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LETHAL DIETARY TOXICITIES OF ENVIRONMENTAL CONTAMINANTS AND PESTICIDES TO COTURNIX

U.S. FISH AND WILDLIFE SERVICE
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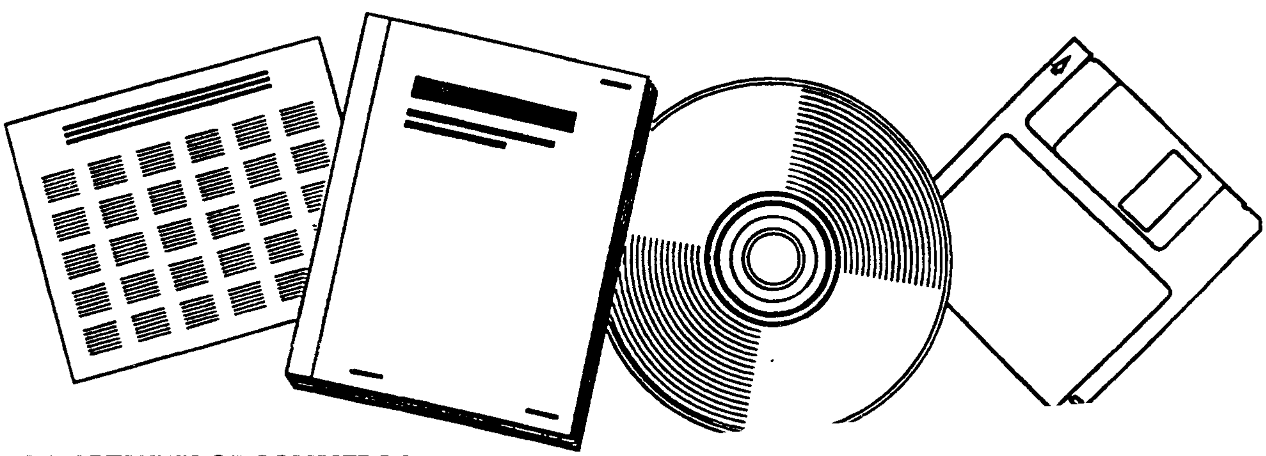

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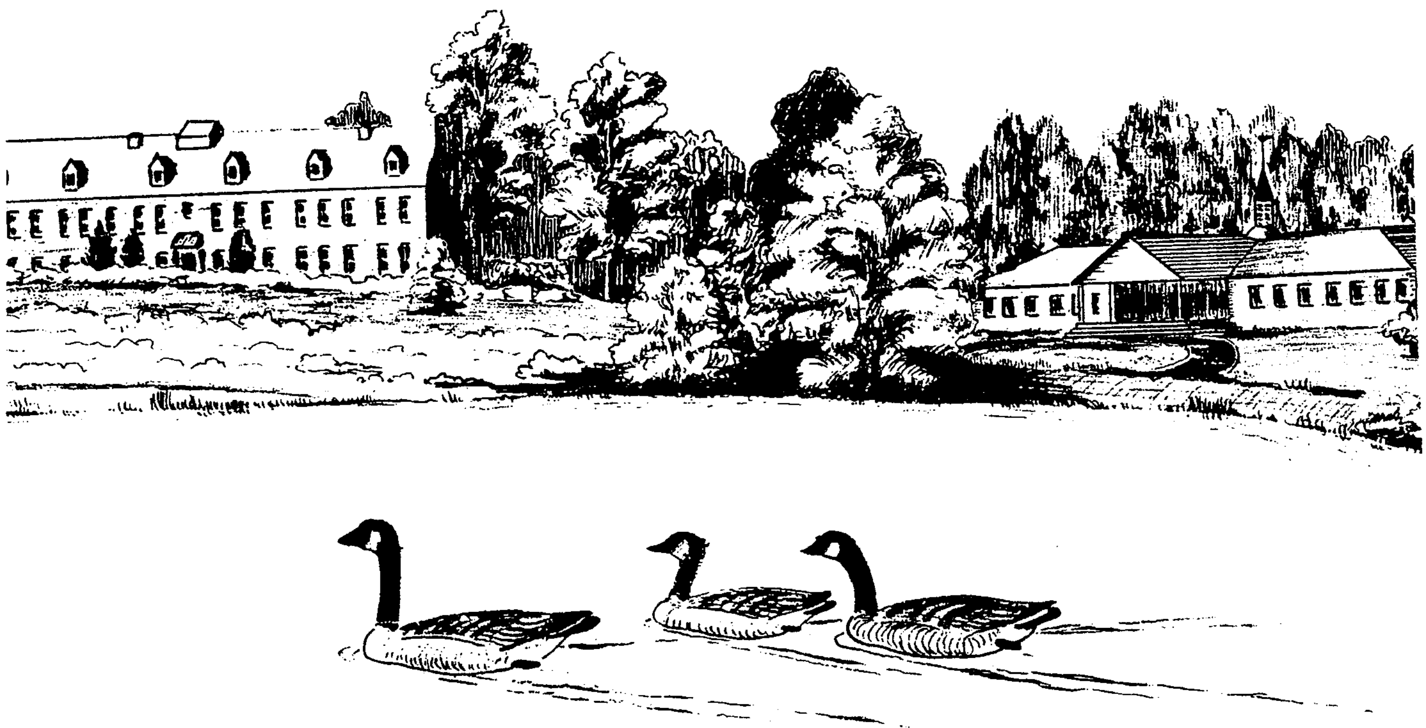

UNITED STATES DEPARTMENT OF THE INTERIOR
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By Elwood F. Hill
Michael B. Camardese

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By

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Abstract

Five-day subacute dietary toxicity tests of 193 potential environmental contaminants, pesticides, organic solvents, and various adjuvants are presented for young coturnix (Japanese quail, *Coturnix japonica* Temminck & Schlegel). The report provides the most comprehensive data base available for avian subacute dietary toxicity tests and is primarily intended for use in ranking toxicities by a standard method that has a reasonable degree of environmental relevance. Findings are presented in two parts: Part I is a critique of selected results that includes discussion of subacute toxicity in relation to chemical class and structure, pesticide formulation, and age of animals; Part II is a summary of toxicologic findings for each test substance and provides a statistical basis for comparing toxicities. Data presented include the median lethal concentration (LC50), slope of the probit regression curve (dose–response curve), response chronology, and food consumption.

We observed that: 1) fewer than 15% of the compounds were classed "very" or "highly" toxic (i.e., LC50 < 200 ppm) and all of these were either chlorinated hydrocarbons, organophosphates, or organometallics; 2) subacute toxicity may vary widely among structurally similar chemicals and between different formulations of the same chemical; therefore, conclusions about lethal hazard must be made cautiously until the actual formulation of interest has been tested; 3) inclusion of a general standard in each battery of tests is useful for detection of atypical trials and monitoring population changes but should not be used indiscriminately for adjusting LC50's for intertest differences unless the chemicals of concern and the standard elicit their toxicities through the same action; 4) although other species have been tested effectively under the subacute protocol, coturnix were ideal for the stated purpose of this research because they are inexpensive, well-adapted to the laboratory environment, and yield good intertest reproducibility of response.

The principal first-line toxicity test used in evaluation of chemicals[1] of environmental interest at the Patuxent Wildlife Research Center (PWRC) is a 5-day dietary trial with 14-day-old coturnix (Japanese quail, *Coturnix japonica* Temminck & Schlegel). From this subacute test the following statistical estimates and observations are made: Median lethal concentration (LC50) and its 95% confidence interval, slope of the dose–response line, dietary acceptability of test substance, and time to onset and characterization of toxic signs and their persistence. The LC50, when coupled with a positive control, gives a mathematical basis for ranking toxicities of chemicals tested against a given species at different times under a single set of conditions (Finney 1964, 1978). The slope of the dose–response curve provides an estimate of the amount of test substance necessary to proportionately change effect

[1]For purposes of this report the terms chemical and compound are used synonymously and refer to a test substance with a single active ingredient (e.g., technical grade), formulation refers to a chemical with additives of known or unknown bioactivity, and test substance is an all-inclusive term.

(mortality) and may be used as an index of margin of safety (Klaassen and Doull 1980; Loomis 1978). These statistical factors, in combination with the other mentioned variables, provide an estimate of the birds' vulnerability to a food source topically contaminated with a poison for a brief period of time (Hill et al. 1977). Vulnerability is a product of the birds' willingness to eat contaminated feed and their rate of feeding, their sensitivity to the contaminant, and the duration of the contaminants' availability in toxic amounts.

The present report summarizes the subacute toxicities and ancillary data for 193 environmental contaminants, pesticides, organic solvents, and adjuvants tested on coturnix chicks at PWRC and supersedes coturnix tests previously reported by Heath et al. (1972) and Hill et al. (1975). Test substances, their chemical names, and selected alternate names are cross-referenced in Table 1. Our objectives were to 1) provide an extensive data base of dietary toxicities for comparision of different chemicals and formulations under a standard methodology for a single bird species and population, 2) provide a quantifiable basis for estimation of a test substance's potential hazard to young birds, 3) quantify the dietary acceptance of the test substance by birds, and 4) define dose-dependent toxic responses and recovery for each test substance.

Table 1. *Compounds tested in 5-day diets of coturnix* (Coturnix japonica) *chicks at the Patuxent Wildlife Research Center, 1965–81.*

Common or trade name[a,b]	Chemical name[a]
Aatrex	(Atrazine)
*Abate	(Temephos)
Accothion	(Fenitrothion)
*Acephate	Acetylphosphoramidothioic acid *O*, *S*-dimethyl ester
*Orthene	
*Acetone	2-Propanone
*Aldicarb	2-Methyl-2-(methylthio)propanal *O*-[(methylamino) carbonyl]oxime
*Aldrin	1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-dimethanonaphthalene
*Allethrin	2,2-Dimethyl-3-(2-methyl-1-propenyl) cyclopropanecarboxylic acid 2-methyl-4-oxo-3-(2-propenyl)-2-cyclopenten-1-yl ester
Amaze	(Isophenphos)
*Aminocarb	4-(Dimethylamino)-3-methyl-phenol methylcarbamate (ester)
*Amitrol	1,2,4-Triazol-3 amine
*Ansar 170HC	(MSMA)
*Anthraquinone	9,10-Anthracenedione
*Aramite	Sulfurous acid 2-chloroethyl 2-[4-(1,1-dimethylethyl)phenoxy]-1-methylethyl ester
*Aroclor 1221	Polychlorinated biphenyl, 21% chlorine
*Aroclor 1232	Polychlorinated biphenyl, 21% chlorine
*Aroclor 1242	Polychlorinated biphenyl, 42% chlorine
*Aroclor 1248	Polychlorinated biphenyl, 48% chlorine
*Aroclor 1254	Polychlorinated biphenyl, 54% chlorine
*Aroclor 1260	Polychlorinated biphenyl, 60% chlorine
*Aroclor 1262	Polychlorinated biphenyl, 62% chlorine
*Aroclor 5442	Polychlorinated terphenyl, 42% chlorine
*Aspon	Thiodiphosphoric acid ([(HO) 2P (*S*)]20)
*Atrazine	6-Chloro-*N*-ethyl-*N*'-(1-methylethyl)-1, 3,5-triazine-2,4-diamine
*Azinphos-methyl	Phosphorodithioic acid *O*,*O*-dimethyl *S*-[(4-oxo-1,2,3-benzotriazine-3(4H)-yl)methyl] ester
Azodrin	(Monocrotophos)
*Banvel D	(Dicamba)
Baygon	(Propoxur)
Baytex	(Fenthion)
Benlate	(Benomyl)
Benomyl	[1-[(Butylamino)carbonyl]-1H-benzimidazol-2-yl] carbamic acid methyl ester
*Benomyl 50	
γ-BHC	(Lindane)
Bidrin	(Dicrotophos)

Table 1. *Continued.*

Common or trade name[a,b]	Chemical name[a]
Biothion	(Temephos)
*Bolstar EC	(Sulprofos)
*Bromacil	5-Bromo-6-methyl-3-(1-methylpropyl)-2,4(1H, 3H) pyrimidinedione
Bromoxynil	(3,5-Dibromo-4-hydrobenzonitrile)
*Bronate	
Bufencarb	3-(1-Ethylpropyl)phenyl methcarbamate and 3-(1-methybutyl)phenyl methylcarbamate
*Bux	
*Cadmium chloride	$CdCl_2$
*Cadmium succinate	Succinic acid cadmium salt
*Captan	3a,4,7,7a-Tetrahydro-2-[(tri-chloromethyl)thio]-1H-isindole-1,3(2H)-dione
*Carbaryl	1-Naphthalenol methylcarbamate
*Sevin 50	
*Sevin-zineb	
*Carbofuran	2,3-Dihydro-2,2-dimethyl-7-benzofuranol methylcarbamate
*Carbophenothion	Phosphorodithioic acid *S*-[[(4-chlorophenyl)thio] methyl]*O,O*-diethyl ester
Carzol	(Formetanate hydrochloride)
Casoron	(Dichlorbenil)
*Ceresan M	Ethyl (4-methyl-*N*-phenylbenzenesulfonamidato-*N*) mercury
*CHE-1843	(*E*)-1,1'-[1,2-Ethenediylbis (sulfonyl)] bispropane
*Chlordane	1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene
*HCS-3260	
*Chlordimeform	*N'*-(4-Chloro-2-methylphenyl)-*N,N*-dimethylmethanimidamide
*Chlorpyrifos	Phosphorothioic acid *O,O*-diethyl *O*-(3,5,6-trichloro-2-pyridinyl) ester
*Dursban	
*Chlorpyrifos-methyl	Phosphorothioic acid *O,O*-dimethyl *O*-(3,5,6-trichloro-2-pyridinyl) ester
*Chromic potassium sulfate	$CrK(SO_4)2 \cdot 12H_2O$
*Chromic sulfate	$Cr_2(SO_4)_3$
*Chromium acetylacetonate	Tris(2,4-pentanedionato-*O,O'*)-chromium
Cidial	(Phenthoate)
*Ciodrin	(Crotoxyphos)
Co-Ral	(Coumaphos)
*Coumaphos	Phosphorothioic acid *O*-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl) *O,O*-diethyl ester
*Counter 15G	(Terbufos)
Crotoxyphos	(*E*)-3-[Dimethoxyphosphinyl)oxy]-2-butenoic acid 1-phenylethyl ester
*Ciodrin	
*Cupric acetoarsenite	(Acetato)trimetaarsenitodi-copper
Cyano(methylmercuri) guanidine	(Cyanoguanidinato-*N'*)methyl-mercury
*Morsodren	
*Cygon 2E	(Dimethoate)
Cyolane	(Phospholan)
Cythion	(Malathion)
*2,4-D	(2,4-Dichlorophenoxy)-acetic acid
*2,4-D(Dimethylamine salt)	(2,4-Dichlorophenoxy)-acetic acid; and *N*-methylmethanamine(1:1)
*Dalapon	2,2-Dichloropropanoic acid
Dasanit	(Fensulfothion)
*2,4-DB(Acid)	4-(2,4-Dichlorophenoxy)-butanoic acid
*2,4-DB(Ester)	(2,4-Dichlorophenoxy)-acetic acid, butyl ester
DDD	(TDE)
*DDE	1,1'-(Dichloroethenylidene)bis[4-chlorobenzene]
*DDT	1,1'-(2,2,2-Trichloroethylidene)bis[4-chlorobenzene]
DDVP	(Dichlorvos)
Delnav	(Dioxathion)
*Demeton	Phosphorothioic acid *O,O*-diethyl *O*-[2-(ethylthio)ethyl] ester; and Phosphorothioic acid *O,O*-diethyl *S*-[2-(ethylthio)ethyl] ester

Table 1. *Continued.*

Common or trade name[a,b]	Chemical name[a]
*Diazinon	Phosphorothioic acid *O,O*-diethyl *O*-[6-methyl-2-(1-methylethyl)-4-pyrimidinyl] ester
*Diazinon AG500	
Dibrom	(Naled)
*Dicamba	3,6-Dichloro-2-methoxybenzoic acid
*Spectrum 33	
*Turf Treeter "T"	
*Dichlobenil	2,6-Dichlorobenzonitrile
*Dichlone	2,3-Dichloro-1,4-naphthalenedione
*Dichlorvos	Phosphoric acid 2,4-dichloroethenyl dimethyl ester
*Stable Spray	
Diclofop methyl	Methyl 2-[4-(2,4-dichlorophenoxy)phenoxy]propanoate
*Hoelon 3EC	
*Dicofol	4-Chloro-α(4-chlorophenyl)-α(trichloromethyl) benzenemethanol
*Kelthane E	
*Dicrotophos	(*E*)-Phosphoric acid 3-(dimethylamino)-1-methyl-3-oxo-1-propenyl dimethyl ester
*Dieldrin	3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-2,7:3,6-dimethanonaphth[2,3-b]oxirene
Dimecron	(Phosphamidon)
*Dimethoate	Phosphorodithioic acid *O,O*-dimethyl *S*-[2-(methylamino)-2-oxoethyl] ester
*Cygon 2E	
*Stable Spray	
Dinitrocresol	(DNOC)
Dinocap	2-Butenoic acid 2-(1-methylheptyl)-4,6-dinitrophenyl ester; and 2-butenoic acid 4-(1-methylheptyl)-2,6-dinitrophenyl ester
*Karathane	
*Dinoseb	2-(1-Methylpropyl)-4,6-dinitrophenyl
*Dioxathion	Phosphorodithioic acid *S,S'*-1,4-dioxane-2,3-diyl *O,O,O', O'*-tetraethyl ester
Dipterex	(Trichlorfon)
*Diquat dibromide	6,7-Dihydrodipyrido[1,2-a:2',1'-c]pyrazinediium dibromide
*Disulfoton	Phosphorodithioic acid *O,O*-diethyl *S*-[2-(ethylthio) ethyl] ester
Disyston	(Disulfoton)
*Diuron	*3'*-(3,4-Dichlorophenyl)-*N,N*-dimethylurea
DNBP	(Dinoseb)
DNOC	2-Methyl-4,6-dinitrophenol
*Elgetol	
DOWCO-214	(Chlorpyrifos-methyl)
*Dowfume 75	(Ethylene dichloride; carbon tetrachloride)
*DRC 1339	3-Chloro-4-methylbenzeneamine hydrochloride
*Dursban	(Chlorpyrifos)
*Dyfonate	(Fonophos)
Dylox	(Trichlorfon)
*Edifenfos	Phosphorothioic acid *O*-ethyl *S,S*-diphenyl ester
*Elgetol	(DNOC)
*Endosulfan	6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodiorathiepin 3-oxide
*Thiodan E	
*Endrin	1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-endo,endo-1,4:5,8-dimethano-naphthalene
*EPN	Phenylphosphonothioic acid *O*-ethyl *O*-(4-nitrophenyl) ester
*Ethion	Phosphorodithioic acid *S,S'*-methylene *O,O,O',O'*-tetraethyl ester
*Ethoprop	Phosphorodithioic acid *O*-ethyl *S,S*-dipropyl ester
*Mocap 6EC	
*Mocap 10G	
*Ethylan	1,1'-(2,2-Dichloroethylidene)bis[4-ethyl benzene]
Ethylene dichloride-carbon tetrachloride	1,2-Dichloroethane; and tetrachloromethane

Table 1. *Continued.*

Common or trade name[a,b]	Chemical name[a]
*Dowfume 75	
Famophos	(Famphur)
*Famphur	Phosphorothioic acid *O*-[4-(dimethylamino)sulfonyl]*O,O*-dimethyl ester
*Fenac	2,3,6-Trichlorobenzeneacetic acid
*Fenamiphos	Phosphorodithioic acid ethyl 3-methyl-4-(methylthio) phenyl(1-methylethyl) ester
*Fenitrothion	Phosphorothioic acid *O,O*-dimethyl *O*-(3-methyl-4-nitrophenyl) ester
Fenoprop	(Silvex)
*Fensulfothion	Phosphorothioic acid *O,O*-diethyl *O*-[4(methylsulfinyl) phenyl] ester
*Fenthion	Phosphorothioic acid *O,O*-dimethyl *O*-[3-methyl-4-(methylthio)phenyl] ester
*Fenuron	*N,N*-Dimethyl-*N'*-phenylurea
*Fonofos	Ethylphosphonodithioic acid *O*-ethyl *S*-phenyl ester
*Dyfonate	
*Formetanate hydrochloride	*N,N*-Dimethyl-*N'*-[3[[(methylamino)carbonyl]oxy]phenyl] methanimidamide monohydrochloride
Fundal	(Chlordimeform)
Furadan	(Carbofuran)
Galecron	(Chlordimeform)
Gardona	(Stirofos)
Glyphosate	*N*-(Phosphonomethyl) glycine
*Roundup	
Guthion	(Azinophos-methyl)
*HCS-3260	(Chlordane)
*Heptachlor	1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene
*Hexachlorobenzene	Hexachlorobenzene
Hinosan	(Edifenphos)
*Hoelon 3EC	(Diclofop methyl)
Hyvar X	(Bromacil)
*Imidan 12WP	(Phosmet)
*Ioxynil	4-Hydro-3,5-diiodobenzonitrile
*Isofenphos	1-Methyethyl-2-[[ethoxy[(1-methylethyl)amino] phosphinothioyl]oxy]benzoic acid ester
*Karathane	(Dinocap)
*Kelthane E	(Dicofol)
*Landrin	2,3,5-Trimethylphenyl methylcarbamate; and 3,4,5-trimethylphenyl methylcarbamate(1:4)
Lannate	(Methomyl)
*Lead	Lead metal
*Lead arsenate	Lead(2+)arsenic acid(H_3ASO_4) salt(2:3)
*Lead nitrate	Lead(2+)nitric acid salt
*Lead subacetate	Bis(acetato-*O*)tetrahydroxytrilead
*Leptophos	Phosphonothioic acid *O*-(4-bromo-2,5-dichlorophenyl) *O*-methylphenyl ester
*Lindane	($1\alpha,2\alpha3\beta,4\alpha,5\alpha,6\beta$)-1,2,3,4,5,6-Hexachlorocyclohexane
*Lindane EC	
*Linuron	*N'*-(3,4-Dichlorophenyl)-*N*-methoxy-*N*-methylurea
Lorsban	(Chlorpyrifos)
*Malathion	[(Dimethoxyphosphinothioyl)thio]butanedioic acid diethyl ester
*Maneb	[[1,2-Ethanediylbis[carbamodithioato]](2-)] manganese
*Manzate 200	
Marlate	(Methoxychlor)
Matacil	(Aminocarb)
*MCPB	4-(4-chloro-2-methylphenoxy)-butanoic acid
Mecoprop	2-(4-Chloro-2-methylphenoxy) propanoic acid, dimethylamine salt
*Spectrum 33	
*Turf Treeter "T"	
Mercaptophos	(Demeton)
*Mercury chloride	$HgCl_2$
*Mesurol 50	(Methiocarb)

