Pteronarcys[2]	YC_2	15	7.0 5.5-9.0
Rainbow trout[3]	2.6	12	140
Bluegill[3]	1.0	24	120

[a]48-h EC50.

NOTE: Variations in water hardness from 44 to 272 ppm did not alter the toxicity to fish. In the metabolite, 2,6-dichlorobenzoic acid, 96-h LC50 values exceeded 100 mg/L for rainbow trout and bluegills.

DICHLOBENIL

Chemical Name: 2,6-Dichlorobenzonitrile

Alternate Names: CAS 1194-65-6, Casoron, 2,6-DBN, DU-SPREX, ENT-26665, NIA 5996.

Principal Use: Herbicide

Sample Description: Technical material, 98.9%[1]; wettable powder, 50%[2]; metabolite (2,6-Dichloro= benzoic acid), technical material, 100%[3]

DICHLOFENTHION

Chemical Name: 0,0-Diethyl 0-(2,4 dichlorophenyl) phosphorothioate

Alternate Names: CAS 97-17-6, dichlorofenthion, ENT-17470, Hexa-Nema, Mobilawn, Nemacide, Tri-VC 13, VC 13, V-C 1-13

Principal Use: Nematocide, insecticide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
G. fasciatus	M	15	110 80-150
G. lacustris	M	15	56 40-78
Pteronarcys	YC_2	15	4.1 3.4-5.0
Cutthroat trout	1.0	13	640 550-740
Rainbow trout	0.9	13	1,250 1,040-1,500
Channel catfish	1.1	18	4,800 4,400-5,240
Bluegill	1.3	18	1,230 1,070-1,390
Largemouth bass	0.7	18	840[a]
Walleye	1.3	18	800[a] 730-880

[a]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Variations in water hardness from 44 to 272 ppm did not alter the toxicity to scuds or rainbow trout.

DICHLOROPROPENE

Chemical Name: 1,3-Dichloropropene

Alternate Names: Telone

Principal Use: Nematocide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Daphnia magna	I_1	21	90[a] 63-129
Fathead minnow	0.9	18	4,100 3,390-4,970
Largemouth bass	1.0	18	3,650[b] 3,520-3,780
Walleye	1.3	18	1,080 990-1,180

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

DICHLORVOS

Chemical Name: 2,2-Dichlorovinyl dimethyl phosphate

Alternate Names: CAS 62-73-7, DDVF, DDVP, Dederap, Dichlorphos, Divipan, ENT-20738, Herkol, Mafu, Marvex, Nogos, No-Pest, Nuvan, Oko, Phosvit, Vapona

Principal Use: Insecticide

Sample Description: Technical material, 100%[1], 93%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Simocephalus[1]	I_1	21	0.28[a] 0.16-0.47
Daphnia pulex[1]	I_1	15	0.07[a] 0.05-0.09
G. lacustris[1]	M	21	0.50 0.37-0.68
Pteronarcys[1]	YC_2	15	0.10 0.07-0.15
Cutthroat trout[1]	2.5	12	170 143-203
Lake trout[1]	0.3	12	187[b] 110-320
Mosquitofish[1]	0.2	17	5,270 2,660-10,400
Bluegill[1]	1.5	18	869 700-1,080
Fathead minnow[2]	0.7	17	11,600 7,830-17,200

[a]48-h EC50.
[b]Tested in hard water, 162 ppm $CaCO_3$.

NOTE: Variations in water hardness from 44 to 162 ppm and pH from 6.0 to 9.0 did not alter the toxicity to cutthroat or lake trout.

DICOFOL

Chemical Name: 1,1-Bis(4-chlorophenyl)-2,2,2-trichloroethanol

Alternate Names: Acarin, CAS 115-32-2, ENT-23648, FW-293, Mitigan, Kelthane

Principal Use: Acaricide

Sample Description: Technical material, 100%[1]; 74.4%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Pteronarcys[1]	YC_2	15	650 280-1,360
Channel catfish[1]	0.8	18	360 290-447
Bluegill[1]	1.0	18	520 42-642
Largemouth bass[1]	0.8	18	395
Cutthroat trout[2]	0.1	12	53 41-68
Lake trout[2]	1.2	12	87 53-142

DICROTOPHOS

Chemical Name: Dimethyl cis-2-dimethyl-carbamoyl-1-methylvinyl phosphate

Alternate Names: Bidrin, Carbicron, CAS 141-66-2, CIBA 709, Ektafos, ENT-24482, SD 3562

Principal Use: Insecticide

Sample Description: Technical material: 80%[1], 90%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Simocephalus[1]	I_1	15	0.27[a] 0.21-0.32
G. fasciatus[1]	M	21	2.6 2.1-3.2
G. lacustris[1]	M	21	0.54 0.40-0.73
Pteronarcys[1]	YC_2	15	0.43 0.34-0.54
Bluegill[1]	1.0	20	24.2 14.3-41.1
Rainbow trout[2]	1.0	13	6.3
Channel catfish[2]	1.4	18	7.7 4.0-13.8

[a]48-h EC50.

DIELDRIN

Chemical Name: 1,2,3,4,10,10-Hexachloro-exo-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo-exo-5,8-dimethanonaphthalene

Alternate Names: Alvit, CAS 60-57-1, Compound 47, Dieldrine, Dieldrite, ENT-16225, HEOD, Octalox, Panoram D-31

Principal Use: Insecticide

Sample Description: Technical material, 85% HEOD[1]; photo-dieldrin 98%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Simocephalus[1]	I_1	15	240[a] 200-280
Daphnia pulex[1]	I_1	15	190[a] 170-210
Asellus[1]	M	21	5.0 3.2-10.0
G. fasciatus[1]	M	21	640 460-880

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Orconectes[1]	M	21	740 680-1,200
Pteronarcys[1]	YC_2	15	0.5 0.4-0.7
Pteronarcella[1]	YC_1	15	0.5 0.4-0.7
Claassenia[1]	YC_2	15	0.6 0.4-0.8
Ischnura[1]	J	24	12
Cutthroat trout[1]	1.1	9	6.0[b] 4.6-8.0
Rainbow trout[1]	1.4	13	1.2 0.9-1.7
Goldfish[1]	1.0	18	1.8 1.2-2.8
Fathead minnow[1]	0.6	18	3.8 3.1-4.6
Channel catfish[1]	1.4	18	4.5 2.5-7.9
Bluegill[1]	1.3	18	3.1 2.1-4.6
Largemouth bass[1]	2.5	18	3.5[b] 2.7-4.5
Cutthroat trout[2]	1.3	8	12[b] 11-14
Channel catfish[2]	1.4	18	19 13-27
Bluegill[2]	1.4	18	11 9.3-13

[a]48-h EC50.
[b]Tested in hard water, 162 ppm $CaCO_3$.

NOTE: Dieldrin rapidly accumulates in invertebrates from a few hundred to several thousand times the exposure level in concentrations as low as 50 ng/L. Plateau levels were reached within 3 days in *Daphnia* and the residue half-life was 2.5 days. Although concentrations of 560 μg/L were not acutely toxic, midge larvae were unable to survive beyond 14 days in concentrations of 180 μg/L, and less than half were able to complete metamorphosis at 5.6 μg/L. The toxicity of dieldrin approximately doubled for rainbow trout and bluegills when temperatures were increased from 2° to 13°C and from 7° to 29°C, respectively. Water hardness did not appear to affect toxicity to fish or invertebrates. Dietary dieldrin significantly altered several physiological and biochemical factors, including serum amino acid composition, adrenal and thyroid function, ammonia detoxification, and phenylketo acid metabolism. The ability to withstand stress was significantly reduced. Whole body residues in treated fish were similar to those in wild fish.

DIFLUBENZURON

Chemical Name: N-[[(4-Chlorophenyl)amino] carbonyl] -2,6-difluorobenzamide

Alternate Names: Dimilin, TH-6040, PH-6040, OMS 1804, ENT-29054

Principal Use: Insecticide

Sample Description: Technical material, 95%[1]; wettable powder, 25%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. pseudolimnaeus[1]	M	12	0.030 0.021-0.043
Rainbow trout[1]	1.0	10	>100
Brook trout[1]	0.6	7	>50
Channel catfish[1]	2.0	22	>100
Bluegill[1]	0.3	20	>100
Yellow perch[1]	0.6	12	>25
Daphnia magna[2]	I_1	22	0.016[a] 0.012-0.020
G. pseudolimnaeus[2]	M	12	0.025 0.016-0.040
Chironomus[2]	I_4	22	0.56[a] 0.47-0.67
Cutthroat trout[2]	1.0	12	57 48-67
Rainbow trout[2]	1.5	10	240 201-286

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Fathead minnow[a]	0.9	20	>100
Channel catfish[a]	2.2	22	>100
Bluegill[a]	0.5	20	>100

[a]48-h EC50.

NOTE: Alterations in test conditions such as pH, temperature, and hardness did not affect the toxicity of diflubenzuron. No adverse effects were observed when eyed eggs and fingerlings of rainbow trout were exposed in a flow-through system for 30 days to concentrations of technical grade diflubenzuron of 0.029 to 0.30 mg/L.

DIMETHOATE

Chemical Name: 0,0-Dimethyl S-(N-methylcarbamoylmethyl) phosphorodithioate

Alternate Names: AC-12880, Asthoate, CAS 60-51-5, Cygon, Daphene, De-Fend, Demos-L40, Dimethogen, Diostop, ENT-24650, Fosfamid, Fosthion MM, L-395, Le-Kuo, Perfekthion, Rebelate, Rogor, Roxion, Trimethion

Principal Use: Insecticide, acaricide

Sample Description: Technical material, 97.4%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. lacustris	M	21	0.20 0.15-0.27
Pteronarcys	YC_2	21	0.043 0.036-0.051
Rainbow trout	1.5	13	6.2 4.1-9.3
Bluegill	0.3	24	6.0

NOTE: Variation in water hardness did not affect the toxicity to rainbow trout.

DIMETHRIN

Chemical Name: 2,4-Dimethylbenzyl-2,2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate.

Alternate Names: CAS 70-38-2, Dimethrine, ENT-21170.

Principal Use: Insecticide (synthetic pyrethroid)

Sample Description: Technical material, 100%.

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Fathead minnow	1.4	13	62[a] 51-76
Channel catfish	F	12	1,140 1,018-1,275
Bluegill	0.5	12	38 28-50
Yellow perch	1.4	12	28 22-37

[a]Flow-through toxicity test.

NOTE: Toxicity to bluegills did not change significantly with variations in pH from 6.5 to 9.5 or with water hardness from 12 to 300 ppm. A temperature increase from 12° to 22°C decreased the toxicity to bluegills and increased the 96-h LC50 from 21 μg/L to 85 μg/L. No change in toxicity was noted in 1-week aqueous degradation tests at pH 6.5, 7.5, and 9.5.

DINITRAMINE

Chemical Name: N, $^3N^3$-Diethyl-2,4-dinitro-6-(trifluoromethyl)-1,3-phenylenediamine

Alternate Names: Cobex, Cobexo, USB-3584

Principal Use: Herbicide

Sample Description: Technical material, 99.2%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Coho salmon	0.9	12	600 503-715

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Rainbow trout	0.3	12	820 625-1,075
Brown trout	0.7	12	590 510-682
Lake trout	0.6	12	920 776-1,090
Carp	1.0	12	1,180 1,020-1,360
Fathead minnow	0.8	12	1,440 1,070-1,930
Channel catfish	0.8	12	1,370 1,040-1,810
Bluegill	1.4	12	1,520 1,140-2,020
Yellow perch	0.8	12	1,000 870-1,150

DINITROCRESOL

Chemical Name: 4,6-Dinitro-o-cresol

Alternate Names: CAS 534-52-1, DNC, Elgetol 30, Nitrador, Selinon, Trifocide, DNOC

Principal Use: Insecticide, fungicide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Daphnia pulex	I_1	21	145[a] 100-210
G. fasciatus	M	21	1,100 730-1,600
Pteronarcys	YC_2	15	320 230-450
Rainbow trout	1.2	13	66 37-117
Bluegill	1.0	18	360 331-392

[a]48-h EC50.

DINOCAP

Chemical Name: 2,4-Dinitro-6-octyl phenyl crotonate; 2,6-dinitro-4-octyl phenyl crotonate and nitrooctyl= phenols. (A mixture of 1-methylheptyl, 1-ethylhexyl, and 1-propylpentyl isomers of the octyl 8-carbon chain.)

Alternate Names: Arathane, CAS 131-72-6, Croto= thane, ENT-24727, Iscothane, Karathane, Mildex

Principal Use: Fungicide, acaricide

Sample Description: Technical material, 78%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
G. fasciatus	M	15	75[a] 57-99
Rainbow trout	1.1	13	15 14-16
Goldfish	1.0	18	33 25-43
Bluegill	0.9	18	20 19-21

[a]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: A sixfold increase in water hardness did not appreciably alter the toxicity to rainbow trout or bluegills.

DINOSEB

Chemical Name: 2-(Sec-butyl)-4,6-dinitrophenol

Alternate Names: Basanite, CAS 88-85-7, Chemox, Dinitrobutylphenol, DN-289, DNBP, Dow General Weed Killer, Elgetol 318, ENT-1122, Kiloseb, Nitropone C, Premerge, Subitex

Principal Use: Herbicide

Sample Description: Technical material, 95.8%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Cutthroat trout	0.3	10	67 56-81
Lake trout	0.3	10	44 38-51

NOTE: A decrease in temperature from 10° to 5°C produced no change in toxicity to cutthroat trout; however, LC50's were 3 times higher for lake trout. A temperature increase from 10° to 15°C produced no substantial change in toxicity to either species. An increase in pH from 6.5 to 8.5 increased LC50 values by as much as 30-fold. Aging of test solutions caused a twofold increase in LC50 values after 1 week but no change in toxicity was observed in solutions aged 4 weeks. Flow-through tests produced TILC50's of 54 μg/L for lake trout and 102 μg/L for cutthroat trout. Cumulative toxicity indices were 1.5 for both species, indicating little cumulative toxic action.

DIOXATHION

Chemical Name: 2,3-p-Dioxanedithiol S,S-bis(0,0-diethyl phosphorodithioate)

Alternate Names: CAS 78-34-2, Delnav, ENT-22897, Hercules AC528, Navadel, Ruphos

Principal Use: Insecticide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Daphnia magna	I_1	2	0.35[a] 0.25-0.49
G. fasciatus	M	15	8.6 5.4-13.8
Cutthroat trout	1.0	13	110[b] 98-120
Rainbow trout	1.4	13	69[b] 59-81
Largemouth bass	1.3	18	22[b] 20-25

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

DIPHENAMID

Chemical Name: N,N-Dimethyl-2,2-diphenylacetamide

Alternate Names: CAS 957-51-7, Dymid, Enide, ENT-28567

Principal Use: Herbicide

Sample Description: Technical material, 100%[1]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Daphnia magna	I_1	21	58[a] 43-79
C. vidua	M	21	51[a] 37-71
Asellus	M	15	>100
G. fasciatus	M	15	>100
Palaemonetes	M	21	32 29-35
Goldfish	1.0	18	53 42-68
Fathead minnow	0.9	18	48 38-60

[a]48-h EC50.

DIQUAT

Chemical Name: 6,7-Dihydrodipyrido [1,2-a:2',1'-c] pyrazinediium dibromide, monohydrate

Alternate Names: Aquacide, CAS 85-00-7, Deiquat, Dextrone, FB12, Reglon, Reglone

Principal Use: Herbicide

Sample Description: Liquid formulation, 35.3%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. fasciatus	M	15	>100[a]
Black bullhead	0.8	12	170 113-255

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Bluegill	1.3	12	245 175-342
Yellow perch	0.6	12	60 39-93

[a]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Variations in temperature from 7° to 22°C did not alter the toxicity to bluegills. A change in pH to 9.5 increased toxicity twofold, whereas an increase in hardness from 40 to 300 ppm decreased toxicity by one-half to one-third. Similar pH effects were noted in black bullheads and yellow perch.

DISULFOTON

Chemical Name: 0,0'Diethyl S-[2-(ethylthio) ethyl] phosphorodithioate

Alternate Names: Bay 19639, CAS 298-04-4; Di-Syston, Dithiodemeton, Dithiosystox, ENT-23427, Frumin AL, M-74, Solvirex, Thiodemeton

Principal Use: Insecticide, acaricide

Sample Description: Technical material, 98%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
G. fasciatus	M	15	52 49-58
Palaemonetes	M	21	3.9[a] 2.7-5.7
Pteronarcys	YC_2	15	5.0 3.7-6.7
Rainbow trout	1.2	13	1,850
Fathead minnow	1.0	18	4,300
Channel catfish	0.8	18	4,700
Bluegill	0.3	24	300
Largemouth bass	0.7	18	60

[a]Tested in hard water, 272 ppm $CaCO_3$.

DIURON

Chemical Name: 3-(3,4-Dichlorophenyl)-1,1-dimethyl= urea

Alternate Names: CAS 330-54-1, Dichlorofenidim, DCMU, Di-on, Diurex, DMU, Karmex, Marmer, Urox D, Vonduron

Principal Use: Herbicide

Sample Description: Technical material, 95%[1]; wettable powder, 80%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Simocephalus[1]	I_1	15	2.0[a] 1.4-2.8
Daphnia pulex[1]	I_1	15	1.4[a] 1.0-1.9
Asellus[1]	M	15	15.5 7.2-33.4
G. fasciatus[1]	M	21	0.16 0.13-0.19
Pteronarcys[1]	YC_2	15	1.2 0.9-1.7
Cutthroat trout[1]	0.3	10	1.4 1.1-1.9
Rainbow trout[1]	0.8	13	4.9 4.1-5.9
Lake trout[1]	1.5	10	2.7 2.4-3.0
Bluegill[1]	0.8	18	8.2 7.4-9.1
Rainbow trout[2]	1.2	13	16 11-23

[a]48-h EC50.

NOTE: Increases in temperature from 2° to 18°C for trout and 7° to 24°C for bluegills had little effect on acute toxicity. Changes in pH from 6.5 to 8.5 and hardness from 44 to 300 ppm did not alter toxicity to trout or bluegills. A substantial decrease in toxicity was noted in test solutions aged from 1 to 4 weeks; LC50 values were as much as ninefold higher. The largest change seemed to occur between 2 and 3 weeks of

aging. Flow-through tests produced TILC50's of 0.14 mg/L for rainbow trout and 0.50 mg/L for cutthroat trout. Cumulative toxicity indices were 12.3 and 3.7, respectively, indicating a moderate degree of cumulative toxic action in rainbow trout.

d-TRANS ALLETHRIN

Chemical Name: d1-2-Allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one ester of d-trans chrysanthemum monocarboxylic acid

Alternate Names: Allyl homolog of cinerin I, Bio= allethrin

Principal Use: Insecticide (synthetic pyrethroid)

Sample Description: Technical material, 90%

SUMMARY OF ACUTE TOXICITY[a]

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Coho salmon	1.0	12	2.6 1.8-3.5
Steelhead	0.2	12	9.7 8.0-11.6
Lake trout	F	12	16.0 14.3-17.8
Northern pike	F	12	3.3 3.0-3.6
Fathead minnow	0.8	12	48.0 34.9-66.0
White sucker	F	12	12.4 10.5-14.6
Channel catfish	0.9	12	>30.0
Bluegill	0.8	12	22.5 20.5-24.7
Smallmouth bass	F	12	7.7 5.8-10.2
Largemouth bass	F	12	>12.0
Yellow perch	F	12	9.9 9.2-10.7

[a]All data from flow-through toxicity tests.

NOTE: Variations in test conditions did not substantially alter toxicity to bluegills. When temperature was increased from 12° to 22°C, pH from 6.5 to 9.5, and hardness from 12 to 300 ppm in static tests, 96-h LC50 values ranged from 35 to 60 μg/L. After aqueous degradation for 1 week at pH 6.5, 7.5, and 9.5, 96-h LC50 values were 40, 34, and 74 μg/L, indicating loss of toxicity at the highest pH.

DU-TER

Chemical Name: Triphenyltin hydroxide

Alternate Names: CAS 76-87-9, ENT-28009, Fenoloro, Fentin hydroxide, TPTH, TPTOH

Principal Use: Fungicide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. fasciatus	M	15	66 42-103
Rainbow trout	0.8	13	<28
Goldfish	1.0	18	62 49-75
Fathead minnow	0.9	18	20 9-42
Bluegill	0.5	24	23 19-28

DYRENE

Chemical Name: 2,4-Dichloro-6-(o-chloroanilino)-s-triazine

Alternate Names: Anilazine, CAS 101-05-3, Direz, Kemate, Triasyn

Principal Use: Fungicide

Sample Description: Technical material, 95.5%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. fasciatus	M	15	0.27 0.21-0.35

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Rainbow trout	1.5	13	140 122-161
Channel catfish	0.7	18	240 110-550
Bluegill	1.1	18	320 142-735
Redear sunfish	2.5	18	<140

ENDOSULFAN

Chemical Name: 6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3-oxide

Alternate Names: CAS 115-29-7, Chlorothiepin, Cyclodan, ENT-23979, FMC-5462, HOE-2671, Insectophene, Kop-Thiodan, Malix, Thifor, Thimul, Thiodan, Thionex

Principal Use: Insecticide

Sample Description: Technical material, 96%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
G. lacustris	M	21	5.8 4.1-8.1
Pteronarcys	YC_2	15	2.3 1.6-3.3
Rainbow trout	1.3	13	1.4 1.2-1.6
Fathead minnow	0.7	18	1.5 1.1-2.0
Channel catfish	1.7	18	1.5 1.3-1.7
Bluegill	1.0	18	1.2 0.9-1.7

ENDOTHALL

Chemical Name: 7-Oxabyclo (2.2.1) heptane-2,3-dicar= boxylic acid

Alternate Names: Accelerate, Aquathol, CAS 129-67-9, Des-i-cate, Endothal, Herbicide 272, Herbicide 273, Herbicide 282, Herbicide 283, Hydout, Hydrothol, Niagrathal, Tri-Endothal

Principal Use: Herbicide

Sample Description: Aquathol K, 40.3%[1]; copper endothall, 25%[2]; Des-i-cate, 5.5%[3]; Herbicide 282, 67.9%[4]; Hydrathol 47, 66.7%[5]; Hydrothol 191, 53%[6]; potassium endothall, 40.3%[7]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Coho salmon[1]	1.4	13	>100
Rainbow trout[1]	1.2	13	230 187-283
Channel catfish[1]	0.4	12	>150
Bluegill[1]	1.3	22	343 308-383
Rainbow trout[2]	1.2	13	0.14 0.08-0.24
Green sunfish[2]	1.1	18	1.3 1.00-1.80
Bluegill[2]	1.2	18	3.33 2.51-4.40
Rainbow trout[3]	2.0	13	0.31
Rainbow trout[4]	1.2	13	0.98
Bluegill[4]	0.5	24	1.20
G. fasciatus[5]	M	15	0.51 0.28-0.95
G. lacustris[6]	M	21	0.50 0.37-0.67
Palaemonetes[6]	M	21	0.05 0.02-0.12
Pteronarcys[6]	YC_2	15	3.25[a]
Cutthroat trout[6]	1.0	10	0.18 0.12-0.27
Rainbow trout[6]	1.2	13	0.56
Fathead minnow[6]	0.6	18	0.75

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Channel catfish[a]	0.3	18	0.49
Bluegill[a]	0.5	24	0.94
G. fasciatus[7]	M	21	313
Rainbow trout[7]	1.2	13	450
Bluegill[7]	0.3	24	440

[a]48-h LC50.

NOTE: Toxicity of Aquathol K increased with increases in test temperatures; the 96-h LC50 decreased from 1,740 mg/L to 343 mg/L when the temperature was increased from 7° to 22°C. However, no change in toxicity was observed when pH varied between 6.5 and 9.5. Copper endothall was slightly more toxic to green sunfish in soft water than in hard water; 96-h LC50's were 1.3 and 4.3 mg/L, respectively.

ENDRIN

Chemical Name: 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo,endo-5,8-dimethanonaphthalene

Alternate Names: CAS 72-20-8, Compound 269, ENT-17251, Hexadrin, Mendrin

Principal Use: Insecticide

Sample Description: Technical material, 99%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	21	45[a] 35-58
Daphnia magna	I_1	21	4.2[a]
Daphnia pulex	I_1	15	20[a] 13-30
Cypridopsis	M	21	1.8[a]
Asellus	M	15	1.5 0.9-3.7
G. lacustris	M	21	3.0 2.0-4.5
G. fasciatus	M	21	4.3 3.5-5.2
Orconectes	I_E	21	3.2[b] 1.6-7.5
Palaemonetes	M	21	3.2[b] 1.8-5.8
Pteronarcella	N	15	0.54 0.40-0.72
Pteronarcys	YC_2	15	0.25 0.20-0.31
Claassenia	YC_2	15	0.08 0.06-0.09
Acroneuria	YC_2	15	>0.18
Hexagenia	I_1	15	62 41-95
Baetis	J	15	0.90 0.57-1.4
Ischnura	J	21	2.4 1.5-3.8
Tipula	J	15	12 7.3-18
Atherix	J	15	4.6 3.1-6.8
Rainbow trout	1.0	13	0.75 0.64-0.88
Goldfish	F	12	0.44[c] 0.29-0.66
Carp	F	12	0.32[c] 0.25-0.41
Fathead minnow	1.2	18	1.8 1.0-3.0
Black bullhead	1.5	24	1.1 1.0-1.3
Channel catfish	1.4	24	0.32 0.29-0.35
Mosquitofish	0.6	17	1.1 0.4-3.4

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Bluegill	1.5	18	0.61 0.50-0.74
Largemouth bass	2.5	18	0.31 0.25-0.39
Yellow perch	F	12	0.15[c] 0.12-0.18

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.
[c]Flow-through toxicity test.

NOTE: A wide variation in 96-h LC50's was observed in 18 species of invertebrates tested, ranging from 7 parts per trillion for *Tipula* to 320 ppb for mature crayfish. Most values ranged from 0.5 to 10 ppb. Comparatively, endrin was more toxic to fish than to invertebrates and showed less variation in LC50's. Effects of pH and water hardness on toxicity were not appreciable, and increases in temperature from 2° to 29°C only doubled the toxicity to rainbow trout and bluegills. Endrin residues accumulated rapidly in fish exposed by diet or bath, reaching levels of 400 to 2,000 times the exposure level. Mortality occurred in channel catfish when whole body residues exceeded 0.5 ppm. Several physiological and biochemical variables were altered by endrin, including growth and reproductive development, adrenal and thyroid function, serum electrolyte balance and osmoregulation, glycogen metabolism, serum protein composition, resistance to stress, and behavioral patterns.

EPN

Chemical Name: 0-Ethyl-0-(p-nitrophenyl) phenyl phosphonothioate

Alternate Names: CAS 2104-64-5, ENT-17798

Principal Use: Acaricide, insecticide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. fasciatus	M	15	6.8 3.5-13.3
Palaemonetes	M	21	0.6[a] 0.4-0.8
Pteronarcys	YC_2	15	7.4 5.5-10.0
Cutthroat trout	1.0	13	160 150-170
Rainbow trout	1.0	13	210[a] 192-230
Channel catfish	1.1	18	420 351-502
Bluegill	1.0	18	110 85-141
Largemouth bass	1.0	18	380[a] 346-417
Walleye	0.8	18	350[a] 333-368

[a]Tested in hard water, 272 ppm $CaCO_3$.

EPTC

Chemical Name: S-Ethyl dipropylthiocarbamate

Alternate Names: CAS 759-94-4, Eptam, Eradicane, R-1608

Principal Use: Herbicide

Sample Description: Technical material, 98%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Asellus	M	15	23[a] 15-36
G. fasciatus	M	15	66[a]
Cutthroat trout	1.0	10	17 15-19
Lake trout	0.9	10	16.2 14.8-17.7

[a]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Variations in temperature (5° to 15°C), pH (6.5 to 8.5), or water hardness (44 to 300 ppm) did not alter the toxicity to cutthroat trout or lake trout, except for a slight increase in toxicity to cutthroat trout at pH

6.5. The TILC50 for cutthroat trout was 7.2 mg/L and the cumulative toxicity index was 3.2, indicating only slight cumulative toxic action.

ETHION

Chemical Name: 0,0,0',0'-Tetraethyl S,S'-methylene biphosphorodithioate

Alternate Names: CAS 563-12-2, Diethion, ENT-24105, NIA-1240, Nialate

Principal Use: Acaricide, insecticide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	15	4.7[a] 3.2-6.9
Daphnia magna	I_1	21	0.056[a] 0.038-0.082
Daphnia pulex	I_1	15	2.8[a] 1.5-5.3
G. fasciatus	M	21	1.8 1.3-2.4
Palaemonetes	M	15	5.6[b] 3.2-9.8
Pteronarcys	YC_2	15	2.8 1.8-4.2
Cutthroat trout	1.0	13	720 580-900
Rainbow trout	1.0	13	500[b] 355-705
Fathead minnow	F	18	720
Channel catfish	1.2	18	7,600 6,390-9,030
Bluegill	0.8	18	210 141-313
Largemouth bass	2.8	18	173[b] 158-190

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Variations in water hardness (44 to 272 ppm) did not alter toxicity to cutthroat trout.

ETHOFUMESATE

Chemical Name: 2-Ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate

Alternate Names: Fluoromidine, NC-4780, Nortron

Principal Use: Herbicide

Sample Description: Technical material, 96%[1]; Formulation, 25%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Rainbow trout[1]	1.0	12	0.8 0.5-1.0
Bluegill[1]	1.5	18	2.5 1.0-5.0
Rainbow trout[2]	1.0	12	0.5 0.1-1.0
Bluegill[2]	1.5	18	6.5 3.5-9.0

FENAC

Chemical Name: 2,3,6-Trichlorophenyl acetic acid

Alternate Names: CAS 85-34-7, Chlorfenac, Kanepar, 2,3,6-TCA, Tri-fen, Trifene

Principal Use: Herbicide

Sample Description: Technical material, 50%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Simocephalus	I_1	15	6.6[a] 4.5-9.6
Daphnia pulex	I_1	15	4.5[a] 3.2-6.3
G. fasciatus	M	15	> 100

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Pteronarcys	YC_2	15	60 50-70
Rainbow trout	1.6	13	11
Bluegill	0.9	24	41
Redear sunfish	3.0	24	>12

[a]48-h EC50.

FENAMINOSULF

Chemical Name: p-(Dimethylamino) benzenediazo sodium sulfonate

Alternate Names: Bay 6027, Bay 22555, CAS 140-56-7, Dexon, Diazoben, ENT-16841

Principal Use: Fungicide

Sample Description: Technical material, 89%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. fasciatus	M	21	3.7 2.7-5.0
Pteronarcys	YC_2	15	24 20-28
Coho salmon	1.4	13	>100
Rainbow trout	1.5	13	>60
Bluegill	0.5	18	85.0 72.7-99.3

FENITROTHION

Chemical Name: 0,0-Dimethyl 0-(4-nitro-m-tolyl) phosphorothioate

Alternate Names: Accothion, Agrothion, Bay 41831, CAS 122-14-5, ENT-25715, Folithion, MEP, Methyl-nitrophos, Novathion, Nuvanol, Sumithion, Cytel, S-5660

Principal Use: Insecticide

Sample Description: Technical material, 95%[1]; liquid concentrate, 87.3%[2]; wettable powder, 40%[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Daphnia magna[1]	I_1	21	0.011[a] 0.005-0.021
G. fasciatus[1]	M	15	0.003[b]
Pteronarcys[1]	YC_1	15	0.004 0.003-0.006
Coho salmon[1]	0.6	12	5.0 4.1-6.1
Cutthroat trout[1]	0.7	10	3.6[b] 2.7-4.9
Rainbow trout[1]	1.5	10	2.4 2.0-2.9
Goldfish[1]	1.0	18	2.8 1.6-4.7
Fathead minnow[1]	1.0	20	3.2 2.4-4.2
Channel catfish[1]	4.7	20	4.3 3.6-5.1
Green sunfish[1]	0.8	18	4.1 2.9-5.9
Bluegill[1]	0.7	20	3.8 3.2-4.5
Cutthroat trout[2]	0.8	10	3.3[b] 2.7-3.9
Rainbow trout[2]	1.5	10	2.4 2.0-2.9
Fathead minnow[2]	1.0	20	4.8 3.8-6.1
Channel catfish[2]	4.7	20	4.8 3.7-6.2
Bluegill[2]	0.7	20	3.8 3.2-4.5
Atlantic salmon[3]	0.4	12	1.7 1.5-2.0
Brown trout[3]	1.0	12	2.2 2.0-2.5
Brook trout[3]	0.4	12	2.0 1.6-2.5

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Carp[3]	1.1	12	12.0 10.2-14.2
Bluegill[3]	0.5	12	4.3 3.2-5.0

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Variations in temperature (7° to 17°C), pH (6.5 to 9.0), or water hardness (12 to 300 ppm) did not effectively alter the toxicity to fish. Toxicity to brown trout did not change after periods of up to 3 weeks of aqueous degradation.

FENTHION

Chemical Name: 0,0-Dimethyl 0-[4-(methylthio)-m-tolyl] phosphorothioate

Alternate Names: Bay 29493, Baytex, CAS 55-38-9, DMPT, ENT-25540, Entex, Lebaycid, Quelatox, S-1752, Tiguron

Principal Use: Insecticide

Sample Description: Technical material, 97%[1]; Baytex spray concentrate, 46%[2]; Baytex spray concentrate, 47.5%[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus[1]	I_1	21	0.62[a] 0.44-0.87
Daphnia pulex[1]	I_1	15	0.80[a] 0.56-1.20
Asellus[1]	M	21	1,800 1,100-4,900
G. lacustris[1]	M	21	8.4 5.0-12.0
Orconectes[1]	I_E	21	50[b,c] 35-90
Pteronarcys[1]	YC_2	15	4.5 3.3-6.7
Cutthroat trout[1]	1.2	10	1,580 1,290-1,930
Lake trout[1]	2.0	10	1,900 1,700-2,020
Cypridopsis[2]	M	21	18[a]
Palaemonetes[2]	M	21	10[c] 7.1-14.0
Coho salmon[2]	0.4	13	1,320 1,020-1,680
Rainbow trout[2]	1.0	13	930 750-1,150
Brown trout[2]	1.1	13	1,330 966-1,820
Carp[2]	0.5	18	1,160 532-2,550
Fathead minnow[2]	0.9	18	2,440 1,830-3,270
Black bullhead[2]	1.2	18	1,350 1,020-1,800
Channel catfish[2]	1.1	18	1,600 1,250-2,060
Green sunfish[2]	1.1	18	2,340 1,750-3,130
Yellow perch[2]	1.4	18	1,650 1,350-2,020
Goldfish[3]	0.9	18	3,404 1,775-6,536
Bluegill[3]	1.5	18	1,380 1,080-1,770
Largemouth bass[3]	0.9	18	1,540 1,430-1,660

[a]48-h EC50.
[b]Five-day LC50.
[c]Hard water, 272 ppm $CaCO_3$.

NOTE: Toxicity to fish did not change within a pH range of 6.0 to 9.0 or a water hardness range of 44 to 272 ppm. The time-independent LC50 for cutthroat trout was 460 μg/L. The cumulative toxicity index of 2.5 indicated a low level of cumulative toxicity.

FIRE-TROL 100

Chemical Name: Ammonium sulfate plus thickening, coloring, and anti-corrosion additives

Alternate Names: None known

Principal Use: Forest fire retardant

Sample Description: Commercial formulation, 62%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. pseudolimnaeus	M	18	62[a] 50-85
Coho salmon	1.0	11	> 1,500
Rainbow trout	0.8	11	> 1,000
Fathead minnow	0.7	21	> 1,500
Bluegill	1.0	21	> 1,500
Largemouth bass	0.5	21	> 1,500

[a]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Early life stages of coho salmon and rainbow trout were more sensitive than fingerlings. The 96-h LC50's of yolk-sac and swim-up fry were 90 and 920 mg/L, respectively, for coho salmon and 150 and 780 mg/L for rainbow trout. Fingerlings were more sensitive at 6°C than at 11°C; 96-h LC50's at 6°C were 780 µg/L for coho salmon and 1,000 µg/L for rainbow trout. Time-independent LC50's were 70 µg/L for coho salmon and 43 mg/L for rainbow trout; cumulative toxicity indices were 4.0 and > 2.3, respectively.

FIRE-TROL 931

Chemical Name: Ammonium polyphosphate plus thickening, coloring, and anti-corrosion additives.

Alternate Names: None known

Principal Use: Forest fire retardant

Sample Description: Commercial formulation, 93%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. pseudolimnaeus	M	18	55[a] 48-62
Coho salmon	1.0	11	1,000 943-1,060
Rainbow trout	0.8	11	940 796-1,110
Fathead minnow	0.7	21	> 1,500
Bluegill	1.0	21	> 1,500
Largemouth bass	0.5	21	1,160 1,050-1,280

[a]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Yolk-sac fry were somewhat more sensitive than fingerlings in coho salmon and rainbow trout; 96-h LC50's for yolk-sac fry were 580 mg/L for coho salmon and 700 mg/L for rainbow trout. A decrease in test temperature from 11° to 6°C did not appreciably alter the toxicity to either species.

FOLPET

Chemical Name: N-(Trichloromethylthio) phthalimide

Alternate Names: CAS 133-07-3, ENT-26539, Folpan, Phaltan, Thiopal

Principal Use: Fungicide

Sample Description: Technical material, 88-93%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
G. fasciatus	M	15	2,500 1,994-3,134
Coho salmon	1.0	12	106 82-137
Rainbow trout	1.5	12	39 18-85
Brown trout	0.6	12	66 56-78

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Lake trout	0.5	12	87 68-110
Fathead minnow	0.3	12	298 207-430
Channel catfish	1.2	20	108 59-201
Bluegill	0.6	20	72 58-89
Smallmouth bass	F	12	91 73-113
Yellow perch	0.6	12	177 149-210

GLYPHOSATE

Chemical Name: N-(Phosphonomethyl) glycine

Alternate Names: Roundup, MON-2139

Principal Use: Herbicide

Sample Description: Technical material, 96.7%[1]; liquid, 41%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Rainbow trout[1]	0.8	12	130 108-156
Fathead minnow[1]	0.6	20	97 79-120
Channel catfish[1]	2.2	22	130 108-156
Bluegill[1]	0.9	22	135 113-162
Daphnia magna[2]	I_1	22	3.0[a] 2.6-3.4
G. pseudolimnaeus[2]	M	12	43 28-66
Chironomus[2]	I_4	22	55[a] 31-97
Rainbow trout[2]	1.0	12	8.3 7.0-9.9
Fathead minnow[2]	0.6	22	2.3 1.9-2.8
Channel catfish[2]	0.6	22	13 11-16
Bluegill[2]	0.7	22	5.6 4.2-7.5

[a]48-h EC50.

NOTE: Test conditions and size of fish altered the toxicity of glyphosate. Toxicity increased with increasing temperature; glyphosate was twice as toxic to rainbow trout at 17°C than at 7°C and to bluegills at 27°C than at 17°C. Toxicity was 2 to 4 times greater to bluegills and rainbow trout at pH 7.5 to 9.5 than at pH 6.5. Toxicity of Roundup (41% liquid) to midge larvae, rainbow trout, or bluegills did not change when test solutions were aged from 1 to 7 days. The egg stage was the least sensitive early life stage for both rainbow trout and channel catfish. Tests with sac fry and swim-up fry yielded 96-h LC50's ranging from 2.4 to 4.3 mg/L. Fingerlings yielded 96-h LC50's of 8.3 mg/L for rainbow trout and 13 mg/L for channel catfish. Overall, the Roundup formulation was 3 to 42 times more toxic than the technical grade material.

HEPTACHLOR

Chemical Name: 1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene

Alternate Names: CAS 76-48-8, E-3314, ENT-15152, H-34, Heptachlore, Heptagran, Heptamul, Velsicol 104

Principal Use: Insecticide

Sample Description: Technical material, 99%[1]; heptachlor epoxide[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Simocephalus[1]	I_1	15	47[a] 32-68

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Daphnia pulex[1]	I_1	15	42[a] 21-63
G. fasciatus[1]	M	15	56 33-78
G. lacustris[1]	M	21	29 18-48
Palaemonetes[1]	M	21	1.8 1.4-2.4
Orconectes[1]	I_E	21	0.5 0.3-1.8
Pteronarcys[1]	YC_2	15	1.1 0.9-1.4
Pteronarcella[1]	N	15	0.9 0.6-1.3
Claassenia[1]	YC_2	15	2.8 2.1-3.7
Rainbow trout[1]	0.8	13	7.4 6.7-8.2
Northern pike[1]	0.7	18	6.2
Fathead minnow[1]	1.3	18	23
Black bullhead[1]	0.9	24	63 46-86
Channel catfish[1]	1.0	18	25 17-36
Bluegill[1]	1.0	17	13 9-19
Redear sunfish[1]	1.1	24	17 15-19
Largemouth bass[1]	0.8	18	10 7.4-14
Rainbow trout[2]	1.2	13	20 16-25
Bluegill[2]	0.5	24	5.3 3.9-7.2

[a]48-h EC50.

NOTE: Test temperatures ranging from 2° to 18°C did not alter the toxicity to rainbow trout; however, a 4.8-fold increase was noted in redear sunfish when temperature was incrementally increased from 7° to 29°C. No change in toxicity to rainbow trout was noted at water hardnesses between 44 and 272 ppm. Significant toxic effects were noted in the two high treatment levels in ponds treated with 12.5, 25, 37.5, and 50 μg/L of heptachlor. Mortalities for bluegills and aquatic invertebrates were 90 and 100%, respectively, within 7 days after treatment. However, invertebrates showed nearly complete recovery within 28 days. Bluegills accumulated peak whole body residues ranging from 11 to 57 ppm within 2 weeks after treatment; residues were reduced about 50% after 28 days and were undetectable after 84 days. Severe degenerative liver lesions that developed within 14 days after treatment were maintained through 56 days post-treatment. A gradual return to normal occurred thereafter. No differences in growth or spawning success were noted between treated and untreated ponds. Bluegills fed diets containing 5 to 25 ppm heptachlor showed toxic responses similar to those of fish in treated ponds.

HEXACHLOROBENZENE

Chemical Name: Hexachlorobenzene

Alternate Names: Anticarie, Bunt Cure, Bunt-No-More, CAS-118-74-1, ENT-1719, HCB, Hexa C.B., No Bunt, Sanocide, Smut-Go.

Principal Use: Fungicide, Industrial intermediate

Sample Description: Technical material, 80-96%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Coho salmon	0.5	7	>50
Fathead minnow	0.7	20	22
Channel catfish	0.8	20	14 11-16
Bluegill	1.0	20	12[a]
Largemouth bass	0.5	21	12[a]

[a]Tested in hard water.

NOTE: In channel catfish the 96-h LC50 for yolk-sac fry was about half the value for fingerlings. Rainbow trout accumulated residues 3,800 to 8,900 times the exposure level of 0.1 to 2.0 μg/L within 28 days, and *Daphnia* accumulated residues near 900 times the exposure level of 0.05 to 0.15 μg/L within 48 h. The

residue half-life in *Daphnia* was 44 h; however, neither trout nor *Daphnia* appeared to degrade HCB significantly. Preliminary food chain studies indicated that bluegills accumulated HCB to a level 1 to 2 times that observed for DDT when they were fed *Daphnia* containing residues of 50 ng/g. In comparison, bluegills accumulated residues about half that of DDT in water exposure at concentrations of only 0.05 to 0.15 μg/L. After 5 days of incubation, both aerobically and anaerobically, hydrosoil samples inoculated with ring labeled HCB showed an 80 to 90% loss of material. Although phenolic volatilization may be responsible for some of this loss, degradation products were revealed, one of which has been tentatively identified as pentachlorophenol.

HOUGHTO-SAFE 1120

Chemical Name: Mixture of tri-aryl phosphate esters containing phenyl, tolyl (cresyl), xylyl, and ethyl substituted benzene groups

Alternate Names: Tri-aryl phosphate ester

Principal Use: Hydraulic fluids

Sample Description: Commercial formulations, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. pseudolimnaeus	M	20	0.70[a] 0.53-0.92
Coho salmon	0.4	12	1.2[b] 0.9-1.5
Rainbow trout	1.4	12	1.7 1.2-2.5
Brook trout	4.0	12	3.6[b] 3.1-4.2
Fathead minnow	1.2	17	35 24-49
Channel catfish	1.6	21	43 31-59
Bluegill	0.6	20	12 8-19
Yellow perch	7.2	12	0.54[a,b] 0.42-0.70

[a]Tested in hard water.
[b]Flow-through toxicity test.

NOTE: Flow-through toxicity tests produced TILC50's ranging from 0.54 mg/L for rainbow trout to 6.60 mg/L for fathead minnows. Cumulative toxicity indices ranged only from 1.20 to 3.14, indicating little or no cumulative toxic action. Sublethal effects were prominent in flow-through tests at concentrations considerably below acutely lethal levels. Such effects included early cessation of feeding, hypersensitivity, and erratic swimming, followed by a loss of motor function, hemorrhage in the dorsal fin region, and occurrence of a characteristic "broken back" syndrome. This condition remained for extended periods until terminated by death from secondary causes.

KEPONE

Chemical Name: Decachlorooctahydro-1,3,4-metheno-2H-cyclobuta [cd] pentalen-2-one

Alternate Names: CAS 143-50-0, ENT-16391, GC-1899, Chlordecone

Principal Use: Insecticide

Sample Description: Technical material, 90.7%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Daphnia magna	I_1	17	260[a] 200-345
G. pseudolimnaeus	M	17	180 110-290
Chironomus	I_4	22	320[a] 220-450
Rainbow trout	1.1	12	30 24-38
Channel catfish	1.6	18	225
Bluegill	2-5	24	72
Redear sunfish	1.0	24	44 41-47

[a]48-h EC50.

NOTE: Variation in water hardness from 44 to 272 ppm did not alter toxicity to rainbow trout. An increase in temperature from 7° to 29°C produced a 4.8-fold increase in toxicity.

LEPTOPHOS

Chemical Name: 0-(4-Bromo-2,5-dichlorophenyl) 0-methylphenylphosphonothioate

Alternate Names: Abar, Lepton, MBCP, Phosvel, VCS 5-d, VDS-506

Principal Use: Insecticide

Sample Description: Technical material, 87.2%[1]; emulsifiable concentrate, 2.7%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Procambarus[1]	I_E	12	>7,000
Cutthroat trout[1]	0.6	10	5.3 4.2-6.8
Rainbow trout[1]	1.0	12	20 12-32
Lake trout[1]	2.2	12	30 21-43
Fathead minnow[1]	0.5	5	>30,000
Bluegill[1]	1.4	5	22 14-35
Rainbow trout[2]	0.6	12	35 29-42

NOTE: Alterations in pH and hardness did not appreciably affect the toxicity to fish. Aging of test solutions for 7 to 21 days lowered toxicity by about one-half.

LIGNASAN

Chemical Name: Methyl 2-benzimidazolecarbamate phosphate

Alternate Names: Correx, Lignasan BLP

Principal Use: Fungicide

Sample Description: Technical material, 98.1%[1]; liquid, 0.7%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Rainbow trout[1]	0.9	12	1.6 1.2-2.1
Fathead minnow[1]	0.9	22	>100
Channel catfish[1]	0.8	22	0.022 0.014-0.034
Bluegill[1]	0.9	22	>100
Rainbow trout[2]	1.0	12	0.56 0.42-0.74
Channel catfish[2]	0.8	22	0.019 0.013-0.028
Bluegill[2]	0.6	22	14.0 9.4-21.0

LIME SULFUR

Chemical Name: Calcium polysulfide

Alternate Names: Eau Grison, Orthorix

Principal Use: Fungicide, acaricide

Sample Description: Liquid concentrate, 29%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Simocephalus	I_1	15	11[a] 9-14
Daphnia pulex	I_1	15	10[a] 7-15
Rainbow trout	0.8	12	8
Fathead minnow	1.2	18	32[b] 24-42
Bluegill	1.0	18	49 44-53

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

LINDANE

Chemical Name: Gamma isomer of 1,2,3,4,5,6-hexachlorocyclohexane

Alternate Names: Benesan, CAS 58-89-9, ENT-7796, Forlin, Gamaphex, Gamma BHC, Gammafog, Gammalin, Gammex, Gammexane, Isotox, Lindafor, Lindagam, Lindamul, Lintox, Novigam, Oko, Silvanol.

Principal Use: Insecticide

Sample Description: Technical material, 99%.

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Simocephalus	I_1	15	520[a] 340-790
Daphnia pulex	I_1	15	460[a] 386-547
Cypridopsis	M	21	3.2 2.2-4.6
Asellus	M	15	10 7-14
G. fasciatus	M	15	10 7-14
G. lacustris	M	21	88 57-136
Pteronarcys	YC_2	15	4.5 3.6-5.7
Coho salmon	0.6	12	23 19-28
Rainbow trout	1.0	12	27 20-36
Brown trout	1.7	13	1.7 1.2-2.4
Lake trout	0.7	12	32 24-42
Goldfish	0.9	18	131 92-187
Carp	0.6	18	90 75-120
Fathead minnow	1.2	18	87 69-101
Black bullhead	1.2	18	64 49-81
Channel catfish	1.5	18	44 37-52
Green sunfish	1.1	18	83 47-149
Bluegill	1.5	18	68 60-78
Largemouth bass	0.9	18	32 27-38
Yellow perch	1.4	18	68 60-76

[a]48-h EC50.

NOTE: Stonefly nymphs of the first-year class were 4.5 times more susceptible to lindane than were those of the second-year class. Variations in water hardness from 44 to 272 ppm did not alter the toxicity to fish or invertebrates. An increase in temperature from 2° to 18°C caused a 2.3-fold decrease in toxicity to rainbow trout; an increase from 7° to 29°C caused a 2.6-fold increase in toxicity to bluegills. Sublethal exposure of fish to lindane produced focal necrotic lesions in the liver and damage to the convoluted tubules in kidney glomeruli.