Table 1. *Continued.*

Common or trade name[a,b]	Chemical name[a]
*Metam-sodium	Methylcarbamodithioic acid monosodium salt
Metasystox R	(Oxydemeton-methyl)
*Methamidophos	Phosphoramidothioic acid *O,S*-dimethyl ester
*Methidathion	Phosphorodithioic acid *S*-[(5-methoxy-2-oxo-1,3,4-thiadiazol-3(2H)yl)methyl]*O,O*-dimethyl ester
*Methiocarb	3,5-Dimethyl-4-(methylthio) phenyl methylcarbamate
*Mesurol 50	
*Methomyl	*N*-[[Methylamino)carbonyl]oxy]ethanimidothioic acid methyl ester
*Methoxychlor	1,1'-(2,2,2-Trichloroethylidene)-bis[4-methoxybenzene]
*Methylmercury chloride	CH_3HgCl
*Methyl parathion	Phosphorothioic acid *O,O*-dimethyl *O*-(4-nitrophenyl) ester
*Methyl trithion	Phosphorodithioic acid *S*-[[(4-chlorophenyl)thio] methyl]*O,O*-dimethyl ester
*Mevinphos	3-[(Dimethoxyphosphinyl)oxy]-2-butenoic acid methyl ester
*Mexacarbate	4-(Dimethylamino)-3,5-dimethylphenol methylcarbamate (ester)
*Mirex	1,1a,2,2,3,3a,4,5,5,5a,5b,6-Dodecachlorooctahydro-1,3,4-methano-1H-cyclobuta[cd]pentalene
*Mocap 6EC	(Ethoprop)
*Mocap 10G	(Ethoprop)
*Molinate	*S*-Ethyl hexahydro-1H-azenpine-1-carbothoic acid ester
Monitor	(Methamidophos)
*Monocrotophos	(*E*)-Phosphoric acid dimethyl[1-methyl-3-(methylamino)-3-oxo-1-propenyl] ester
*Monuron	*N'*-(4-Chlorophenyl)-*N,N*-dimethyl urea
*Morsodren	(Cyano(methylmercuri)guanidine)
MSMA	Methylarsonic acid monosodium salt
*Ansar 170HC	
*Nabam	1,2-Ethanediylbiscarbamodithioic acid disodium salt
*Naled	Phosphoric acid 1,2-dibromo-2,2-dichloroethyl dimethyl ester
Nemacur	(Fenamiphos)
*Nickel sulfate	Sulfuric acid nickel(2+)salt (1:1)
Oftenol	(Isophenphos)
Ordram	(Molinate)
*Orthene	(Acephate)
*Ortho 11775	3-(2-Butyl)phenyl-*N*-methyl-*N*-(phenylsulfenyl) carbamate
*Oxydemeton-methyl	Phosphorothioic acid *S*-[2-(ethylsulfinyl)ethyl]*O,O*-dimethyl ester
Panogen	(Morsodren)
*Paraquat CL	1,1'-Dimethyl-4,4'-bipyridinium dichloride
*Parathion	Phosphorothioic acid *O,O*-diethyl *O*-(4-nitrophenyl) ester
*Parathion 6EC	
*Paris green	(Cupric acetoarsenite)
*Pentachlorophenol	Pentachlorophenol
*Permethrin	(3-Phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2,2-dimethyl cyclopropanecarboxylic acid ester
*Pounce	
Perthane	(Ethylan)
*Phenylthiocarbamide	1-Phenyl-2-thiourea
*Phenthoate	α-[(Dimethoxyphosphinothioyl)thio]benzene acetic acid
*Phorate	Phosphorodithioic acid *O,O*-diethyl *S*-(ethylthio) methyl]ester
Phosalone	Phosphorodithioicacid *S*-[6-chloro-2-oxo-3(2H)-benzoxazolyl)methyl]*O,O*-diethyl ester
*Zolone WP	
Phosdrin	(Mevinphos)
*Phosfolan	Phosphoromidic acid 1,3-dithiolan-2-ylidene diethyl ester
*Phosmet	Phosphorodithioic acid *S*-[(1,3-dihydro-1,3-dioxo-2H-isoindol-2-yl)methyl] *O,O*-dimethyl ester
*Imidan 12WP	
*Phosphamidon	Phosphoric acid 2-chloro-3-(dimethylamino)-1-methyl-3-oxo-1-propenyl dimethyl ester
Phosvel	(Leptophos)
Phygon	(Dichlone)
*Picloram	4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid
*Piperony butoxide	5-[[2-(2-Butoxyethoxy)ethoxy]methyl]-6-propyl-1,3-benzodioxole

Table 1. *Continued.*

Common or trade name[a,b]	Chemical name[a]
•PMA	(Acetate-*O*)phenylmercury
•Potassium dichromate	Chromic acid dipotassium salt
•Pounce	(Permethrin)
Prolate	(Phosmet)
Propanil	*N*-(3,4-Dichlorophenyl) propanamide
•Stampede 3E	
Prophos	(Ethoprop)
•Propoxur	2-(1-Methylethoxy)phenol methylcarbamate
•Pyrethrius	Extracts of *Chrysanthemum cinerariaefolium* (pyrethrins I and II; cinerins I and II; and jasmolin I and II)
•Resmethrin	2,2-Dimethyl-3-(2-methyl-1-propenyl) cyclopropanecarboxylic acid[5-phenylmethyl)-3-furanyl] methyl ester
•SBP-1382, 40%	
Rhothane	(TDE)
Rogor	(Dimethoate)
•Ronnel	Phosphorothioic acid *O,O*-dimethyl *O*-(2,4,5-trichlorophenyl)ester
•Rotenone	1,2,12,12a-Tetrahydro-8,9-dimethoxy-2-(1-methylethenyl)-[1]benzopyrano[3,4-b]furo[2,3-h][1]benzopyran-6[6H]-one
•Roundup	(Glyphosate)
•SBP-1382	Resmethrin)
Sevin	(Carbaryl)
•Sevin 50	(Carbaryl)
•Sevin-zineb	(Carbaryl; zineb)
•Silvex	2-(2,4,5-Trichlorophenoxy) proprionic acid
•Simazine	6-Chloro-*N,N'*-diethyl-1,3,5-triazine-2,4-diamine
•Simazine 80W	
•Spectrum 33	(Mecoprop; dicamba)
•Stable Spray	(Dimethoate; Dichlorvos)
•Stampede 3E	(Propanil)
Starlicide	(DRC-1399)
•Stirofos	Phosphoric acid 2-chloro-1-(2,4,5-trichlorophenyl) ethenyl dimethyl ester
•Strobane	Polychlorinates of camphene, pinene, and related terpenes
•Sulprofos	*O*-Ethyl *O*-[4-(methylthio) phenyl]*S*-propyl phosphorodithioate
•Bolstar EC	
Sumithion	(Fenitrothion)
Supracide	(Methidathion)
Systox	(Demeton)
•2,4,5-T,butoxyethanol ester	(2,4,5-Trichlorophenoxy) acetic acid 2-butoxyethyl ester
•TDE	1,1'-(2,2-Dichloroethylidene) bis[4-chlorobenzene]
Tedion	(Tetradifon)
Temephos	Phosphorothioic acid *O,O'*-(thiodi-4,1-phenylene)*O, O, O',O'*-tetramethyl ester
•Abate	
Temik	(Aldicarb)
•TEPP	Diphosphoric acid tetraethyl ester
•TEPP 40	
•Terbufos	Phosphorodithioic acid *S*-[[1,1-dimethylethyl)thio]methyl] *O,O*-diethyl ester
•Counter 15G	
•Tetradifon	1,2,4-Trichloro-5-[(4-chlorophenyl)-sulfonyl] benzene
Thimet	(Phorate)
•Thiodan E	(Endosulfan)
Thiodemeton	(Disulfoton)
•Thionazin	Phosphorothioic acid *O,O*-diethyl *O*-pyrazinyl ester
•Thiram	Tetramethylthioperoxydicarbonic diamide
Tordon	(Picloram)

Table 1. *Continued.*

Common or trade name[a,b]	Chemical name[a]
*Toxaphene	Chlorinated camphene
*Toxaphene EC	
*Treflan EC	(Trifluralin)
*Trichlorfon	(2,2,2-Trichloro-1-hydroxyethyl)-phosphonic acid dimethyl ester
Trifluralin	2,6-Dinitro-*N,N*-dipropyl-4-(trifluoromethyl) benzenamine
*Treflan EC	
Trithion	(Carbophenthion)
*Turf Treeter "T"	(Mecoprop; dicamba)
*Vanadium pentoxide	Vanadium oxide
Vapam	(Metam-sodium)
Vapona	(Dichlorvos)
Warbex	(Famphur)
*Xylene	Dimethylbenzene
Zectran	(Mexacarbate)
*Zinc phosphide	Zinc phosphide
*Zineb	[[1,2-Ethanediylbis[carbamodithioato]]-(2-)]zinc
*Sevin-zineb	
Zinophos	(Thionazin)
*Ziram	Bis(dimethylcarbamodithioato-*S,S'*)zinc
*Zolone WP	(Phosalone)

[a] Nomenclature is after *Chemical Abstracts*, 9th Chemical Index.
[b] Test compounds are prefaced with an asterisk (formulations are indented). Commonly used alternative names are provided in combination with common names (in parentheses) for cross-reference.

Methods

Test Protocol

The subacute coturnix test was standardized from methods described by Heath and Stickel (1965), Heath et al. (1972), Hill et al. (1975), and Hill and Camardese (1981). The basic test was to feed five or six geometrically-arranged concentrations of a chemical substance to 14-day-old coturnix for 5 days followed by at least 3 days of untreated feed. When overt toxic signs persisted, posttreatment observations were continued until 1 day after their remission. The LC50, defined as ppm active ingredient in a 5-day ad libitum diet calculated to kill 50% of the test population, its 95% confidence interval, and the slope and standard error of the probit regression curve were derived by probit analysis (Finney 1971). (Compounds with LC50's above 5,000 ppm in preliminary range-finding tests were not tested further.) Rationales for use of the experimental and statistical procedures are presented in Appendix A.

Five to eight compounds and three sets of controls, one negative and two positive, were normally tested simultaneously in a completely randomized experiment. The negative controls (n = 5 or 6 per experiment), equivalent to other test groups in all respects except for the absence of toxicant, received diluent-treated feed and provided the basis for assessing dietary acceptance of test substance and adjusting for extraneous mortality as described in Appendix B. The two positive controls, dicrotophos and dieldrin, provide a means of statistically correcting for differences between standardized tests conducted at different times or laboratories. Dieldrin was included as a general standard (Heath et al. 1972; Hill et al. 1975; American Society for Testing and Materials 1982) and dicrotophos as a standard for anticholinesterases; i.e., organophosphorus and carbamate compounds (Hill 1981). A detailed rationale for use of standard preparations has been presented by Finney (1971); procedures for adjusting data through the standards are provided in Appendix B.

Assignment of test animals and treatment (concentration) to test groups was by random numbers. One test group was established per concentration and comprised the basic statistical unit. These groups were established 12 days after chicks were removed from the incubator and normally consisted of 10 to 15 individuals. (Experimental conditions were as described in the following section, *Test Animals and Facilities*.) On day 13 any deformed, injured, or obviously aberrant specimens were replaced by random selection from surplus hatchmates.

Testing commenced midmorning of day 14 posthatch. (Some pre-1970 tests used ages other than 14 days [Hill et al. 1975]; most of these discrepant tests were repeated and are superseded by this report). Mortality, overt toxic signs, and food consumption were recorded at 24-hour intervals. Fresh feed was added to all pens each day. Food consumption measurements were usually based on three randomly selected negative control groups and the second lowest and second highest concentrations of each test compound. The second lowest and highest concentrations were used because they usually resulted in partial kills, whereas the lowest and highest concentrations often killed none or 100% of the test subjects. After day 5, all feed, including that of negative controls, was replaced by untreated feed. Minor deviations from the basic procedures were sometimes necessary; e.g., duration of pretest conditioning, numbers of individuals per test group, or number of test concentrations.

Test Animals and Facilities

Test birds were incubator-hatched progeny of successive generations of a randomly bred, but genetically closed, coturnix colony maintained at PWRC. The colony was entirely replaced twice each year. The original stock was obtained from Auburn University, Auburn, Alabama, about 1960 and supplemented (≈30% replacement) with coturnix from the University of Maryland, College Park, Maryland, in 1975 and 1980.

Chicks were brooded and tested in six-tiered brood units with each tier divided into four pens measuring 35×100×24 cm high. Floors and external walls were of wire mesh; ceilings and common walls were galvanized sheeting. Tiers were equipped with thermostatically controlled heat and fluorescent lighting. Pen temperatures were adjusted according to the age of the birds (Wilson et al. 1961), whereas room temperature was maintained between 20 and 25 °C. Free access to water and unmedicated gamebird starter (Ziegler Brothers, Inc., Gardners, Pennsylvania) was permitted at all times.

Selection and Preparation of Test Diets

Test concentrations were derived by preliminary range-finding tests consisting of three widely spaced concentrations (5 to 10 chicks per concentration) of technical grade chemical. Because relative toxicities often differ markedly among compounds between avian subacute and avian (Heinz et al. 1979; Tucker and Crabtree 1970) or mammalian (Gaines 1969; Hill et al. 1975) acute tests, and only acute data were usually available for setting range-finding concentrations, compounds were initially categorized as either "very" or "slightly" toxic (Hill et al. 1975) and initial concentrations were typically set at 100, 316, and 1,000 ppm or 1,000, 2,236, and 5,000 ppm. When little relevant data were available for a compound, concentrations of 100, 707, and 5,000 ppm were used. From these or similar range-finders, the LC10 and LC90 could usually be interpolated (or extrapolated) from resultant log probability plots. Three or four intermediate concentrations were then added at constant log intervals between the estimated LC10 and LC90. Concentrations set by this method nearly always provided an acceptable test with at least three concentrations that killed some but not all of the test subjects, and included at least one such concentration below and one above 50% mortality. If these criteria were not met, concentrations were rearranged and the test was repeated in its entirety.

Test diets were prepared by blending a toxicant-diluent solution into game-bird starter mash in the ratio of 2:98 (w/w). Corn oil was the usual diluent (93% of tests); propylene glycol was substituted when compounds were insoluble in oil. Initially, a stock solution of toxicant–diluent was prepared by direct addition of test substance to diluent or by first dissolving the compound in minimal quantities of acetone; solutions were mixed cold with a magnetic stirrer. The stock solutions were then serially diluted to give the final concentration of active ingredient in a 1.0 kg batch of feed. For pre-1971 tests, highly stable compounds (e.g., chlorinated hydrocarbons) were heated into solution. If extremely large quantities of test substance were required, or if the compound had a talc base, it was mixed directly into the feed and appropriate amounts of diluent were added to the mixture as a supplement. Control diets contained corn oil or propylene glycol in the ratio of 2:98 (w/w). Although propylene glycol was sometimes used as a diluent, it was not routinely used as a supplemental negative control.

Test Chemicals

Test chemicals, usually technical grade, were procured from the manufacturer, Chem Service, Inc., West Chester, Pennsylvania, or other retailers. Test compounds were selected primarily from nominations by PWRC staff and were based on known or anticipated use patterns and thus potential environmental availability to nontarget animals. Initial emphasis was on technical grade chemicals in order to generate base-line data on many compounds rather than various formulations of a selected few. It was realized that biological activity could be altered by additives such as solubilizers and dispersing agents, but it was felt that tests of technical material gave the best single estimate of a compound's inherent toxicity. In 1980, our emphasis shifted to comparative testing of various pesticidal formulations, and retesting compounds earlier tested with birds less than 12 or more than 16 days old at start.

Results and Discussion

Subacute toxicity tests of 193 potential environmental contaminants, pesticides, organic solvents, and various adjuvants have been completed on young coturnix at PWRC since 1965. About 95% of the tests were conducted under standardized conditions and may (theoretically) be compared without discrimination through positive controls. The remaining 5% of the tests were associated with some discrepancy, e.g., age of chicks, but nearly all of the involved compounds were of very low toxicity and retesting was not justified. Results are presented in two parts: Part I is a discussion of selected comparative data drawn from Part II and other sources. Part II is an alphabetical presentation, by common name, of each substance tested, its chemical description, and a summary of toxicologic findings.

Part I. Comparative Toxicology

Lethal tests on birds often constitute the entire wildlife data bank for assessing a chemical's potential environmental hazard to free-ranging homoiotherms. These tests, acute and subacute, are conceptually similar of design and both use lethality as the primary endpoint, but the methods of exposure are different and provide complementary information. The acute test, yielding a median lethal dosage (LD50), uses controlled dosages based on body weight and gives an estimate of a chemical's inherent toxicity to a given species, and through which interspecies comparisons may be made. Reproductively quiescent adults of both sexes are normally used in acute testing because both age (Hudson et al. 1972) and sex (Tucker and Haegele 1971) may influence LD50's. The subacute test, yielding a 5-day LC50, permits animals to freely choose potentially lethal concentrations of chemical and, as previously discussed, may indicate a species' vulnerability to short-term exposure to contaminated diets. For this test of prepubescent chicks, the sex of test subjects has not proved critical but age must be constant among tests for optimal comparisons (Hill and Camardese 1981). The toxicological relations between acute and subacute results have discussed by Hill et al. (1975) and Heinz et al. (1979). Reports of acute data for birds have been published by Tucker and Crabtree (1970), Schafer (1972), Schafer and Cunningham (1972), Schafer et al. (1983), and Hudson et al. (1984).

Subacute Toxicity in Relation to Chemical Class

Toxicity is a relative term used to define a particular risk, such as death, associated with exposure to a foreign substance under a specified set of conditions. Toxicity can be described statistically to quantify the relations between specific substances, or qualitatively for characterizing potential hazard associated with a given substance. The following qualitative scheme has been devised for rating 5-day subacute dietary LC50's (Hill et al. 1975):

Class	Definition	LC50 (ppm)
I	Highly toxic	≤40
II	Very toxic	>40≤200
III	Moderately toxic	>200≤1000
IV	Slightly toxic	>1000≤5000
V	Practically nontoxic	>5000

Only 2.4% of the chemicals tested, i.e., two chlorinated hydrocarbons (DRC 1339 and endrin) and two organophosphates (mono- and dicrotophos), were Class I or "highly" toxic, and another 9.7% (all either chlorinated hydrocarbon, organophosphorus, or organometallic compounds) were Class II. Of the remaining 88%, about 25% were only "moderately" toxic to coturnix in a 5-day diet and the balance were even less toxic, i.e., LC50>1,000 ppm or 0.1% of the diet (Table 2). Carboxylate herbicides and carbamates of the dithiocarbamic acid group were predominantly Class V compounds. When avian subacute dietary tests were compared with similar toxicity classification schemes for single-dose acute tests of (either avian or mammalian species), the acute test almost always confirmed, or increased, the degree of toxicity indicated by subacute tests (Hill et al. 1975; Heinz et al. 1979). Exceptions to this generalization incude carbamates such as aldicarb, carbofuran, and mexacarbate, and the organophosphate, temephos. Each of these carbamates are known for their extreme acute toxicity, i.e., LD50 ≤ 10 mg/kg, to birds (Hudson et al. 1983) and mammals (Gaines 1969) and yet were only moderately toxic when presented in feed to coturnix (cf. Part II) and other birds (Hill et al. 1975). Temephos was essentially nontoxic to rats (LD50 >8000 mg/kg, Gaines 1969) but was consistently highly toxic when fed to birds (Part II; Hill 1971; Hill et al. 1975). Although the frequency distributions of LC50's for alicyclic hydrocarbon, phosphoric and thiophosphoric acids, and organometallic pesticides show them as characteristically toxic when presented in the diet, there are enough exceptions to invalidate any generalizations of toxicity based purely on chemical class. Also, definitive assessment of hazard associated with carbamic acids would likely result in errors if based on LC50's alone because some are acutely toxic and one, carbofuran, has been implicated in large-scale kills of wildfowl (Flickinger et al. 1980).

Table 2. *Percentage frequency distribution by toxicity class for some common classes of pesticides and pollutants tested in 5-day diets of coturnix chicks.*[a]

		Toxicity class[b]				
Chemical class	(*n*)	I	II	III	IV	V
Chlorinated Hydrocarbon Compounds						
Alicyclic hydrocarbons	(12)	8	25	50	8	8
Aromatic hydrocarbons	(17)	6	0	18	41	35
Organophosphorus Compounds						
Phosphoric acids	(9)	22	11	33	22	11
Thiophosphoric acids	(19)	0	37	32	21	11
Dithiophosphoric acids	(17)	0	12	41	29	18
Phosphonic acids	(5)	0	0	60	40	0
Carbamate Compounds						
Carbamic acids	(15)	0	0	27	40	33
Dithiocarbamic acids	(5)	0	0	0	0	100
Metallic Compounds						
Inorganic	(12)	0	0	17	25	58
Organic	(7)	0	43	14	29	14
Carboxylate Compounds						
All classes	(22)	0	0	0	9	91
Miscellaneous Compounds						
Various classes[c]	(25)	0	0	16	8	76
Pooled Comparison						
All classes	(165)	2	10	24	22	42

[a] Frequencies are based on LC50's for 12- to 14-day-old chicks in Part II. Comparisons are restricted to compounds of technical grade and formulations for which their technical form was not tested.
[b] Bounds of toxicity classes: I = ≤41 ppm; II = 41-200 ppm, III = 201-1,000 ppm; IV = 1,001-5,000 ppm; and V = >5,000 ppm (Hill et al. 1975).
[c] Arsenic, formamidine, ketone, organonitrogen, organosulfur, phenolic, and synthetic urea.

Subacute Toxicity in Relation to Chemical Structure or Formulation

Analogues of a biologically active substance may vary widely in their toxic properties. Even single substituent changes can cause marked differences in a compound's activity (Kolbezen et al. 1954), and multiple substituents have been observed to change insecticidal activity up to 2,600-fold (Metcalf and Fukuto 1967). These activity differences may also apply (to some degree and not necessarily in the same direction) to vertebrates and provide the basis of selective toxicity, a poorly understood phenomenon (Albert 1965; O'Brien 1967).