MALATHION

Chemical Name: 0,0-Dimethyl S-(1,2-dicarbethoxyethyl) phosphorodithioate

Alternate Names: AC-4049, Carbofos, Carbophos, CAS 121-75-5, Chemathion, Cythion, Emmatos, ENT-17034, For-Mal, Fyfanon, Karbofos, Kop-Thion, Kypfos, Malamar, Malaphos, Malaspray, Malathon, MLT, Mercaptothion, Mor-Mal, Zithiol

Principal Use: Insecticide

Sample Description: Technical material, 95%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	15	3.5[a] 2.6-4.8
Daphnia magna	I_1	15	1.0[a] 0.7-1.4
Daphnia pulex	I_1	15	1.8[a] 1.4-2.4
Cypridopsis	M	21	47[a] 32-69
Asellus	M	21	3,000 1,500-8,500
G. fasciatus	M	21	0.76 0.63-0.92
Orconectes	I_E	15	180[b] 140-230
Palaemonetes	M	21	90[b] 67-120
Pteronarcys	YC_2	15	10 7.0-13
Pteronarcella	N	15	1.1 0.8-1.5
Claassenia	YC_2	15	2.8 1.4-4.3
Isoperla	YC_1	15	0.69 0.20-2.4
Lestes	J	15	10 6.5-15
Hydropsyche	J	15	5.0 2.9-8.6
Limnephilus	J	15	1.3 0.8-2.0
Atherix	J	15	385 246-602
Coho salmon	0.9	12	170 160-180
Cutthroat trout	1.0	12	280 270-310
Rainbow trout	1.4	12	200 160-240
Brown trout	1.1	12	101 84-115
Lake trout	0.3	12	76[b] 47-123
Goldfish	0.9	18	10,700 8,340-13,800
Carp	0.6	18	6,590 4,920-8,820
Fathead minnow	0.9	18	8,650 6,450-11,500
Black bullhead	1.2	18	12,900 10,700-15,600
Channel catfish	1.5	18	8,970 6,780-12,000
Green sunfish	1.1	18	175 134-228
Bluegill	1.5	18	103 87-122
Redear sunfish	3.2	24	62 58-67
Largemouth bass	0.9	18	285 254-320
Yellow perch	1.4	18	263 205-338
Walleye	1.3	18	64 59-70

[a]48-h EC50.
[b]Tested in hard water (162-272 ppm $CaCO_3$).

NOTE: In lake trout, fry (0.3 g) were twice as sensitive as fingerlings (4.5 g) to malathion. An increase in temperature from 10° to 21°C caused an 11-fold decrease in toxicity to the daphnid *Simocephalus*; however, an increase from 7° to 29°C caused a fourfold increase in toxicity to bluegills. Variations in water hardness did not appreciably alter the toxicity to fish or invertebrates. Mixtures of malathion with Baytex, parathion, EPN, Perthane, or carbaryl were synergistic in their toxicity to rainbow trout and bluegills. Combinations of malathion with DDT or toxaphene were

only additive. Salmonids exposed to 120 to 300 μg/L malathion showed acetylcholinesterase (AChE) inhibition of 70 to 80%, and activity indices were reduced by 50 to 70% of that of unexposed fish. Goldfish exposed to sublethal levels showed a significantly reduced frequency of avoidance response at levels below that causing a reduced AChE activity. One-hour bath exposures of rainbow trout to sublethal levels of malathion caused severe tissue damage to the gills and minor nonspecific liver lesions. Ponds given four semimonthly treatments during May-July at levels up to 0.02 mg/L produced no discernible effects on resident bluegill and channel catfish populations. Aquatic insect populations were significantly depressed at the high treatment level but not at the lower levels.

METHOMYL

Chemical Name: S-Methyl-N-[(methylcarbamoyl)oxy] thioacetimidate

Alternate Names: CAS 16752-77-5, Dupont 1179, Lannate, Nudrin

Principal Use: Insecticide-nematocide

Sample Description: Technical material, 95-98%[1]; liquid concentrate, 24%[2]; liquid formulation, 29%[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Daphnia magna[1]	I_1	21	8.8[a,b] 4.1-19
Pteronarcella[1]	N	7	69 34-143
Skwala[1]	N	7	34 27-44
Cutthroat trout[1]	1.0	10	6,800 2,180-7,530
Rainbow trout[1]	1.1	12	1,600 1,190-2,150
Fathead minnow[1]	0.8	17	2,800 1,820-4,310
Atlantic salmon[1]	0.5	12	1,120 930-1,350
Brook trout[1]	1.2	12	1,500 1,230-1,830
Channel catfish[1]	1.0	22	530 375-748
Bluegill[1]	0.9	20	1,050 859-1,280
Largemouth bass[1]	3.0	22	1,250 971-1,610
Daphnia magna[2]	I_1	20	3,200[a,b] 1,990-5,130
G. pseudolimnaeus[2]	M	12	1,050[b] 424-2,600
Pteronarcella[2]	N	7	60 50-80
Skwala[2]	N	7	29 21-41
Chironomus[2]	I_4	20	32[c] 13-80
Rainbow trout[2]	1.0	12	1,200 1,100-1,400
Atlantic salmon[2]	0.3	12	1,400 1,250-1,570
Brook trout[2]	1.2	12	2,200 1,600-3,010
Fathead minnow[2]	0.2	22	1,800 1,200-2,700
Channel catfish[2]	0.5	22	300 200-430
Bluegill[2]	0.9	20	710 561-898
Largemouth bass[2]	3.0	22	760 589-979
Rainbow trout[3]	0.6	12	1,200 764-1,880
Fathead minnow[3]	0.8	17	1,500 890-2,540
Atlantic salmon[3]	0.3	12	1,200 1,050-1,380
Brook trout[3]	1.2	12	1,220 860-1,730

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Channel catfish[a]	0.8	17	320 275-371
Bluegill[a]	0.8	17	670 428-1,048

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.
[c]48-h LC50.

NOTE: Eyed eggs of rainbow trout, with a 96-h LC50 of 32,000 μg/L, were much less sensitive than fingerlings to methomyl. Yolk-sac fry, with a 96-h LC50 of 3,200 μg/L, were about twice as tolerant as were fingerlings. Swim-up fry and fingerlings were equally susceptible. No changes in toxicity were noted at test temperatures between 12° and 17°C for rainbow trout and 17° and 27°C for bluegills. Variations in pH from 6.5 to 8.5 did not alter toxicity to either rainbow trout or bluegills. Aging of test solutions for 7 days increased the toxicity to scuds (*G. pseudolimnaeus*) threefold but did not alter the toxicity to rainbow trout.

METHOPRENE

Chemical Name: Isopropyl (2E,4E)-11-methoxy-3,7,11-trimethyl-2,4,-dodecadienoate

Alternate Names: Altosid, ZR-515

Principal Use: Insecticide

Sample Description: Technical material, 68.9%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Rainbow trout	0.6	12	1.6 1.0-2.4
Fathead minnow	0.7	20	>10.0
Channel catfish	1.2	20	>100
Bluegill	0.6	20	2.9 1.9-4.5

METHOXYCHLOR

Chemical Name: 2,2-Bis(p-methoxyphenyl)-1,1,1-tri=chloroethane

Alternate Names: CAS 72-43-5, Dimethoxy-DT, DMDT, ENT-1716, Marlate, Methoxo, Methoxy-DDT

Principal Use: Insecticide

Sample Description: Technical material, 89.5%[1]; granular, 50%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus[1]	I_1	15	5.0[a] 3.8-6.6
Daphnia pulex[1]	I_1	15	0.78[a] 0.57-1.07
Cypridopsis[1]	M	21	32[a] 23-45
Asellus[1]	M	18	34 25-47
G. fasciatus[1]	M	15	1.9 1.2-3.1
G. lacustris[1]	M	21	0.80 0.56-1.14
Orconectes[1]	I_E	21	0.50 0.25-1.80
Palaemonetes[1]	M	21	1.05 0.76-1.46
Pteronarcella[1]	N	10	5.0 3.9-6.3
Pteronarcys[1]	YC_2	15	1.4 1.1-1.8
Cutthroat trout[1]	0.5	12	15 14-17
Rainbow trout[1]	1.2	12	62 55-69
Atlantic salmon[1]	0.6	12	16.4 13.8-19.5
Brook trout[1]	1.2	12	19.0 16.4-22.0

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Lake trout[1]	3.0	12	17 13-24[b]
Northern pike[1]	0.7	18	12[b]
Goldfish[1]	1.0	18	42 33-52
Fathead minnow[1]	1.0	18	39 31-49
Channel catfish[1]	1.2	18	52 38-71
Bluegill[1]	1.2	17	32 20-49
Largemouth bass[1]	0.8	18	16 13-18[b]
Yellow perch[1]	1.0	12	30.0 22.8-39.4
Atlantic salmon[2]	0.6	12	1.7 1.1-2.8
Brook trout[2]	0.7	12	11.7 9.3-14.8
Yellow perch[2]	1.0	12	17.5 13.3-23.1

[a]48-h EC50.
[b]Tested in hard water, 162-272 ppm $CaCO_3$.

NOTE: Variations in temperature from 15° to 21°C did not alter toxicity to daphnids. A slight decrease in toxicity was noted when temperatures increased from 2° to 18°C for rainbow trout and from 12° to 24°C for bluegills. Brook trout were equally susceptible to test solutions of pH 6.5, 7.5, and 8.5. Variations in hardness from 42 to 300 mg/L did not alter toxicity to cutthroat trout, brook trout, or bluegills. No difference in susceptibility was noted between species of trout; 96-h LC50's ranged from 9 to 25 μg/L. Yolk-sac fry and eyed eggs of brook trout were highly tolerant of methoxychlor; 96-h LC50's exceeded 400 μg/L for fry and 50,000 μg/L for eyed eggs. The TILC50's for cutthroat trout and brook trout were 1.5 and 4.1 μg/L, respectively. The cumulative toxicity indices were 3.0 and 4.1, indicating slight cumulative toxicity. The major degradation product of hydrosoil microorganisms was methoxychlor olefin (MDE); degradation occurred only under aerobic conditions. No evidence of metabolism by daphnids, mayflies, or rainbow trout was observed; however, in vitro preparations of liver microsomes of channel catfish produced olefin as a major degradation product. Compared with the parent molecule, MDE was about 0.001 as toxic to crustacea and aquatic insect larvae and 0.03 as toxic to bluegills. Microorganisms rapidly accumulated ^{14}C-methoxychlor to levels 1,000 to 3,000 times the exposure levels of 0.1 to 5.0 μg/L. Uptake appeared to be a passive process. *Daphnia*, mayfly larvae, and rainbow trout fry exposed to a concentration of 50 ng/L had accumulation factors similar to these values. However, neither mosquito larvae nor damselfly naiads appeared to accumulate residues. No magnification of residues between trophic levels was observed when *Daphnia* were fed bacteria containing residues of 0.1 μg/g, or when fingerling largemouth bass were fed *Daphnia* containing residues up to 0.06 μg/g. At concentrations of 1 μg/L of methoxychlor or MDE, *Daphnia* exposed for three generations grew and reproduced normally, but the emergence of mayfly nymphs was drastically reduced. In ponds treated with 10 to 40 μg/L, the total number of benthic organisms increased and species composition changed, chironomids becoming the dominant species. Neither survival nor growth of bluegills in the treated ponds was affected; however, most of the fish examined showed nonspecific liver degeneration and an accumulation of a muco- or glyco-proteinaceous material inside the major blood vessels. Regression of these effects had occurred by 56 days after treatment.

METHYL TRITHION

Chemical Name: S-(((p-Chlorophenyl)thio)methyl) 0,0-dimethyl phosphorodithioate

Alternate Names: CAS 953-17-3, ENT-25586, Stauffer R-1492, TRI-ME

Principal Use: Insecticide

Sample Description: Technical material, 91.4%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. fasciatus	M	21	11 8-15
Pteronarcys	YC_2	15	6.2
Cutthroat trout	1.0	12	1,200 1,100-1,400
Rainbow trout	1.2	12	760 605-95

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Channel catfish	1.1	18	2,800 2,330-3,365
Bluegill	1.1	18	960 743-1,240
Largemouth bass	0.7	18	610[a] 442-841

[a]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Toxicity to bluegills was not altered when water hardness varied from 44 to 272 ppm.

MEVINPHOS

Chemical Name: Dimethyl phosphate of methyl-3-hydroxy-cis-crotonate

Alternate Names: Phosdrin, OS-2046, Phosfene, Menite

Principal Use: Systemic insecticide-acaricide

Sample Description: Technical material, 60%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	15	0.42[a] 0.32-0.56
Daphnia pulex	I_1	15	0.18[a] 0.13-0.25
Asellus	J	15	61 39-95
G. fasciatus	J	15	3.5 3.1-3.9
Pteronarcys	YC_1	15	5.0 3.6-6.9
Rainbow trout	0.9	12	11.9 10.7-13.2
Bluegill	0.9	24	22.5 19.6-25.8

[a]48-h EC50.

MEXACARBATE

Chemical Name: 4-(Dimethylamino)-3,5-xylyl methyl=carbamate

Alternate Names: CAS 315-18-4, Dowco 139, ENT-25766, Zectran

Principal Use: Insecticide

Sample Description: Technical material, 90-95%[1]; metabolites (analytical grade 99%): 4-dimethyl=amino-3,5-xylenol[2]; 4-amino-3,5-xylenol[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Simocephalus[1]	I_1	15	0.013[a] 0.011-0.016
Daphnia pulex[1]	I_1	15	0.010[a] 0.007-0.015
G. fasciatus[1]	M	21	0.04 0.03-0.06
Procambarus[1]	I_E	12	1.2
Pteronarcys[1]	YC_2	15	0.010 0.007-0.014
Coho salmon[1]	0.5	12	23.0 19.7-26.9
Cutthroat trout[1]	0.8	10	15.8 15.1-16.5
Rainbow trout[1]	1.0	11	12.0 10.3-14.0
Atlantic salmon[1]	0.5	12	22.3 19.2-25.9
Lake trout[1]	1.0	12	8.2 3.7-18.0
Carp[1]	0.6	18	13.4 11.3-16.0
Fathead minnow[1]	1.0	18	17.0 15.7-18.2
Channel catfish[1]	1.4	18	11.4 8.3-15.9
Green sunfish[1]	1.1	18	16.7 14.5-19.3

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Bluegill[1]	0.7	12	22.9 21.3-24.6
Largemouth bass[1]	0.9	18	14.7 13.8-15.8
Yellow perch[1]	0.4	12	16.2 13.8-19.0
Daphnia magna[2]	I_1	21	0.10-0.32[a,b]
Bluegill[2]	0.5	12	7.2 5.6-9.2
Bluegill[3]	0.5	12	0.32 0.23-0.44

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Variations of species, temperature, or water hardness did not produce 96-h LC50's outside the range of 10-25 mg/L for 17 species of fish tested. Although pH did not alter the toxicity to crayfish, an increase in pH from 6.5 to 9.5 increased the toxicity to fish up to 40 times. Similar increases in toxicity were noted in test solutions aged up to 3 weeks at different pH's, but solutions aged 4 weeks showed reduced toxicity; the early increases can be attributed to the instability of mexacarbate and the increased toxicity of the degradation products, 4-dimethylamino-3,5-xylenol and 4-amino-3,5-xylenol, particularly at alkaline pH's. Cumulative toxicity indices ranged between 1 and 4 for three species of fish, indicating only slight cumulative toxicity.

MIREX

Chemical Name: Dodecachloroctahydro-1,3,4-metheno-2H-cyclobuta(cd)pentalene

Alternate Names: Dechlorane, GC-1283

Principal Use: Stomach insecticide

Sample Description: Technical material, 98%[1]; wettable powder, 50%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Simocephalus[1]	I_1	16	>0.100[a]
Daphnia pulex[1]	I_1	16	>0.100[a]
Daphnia magna[1]	I_1	17	>1.0[a]
G. pseudolimnaeus[1]	M	17	>1.0
Chironomus[1]	I_4	22	>1.0[a]
Rainbow trout[1]	1.0	12	>100
Yellow perch[1]	2.6	15	>100
Fathead minnow[2]	1.3	18	>100
Bluegill[2]	1.1	18	>100
Walleye[2]	1.4	18	>100

[a]48-h EC50.

MOLINATE

Chemical Name: S-Ethyl hexahydro-1 H-azepine-1-carbothioate

Alternate Names: Ordram, Hydram

Principal Use: Selective herbicide

Sample Description: Technical material, 98.6%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. fasciatus	M	21	4.5 3.5-5.8
Pteronarcys	M	15	0.34 0.24-0.47
Rainbow trout	1.6	12	0.21 0.16-0.29
Bluegill	1.0	24	0.32 0.19-0.53

MON-0818

Chemical Name: Not known

Alternate Names: Not known

Principal Use: Surfactant for MON-2139 (Glyphosate)

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Chironomus	I_4	22	13.0[a] 7.1-24
Rainbow trout	0.8	12	2.0 1.5-2.7
Fathead minnow	0.6	22	1.4 1.2-1.7
Channel catfish	0.6	22	13.0 9.9-16.9
Bluegill	0.8	22	3.0 2.5-3.7

[a]48-h EC50.

NOTE: The toxicity of the technical grade surfactant alone was similar to that of the Roundup formulation of glyphosate. This surfactant alone is primarily responsible for the toxicity of the commercial product Roundup; it does not merely enhance the biological availability of glyphosate.

MSMA

Chemical Name: Monosodium methanearsonate

Alternate Names: CAS 2163-80-6, Arsar 529, Daconate

Principal Use: Herbicide

Sample Description: Liquid formulations, 34.8%[1]; plus surfactant, 37.7%[2]

SUMMARY OF ACUTE TOXICITY[a]

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. fasciatus[1]	M	15	>100
Cutthroat trout[1]	0.6	10	>100
Goldfish[1]	0.9	18	31.1 24.4-38.8
Fathead minnow[1]	0.9	18	13.3 5.1-35.8
Bluegill[1]	0.9	18	12
Channel catfish[2]	2.1	17	26.8 20.0-35.9
Bluegill[2]	1.0	17	49.2 25.3-95.8

[a]Computations based on total material.

NALED

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

Alternate Names: Bromchlophos, Bromex, CAS 300-76-5, Dibrom, ENT-24988, RE-4355

Principal Use: Insecticide, acaricide

Sample Description: Technical material, 90%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	15	1.1[a] 1.0-1.2
Daphnia pulex	I_1	15	0.4[a] 0.2-0.8
Asellus	M	15	41
G. fasciatus	M	15	18 16-20
Palaemonetes	M	15	92[b]
Pteronarcys	YC_2	15	8 6-11
Cutthroat trout	2.3	12	127[b] 115-139
Rainbow trout	1.5	13	195 126-302
Lake trout	0.3	12	87 53-142

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Fathead minnow	1.3	18	3,300
Channel catfish	5.2	18	710
Bluegill	1.4	18	2,200[b]
Largemouth bass	0.7	18	1,900[b]

[a]48-h EC50.
[b]Tested in hard water, 162-272 ppm $CaCO_3$.

NOTE: Naled was about twice as toxic to rainbow trout at 13°C as at 2°C. Toxicity was not affected by variations in water hardness.

NITRALIN

Chemical Name: 4-(Methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline

Alternate Names: Planavin, SD 11831

Principal Use: Selective pre-emergence herbicide

Sample Description: Wettable powder, 75%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Daphnia magna	I_1	21	0.004[a,b] 0.002-0.008
G. fasciatus	M	15	1.3[b] 0.8-2.2
Rainbow trout	0.6	12	30.0 22.0-40.8
Bluegill	0.8	24	62 51-76

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

ORTHO 11775

Chemical Name: 3-(2-Butyl) phenyl-N-methyl-N-(phenylsulfenyl) carbamate

Alternate Names: Not known

Principal Use: Insecticide

Sample Description: Technical material, 46%[1]; liquid formulation, 22.9%[2]; granular formulation, 10%[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Fathead minnow[1]	0.5	17	61 42-88
Bluegill[1]	1.3	17	16 6.7-36
Rainbow trout[2]	0.7	12	7
Fathead minnow[2]	0.5	17	25 15-42
Rainbow trout[3]	0.7	12	11
Channel catfish[3]	2.6	17	23 13-40

OXYDEMETON-METHYL

Chemical Name: S-[2-(Ethylsulfinyl) ethyl] 0,0-dimethyl phosphorothioate

Alternate Names: Bay 21097, CAS 301-12-2, Demeton-S-methyl sulfoxid, Metasystemox, Metasystox-R, Metilmercaptofosoksid, R 2170

Principal Use: Insecticide

Sample Description: Liquid concentrate, 50%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Asellus	M	15	1.4
G. fasciatus	M	15	1.0 0.6-1.7
Rainbow trout	1.1	12	6.4 4.4-9.2
Channel catfish	1.4	18	< 18
Bluegill	1.0	18	13.0[a] 10.6-16.7

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Largemouth bass	0.7	18	31.5[a] 27.4-36.2
Walleye	1.4	18	18.0 15.6-20.8

[a]Tested in hard water, 272 ppm $CaCO_3$.

PARAQUAT

Chemical Name: 1,1-Demethyl-4,4'-bipyridinium ion (dichloride and bis(methylsulfate) salt)

Alternate Names: Dichloride salt: CAS 1910-42-5, Dextrone X, Gramoxone, Ortho Paraquat CL, Paraquat Chloride, PP 148, Preeglone, Weedol. Bis(methylsulfate) salt: Aerial Gramoxone, Dual Paraquat, PP 910.

Principal Use: Herbicide

Sample Description: Technical material, 42% (cation)[1]; soluble concentrate, 2 lb (cation)/gal[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Channel catfish[1]	1.4	18	>100
Simocephalus[2]	I_1	16	3.7[a] 2.8-4.8
Daphnia pulex[2]	I_1	16	4.0[a] 2.7-6.0
G. fasciatus[2]	M	21	11 8.1-15
Pteronarcys[2]	YC_2	16	>100
Rainbow trout[2]	0.5	13	15 11-19
Bluegill[2]	0.9	24	13.0 8.5-19.0

[a]48-h EC50.

PARATHION ETHYL

Chemical Name: 0,0-Diethyl 0-p-nitrophenyl phos=phorothioate

Alternate Names: AAT, AC 3422, Alkron, Alleron, Aphamite, Bladan, CAS 56-38-2, Corothion, DNTP, E-605, ENT-15108, Ethyl parathion, Ethilon, Folidol E-605, Fosferno 50, Nitrostigmine, Orthophos, Panthion, Paramar, Paraphos, Parathene, Parawet, Phoskil, Rhodiatox, SNP, Soprathion, Stathion, Thiophos

Principal Use: Insecticide

Sample Description: Technical material, 98.7%[1]; thioate analogue, 100% technical grade[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus[1]	I_1	21	0.47[a] 0.34-0.66
Daphnia pulex[1]	I_1	15	0.60[a] 0.45-0.79
Asellus[1]	M	15	2,130 1,450-3,120
G. lacustris[1]	M	21	3.5 2.6-4.8
G. fasciatus[1]	M	21	1.3 0.60-1.9
Orconectes[1]	I_E	21	0.04 0.01-0.20
Procambarus[1]	M	12	<250
Palaemonetes[1]	M	21	1.5 0.82-2.7
Pteronarcys[1]	YC_2	15	5.4 4.7-6.2
Pteronarcella[1]	N	15	4.2 3.4-5.2
Claassenia[1]	YC_2	15	1.5 1.0-2.2
Hexagenia[1]	J	24	15
Ischnura[1]	J	24	0.64
Cutthroat trout[1]	0.3	12	1,560[b] 985-2,470
Rainbow trout[1]	1.0	12	1,430 962-2,110

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Lake trout[1]	0.7	12	1,920[b] 1,750-2,100
Goldfish[1]	0.9	18	1,830 1,350-2,470
Fathead minnow[1]	0.8	18	2,350 1,760-3,120
Channel catfish[1]	1.4	18	2,650 2,160-3,260
Mosquitofish[1]	0.6	17	320 156-647
Green sunfish[1]	1.1	18	930 675-1,282
Bluegill[1]	1.0	18	400 295-543
Largemouth bass[1]	0.7	18	620[b] 462-830
Rainbow trout[2]	1.5	12	750 520-1,100
Channel catfish[2]	1.4	18	3,300 3,090-3,520
Bluegill[2]	1.4	18	24 15-38

[a]48-h EC50.
[b]Tested in hard water, 162-272 ppm $CaCO_3$.

NOTE: Early instar crayfish (*Orconectes*) were much more susceptible than adults. No change in susceptibility was noted among trout weighing 0.3 to 4.5 g. Increases in toxocity ranging from 3- to 10-fold were produced when temperatures were increased from 15° to 21°C for sowbugs and from 7° to 29°C for bluegills. Toxicity to invertebrates and fish was generally unaffected by water hardness; however, toxicity to green sunfish increased slightly when hardness was increased from 44 to 272 ppm. Acute exposures of bluegills for periods up to 2 weeks produced pathological changes in gills, liver, and kidneys. Paraoxon, a primary metabolite of parathion, was found to be a potent brain acetylcholinesterase inhibitor in cutthroat trout, channel catfish, and bluegills.