Because of unpredictable bioactivity and a scarcity of such comparisons for subacute studies with birds, a variety of structurally similar pesticides, analogues, and selected formulations were tested on 14-day-old coturnix (Table 3). The cyclodienes, chlordane, heptachlor, aldrin, dieldrin, and endrin differed more than 18-fold in their subacute toxicity to coturnix chicks and were spread among toxicity Classes I, II, and III. Only aldrin and its epoxy, dieldrin, were of equivalent toxicity under this test protocol. HCS-3260, purported to be a highly purified form of chlordane, was only half as toxic as technical chlordane. DDT and three of its analogues, DDE, TDE, and dicofol (the last two have also been synthesized for use as pesticides), differed more than sixfold in their subacute toxicities and the LC50 of each was statistically separable from all others. Four chlorinated hydrocarbon formulations were tested and Lindane EC was found significantly ($P \leq 0.05$) less toxic than its technical grade; all others were

Table 3. *Comparative dietary toxicities of structurally similar pesticides, metabolites, and formulations to 14-day-old coturnix.*

Pesticide	Formulation	AI[a]	LC50[b]	95% CI
Chlorinated Hydrocarbon Compounds				
Heptachlor	Technical	72%	99[a]	85–115
Chlordane	Technical	100%	308[b]	262–361
HCS-3260	Technical	97%	657[c]	513–842
Aldrin	Technical	95%	62[a]	53–74
Dieldrin	Technical	100%	60[a]	57–63
Endrin	Technical	>95%	17[b]	15–20
Endosulfan	Technical	96%	2,906[a]	2,278–3,708
	Thiodan E	23%	2,160[a]	1,658–2,815
DDT	Technical	100%	416[a]	341–509
DDE	Technical	99%	859[b]	696–1,060
TDE	Technical	100%	2,636[c]	2,225–3,122
Dicofol	Technical	95%	1,535[d]	1,201–1,962
	Kelthane E	18%	1,027[bd]	852–1,259
Lindane	Technical	93%	490[a]	408–589
	Lindane EC	13%	663[b]	587–748
Toxaphene	Technical	100%	529[a]	436–641
	Toxaphene EC	59%	565[a]	470–679
Organophosphorus Compounds				
TEPP	Technical	99%	1,517[a]	1,258–1,828
	TEPP 40	40%	403[b]	308–529
Dicrotophos	Technical	85%	37[a]	34–40
Monocrotophos	Technical	8%	2.4[b]	2–3
Terbufos	Technical	99%	284[a]	239–342
	Counter 15G	15%	225[b]	194–265
Ethoprop	Technical	95%	89[a]	72–109
	Mocap 6EC	70%	91[a]	68–122
	Mocap 10G	10%	90[a]	78–102
Dimethoate	Technical	99%	341[a]	286–409
	Cygon 2E	23%	469[b]	373–659
	Stable Spray	16%X	531[b]	434–650

Table 3. *Continued.*

Pesticide	Formulation	AI[a]	LC50[b]	95% CI
Acephate	Technical	98%	3,275[a]	2,691–3,986
	Orothene	16%	718[b]	593–868
Methamidophos	Technical	73%	92[c]	73–116
Methyl parathion	Technical	80%	69[a]	61–78
Parathion	Technical	99%	238[b]	152–371
	Parathion 6EC	79%	238[b]	181–312
Sulprofos	Technical	99%	477[a]	402–571
	Bolstar EC	64%	367[b]	305–436
Fonofos	Technical	93%	290[a]	224–377
	Dyfonate	45%	284[a]	247–326
Methyl trithion	Technical	85%	3,235[a]	2,575–4,062
Carbophenthion	Technical	95%	4,434[a]	2,492–7,887
Phosmet	Technical	98%	2,072[a]	1,721–2,426
	Imidan 12WP	12%	2,041[a]	1,492–2,792
Chlorpyrifos methyl	Technical	96%	>5,000[a]	–
Chlorpyrifos	Technical	97%	293[b]	112–767
	Dursban	40%	492[b]	351–688
Diazinon	Technical	99%	167[a]	131–212
	AG 500	48%	101[b]	81–126
Carbamate Compounds				
Aminocarb	Technical	99%	2,325[a]	1,947–3,020
Mexacarbate	Technical	93%	605[b]	526–697
Methiocarb	Technical	97%	1,342[c]	1,048–1,719
	Mesurol 50	50%	1,182[c]	966–1,446
Aldicarb	Technical	99%	387[a]	336–445
Methomyl	Technical	>95%	3,463[b]	1,992–5,928

[a] Active ingredient. All toxicities (LC50) have been corrected to equal 100% AI.
[b] LC50's within a given group (bounded by intermittent lines) that do not share a common letter are significantly different (two-tailed *t*-test; $P \leq 0.05$).

statistically inseparable from the parent compound.

Differences between substituted organophosphorus compounds were large and erratic. For example, methyl parathion was more than 3 times as toxic as ethyl parathion but chlorpyrifos (ethyl) was more than 17 times as toxic as chlorpyrifos methyl. Whereas all of the above mentioned DDT metabolites were less toxic than DDT, monocrotophos, the *N*-dealkylation product of dicrotophos, was about 15 times as toxic as dicrotophos, and methamidophos, a possible metabolite of acephate, was 36 times more toxic than acephate. Eleven organophosphorus formulations could be contrasted with their technical grade bases (Table 3). The formulation was most toxic ($P < 0.05$) twice, and the two forms were of equivalent toxicity 4 times. TEPP 40 and Orthene were about 4 times as toxic as their technical grade bases. Our data indicate that subacute toxicities of pesticides often differ markedly between analogues or formulations and, therefore, any conclusions about lethal hazard associated with field use of a chemical must be made with caution until the actual formulation has been tested.

Subacute Toxicity in Relation to Age of Test Animals

Birds of a single age should be tested to achieve optimal intertest comparisons of avian subacute toxicity data (Hill et al. 1975; Ludke et al. 1975; Heinz et al. 1979; Hill 1981; Hill and Camardese 1981). Age-related changes in vulnerability to the protocol and its derived LC50's occur during early life. For example, over a span of 3 weeks from hatching, LC50's increased an average of 2.5-fold for nine pesticides (three organophosphorus and two each of carbamate, chlorinated hydrocarbon, and organomercurial compounds) that we tested at 1-week intervals on coturnix from a single hatch (Hill and Camardese 1981). LC50's increased weekly for 26 of 27 comparisons, but only five of these individual week-to-week changes were significant ($\alpha = 0.05$). Mean increases for the consecutive ages were 1.4-, 1.4-, and 1.3-fold between hatch and 7, 7 and 14, and 14 and 21 days of age, and these mean increases were statistically inseparable (one-way ANOVA, $P > 0.10$). Because the degree of change was essentially constant, i.e., pooled mean change of 1.35-fold per week (CV = 15.6%), over time during the first 3 weeks posthatch, and a variety of chemicals were involved in the study, we postulated that a correction factor of 1.05 per day may be used for adjusting LC50's between disparate ages within this 3-week limit. However, adjustment of some pre-1969 LC50's for 6- to 19-day-old coturnix (Hill et al. 1975) to 14 days, the presently recommended test age (Heinz et al. 1979; Hill and Camardese 1981; American Society for Testing and Materials 1982), did not support the use of such a factor when the corrected LC50's were compared with actual tests of 14-day-old chicks.

The relation between LC50 and age of coturnix for six chlorinated hydrocarbon insecticides are illustrated by comparing toxicities adjusted by the above factor of 1.05 per day and through concurrent tests of dieldrin, a positive control (Table 4). For heptachlor, chlordane, and DDT the actual LC50's were negatively rather than positively related with test age and therefore did not fulfill the basic premise of our correction factor, i.e., LC50's increase over age from hatching through 3 weeks. Although the other chemicals did meet the criterion of positive correlation, the relation to unity after adjustment for age was improved for only aldrin and toxaphene. Lindane was

Table 4. *Direct comparisons of chlorinated hydrocarbon toxicities to coturnix in relation to age, and after adjustment through the dieldrin standard and by the method of Hill and Camardese (1981).*

Compound	Age[a]	LC50[b]	95% CI	TR[c]	RTD[d]	$LC50_A$[b,e]	TR_A[f]
Heptachlor	14 Days	99	85–115			99	
				1.06	0.93		1.36
	19 Days	93	74–116			73[g]	
Chlordane	14 Days	308	262–361			308	
				0.88	0.78		0.63
	7 Days	350	305–403			492[g]	
Aldrin	14 Days	62	53–74			62	
				1.82	1.23		1.24
	6 Days	34[g]	28–41			50	
DDT	14 Days	416	341–509			416	
				0.73	0.66		0.52
	7 Days	568	470–687			799[g]	
Lindane	14 Days	490	408–589			490	
				1.15	1.35		0.83
	7 Days	425	347–520			598	
Toxaphene	14 Days	529	436–641			529	
				0.77	1.24		0.89
	17 Days	686	520–1,002			593	

[a] Age at the start of the 5-day feeding trial. Data for 14-day-old chicks are from Part II; data for other ages are from Hill et al. (1975).
[b] LC50: Parts per million of the compound in a 5-day diet estimated to kill 50% of the test population.
[c] TR: Toxicity ratio of the paired ages, i.e., a division of the LC50 for 14-day-old chicks by the LC50 of the alternate aged chicks.
[d] RTD: Toxicity ratio of the paired ages based on the RTD for each test as described in Appendix B.
[e] $LC50_A$: The LC50 adjusted by a factor of 1.05 per day (Hill and Camardese 1981).
[f] TR_A: Toxicity ratio of the adjusted LC50's of the paired ages.
[g] Significantly different from 14-day-old counterpart ($P < 0.05$).

over-corrected to a negative relation which was further from unity than the initial LC50's. For the pairs of LC50's in Table 4, the mean toxicity ratios before adjustment, after adjustment for age, and after adjustment through concurrent tests of dieldrin were 1.07 (CV = 37%), 0.91 (CV = 36%), and 1.03 (CV = 27%), respectively. The theoretical relation between adjusted LC50's is 1.0. Comparisons such as those presented in Table 4 were also made for other classes of chemicals and the results were often better than shown for chlorinated hydrocarbons; on the basis of our overall evaluation, however, we now recommend against use of the aforementioned constant as a means of correction for differences of test age. We recommend instead adhering to a single test age, within reasonable limits, e.g., 14 ± 2 days, for general subacute toxicity screening with coturnix and, of course, accompanying each test with an appropriate positive control.

Ancillary Observations and Subacute Toxicity

Positive Controls

"One feature possessed by all biological assays is the variability in the reaction of the test subjects and the consequent impossibility of reproducing at will the same results in successive trials, however carefully the experimental conditions are controlled" (Finney 1964). This variability can be corrected statistically by concurrent testing of a standard preparation that has the same biologically active principle as the test preparation (Finney 1964). However, when tests are conducted on such diverse chemicals as included in the present report, the condition of identical action was not always met, but our use of dieldrin and dicrotophos as standards represented two very important pesticidal modes of action, i.e., central nervous system stimulation (dieldrin) and cholinesterase inhibition (dicrotophos). Chemicals working through one or the other of these actions, mainly chlorinated hydrocarbons, organophosphates, and carbamates, constituted 60% of all compounds tested. In addition to serving as the standard for chlorinated hydrocarbons, dieldrin was also used as a general standard for all tests regardless of specific mechanisms of action (Heath et al. 1972). As a general standard, dieldrin is perhaps best used as a means of detecting atypical trials and demonstrating population changes over time (Hill et al. 1977).

PWRC tests of dieldrin and dicrotophos with 14-day-old coturnix since inception of routine subacute toxicity testing in 1965 are compared over time in Table 5. Dieldrin LC50's remained similar over 16 years of testing progeny from about 30 generations of coturnix. Mean and extreme LC50's of 1965–1969 tests were virtually the same as after procedural standardization completed in 1970, and continued even though new stock was infused into the breeding colony in 1975 and 1980. Tests of dicrotophos did not commence until 1972 and therefore do not provide the same basis for long-term comparison as does dieldrin, but the mean LC50 for dicrotophos was significantly ($P < 0.05$) less during 1979 than in other years. The reason for the lower LC50's of dicrotophos in 1979 was not determined, but eight of nine LC50's during 1979 were less than the mean LC50 for either 1972–73, 1980, or 1981 (cf. individual tests in Appendix C). Also, the LC50

Table 5. *Comparative LC50's for positive controls during 16 years of subacute toxicity testing with 14-day-old coturnix*[a].

Test years	No. of tests	Dieldrin[b] Extremes	Dieldrin[b] Mean	Dicrotophos[b] Extremes	Dicrotophos[b] Mean	Toxicity ratio[c] Extremes	Toxicity ratio[c] Mean
1965–69	10	49, 76	58	No tests		No tests	
1970–73	11[d]	50, 73	59	33, 51	41	1.0, 1.9	1.6
1979	9	52, 68	58	24, 40	32[e]	1.5, 2.1	1.8[f]
1980	8	49, 81	64	34, 48	40	1.4, 1.7	1.6
1981	6	50, 76	62	29, 48	38	1.3 1.9	1.6

[a] All statistics were based on pooled LC50 values for the designated test years.
[b] LC50: Parts per million of compound in a 5-day diet estimated to kill 50% of the test population.
[c] Toxicity ratio of the paired tests; i.e., a division of the LC50 for dieldrin by the LC50 for dicrotophos.
[d] Dicrotophos tests confined to 1972 and 1973 (n = 3).
[e] Significantly different from 1981 ($P < 0.05$) and 1972–73 and 1980 ($P < 0.01$), one-way ANOVA and Duncan's (1955) multiple-range test.
[f] Significantly different from 1970–73, 1980, and 1981 ($P < 0.05$), one-way ANOVA and Duncan's (1955) multiple-range test.

ratios of dicrotophos to dieldrin averaged a constant 1.6 in 1972–73, 1980, and 1981 compared with 1.8 ($P<0.05$) in 1979. These results seem to indicate that our colony experienced increased sensitivity to dicrotophos in 1979 compared with other years. Whether this differential sensitivity was exclusive to dicrotophos or representative of anticholinesterases is unknown. However, our 1979 results did demonstrate that differences of sensitivity to toxic challenge may occur within an apparently normal population over time and may not be equivalent for chemicals of different toxic action. This finding 1) supports Finney's (1964) idealized requirement of like-action of standard and test preparation, 2) indicates caution in use of a general standard in routine adjustment of toxicants tested at different times, and 3) confirms the necessity of a standard for overall quality control.

Negative Controls

For purposes of this report negative controls refer to chicks fed diluent-treated feed but are otherwise treated identically to all other test groups. Their value is in establishment of the norm for comparison to toxic response, e.g., behavior, food consumption, and extraneous mortality. Although there is a statistical method of adjusting toxic response for control mortality (Abbott's formula, Appendix B), it is not necessary for any of the tests reported in Part II. Overall, control mortality occurred in 7 of 49 tests (all pre-1979) and consisted of a single death 5 times, two deaths 1 time, and three deaths 1 time. The median and extreme numbers of controls per test were 60 and 42 and 120 individuals. True negative controls, i.e., untreated feed, were not used in the protocol.

Dose-Response Curve

The slope of the dose–response line is a critical variable in evaluating both subacute toxicity and potential hazard associated with a chemical substance. The steepness of the line's slope may represent the birds' ability to cope with chemically contaminated feed for a specified period of time and, when associated with the LC50, gives an estimate of the species' vulnerability to brief but continuous exposure to the contaminant (Hill et al. 1977; Hill 1981). Although the tests reported in Part II were not designed for detailed comparison of dose-response lines, the single-test estimates of slope are adequate for approximating the amount of chemical necessary to change effect. This line may then be used for evaluation of different pesticidal applications, i.e., treatment levels, and for defining acceptable margin of error associated with such applications. As a general rule, pesticides of equivalent toxicity yielding steep slopes seem more hazardous than those with shallow slopes because it takes proportionally less chemical to increase effect; thus, applicator precision is essential. Also, in our 5-day feeding trial, steep slopes are frequently associated with chemicals that are readily accepted in the diet, in contrast with shallow slopes which often indicate some degree of feed avoidance (Hill and Camardese 1981). Discussions on the use of dose-response lines in wildlife toxicology have been presented for both subacute (Ludke et al. 1975; Hill et al. 1977; Hill 1981; Hill and Camardese 1981) and acute (Hill and Camardese 1984) toxicity tests.

Statistically, the predictive value of the dose-response line is limited to the linear portion of its curve, i.e., ± 1 SD of the LC50, and it has been recommended that estimates of specific LC-values outside the bounds of this range (LC16 and LC84) be determined by especially designed experiments (*see* Appendix A). This is not meant to discourage use of dose-response lines in toxicologic interpretation, but only to caution against their indiscriminate use. In fact, slopes of dose-response curves must be calculated and meet the test for parallelism before certain toxicologic relations between two compounds can be assumed valid (Finney 1978; Heath et al. 1972). Statistical methods for comparison of toxicity, between chemicals and calculations of alternative response levels are presented in Appendix B.

Dose-response curves of subacute toxicity tests have been studied for coturnix at a single age over time and at different ages (Hill et al. 1977; Hill and Camardese 1981). Both of the studies showed that slopes of the curve may vary haphazardly for birds of a single age between sequential tests of a single compound, but few of the test-to-test changes were statistically significant. The present study confirmed this unpredictable test-to-test relation for both positive controls, the only chemicals for which such data were available (cf. Appendix C). Furthermore, there was no correlation between slopes of the two standards when tested concurrently, i.e., $n = 26$ pairs, coefficient of determination = 0.09, $0.1 < P < 0.2$. But when dose-response curves were pooled over time (as shown for LC50s in Table 5), slopes of dieldrin tests increased ($P<0.05$) from a 1965–1969 mean of 6.3 to 7.4 in 1970–1973 and 8.8 in 1979; thereafter annual changes were statistically insignificant. Slopes of dicrotophos tests followed a similar overall pattern as dieldrin during 1979–1981. In our previous study of intertest variability of subacute toxicity, slopes of concurrent tests of dicrotophos varied nearly as much as did sequential tests shown in Appendix C (Hill and Camardese 1981). The coefficients of variation of dose-response slopes for four sets of three concurrent tests of technical dicrotophos with 14-day-old coturnix were 3.1, 15.0, 7.0, and 12.8 compared to 16.0, 19.7, 23.7, and 28.5 during 1972, 1979, 1980, and 1981, respectively. All combinations of individual slopes in the above data sets met the statistical test for parallelism (two-tailed t-test, $\alpha = 0.05$). The slope of the dose-response line may therefore be expected to vary to some degree between individual tests of a given toxicant and yet retain its general characteristic for interpretive purposes. But if estimates of subtle differences between slopes are desired, they are best derived through well-replicated experiments. Also, we caution that comparisons of dose-response slopes from subacute tests of coturnix be confined to a single age of chick. In our earlier work the slope of the dose-response curve changed from hatch to 3 weeks and the pattern of change was not consistent even among chemicals evoking toxicity through the same action (Hill and Camardese 1981).

Response Patterns and Toxic Signs

Mortality patterns during the 5-day subacute toxicity trial vary markedly among chemical classes and provide insight into potential hazard associated with dietary exposure. Fig. 1 typifies daily mortality of coturnix chicks of four ages from hatching to 21 days when fed our two positive controls, dicrotophos and dieldrin, as representative organophosphorus and chlorinated hydrocarbon compounds, carbofuran, a carbamate, and the organomercury, Ceresan M (Hill and Camardese 1981). The reason for showing various ages is to emphasize age-related mortality peak shifts that are associated with birds' vulnerability to potentially lethal short-term dietary exposure to chemicals, and to demonstrate that a single

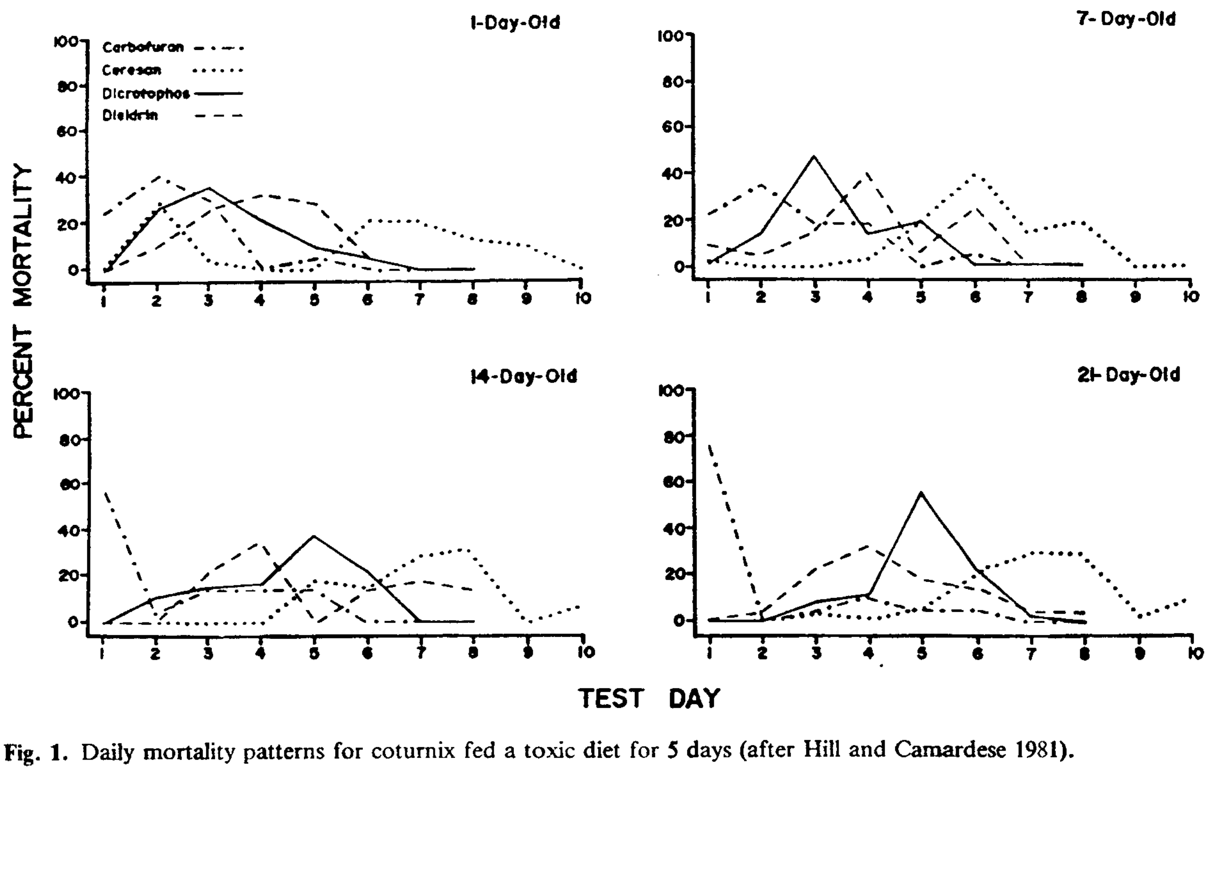

Fig. 1. Daily mortality patterns for coturnix fed a toxic diet for 5 days (after Hill and Camardese 1981).

test has limited interpretive value. In general, the following response patterns occurred: 1) Dicrotophos and dieldrin each produced mortality peaks characteristic of response to cumulative toxic insult and posttreatment recovery, i.e., deaths increased over time, peaking near the end of exposure (dieldrin, Day 4; dicrotophos, Day 5), and then decreased precipitously after toxic feed was withdrawn; 2) Carbofuran produced the majority of deaths within the first 24 or 72 h (depending on ages of the chick); few deaths occurred during the balance of the 5-day test; 3) Nearly all deaths from Ceresan M occurred after removing the toxicant. Day-old chicks were exceptions to this Ceresan M pattern because they had a bimodal mortality distribution; about one-fourth of deaths occurred on Day 2 and most of the others died after toxicant was withdrawn on Day 5. Mortality from organosphosphorus, carbamate, and chlorinated hydrocarbon compounds subsided within the standard 3-day posttreatment observation period. Mortality patterns for the individual chemicals can be generally deduced from response chronologies presented in Part II and usually correspond with one of the above examples.

Toxic signs associated with subacute dietary toxicity trials were usually less intense than those seen with single-dose acute trials. This was probably because toxicity from dietary exposure is a function of cumulative response to multiple doses (voluntary bites of contaminated feed) of chemical over time, a compounding effect of physiological debilitation associated with reduced nutriment. Thus, onset of toxic signs were often deferred until the second or third day of treatment and then either intensified and culminated in death or remissed within about 48 hours posttreatment. Carbamates, as seen with mortality from carbofuran (Fig. 1), were often associated with almost immediate reactivity and death of chicks within 2 to 6 h after treated feed was presented. Toxic signs remissed in survivors almost as rapidly as they began even though the birds continued to feed on carbamate-treated feed over the 5-day study at rates about equal to their negative controls. Methylmercuries were the only chemicals for which toxic signs consistently persisted beyond the standard 3-day posttreatment observation period.

Clinical signs of subacute poisoning did not seem consistently unique for any class of chemicals other than carbamate and organomercury compounds, and these were unusual only because of the mentioned rapid onset and severity of signs associated with carbamates and persistence of signs associated with the mercurials. Otherwise, most of the chemicals tested caused a gradual occurrence of apparent neurological dysfunction (mild to moderate tremoring) coupled with reduced activity, feather fluffing, stumbling gait, and seclusiveness preceding death. Although differences of toxic signs were often vague, they were virtually always dose-dependent for all test animals. Because all birds were penned together by treatment it was difficult to characterize individual responses, and no attempt was made to list specific signs, but only their presence or absence. Tucker and Crabtree (1970) and Hudson et al. (1984) provide excellent summaries of toxic signs associated with lethal poisoning and include most of the chemicals presented in Part II.

Food Consumption

Daily feeding rates were measured for coturnix on the second lowest and second highest concentrations of most chemicals in Part II. Because treatments were not replicated, feeding data cannot be compared statistically and are presented only as a general guide to feeding behavior on potentially lethal chemical concentrations at two effect levels. These data, coupled with mortality, provide insight into palatability of chemical on the surface of a feedstuff and the potential hazard associated with the chemical's presence for a comparatively brief, but continuous, duration. Table 6 shows daily food consumption rates for coturnix from nine randomly selected concurrent tests of both negative and positive controls, dicrotophos and dieldrin, and gives an estimate of the variance associated with such measurements. Detailed comparisions of food consumption during subacute tests of a variety of chemicals can be found in an earlier report of Hill and Camardese (1981).

Conclusions

The subacute dietary toxicity of 193 compounds of potential environmental importance has been estimated for young coturnix under a standardized

Table 6. *Daily food consumption rates for 14-day-old coturnix fed potentially lethal concentrations of dicrotophos or dieldrin for 5 days.*[a]

Treatment		Food consumption, grams per bird-day[b]					Overall mean(SD)
		Day 1	Day 2	Day 3	Day 4	Day 5	
Control	Mean(SD)	11.2 (0.84)	11.1 (0.44)	12.0 (1.07)	11.7 (1.02)	12.0 (0.88)	
	Extremes	9.9–12.2	10.4–11.7	10.2–13.4	10.5–13.4	10.6–13.1	
Dicrotophos (26 ppm)	Mean(SD)	8.7 (1.23)	5.9 (1.38)	6.6 (1.85)	6.3[c] (1.96)	6.2 (2.06)	
	Extremes	7.1–10.4	3.3–7.4	3.9–9.8	4.0–10.0	2.9–9.3	
	Control (%)	77	53	55	54	51	58(10.7)
	Mortality (%)	0	0	2	8	9	32(20.4)
Dicrotophos (46 ppm)	Mean(SD)	6.4 (1.55)	4.5 (1.72)	4.3 (2.15)	2.5 (1.84)	3.3 (2.39)	
	Extremes	4.9–9.1	2.7–7.8	1.7–7.6	0.4–5.7	1.0–6.8	
	Control (%)	57	40	36	22	27	36(13.5)
	Mortality (%)	0	1	7	25	24	77(18.6)
Dieldrin (46 ppm)	Mean(SD)	10.4[c] (1.24)	9.3[c] (0.88)	9.4[c] (1.06)	8.9[c] (1.24)	9.0[c] (1.58)	
	Extremes	8.4–11.9	7.7–10.3	7.9–11.4	7.1–10.7	6.5–11.1	
	Control (%)	93	83	78	76	75	81 (7.4)
	Mortality (%)	0	1	1	2	7	26 (9.3)
Dieldrin (80 ppm)	Mean(SD)	8.4[d] (1.06)	6.0[d] (1.35)	4.7[d] (1.61)	3.7[d] (2.04)	4.4[d] (1.46)	
	Extremes	7.3–10.0	4.1–8.4	2.3–7.1	1.5–6.2	1.2–5.7	
	Control (%)	75	54	39	32	37	47(17.5)
	Mortality (%)	0	3	14	37	21	85 (9.3)

[a] Statistics were based on nine randomly selected tests (13–15 birds per treatment per test); test reference numbers 79-6, 11, and 12, 80-2, 5A, and 7B, and 81-4, 7B, and 8.

[b] Mean daily food consumption was significantly different when compared to controls for all treatments and days except 46 ppm dieldrin on Day 1 (one-way ANOVA, $P < 0.05$).

[c] Significantly different from 46 ppm dicrotophos (one-way ANOVA, $P < 0.05$).

[d] Significantly different from 46 ppm dieldrin (one-way ANOVA, $P < 0.05$).

protocol at the Patuxent Wildlife Research Center since 1965. From the data provided in Part II of this report, it is possible to statistically rank the chemicals in accordance with their relation to a general toxicity standard—dieldrin—or, for antichlinesterases, perform a more exacting comparision through the second standard, dicrotophos. It is also possible to assess potential hazard associated with topical dietary exposure of chemical beyond comparison of LC50's by evaluating the onset and remission of toxic signs, time of death, and food consumption.

Only 4 of 165 technical grade chemicals tested were classed "highly" toxic, i.e., LC50 < 40 ppm, and fewer than 15% had LC50's less than 200 ppm. All of these "highly" or "very" toxic chemicals were either chlorinated hydrocarbons, organophosphates, or organometallics. When compared to acute tests chemicals that were considered potentially hazardous because of LC50's also gave low LD50's, but low LD50's were not necessarily associated with low LC50's. Carbamates such as aldicarb, carbofuran, and mexacarbate, were the important exceptions, i.e., LD50 < 10 mg/kg and LC50's = 400 ppm.

Subacute toxicity may vary widely among structurally similar chemicals and even between formulations of the same chemical. Therefore, any conclusions about lethal hazard associated with the field application of a given chemical must be made with caution until the actual formulation has been tested. It cannot be assumed that toxicities will be equivalent. This is particularly important when adjuvants are included in the formulation.

Comparisons of subacute toxicity may be influenced by the age of the test animals. Thus, toxic rankings are best achieved with a single age of chick, but potential hazards associated with short-term dietary exposure may vary (usually decrease) as the chicks mature. Attempts to statistically adjust LC50's for age were unsatisfactory, whether based on positive controls or previously proposed constants.

Inclusion of positive controls in each battery of tests is recommended, but it is not practical to have a control for each toxic action as is theoretically necessary. Therefore it is suggested that dieldrin be considered principally as a general standard for use in detecting atypical trials and monitoring population changes over time rather than as a routine means of adjusting LC50's for intertest differences. Of course the dieldrin standard can also be used for adjusting LC50's of other central nervous system stimulators, just as dicrotophos can be used to adjust LC50's for anticholinesterases.

Part II. Toxicologic Summaries of PWRC 5-Day Dietary Tests of 14-Day-Old Coturnix

A toxicity summary has been prepared for each chemical or formulation tested against 14-day-old coturnix and is presented alphabetically by the common name of the principal active ingredient. For formulations, the specific test material follows the common name of the principal active ingredient and is inserted alphabetically after the parent compound. A cross-reference of common and well-known trade names is provided for quick reference to all compounds tested (Table 1).

The chemical name according to *Chemical Abstracts*, 9th Chemical Index, and the grade, purity, and Chemical Abstracts Registry Number (CAS) of the principal active ingredients are immediately beneath the common name of each compound. Frequently used alternate names, including manufacturer's experimental numbers, and principal uses of each chemical are listed. Neither list is intended to be complete.

In the "Experimental" section, the number of concentrations tested and extreme concentrations given are for those used in the probit analysis. Statistically superfluous concentrations were omitted, i.e., more than a single concentration of zero or 100% mortality. Birds per concentration are averages for the study, but are usually the exact number tested per concentration. Probit analysis does not require equal sample size per concentration. The control reference number, given in parentheses, keys the test to concurrent tests of positive and negative controls (Appendix C) which may be used for adjustment of LC50's as described in Appendix B.

The toxicity summary includes the LC50 and its 95% confidence interval; the slope of the probit regression curve (dose-response line) and its standard error; the general response chronology over the 5 days of treated diet and 3 or more days, as necessary, on untreated diet; and daily food consumption measurements during the 5 days of treated diet. Statistical methods for comparison of LC50's and slopes of dose-response lines are described in Appendix B. The response chronology represents the first and last days on which overt signs of intoxication were observed in any animal on a given treatment. Because responses were usually dose-dependent, results were intended to bracket significant responses and were therefore restricted to the following test concentrations: 1) The highest not evoking overt signs; 2) the lowest evoking overt signs; 3) the lowest causing death; and 4) the highest causing less than 100% mortality. Theoretically, all concentrations should have caused both overt signs and death; the proportion of respondents being dose-dependent. Food consumption measurements were normally restricted to the second lowest and second highest test concentrations. Both overt responses and food consumption measurements were based on a single pen of birds; therefore, no statistical significance was attached to any of the results. Exceptions to the general protocol (such as age) are noted on each summary when appropriate. Where LC50's clearly exceeded 5,000 ppm during preliminary range-finding trials, the chemical was not tested further, the LC50 was reported >5,000 ppm, and supporting data must be considered preliminary. All pre-1979 tests reported have been reanalyzed statistically and supersede results of Heath et al. (1972) and Hill et al. (1975).

Acephate

Principal Ingredient: Acetylphosphoramidothioic acid *O,S*-dimethyl ester; technical grade, 98% AI; CAS 30560-19-1

Alternate Names: Acetamidophos; ENT 27822; Orthene; Ortho 12420; Ortran; Ortril; RE 12420

Principal Use: Insecticide (contact and systemic)

Experimental: Concentrations tested (*n*): 6 (Control Reference: 79-5A)
Extreme concentrations: 2,000–5,000 ppm
Birds per concentration: 11
Diluent: Propylene glycol

Toxicity Summary

LC50: 3,275 ppm	95% CI: 2,691–3,986 ppm	Slope: 4.98	SE: 1.29		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
2,000 ppm	3	–	–	6	0/11
2,402 ppm	2	2	7	8	5/11
5,000 ppm	1	2	5	6	10/12

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control ($n = 3$)	10.9	10.1	11.9	10.2	10.7	0/33
2,402 ppm	4.3	5.1	5.4	5.4	5.0	
Deaths	0	1	1	0	0	5/11
3,466 ppm	5.7	6.4	8.3	5.5	7.7	
Deaths	0	2	0	3	0	5/11

Acephate (Orthene)

Principal Ingredient: Acetylphosphoramidothioic acid *O,S*-dimethyl ester; commercial formulation, 15.6% AI; CAS 30560-19-1

Alternate Names: ENT 27822; Ortho 12420; RE 12420

Principal Use: Insecticide (contact and systemic)

Experimental: Concentrations tested (*n*): 4 (Control Reference: 79-11)

Extreme concentrations: 500–1,150 ppm
Birds per concentration: 14
Diluent: Propylene glycol

Toxicity Summary

LC50: 718 ppm	95% CI: 593–868 ppm	Slope: 7.71	SE: 1.77		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
500 ppm	2	2	6	7	3/14
871 ppm	1	2	8	9	11/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 2)	12.0	11.7	13.4	11.7	13.1	0/20
500 ppm	7.3	6.7	10.1	8.6	8.7	
Deaths	0	1	0	0	1	3/14
871 ppm	4.9	3.9	4.9	4.6	3.1	
Deaths	0	2	1	2	3	11/15

Acetone

Principal Ingredient: 2-Propanone; reagent grade, 100% AI; CAS 67-64-1

Alternate Names: Dimethylformaldehyde; methyl ketone; pyroacetic ether

Principal Use: Organic solvent; carrier

Experimental: Concentrations tested (n): 3 (Control Reference: 80-1)
Extreme concentrations: 10,000–40,000 ppm
Birds per concentration: 15
Diluent: None

Toxicity Summary

LC50: >40,000 ppm	No overt signs of toxicity to 40,000 ppm

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	11.2	10.2	11.8	11.7	11.8	0/45
20,000 ppm	10.6	10.6	11.7	11.2	11.9	0/45

Aldicarb

Principal Ingredient: 2-Methyl-2-(methylthio)propanal *O*-[(methylamino) carbonyl]oxime; technical grade, 99% AI; CAS 116-06-03

Alternate Names: Ambush; Bermethrin; Ectiban; ENT 27093; Temik; UC 21149

Principal Use: Acaricide; insecticide; nematocide (systemic)

Experimental: Concentrations tested (n): 5 (Control Reference: 72-11)
Extreme concentrations: 300–592 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 387 ppm 95% CI: 336–445 ppm Slope: 10.23 SE: 2.57

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
300 ppm	–	1	1	–	1/10
499 ppm	–	1	1	–	8/10

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 2)	11.0	13.3	12.0	11.5	12.1	1/20
356 ppm	2.9	10.4	9.4	4.6	0.6	
Deaths	5	0	0	0	0	5/10
592 ppm	2.0	7.5	3.5	2.0	0	
Deaths	8	0	0	1	0	10/10

Aldrin

Principal Ingredient: 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-dimethanonaphthalene; technical grade, 95% AI; CAS 309-00-02

Alternate Names: Aldrex; Aldrite; Aldrosol; Compound 118; ENT 15949; HHDN; Octalene; Seedrin

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-3)
Extreme concentrations: 25–100 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 62 ppm 95% CI: 53–74 ppm Slope: 10.37 SE: 2.29

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
25 ppm	No overt signs of toxicity				0/15
50 ppm	4	5	7	8	3/15
71 ppm	3	4	7	8	10/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	11.0	10.2	12.2	11.0	11.2	0/45
35 ppm	9.5	8.8	11.3	8.0	9.2	
Deaths	0	0	0	0	0	0/15
71 ppm	8.3	6.9	6.8	6.7	5.6	
Deaths	0	0	0	2	3	10/15

Allethrin

Principal Ingredient: 2,2-Dimethyl-3-(2-methyl-1-propenyl) cyclopropanecarboxylic acid 2-methyl-4-oxo-3-(2-propenyl)-2-cyclopenten-1-yl ester; technical grade, 90% AI; CAS 584-79-2

Alternate Names: Allyl cinerin I; Bioallethrin; Cinerin; Cinerin I allyl homolog; ENT 17510; Pallethrine; Pynamin; Pyresyn

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 2 (Control Reference: 81-3)
Extreme concentrations: 2,500–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm					
Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (*n* = 3)	12.2	13.7	12.5	13.2	13.2	0/45
5,000 ppm	11.0	11.2	12.5	11.8	11.9	
Deaths	0	0	0	0	0	0/10

Aminocarb

Principal Ingredient: 4-(Dimethylamino)-3-methylphenol methylcarbamate (ester); technical grade, 99% AI; CAS 2032-59-9

Alternate Names: A 363; BAY 44646; ENT 25784; Matacil

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 81-8)
Extreme concentrations: 1,500–3,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 2,325 ppm	95% CI: 1,947–3,020 ppm	Slope: 3.85	SE: 0.98		
Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
1,500 ppm	1	–	–	6	0/10
3,000 ppm	1	1	5	–	10/10

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (*n* = 5)	9.9	10.4	10.2	11.3	12.4	0/75
1,783 ppm	3.8	6.3	5.7	7.2	6.7	
Deaths	0	0	1	1	1	3/10
2,522 ppm	2.9	4.4	5.0	4.8	6.1	
Deaths	0	0	0	1	2	3/10

Amitrole

Principal Ingredient: 1,2,4-Triazol-3-amine; technical grade, 90% AI; CAS 61-82-5

Alternate Names: Amigol; Aminotriazole; Amizol; ATA; Cytrol; ENT 25445; Herbizol; Weedazol

Principal Use: Herbicide (nonselective systemic)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 66-11B)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Note: Test age, 12 days

Anthraquinone

Principal Ingredient: 9,10-Anthracenedione; technical grade, 99% AI; CAS 84-65-1

Alternate Names: Anthradione; Corbit; Heolite; Morkit

Principal Use: Avian repellent; industrial

Experimental: Concentrations tested (*n*): 3 (Control Reference: 81-8)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: -	Slope: -	SE: -

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
2,236 ppm	No overt signs of toxicity				0/15
5,000 ppm	5	0	0	7	0/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 5$)	9.9	10.4	10.2	11.3	12.4	0/45
2,236 ppm	8.4	11.3	10.0	11.8	13.2	
Deaths	0	0	0	0	0	0/15
5,000 ppm	6.9	9.5	8.9	10.6	11.7	
Deaths	0	0	0	0	0	0/15

Aramite

Principal Ingredient: Sulfurous acid 2-chloroethyl 2-[4-(1,1-dimethylethyl)phenoxy]-1-methylethyl ester; technical grade, 92% AI; CAS 140-57-8

Alternate Names: Acaracide; Aracide; Aratron; Compound 88R; ENT 16519; Niagaramite; Ortho-mite

Principal Use: Acaricide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 68-11)
Extreme concentrations: 200–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Aroclor 1221

Principal Ingredient: Polychlorinated biphenyl, 21% chlorine; technical grade, 100% AI; CAS 11104-28-2

Alternate Names: Arochlor 1221; PCB-1221

Principal Use: Industrial

Experimental: Concentrations tested (*n*): 3 (Control Reference: 68-11)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Aroclor 1232

Principal Ingredient: Polychlorinated biphenyl, 32% chlorine; technical grade, 100% AI; CAS 11141-16-5

Alternate Names: Aroclor 1232; PCB-1232

Principal Use: Industrial

Experimental: Concentrations tested (*n*): 3 (Control Reference: 68-11)

Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Aroclor 1242

Principal Ingredient: Polychlorinated biphenyl, 42% chlorine; technical grade, 100% AI; CAS 53469-21-9

Alternate Names: Arochlor 1242; PCB-1242

Principal Use: Industrial

Experimental: Concentrations tested (n): 8 (Control Reference: 70-3)
Extreme concentrations: 2,000–6,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >6,000 ppm — 95% CI: - — Slope: - — SE: -

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
5,432 ppm	-	5	5	-	2/10
6,000 ppm	-	5	5	-	2/10

Aroclor 1248

Principal Ingredient: Polychlorinated biphenyl, 48% chlorine; technical grade, 100% AI; CAS 12672-29-6

Alternate Names: Arochlor 1248; PCB-1248

Principal Use: Industrial

Experimental: Concentrations tested (n): 7 (Control Reference: 70-3)
Extreme concentrations: 3,312–6,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 4,819 ppm	95% CI: 4,267–5,443 ppm		Slope: 7.89	SE: 2.0	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
3,312 ppm	–	5	5	–	1/10
6,000 ppm	–	2	7	–	9/10

Aroclor 1254

Principal Ingredient: Polychlorinated biphenyl, 54% chlorine; technical grade, 100% AI; CAS 11097-69-1

Alternate Names: Arochlor 1254; PCB-1254

Principal Use: Industrial

Experimental: Concentrations tested (*n*): 8 (Control Reference: 70-3)
Extreme concentrations: 1,500–4,500 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 2,929 ppm	95% CI: 2,516–3,409 ppm		Slope: 5.96	SE: 1.20	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,755 ppm	–	6	7	–	2/10
3,848 ppm	–	4	8	–	6/10

Aroclor 1260

Principal Ingredient: Polychlorinated biphenyl, 60% chlorine; technical grade, 100% AI; CAS 11096-82-5

Alternate Names: Arochlor 1260; PCB-1260

Principal Use: Industrial

Experimental: Concentrations tested (*n*): 6 (Control Reference: 70-3)
Extreme concentrations: 1,500–3,848 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 2,195 ppm	95% CI: 1,861–2,589 ppm		Slope: 7.27	SE: 1.55	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,500 ppm	–	7	7	–	1/10
3,289 ppm	–	3	7	–	9/10

Aroclor 1262

Principal Ingredient: Polychlorinated biphenyl, 62% chlorine; technical grade, 100% AI; CAS 37324-23-5