PARATHION METHYL

Chemical Name: 0,0-Dimethyl-0-p-nitrophenyl phosphorothioate

Alternate Names: CAS 298-00-0, Dalf, Dimethyl parathion, E601, ENT-17292, Folidol M, Fosferno M50, Gearphos, Metacide, Metaphos, Methyl Niran, Metron, Nitrox 80, Parathion methyl, Partron M, Pencap-M, Tekwaisa, Wofatox

Principal Use: Insecticide

Sample Description: Technical material, 80-99%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (µg/L)
Simocephalus	I_1	15	0.37[a] 0.23-0.57
Daphnia magna	I_1	21	0.14[a] 0.09-0.20
G. fasciatus	M	15	3.8 2.6-5.5
Orconectes	M	15	15[b]
Ischnura	J	15	33[b]
Coho salmon	1.0	12	5,300 4,900-5,600
Cutthroat trout	0.2	12	1,850[b] 1,390-2,470
Rainbow trout	1.1	12	3,700 3,130-4,380
Brown trout	1.1	12	4,700 3,900-5,750
Lake trout	0.5	12	3,780 2,810-5,090
Goldfish	0.9	18	9,000 8,100-9,900
Carp	0.6	18	7,130 6,440-7,870
Fathead minnow	1.2	18	8,900 7,780-10,200
Black bullhead	1.2	18	6,640 4,970-8,880
Channel catfish	1.4	18	5,240 4,270-6,440
Green sunfish	0.8	18	6,860 5,590-8,420

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Bluegill	1.0	17	4,380 3,480-5,510
Largemouth bass	0.9	18	5,220 4,320-6,310
Yellow perch	1.4	18	3,060 2,530-3,700

[a]48-h EC50.
[b]Tested in hard water, 162 to 272 ppm $CaCO_3$.

NOTE: Changes in water hardness from 44 to 272 ppm did not appreciably alter the toxicity to daphnids, scuds, rainbow trout, fathead minnows, green sunfish, or bluegills.

PENTACHLOROPHENOL

Chemical Name: Pentachlorophenol

Alternate Names: Dowicide-7, penchlorol, Pentacon, Penwar, Weedone, Sinituho

Principal Use: Herbicide, wood preservative, defoliant, molluscicide

Sample Description: Technical material, 96%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (c)	96-h LC50 95% CI (μg/L)
Chinook salmon	1.0	10	68 48-95
Rainbow trout	1.0	11	52 48-56
Fathead minnow	1.1	20	205 179-234
Channel catfish	0.8	20	68 58-80
Bluegill	0.4	15	32 23-44

PENTACHLOROPHENOL SODIUM SALT

Chemical Name: Sodium pentachlorophenate

Alternate Names: Dowicide G, Santobrite, Weedbeads

Principal Use: Contact and pre-emergence herbicide

Sample Description: Liquid, 90%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Chinook salmon	1.0	10	68 48-95
Rainbow trout	1.0	12	55 47-64
Channel catfish	0.8	20	77 61-98
Bluegill	0.4	15	44 25-78

NOTE: Flow-through tests with chinook salmon and rainbow trout produced TILC50 values of 170 and 104 μg/L and cumulative toxicity indices of 1.0 and 1.2, respectively.

PERMETHRIN

Chemical Name: 3-(Phenoxyphenyl)methyl(I)-cis, trans-3-(2,2-dichloroethenyl)-2,2-dimethylcyclo= propanecarboxylate

Alternate Names: Pounce, Ambush, SBP-1513, NRDC-143

Principal Use: Insecticide (synthetic pyrethroid)

Sample Description: Technical material 92.5%[1]; liquid 5.7%[2]; emulsifiable concentrate 13.3%[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Brook trout[1]	1.2	12	3.2 2.2-4.8
Brook trout[2]	1.2	12	5.2 3.5-7.9
Brook trout[3]	1.2	12	2.3 1.4-3.7

PHENOXY HERBICIDES[a]: 2,4-D

Chemical Name: 2,4-Dichlorophenoxyacetic Acid (derivatives shown in sample description)

Alternate Names: (Superscript numbers refer to superscripts in sample description and summary table) 2,4-D, CAS 94-75-7, Weedar[1]; 2,4-DB, Butyrac, Embutox[2]; Esteron 76-BE, CAS 90-80-4[3]; Esteron-99[4]; DED-WEED LV-69[6]; 2,4-D DMA, Weedar 64, Floratox[9]; Dacamine 4-D[8]; Emulsamine E-3[8]; Emulsavert D[10]; Diclofop, HOE-23408, HOE-Grass, Illoxan, Hoelon[11]

Principal Use: Herbicide

Sample Description: 2,4-Dichlorophenoxyacetic acid, granular 100%[1]; 4-(2,4-Dichlorophenoxy) butyric acid, technical grade 100%[2]; butyl ester of 2,4-D, liquid 98.4%[3]; propylene glycol butyl ether ester of 2,4-D, liquid 100%[4]; butoxy ethanol ester of 2,4-D, technical 62.5%[5]; isooctyl (2-ethylhexyl) ester of 2,4-D, 67%[6]; dimethyl amine salt (DMA) of 2,4-D, liquid 49%[7]; N-oleyl-1,3-propylenediamine salt of 2,4-D, commercial 57%[8]; dodecyl (50.7%)/tetradodecyl (12.7%) amine of 2,4-D, oil soluble liquid 63.4%[8]; N,N-dimethyl-2,4-Dichlorophenoxy-acetamide, technical 99%[10]; methyl 2- 4-(2,4-Dichlorophenoxy)-phenoxy proanoate, technical 95%[11]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Cutthroat trout[1]	0.3	10	64 57-72
Lake trout[1]	0.3	10	45 35-56
Pteronarcys[2]	J	15	15 10-22
Rainbow trout[2]	0.8	12	2.0 1.2-3.2
Fathead minnow[2]	0.5	17	18 13-25
Bluegill[2]	1.4	17	7.5 5.5-10.5
Pteronarcella[3]	N	10	1.5 1.2-1.9
Cutthroat trout[3]	0.8	10	0.9 0.7-1.0
Lake trout[3]	0.6	10	0.9 0.8-1.0
Simocephalus[4]	I_1	15	4.9 4.0-6.7
Daphnia magna[4]	I_1	21	1.2[b,c] 0.7-2.0
Cypridopsis[4]	M	21	0.4[b] 0.3-0.7
G. fasciatus[4]	M	15	2.9 1.7-4.7
Palaemonetes[4]	M	21	0.4[c] 0.09-1.4
Pteronarcys[4]	YC_2	10	2.6[c] 1.8-3.8
Pteronarcella[4]	N	10	2.4 1.9-3.2
Cutthroat trout[4]	1.0	10	1.0 0.9-1.2
Rainbow trout[4]	1.5	15	1.0 0.8-1.1
Lake trout[4]	0.6	10	1.1 1.0-1.2
Bluegill[4]	1.0	18	0.6 0.4-0.7
Daphnia magna[5]	I_1	21	6.4 4.5-9.1
Cypridopsis[5]	M	21	2.2[b,c] 1.5-3.3
Asellus[5]	M	15	2.6 1.3-5.3
G. fasciatus[5]	M	15	6.1[c] 4.5-8.3
Fathead minnow[5]	0.9	18	3.3 2.5-4.2
Bluegill[5]	1.4	18	1.2 1.1-1.3
G. fasciatus[6]	M	21	2.4 1.9-3.0

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Daphnia magna[7]	I_1	21	4.0[b,c] 3.4-4.9
Cypridopsis[7]	M	21	8.0[b,c] 5.9-10.8
G. fasciatus[7]	M	15	>100[c]
Palaemonetes[7]	M	21	0.15[b] 0.11-0.20
Chinook salmon[7]	1.0	10	>100
Rainbow trout[7]	1.4	10	>100
Fathead minnow[7]	0.8	17	335 245-458
Channel catfish[7]	1.9	18	155 142-169
Bluegill[7]	1.1	18	168 123-230
Smallmouth bass[7]	0.4	10	236 185-300
Channel catfish[8]	1.9	18	0.3 0.2-0.5
Bluegill[8]	1.1	18	0.8 0.6-0.9
Chinook salmon[9]	1.0	10	4.8 4.0-5.8
Rainbow trout[9]	1.4	10	3.1 2.2-4.3
Fathead minnow[9]	0.9	20	2.7 1.8-4.0
Channel catfish[9]	0.8	20	7.0 5.6-8.7
Bluegill[9]	1.4	20	7.4 6.1-9.0
Smallmouth bass[9]	0.4	20	3.1 2.6-3.7
Bluegill[10]	1.3	18	816 635-1,050
Rainbow trout[11]	0.6	12	0.25 0.19-0.33
Bluegill[11]	0.8	22	0.54 0.38-0.78

[a]Separate summaries of acute toxicity data are given for four groups of phenoxy herbicides: 2,4-D; 2,4,5-T; mixtures of 2,4-D and 2,4,5-T; and others.
[b]48-h EC50.
[c]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: (Superscript numbers refer to equivalent numbers shown in sample description) Alterations in water hardness (44 to 300 ppm) did not appreciably change the toxicity of 2,4-D or any of its derivatives tested. Variations in pH from 6.5 to 8.5 did affect toxicity of some 2,4-D test chemicals. The 2,4-D acid,[1] a butyl ester,[3] and a dimethyl amine salt[7] of 2,4-D were about half as toxic to fish at pH 8.5 as at pH 6.5. However, the dodecyl/tetradodecyl amine[9] was nearly 4 times more toxic to fathead minnows at pH 8.5 than at 6.5; 96-h LC50's increased from 2.4 to 8.4 mg/L as pH decreased. Aging of test solutions for up to 21 days also altered toxicity of certain 2,4-D compounds. Toxicity of the butyl ester[3] and the propylene glycol butyl ether ester[4] was halved by the aging of test solutions for 21 days. The toxicities of two amine salts[7,9] to fathead minnows did not change after test solutions were aged for 21 days. Fry and fingerlings were considerably more sensitive than eggs to two amine salts of 2,4-D: in fathead minnows, tests with the dimethyl amine of 2,4-D[7] yielded 96-h LC50's from 320 to 630 mg/L for fingerlings and swim-up fry, compared with over 1,400 mg/L for the egg stage; in rainbow trout, tests with dodecyl/tetradodecyl amine[9] against several early life stages yielded LC50's (mg/L) of 3.2 for fingerlings, 1.4 for swim-up fry, 7.6 for yolk-sac fry, and 47 for eggs.

Flow-through tests with a propylene glycol butyl ester of 2,4-D[4] produced a TILC50 of 313 μg/L and a cumulative toxicity index of 1.05 μg/L in cutthroat trout. Tests with dodecyl/tetradodecyl amine[9] against rainbow trout and bluegills produced TILC50's of 497 and 1,093 μg/L and cumulative toxicity indices of 2.0 and 4.2, respectively.

PHENOXY HERBICIDES: 2,4,5-T

Chemical Name: 2,4,5-Trichlorophenoxyacetic acid (derivatives shown in sample description)

Alternate Names: (Superscript numbers refer to superscripts in sample description and summary table) 2,4,5-T, Silvex, Kurosal, Silvi-Rhap[1]; Weedone 2,4,5-TP[4]; Kuron, Visko-Rhap 2TP[5]

Principal Use: Herbicide

Sample Description: 2-(2,4,5-Trichlorophenoxy) propionic acid, liquid 65.2%[1]; triethyl amine of 2,4,5-T, technical 56.7%[2]; butoxy ethanol ester of 2,4,5-Trichlorophenoxyacetic acid, liquid 58.3%[3]; butoxy ethanol ester of 2-(2,4,5-Trichlorophenoxy) propionic acid, technical 58.9%[4]; propylene glycol butyl ether ester of 2-(2,4,5-Trichlorophenoxy) propionic acid, liquid 69.2%[5]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Asellus[1]	M	18	>32
G. fasciatus[1]	M	21	>100
Coho salmon[1]	1.4	12	0.6 0.5-0.8
Rainbow trout[1]	1.1	12	17.2 14.0-21.0
Channel catfish[1]	1.6	17	19.4 15.9-23.7
Bluegill[1]	0.7	17	10.4 8.5-12.6
Fathead minnow[2]	0.8	17	>100
Channel catfish[2]	2.0	17	>100
Bluegill[2]	1.1	18	>100
Asellus[3]	M	15	>3.2[a]
G. fasciatus[3]	M	15	0.12 0.08-0.18
Palaemonetes[3]	M	21	2.7[a] 1.9-3.9
Cypridopsis[4]	M	21	4.6[a,b] 3.7-5.8
Asellus[4]	M	15	88 57-136
Goldfish[4]	0.8	18	62 48-78
Bluegill[4]	1.0	18	45 42-47
Rainbow trout[5]	1.5	12	0.64 0.53-0.77

[a]Tested in hard water, 272 ppm $CaCO_3$. [b]48-h EC50.

PHENOXY HERBICIDES MIXTURES OF 2,4-D AND 2,4,5-T

Chemical Name: Mixture of 2,4-dichlorophenoxy acetic acid/2,4,5-trichlorophenoxy acetic acid (see sample description)

Alternate Names: (Superscript numbers refer to superscripts in sample description and summary table) Brush Rhap[1]; Veon[2]; Brush Killer[3,4]; Weed and Brush-Off 400[5]

Principal Use: Herbicide

Sample Description: 2,4-Dichlorophenoxyacetic acid dimethylamine salt/2,4,5-Trichlorophenoxyacetic acid triethylamine salt mixture, liquid 53.3% (20.5% 2,4-D and 20.5% 2,4,5-T)[1]; as above, liquid 52.5% (20.2% 2,4-D and 20.2% 2,4,5-T)[2]; 2,4-Dichlorophenoxyacetic acid (34.4%)/2,4,5-Trichlorophenoxyacetic acid (16.9%) dimethylamine salt, liquid 51.3% (28.5% 2,4-D and 14.3% 2,4,5-T)[3]; 2,4-Dichlorophenoxyacetic acid (29.7%)/2,4,5-Trichlorophenoxyacetic acid (28.5%) triethylamine salt, liquid (20.3% 2,4-D and 20.3% 2,4,5-T)[4]; 2,4-Dichlorophenoxyacetic acid (17.5%)/2,4,5-trichlorophenoxyacetic acid (8.8%), diethylethanolamine salt, liquid (12.1% 2,4-D and 6.1% 2,4,5-T)[5]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Channel catfish[1]	1.5	18	>100
Bluegill[1]	1.3	18	>100
Rainbow trout[2]	1.0	12	51 38-68
Bluegill[2]	1.1	18	41 32-52
Bluegill[3]	1.1	18	>100
Rainbow trout[4]	1.0	12	24 18-31
Bluegill[4]	1.1	18	23 16-32
Bluegill[5]	0.6	18	0.16 0.08-0.29

PHENOXY HERBICIDES: OTHERS

Chemical Name: See sample description.

Alternate Names: (Superscript numbers refer to superscripts in sample description and summary table.) MCPB Acid, Can-Trol[1]; MCPA-DMA, Agroxone, Chiptox, Hormotuho, Kilsem, Mephanac, Phenoxylene, Rhonox, Zelan[2]

Principal Use: Herbicide

Sample Description: 4-(2-methyl-4-chlorophenoxy) butyric acid, technical 90.5%[1]; 2 methyl-4-chloro= phenoxyacetic acid, liquid concentrate 27.6%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Rainbow trout[1]	1.1	12	<0.07
Fathead minnow[1]	0.5	17	12.5 8.8-17.5
Bluegill[1]	0.8	17	3.3 2.0-5.6
Bluegill[2]	F	24	>10

PHORATE

Chemical Name: 0,0-Diethyl S-[(ethylthio) methyl] phosphorodithioate

Alternate Names: Timet, Thimet, Rampart, Vegfru

Principal Use: Insecticide

Sample Description: Technical material, 100%[1], 91%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. fasciatus[1]	M	15	4 2-7
Pteronarcys[1]	YC_2	15	4 2-6
Rainbow trout[1]	1.2	12	13 11-16
Northern pike[1]	0.7	15	110[a] 90-130
Cutthroat trout[2]	1.0	12	6.0 5.2-6.8
Largemouth bass[2]	0.9	15	5.0[a] 4.7-5.4
Bluegill[2]	1.0	15	2.0 1.5-2.5
Channel catfish[2]	1.0	15	280 115-680

[a]Tested in hard water, 272 ppm $CaCO_3$.

PHOSALONE

Chemical Name: 0,0-Diethyl S-[6-chloro-3-(mercapto= methyl)-2-benzoxazolinone] phosphorodithioate

Alternate Names: Azofene, Benzphos, CAS 2310-17-01, ENT-27163, NIA-9241, RP-11974, Rubitox, Zolone

Principal Use: Insecticide-acaricide

Sample Description: Wettable powder, 25%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Rainbow trout	1.1	12	150 70-330
Fathead minnow	0.5	18	320 190-540
Bluegill	0.8	18	100 70-140

PHOS-CHEK

Chemical Name: Diammonium phosphate plus thickening, coloring, and anti-corrosion additives

Alternate Names: None known

Principal Use: Forest fire retardant

Sample Description: Commercial formulation, 89%; Phos-Chek 202[1]; Phos-Chek 259[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. pseudolimnaeus[1]	M	18	52 48-68
Coho salmon[1]	1.0	11	320 279-367
Rainbow trout[1]	0.8	11	230 204-259
Fathead minnow[1]	0.7	21	650 497-851
Bluegill[1]	1.0	21	840 753-937
Largemouth bass[1]	0.5	21	840 753-937
G. pseudolimnaeus[2]	M	18	40 32-46
Coho salmon[2]	1.0	11	245 216-277
Rainbow trout[2]	0.8	11	160 150-171
Fathead minnow[2]	0.7	21	300 265-340
Bluegill[2]	1.0	21	350 300-404
Largemouth bass[2]	0.5	21	450 402-504

NOTE: Yolk-sac fry were more sensitive than fingerlings in both coho salmon and rainbow trout. A decrease in test temperature from 11° to 6°C did not appreciably alter toxicity for either species.

PHOSMET

Chemical Name: N-(Mercaptomethyl)phthalimide S-(0,0-dimethyl phosphorodithioate)

Alternate Names: CAS 732-11-6, ENT-25705, Imidan, Phthalophos, Prolate, R-1504

Principal Use: Insecticide

Sample Description: Technical material, 95.3%[1]; wettable powder, 50%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Streptocephalus[1]	M	21	170[a] 145-220
Daphnia magna[1]	I_1	21	5.6[b] 4.2-8.4
Asellus[1]	M	20	90 62-130
G. fasciatus[1]	M	15	2.0 1.4-2.8
Chironomus[1]	I_4	20	3,150[b] 2,370-4,190
Chinook salmon[1]	1.0	10	150 112-200
Rainbow trout[1]	0.8	10	300 213-423
Fathead minnow[1]	0.1	20	7,300 4,700-11,400
Channel catfish[1]	0.4	20	10,600 8,400-13,400
Bluegill[1]	0.5	20	200 150-270
Smallmouth bass[1]	0.4	20	150 100-224
Largemouth bass[1]	0.5	20	160 105-244
Daphnia magna[2]	I_1	21	11[b,c] 9-14
Chironomus[2]	I_4	20	3,400[b] 2,470-4,680
Rainbow trout[2]	0.2	10	500 318-785
Fathead minnow[2]	0.1	20	9,000 6,200-13,200
Channel catfish[2]	0.4	20	7,500 6,300-8,900
Bluegill[2]	0.5	20	160 120-220

[a]48-h LC50.
[b]48-h EC50.
[c]Tested in hard water.

NOTE: An increase in temperature from 10° to 25°C produced a ninefold increase in toxicity to bluegills; however, rainbow trout were slightly more sensitive at 5°C than at 10°C. The toxicity of phosmet at pH 8.5 was 0.03 that at pH 6.5. Toxicity was unaffected by water hardness. Eyed eggs and yolk-sac fry were considerably less sensitive than swim-up fry or fingerlings. After 3 to 4 days of aging in aqueous solution, toxicity to midge larvae and bluegills was reduced to 0.04 that of fresh solution. Aqueous degradation appeared to be slower at pH 6.3 than at 7.4. Fish and invertebrates continuously exposed to 1.2 μg/L accumulated residues 2 to 9 times greater than the water concentration. After 10 days of exposure in flow-through tests, LC50 values ranged from 44 μg/L for aquatic sowbugs to 78 μg/L for rainbow trout. Prominent sublethal effects were noted in trout in concentrations down to 35 μg/L.

PHOSPHAMIDON

Chemical Name: 2-Chloro-N,N-diethyl-3-(dimethoxyphosphinyloxy) crotonamide

Alternate Names: Dimecron, Dixon, C570

Principal Use: Systemic and contact insecticide-acaricide

Sample Description: Technical material, 80%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Simocephalus	I_1	15	0.012[a] 0.0079-0.018
Daphnia pulex	I_1	15	0.010[a] 0.0067-0.015
G. fasciatus	M	15	0.013 0.006-0.028
Pteronarcys	YC_2	15	1.5 0.77-2.92
Rainbow trout	0.8	15	7.8 6.2-9.8
Fathead minnow	1.0	18	100 91-110
Channel catfish	0.8	18	70 67-74
Bluegill	0.5	24	3.4 2.4-4.9

[a]48-h EC50.

PHOXIM

Chemical Name: Phenylglyoxylonitrile oxime 0,0-diethyl phosphorothioate

Alternate Names: Bay 5621, Bay 77488, Bayer 77488, Baythion, ENT-27488, Phoxime, Valexon, Volaton

Principal Use: Insecticide

Sample Description: Technical material, 89%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Procambarus	I_E	12	6.5 4.3-9.7
Coho salmon	0.5	12	407 327-507
Rainbow trout	0.2	12	180[a] 119-272
Atlantic salmon	0.5	12	380 311-465
Brown trout	0.6	12	<300
Brook trout	1.5	12	432 371-503
Northern pike	F	12	165[a,b] 123-221
Fathead minnow	0.3	12	2,900 2,260-3,721
Channel catfish	F	12	1,210 1,009-1,451
Bluegill	1.1	22	82 61-110

[a]Tested in hard water, 314 ppm $CaCO_3$.
[b]Flow-through test.

NOTE: Increases in toxicity ranging from twofold to fivefold occurred when temperatures were increased from 7° to 17°C for coho salmon and from 12° to 22°C for bluegills. Variations in pH (6.5 to 9.5) or water hardness (12 to 300 ppm) did not alter toxicity to coho salmon or bluegills. Prolonged exposure of coho salmon, brook trout, northern pike, bluegills, and yellow perch produced TILC50's ranging from 21 μg/L for northern pike to 309 μg/L for coho salmon. Cumulative toxicity indices ranged from 1.2 to 7.9, indicating only a slight cumulative toxic effect.

PHTHALIC ACID ESTERS

Chemical Name: n-Butyl and di-2-ethylhexyl esters of phthalic acid

Alternate Names: PAE, DBP, DEHP

Principal Use: Industrial chemical: plasticizer

Sample Description: Commercial formulation, 100%: di-n-butyl phthalate[1], di-2-ethylhexyl phthalate[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. pseudolimnaeus[1]	M	21	2.1[a]
Orconectes[1]	I_E	21	>10.0[a]
Rainbow trout[1]	1.5	12	2.6 1.2-5.3
Fathead minnow[1]	0.8	17	1.3 0.3-5.5
Channel catfish[1]	1.4	17	2.9 1.4-6.1
Bluegill[1]	1.3	17	0.7 0.4-1.3
G. pseudolimnaeus[2]	J	21	>32
Coho salmon[2]	1.5	16	>100
Rainbow trout[2]	1.5	12	>100
Channel catfish[2]	1.5	20	>100
Bluegill[2]	0.6	17	>100

[a]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Variation in water hardness from 44 to 272 ppm or pH from 6.5 to 9.0 did not alter toxicity of DBP. In channel catfish, yolk-sac fry were slightly more sensitive than fingerlings. Fathead minnows accumulated equilibrium levels of DEHP 1,380 times the water concentration of 2.5 μg/L after 28 days. Residue half-life was 7 days. Invertebrates accumulated DBP and DEHP up to 6,700 and 13,400 times, respectively, when exposed to water concentrations ranging from 0.08 to 0.3 μg/L. Over 90% of the residues were lost within 10 days in clean water. DEHP reduced reproduction in *Daphnia magna* and increased abortion and fry mortality in guppies (*Poecilia* sp.) DBP was metabolized 16 times faster than DEHP by hepatic microsomes of channel catfish. The monoester was the predominant metabolite. The TILC50's for rainbow trout, fathead minnows, bluegills, and yellow perch ranged from 0.2 to 4.0 μg/L; cumulative toxicity indices between 1.0 and 1.8 indicated little or no cumulative toxic effect.

PHYGON XL

Chemical Name: 2,3-Dichloro-1,4-naphthoquinone

Alternate Names: Phygon, Seed Protectant, dichlone

Principal Use: Fungicide

Sample Description: Wettable powder, 50%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Cypridopsis	M	21	32[a] 20-50
G. fasciatus	M	21	1,100 802-1,507
Rainbow trout	0.5	12	49 41-58
Bluegill	1.5	18	148 107-205

[a]48-h EC50, tested in hard water, 272 ppm $CaCO_3$.

PHYTAR 560

Chemical Name: Sodium salt of cacodylic acid

Alternate Names: Rad-E-Cate 25, sodium cacodylate

Principal Use: Herbicide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. fasciatus	M	15	>100
Palaemonetes	M	21	28[a] 14-58
Bluegill	0.8	18	17 15-19

[a]Tested in hard water, 272 ppm $CaCO_3$.