Alternate Names: Arochlor 1262; PCB-1262

Principal Use: Industrial

Experimental: Concentrations tested (*n*): 6 (Control Reference: 70-3)
Extreme concentrations: 1,755–4,500 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 2,304 ppm	95% CI: 1,978–2,684 ppm		Slope: 7.82	SE: 1.89	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,755 ppm	–	7	7	–	1/10
3,848 ppm	–	3	6	–	9/10

Aroclor 5442

Principal Ingredient: Polychlorinated terphenyl, 42% chlorine; technical grade, 100% AI; CAS 12642-23-8

Alternate Names: Arochlor 5442; PCB-5442

Principal Use: Industrial

Experimental: Concentrations tested (*n*): 3 (Control Reference: 72-2A)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 4,477 ppm	95% CI: 1,301-15,402 ppm		Slope: 1.24	SE: 1.11	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
2,236 ppm	-	4	5	-	3/10
5,000 ppm	-	5	7	-	5/10

Aspon

Principal Ingredient: Thiodiphosphoric acid ([(HO)2P(S)]20); technical grade, 95% AI; CAS 3244-90-4

Alternate Names: A-42; ASP-51; E-8573; NPD

Principal Use: Acaracide; insecticide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 72-3A)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Atrazine

Principal Ingredient: 6-Chloro-*N*-ethyl-*N*;-(1-methylethyl)-1,3,5-triazine-2,4-diamine; technical grade, 99% AI; CAS 1912-24-9

Alternate Names: Aatram; Aatrex; Aktikon; Argezin; Atratol; Cyazin; ENT 28244; G-30027; Gesaprim; Primatol

Principal Use: Herbicide (selective)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 68-2)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: –		Slope: –	SE: –	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
2,500 ppm	–	–	–	–	0/14
5,000 ppm	–	3	3	–	1/14

Note: test age, 7 days

Azinophos-Methyl

Principal Ingredient: Phosphorodithioic acid *O,O*-dimethyl *S*-[(4-oxo-1,2,3-benzotriazin-3(4H)-yl)methyl] ester; technical grade, 92% AI; CAS 86-50-0

Alternate Names: Azinophos; BAY 9027; BAY 17147; Carfene; ENT 23233; Gusathion; Gusathion methyl; Guthion; R 1582

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 84-8)
Extreme concentrations: 300–1,500 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 935 ppm	95% CI: 706–1,239 ppm		Slope: 4.88	SE: 1.20	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
448 ppm	3	–	–	6	0/15
671 ppm	1	4	4	7	1/15
1,003 ppm	1	3	6	7	9/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 2$)	11.4	10.7	11.6	12.5	12.6	0/30
448 ppm	9.9	8.9	11.7	12.5	11.7	
Deaths	0	0	0	0	0	0/15
1,003 ppm	5.8	4.9	7.4	6.8	7.0	
Deaths	0	0	1	2	4	9/15

Benomyl (Benomyl 50)

Principal Ingredient: [1-[(Butylamino)carbonyl]-1H-benzimidazol-2-yl] carbamic acid methyl ester; commercial formulation, 50% AI; CAS 17804-35-2

Alternate Names: Du Pont 1991; F 1991

Principal Use: Fungicide (systemic)

Experimental: Concentrations tested (*n*): 2 (Control Reference: 80-5B)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm					
Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	11.2	11.7	12.3	11.8	12.6	0/45
1,000 ppm	13.4	13.2	14.9	14.9	10.3	
Deaths	0	0	0	0	0	0/15
5,000 ppm	9.3	10.7	13.0	12.1	14.9	
Deaths	0	0	0	0	0	0/15

Bromacil

Principal Ingredient: 5-Bromo-6-methyl-3-(1-methylpropyl)-2,4(1H,3H) pyrimidinedione; technical grade, 80.0% AI; CAS 314-40-9

Alternate Names: Borea; Herbicide 976; Hyvar; Hyvar X; Krovar II

Principal Use: Herbicide (broad spectrum)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 80-3)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Bromoxynil (Bronate)

Principal Ingredient: (3,5-Dibromo-4-hydrobenzonitrile, 31.7%AI; and 2-methyl-4-chlorophenoxyacetic acid, 34.0%AI; commercial formulation, 65.7%AI; CAS 1689-84-5

Alternate Names: MCPA

Principal Use: Herbicide (selective)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 81-10)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm 95% CI: - Slope: - SE: -

Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
	Response chronology (day of occurrence)				
2,236 ppm		No overt signs of toxicity			0/14
5,000 ppm	2	5	5	7	1/14

Dietary concentration	Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
	Food consumption (grams per bird-day)					
Control (*n* = 3)	12.2	9.1	11.1	12.3	11.2	0/42
5,000 ppm	5.3	5.4	7.6	8.7	8.7	
Deaths	0	0	0	0	0	1/14

Bufencarb (Bux)

Principal Ingredient: 3-(1-Ethylpropyl)phenyl methylcarbamate mixture with 3-(1-methybutyl)phenyl methylcarbamate (1:3); technical grade; CAS 8065-36-9

Alternate Names: ENT 27127; Ortho 5353; RE 5353

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 71-3)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 12
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: –	Slope: –	SE: –		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,000 ppm		No overt signs of toxicity			1/12
2,236 ppm	–	2	2	–	1/12
5,000 ppm	–	1	6	–	5/12

Cadmium Chloride

Principal Ingredient: $CdCl_2$; reagent grade, 100% AI; CAS 10108-64-2

Alternate Names: Cadmium dichloride; Dichlorocadmium

Principal Use: Industrial, fungicide

Experimental: Concentrations tested (*n*): 6 (Control Reference: 73-3)
Extreme concentrations: 1,000–4,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 2,440 ppm	95% CI: 1,807–3,294 ppm	Slope: 3.72	SE: 0.97		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,000 ppm	–	2	2	–	1/10
4,000 ppm	–	3	5	–	8/10

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (*n* = 6)	14.0	11.2	14.5	11.9	14.6	3/60
1,320 ppm	4.2	3.3	4.1	5.1	4.1	
Deaths	0	0	1	1	0	2/10
3,036 ppm	4.2	3.0	1.4	2.0	3.8	
Deaths	0	0	0	4	2	8/10

Cadmium Succinate

Principal Ingredient: Succinic acid cadmium salt; technical grade, 60% AI[29% Cd]; CAS 141-00-4

Alternate Names: Succinic acid; cadmium salt (1:1)

Principal Use: Industrial; fungicide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-2)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 2,052 ppm	95% CI: 1,621–2,598 ppm	Slope: 4.80	SE: 0.97

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
1,250 ppm	2	4	6	8	4/15
3,535 ppm	1	4	6	8	13/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	10.2	10.4	12.2	10.5	10.6	0/45
1,768 ppm	3.5	3.4	4.0	2.5	2.2	
Deaths	0	0	0	1	0	3/15
3,535 ppm	2.5	2.6	3.4	3.1	4.0	
Deaths	0	0	0	10	1	13/15

Captan

Principal Ingredient: 3a,4,7,7a-Tetrahydro-2-[(trichloromethyl)thio]-1H-isoindole-1,3(2H)-dione; technical grade, 95% AI; CAS 133-06-2

Alternate Names: Captane; Captex; ENT 26538; Flit 406; Glyodex 37-22; Merpan; Orthocide; SR 406; Vancide 95RE; Vondecaptan

Principal Use: Fungicide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 66-10)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Carbaryl

Principal Ingredient: 1-Naphthalenol methylcarbamate; technical grade, 98% AI; CAS 63-25-2

Alternate Names: Arylam; Caprolin; Dicarban; ENT 23969; Hexavin; Karbaspray; Ravyon; Septene; Sevin; Tricarnam; UC 7744

Principal Use: Insecticide (broad spectrum)

Experimental: Concentrations tested (n): 5 (Control Reference: 80-5B)
Extreme concentrations: 2,500–10,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >10,000 ppm	95% CI: –	Slope: –	SE: –

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
7,070 ppm	3	–	–	6	0/15
10,000 ppm	3	–	–	6	0/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	11.2	10.7	12.3	11.8	12.6	0/45
3,540 ppm	9.4	10.1	10.9	11.8	15.3	
Deaths	0	0	0	0	0	0/15
7,070 ppm	6.4	10.5	11.2	9.8	13.7	
Deaths	0	0	0	0	0	0/15

Carbaryl (Sevin 50)

Principal Ingredient: 1-Naphthalenol methylcarbamate; commercial formulation, 50% AI; CAS 63-25-2

Alternate Names: ENT 23969; UC 7744

Principal Use: Insecticide (broad spectrum)

Experimental: Concentrations tested (n): 5 (Control Reference: 80-5B)
Extreme concentrations: 2,500–10,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >10,000 ppm	95% CI: -	Slope: -	SE: -		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
7,070 ppm	3	-	-	6	0/15
10,000 ppm	3	-	-	5	0/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	11.2	10.7	12.3	11.8	12.6	0/45
3,540 ppm	7.3	10.3	12.5	12.2	13.5	
Deaths	0	0	0	0	0	0/15
7,070 ppm	8.5	9.0	13.6	11.9	13.0	
Deaths	0	0	0	0	0	0/15

Carbaryl-Zineb (Sevin-Zineb)

Principal Ingredient: 1-Naphthalenol methylcarbamate (3.0%AI) and [[1,2-Ethanediylbis [carbamodithioate]]-(2)]zinc (5.2%AI); commercial formulation; CAS 62-25-2 and 12122-67-7

Alternate Names: Carbaryl = ENT 23969; UC 7744; Zineb = ENT 14874; Z 78

Principal Use: Carbaryl-insecticide (broad spectrum); zineb-fungicide

Experimental: Concentrations tested (n): 5 (Control Reference: 80-5B)
Extreme concentrations: 2,500–10,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >10,000 ppm	95% CI: -	Slope: -	SE: -		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
7,070 ppm	3	-	-	5	0/15
10,000 ppm	3	-	-	6	0/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	11.2	11.7	12.3	11.8	12.6	0/45
3,540 ppm	12.0	12.0	14.0	13.5	13.7	
Deaths	0	0	0	0	0	0/15
7,070 ppm	10.8	11.7	13.3	13.4	12.9	
Deaths	0	0	0	0	0	0/15

Carbofuran

Principal Ingredient: 2,3-Dihydro-2,2-dimethyl-7-benzofuranol methylcarbamate; technical grade, 99% AI; CAS 1563-66-2

Alternate Names: BAY 70143; Curaterr; D 1221; ENT 27164; FMC 10242; Furadan; NIA 10242; OMS 864

Principal Use: Insecticide (systemic); miticide; nematocide (broad spectrum)

Experimental: Concentrations tested (*n*): 5 (Control Reference: 76-4)
Extreme concentrations: 400–1,200 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 746 ppm | 95% CI: 549–1,014 ppm | Slope: 4.06 | SE: 1.22

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
400 ppm	–	3	3	–	0/10
577 ppm	–	1	5	–	7/10

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 5)	10.2	8.0	9.4	10.7	9.4	0/50
526 ppm	5.8	7.1	10.4	15.8	9.6	
Deaths	3	0	0	0	0	3/10
911 ppm	2.7	4.8	4.8	10.0	8.3	
Deaths	5	0	0	1	2	8/10

Carbophenothion

Principal Ingredient: Phosphorodithioic acid S-[[(4-chlorophenyl)thio] methyl] *O,O*-diethyl ester; technical grade, 95% AI; CAS 786-19-6

Alternate Names: Acarithion; ENT 23708; Garrathion; Hexathion; Lethox; R-1303; Trithion

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (*n*): 4 (Control Reference: 81-4)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 4,434 ppm	95% CI: 2,492–7,887 ppm	Slope: 4.33	SE: 0.46

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
1,250 ppm	3	–	–	7	0/10
5,000 ppm	1	1	5	8	6/10

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 3$)	11.4	11.1	10.6	12.9	12.0	0/35
1,768 ppm	8.1	8.0	10.0	11.5	12.8	
Deaths	0	0	0	1	0	1/15
5,000 ppm	2.0	3.3	2.8	4.2	8.0	
Deaths	1	0	0	4	1	6/10

Ceresan M

Principal Ingredient: Ethyl(4-methyl-*N*-phenylbenzenesulfonamidato-*N*) mercury; commercial formulation, 7.7% AI [3.2% Hg]; CAS 517-16-8

Alternate Names: Ceresan M-DB; Mergon

Principal Use: Fungicide (seed treatment)

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-5A)
Extreme concentrations: 60–180 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 147 ppm	95% CI: 120–180 ppm	Slope: 6.54	SE: 1.50

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
60 ppm	8	–	–	9	0/15
79 ppm	7	8	8	9	1/15
180 ppm	5	7	13	14	11/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (*n* = 3)	12.2	11.0	11.8	11.4	10.6	0/45
79 ppm	11.7	11.0	11.9	11.1	11.5	
Deaths	0	0	0	0	0	1/15
137 ppm	11.5	10.0	11.0	8.6	10.1	
Deaths	0	0	0	0	0	6/15

CHE 1843

Principal Ingredient: (*E*)-1,1'-[1,2-Ethenediylbis (sulfonyl)]bispropane; technical grade, 95% AI; CAS 113-14-0

Alternate Names: B 1843; C-272; Vancide PA

Principal Use: Fungicide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 72-2B)
Extreme concentrations: 500–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Chlordane

Principal Ingredient: 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene; technical grade, 100% AI [60% chlordane isomers, 40% related compounds]; CAS 57-74-9

Alternate Names: Belt, Chlor-Kill, Chlordan, Chlorindan, CD 68, Corodane, Dichlorochlordene, Dowchlor, ENT 9932, Krypchlor, Niran, Octachlor, Ortho-Klor, Synklor, Topiclor 20, Toxichlor, Velsicol 1068

Principal Use: Insecticide (contact, stomach, fumigant)

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-5A)
Extreme concentrations: 150–500 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 308 ppm	95% CI: 262–361 ppm	Slope: 7.77	SE: 1.48

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
150 ppm	5	–	–	7	0/15
203 ppm	4	7	7	8	1/15
500 ppm	2	4	6	7	14/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control ($n = 3$)	12.2	11.0	11.8	11.4	10.6	0/45
203 ppm	12.3	10.8	12.1	10.7	10.6	
Deaths	0	0	0	0	0	1/15
370 ppm	7.8	5.8	5.4	2.3	3.4	
Deaths	0	0	0	0	8	11/15

(GAMMA) Chlordane (HCS-3260)

Principal Ingredient: 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene; technical grade, 95% AI; CAS 57-74-9

Alternate Names: CD 68; ENT 9932

Principal Use: Insecticide

Experimental: Concentrations tested (n): 5 (Control Reference: 80-5A)
Extreme concentrations: 250–1,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 657 ppm	95% CI: 513–842 ppm	Slope: 4.71	SE: 0.99

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
250 ppm	4	–	–	7	0/15
354 ppm	4	5	5	6	3/15
1,000 ppm	1	4	7	8	11/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	12.2	11.0	11.9	11.5	10.6	0/45
354 ppm	9.3	7.5	8.7	9.7	8.3	
Deaths	0	0	0	0	1	1/15
707 ppm	6.5	5.3	5.2	3.6	6.9	
Deaths	0	0	1	3	1	9/15

Chlordimeform

Principal Ingredient: *N'*-(4'Chloro-2-methylphenyl)-*N,N*-dimethylmethanimidamide; technical grade, 96.9% AI; CAS 6164-98-3

Alternate Names: C 8514; Chlorphenamidine; CIBA 8514; Fundal; Galecron; Schering 36268

Principal Use: Acaricide; insecticide; ovicide

Experimental: Concentrations tested (n): 5 (Control Reference: 81-4)
Extreme concentrations: 2,000–6,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 5,079 ppm | 95% CI: 4,014–6,426 ppm | Slope: 5.82 | SE: 1.40

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
2,000 ppm	3	–	–	7	0/15
2,632 ppm	3	3	6	7	2/15
6,000 ppm	1	4	6	8	11/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	11.4	11.1	10.6	12.9	12.0	0/45
2,632 ppm	2.9	4.3	5.0	5.6	6.6	
Deaths	0	0	1	0	0	2/15
4,559 ppm	1.8	2.1	3.7	3.8	4.6	
Deaths	0	0	0	3	2	5/15

Chlorpyrifos

Principal Ingredient: Phosphorothioic acid *O,O*-diethyl *O*-(3,5,6-trichloro-2-pyridinyl) ester; technical grade, 97% AI; CAS 2921-88-2

Alternate Names: Dowco 179; Dursban; ENT 27311; Lorsban; Norsban

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (*n*): 6 (Control Reference: 67-3)
Extreme concentrations: 75–300 ppm
Birds per concentration: 13
Diluent: Corn Oil

Toxicity Summary

LC50: 293 ppm 95% CI: 112–767 ppm Slope: 1.54 SE: 0.74

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
75 ppm	–	3	5	–	3/13
300 ppm	–	1	6	–	8/13

Chlorpyrifos (Dursban)

Principal Ingredient: Phosphorothioic acid *O,O*-diethyl *O*-(3,5,6-trichloro-2-pyridinyl)ester; commercial formulation, 40.7%AI + aromatic petroleum derivatives, 22.8%; CAS 2921-88-2

Alternate Names: Dowco 179; Ent 27311

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (*n*): 4 (Control Reference: 77-11)
Extreme concentrations: 500–1,140 ppm
Birds per concentration: 14
Diluent: Corn oil

Toxicity Summary

LC50: 492 ppm 95% CI: 351–680 ppm Slope: 6.99 SE: 2.32

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
500 ppm	2	3	5	6	7/14
866 ppm	1	2	6	7	13/14

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 2)	12.0	11.7	13.4	11.7	13.1	0/20
658 ppm	3.9	2.7	2.7	3.3	4.6	
Deaths	0	2	5	3	1	12/14
1,140 ppm	3.0	1.9	2.0	2.0	-	
Deaths	0	3	8	3	-	14/14

Chlorpyrifos-Methyl

Principal Ingredient: Phosphorodithioic acid *O,O*-dimethyl *O*-(3,5,6-trichloro-2-pyridinyl) ester; technical grade, 95.6% AI; CAS 5598-13-0

Alternate Names: Dowco 214; ENT 27520; Reldan

Principal Use: Insecticide

Experimental: Concentrations tested (n): 3 (Control Reference: 71-9)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: -	Slope: -	SE: -		
Dietary concentration	**Response chronology (day of occurrence)**				**Total mortality**
	Onset of signs	First death	Last death	Remission of signs	
2,236 ppm	No overt signs of toxicity				0/10
5,000 ppm	-	5	6	-	2/10

Chromic Potassium Sulfate

Principal Ingredient: $CrK(SO_4)_2 \cdot 12H_2O$; technical grade, 100% AI; CAS 10141-00-1

Alternate Names: Chrome alum; Potassium disulfato-chromate(III)

Principal Use: Industrial

Experimental: Concentrations tested (n): 3 (Control Reference: 80-1)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Chromic Sulfate

Principal Ingredient: $Cr_2(SO_4)_3 \cdot 15H_2O$; technical grade, 100% AI; CAS 10101-53-8

Alternate Names: Chromium III sulfate; Dichromium sulfate; Dichromium trisulfate

Principal Use: Industrial

Experimental: Concentrations tested (*n*): 3 (Control Reference: 80-1)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Chromium Acetylacetonate

Principal Ingredient: Tris(2,4-pentanedionato-*O,O'*)-chromium; reagent grade, 100% AI; CAS 21679-31-2

Alternate Names: Chromium (III) acetylacetonate

Principal Use: Fungicide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 81-5)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 2,476 ppm 95% CI: 1,785–3,434 ppm Slope: 3.36 SE: 0.78

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
1,000 ppm	3	5	5	8	2/15
5,000 ppm	2	2	6	11	8/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	11.5	10.6	12.0	11.8	12.2	0/45
1,495 ppm	5.6	4.3	5.4	4.8	4.1	
Deaths	0	0	0	0	2	2/15
3,344 ppm	4.7	4.2	4.0	2.4	1.4	
Deaths	0	0	0	0	2	11/15

Coumaphos

Principal Ingredient: Phosphorothioic acid *O*-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl)*O,O*-diethyl ester; technical grade, 95% AI; CAS 56-72-4

Alternate Names: Ansuntol; BAY 21/199; Baymix; Co-Ral; ENT 17957; Meldane; Muscatox; Resitox

Principal Use: Acaracide; insecticide (livestock)

Experimental: Concentrations tested (n): 5 (Control Reference: 69-2)
Extreme concentrations: 50–400 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 222 ppm 95% CI: 158–312 ppm Slope: 4.70 SE: 1.19

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
50 ppm	–	–	–	–	0/10
84 ppm	–	4	4	–	1/10
239 ppm	–	2	6	–	4/10

Crotoxyphos (Ciodrin)

Principal Ingredient: (*E*)-3-[(Dimethoxyphosphinyl)oxy]-2-butenoic acid 1-phenylethyl ester; commercial formulation, 25% AI + xylene 63.7%; CAS 7700-17-6

Alternate Names: ENT 24717; SD 4294

Principal Use: Insecticide

Experimental: Concentrations tested (n): 6 (Control Reference: 79-5A)
Extreme concentrations: 264–800 ppm

Birds per concentration: 11
Diluent: Corn Oil

Toxicity Summary

LC50: 520 ppm	95% CI: 429–631 ppm		Slope: 6.97	SE: 1.56	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
264 ppm	4	–	–	6	0/11
348 ppm	3	4	6	7	3/11
606 ppm	1	5	8	9	7/12

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	10.9	10.1	11.9	10.2	10.7	0/33
264 ppm	9.7	8.7	11.4	9.8	10.2	
Deaths	0	0	0	0	0	0/11
459 ppm	7.0	4.9	5.8	4.5	4.8	
Deaths	0	0	1	0	1	2/11

Cupric Acetoarsenite

Principal Ingredient: (Acetato)trimetaarsenitodicopper; technical grade, 97.4% AI; CAS 12002-03-8

Alternate Names: C.I. pigment green 21; Basle Green; C.I. 77410; Emerald Green; French Green; Mineral Green; Mitis Green; Paris Green; Schweinfurt Green

Principal Use: Insecticide (stomach)

Experimental: Concentrations tested (n): 4 (Control Reference: 79-12)
Extreme concentrations: 500–1,313 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 652 ppm	95% CI: 547–778 ppm		Slope: 9.52	SE: 2.17	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
500 ppm	2	5	7	8	2/15
952 ppm	3	3	6	7	14/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	11.0	11.5	12.8	11.2	11.8	0/45
500 ppm	3.1	5.0	6.4	5.0	5.5	
Deaths	0	0	0	0	0	2/15
952 ppm	2.5	3.9	3.9	1.7	1.2	
Deaths	0	0	2	3	8	14/15

Cyano (Methylmercuri) Guanidine (Morsodren)

Principal Ingredient: (Cyanoguanidinato-*N*′)methylmercury; commercial grade, 2.2% AI[1.51% Hg]; CAS 502-39-6

Alternate Names: EP-227; Panogen

Principal Use: Fungicide

Experimental: Concentrations tested (n): 5 (Control Reference: 76-4)
Extreme concentrations: 30–90 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 45 ppm 95% CI: 40–52 ppm Slope: 9.73 SE: 1.88

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
30 ppm		No overt signs of toxicity			0/10
39 ppm	-	7	8	-	2/10
90 ppm	-	5	8	-	9/10

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 5)	10.2	8.0	9.4	10.7	9.4	0/50
39 ppm	9.4	7.3	8.3	10.5	7.3	
Deaths	0	0	0	0	0	2/10
68 ppm	9.9	6.0	7.5	9.9	4.1	
Deaths	0	0	0	1	1	8/10

2,4-D

Principal Ingredient: (2,4-Dichlorophenoxy)-acetic acid; technical grade, 75.0% AI; CAS 94-75-7

Alternate Names: 2,4-D acetamide; Ded-weed; Dicopur; Esteron 99; Fernimine; Foredex 75; Hedonal; Ipaner; Monosan; Pennamine D; Vertron 2D; U 46 DP; Weedar 64; Weed-B-Gon

Principal Use: Herbicide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 66-12)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 16
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: –	Slope: –	SE: –

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
1,250 ppm	–	–	–	–	0/16
2,500 ppm	–	2	2	–	1/16
5,000 ppm	–	–	–	–	0/16

2,4-D (Dimethylamine salt)

Principal Ingredient: (2,4-Dichlorophenoxy)-acetic acid and *N*-methylmethanamine (1:1); commercial formulation, 49.4% AI; CAS 2008-39-1

Alternate Names: Banvel K; Banvel M; Bladex G; 2,4-D amine; Formula 40; Phordene

Principal Use: Herbicide

Experimental: Concentrations tested (*n*): 4 (Control Reference: 66-2)
Extreme concentrations: 500–5,000 ppm
Birds per concentration: 20
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Note: Test age, 20 days

Dalapon

Principal Ingredient: 2,2-Dichloropropanoic acid; technical grade, 74% AI; CAS 75-99-0

Alternate Names: Alatex; Basinex P; Dowpon; DPA; Radapon; Unipon

Principal Use: Herbicide (selective)

Experimental: Concentrations tested (n): 3 (Control Reference: 66-11B)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 14
Diluent: Propylene Glycol

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Note: Test age, 12 days

2,4-DB (acid)

Principal Ingredient: 4-(2,4-Dichlorophenoxy)-butanoic acid; technical grade, 100% AI; CAS 94-82-6

Alternate Names: Butoxone; Butyrac; 2,4-DM; Embutox; Legumex; MB 2878

Principal Use: Herbicide

Experimental: Concentrations tested (n): 2 (Control Reference: 71-3)
Extreme concentrations: 2,500–5,000 ppm
Birds per concentration: 12
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

2,4-DB (ester)

Principal Ingredient: (2,4-Dichlorophenoxy)-acetic acid, butyl ester; technical grade, 69.3% AI; CAS 94-80-4

Alternate Names: Butyl 2,4-D; Esso Herbicide 10; Fernesta; Lironox

Principal Use: Herbicide

Experimental: Concentrations tested (n): 3 (Control Reference: 66-11A)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

DDE

Principal Ingredient: 1,1′-(Dichloroethenylidene)bis[4-chlorobenzene]; technical grade, 99.9% AI; CAS 72-55-9

Alternate Names: p,p′-DDE

Principal Use: Degradation product of DDT

Experimental: Concentrations tested (*n*): 4 (Control Reference: 80-3)
Extreme concentrations: 750–2,121 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 859 ppm	95% CI: 696–1,060 ppm	Slope: 8.67	SE: 2.36

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
750 ppm	3	5	7	8	5/15
1,061 ppm	3	3	6	7	11/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	11.0	10.2	12.2	11.0	11.2	0/45
1,061 ppm	10.0	8.3	6.3	5.1	10.3	
Deaths	0	0	1	5	4	11/15
2,121 ppm	9.1	4.7	2.9	7.0	4.0	
Deaths	0	2	7	4	1	14/14

DDT

Principal Ingredient: 1,1′-(2,2,2-Trichloroethylidene)bis[4-chlorobenzene]; technical grade, 100% AI; CAS 50-29-3

Alternate Names: Anofex; Arkotine; Azotox; Chlorophenothane; Dicochlorodiphenyltrichloroethane; Dicophane; ENT 1506; Gesapon; Gesarex; Gesarol; Gyron; Ixodex; Kopsol; Neosid; Pentachlorin; p,p′-DDT; Rukseam; Zerdane

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-3)
Extreme concentrations: 200–1,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 416 ppm	95% CI: 341–509 ppm	Slope: 6.57	SE: 1.26

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
200 ppm		No overt signs of toxicity			0/15
299 ppm	5	7	8	9	4/15
669 ppm	2	3	6	7	14/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	11.0	10.2	12.2	11.0	11.2	0/45
299 ppm	10.7	10.9	11.8	10.9	11.2	
Deaths	0	0	0	0	0	4/15
669 ppm	10.7	9.9	10.2	9.1	5.3	
Deaths	0	0	4	7	2	14/15

Demeton

Principal Ingredient: Phosphorothioic acid *O,O*-diethyl *O*-[2-(ethylthio) ethyl]ester; and Phosphorothioic acid *O,O*-diethyl *S*-[2-(ethylthio)ethyl] ester; technical grade, 96% AI; CAS 8065-48-3

Alternate Names: Bay 8169; Demox; E 1059; Ethyl systox; Mercaptophos; Septox; Systox

Principal Use: Insecticide (systemic); acaricide (systemic)

Experimental: Concentrations tested (*n*): 6 (Control Reference: 69-1)
Extreme concentrations: 200–600 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 275 ppm	95% CI: 218–346 ppm	Slope: 5.17	SE: 1.31

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
200 ppm	–	3	4	–	3/10
600 ppm	–	1	4	–	9/10

Note: Test age, 12 days

Diazinon

Principal Ingredient: Phosphorothioic acid *O,O*-diethyl *O*-[6-methyl-2-(1-methylethyl)-4-pyrimidinyl]ester; technical grade, 99% AI; CAS 333-41-5

Alternate Names: Alfa-tox; AG 500; Basudin; Ciazinon; Dassitox; Dazzel; Diagran; Diazatol; Diazide; Diazol; ENT 19507; G-24480; Gardentox; Neocidal; Nipsan; Sarolex; Spectracide

Principal Use: Insecticide; nematocide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 81-5)
Extreme concentrations: 85–240 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 167 ppm   95% CI: 131–212 ppm   Slope: 6.01   SE: 1.35

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
85 ppm	2	–	–	8	0/15
240 ppm	2	3	6	6	13/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	11.5	10.6	12.0	11.8	12.2	0/45
85 ppm	10.1	8.0	9.4	9.1	8.5	
Deaths	0	0	0	0	0	0/15
170 ppm	5.6	4.2	5.2	4.6	3.8	
Deaths	0	0	0	0	2	8/15

Diazinon (AG 500)

Principal Ingredient: Phosphorothioic acid *O,O*-diethyl *O*-[6-methyl-2-(1-methylethyl)-4-pyrimidinyl]ester; commercial formulation, 48% AI; CAS 333-41-5

Alternate Names: ENT 19507; G-24480

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 4 (Control Reference: 80-2)
Extreme concentrations: 45–150 ppm
Birds per concentration: 15
Diluent: Propylene Glycol

Toxicity Summary

LC50: 101 ppm	95% CI: 81–126 ppm		Slope: 7.53	SE: 1.65	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
30 ppm		No overt signs of toxicity			0/15
67 ppm	2	5	5	7	2/15
100 ppm	3	4	6	7	6/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	10.6	11.1	12.9	11.5	11.6	0/45
45 ppm	9.6	8.7	10.9	9.7	9.5	
Deaths	0	0	0	0	0	0/15
100 ppm	5.4	4.4	5.7	4.1	4.2	
Deaths	0	0	0	2	1	6/15

Dicamba

Principal Ingredient: 3,6-Dichloro-2-methoxybenzoic acid; technical grade, 89.3% AI; CAS 1918-00-9

Alternate Names: Banex; Banvel D; Dianat; Mediben; Mondak; Vel 58-CS-11; Velsicol Compound R

Principal Use: Herbicide

Experimental: Concentrations tested (n): 3 (Control Reference: 80-6)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm					
	Food consumption (grams per bird-day)					
Dietary concentration	Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	12.9	11.4	13.4	13.2	13.1	0/45
2,236 ppm	11.0	10.5	12.0	13.1	12.5	
Deaths	0	0	0	0	0	0/15

Dichlobenil

Principal Ingredient: 2,6-Dichlorobenzonitrile; technical grade, 96.4% AI; CAS 1194-65-6

Alternate Names: Casoron; Casoron 133; DBN; Du-Sprex; ENT 26665; H 133; NIA 5996

Principal Use: Herbicide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 66-12)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 16
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: –	Slope: –	SE: –		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,000 ppm	–	–	–	–	0/16
2,500 ppm	–	4	7	–	2/16
5,000 ppm	–	4	6	–	3/16

Dichlone

Principal Ingredient: 2,3-Dichloro-1,4-naphthalenedione; technical grade, 95% AI; CAS 117-80-6

Alternate Names: Algistat; Compound 604; Dichloronaphthoquinone; ENT 3776; Phygon; Phygon XL; Sanquinon; Uniroyal; USR 604

Principal Use: Fungicide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 67-4)
Extreme concentrations: 50–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Note: Test age, 17 days

Dichlorvos

Principal Ingredient: Phosphoric acid 2,2-dichloroethenyl dimethyl ester; technical grade, 94.8% AI; CAS 62-73-7

Alternate Names: Atgard; Benfos; Brevinyl; Cekusan; Dichlorman; Dichlorphos; DDVF; DDVP; Dedevap; Divipan; ENT 20738; Herkol; Mafu; Marvex; Nogos; No-Pest; Nuvan; Phosvit; SD 1750; Vapona

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-7A)
Extreme concentrations: 100–600 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 265 ppm	95% CI: 191-370 ppm	Slope: 3.18	SE: 0.67		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
100 ppm	3	6	6	7	1/15
600 ppm	2	3	6	7	14/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	12.2	12.6	10.4	12.5	12.2	0/45
157 ppm	5.9	4.6	5.1	6.2	7.6	
Deaths	0	0	0	3	2	5/15
383 ppm	2.9	2.3	1.9	3.0	3.6	
Deaths	0	0	1	6	1	9/15

Diclofop-Methyl (Hoelon 3EC)

Principal Ingredient: 2-(4-(2,4-Dichlorophenoxy)phenoxy)-propionicacid, methylester; commercial formulation, 35.4% AI; CAS 51338-27-3

Alternate Names: Hoe-23408

Principal Use: Herbicide (control of annual grassy weeds)

Experimental: Concentrations tested (*n*): 2 (Control Reference: 81-7B)
Extreme concentrations: 2,500–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm					
Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	9.9	10.0	10.4	11.8	11.6	0/45
2,500 ppm	9.6	9.7	10.2	11.3	11.4	
Deaths	0	0	0	0	0	0/15
5,000 ppm	7.5	9.7	10.1	10.3	10.1	
Deaths	0	0	0	0	0	0/15

Dicofol

Principal Ingredient: 4-Chloro-∝-(4-chlorophenyl)-∝-(trichloromethyl) benzenemethanol; technical grade, 75% AI; CAS 115-32-2

Alternate Names: Acarin; Dichlorokelthane; DTMC; ENT 23684; FW 293; Kelthane; Mitigan

Principal Use: Acaricide

Experimental: Concentrations tested (n): 5 (Control Reference: 80-5B)
Extreme concentrations: 800–2,400 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 1,535 ppm	95% CI: 1,201–1,962 ppm		Slope: 4.20		SE: 1.01
Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
800 ppm	4	5	5	6	2/15
2,400 ppm	2	3	6	7	12/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	11.2	10.7	12.3	11.8	12.6	0/45
1,053 ppm	12.9	12.0	13.2	12.7	15.5	
Deaths	0	0	0	0	3	4/15
1,824 ppm	10.6	7.7	8.9	6.9	8.1	
Deaths	0	0	0	3	2	10/15

Dicofol (Kelthane E)

Principal Ingredient: 4-Chloro-α-(4-chlorophenyl)-α-(trichloromethyl) benzenemethanol; commercial formulation, 18.5% AI; CAS 115-32-2

Alternate Names: ENT 23684; FW 293

Principal Use: Acaricide

Experimental: Concentrations tested (*n*): 4 (Control Reference: 80-5B)
Extreme concentrations: 800–1,824 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 1,027 ppm | 95% CI: 852–1,259 ppm | Slope: 8.06 | SE: 1.83

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
800 ppm	2	2	5	6	4/15
1,386 ppm	2	3	5	6	13/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	11.2	10.7	12.3	11.8	12.6	0/45
1,053 ppm	10.1	8.9	11.2	7.5	7.6	
Deaths	0	0	0	2	3	6/15
1,824 ppm	9.0	4.0	2.4	0.9	1.3	
Deaths	0	0	7	5	3	15/15

Dicrotophos

Principal Ingredient: (*E*)-Phosphoric acid 3-(dimethylamino)-1-methyl-3-oxo-1-propenyl dimethyl ester; technical grade, 85% AI; CAS 141-66-2

Alternate Names: Bidrin; C 709; Carbicron; Ektafos; SD 3562

Principal Use: Insecticide (contact and systemic)

Experimental: Concentrations tested (*n*): 5–6 (Control Reference: Pool)
Extreme concentrations: 20–60 ppm
Birds per concentration: 10–15
Diluent: Corn Oil

Toxicity Summary

LC50: 37 ppm	95% CI: 34–40 ppm	Slope: 7.15	SE: 0.34	

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
20 ppm	4	5	6	6	12/177
60 ppm	1	2	6	8	160/179

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 10)	11.2	11.1	12.0	11.7	12.0	0/135
26 ppm	8.7	5.9	6.6	6.3	6.2	
Deaths (pool)	0	0	3	10	12	42/132
46 ppm	6.4	4.5	4.3	2.5	3.3	
Deaths (pool)	0	2	10	33	32	103/134

Note: Cumulative pool (Appendix C)

Dieldrin

Principal Ingredient: 3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-2,7:3,6-dimethanonaphth[2,3-b]oxirene; technical grade, 100% AI; CAS 60-57-1

Alternate Names: Alvit; Dieldrex; Dieldrine; ENT 16225; HEOD; Octalox; Panoram D-31

Principal Use: Insecticide

Experimental: Concentrations tested (n): 5–6 (Control Reference: Pool)
Extreme concentrations: 15–120 ppm
Birds per concentration: 8–15
Diluent: Corn Oil

Toxicity Summary

LC50: 60 ppm	95% CI: 57–63 ppm	Slope: 7.72	SE: 0.29	

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
35 ppm	4	6	6	7	6/179
105 ppm	2	2	5	7	168/175

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 10)	11.2	11.1	12.0	11.7	12.0	0/135
46 ppm	10.4	9.2	9.4	8.9	9.0	
Deaths (pool)	0	1	1	3	9	35/134
80 ppm	8.4	6.0	4.7	3.7	4.4	
Deaths (pool)	0	4	18	49	28	113/133

Note: Cumulative pool (Appendix C)

Dimethoate

Principal Ingredient: Phosphorodithioic acid *O,O*-dimethyl *S*-[2-(methylamino)-2-oxoethyl]ester; technical grade, 99% AI; CAS 60-51-5

Alternate Names: AC 12880; BI 58; Cygon; Daphene; De-Fend; Demos L40; Dimethogen; EI 12880; ENT 24650; Fostion MM; L 395; NC 262; Perfekthion; Rebelate; Rogor; Roxion; Trimetion

Principal Use: Acaricide, insecticide (systemic)

Experimental: Concentrations tested (n): 5 (Control Reference: 66-12)
Extreme concentrations: 200–715 ppm
Birds per concentration: 16
Diluent: Propylene Glycol

Toxicity Summary

LC50: 341 ppm 95% CI: 286–407 ppm Slope: 6.51 SE: 1.19

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
200 ppm	-	5	5	-	1/16
520 ppm	-	1	6	-	13/16

Dimethoate (Cygon 2E)

Principal Ingredient: Phosphorodithioic acid *O,O*-dimethyl *S*-[2-(methylamino)-2-oxoethyl]ester; commercial formulation, 23.4% AI; CAS 60-51-5

Alternate Names: AC 12880; ENT 24650

Principal Use: Acaracide; insecticide (systemic)

Experimental: Concentrations tested (n): 5 (Control Reference: 80-6)
Extreme concentrations: 200–600 ppm
Birds per concentration: 15
Diluent: Propylene glycol

Toxicity Summary

LC50: 496 ppm 95% CI: 373–659 ppm Slope: 4.58 SE: 1.14

	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
250 ppm	–	–	–	–	0/15
263 ppm	2	4	4	6	2/15
600 ppm	2	3	6	7	9/15

	Food consumption (grams per bird-day)					
Dietary concentration	Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	11.7	10.3	11.8	12.5	11.7	0/45
263 ppm	10.1	7.0	8.4	8.6	11.4	
Deaths	0	0	0	2	0	2/15
456 ppm	9.7	9.1	9.2	12.1	15.2	
Deaths	0	0	1	1	1	7/15

Dimethoate-Dichlorvos (Stable Spray)

Principal Ingredient: Phosphorodithioic acid *O,O*-dimethyl *S*-[2-(methylamino)-2-oxoethyl]ester, 15.9% AI; and phosphoric acid 2,2-dichloroethenyl dimethyl ester, 0.95% AI, commercial formulation; CAS 60-51-5 and 62-73-7

Alternate Names: Dimethoate = AC 12880; ENT 24650; L 395; NC 262: Dichlorvos = BAY 19149; ENT 20738

Principal Use: Insecticide; acaricide (systemic)

Experimental: Concentrations tested (n): 5 (Control Reference: 80-7A)
Extreme concentrations: 250–750 ppm
Birds per concentration: 15
Diluent: Propylene glycol

Toxicity Summary

LC50: 531 ppm 95% CI: 434–650 ppm Slope: 5.67 SE: 1.20

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
250 ppm	2	4	4	7	1/15
750 ppm	2	3	5	6	14/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	12.2	12.6	10.4	12.5	12.2	0/45
329 ppm	8.2	6.3	5.3	8.6	7.1	
Deaths	0	0	0	1	1	2/15
570 ppm	7.1	8.2	5.4	11.1	8.8	
Deaths	0	0	0	1	4	6/15

Dinocap (Karathane)

Principal Ingredient: 2-Butenoic acid 2-(1-methylheptyl)-4,6-dinitrophenyl ester, 18.25% AI; and 2-butenoic acid 4-(1-methylheptyl)-2,6-dimtro-phenyl ester, 1.25% AI, commercial formulation; CAS 39300-45-3

Alternate Names: CR 1639

Principal Use: Acaricide; fungicide (foliage)

Experimental: Concentrations tested (n): 5 (Control Reference: 79-10)
Extreme concentrations: 230–1,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 790 ppm	95% CI: 662–934 ppm	Slope: 8.79	SE: 2.00

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
330 ppm	2	–	–	7	0/15
574 ppm	2	7	7	8	1/15
1,000 ppm	1	2	6	7	11/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	12.7	10.6	11.9	11.3	11.8	0/45
435 ppm	7.8	7.5	9.6	9.0	9.3	

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Deaths	0	0	0	0	0	0/15
758 ppm	4.6	5.9	5.5	4.9	7.0	
Deaths	0	0	1	3	3	9/15

Dinoseb

Principal Ingredient: 2-(1-Methylpropyl)-4,6-dinitrophenol; technical grade, 95.8% AI; CAS 88-85-7

Alternate Names: Aatox; Butaphene; Chemox P.E.; Dinitrobutylphenol; DN 289; DNBP; DNOSBP; DNSBP; Dow General Weedkiller; Elgetol 318; ENT 1122; Kiloseb; Nitropone C; Premerge; Sinox General

Principal Use: Herbicide; dessicant; dormant foliage spray

Experimental: Concentrations tested (n): 4 (Control Reference: 79-12)
Extreme concentrations: 250–570 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 354 ppm	95% CI: 314–398 ppm	Slope: 17.50	SE: 4.25

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
250 ppm		No overt signs of toxicity			0/15
324 ppm	3	3	6	7	4/15
433 ppm	2	2	7	8	14/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	11.0	11.5	12.8	11.3	11.8	0/45
324 ppm	9.3	11.1	14.0	10.8	11.7	
Deaths	0	0	1	0	2	4/15
570 ppm	6.2	4.9	4.5	1.5	0	
Deaths	1	5	7	1	1	15/15

Dioxathion

Principal Ingredient: Phosphorodithioic acid *S,S'*-1,4-dioxane-2,3-diyl *O,O,O',O'*-tetraethyl ester; technical grade 100% AI; CAS 78-34-2

Alternate Names: AC 528; Delnatex; Delnav; ENT 22897; Hercules 528; Navadel; Ruphos

Principal Use: Insecticide; acaricide

Experimental: Concentrations tested (n): 5 (Control Reference: 66-11B)
Extreme concentrations: 3,500–6,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: 6,130 ppm	95% CI: 4,766–7,806 ppm		Slope: 7.21	SE: 2.27	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
3,000 ppm	–	–	–	–	0/13
3,450 ppm	–	7	7	–	1/13
6,000 ppm	–	3	5	–	7/14

Note: Test age, 12 days

Diquat Dibromide

Principal Ingredient: 6,7-Dihydrodipyrido [1,2-a:2′,1′-c]pyrazinediium dibromide; commercial formulation, 37% AI; CAS 85-00-7

Alternate Names: Aquacide; Dextrone; Diquat; FB/2; Reglone

Principal Use: Herbicide (contact and dessicant)