PICLORAM

Chemical Name: 4-Amino-3,5,6-trichloropicolinic acid

Alternate Names: Amdon, Borolin, CAS 1918-02-1, M-3179, Tordon

Principal Use: Herbicide

Sample Description: Technical material, 90-100%[1]; isooctylester, 90%[2]; potassium salt, 24.9%[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. fasciatus[1]	M	21	0.027 0.020-0.037
Pteronarcella[1]	N	10	>10.0
Pteronarcys[1]	YC_2	15	0.048 0.037-0.062
Cutthroat trout[1]	0.4	12	4.8 3.8-6.2
Rainbow trout[1]	0.8	12	12.5 9.5-16.5
Lake trout[1]	0.3	10	4.3 4.0-4.5
Channel catfish[1]	1.4	18	6.3 3.6-11.1
Channel catfish[1]	1.0	22	15.5 11.4-20.9
Bluegill[1]	0.9	22	23.0 17.8-29.9
Rainbow trout[2]	1.1	12	4.0 2.8-5.9
Channel catfish[2]	1.4	18	1.4 0.7-2.5
Cutthroat trout[3]	0.9	10	1.5 0.8-3.0
Bluegill[3]	0.9	18	26.8 22.9-31.3

NOTE: Toxicity to cutthroat trout or lake trout was not substantially altered by variations in temperature or water hardness, or by aqueous degradation for 4 weeks. Toxicity was reduced by 50% by a decrease in pH from 7.5 to 6.5 but was not altered by an increase to pH 8.6. No cumulative toxic action was indicated in flow-through tests; cumulative toxicity indices were 1.6 or less and TILC50's were 1.5 mg/L for cutthroat trout and 1.2 mg/L for lake trout. Toxicity to fry of rainbow trout and channel catfish did not differ appreciably from that of fingerlings; 96-h LC50's ranged from 5.8 to 8.0 mg/L for yolk-sac and swim-up fry. In chronic toxicity studies, the rate of yolk sac absorption and growth of lake trout fry was reduced at concentrations as low as 35 μg/L. The no-effect concentration of picloram for lake trout is apparently below this value.

PIPERONYL BUTOXIDE

Chemical Name: a-[2-(2-Butoxyethoxy)ethoxy]-4,5-methylenedioxy-2-propyltoluene

Alternate Names: FMC-5273, Butacide

Principal Use: Synergist with pyrethrins, tetra=methrin, and rotenone

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Asellus	M	15	12[a] 7-22
Rainbow trout	0.6	12	3.4 2.7-4.3
Bluegill	0.7	18	4.2 3.8-4.6

[a]Tested in hard water, 272 ppm $CaCO_3$.

PLICTRAN

Chemical Name: Tricyclohexyltin hydroxide

Alternate Names: CAS 13121-70-5, Cyhexatin, Dowco 213, M-3180

Principal Use: Acaricide

Sample Description: Technical material, 96.8%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Daphnia magna	I_1	21	0.17[a] 0.12-0.26
G. fasciatus	M	15	5
Bluegill	1.1	18	6.7 5.8-7.7
Largemouth bass	0.8	18	2.1[b] 1.9-2.3

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

POLYCHLORINATED BIPHENYLS AND TERPHENYLS

Chemical Name: See Aroclor numbers

Alternate Names: Aroclor, PCB

Principal Use: Industrial chemical: plasticizer, dielectric fluid

Sample Description: Commercial formulations, 100%: Aroclors 1016[1], 1221[2], 1232[3], 1242[4], 1248[5], 1254[6], 1260[7], 1262[8], 1268[9], 4465[10], 5442[11], 5460[12]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Pteronarcella[1]	N	10	610[a] 424-878
Rainbow trout[1]	0.5	12	135 114-159
Atlantic salmon[1]	5.6	12	134[b] 113-159
Brown trout[1]	4.6	12	138[b] 109-175
Brook trout[1]	3.0	12	>800[b]
Lake trout[1]	YSF	10	890[a] 686-1,154
Lake trout[1]	SUF	10	480[a] 386-596
Longnose sucker[1]	F	12	330[b] 222-490
White sucker[1]	1.9	12	435[b] 325-582
Channel catfish[1]	YSF	25	440 340-560
Bluegill[1]	0.9	12	460[b] 390-540
Yellow perch[1]	0.8	12	240 153-376
Cutthroat trout[2]	2.7	9	1,170 957-1,430
Cutthroat trout[3]	2.2	9	2,500 1,720-3,080
G. pseudolimnaeus[4]	M	15	10[b]
Orconectes[4]	I_E	21	30[c]
Macromia[4]	J	21	800[c]
Ischnura[4]	J	15	400[b]
Cutthroat trout[4]	F	9	5,420 3,820-7,680
Rainbow trout[4]	1.8	17	67[b,d]
Channel catfish[4]	2.8	17	>100[b]
Bluegill[4]	2.2	17	125[b,d]
Yellow perch[4]	1.2	17	>150[a,b]
G. fasciatus[5]	M	21	52
Cutthroat trout[5]	2.5	9	5,750 5,100-6,480
Rainbow trout[5]	1.8	17	54[b,d]

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Channel catfish[5]	2.8	22	>100[b]
Bluegill[5]	0.8	18	690 480-990
Yellow perch[5]	1.1	17	>100[b]
G. fasciatus[6]	M	21	2,400
Orconectes[6]	I_E	21	100[a]
Procambarus[6]	I_E	12	>550
Palaemonetes[6]	M	15	3.0[b,c]
Macromia[6]	J	21	800[c]
Ischnura[6]	J	15	200[b]
Cutthroat trout[6]	2.5	9	42,500 38,700-46,700
Rainbow trout[6]	1.8	17	142[b,d]
Channel catfish[6]	2.8	22	>200[b]
Bluegill[6]	0.8	18	2,740 1,294-5,810
Yellow perch[6]	1.0	17	>150[b]
Cutthroat trout[7]	2.6	9	60,900 55,400-67,000
Rainbow trout[7]	1.8	17	>232[b]
Channel catfish[7]	2.8	22	>400[b]
Bluegill[7]	2.2	22	>400[b]
Yellow perch[7]	1.2	17	>200[b]
Cutthroat trout[8]	F	9	>50,000
Cutthroat trout[9]	F	9	>50,000
Cutthroat trout[10]	F	9	>65,000
Cutthroat trout[11]	F	9	>50,000
Cutthroat trout[12]	F	9	>50,000

[a]Tested in hard water, 162-272 ppm $CaCO_3$.
[b]Flow-through test.
[c]Seven-day LC50.
[d]Five-day LC50.

NOTE: The LC50's for fish in flow-through tests of 25 to 30 days ranged from 3 to 433 μg/L and those for invertebrates in 5- to 10-day exposures ranged from 0.6 to 80 μg/L. TILC50's ranged from 33 to 80 μg/L for fish; however, mortality did not reach time-independence within 30 days in most tests. Cumulative toxicity indices ranged from 2 to 15, indicating a low to moderate degree of accumulative action. Biological magnification of Aroclors 1248 and 1254 by channel catfish was 56,370 to 60,190 times the levels in water after 60 days. Invertebrates showed a magnification of Aroclor 1254 up to 6,300 times within 21 days. Chronic dietary exposures of Aroclor 1254 produced no observable toxicosis or effects on growth in coho salmon or channel catfish within a 260-day exposure, although thyroid activity was stimulated. In other chronic toxicity studies, growth decreased in brook trout fry after 48 days of exposure to concentrations of Aroclor 1254 of 1.5 μg/L or greater. As judged by decreased hydroxyproline concentration in collagen isolated from the backbone of brook trout, 0.43 μg/L was considered the no-effect concentration for Aroclor 1254.

PROPHAM

Chemical Name: Isopropyl N-phenylcarbamate

Alternate Names: CAS 122-42-9, Chem-hoe, IFC, IFK, INPC, IPC, IPPC, Iso-PPC, Triherbide-IPC, Tuberite, Y-2

Principal Use: Herbicide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Simocephalus	I_1	15	10[a] 7-15
Daphnia pulex	I_1	15	8[a] 5-13
G. fasciatus	M	15	19[a,b] 10-34
Rainbow trout	0.8	12	38 34-43
Bluegill	0.3	24	29

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

PROPOXUR

Chemical Name: o-Isopropoxyphenyl N-methyl= carbamate

Alternate Names: Aprocarb, Bay 9010, Bay 39007, Blattanex, CAS 114-26-1, ENT-25671, Baygon, Sendran, Suncide, Tendex, Tugon Fliegankugel, Unden

Principal Use: Insecticide

Sample Description: Technical material, 88%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. lacustris	M	21	34 29-39
Pteronarcys	YC_2	15	18
Rainbow trout	1.2	13	8,200
Fathead minnow	0.6	18	25,000
Bluegill	0.8	24	4,800

PURIFLOC C-31

Chemical Name: High molecular weight, cationic, water soluble, synthetic organic polyelectrolyte

Alternate Names: None known

Principal Use: Flocculant

Sample Description: Commercial formulation, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Chinook salmon	YSF	10	357 251-507
Rainbow trout	1.3	11	446 310-640
Fathead minnow	1.2	17	490 419-596
Channel catfish	1.5	20	680 539-858
Bluegill	0.6	20	1,470 1,250-1,730

NOTE: The TILC50 is 128 μg/L for rainbow trout and 871 μg/L for bluegills. Cumulative toxicity indices of 1.5 and 1.4, respectively, indicate little or no cumulative action.

PYDRAUL 50E

Chemical Name: Mixture of tri-aryl phosphate esters containing phenol, tolyl (cresyl), xylyl, and ethyl substituted benzene groups

Alternate Names: Tri-aryl phosphate ester

Principal Use: Hydraulic fluid

Sample Description: Commercial formulation, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. pseudolimnaeus	M	20	0.56[a] 0.40-0.78
Orconectes	M	16	>1.5[a,b]
Pteronarcella	N	10	12.5 8.7-17.9
Coho salmon	0.5	12	0.1
Rainbow trout	1.3	10	0.7 0.5-1.0
Brook trout	4.0	12	1.4[b] 1.2-1.7
Fathead minnow	1.0	20	1.3 0.5-3.2
Channel catfish	1.6	21	3.0 2.2-4.1
Bluegill	0.6	20	2.2 1.5-3.2
Lake trout	YSF	10	2.8 2.1-3.7

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Lake trout	SUF	10	2.9 2.4-3.4
Lake trout	0.8	10	1.5[a] 1.1-1.9

[a]Tested in hard water, 170–272 ppm $CaCO_3$.
[b]Flow-through toxicity test.

NOTE: Green eggs of brown trout were much less sensitive than fingerlings, for which the 96-h LC50 was 11 mg/L. Variations in water hardness from 44 to 300 ppm did not alter toxicity to eggs. The TILC50's ranged from 0.25 mg/L for rainbow trout to 2.09 mg/L for channel catfish. Cumulative toxicity indices varied from 1.1 to 2.7, indicating little or no cumulative toxic action. Sublethal effects were prominent in flow-through tests at concentrations considerably below acutely lethal levels. Effects included early cessation of feeding, hypersensitivity, and erratic swimming. Those effects were followed by a loss of motor function, associated with hemorrhage in the dorsal fin region and occurrence of a characteristic "broken back" syndrome. This condition remained for extended periods, and death usually resulted from secondary causes. Opaqueness of the eye lens of rainbow trout was a characteristic lesion after 90-day exposures to concentrations greater than 2.1 μg/L.

PYDRAUL 115E

Chemical Name: Mixture of tri-aryl phosphate esters containing phenol, tolyl (cresyl), xylyl, and ethyl substituted benzene groups

Alternate Names: Tri-aryl phosphates

Principal Use: Hydraulic fluid

Sample Description: Commercial formulation, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Rainbow trout	1.0	12	45 34-60
Rainbow trout	0.6	12	10 5.7-17.4
Channel catfish	1.3	20	>100
Bluegill	0.6	20	>100

NOTE: Sublethal effects were similar to those of Pydraul 50E.

PYRETHRUM

Chemical Name: Mixture of Pyrethrin I, Pyrethrin II, Cinerin I, Cinerin II, Jasmolin I, and Jasmolin II

Alternate Names: Pyrethrins (natural)

Principal Use: Botanical insecticide

Sample Description: Liquid, 20% active

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. fasciatus	M	15	1.4 0.9-2.1
Coho salmon	0.7	12	42 35-50
Coho salmon	F	12	28[a] 18-30
Atlantic salmon	0.2	7	40 30-53
Brown trout	0.6	12	50 44-57
Lake trout	0.5	12	37 32-44
Channel catfish	0.7	18	9.0 6.7-12.0
Channel catfish	0.7	18	13[b] 8-23
Bluegill	0.8	22	58 52-65

[a]Flow-through test, hard water (314 ppm $CaCO_3$).
[b]n-Propyl isome, a pyrethrin synergist (dipropyl-5,6,7,8-tetrahydro-7-methylnaphtho (2,3-d)-1,3-dixole-5,6-dicarb= oxylate).

NOTE: Temperature and pH of test solutions affected the biological activity of natural pyrethrins. Toxicity

to channel catfish was 12-fold higher at 18°C than at 12°C. Toxicity increased in acid water; the 96-h LC50 for bluegills was 41 μg/L at pH 6.5 and 87 μg/L at pH 9.5. Water hardness (44-314 ppm) had little influence on toxicity.

RESMETHRIN

Chemical Name: (5-Benzyl-3-furyl)methyl 2,2-dimethyl-3-(2-methyl propenyl) cyclopropane= carboxylate

Alternate Names: Chryson, benzofuroline, NRDC 104, SBP-1382

Principal Use: Insecticide (synthetic pyrethroid)

Sample Description: Technical material, 84.5%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Coho salmon	0.5	18	1.8[a] 0.55-5.6
Lake trout	0.7	12	1.7 1.1-2.5
Fathead minnow	0.7	17	3.0 0.89-9.9
Channel catfish	0.7	18	16.6 9.6-28.6
Bluegill	0.6	18	1.7 0.31-9.3

[a]Tested in hard water, 262 ppm $CaCO_3$.

RONNEL

Chemical Name: 0,0-Dimethyl 0-(2,4,5-trichlorophenyl) phosphorothioate

Alternate Names: Fenchlorphos, Ectoral, Etrolene, Nankor, Korlan, Trolene, Viozene

Principal Use: Insecticide

Sample Description: Technical material, 95%[1], crystal, 98.4%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. fasciatus[1]	M	15	4,300[a] 3,400-5,400
Rainbow trout[1]	1.1	12	550 410-730
Channel catfish[1]	1.1	18	1,600 1,480-1,730
Bluegill[1]	1.0	18	1,300 1,180-1,430
Cutthroat trout[2]	2.2	12	555 415-742
Lake trout[2]	1.2	12	490[a] 395-608

[a]Tested in hard water, 267 ppm $CaCO_3$.

ROTENONE

Chemical Name: 1,2,12,12a-Tetrahydro-2-isopropenyl-8,9-dimethoxy[1]benzopyrano [3,4-b]furo[2,3-b] [1] benzopyran-6(6aH)-one

Alternate Names: Derrin, Nicouline, Tubatoxin, Noxfish

Principal Use: Insecticide, piscicide

Sample Description: Technical material, 44%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	15	310[a] 239-402
Daphnia pulex	I_1	15	100,000[a] 74,000-134,000
G. fasciatus	M	21	2,600 2,100-3,200
Rainbow trout	0.3	12	31 27-36
Channel catfish	0.5	24	2.6 2.1-3.2

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Bluegill	0.6	24	23 20-25

[a]48-h EC50.

RU-11679

Chemical Name: (5-Benzyl-3-furyl) methyl 1R, 2R-2-[(cyclopentylidene) methyl]-3,3-dimethylcyclo= propane carboxylate

Alternate Names: NIA 24110, ENT 27985-B; Roussel-Uclaf 11679, K-Othrine

Principal Use: Insecticide (synthetic pyrethroid)

Sample Description: Technical material, 96%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Coho salmon	1.1	12	0.63 0.58-0.69
Atlantic salmon	0.6	12	0.41 0.35-0.49
Lake trout	0.4	12	0.17 0.14-0.20
Fathead minnow	0.7	12	0.8 0.7-1.0
White sucker	0.7	12	10.0 3.6-28.0
Bluegill	F	12	0.3 0.2-0.5

NOTE: RU-11679 was deactivated considerably at all pH's tested (6.5-9.5). In flow-through tests, toxicity to channel catfish stabilized after 15 to 20 days of exposure, yielding a TILC50 of 0.19 μg/L.

RYANIA

Chemical Name: Powdered stemwood of *Ryania speciosa*

Alternate Names: Ryanicide

Principal Use: Insecticide

Sample Description: Powdered stems, 100%[1]; powdered stems, 22%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Rainbow trout[1]	1.1	12	3.2 2.9-3.5
Bluegill[1]	1.0	18	18.5 16.1-21.2
Channel catfish[2]	0.7	18	20.0 16.4-24.4

S-BIOALLETHRIN

Chemical Name: d-trans-Chrysanthemum mono= carboxylic acid ester of d-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one

Alternate Names: None known

Principal Use: Insecticide (synthetic pyrethroid)

Sample Description: Technical material, 98%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Fathead minnow	0.7	12	80 66-97
Channel catfish	0.9	12	15[a] 10-21
Bluegill	0.8	12	24 19-30
Yellow perch	1.5	12	7.8 6.5-9.4

[a]Flow-through test.

NOTE: When test temperature was varied from 12° to 22°C, pH from 6.5 to 9.5, and hardness from 12 to 300 ppm, the 96-h LC50 for bluegills remained within the range of 24-39 μg/L.

SD-14114

Chemical Name: Distannoxane, hexakis (beta, beta-dimethyl-phenethyl)

Alternate Names: Vendex, Torque

Principal Use: Acaricide

Sample Description: Technical material, 100%[1]; wettable powder, 50%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Rainbow trout[1]	1.0	12	1.7 1.3-2.4
Fathead minnow[1]	0.7	17	1.9 1.0-3.5
Bluegill[1]	1.2	17	4.8 2.5-9.3
Channel catfish[2]	1.0	17	1.5 0.9-2.7

SD-17250

Chemical Name: N-[(Methylcarbamoyl) oxy] thio= acetimidic acid, ester with 3-mercaptopropionitrile

Alternate Names: None known

Principal Use: Insecticide

Sample Description: Technical material, 100%[1], wettable powder, 75%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Coho salmon[1]	1.4	12	3.1 2.3-4.1
Rainbow trout[1]	0.8	12	1.5 1.0-2.2
Bluegill[1]	0.5	18	5.7 3.4-9.5
Bluegill[2]	0.5	18	1.1 0.9-1.4

SIMAZINE

Chemical Name: 2-Chloro-4,6-bis(ethylamino)-s-triazine

Alternate Names: Princep, Aquazine, Simadex, Primatol

Principal Use: Herbicide

Sample Description: Technical material, 98.1%[1]; wettable powder, 80%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Daphnia magna[1]	I_1	21	1.1[a] 0.56-2.2
Cypridopsis[1]	M	21	3.7[a] 2.6-5.3
G. fasciatus[1]	M	15	>100
Pteronarcys[1]	YC_2	15	1.9 0.9-4.0
Rainbow trout[1]	1.2	12	>100
Fathead minnow[1]	0.7	25	>100
Bluegill[2]	1.0	24	100 90-110

[a]48-h EC50, water hardness 272 ppm $CaCO_3$.

SODIUM ARSENITE

Chemical Name: Sodium meta-arsenite

Alternate Names: Atlas "A," Chem Pels C, Kill-All, Penite

Principal Use: Herbicide, insecticide

Sample Description: Liquid, 99%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Daphnia pulex	I_1	15	3.0[a] 2.2-4.1

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Pteronarcys	YC_2	15	38 30-48
Rainbow trout	2.6	12	23 14-39
Bluegill	1.0	24	30 21-42

[a]48-h EC50.

STROBANE

Chemical Name: Polychlorinates of camphene, pinene, and related terpenes (65% chlorine)

Alternate Names: Terpene polychlorinates

Principal Use: Insecticide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Pteronarcys	YC_2	15	7[a] 4.4-11
Rainbow trout	1.0	12	12 9-14
Bluegill	0.9	24	8.7 7.4-10.2

[a]48-h LC50.

SUFFIX

Chemical Name: Ethyl N-benzoyl-N-(3,4-dichloro=phenyl)-2-aminopropionate

Alternate Names: Suffix 25, WL 17731, SD30053

Principal Use: Selective herbicide

Sample Description: Technical material, 100%[1]; emulsified concentrate: 1.6 lb/gal[2]; 2.0 lb/gal[3]; 17.6%[4]; 22.2%[5]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Fathead minnow[1]	0.5	17	860 660-1,120
Bluegill[1]	0.8	17	1,200 1,073-1,341
Bluegill[2]	0.8	17	1,000 808-1,238
Bluegill[3]	0.8	17	720 564-919
Fathead minnow[4]	0.5	17	460 330-640
Fathead minnow[5]	0.5	17	760 525-1,100

TEMEPHOS

Chemical Name: 0,0,0',0'-Tetramethyl 0,0'-(thiodi-p-phenylene) phosphorothioate

Alternate Names: AC-5216, Bathion, CAS-3383-96-8, ENT-27165, Difenthos, Abate, Nimitox

Principal Use: Insecticide

Sample Description: Technical material 86-90%[1]; emulsifiable concentrate (4-E), 46%[2]; wettable powder, 50%[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
G. lacustris[1]	M	21	0.08 0.03-0.21
Pteronarcella[1]	N	10	0.031 0.023-0.041
Pteronarcys[1]	YC_2	17	0.010 0.007-0.015
Cutthroat trout[1]	0.2	12	1.27 0.87-1.86
Rainbow trout[1]	1.3	12	3.49 2.33-5.23

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Atlantic salmon[1]	0.5	12	21.0 17.5-25.0
Brook trout[1]	1.2	12	12.8 9.75-16.80
Lake trout[1]	2.3	10	3.65 2.70-4.92
Fathead minnow[1]	0.7	17	34.1 19.7-59.2
Channel catfish[1]	1.0	17	>10.0
Bluegill[1]	1.0	17	21.8 15.6-30.5
Coho salmon[2]	0.9	12	0.35 0.23-0.33
Rainbow trout[2]	1.2	12	0.16 0.10-0.24
Channel catfish[2]	1.9	17	3.23 1.71-6.67
Bluegill[2]	1.4	17	1.14 0.80-1.53
Largemouth bass[2]	0.9	17	1.44 0.92-2.25
Atlantic salmon[3]	0.5	12	6.70 5.66-7.94
Brook trout[3]	1.2	12	5.00 3.69-6.77

NOTE: Test conditions and size did not appreciably change the toxicity of temephos to fish. Variations in pH from 6.0 to 9.0, hardness from 40 to 162 ppm, or size from 1 to 20 g gave a range of less than 4 mg/L in 96-h LC50 values. Flow-through tests for up to 15 days with cutthroat trout and lake trout produced TILC50 values of 0.20 and 1.05 mg/L and cumulative toxicity indices of 5.0 and 1.0, respectively.

TEPP

Chemical Name: Tetraethyl diphosphate

Alternate Names: Kilmite 40, Tetron, Vapotone, Nifos

Principal Use: Insecticide

Sample Description: Formulation, 40%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. fasciatus	M	21	39 27-57
Rainbow trout	1.0	12	700 500-980
Fathead minnow	0.6	18	240 144-401
Bluegill	0.8	24	640 537-762

TETRADIFON

Chemical Name: 4-Chlorophenyl 2,4,5-trichlorophenyl sulfone; (2,4,5,4'-tetrachlorodiphenyl sulfone)

Alternate Names: Tedion, Nia-5488

Principal Use: Acaricide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. fasciatus	M	21	111 82-150
Rainbow trout	1.1	12	1,200 949-1,600
Channel catfish	0.3	18	2,100 1,150-3,830
Bluegill	0.8	24	880 664-1,166

TETRAMINE

Chemical Name: Tetramethylene disulfotetramine

Alternate Names: TEM

Principal Use: Rodenticide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
G. fasciatus	M	21	18 12-26
Pteronarcys	YC_2	15	>1,000
Rainbow trout	2.0	12	56 51-62
Bluegill	1.3	18	89 78-101

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Daphnia magna	I_1	—	115[a] 79-168
G. fasciatus	M	15	740 451-1,214
Cutthroat trout	0.3	12	160[b] 142-180
Lake trout	0.3	12	109 90-132

[a]48-h EC50.
[b]Tested in hard water, 162 ppm $CaCO_3$.

TFM

Chemical Name: 3-Trifluoromethyl-4-nitrophenol, sodium salt

Alternate Names: TFN, Hoe-02770, Lampricide

Principal Use: Lampricide

Sample Description: Technical material, 95%[1]; field grade, 35.7%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage	Temp (C)	96-h LC50 95% CI (mg/L)
G. pseudolimnaeus[1]	M	21	22.3[a] 16.0-31.4
Orconectes	I_E	21	17.8 14.9-21.2
G. pseudolimnaeus[2]	M	21	57[a] 47-69

[a]Tested in hard water, 272 ppm $CaCO_3$.

THANITE

Chemical Name: Isobornyl thiocyanoacetate, 82%; other related terpenes, 18%

Alternate Names: None known

Principal Use: Contact insecticide

Sample Description: Liquid, 82%

THIOBENCARB

Chemical Name: S-(4-Chlorobenzyl) N,N-diethylthiol= carbamate

Alternate Names: None known

Principal Use: No known uses

Sample Description: Liquid 95.5%[1], 85.2%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Rainbow trout[1]	0.6	12	1.2 0.74-1.8
Channel catfish[1]	1.2	20	2.3 1.2-4.4
Bluegill[1]	0.6	20	2.5 1.7-3.7
Rainbow trout[2]	0.6	12	1.2 0.7-1.6
Channel catfish[2]	1.2	20	2.3 1.2-4.4
Bluegill[2]	0.6	20	1.7 1.2-2.3

THYNON

Chemical Name: 5,10-Dihydro-5,10-dioxonaphtho-(2,3b)-p-dithiin-2,3-dicarbonitrile

Alternate Names: Dithianon, Delan, Delan-Col

Principal Use: Fungicide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Goldfish	1.0	18	150 66-330
Fathead minnow	0.9	18	165 123-223
Channel catfish	1.6	18	130 120-140

TOXAPHENE

Chemical Name: Chlorinated camphene mixture (content of combined chlorine, 67-69%)

Alternate Names: polychlorocamphene, camphechlor (common names) Clor Chem T-590, Cristoxo, Motox, Phenacide, Phenatox, Strobane-T, Toxakil, Toxon 63

Principal Use: Insecticide

Sample Description: Technical material, 100%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus	I_1	15	19[a] 12.2-29.5
Daphnia magna	I_1	21	10[a] 6.8-14.2
Daphnia pulex	I_1	15	14.2[a] 10.5-19.1
G. fasciatus	M	21	26 18.9-35.7
Pteronarcys	YC_2	15	2.3 1.3-4.0
Tipula	J	15	18.0 12.8-25.4
Chironomus	J	15	30[a] 16.0-56.4
Claassenia	J	15	1.3 1.0-1.6
Atherix	J	15	40 27-60
Coho salmon	1.0	12	8 6-10
Rainbow trout	1.4	12	10.6 7.9-12.7
Brown trout	1.7	12	3.1 2.1-4.7
Goldfish	1.0	18	14 11-19
Carp	0.6	18	3.7 2.8-4.7
Fathead minnow	1.1	20	18 12-27
Black bullhead	0.9	24	5.8 5.1-6.6
Channel catfish	1.5	18	13.1 9.8-17.5
Green sunfish	1.1	18	13 8-17
Bluegill	0.8	24	2.4 2.0-2.8
Largemouth bass	0.9	18	2.0 1.3-3.2
Yellow perch	1.4	18	12 9-14

[a]48-h EC50.

NOTE: Alterations in pH and water hardness did not change the toxicity of toxaphene to fish. In channel catfish, swim-up fry were more sensitive than other life stages tested; 96-h LC50's (μg/L) were 8.0 for yolk-sac fry, 0.8 for swim-up fry, and 2.0 for fingerlings. Flow-through tests with channel catfish and bluegills produced TILC50's of 1.82 and 1.04 μg/L and cumulative toxicity indices of 3.9 and 1.0 μg/L, respectively. Continuous exposures of catfish fry for 90 days to concen-

trations of toxaphene ranging from 72 to 630 ng/L caused significant reductions in collagen and increases in calcium in the backbone; this decrease in organic matrix and increase in mineral content increased the fragility of the backbone.

TRETOLITE

Chemical Name: Not known

Alternate Names: None known

Principal Use: Oil demulsifier

Sample Description: Technical material, 100%; J-146[1], JW-8226[2], and JN9045[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Pteronarcella[1]	N	10	61 37-102
Cutthroat trout[1]	0.6	10	1.4 1.1-1.9
Cutthroat trout[2]	0.5	10	0.36 0.26-0.49
Cutthroat trout[3]	0.5	10	0.36 0.26-0.50

NOTE: Tests with tretolite JW-8226 in hard water against cutthroat trout yielded 96-h LC50's of 0.048 mg/L for eyed eggs and 2.9 mg/L for yolk-sac fry.

TRICHLORFON

Chemical Name: Dimethyl (2,2,2-trichloro-1-hydroxy=ethyl) phosphonate

Alternate Names: Anthon, Bay 13/59, Bayer 15922, Bayer L 13/59, Bovinox, Briton, CAS 52-68-6, Cekufon, Chlorofos, Cicloxom, Clorofos, Danex, Dipterex, Diptetes, Dylox, ENT-19739, Equino-Acid, Masoten Neguvon, Proxol, Trichlorphon, Trinex, Tugon

Principal Use: Insecticide

Sample Description: Technical material, 98%[1]; soluble powder, 80%[2]; liquid, 40%[3]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus[1]	I_1	16	0.70[a] 0.56-0.87
Daphnia pulex[1]	I_1	16	0.18[a] 0.13-0.25
G. lacustris[1]	M	21	40 26-60
Procambarus[1]	M	12	7,800 6,520-9,330
Pteronarcella[1]	N	16	11 7.6-16
Pteronarcys[1]	YC_2	16	35 22-55
Claassenia[1]	YC_1	16	22 16-29
Skwala[1]	N	7	24 17-32
Cutthroat trout[1]	0.6	12	2,700 1,920-3,800
Rainbow trout[1]	0.5	12	1,750 1,250-2,460
Atlantic salmon[1]	0.5	12	1,400 1,130-1,730
Brown trout[1]	4.6	12	3,500 2,490-4,910
Brook trout[1]	0.8	12	2,500 2,180-2,860
Lake trout[1]	2.3	12	550 354-854
Fathead minnow[1]	0.9	18	7,900 6,740-9,260
Channel catfish[1]	1.6	18	880 766-1,010
Bluegill[1]	1.0	18	3,170 2,680-3,750
Largemouth bass[1]	0.8	18	3,450[b] 3,030-3,930
Skwala[2]	N	7	12 8.9-15

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Cutthroat trout[2]	0.9	12	3,250 2,740-3,860
Rainbow trout[2]	1.0	12	700 500-969
Brook trout[2]	0.7	12	9,200 6,740-12,500
Bluegill[2]	0.8	18	940 645-1,360
Rainbow trout[3]	0.6	12	1,400 1,050-1,850

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Variations in temperature and pH significantly altered the toxicity of trichlorfon to test animals. Naiads of the stonefly *Pteronarcella badia* were 19 times more susceptible at pH 8.5 than at pH 6.5. In tests with trout and bluegills, increases in temperature (7° to 17°C) and pH (6.5 to 9.0) were marked by increases in toxicity ranging from 3.4- to 11-fold and 5- to 35-fold, respectively. The increase in toxicity was greatest as pH increased from 7.5 to 8.5; the increase between pH 8.5 and 9.5 was small. Water hardness variations (12 to 300 ppm) did not alter toxicity to cutthroat trout but were accompanied by a fourfold increase in toxicity to brook trout. Toxicity to brook trout increased 10-fold after solutions were aged for 2 weeks but only 5-fold after the solutions were aged for 3 weeks. Small trout (0.6 to 2 g) were 2 to 3 times more susceptible than larger fish (3.2 to 4.4 g). The TILC50 for coho salmon was 3.5 mg/L and the cumulative toxicity index was less than 1.2, indicating no significant cumulative toxic action. Bluegills and channel catfish from ponds given four successive treatments of trichlorfon (0.25 or 1.0 mg/L) at 7-day intervals showed severe acetylcholinesterase inhibition; cumulative mortalities were as high as 29% in channel catfish and 83% in bluegills.

TRICRESYL PHOSPHATE

Chemical Name: Tricresyl phosphate

Alternate Names: TCP

Principal Use: Industrial chemical: flame-retardant plasticizer

Sample Description: Commercial formulation, 100%

SUMMARY OF ACUTE TOXICITY[a]

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Rainbow trout	0.2	12	260 210-322
Channel catfish	1.3	12	803 672-959
Bluegill	0.6	12	150 102-220
Yellow perch	0.7	12	502 384-656

[a]All data are for flow-through tests.

TRIFLURALIN

Chemical Name: *a,a,a*-Trifluoro-2,6-dinitro-N,N,-dipropyl-*p*-toludine

Alternate Names: Treflan, Elancolan, Ipersan, Trefanocide, Triflurex

Principal Use: Selective, pre-emergence herbicide

Sample Description: Technical material, 95.9%[1]; emulsifiable concentrate, 46%[2]

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Simocephalus[1]	I_1	15	900[a] 651-1,245
Daphnia magna[1]	I_1	21	560[a,b] 320-1,000
Daphnia pulex[1]	I_1	15	625[a] 446-876
G. fasciatus[1]	M	21	2,200 1,400-3,400
Pteronarcys[1]	YC_2	15	2,800 2,100-3,700
Rainbow trout[1]	0.8	12	41 26-62
Fathead minnow[1]	0.8	18	105 83-134
Channel catfish[1]	0.8	22	2,200 1,420-3,410

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (μg/L)
Bluegill[1]	0.8	22	58 47-70
Largemouth bass[1]	0.7	18	75[b] 65-87
Goldfish[2]	1.0	18	145 108-195

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

NOTE: Variations in test conditions such as temperature, pH, and water hardness did not appreciably alter the toxicity of trifluralin to fish. However, size of fish did affect toxicity; in rainbow trout, trifluralin was 20 times more toxic to swim-up fry and fingerlings than to yolk-sac fry. In channel catfish, yolk-sac and swim-up fry were 4 to 5 times more sensitive than fingerlings.

UREABOR

Chemical Name: Sodium metaborate tetrahydrate (66.5%), sodium chlorate (30.0%), bromacil (1.5%)

Alternate Names: None known

Principal Use: Herbicide

Sample Description: Dry granule formulation, 98%

SUMMARY OF ACUTE TOXICITY

Test organism	Wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Chinook salmon	1.0	10	352 289-428
Rainbow trout	1.1	10	640 387-1,057
Fathead minnow	0.7	17	>100
Channel catfish	0.9	20	>100
Bluegill	0.9	20	>100

VERNOLATE

Chemical Name: S-Propyl N,N-dipropylthiocarbamate

Alternate Names: Vernam

Principal Use: Selective herbicide

Sample Description: Technical material, 97.7%

SUMMARY OF ACUTE TOXICITY

Test organism	Stage or wt (g)	Temp (C)	96-h LC50 95% CI (mg/L)
Cypridopsis	M	21	0.25[a,b] 0.15-0.42
Asellus	M	15	0.23[b] 0.16-0.33
G. fasciatus	M	15	14.0 9.6-20.0
Palaemonetes	J	2.1	0.53[b] 0.14-2.0
Rainbow trout	1.3	12	4.3 3.9-4.7
Bluegill	1.2	24	2.5 1.7-3.7

[a]48-h EC50.
[b]Tested in hard water, 272 ppm $CaCO_3$.

Table 4. *Summary of Acute Toxicity Data for Chemicals that Received only Limited Testing.*[a]

Compound and test organism	Stage or wt (g)	Temp (C)	96-h LC50 (mg/L)	95% CI
Acetone				
Rainbow trout	1.0	12	5,540	4,740-6,330
Aldicarb				
Rainbow trout	0.5	12	0.56	0.39-0.80
Bluegill	1.3	24	0.05	0.03-0.08
Ametryn				
Rainbow trout	1.2	13	3.2	—
Bluegill	0.8	24	3.7	—
Amitrol				
G. fasciatus	—	18	>10	—
Fathead minnow	1.2	18	>100	—
Channel catfish	1.8	18	>160	—
Benefin				
G. fasciatus	M	15	1.1	0.6-1.9
Goldfish	1.0	18	0.8	0.7-1.0
Fathead minnow	0.9	18	<1.0	—
Bensulide				
G. fasciatus	M	15	1.4	0.4-5.1
Rainbow trout	1.6	13	0.7	—
Bluegill	0.2	24	0.8	—
Benzene				
Rainbow trout	2.4	12	9.2	7.2-11.7
Channel catfish	0.1	22	425	357-505
Bluegill	0.2	22	100	70-142
Bufencarb				
G. fasciatus	M	15	0.001	0.0006-0.002
Palaemonetes	M	21	0.001	—
Goldfish	1.0	18	0.29	0.22-0.39
Butylate				
G. fasciatus	M	15	11	8-16
Chlorbromuron				
Rainbow trout	0.7	12	1.4	0.7-3.1
Channel catfish	0.7	18	10.2	8.4-12.4
Chlordimeform				
Rainbow trout	0.7	12	13.2	8.1-21.3
Channel catfish	0.7	18	20.2	14.8-27.6
Chlorfenethol				
Fathead minnow	1.2	18	1.4	1.0-2.1
Channel catfish	1.4	18	0.9	0.7-1.2

Table 4. Continued

Compound and Test Organism	Stage or wt (g)	Temp (C)	95-h LC50 (mg/L)	95% CI
Chlorobenzilate				
Simocephalus	I_1	15	0.6[b]	0.5-0.7
Daphnia pulex	I_1	15	0.9[b]	0.7-1.1
Rainbow trout	0.8	13	0.7	—
Chloronitropropane				
G. lacustris	M	21	0.64	0.50-0.90
Rainbow trout	1.5	12	0.11	0.09-0.13
Bluegill	1.1	18	0.15	0.14-0.16
Chloroxuron				
Rainbow trout	0.7	12	0.43	0.36-0.51
Channel catfish	1.3	18	0.45	0.16-1.24
Crufomate				
G. fasciatus	M	15	3.7	3.4-4.1
Bluegill	1.0	18	1.8	1.3-2.4
Cycloheximide				
Rainbow trout	3.5	12	1.4	—
Cycocel				
Rainbow trout	1.4	12	>100	—
Fathead minnow	1.5	17	>100	—
Channel catfish	1.5	17	>100	—
Bluegill	1.5	17	>100	—
Deet				
G. fasciatus	M	15	>100	—
Dichlormate				
Rainbow trout	0.8	12	4.9	3.8-6.4
Dilan				
G. lacustris	M	13	0.350	0.30-0.40
Rainbow trout	1.1	13	0.034	0.032-0.036
Dimethylformamide				
Rainbow trout	0.8	12	12,000	10,000-13,000
Dimethyl sulfoxide				
Rainbow trout	0.7	12	35,000	33,000-37,000
Bluegill	1.0	24	>400,000	—
Dodine				
G. fasciatus	M	15	1.1	—
Emcol AD-410				
Rainbow trout	0.9	12	9.0	6.7-12.2
Bluegill	0.9	12	16.5	14.2-19.1
Ethanol				
Palaemonetes	M	21	>250	—
Rainbow trout	0.8	12	13,000	12,000-16,000

Table 4. Continued

Compound and test organism	Stage or wt (g)	Temp (C)	96-h LC50 (mg/L)	95% CI
Ethyl Benzene				
Rainbow trout	2.4	12	14	11-18
Channel catfish	0.1	22	210	134-330
Bluegill	0.2	17	88	63-122
Ethylene Dichloride				
G. fasciatus	M	21	>100	—
Pteronarcys	YC_2	15	>100	—
Rainbow trout	1.8	13	225	—
Ethylene Glycol				
Rainbow trout	0.7	12	41,000	36,000-47,000
Ethylene Glycol (monomethyl ether)				
Rainbow trout	1.1	12	16,000	14,000-18,000
Fenson				
Rainbow trout	0.7	13	6.6	5.5-8.0
Bluegill	0.5	24	5.1	3.6-7.3
Fensulfothion				
G. fasciatus	M	15	0.01	0.007-0.014
Fluometuron				
Rainbow trout	0.7	12	3.0	2.0-4.5
Channel catfish	0.8	18	0.6	0.3-1.3
Fonofos				
Rainbow trout	1.7	13	0.020	0.016-0.025
Bluegill	1.0	24	0.007	0.005-0.009
Garlon 3A				
Rainbow trout	0.9	12	>100	—
Bluegill	0.8	22	>100	—
Geranol				
Rainbow trout	F	12	3.7	3.3-4.1
Brown trout	0.8	12	2.6	2.3-3.0
Fathead minnow	0.5	12	5.0	4.1-6.1
Fathead minnow	0.8	17	3.2	2.7-3.8
Glycerol				
Rainbow trout	0.9	12	54,000	51,000-57,000
Gophacide				
Rainbow trout	1.4	13	0.44	0.39-0.50
Halowax 1099				
Fathead minnow	0.7	20	>100	—
Channel catfish	0.8	20	>100	—
Jodfenphos				
Rainbow trout	0.7	12	0.016	0.012-0.023
Channel catfish	0.8	18	0.390	0.300-0.490

Table 4. Continued

Compound and test organism	Stage or wt (g)	Temp (C)	96-h LC50 (mg/L)	95% CI
Kling-Tite 800				
Coho salmon	1.4	12	76	47-117
Landrin				
Rainbow trout	1.2	12	1.0	0.8-1.3
Bluegill	0.9	18	11.6	10.6-12.7
Lead arsenate				
Channel catfish	1.6	18	>100	—
Lethane 384				
G. fasciatus	M	15	4.8	3.7-6.1
Cutthroat trout	0.6	12	6.5	4.9-8.7
Lake trout	1.2	12	3.9	3.4-4.5
Merphos				
Rainbow trout	0.6	12	33	20-53
Rainbow trout[c]	0.6	12	10	7-14
Methanol				
Rainbow trout	0.8	12	19,000	18,000-20,000
Methidathion				
Rainbow trout	0.8	12	0.014	0.009-0.022
Bluegill	0.7	24	0.009	0.006-0.013
Methiocarb				
Pteronarcys	YC_2	15	0.005	0.004-0.006
Rainbow trout	1.3	12	0.80	0.63-0.89
Bluegill	1.0	24	0.21	0.12-0.36
Methorprotryne				
Bluegill	0.9	18	15.5	13.9-17.2
Methyl-Demeton				
G. lacustris	M	21	0.190	0.170-0.210
Pteronarcys	YC_2	15	0.035	0.030-0.039
Monoethanolamine				
Rainbow trout	YSF	10	150	114-196
Bluegill	0.3	20	>300	—
Morsodren				
Rainbow trout	1.0	12	0.06	0.03-0.10
Niclosamide				
Cypridopsis	M	21	0.31[b]	0.23-0.42
G. fasciatus	M	15	0.36	0.22-0.59
Nitrofen				
G. fasciatus	M	15	3.1	1.7-5.6
Norea				
Goldfish	1.0	18	37	28-50
Fathead minnow	0.9	18	32	23-44
Bluegill	0.4	24	13	11-16

Table 4. Continued

Compound and test organism	Stage or wt (g)	Temp (C)	96-h LC50 (mg/L)	95% CI
N-serve				
Rainbow trout	1.1	12	7.5	6.9-8.2
Fathead minnow	1.2	18	10.2	8.8-11.7
Channel catfish	1.5	18	5.8	4.6-7.3
Oryzalin				
Asellus	M	18	0.40	0.19-0.84
G. fasciatus	M	18	0.19	0.14-0.26
Perthane				
Rainbow trout	0.7	12	0.004	0.003-0.006
Bluegill	0.9	24	0.020	0.016-0.025
Pipron				
Goldfish	1.0	18	2.0	1.5-2.6
Propanil				
G. fasciatus	M	15	16	9-32
Reldan				
Brook trout	1.2	12	0.20	0.14-0.28
Roccal				
Rainbow trout	1.8	12	1.20	0.8-1.6
Bluegill	0.3	24	0.32	0.22-0.46
Stabilene				
G. fasciatus	M	15	17	7.1-40.9
Stirofos				
Rainbow trout	0.8	13	0.43	0.33-0.56
Channel catfish[d]	2.0	18	>0.50	—
Bluegill[d]	1.0	18	0.53	0.36-0.77
2,3,6-TBA				
Fathead minnow	0.9	18	0.009	0.007-0.011
Tepa				
Rainbow trout	0.8	12	>100	—
Terbutryn				
Rainbow trout	0.8	13	0.82	0.56-1.20
Bluegill	1.3	18	2.70	1.40-5.30
Toluene				
Rainbow trout	2.4	12	24	17.6-32.6
Channel catfish	0.1	22	240	187-309
Bluegill	0.1	17	170	139-208
Tranid				
Rainbow trout	1.0	12	13	11-16
Bluegill	1.3	24	4.2	2.8-6.4
Trefmid				
Rainbow trout	1.3	12	0.13	0.09-0.18
Bluegill	1.0	24	0.35	0.28-0.40

Table 4. Continued

Compound test organism	Stage or wt (g)	Temp (C)	96-h LC50 (mg/L)	95% CI
Trichloronat				
Pteronarcys	YC_2	16	0.0001	0.00009-0.00012
Rainbow trout	1.4	12	0.14	0.11-0.18
Bluegill	0.8	24	0.22	0.15-0.33
Velpar				
Rainbow trout	0.7	12	>100	—
Bluegill	0.8	22	>100	—
Warfarin				
Channel catfish	0.8	18	34.3	28.1-42.0
Xylene				
Rainbow trout	0.6	12	8.2	6.7-10.0
Bluegill	0.9	12	13.5	12.1-15.0

[a]See Table 3 for chemical names. Abbreviations are as follows: *G.* = *Gammarus*; YSF = yolk-sac fry; F=fingerling; M=mature; I_1=first instar; YC_2=second year class.
[b]48-h EC50.
[c]Liquid material, 72%.
[d]Wettable powder, 75%.

References

American Institute of Biological Sciences. 1978*a*. Criteria and rationale for decision making in aquatic hazard evaluation. AIBS report to the Office of Pesticide Programs, EPA. 79 pp.

American Institute of Biological Sciences. 1978*b*. Aquatic hazard evaluation of chemical pesticides. BioScience 28(9):600.

American Public Health Association. 1971. Standard methods for the examination of water and wastewater, 13th edition. Washington, D.C.

Boyd, J. 1957. The use of *Daphnia magna* in the microbioassay of insecticides. Ph.D. Thesis. Pennsylvania State University, University. 194 pp.

Brauhn, J. L., and R. A. Schoettger. 1975. Acquisition and culture of research fish: rainbow trout, fathead minnows, channel catfish, and bluegills. U.S. Environmental Protection Agency, Ecol. Res. Serv., EPA-600/3-75-011. 45 pp.

Brungs, W. A., and D. I. Mount. 1978. Introduction to a discussion of the use of aquatic toxicity tests for evaluation of the effects of toxic substances. Page 15 *in* J. Cairns, Jr., K. L. Dickson, and A. W. Maki, eds. Estimating the hazard of chemical substances to aquatic life. American Society for Testing and Materials STP 657.

Committee on Methods for Toxicity Tests with Aquatic Organisms. 1975. Methods for acute toxicity tests with fish, macroinvertebrates, and amphibians. U.S. Environmental Protection Agency, Ecol. Res. Serv., EPA-660/3-75-009. 61 pp.

Green, R. H. 1965. Estimation of tolerance over an indefinite time period. Ecology 46(6):887.

Hayes, W. J. 1967. The 90-dose LD50 and a chronic factor as measures of toxicity. Toxicol. Appl. Pharmacol. 11(2):327.

Henderson, C., Q. H. Pickering, and C. M. Tarzwell. 1960. The toxicity of organic phosphate and chlorinated hydrocarbon insecticides to fishes. Pages 76-88 *in* Transactions of the Second Seminar on Biological Problems in Water Pollution. U.S. Public Health Service. R. A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

Johnson, W. W., and A. M. Julin. 1980. Acute toxicity of toxaphene to fathead minnows, channel catfish, and bluegills. U.S. Environmental Protection Agency, Ecol. Res. Serv. In press.

Lennon, R. E., and C. R. Walker. 1964. Laboratories and methods for screening fish-control chemicals. U.S. Fish Wildl. Serv., Invest. Fish Control 1 (Circular 185). 15 pp.

Litchfield, J. T., and F. Wilcoxon. 1949. A simplified method of evaluating dose-effect experiments. J. Pharmacol. Exp. Ther. 96-99.

Macek, K. J., and W. A. McAllister. 1970. Insecticide susceptibility of some common fish family representatives. Trans. Am. Fish. Soc. 99(1):20.

Marking, L. L. 1969. Toxicological assays with fish. Bull. Wildl. Dis. Assoc. 5:291.

Sanders, H. O., and O. B. Cope. 1966. Toxicities of several pesticides to two species of cladocerans. Trans. Am. Fish. Soc. 96:165.

Sprague, J. D. 1969. Measurement of pollutant toxicity to fish. I. Bioassay methods for acute toxicity. Water Res. 3:793.

Sprague, J. D. 1970. Measurement of pollutant toxicity to fish. II. Utilizing and applying bioassay results. Water Res. 4:3.

Sprague, J. D. 1971. Measurement of pollutant toxicity to fish. III. Sublethal effects and "safe" concentrations. Water Res. 5:245.

Tucker, R. K., and D. G. Crabtree. 1970. Handbook of toxicity of pesticides to wildlife. U.S. Fish Wildl. Serv., Resour. Publ. 84. 131 pp.

APPENDIX I

Glossary

acute A condition or test in which the stimulus applied is severe enough to elicit a biological response; the response is usually death or immobilization of the test organism within 96 h.

chronic A condition or test in which exposure to a stimulus continues for an extended time and typically induces sublethal biological response. Aquatic toxicity tests usually involve a portion of an organism's life cycle (partial or embryo-larval chronic toxicity tests). Full chronic toxicity tests cover one complete life cycle.

conditional toxicity tests Tests additional to the standard acute toxicity tests recommended by the U.S. Environmental Protection Agency for registration of chemicals. Conditional tests are acute toxicity tests conducted in the laboratory under controlled conditions that reflect the effects on chemical toxicity of such natural environmental variables as pH, temperature, water hardness, deactivation (aging of test solutions), and different life stages of organisms, or other water quality tests.

cumulative toxicity index Numerical ratio of the 96-h LC50 to the TILC50 for a chemical. This ratio can serve as an estimate of the cumulative action of a toxicant. For example, ratio or index of 2 suggests little cumulative action, whereas an index of 50 suggests high cumulative action.

deactivation tests Conditional toxicity tests not included in routine standard toxicity testing. Organisms are exposed to a series of test solutions that have been prepared and allowed to age for a predetermined period, usually 1 to 4 weeks. A deactivation index is calculated by dividing the LC50 of the aged solution by the LC50 of the fresh solution.