Experimental: Concentrations tested (n): 5 (Control Reference: 66-12)
Extreme concentrations: 600–2,180 ppm
Birds per concentration: 16
Diluent: Propylene Glycol

Toxicity Summary

LC50: 1,337 ppm	95% CI: 1,090–1,641 ppm		Slope: 5.39	SE: 1.03	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
830 ppm	–	7	8	–	2/16
2,180 ppm	–	4	7	–	14/16

Disulfoton

Principal Ingredient: Phosphorodithioic acid *O,O*-diethyl *S*-[2-(ethylthio) ethyl]ester; technical grade, 100% AI; CAS 298-04-4

Alternate Names: Bay 19639; Di-Syston; Dimaz; Disipton; Disystox; Dithiodemeton; Dithioseptox; ENT 23427; Frumin AL; Frumin G; S 276; Solvirex; Thiodemeton

Principal Use: Insecticide (systemic); acaricide

Experimental: Concentrations tested (*n*): 6 (Control Reference: 69-1)
Extreme concentrations: 200–600 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 334 ppm	95% CI: 275–405 ppm	Slope: 5.84	SE: 1.32

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
200 ppm	–	3	4	–	2/10
600 ppm	–	1	4	–	9/10

Diuron

Principal Ingredient: *N'*-(3,4-Dichlorophenyl)-*N,N*-dimethyl urea; technical grade, 100% AI; CAS 330-54-1

Alternate Names: Dailon; DCMU; Di-On; Dichlorofenidim; Diurex; DMU; Duran; Dynax; Herbatox; Karmex; Marmer; Vonduron

Principal Use: Herbicide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 66-11A)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: –	Slope: –	SE: –

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
1,250 ppm	–	–	–	–	0/14
2,500 ppm	–	4	5	–	2/14
5,000 ppm	–	5	6	–	2/14

Note: Test age, 12 days

DNOC (Elgetol)

Principal Ingredient: 2-Methyl-4,6-dinitrophenol; commercial formulation, 19% AI; CAS 534-52-1

Alternate Names: ENT 154

Principal Use: Insecticide; herbicide; fungicide; defoliant

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-2)
Extreme concentrations: 2,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm					
Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (*n* = 3)	10.7	10.5	12.3	10.5	10.6	0/45
2,515 ppm	10.9	10.5	12.3	10.7	10.5	
Deaths	0	0	0	0	0	0/15
3,977 ppm	11.3	11.1	12.7	11.4	10.9	
Deaths	0	0	0	0	0	0/15

DRC-1399

Principal Ingredient: 3-Chloro-4-methylbenzenamine hydrochloride; technical grade, 89% AI; CAS 7745-89-3

Alternate Names: Starlicide

Principal Use: Bird repellent (avicide)

Experimental: Concentrations tested (n): 5 (Control Reference: 67-3)
Extreme concentrations: 12–36 ppm
Birds per concentration: 13
Diluent: Propylene Glycol

Toxicity Summary

LC50: 22 ppm	95% CI: 19–27 ppm		Slope: 6.90	SE: 1.40	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
12 ppm	–	6	6	–	1/13
28 ppm	–	2	5	–	9/13

Edifenphos

Principal Ingredient: Phosphorothioic acid *O*-ethyl *S,S*-diphenyl ester; technical grade, 83% AI; CAS 17109-49-8

Alternate Names: BAY 78418; DDP; EDDP; Hinosan

Principal Use: Fungicide

Experimental: Concentrations tested (n): 6 (Control Reference: 72-3A)
Extreme concentrations: 1,200–5,500 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 2,505 ppm	95% CI: 1,928–3,253 ppm		Slope: 4.27	SE: 0.96	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,200 ppm	–	–	–	–	0/10
1,627 ppm	–	2	2	–	2/10
4,057 ppm	–	1	2	–	6/10

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 2)	9.2	10.0	9.2	10.6	11.5	0/20
1,627 ppm	6.9	6.4	5.8	10.2	9.9	

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Deaths	0	2	0	0	0	2/10
4,057 ppm	3.9	2.6	3.5	7.0	2.0	
Deaths	4	2	0	0	0	6/10

Endosulfan

Principal Ingredient: 6,7,8,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin 3-oxide; technical grade, 96% AI; CAS 115-29-7

Alternate Names: BIO 5462; Chlorthiepin; Cyclodan; ENT 23979; FMC 5462; HOE 2671; Insectophene; Malix; OMS 570; Thifor; Thimul; Thiodan; Thionex

Principal Use: Insecticide; acaricide

Experimental: Concentrations tested (n): 5 (Control Reference: 80-6)
Extreme concentrations: 1,200–3,600 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 2,906 ppm	95% CI: 2,278–3,708 ppm	Slope: 5.24	SE: 1.23

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
1,200 ppm	2	–	–	7	0/15
1,579 ppm	2	5	5	7	1/15
3,600 ppm	1	3	7	8	10/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	11.7	10.3	11.8	12.5	11.7	0/45
1,579 ppm	8.7	8.5	9.2	10.4	10.9	
Deaths	0	0	0	0	1	1/15
2,735 ppm	6.3	5.0	6.2	8.8	12.6	
Deaths	0	0	0	3	2	9/15

Endosulfan (Thiodan E)

Principal Ingredient: 6,7,8,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin 3-oxide; commercial formulation, 22.8% AI; CAS 115-29-7

Alternate Names: BIO 5426; ENT 23979; FMC 5462; HOE 2671; OMS 570

Principal Use: Insecticide; acaricide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-6)
Extreme concentrations: 1,200–3,600 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 2,160 ppm | 95% CI: 1,658–2,815 ppm | Slope: 3.77 | SE: 0.97

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
1,200 ppm	3	4	5	6	2/15
3,600 ppm	1	1	6	7	12/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	11.7	10.3	11.8	12.5	11.7	0/45
1,579 ppm	4.0	4.0	6.7	7.4	9.2	
Deaths	0	0	0	0	1	5/15
2,735 ppm	3.4	2.8	4.2	5.5	8.3	
Deaths	1	0	1	2	1	10/15

Endrin

Principal Ingredient: 1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-endo,endo-1,4:5,8-dimethanonaphthalene; technical grade, 98% AI; CAS 72-20-8

Alternate Names: Compound 269; Endrex; EN 57; ENT 17251; Hexadrin; Mendrin; SD 3419

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 67-3)
Extreme concentrations: 12–36 ppm
Birds per concentration: 13
Diluent: Corn Oil

Toxicity Summary

LC50: 17 ppm | 95% CI: 25–20 ppm | Slope: 8.85 | SE: 1.87

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
12 ppm	–	2	3	–	1/13
28 ppm	–	3	6	–	12/13

EPN

Principal Ingredient: Phenylphosphonothioic acid *O*-ethyl *O*-(4-nitrophenyl) ester; technical grade, 100% AI; CAS 2104-64-5

Alternate Names: ENT 17798; EPN 300

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 68-2)
Extreme concentrations: 300–750 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 437 ppm 95% CI: 302–632 ppm Slope: 3.27 SE: 1.35

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
300 ppm	–	5	6	–	3/10
750 ppm	–	1	4	–	9/10

Ethion

Principal Ingredient: Phosphorodithioic acid *S,S*-methylene *O,O,O',O'*-tetraethyl ester; technical grade, 95% AI; CAS 563-12-2

Alternate Names: Diethion; Ethopaz; ENT 24105; FMC 1240; Fosfatox E; NIA 1240; Nialate; Phosphotox E; Rhodocide; RP 8167

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 71-9)
Extreme concentrations: 1,000–5,000 ppm

Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: –	Slope: –	SE: –		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,000 ppm	–	–	–	–	0/10
2,236 ppm	–	3	3	–	1/10
5,000 ppm	–	5	5	–	1/10

Ethoprop

Principal Ingredient: Phosphorodithioic acid *O*-ethyl *S,S*-dipropyl ester; technical grade, 95% AI; CAS 13194-48-4

Alternate Names: ENT 27318; Ethoprop; Ethoprophos; Mocap; Prophos; Rovokil; VC 9-104

Principal Use: Soil-insecticide; nematocide

Experimental: Concentrations tested (n): 6 (Control Reference: 79-5B)
Extreme concentrations: 60–180 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 89 ppm	95% CI: 72–109 ppm	Slope: 12.01	SE: 4.66		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
60 ppm	2	–	–	6	0/15
75 ppm	2	6	6	7	1/15
144 ppm	1	3	5	6	14/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	10.7	10.9	10.1	10.5	8.9	0/45
75 ppm	3.5	6.3	6.9	6.8	12.8	
Deaths	0	0	0	0	0	1/15
116 ppm	3.5	2.4	2.0	1.5	1.2	
Deaths	0	1	0	4	7	14/15

Ethoprop (Mocap 6EC)

Principal Ingredient: Phosphorodithioic acid *O*-ethyl *S,S*-dipropyl ester; commercial formulation, 69.6% AI; CAS 13194-48-4

Alternate Names: ENT 27318; VC 9-104

Principal Use: Nematocide; soil-insecticide

Experimental: Concentrations tested (*n*): 6 (Control Reference: 79-5)
Extreme concentrations: 60–180 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 91 ppm | 95% CI: 68–122 ppm | Slope: 5.47 | SE: 1.85

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
60 ppm	3	5	5	6	1/15
180 ppm	1	2	6	7	14/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 3$)	10.7	10.9	10.1	10.5	8.9	0/45
75 ppm	5.5	4.4	3.9	3.5	3.0	
Deaths	0	0	1	1	5	9/15
116 ppm	4.5	3.3	2.9	2.1	2.0	
Deaths	0	0	0	2	5	8/15

Ethoprop (Mocap 10G)

Principal Ingredient: Phosphorodithioic acid *O*-ethyl *S,S*-dipropyl ester; commercial formulation, 100% AI; CAS 13194-48-4

Alternate Names: ENT 27318; VC 9-104

Principal Use: Nematocide; soil-insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 79-5B)
Extreme concentrations: 60–144 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 90 ppm	95% CI: 78–122 ppm	Slope: 9.25	SE: 1.73

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
60 ppm	1	3	6	7	2/15
116 ppm	1	3	6	7	14/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 3$)	10.7	10.9	10.1	10.5	8.9	0/45
75 ppm	5.8	6.4	5.6	4.5	4.3	
Deaths	0	0	0	0	1	3/15
116 ppm	3.9	3.3	2.7	1.8	1.3	
Deaths	0	0	2	1	8	14/15

Ethylan

Principal Ingredient: 1,1′-(2,2-Dichloroethylidene)bis[4-ethyl benzene]; technical grade, 95% AI; CAS 72-56-0

Alternate Names: Perthane; ENT 17082; Q 137

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 4 (Control Reference: 66-2)
Extreme concentrations: 500–5,000 ppm
Birds per concentration: 20
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Ethylene Dichloride – Carbon Tetrachloride (Dowfume 75)

Principal Ingredient: 1,2-Dichloroethane, commercial formulation, 70% AI; and tetrachloromethane, commercial formulation, 30% AI; CAS 8003-06-3

Alternate Names: Chlorasol; EDC; ED/CT

Principal Use: Insecticide (fumigant)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 81-4)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: –	Slope: –	SE:–		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,000 ppm	No overt signs of toxicity				0/15
2,236 ppm	3	5	5	6	1/15
5,000 ppm	2	2	2	7	1/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	11.4	11.1	10.6	12.9	12.0	0/45
5,000 ppm	11.3	12.3	12.6	14.6	13.6	
Deaths	0	1	0	0	0	1/15

Famphur

Principal Ingredient: Phosphorodithioic acid *O*-[(dimethylamino)sulfonyl] phenyl] *O,O*-dimethyl ester; technical grade, 100% AI; CAS 52-85-7

Alternate Names: AC 38023; CL 38023; Dovip; ENT 25644; Famophos; Warbex

Principal Use: Insecticide (systemic)

Experimental: Concentrations tested (*n*): 5 (Control Reference: 72-2A)
Extreme concentrations: 40–100 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 69 ppm	95% CI: 49–97 ppm	Slope: 7.57	SE: 3.38		

	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
40 ppm	–	–	–	–	0/10
50 ppm	–	3	6	–	4/10
79 ppm	–	2	6	–	6/10

Fenac

Principal Ingredient: 2,3,6-Trichlorobenzeneacetic acid; technical grade, 100% AI; CAS 85-34-7

Alternate Names: Chlorfenac; Fenatrol; Trifene; 2,3,6 TCA; TCPA

Principal Use: Herbicide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 66-12)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 16
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Fenamiphos

Principal Ingredient: Phosphoramidic acid ethyl 3-methyl-4-(methylthio) phenyl)1-methylethyl)ester; technical grade, 81% AI; CAS 22224-92-6

Alternate Names: BAY 68138; ENT 27572; Nemacur; Phenamiphos

Principal Use: Nematocide (systemic)

Experimental: Concentrations tested (*n*): 6 (Control Reference: 72-3A)
Extreme concentrations: 25–100 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 59 ppm	95% CI: 46–75 ppm	Slope: 4.54	SE: 1.06

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
25 ppm	–	–	–	–	0/10
33 ppm	–	5	5	–	2/10
100 ppm	–	1	6	–	8/10

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 2$)	9.2	10.0	9.2	10.6	11.5	0/10
33 ppm	6.9	4.8	4.6	5.5	5.6	
Deaths	0	0	0	0	2	2/10
76 ppm	2.1	1.4	1.5	1.5	0.2	
Deaths	0	0	1	2	4	8/10

Fenitrothion

Principal Ingredient: Phosphorothioic acid *O,O*-dimethyl *O*-(3-methyl-4-nitrophenyl)ester; technical grade, 95% AI; CAS 122-14-5

Alternate Names: AC 47300; Accothion; Agrothion; BAY 41831; Bayer S 5660; CP 47114; Cytel; ENT 25715; Fenitox; Folithion; MEP; Methylnitrophos; Novathion; Nuvanol; OMS 43; S-1102A; S 5660; Sumithion; Sumitomo

Principal Use: Acaricide; insecticide (contact)

Experimental: Concentrations tested (n): 5 (Control Reference: 81-4)
Extreme concentrations: 250–1,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 652 ppm	95% CI: 512–914 ppm	Slope: 5.00	SE: 1.03

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
250 ppm	4	–	–	7	0/15
354 ppm	3	6	6	8	1/15
1,000 ppm	2	3	5	8	12/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 3$)	11.4	11.1	10.6	12.9	12.0	0/34

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
354 ppm	8.8	6.6	7.3	8.6	8.7	
Deaths	0	0	0	0	0	1/15
707 ppm	6.5	6.2	5.9	4.8	4.3	
Deaths	0	0	0	2	5	8/15

Fensulfothion

Principal Ingredient: Phosphorodithioic acid *O,O*-diethyl *O*-[4(methylsulfinyl) phenyl] ester; technical grade, 94.0% AI; CAS 115-90-2

Alternate Names: Bayer S-767; Bay 25141; Dasanit; DMSP; ENT 24945; Terracur-P

Principal Use: Insecticide; nematocide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 71-4)
Extreme concentrations: 34–125 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 85 ppm 95% CI: 62–116 ppm Slope: 4.37 SE: 1.19

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
34 ppm	–	–	–	–	0/10
48 ppm	–	4	4	–	1/10
125 ppm	–	2	5	–	6/10

Fenthion

Principal Ingredient: Phosphorothioic acid *O,O*-dimethyl *O*-[3-methyl-4-(methylthio)phenyl]ester; technical grade, % AI; CAS 55-38-9

Alternate Names: Baycid; Bayer 9007; Baytex; Bay 29493; Entex; ENT 25540; Lebaycid; Mercaptophos; MPP; OMS 2; Queletox; S-1752; Tiguron

Principal Use: Insecticide (systemic); acaricide

Experimental: Concentrations tested (*n*): 6 (Control Reference: 82-10)

Extreme concentrations: 50–250 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 132 ppm	95% CI: 106–169 ppm		Slope: 4.62	SE: 0.36	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
50 ppm	4	–	–	7	0/15
69 ppm	4	6	6	7	2/15
250 ppm	1	2	6	7	13/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control ($n = 3$)	12.1	12.5	10.0	12.7	13.5	0/15
95 ppm	10.7	8.9	7.5	10.5	11.5	
Deaths	0	0	0	0	1	3/15
181 ppm	7.7	5.2	3.4	6.3	10.5	
Deaths	0	0	3	5	3	11/15

Fenuron

Principal Ingredient: *N,N*-Dimethyl-*N'*-phenylurea; technical grade; CAS 101-42-8

Alternate Names: Dybar; Fenidrim; Fenulon; PDU

Principal Use: Herbicide (weed brush killer)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 66-11A)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Note: Test age, 12 days

Fonofos

Principal Ingredient: Ethylphosphonodithioic acid *O*-ethyl *S*-phenyl ester; technical grade, 93% AI; CAS 944-22-9

Alternate Names: Dyfonate; ENT 25796; N 2790

Principal Use: Insecticide (soil)

Experimental: Concentrations tested (*n*): 5
Extreme concentrations: 200–482 ppm
Birds per concentration: 15
Diluent: Corn Oil

(Control Reference: 79-5B)

Toxicity Summary

LC50: 290 ppm	95% CI: 224–377 ppm	Slope: 6.89	SE: 2.36

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
200 ppm	1	5	6	7	3/15
387 ppm	2	3	6	7	13/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	10.7	10.9	10.1	10.5	8.9	0/45
249 ppm	6.1	5.5	4.7	3.2	2.5	
Deaths	0	0	0	0	3	6/15
387 ppm	4.8	3.7	3.0	1.8	1.1	
Deaths	0	0	1	3	5	13/15

Fonofos (Dyfonate)

Principal Ingredient: Ethylphosphonodithioic acid *O*-ethyl *S*-phenyl ester; commercial formulation, 44.6% AI; CAS 944-22-9

Alternate Names: ENT 25796; N 2790

Principal Use: Insecticide (soil)

Experimental: Concentrations tested (*n*): 6
Extreme concentrations: 200–600 ppm
Birds per concentration: 15
Diluent: Corn Oil

(Control Reference: 79-5B)

Toxicity Summary

LC50: 284 ppm	95% CI: 247–326 ppm	Slope: 7.43	SE: 1.37

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
200 ppm	2	6	7	8	2/15
482 ppm	2	2	6	7	14/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 3$)	10.7	10.9	10.1	10.5	8.9	0/45
249 ppm	6.9	6.5	5.3	4.0	4.2	
Deaths	0	0	0	0	4	5/15
387 ppm	4.8	3.7	3.0	1.8	1.1	
Deaths	0	1	2	2	7	13/15

Formetanate Hydrochloride

Principal Ingredient: *N,N*-Dimethyl-*N′*-[3-[[(methylamino)carbonyl]oxy]phenyl]methanimidamide monohydrochloride; technical grade, 93% AI; CAS 23422-53-9

Alternate Names: Carzol SP; ENT 27566; EP 332; Schering 36056

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (*n*): 6 (Control Reference: 79-11)
Extreme concentrations: 600–3,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: 993 ppm	95% CI: 673–1,465 ppm	Slope: 2.46	SE: 0.66

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
600 ppm	1	1	5	6	6/14
3,000 ppm	1	1	5	6	12/13

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 2$)	12.0	11.7	13.4	11.7	13.1	0/20
600 ppm	8.1	8.8	11.4	8.1	10.1	
Deaths	3	1	0	1	1	6/14
2,174 ppm	5.7	6.6	9.2	9.1	8.8	
Deaths	6	2	0	1	2	11/14

Glyphosate (Roundup)

Principal Ingredient: *N*-(Phosphonomethyl)glycine; comercial formulation, 41% AI; CAS 1071-83-6

Alternate Names: CP 67573; CP 70139; MON 2139; MON 39

Principal Use: Herbicide (nonselective)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 79-8)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm — No overt signs of toxicity to 5,000 ppm

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (*n* = 3)	14.4	11.5	12.8	11.6	11.3	0/45
2,236 ppm	13.9	11.7	12.7	10.9	11.1	
Deaths	0	0	0	0	0	0/15

Heptachlor

Principal Ingredient: 1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methano-1H-indene; technical grade, 71.9% AI; CAS 76-44-8

Alternate Names: Aahepta; Drinox H-34; E 3314; ENT 15152; Heptachlorane; Heptagran; Heptamul; Velsicol 104

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-2)
Extreme concentrations: 50–200 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 99 ppm 95% CI: 85–115 ppm Slope: 10.25 SE: 2.22

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
50 ppm	4	–	–	7	0/15
71 ppm	5	6	6	7	1/15
141 ppm	3	3	6	7	14/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	10.2	10.5	12.3	10.5	10.6	0/45
71 ppm	9.5	9.3	11.1	9.3	7.9	
Deaths	0	0	0	0	0	1/15
141 ppm	7.7	6.1	6.5	3.9	1.0	
Deaths	0	0	2	3	6	14/15

Hexachlorobenzene

Principal Ingredient: Hexachlorobenzene; technical grade, 100% AI; CAS 118-74-1

Alternate Names: Amatin; Anticarie; Bunt-Cure; Bunt-No-More; ENT 1719; Hexa C.B.; Hexachlorbenzol; Perchlorobenzene

Principal Use: Seed protectant

Experimental: Concentrations tested (n): 5 (Control Reference: 79-7)
Extreme concentrations: 200–1,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 568 ppm	95% CI: 416–774 ppm	Slope: 3.56	SE: 0.77

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
200 ppm		No overt signs of toxicity			0/15
299 ppm	3	7	7	8	3/15
1,000 ppm	3	4	7	8	11/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	11.8	10.7	11.5	12.8	11.7	0/30
299 ppm	9.9	9.5	10.1	10.6	10.1	

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Deaths	0	0	0	0	0	3/15
669 ppm	9.6	8.7	5.7	4.7	4.4	
Deaths	0	0	0	0	6	10/15

Ioxynil

Principal Ingredient: 4-Hydroxy-3,5-diiodo-benzonitrile; technical grade, 98% AI; CAS 1689-83-4

Alternate Names: ACP 63-303; Actril; Bantrol; CA 69-15; Certrol; Oxytril; Totril; Trebespan

Principal Use: Herbicide (HBN type)

Experimental: Concentrations tested (*n*): 5 (Control Reference: 81-8)
Extreme concentrations: 1,500–3,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 2,469 ppm 95% CI: 2,153–2,842 ppm Slope: 9.87 SE: 2.77

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
1,783 ppm		No overt signs of toxicity			0/10
2,121 ppm	4	6	6	8	1/10
2,522 ppm	2	4	6	8	5/10