EC50 (effective concentration) A statistical estimate of the concentration of a test material necessary to produce a particular effect (usually immobilization) in 50% of a test population within a given time (often 48 h).

flow-through toxicity tests Exposures of test organisms to a series of toxicant concentrations in which both the toxicant and the dilution water are continuously renewed. Organisms are exposed to toxicants in flow-through diluter systems for 4 days or longer.

instar Growth stage or period of growth occurring between any two successive molts, as in insects and crustaceans.

LC50 (median lethal concentration) A statistical estimate of the concentration of a test material necessary to cause death to 50% of a test population within a given time (often 96 h).

naiad Any of the immature or nymphal stages of certain aquatic insects (e.g., stoneflies, dragonflies, and damselflies).

reconstituted water Recommended dilution water for standard acute toxicity tests. This water is reconstituted from deionized water by adding known amounts of specified reagent grade chemicals. Freshwater organisms are tested in reconstituted water of pH 7.4, alkalinity 35 mg/L, and hardness of 40 mg/L as $CaCO_3$.

standard toxicity tests The group of initial tests that the U.S. Environmental Protection Agency recommends be included to support applications for pesticide registration. These tests are routinely used to determine the relative toxicity of a chemical. The toxicity data presented in this Handbook are a product of standard toxicity testing; basic tests are run on a chemical (both technical and formulated materials) against one or more representative species of invertebrates and fish. The 96-h LC50's are determined by following standardized test procedures.

static toxicity tests Acute toxicity tests in which test organisms are exposed to the toxicant throughout the duration of the testing period, without renewal of the test solution.

subacute Condition or tests involving a stimulus that is less severe than an acute stimulus; the response is produced over a longer period. Test conditions may approach those in chronic toxicity tests.

sublethal Usually refers to a stimulus that causes biological responses less severe than death of the test organisms.

TILC50 (time-independent LC50) Statistical estimate of the toxicant concentration at which 50% of the test population would be expected to survive indefinitely.

toxicity Property of a chemical substance that causes a measurable adverse biological response.

toxicology Study of the effects of chemicals on living systems, including the mechanisms of these effects and the conditions under which they occur.

APPENDIX II

Cross-index to Chemicals

Alternate Name	*Common Name*	*Alternate Name*	*Common Name*
Abar	**Leptophos**	Atlas A	**Sodium Arsenite**
Abate	**Temephos**	Axiom	**Akton**
Acaraben	**Chlorobenzilate**	Azide	**Azide**
Acarin	**Dicofol**	Azinphos ethyl	**Azinphos ethyl**
Acarithion	**Carbophenothion**	Azinphos methyl	**Azinphos methyl**
Accelerate	**Endothall**	Azodrin	**Azodrin**
Accothion	**Fenitrothion**	Azofene	**Phosalone**
Acephate	**Acephate**		
Acetone	**Acetone**	Balan	**Benefin**
Acricid	**Binapacryl**	Balfin	**Benefin**
Actidione	**Cycloheximide**	Banex	**Dicambia**
Aerial gramoxone	**Paraquat**	Banvel	**Dicambia**
Agritox	**Trichloronat**	Baraquat	**Roccal**
Agrothion	**Fenitrothion**	Basanite	**Dinoseb**
Agroxone	**Phenoxy herbicides**	Basapon	**Dalapon**
Akton	**Akton**	Basudin	**Diazinon**
Alaclor	**Alaclor**	Bathion	**Temephos**
Aldicarb	**Aldicarb**	Bay 2352	**Niclosamide**
Aldrin	**Aldrin**	Bay 25141	**Fensulfothion**
Aldrite	**Aldrin**	Bay 30130	**Propanil**
Aldrosol	**Aldrin**	Bay 37344	**Methiocarb**
Alfacron	**Jodfenphos**	Bay 38819	**Gophacide**
Alfa-tox	**Diazinon**	Bay 68138	**Perthane**
Alkron	**Parathion ethyl**	Bayer L13/59	**Trichlorfon**
Alleron	**Parathion ethyl**	Bayer 73	**Bayluscide**
Allethrin	**Allethrin**	Bayer 15922	**Trichlorfon**
Altosid	**Methoprene**	Bayer 77488	**Phoxim**
Alvit	**Dieldrin**	Baygon	**Propoxur**
Ambox	**Binapacryl**	Bayluscide	**Bayluscide**
Ambush	**Permethrin**	Baymix	**Coumaphos**
Amdon	**Picloram**	Baytex	**Fenthion**
Ametryn	**Ametryn**	Baythion	**Phoxim**
Aminocarb	**Aminocarb**	Belt	**Chlordane**
Aminocarbe	**Aminocarb**	Benefin	**Benefin**
Amitril-TL	**Cytrol Amitrole-T**	Benesan	**Lindane**
Amitrol	**Amitrol**	Benlate	**Benomyl**
Amitrole-T	**Cytrol Amitrol-T**	Benofuroline	**Resmethrin**
Anilazine	**Dyrene**	Benomyl	**Benomyl**
Anofax	**DDT**	Bensulide	**Bensulide**
Ansar 529	**MSMA**	Benzac	**2,3,6-TBA**
Anthon	**Trichlorfon**	Benzahex	**Benzene Hexachloride**
Anticarie	**Hexachlorobenzene**	Benzalkonium chloride	**Roccal**
Antimycin	**Antimycin A**	Benzene	**Benzene**
Aphamite	**Parathion Ethyl**	Benzene Hexachloride	**Benzene Hexachloride**
Aphoxide	**TEPA**	Benzex	**Benzene Hexachloride**
APO	**TEPA**	Benzphos	**Phosalone**
Aquacide	**Diquat**	Betasan	**Bensulide**
Aquathol	**Endothall**	BHC	**Benzene Hexachloride**
Aquazine	**Simazine**	Bidrin	**Dicrotophos**
Aracide	**Aramite**	Binapacryl	**Binapacryl**
Aramite	**Aramite**	Bioallethrin	**Trans Allethrin**
Arathane	**Dinocap**	Bladan	**Parathion ethyl**
Araclors	**Polychlorinated biphenyls**	Bladex	**Cyanazine**
Aspon	**Chlordane**	Blattane	**Propoxur**
Asthoate	**Dimethoate**	Blue Copperas	**Copper sulfate**
Asuntol	**Coumaphos**	Bluestone	**Copper sulfate**

Alternate Name	*Common Name*
Blue vitriol	**Copper sulfate**
Borolin	**Picloram**
Bovinox	**Trichlorfon**
Briton	**Trichlorfon**
Bromchlophos	**Naled**
Bromex	**Chlorbromuron**
Brush killer	**Phenoxy herbicides**
Brush rhap	**Phenoxy herbicides**
BTC	**Roccal**
Bufencarb	**Bufencarb**
Bulan	**Dilan**
Butacide	**Piperonyl butoxide**
Butylate	**Butylate**
Butyrac	**Phenoxy herbicides: 2,4-D**
Bux	**Bufencarb**
Camphechlor	**Toxaphene**
Can-Trol	**Phenoxy herbicides**
Captafol	**Captafol**
Captan	**Captan**
Carbaryl	**Carbaryl**
Carbicron	**Dicrotophos**
Carbinol	**Methanol**
Carbofos	**Malathion**
Carbofuran	**Carbofuran**
Carbophenothion	**Carbophenothion**
Carbophos	**Malathion**
Carfene	**Azinphos ethyl**
Carpene	**Dodine**
Carpolin	**Carbaryl**
Casoron	**Dichlobenil**
Cekufon	**Trichlorfon**
Cenapon	**Carbaryl**
Chemathion	**Malathion**
Chemox	**Dinoseb**
Chem Pels C	**Sodium Arsenite**
Chem Rice	**Propanil**
Chiptox	**Phenoxy herbicides**
Chlorbromuron	**Chlorbromuron**
Chlordan	**Chlordane**
Chlordane	**Chlordane**
Chlordane, HCS-3260	**Chlordane, HCS-3260**
Chlordecone	**Kepone**
Chlordimeform	**Chlordimeform**
Chlorendate	**Chlorendate**
Chlorfenac	**Fenac**
Chlorfenethol	**Chlorfenethol**
Chlorinated paraffin	**Chlorowax**
Chlor-Kill	**Chlordane**
Chlorobenzilate	**Chlorobenzilate**
Chlorofos	**Trichlorfon**
Chloronitropropane	**Chloronitropropane**
Chlorophenothane	**DDT**
Chlorothiepin	**Endosulfan**
Chlorowax	**Chlorowax**
Chloroxuron	**Chloroxuron**
Chlorpyrifos	**Chlorpyrifos**
Chryson	**Resmethrin**
Cicloxom	**Trichlorfon**

Alternate Name	*Common Name*
Cinerin	**Allethrin**
Cinerolone	**Allethrin**
Ciodrin	**Crotoxyphos**
Clonitralid	**Bayluscide**
Clorofos	**Trichlorfon**
Cobex	**Dinitramine**
Cobexo	**Dinitramine**
Copper count	**Copper count**
Copper sulfate	**Copper sulfate**
Co-Ral	**Coumaphos**
Corodane	**Chlordane**
Corothion	**Parathion ethyl**
Correx	**Lignasan**
Cotnion-Ethyl	**Azinphos ethyl**
Cotnion-Methyl	**Azinophos methyl**
Cotoran	**Fluometuron**
Coumaphos	**Coumaphos**
Cristoxo	**Toxaphene**
Crotothane	**Dinocap**
Crotoxyphos	**Crotoxyphos**
Crufomate	**Crufomate**
Cryolite	**Cryolite**
Curaterr	**Carbofuran**
Curitan	**Dodine**
Cyanazine	**Cyanazine**
Cyclodan	**Endosulfan**
Cycloheximide	**Cycloheximide**
Cycocel	**Cycocel**
Cygon	**Dimethoate**
Cyhexatin	**Plictran**
Cyprex	**Dodine**
Cytel	**Fenitrothion**
Cythion	**Malathion**
Cytrol	**Amitrol**
Cytrol amitrole-T	**Cytrol amitrole-T**
Dacamine 4-D	**Phenoxy herbicides-2,4-D**
Daconate	**MSMA**
Dagadip	**Carbophenothion**
Dalapon	**Dalapon**
Danex	**Trichlorfon**
Daphene	**Dimethoate**
Dasanit	**Fensulfothion**
Dazzel	**Diazinon**
DBP	**Phthalic acid ester**
D-D soil fumigant	**D-D soil fumigant**
DDD	**DDD**
DDE	**DDE**
DDT	**DDT**
DDVF	**Dichlorvos**
DDVP	**Dichlorvos**
Dechlorane	**Mirex**
Dedelo	**DDT**
Dederap	**Dichlorvos**
Ded-Weed	**Dalapon**
Ded-Weed LV-69	**Phenoxy herbicides-2,4-D**
Deet	**Deet**
DEF	**DEF**
De Fend	**Dimethoate**

Alternate Name	*Common Name*
De-Green	**DEF**
DEHP	**Phthalic acid ester**
Deiquat	**Diquat**
Delan	**Thynon**
Delan-Col	**Thynon**
Delnav	**Dioxathion**
Delphene	**Deet**
Demaso	**Dimethyl sulfoxide**
Demasorb	**Dimethyl sulfoxide**
Demavet	**Dimethyl sulfoxide**
Demeton	**Demeton**
Demeton-Methyl	**Methyl-Demeton**
Demeton-S-Methyl sulfoxiod	**Oxydemeton-Methyl**
Demo-L40	**Dimethoate**
Dedrin	**Rotenone**
DET	**Deet**
Detamide	**Deet**
Dexon	**Fenaminosulf**
Dextrone	**Diquat**
Dextrone X	**Paraquat**
Dianet	**Dicambia**
Diazajet	**Diazinon**
Diazide	**Diazinon**
Diazinon	**Diazinon**
Diazoben	**Fenaminosulf**
Diazol	**Diazinon**
Dibrom	**Naled**
Dicambia	**Dicambia**
Dicarbam	**Carbaryl**
Dichlobenil	**Dichlobenil**
Dichlofenthion	**Dichlofenthion**
Dichlone	**Phygon XL**
Dichlormate	**Dichlormate**
Dichlorofenidim	**Diuron**
Dichlorofenthion	**Dichlofenthion**
Dichloropropene	**Dichloropropene**
Dichlorphos	**Dichlorvos**
Dichlorvos	**Dichlorvos**
Diclofop	**Phenoxy herbicides-2,4-D**
Dicofol	**Dicofol**
Dicrotophos	**Dicrotophos**
Dedimac	**DDT**
Dieldrin	**Dieldrin**
Dieldrine	**Dieldrin**
Dieldrite	**Dieldrin**
Diethione	**Ethion**
Difenthos	**Temephos**
Diflubenzuron	**Diflubenzuron**
Difolatan	**Captafol**
Dilan	**Dilan**
Dimecron	**Phosphamidon**
Dimethoate	**Dimethoate**
Dimethogen	**Dimethoate**
Dimethoxy-DT	**Methoxychlor**
Dimethrin	**Dimethrin**
Dimethylformamide	**Dimethylformamide**
Dimethyl parathion	**Parathion methyl**
Dimethyl sulfoxide	**Dimethyl sulfoxide**
Dimilin	**Diflubenzuron**

Alternate Name	*Common Name*
Dimite	**Chlorfenethol**
Dinitramine	**Dinitramine**
Dinitrobutylphenol	**Dinoseb**
Dinitrocresol	**Dinitrocresol**
Dinocap	**Dinocap**
Dinoseb	**Dinoseb**
Dinoseb methacrylate	**Binapacryl**
DI-ON	**Diuron**
Diostop	**Dimethoate**
Dioxathion	**Dioxathion**
Diphenamid	**Diphenamid**
Diquat	**Diquat**
Dipterex	**Trichlorfon**
Diptetes	**Trichlorfon**
Direz	**Dyrene**
Disulfoton	**Disulfoton**
Di-Syston	**Disulfoton**
Dithianon	**Thynon**
Dithiodemeton	**Disulfoton**
Dithiosystox	**Disulfoton**
Diurex	**Diuron**
Diuron	**Diuron**
Divipan	**Dichlorvos**
Dixon	**Phosphamidon**
DMF	**Dimethylformamide**
DMFA	**Dimethylformamide**
DMSO	**Dimethyl sulfoxide**
Dodine	**Dodine**
Dolmix	**Benzene hexachloride**
Dowcide-G	**Pentachlorophenol (sodium salt)**
Dowcide-7	**Pentachlorophenol**
Dowpon	**Dalapon**
DPA	**Propanil**
d-trans allethrin	***d*-trans-allethrin**
Dual paraquat	**Paraquat**
Dursban	**Chlorpyrifos**
Dusprex	**Dichlobenil**
Du-ter	**Du-ter**
Dyfonate	**Fonofos**
Dylox	**Trichlorfon**
Dymid	**Diphenamid**
Dyrene	**Dyrene**
2,4-D	**Phenoxy herbicides**
2,4-DB	**Phenoxy herbicides-2,4-D**
2,4-D DMA	**Phenoxy herbicides-2,4-D**
2,6,DBN	**Dichlobenil**
Ectoral	**Ronnel**
Ektafos	**Dicrotophos**
Elancolan	**Trifluralin**
Elgetol 30	**Dinitrocresol**
Elgetol 318	**Dinoxeb**
Embutox	**Phenoxy herbicides-2,4-D**
Emcol AD-410	**Emcol AD-410**
Emmatos	**Malathion**
Emulsamine E-3	**Phenoxy herbicides-2,4-D**
Emulsavert D	**Phenoxy herbicides-2,4-D**
Endosan	**Binapacryl**
Endosulfan	**Endosulfan**

Alternate Name	*Common Name*
Endothall	**Endothall**
Endrin	**Endrin**
Enide	**Diphenamid**
Entex	**Fenthion**
EPN	**EPN**
Eptam	**EPTC**
EPTC	**EPTC**
Equino-Acid	**Trichlorfon**
Eradicane	**EPTC**
Esteron 76-BE	**Phenoxy herbicides-2,4-D**
Esteron-99	**Phenoxy herbicides-2,4-D**
Ethanol	**Ethanol**
Ethilon	**Parathion ethyl**
Ethion	**Ethion**
Ethofumesate	**Ethofumesate**
Ethyl Guthion	**Azinphos ethyl**
Ethyl Parathion	**Parathion ethyl**
Ethylan	**Perthane**
Ethyl benzene	**Ethyl benzene**
Ethylene dichloride	**Ethylene dichloride**
Ethylene glycol	**Ethylene glycol**
Etrolene	**Ronnel**
Evik	**Ametryn**
E-Z-Off D	**DEF**
Fenac	**Fenac**
Fen-All	**2,3,6-TBA**
Fenaminosulf	**Fenaminosulf**
Fenchlorphos	**Ronnel**
Fenitrothion	**Fenitrothion**
Fenizon	**Fenson**
Fenoloro	**Du-ter**
Fenson	**Fenson**
Fensulfothion	**Fensulfothion**
Fenthion	**Fenthion**
Fentin hydroxide	**Du-ter**
Fintrol	**Antimycin A**
Fire-Trol 100	**Fire-Trol 100**
Fire-Trol 931	**Fire-Trol 931**
Floratox	**Phenoxy herbicides-2,4-D**
Fluometruon	**Fluometruon**
Fluoromidine	**Ethofumesate**
Folcid	**Captafol**
Folex	**Merphos**
Folidol E605	**Parathion ethyl**
Folidol M	**Parathion methyl**
Folithion	**Fenitrothion**
Folpan	**Folpet**
Folpet	**Folpet**
Fonofos	**Fonofos**
Forlin	**Lindane**
Fos-Fall "A"	**DEF**
Fosfamid	**Dimethoate**
Fosfern M50	**Parathion methyl**
Fosferno 50	**Parathion ethyl**
Fosthion MM	**Dimethoate**
Frumin AL	**Disulfoton**
Fundal	**Chlordimeform**
Furadan	**Carbofuran**
Fyfanon	**Malathion**
Galecron	**Chlordimeform**
Gamaphex	**Lindane**
Gamasol-90	**Dimethyl sulfoxide**
Gamma BHC	**Lindane**
Gammafog	**Lindane**
Gammalin	**Lindane**
Gammex	**Lindane**
Gammexane	**Lindane**
Gardona	**Stirofos**
Gardentox	**Diazinon**
Garlon 3A	**Garlon 3A**
Garrathion	**Carbophenothion**
Gearphos	**Parathion methyl**
Geranol	**Geranol**
Geritox	**DDT**
Gesapon	**DDT**
Gesaran	**Methoprotryne**
Gesarex	**DDT**
Gesarol	**DDT**
Glycerin	**Glycerol**
Glycerol	**Glycerol**
Glyphosate	**Glyphosate**
Gophacide	**Gophacide**
Gramevin	**Dalapon**
Gramoxone	**Paraquat**
Gusathion A	**Azinphos ethyl**
Gusathion M	**Azinphos methyl**
Guthion	**Azinphos methyl**
Gyron	**DDT**
Halowax 1099	**Halowax 1099**
HCB	**Hexachlorobenzene**
HCS-3260	**Chlordane HCS-3260**
Heptachlor	**Heptachlor**
Heptagran	**Heptachlor**
Heptamul	**Heptachlor**
Herban	**Norea**
Herkol	**Dichlorvos**
Hexachlor	**Benzene hexachloride**
Hexachloran	**Benzene hexachloride**
Hexachlorobenzene	**Hexachlorobenzene**
Hexaclan	**Benzene hexachloride**
Hexadrin	**Endrin**
Hexafor	**Benzene hexachloride**
Hexa-Nema	**Dichlofenthion**
Hexavin	**Carbaryl**
HOE-23408	**Phenoxy herbicides-2,4-D**
HOE-Grass	**Phenoxy herbicides-2,4-D**
Hoelon	**Phenoxy herbicides-2,4-D**
Hormotuho	**Phenoxy herbicides**
Houghto-Safe 1120	**Houghto-Safe 1120**
Hydout	**Endothall**
Hydram	**Molinate**
Hydrothol	**Endothall**
Igran	**Terbutryn**
Illoxan	**Phenoxy herbicides-2,4-D**
Imidan	**Phosmet**
Insectophene	**Endosulfan**
Ipersan	**Trifluralin**
Iscothane	**Dinocap**
Isotox	**Lindane**
Ixodex	**DDT**

Alternate Name	*Common Name*
Jodfenphos	**Jodfenphos**
Kanepar	**Fenac**
Karathane	**Dinocap**
Karbaspray	**Carbaryl**
Karbofos	**Malathion**
Karmex	**Diuron**
Kazoe	**Azide**
Kelthane	**Dicofol**
Kemate	**Dyrene**
Kepone	**Kepone**
Kill-All	**Sodium arsenite**
Killmite 40	**TEPP**
Kiloseb	**Dinoseb**
Kilsem	**Phenoxy herbicides**
Kling-Tite 800	**Kling-Tite 800**
Kopsol	**DDT**
Kop-Thiodan	**Endosulfan**
Kop-Thion	**Malathion**
Korlan	**Ronnel**
K-Orthrine	**RU-11679**
Kryocide	**Cryolite**
Krypclor	**Chlordane**
Kuron	**Phenoxy herbicide-2,4,5-T**
Kurosal	**Phenoxy herbicide-2,4,5-T**
Kypfos	**Malathion**
Landrin	**Landrin**
Lanex	**Fluometuron**
Lannate	**Methyomyl**
Lasso	**Alachlor**
Lazo	**Alachlor**
Lead arsenate	**Lead arsenate**
Lebaycid	**Fenthion**
Lepton	**Leptophos**
Leptophos	**Leptophos**
Lethane 384	**Lethane 384**
Lethox	**Carbophenothion**
Lignasan	**Lignasan**
Lime sulfur	**Lime sulfur**
Lindafor	**Lindane**
Linagam	**Lindane**
Linamul	**Lindane**
Lindane	**Lindane**
Lintox	**Lindane**
Lorsban	**Chlorpyrifos**
Lumeton	**Methoprotryne**
MAF	**Alachlor**
Mafu	**Dichlorvos**
Malamar	**Malathion**
Malaphos	**Malathion**
Malaspray	**Malathion**
Malathion	**Malathion**
Malix	**Endosulfan**
Maloran	**Chlorbromuron**
Marlate	**Methoxychlor**
Marmer	**Du-ter**
Marvex	**Dichlorvos**
Masoten	**Trichlorfon**
Matacil	**Aminocarb**

Alternate Name	*Common Name*
MCPB acid	**Phenoxy herbicides**
MCPA-DMA	**Phenoxy herbicides**
Mediben	**Dicambia**
Meldane	**Coumaphos**
Melprex	**Dodine**
Mendrin	**Endrin**
Menite	**Mevinphos**
Mephanac	**Phenoxy herbicides**
Mercaptothion	**Malathion**
Merpan	**Captan**
Merphos	**Merphos**
Mesurol	**Methiocarb**
Metacide	**Parathion methyl**
Metacil	**Aminocarb**
Metaphos	**Parathion methyl**
Metasystox	**Methyl-demeton**
Meta-Systox	**Methyl-demeton**
Metasystemox	**Oxydemeton-methyl**
Metasystox-R	**Oxydemeton-methyl**
Methanol	**Methanol**
Methidathion	**Methidathion**
Methiocarb	**Methiocarb**
Methomyl	**Methomyl**
Methoprene	**Methoprene**
Methoprotryne	**Methoprotryne**
Methyl-Demeton	**Methyl-Demeton**
Methyl trithion	**Methyl trithion**
Methoxo	**Methoxychlor**
Methyoxychlor	**Methoxychlor**
Methoxy-DDT	**Methoxychlor**
Methyl-niran	**Parathion methyl**
Methylnitrophos	**Fenitrothion**
Metilmercaptofosoksid	**Oxydemeton-methyl**
Metiltrazotion	**Azinphos methyl**
Metoprotryn	**Methoprotryne**
Metron	**Parathion methyl**
Mevinphos	**Mevinphos**
Mexacarbate	**Mexacarbate**
Mildex	**Dinocap**
Mirex	**Mirex**
Mitigan	**Dicofol**
Mobilawn	**Dichlofenthion**
Molinate	**Molinate**
MON-0818	**MON-0818**
MON-2139	**Glyphosate**
Monocron	**Azodrin**
Monocrotophos	**Azodrin**
Monoethanolamine	**Monoethanolamine**
Morocide	**Binapacryl**
Morsodren	**Morsodren**
Motox	**Toxaphene**
MSMA	**MSMA**
Muscatox	**Coumaphos**
Naled	**Naled**
Nankor	**Ronnel**
Navadel	**Dioxathion**
Neguvon	**Trichlorfon**
Nemacide	**Dichlofenthion**
Nemafene	**D-D soil fumigant**
Nemax	**D-D soil fumigant**

Alternate Name	*Common Name*
Neocid	**DDT**
Neocidal	**Diazinon**
Nephocarp	**Carbophenothion**
Niagaramite	**Aramite**
Niagrathal	**Endothall**
Nialate	**Ethion**
Niclosamide	**Niclosamide**
Nicouline	**Rotenone**
Nifos	**TEPP**
Nimitox	**Temephos**
Nitrador	**Dinitrocresol**
Nitralin	**Nitralin**
Nitrofen	**Nitrofen**
Nitrophen	**Nitrofen**
Nitropone	**Dinoseb**
Nitrostigmine	**Parathion ethyl**
Nitrox 80	**Parathion methyl**
Nogos	**Dichlorvos**
Norea	**Norea**
Norex	**Chloroxuron**
Nortron	**Ethofumesate**
Noruron	**Norea**
N-Serve	**N-Serve**
Novathion	**Fenitrothion**
Novigam	**Lindane**
Noxfish	**Rotenone**
Nudrin	**Methomyl**
Nuracron	**Azodrin**
Nuvan	**Dichlorvos**
Nuvanol	**Fenitrothion**
Nuvanol N	**Jodfenphos**
Octachlor	**Chlordane**
Octalene	**Aldrin**
Octalox	**Dieldrin**
Ordram	**Molinate**
Orthene	**Acephate**
Ortho-11775	**Ortho-11775**
Orthocide	**Captan**
Ortho-Klor	**Chlordane**
Orthophos	**Parathion ethyl**
Orthorix	**Lime sulfur**
Ortran	**Acephate**
Oryzalin	**Oryzalin**
Oxy-Cop 8LS	**Copper count**
Oxydemeton-methyl	**Oxydemeton-methyl**
PAE	**Phthalic acid esters**
Pallethrine	**Allethrin**
Panodrin	**Morsodren**
Panogen	**Morsodren**
Panoram D-31	**Dieldrin**
Panthion	**Parathion ethyl**
Paramar	**Parathion ethyl**
Paraphos	**Parathion ethyl**
Paraquat	**Paraquat**
Paraquat Chloride	**Paraquat**
Parathene	**Parathion ethyl**
Parathion ethyl	**Parathion ethyl**
Parathion methyl	**Parathion methyl**
Parawet	**Parathion ethyl**
Partron M	**Parathion methyl**
Payze	**Cyanazine**
PCB	**Polychlorinated biphenyls**
Pencap-M	**Parathion methyl**
Penchlorol	**Pentachlorophenol**
Penite	**Sodium arsenite**
Pentachlorin	**DDT**
Pentachlorophenol	**Pentachlorophenol**
Pentacon	**Pentachlorophenol**
Penwar	**Pentachlorophenol**
Perfekthion	**Dimethoate**
Permethrin	**Permethrin**
Perthane	**Perthane**
PH 6040	**Diflubenzuron**
Phaltan	**Folpet**
Phenacide	**Toxaphene**
Phenatox	**Toxaphene**
Phenoxy herbicides	**Phenoxy herbicides**
Phenoxylene	**Phenoxy herbicides**
Phoxime	**Phoxim**
Phthalophos	**Phosmet**
Phorate	**Phorate**
Phosalone	**Phosalone**
Phos-Chek	**Phos-Chek**
Phosdrin	**Mevinphos**
Phosfene	**Mevinphos**
Phoskil	**Parathion ethyl**
Phosmet	**Phosmet**
Phosphamidon	**Phosphamidon**
Phosvel	**Leptophos**
Phosvit	**Dichlorvos**
Phoxim	**Phoxim**
Phthalic acid esters	**Phthalic acid esters**
Phygon	**Phygon XL**
Phytar 560	**Phytar 560**
Picloram	**Picloram**
Piperalin	**Pipron**
Piperonyl butoxide	**Piperonyl butoxide**
Pipron	**Pipron**
Planavin	**Nitralin**
Plictran	**Plictran**
Polychlorcamphene	**Toxaphene**
Polychlorinated naphthalene	**Halowax 1099**
Polychlorinated phenyls	**Polychlorinated phenyls**
Pounce	**Permethrin**
Prebane	**Terbutryn**
Preeglone	**Paraquat**
Prefar	**Bensulide**
Primatol	**Simazine**
Princep	**Simazine**
Prolan	**Dilan**
Prolate	**Phosmet**
Propanex	**Propanil**
Propanil	**Propanil**
Propham	**Propham**
Propoxur	**Propoxur**

Alternate Name	*Common Name*
Proxol	**Trichlorfon**
Purifloc-C31	**Purifloc-C31**
Pydraul	**Pydraul**
Pynamin	**Allethrin**
Pyresyn	**Allethrin**
Pyrethrins (Natural)	**Pyrethrum**
Pyrethrum	**Pyrethrum**
Pyrocide	**Allethrin**
Quelatox	**Fenthion**
Rabon	**Stirofos**
Radapon	**Dalapon**
Rampart	**Phorate**
Rasitox	**Coumaphos**
Ravion	**Carbaryl**
Ravyon	**Carbaryl**
Rebelate	**Dimethoate**
Reglon	**Diquat**
Reldan	**Reldan**
Resmethrin	**Resmethrin**
Rhodiatox	**Parathion ethyl**
Rhonox	**Phenoxy herbicides**
Roccal	**Roccal**
Rogor	**Dimethoate**
Ronnel	**Ronnel**
Rotenone	**Rotenone**
Rothane	**DDD**
Roundup	**Glyphosate**
Roussel-Uclaf 11679	**RU-11679**
Rowmate	**Dichlormate**
Roxion	**Dimethoate**
RU-11679	**RU-11679**
Rubitox	**Phosalone**
Ruelene	**Crufomate**
Rukseam	**DDT**
Ruphos	**Dioxathion**
Ryania	**Ryania**
Ryanicide	**Ryania**
Ryzelan	**Oryzalin**
Sanocide	**Hexachlorobenzene**
Sanspor	**Captafol**
Santobrite	**Pentachlorophenol (sodium salt)**
S-bioallethrin	**S-bioallethrin**
SD-14114	**SD-14114**
SD-17250	**SD-17250**
Seed protectant	**Phygon X2**
Seedrin	**Aldrin**
Selinon	**Dinoseb**
Sendran	**Propoxur**
Septene	**Carbaryl**
Sevin	**Carbaryl**
Silvanol	**Lindane**
Silvex	**Phenoxy herbicides-2,4,5-T**
Silvi-Rhap	**Phenoxy herbicides-2,4,5-T**
Simadex	**Simazine**
Simazine	**Simazine**
Sirmate	**Dichlomate**
Smite	**Azide**
Sodium arsenite	**Sodium arsenite**
Sodium Cacodylate	**Phytar 560**
Solvirex	**Disulfoton**
Soprathion	**Parathion ethyl**
Soprocide	**Benzene hexachloride**
Stabilene	**Stabilene**
Stathion	**Parathion ethyl**
Stirofos	**Stirofos**
Strobane	**Strobane**
Strobane-T	**Toxaphene**
Subitex	**Dinoseb**
Suffix 25	**Suffix**
Sulfenimide	**Captafol**
Sumithion	**Fenitrothion**
Suncide	**Propoxur**
Surflan	**Oryzalin**
Sutan	**Butylate**
Synklor	**Chlordane**
Systox	**Demeton**
2,3,6-TBA	**2,3,6-TBA**
TBA	**2,3,6-TBA**
TCP	**Tricresyl phosphate**
TDE	**DDD**
Tedion	**Tetradifon**
Tekwaisa	**Parathion methyl**
Telone	**Dichloropropene**
TEM	**Tetramine**
Temephos	**Temephos**
Temik	**Aldicarb**
Tendex	**Propoxur**
Tenoran	**Chloroxuron**
Tepa	**Tepa**
Terpene polychlorinates	**Strobane**
TEPP	**TEPP**
Terbutryn	**Terbutryn**
Tersan	**Benomyl**
Tetrachlorvinphos	**Stirofos**
Tetradifon	**Tetradifon**
Tetramine	**Tetramine**
TFM	**TFM**
Tetron	**TEPP**
TH-6040	**Diflubenzuron**
Thanite	**Thanite**
Thifor	**Endosulfan**
Thimet	**Phorate**
Thimul	**Endosulfan**
Thiobencarb	**Thiobencarb**
Thiodan	**Endosulfan**
Thiodemeton	**Dimethoate**
Thionex	**Dendosulfan**
Thiopal	**Folpet**
Thiophos	**Parathion ethyl**
Thynon	**Thynon**
Timet	**Azinphos ethyl**
Tiguron	**Fenthion**
Toluene	**Toluene**
Topiclor	**Chlordane**
Tordon	**Picloram**

Alternate Name	*Common Name*
Torque	SD-14114
Toxakil	Toxaphene
Toxaphene	Toxaphene
Toxon 63	Toxaphene
Tranid	Tranid
Trefanocide	Trifluralin
Treflan	Trifluralin
Trefmid	Trefmid
Tretolite	Tretolite
Triasyn	Dyrene
Triazotion	Azinphos ethyl
Tricarnam	Carbaryl
Trichlorfon	Trichlorfon
Trichloronat	Trichloronat
Tricresyl phosphate	Tricresyl phosphate
Tri-Endothal	Endothall
Trifen	Fenac
Trifene	Fenac
Trifenson	Fenson
Trifluralin	Trifluralin
Triflurex	Trifluralin
Trifocide	Dinitrocresol
Triherbide-1PC	Propham
Trimethion	Dimethoate
Trinex	Trichlorfon
Trithion	Carbophenothion
Trolene	Ronnel
Trysben 200	2,3,6-TBA
Tubatoxin	Rotenone
Tuberite	Propham
Tugon fliegankugel	Propoxur
2,4-D	Phenoxy herbicides
2,4,5-T	Phenoxy herbicides
2,3,6-TCA	Fenac
Ultracide	Methidathion
Unden	Propoxur
Unipon	Dalapon
Ureabor	Ureabor
Urox-D	Diuron
Valexon	Phoxim
Vapona	Dichlorvos
Vapotone	TEPP
Vegfru	Phorate
Velpar	Velpar
Vendex	SD-14114
Veon	Phenoxy herbicides
Vernam	Vernolate
Vernolate	Vernolate
Vidden D	D-D soil fumigant
Viozene	Ronnel
Visko-Rhap 2TP	Phenoxy herbicides-2,4,5-T
Volaton	Phoxim
Vondcaptan	Captan
Vonduron	Diuron
Warfarin	Warfarin
Weedar	Phenoxy herbicides-2,4-D
Weedbeads	Pentachlorophenol (sodium salt)
Weed/Brush Off 400	Phenoxy herbicides
Weedol	Paraquat
Weedone	Pentachlorophenol
Weedone 2,4,5-TP	Phenoxy herbicides-2,4,5-T
Wofatox	Parathion methyl
WSSA	Alachlor
Xylene	Xylene
Xylol	Xylene
Yomesan	Niclosamide
Zectran	Mexacarbate
Zelan	Phenoxy herbicides
Zephiran	Roccal
Zerdane	DDT
Zithiol	Malathion
Zolone	Phosalone

APPENDIX III

Publications of the Columbia National Fisheries Research Laboratory Containing Toxicity Data on Chemicals Included in this Handbook

Allison, D., B. J. Kallman, O. B. Cope, and C. C. Van Valin. 1963. Insecticides: Effects on cutthroat trout of repeated exposure to DDT. Science 142(3594):958-961.

Allison, D., B. J. Kallman, O. B. Cope, and C. C. Van Valin. 1964. Some chronic effects of DDT on cutthroat trout. U.S. Fish Wildl. Serv., Res. Rep. 64. 30 pp.

Andrews, A. K., C. C. Van Valin, and B. E. Stebbings. 1966. Some effects of heptachlor on bluegills (*Lepomis macrochirus*). Trans. Am. Fish. Soc. 95(3):297-309.

Berger, B. L., R. E. Lennon, and J. W. Hogan. 1969. Laboratory studies on antimycin A as a fish toxicant. U.S. Fish Wildl. Serv., Invest. Fish Control 26. 21 pp.

Bridges, W. R., and A. K. Andrews. 1961. Effects of DDT spray on fish and aquatic insects in Gallatin River drainage in Montana. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 391. 4 pp.

Cope, O. B., E. M. Wood, and G. H. Wallen. 1970. Some chronic effects of 2,4-D on the bluegill (*Lepomis macrochirus*). Trans. Am. Fish. Soc. 99(1):1-12.

Dwyer, W. P., F. L. Mayer, J. L. Allen, and D. R. Buckler. 1978. Chronic and simulated use-pattern exposures of brook trout (*Salvelinus fontinalis*) to 3-trifluoromethyl-4-nitrophenol (TFM). U.S. Fish Wildl. Serv., Invest. Fish Control 84. 6 pp.

Earnest, R. D. 1971. Amino acid metabolism of rainbow trout (*Salmo gairdneri*) as affected by chronic dieldrin exposure. Ph.D. Thesis, University of Missouri, Columbia.

Folmar, L. C. 1976. Overt avoidance reaction of rainbow trout fry to nine herbicides. Bull. Environ. Contam. Toxicol. 15(5):509-514.

Folmar, L. C. 1977. Acrolein, dalapon, dichlobenil, diquat, and endothall; bibliography of toxicity to aquatic organisms. U.S. Fish Wildl. Serv., Tech. Pap. 88. 16 pp.

Folmar, L. C. 1978. Avoidance chamber responses of mayfly nymphs exposed to eight herbicides. Bull. Environ. Contam. Toxicol. 19:312-318.

Folmar, L. C., H. O. Sanders, and A. M. Julin. 1979. Toxicity of the herbicide glyphosate and several of its formulations to fish and aquatic invertebrates. Arch. Environ. Contam. Toxicol. 8:269-278.

Gilderhus, P. A. 1966. Some effects of sublethal concentrations of sodium arsenite on bluegills and the aquatic environment. Trans. Am. Fish. Soc. 95(2):153-159.

Gilderhus, P. A. 1967. Effects of diquat on bluegills and their food organisms. Prog. Fish-Cult. 29(2):67-74.

Grant, B. F., and P. M. Mehrle. 1970. Chronic endrin poisoning in goldfish, *Carassius auratus*. J. Fish. Res. Board Can. 27:2225-2232.

Grant, B. F., and P. M. Mehrle. 1973. Endrin toxicosis in rainbow trout (*Salmo gairdneri*). J. Fish Res. Board Can. 30(1):31-40.

Hogan, J. W., and J. L. Brauhn. 1975. Abnormal rainbow trout fry from eggs containing high residues of a PCB (Aroclor 1242). Prog. Fish.-Cult. 37(4):229-230.

Inglis, A., and E. L. Davis. 1972. Effects of water hardness on the toxicity of several organic and inorganic herbicides to fish. U.S. Fish Wildl. Serv., Tech. Pap. 67. 22 pp.

Johnson, W. W., and A. M. Julin. 1980. Acute toxicity of toxaphene to fathead minnows, channel catfish and bluegills. Ecol. Res. Ser., U.S. Environ. Prot. Agency, Washington, D.C. In press.

Johnson, B. T., and W. Lulves. 1975. Biodegradation of di-*n*-butyl phthalate and di-2-ethylhexyl phthalate in freshwater hydrosoil. J. Fish. Res. Board Can. 32(3):333-339.

Johnson, B. T., D. L. Stalling, J. W. Hogan, and R. A. Schoettger. 1977. Dynamics of phthalic acid esters in aquatic organisms. Pages 283-300 *in* I. H. Suffet, ed. Fate of pollutants in air and water environments. Part 2. Wily Interscience Publishers, New York.

Julin, A. M., and H. O. Sanders. 1977. Toxicity and accumulation of the insecticide Imidan in freshwater invertebrates and fishes. Trans. Am. Fish. Soc. 106(4):386-392.

Julin, A. M., and H. O. Sanders. 1978. Toxicity of the IGR, diflubenzuron, to freshwater invertebrates and fishes. Mosq. News 38(2):256-259.

Kennedy, H. D., L. L. Eller, and D. F. Walsh. 1970. Chronic effects of methoxychlor on bluegills and aquatic invertebrates. U.S. Fish Wildl. Serv., Tech. Pap. 53. 18 pp.

Kennedy, H. D., and D. F. Walsh. 1970. Effects of malathion on two warmwater fishes and aquatic

invertebrates in ponds. U.S. Fish Wildl. Serv., Tech. Pap. 55. 13 pp.

King, S. F. 1962. Some effects of DDT on the guppy and the brown trout. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 399. 22 pp.

Korn, S. 1973. The uptake and persistence of carbaryl in channel catfish. Trans. Am. Fish. Soc. 102(1):137-139.

Macek, K. J. 1975. Acute toxicity of pesticide mixtures to bluegills. Bull. Environ. Contam. Toxicol. 14(6):648-652.

Macek, K. J., C. Hutchinson, and O. B. Cope. 1969. The effects of temperature on the susceptibility of bluegills and rainbow trout to selected pesticides. Bull. Environ. Cont. Toxicol. 4(3):174-183.

Macek, K. J., and W. A. McAllister. 1970. Insecticide susceptibility of some common fish family representatives. Trans. Am. Fish. Soc. 99(1):20-27.

Macek, K. J., C. R. Rodgers, D. L. Stalling, and S. Korn. 1970. The uptake, distribution, and elimination of dietary ^{14}C-DDT and ^{14}C-dieldrin in rainbow trout. Trans. Am. Fish. Soc. 99(4):689-695.

Macek, K. J., and H. O. Sanders. 1970. Biological variation in the susceptibility of fish and aquatic invertebrates to DDT. Trans. Am. Fish. Soc. 99(1):89-90.

Macek, K. J., D. F. Walsh, J. W. Hogan, and D. D. Holz. 1972. Toxicity of the insecticide Dursban® to fish and aquatic invertebrates in ponds. Trans. Am. Fish. Soc. 101(3):420-427.

Marking, L. L., and W. L. Mauck. 1975. Toxicity of paired mixtures of candidate forest insecticides to rainbow trout. Bull. Environ. Contam. Toxicol. 13(5):518-523.

Mauck, W. L., F. L. Mayer, Jr., and D. D. Holz. 1976. Simazine residue dynamics in small ponds. Bull. Environ. Contam. Toxicol. 16(1):1-8.

Mauck, W. L., P. M. Mehrle, and F. L. Mayer. 1978. Effects of the polychlorinated biphenyl Aroclor® 1254 on growth, survival, and bone development in brook trout (*Salvelinus fontinalis*). J. Fish. Res. Board Can. 35(8):1084-1088.

Mauck, W. L., L. E. Olson, and J. W. Hogan. 1977. Effects of water quality on deactivation and toxicity of mexacarbate (Zectran®) to fish. Arch. Environ. Contam. Toxicol. 6:385-393.

Mauck, W. L., L. E. Olson, and L. L. Marking. 1976. Toxicity of natural pyrethrins and five pyrethroids to fish. Arch. Environ. Contam. Toxicol. 4:18-29.

Mayer, F. L., Jr. 1974. Pesticides as pollutants. Pages 405-418 *in* Bela G. Liptak, ed. Environmental engineers' handbook. Chilton Book Company, Radnor, Pennsylvania.

Mayer, F. L. 1976. Residue dynamics of di-2-ethylhexyl phthalate in fathead minnows (*Pimephales promelas*). J. Fish. Res. Board Can. 33(11):2610-2613.

Mayer, F. L., and P. M. Mehrle. 1977. Toxicological aspects of toxaphene in fish: a summary. Trans. N. Am. Wildl. Nat. Resour. Conf. 42:365-373.

Mayer, F. L., P. M. Mehrle, and P. L. Crutcher. 1978. Interactions of toxaphene and vitamin C in channel catfish. Trans. Am. Fish. Soc. 107(2):325-333.

Mayer, F. L., P. M. Mehrle, and W. P. Dwyer. 1975. Toxaphene effects on reproduction, growth, and mortality of brook trout. U.S. Environ. Prot. Agency, Ecol. Res. Ser. EPA-600/3-75-013. 43 pp.

Mayer, F. L., P. M. Mehrle, and H. O. Sanders. 1977. Residue dynamics and biological effects of polychlorinated biphenyls in aquatic organisms. Arch. Environ. Contam. Toxicol. 5:501-511.

Mayer, F. L., and H. O. Sanders. 1973. Toxicology of phthalic acid esters in aquatic organisms. Environ. Health Perspect. 4:153-157.

Mayer, F. L., D. L. Stalling, and J. L. Johnson. 1972. Phthalate esters as environmental contaminants. Nature (Lond.) 238:411-413.

McCraren, J. P., O. B. Cope, and L. L. Eller. 1969. Some chronic effects of diuron on bluegills. Weed Sci. 17(4):497-504.

Mehrle, P. M., and F. L. Mayer, Jr. 1975. Toxaphene effects on growth and development of brook trout (*Salvelinus fontinalis*). J. Fish. Res. Board Can. 32(5):609-613.

Mehrle, P. M., and F. L. Mayer, Jr. 1975. Toxaphene effects on growth and bone composition of fathead minnows, *Pimephales promelas*. J. Fish. Res. Board Can. 32(5):593-598.

Mehrle, P. M., and F. L. Mayer, Jr. 1977. Di-2-ethylhexyl phthalate: residue dynamics and biological effects in rainbow trout and fathead minnows. Pages 519-524 *in* D. D. Hemphill, ed. Trace substances in environmental health, Vol. 10. Proceedings of University of Missouri's 10th annual conference on trace substances in environmental health.

Mehrle, P. M., and F. L. Mayer. 1977. Bone development and growth of fish as affected by toxaphene. Pages 301-314 *in* I. H. Suffet, ed. Fate of pollutants in air and water environments. Part 2. Wiley Interscience Publishers, New York.

Mount, D. I. 1962. Chronic effects of endrin on bluntnose minnows and guppies. U.S. Fish Wildl. Serv., Res. Rep. 58. 38 pp.

Nevins, M. J., and W. W. Johnson. 1978. Acute toxicity of phosphate ester mixtures to invertebrates and fish. Bull. Environ. Contam. Toxicol. 19:250-256.

Olson, L. E., J. L. Allen, and J. W. Hogan. 1977. Biotransformation and elimination of the herbicide Dinitramine in carp. J. Agric. Food Chem. 25(3):556.

Olson, L. E., J. L. Allen, and W. L. Mauck. 1975. Dinitramine: Residues in and toxicity to freshwater fish. J. Agric. Food Chem. 23(3):437-439.

Rodgers, C. A. 1970. Uptake and elimination of simazine by green sunfish (*Lepomis cyanellus* Raf.). Weed Sci. 18(1):134-136.

Sanders, H. O. 1970. Toxicities of some herbicides to six species of freshwater crustaceans. J. Water Pollut. Control Fed. 42(8):1544-1550.

Sanders, H. O. 1972. Toxicity of some insecticides to four species of malacostracan crustaceans. U.S. Fish Wildl. Serv., Tech. Pap. 66. 19 pp.

Sanders, H. O., and O. B. Cope. 1966. Toxicities of several pesticides to two species of cladocerans. Trans. Am. Fish. Soc. 95(2):165-169.

Sanders, H. O., and O. B. Cope. 1968. The relative toxicities of several pesticides to naiads of three species of stoneflies. Limnol. Oceanogr. 13(1):112-117.

Sanders, H. O., F. L. Mayer, Jr., and D. F. Walsh. 1973. Toxicity, residue dynamics and reproductive effects of phthalate esters in aquatic invertebrates. Environ. Res. 6(1):84-90.

Sanders, H. O., and D. F. Walsh. 1975. Toxicity and residue dynamics of the lampricide 3-trifluoromethyl-4-nitrophenol (TFM) in aquatic invertebrates. U.S. Fish Wildl. Serv., Invest. Fish Control 59. 9 pp.

Schoettger, R. A., and W. L. Mauck. 1978. Toxicity of experimental forest insecticides to fish and aquatic invertebrates. Pages 11-27 *in* Proceedings of the 1st and 2nd USA-USSR Symposia on the Effects of Pollutants Upon Aquatic Ecosystems, Vol. 2. U.S. Environ. Prot. Agency, Environ. Res. Lab. Duluth, Spec. Publ. EPA-600/3-78-076.

Stalling, D. L., and J. N. Huckins. 1978. Metabolism of 2,4-dichlorophenoxyacetic acid (2,4-D) in bluegills and water. J. Agric. Food Chem. 26(2):447-452.

Stalling, D. L., R. C. Tindle, and J. L. Johnson. 1972. Cleanup of pesticide and polychlorinated biphenyl residues in fish extracts by gel permeation chromatography. J. Assoc. Off. Anal. Chem. 55(1):32-38.

Stock, J. N., and O. B. Cope. 1969. Some effects of TEPA, an insect chemosterilant, on the guppy, *Poecilia reticulata*. Trans. Am. Fish. Soc. 98(2):280-287.

Van Valin, C. C., A. K. Andrews, and L. L. Eller. 1968. Some effects of mirex on two warm-water fishes. Trans. Am. Fish. Soc. 97(2):185-196.

Walsh, D. F., J. G. Armstrong, T. R. Bartley, H. A. Salman, and P. A. Frank. 1977. Residues of emulsified xylene in aquatic weed control and their impact on rainbow trout, *Salmo gairdneri*. U.S. Bureau of Reclamation joint report with U.S. Fish and Wildlife Service and U.S. Agricultural Research Service, REC-ERC-76-11. 15 pp.

Woodward, D. F. 1976. Toxicity of the herbicides dinoseb and picloram to cutthroat (*Salmo clarki*) and lake trout (*Salvelinus namaycush*). J. Fish. Res. Board Can. 33(8):1671-1676.

Woodward, D. F., and F. L. Mayer, Jr. 1978. Toxicity of three herbicides (butyl, isooctyl, and propylene glycol butyl ether esters of 2,4-D) to cutthroat trout and lake trout. U.S. Fish Wildl. Serv., Tech. Pap. 97. 6 pp.

*U.S. GOVERNMENT PRINTING OFFICE: 1981 — 781-449/500 REGION NO. 8

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
EDITORIAL OFFICE
AYLESWORTH HALL, CSU
FORT COLLINS, COLORADO 80523

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF THE INTERIOR
INT 423

U.S.MAIL

NOTE: Mailing lists are computerized. Please return address label with change of address.