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (*n* = 75)	9.9	10.4	10.2	11.3	12.4	0/75
1,783 ppm	7.1	12.6	13.1	14.6	N.D.	
Deaths	0	0	0	0	0	0/10
2,522 ppm	6.2	8.3	9.0	8.4	7.9	
Deaths	0	0	0	2	2	5/10

Isofenphos

Principal Ingredient: 1-Methylethyl-2-[[ethoxy[(1-methylethyl)amino] phosphinothioyl]oxy]benzoic acid ester; technical grade, 73% AI; CAS 25311-71-1

Alternate Names: Amaze; Bay 92114; Bay SRA 12869; Oftenol

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 79-10)
Extreme concentrations: 200–545 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 299 ppm	95% CI: 256–345 ppm	Slope: 7.62	SE: 1.46		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
200 ppm	3	3	6	7	2/15
424 ppm	1	4	6	7	13/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	12.7	10.6	11.9	11.3	11.8	0/45
200 ppm	8.7	8.3	9.0	10.2	9.4	
Deaths	0	0	1	0	0	2/15
330 ppm	6.2	4.7	5.1	3.8	3.8	
Deaths	0	0	1	0	6	9/15

Landrin

Principal Ingredient: 2,3,5-Trimethylphenol methylcarbamate and 3,4,5-Trimethylphenyl methylcarbamate (1:4); technical grade, 94.4% AI; CAS 2655-15-4 and 2686-99-9

Alternate Names: SD 8530; SD 8786

Principal Use: Insecticide (soil)

Experimental: Concentrations tested (*n*): 6 (Control Reference: 72-2B)
Extreme concentrations: 1,200–3,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 2,037 ppm	95% CI: 1,629–2,548 ppm	Slope: 4.67	SE: 1.36

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
1,200 ppm	-	3	6	-	3/10
3,000 ppm	-	1	6	-	8/10

Lead

Principal Ingredient: Lead metal; 100%; CAS 7439-92-1

Alternate Names: C.I. pigment metal 4; C.I. 77575; KS-4; Lead S2

Principal Use: Industrial

Experimental: Concentrations tested (n): 5 (Control Reference: 80-5B)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: -	Slope: -	SE: -

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
1,000 ppm	7	-	-	11	0/15
2,236 ppm	7	-	-	11	0/15
5,000 ppm	7	-	-	12	0/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	11.2	11.7	12.3	11.8	12.6	0/45
1,495 ppm	11.0	10.5	11.9	11.0	12.7	
Deaths	0	0	0	0	0	0/15
2,236 ppm	11.8	11.3	11.5	13.2	12.7	
Deaths	0	0	0	0	0	0/15

Lead Arsenate

Principal Ingredient: Lead(2^+)arsenic acid(H_3ASO_4)salt(2:3); technical grade, 70.5% AI; CAS 3687-31-8

Alternate Names: Nu Rexform

Principal Use: Insecticide (stomach)

Experimental: Concentrations tested (*n*): 6 (Control Reference: 72-11)
Extreme concentrations: 2,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 2,761 ppm	95% CI: 1,622–4,701 ppm	Slope: 1.98	SE: 1.24		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
2,000 ppm	-	5	6	-	4/10
5,000 ppm	-	2	6	-	6/9

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 2$)	11.1	13.3	12.0	11.5	12.1	1/10
2,402 ppm	3.3	6.1	4.0	2.6	1.7	
Deaths	0	0	0	1	0	4/10
4,161 ppm	2.9	6.2	3.3	2.9	2.0	
Deaths	0	0	0	2	2	6/10

Lead Nitrate

Principal Ingredient: Lead(2^+)nitric acid salt; N_2O_6Pb; reagent grade, 100% AI; CAS 10099-74-8

Alternate Names: Lead dinitrate; Lead (II) nitrate

Principal Use: Industrial

Experimental: Concentrations tested (*n*): 3 (Control Reference: 80-5A)
Extreme concentrations: 100–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Lead Subacetate

Principal Ingredient: Bis(acetato-*O*)tetrahydroxytrilead; $C_4H_{10}O_8Pb_3$; reagent grade, 100% AI; CAS 1335-32-6

Alternate Names: Monobasic lead acetate

Principal Use: Industrial

Experimental: Concentrations tested (*n*): 3 (Control Reference: 80-5A)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Leptophos

Principal Ingredient: Phosphonothioic acid *O*-(4-bromo-2,5-dichlorophenyl) *O*-methylphenyl ester; technical grade, 93% AI; CAS 21609-90-5

Alternate Names: Abar; Fosvel; K62-105; Lepton; MBCP; NK 711; Oleophosvel; Phosvel; VCS 506

Principal Use: Fungicide; insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 79-6)
Extreme concentrations: 750–3,000 ppm
Birds per concentration: 30
Diluent: Corn Oil

Toxicity Summary

LC50: 2,645 ppm 95% CI: 2,270–3,081 ppm Slope: 6.83 SE: 1.21

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
750 ppm	2	–	–	5	0/31
1,306 ppm	1	3	3	5	1/30
3,000 ppm	1	1	5	7	18/30

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 3$)	11.3	11.2	13.0	10.5	12.2	0/45
1,306 ppm	5.0	9.3	12.1	9.3	11.8	
Deaths	0	0	1	0	0	1/30
2,273 ppm	2.4	5.7	7.7	7.1	8.7	
Deaths	4	1	4	2	2	13/30

Lindane

Principal Ingredient: (1a,2a,3b,4a,5a,6b)-1,2,3,4,5,6-Hexachlorocyclohexane; technical grade, 93% AI; CAS 58-89-9

Alternate Names: Aparasin; Aphtiria; Benesan; Ben-Hex; Benhexachlor; ENT 7796; Exagamer; Forlin; Gamaphex; Gamma BHC; Gamma HCH; Gammalin; Gammex; Gammexane; Gammopaz; HCH; Isotox; Kwell; Lindfor; Lindagam; Lindatox; Norigan; Silvanol; Streunex; Viton

Principal Use: Insecticide

Experimental: Concentrations tested (n): 5 (Control Reference: 79-6)
Extreme concentrations: 250–877 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 490 ppm 95% CI: 408–589 ppm Slope: 6.36 SE: 1.19

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
250 ppm	2	–	–	2	0/15
342 ppm	1	3	7	8	5/15
641 ppm	2	3	6	7	11/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	11.3	11.2	13.0	10.5	12.2	0/45
250 ppm	6.3	9.3	11.6	10.2	11.9	
Deaths	0	0	0	0	0	0/15
468 ppm	3.7	4.7	5.9	6.5	9.1	
Deaths	0	0	0	3	1	4/15

Lindane (Lindane EC)

Principal Ingredient: (1α,2α,3β,4α,5α,6β)-1,2,3,4,5,6-Hexachlorocyclohexane; commercial formulation, 12.7% AI; CAS 58-89-9

Alternate Names: ENT 7796

Principal Use: Insecticide

Experimental: Concentrations tested (n): 4 (Control Reference: 79-8)
Extreme concentrations: 300–900 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 663 ppm	95% CI: 587–748 ppm	Slope: 15.9	SE: 3.83		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
300 ppm	2	–	–	2	0/15
520 ppm	1	3	3	6	1/15
684 ppm	2	4	6	7	8/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	14.4	11.5	12.8	11.6	11.3	0/45
395 ppm	5.5	6.5	7.5	8.9	10.7	
Deaths	0	0	0	0	0	0/15
684 ppm	3.1	3.2	2.8	2.4	3.0	
Deaths	0	0	0	2	5	8/15

Linuron

Principal Ingredient: N'-(3,4-Dichlorophenyl)-N-methoxy-N-methylurea; commercial formulation, 50% AI; CAS 330-55-2

Alternate Names: Afalon; Cephalon; DuPont 326; Garnitan; H-326; HOE 2810; Linurex; Lorox; Sarclex

Principal Use: Herbicide

Experimental: Concentrations tested (n): 3 (Control Reference: 73-3)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: –	Slope: –	SE: –		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
2,236 ppm	–	–	–	–	0/10
5,000 ppm	–	3	5	–	3/11

Malathion

Principal Ingredient: [(Dimethoxyphosphinothioyl)thio]butanedioic acid diethyl ester; technical grade, 95% AI; CAS 121-75-5

Alternate Names: AC 4049; Carbophos; Chemathion; Compound 4049; Cythion; Emmatos; ENT 17034; For-Mal; Fyfanon; Karbofos; Kop-Thion; Kypfos; Malamar; Malaphos; Malatrol; Mercaptothion; MLT; Phosphothion; Sumitox; Zithiol

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 72-3B)
Extreme concentrations: 1,320–4,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 2,968 ppm	95% CI: 2,240–3,932 ppm		Slope: 5.11	SE: 1.41	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,320 ppm	–	–	–	–	0/10
1,741 ppm	–	4	5	–	2/10
4,000 ppm	–	3	6	–	8/10

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 2)	11.2	9.5	9.3	10.6	11.5	0/10
1,320 ppm	8.1	9.2	9.8	9.8	8.1	
Deaths	0	0	0	0	0	0/10
3,031 ppm	6.2	4.4	5.8	6.4	4.4	
Deaths	0	0	1	1	2	4/10

Maneb (Manzate D)

Principal Ingredient: [[1,2-Ethanediylbis[carbamodithioato]](2-)]manganese; technical grade, 80% AI; CAS 12427-38-2

Alternate Names: F 10

Principal Use: Fungicide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 79-12)
Extreme concentrations: 1,000–5,000 ppm

Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm		95% CI: –		Slope: –	SE: –
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
2,236 ppm		No overt signs of toxicity			0/15
5,000 ppm	4	–	–	5	0/15

Maneb (Manzate 200)

Principal Ingredient: [[1,2-Ethanediylbis[carbamodithioato]](2-)]manganese and [[1,2-ethanediylbis[carbamodithioato]](2-)]zinc; commercial formulation, 80% AI including 16% zinc; CAS 8018-01-7

Alternate Names: F 2966

Principal Use: Fungicide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 79-12)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm		95% CI: –		Slope: –	SE: –
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
2,236 ppm		No overt signs of toxicity			0/15
5,000 ppm	3	–	–	5	0/15

MCPB

Principal Ingredient: 4-(4-Chloro-2-methylphenoxy)-butanoic acid; technical grade; CAS 94-81-5

Alternate Names: Bexone, Cantrol, Thitrol, Tropotox, U 46 MCPB, 2,4-MCPB, 2M-4Kh-M

Principal Use: Herbicide (susceptible plants metabolize to MCPA)

Experimental: Concentrations tested (*n*): 2 (Control Reference: 71-3)
Extreme concentrations: 2,500–5,000 ppm
Birds per concentration: 12
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Mecoprop (Spectrum 33)

Principal Ingredient: 2-(4-Chloro-2-methylphenoxy)propanoic acid, dimethylamine salt, 10.8% AI; (2-4-dichlorophenoxy)-acetic acid, dimethylamine salt, 6.25% AI; and 3,6-dichloro-2-methylbenzoic acid, dimethylamine salt, 1.20% AI; commercial formulation

Alternate Names: None

Principal Use: Herbicide (systemic)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 80-7A)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Propylene glycol

Toxicity Summary

LC50: >5,000 ppm	95% CI: -	Slope: -	SE: -

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
2,236 ppm	No overt signs of toxicity				0/15
5,000 ppm	5	8	8	9	1/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* =)	12.2	12.6	10.4	12.5	12.2	0/45
2,236 ppm	11.3	12.1	11.7	12.6	11.7	
Deaths	0	0	0	0	0	0/15

Mecoprop (Turf Treeter "T")

Principal Ingredient: 2-(4-Chloro-2-methylphenosy)propanoic acid, dimethyl-amine salt, 10.5% AI; 2,4-dichlorophenoxy)-acetic acid, dimethylamine salt, 3.23% AI; and 3,6-dichloro-2-

methylbenzoic acid, dimethylamine salt, 1.28% AI; commercial formulation

Alternate Names: None

Principal Use: Herbicide (systemic)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 80-6)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm					
	Food consumption (grams per bird-day)					
Dietary concentration	Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	12.9	11.4	13.4	13.2	13.1	0/45
2,236 ppm	12.1	11.4	13.1	12.3	12.5	
Deaths	0	0	0	0	0	0/15

Mercury Chloride

Principal Ingredient: $HgCl_2$; reagent grade, 100% AI; CAS 7487-94-7

Alternate Names: Abavit B; Corrosive Sublimate; Dichloromercury; Mercuric Chloride; Mercury Bichloride; Mercury (II) Chloride

Principal Use: Fungicide; insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 77-6)
Extreme concentrations: 2,500–10,000 ppm
Birds per concentration: 15
Diluent: Propylene Glycol

Toxicity Summary

LC50: 5,086 ppm	95% CI: 3,743–6,912 ppm		Slope: 3.28	SE: 0.79	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
2,500 ppm	3	3	4	10	2/15
10,000 ppm	2	2	6	7	12/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	7.4	8.0	8.1	8.1	9.4	1/45
3,535 ppm	2.4	2.5	3.9	3.6	2.9	
Deaths	0	0	0	0	1	5/15
7,070 ppm	1.6	1.7	3.3	3.4	2.9	
Deaths	0	1	0	4	3	11/15

Metam-Sodium

Principal Ingredient: Methylcarbamodithioic acid monosodium salt; technical grade; CAS 137-42-8

Alternate Names: A 7 Vapam; Carbam; Karbation; Mapasol; Metam; Sistan; SMDC; Sometam; Trimaton; Vapam; VPM

Principal Use: Fungicide; herbicide; nematocide (soil)

Experimental: Concentrations tested (n): 3 (Control Reference: 68-2)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: -	Slope: -	SE: -

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
1,250 ppm	-	-	-	-	0/14
2,500 ppm	-	3	3	-	1/14
5,000 ppm	-	4	5	-	2/14

Note: Test age, 7 days

Methamidophos

Principal Ingredient: Phosphoramidothioic acid *O,S*-dimethyl ester; technical grade, 73% AI; CAS 10265-92-6

Alternate Names: BAY 71628; ENT 27396; Hamidop; Monitor; Ortho-9006; RE 9006; SRA 5172; Tamaron

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (n): 4 (Control Reference: 79-5A)
Extreme concentrations: 75–131 ppm
Birds per concentration: 11
Diluent: Corn Oil

Toxicity Summary

LC50: 92 ppm 95% CI: 73–116 ppm Slope: 12.00 SE: 3.40

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
75 ppm	1	5	6	8	2/11
99 ppm	1	4	5	7	6/11

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	10.9	10.1	11.9	10.2	10.7	0/33
99 ppm	4.3	4.9	6.7	5.9	2.9	
Deaths	0	0	0	1	5	6/11
172 ppm	2.9	2.4	1.7	1.4	2.0	
Deaths	0	0	1	7	2	11/11

Methidathion

Principal Ingredient: Phosphoramidothioic acid *S*-[(5-methoxy-2-oxo-1,3,4-thiadiazol-3(2H)-yl)methyl] *O,O*-dimethyl ester; technical grade, 99% AI; CAS 950-37-8

Alternate Names: GS-13005; ENT 27193; Somonil; Supracide; Ultracide

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (n): 4 (Control Reference: 81-7A)
Extreme concentrations: 700–1,595 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 980 ppm 95% CI: 793–1,193 ppm Slope: 4.56 SE: 0.96

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
700 ppm	4	6	6	7	1/15
1,212 ppm	2	3	5	8	12/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 5)	11.0	11.6	10.9	12.1	11.3	0/75
921 ppm	5.9	6.1	6.7	5.8	6.4	
Deaths	0	0	0	1	4	6/15
1,595 ppm	4.4	3.0	1.9	1.5	0.3	
Deaths	0	0	5	5	4	15/15

Methiocarb

Principal Ingredient: 3,5-Dimethyl-4-(methylthio)phenyl methylcarbamate; technical grade, 97% AI; CAS 2032-65-7

Alternate Names: BAY 5024; BAY 37344; DRC 736; ENT 25726; Esurol; H-321; Mesurol; Metmercapturon; SD 9228

Principal Use: Avian repellent (broad spectrum); insecticide (nonsystemic)

Experimental: Concentrations tested (n): 6 (Control Reference: 72-11)
Extreme concentrations: 600–2,400 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 1,342 ppm 95% CI: 1,048–1,719 ppm Slope: 4.53 SE: 1.04

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
600 ppm	-	5	8	-	2/10
2,400 ppm	-	1	6	-	9/10

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 2)	11.1	13.3	12.0	11.5	12.1	1/10
792 ppm	5.6	9.2	8.8	8.3	14.7	
Deaths	0	0	1	0	0	1/10
1,822 ppm	3.3	4.8	3.2	3.9	3.6	
Deaths	0	0	1	2	4	8/10

Methiocarb (Mesurol 50)

Principal Ingredient: 3,5-Dimethyl-4-(methylthio)phenyl methylcarbamate; commercial formulation, 50% AI; CAS 2032-65-7

Alternate Names: BAY 5024; BAY 37344; DRC 736; ENT 25726; H-321; SD 9228

Principal Use: Avian repellent (broad spectrum); insecticide (nonsystemic)

Experimental: Concentrations tested (*n*): 6 (Control Reference: 72-11)
Extreme concentrations: 500–2,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 1,182 ppm 95% CI: 966–1,446 ppm Slope: 6.15 SE: 1.33

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
500 ppm	–	–	–	–	0/10
660 ppm	–	3	3	–	1/10
1,518 ppm	–	2	5	–	6/10

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 2)	11.1	13.3	12.0	11.5	12.1	1/10
660 ppm	4.0	7.2	6.1	7.6	9.8	
Deaths	0	0	1	0	0	1/10
1,518 ppm	3.3	5.4	5.2	4.0	3.1	
Deaths	0	1	2	2	1	6/10

Methomyl

Principal Ingredient: *N*-[[(Methylamino)carbonyl]oxy]ethanimidothioic acid methyl ester; technical grade; CAS 16752-77-5

Alternate Names: Dupont 1179; Lannate; Mesomile; Nudrin; SD 14999; WL 18236

Principal Use: Insecticide; nematocide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 70-11)
Extreme concentrations: 1,075–3,500 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 3,436 ppm 95% CI: 1,992–5,928 ppm Slope: 3.60 SE: 1.30

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
1,444 ppm	-	1	2	-	2/10
3,500 ppm	-	1	4	-	6/11

Methoxychlor

Principal Ingredient: 1,1′-(2,2,2-Trichloroethylidene)-bis[4-methoxybenzene]; technical grade, 89% AI; CAS 72-43-5

Alternate Names: Chemform; Dimethoxy-DT; DMDT; ENT 1716; Marlate; Methoxo; Methoxy-DDT

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 71-3)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 12
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Methylmercury Chloride

Principal Ingredient: CH_3HgCl; reagent grade, 100% AI; CAS 115-09-03

Alternate Names: None

Principal Use: Experimental

Experimental: Concentrations tested (*n*): 5 (Control Reference: 77-6)
Extreme concentrations: 15–60 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 47 ppm	95% CI: 36–60 ppm	Slope: 5.17	SE: 1.23

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
15 ppm	3	–	–	10	0/15
21 ppm	8	11	11	12	1/15
60 ppm	4	7	11	12	11/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	7.4	8.0	8.1	8.1	9.4	1/45
21 ppm	5.8	7.8	8.1	9.6	9.1	
Deaths	0	0	0	0	0	1/15
42 ppm	8.1	8.3	9.3	9.3	8.6	
Deaths	0	0	0	0	1	6/15

Methyl Parathion

Principal Ingredient: Phosphorothioic acid *O,O*-dimethyl *O*-(4-nitrophenyl) ester; technical grade, 80% AI; CAS 298-00-0

Alternate Names: Alkron; Azophos; BAY 11405; BAY E-601; Dalf; Dimethyl parathion; ENT 17292; Folidol M; Metacide; Metaphos; Metron; MPT; Nitrox; Parathion methyl; Parton M; Tekwaisa

Principal Use: Insecticide

Experimental: Concentrations tested (n): 6 (Control Reference: 72-10)
Extreme concentrations: 40–120 ppm
Birds per concentration: 30
Diluent: Corn Oil

Toxicity Summary

LC50: 69 ppm	95% CI: 61–78 ppm	Slope: 4.93	SE: 0.70

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
40 ppm	–	5	6	–	4/30
120 ppm	–	3	6	–	29/31

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 4)	13.1	10.5	10.4	13.7	12.6	0/40
50 ppm	9.2	8.2	7.5	7.2	3.5	

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Deaths	0	0	0	1	2	8/30
96 ppm	7.1	6.0	5.1	3.7	2.1	
Deaths	0	0	1	8	5	21/31

Methyl Trithion

Principal Ingredient: Phosphorodithioic acid *S*-[[(4-chlorophenyl)thio]methyl]*O,O*-dimethyl ester; technical grade, 85% AI; CAS 953-17-3

Alternate Names: ENT 25886; Methyl Carbophenthion; R-1492; Tri-Me

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (*n*): 6 (Control Reference: 72-2B)
Extreme concentrations: 1,500–4,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 3,235 ppm 95% CI: 2,575–4,062 ppm Slope: 5.60 SE: 1.50

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
1,500 ppm	–	–	–	–	0/10
1,825 ppm	–	7	7	–	1/10
4,000 ppm	–	2	7	–	6/10

Mevinophos

Principal Ingredient: 3-[(Dimethoxyphosphinyl)oxy]-2-butenoic acid methyl ester; technical grade; CAS 7786-34-7

Alternate Names: CMPD; Duraphos; Gesfid; Menite; OS-2046; PD 5; Phosdrin; Phosfene

Principal Use: Acaricide; insecticide (contact and systemic)

Experimental: Concentrations tested (*n*): 4 (Control Reference: 72-2A)
Extreme concentrations: 250–574 ppm

Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 254 ppm	95% CI: 136–475 ppm		Slope: 3.89	SE: 1.76	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
250 ppm	-	2	6	-	4/10
574 ppm	-	3	5	-	8/10

Mexacarbate

Principal Ingredient: 4-(Dimethylamino)-3,5-dimethylphenol methylcarbamate (ester); technical grade, 93.3% AI; CAS 315-18-4

Alternate Names: Dowco 139; ENT 25766; NCI-C00544; OMS-47; Zectran

Principal Use: Insecticide; acaricide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 79-8)
Extreme concentrations: 400–1,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 605 ppm	95% CI: 526–697 ppm		Slope: 8.86	SE: 1.60	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
400 ppm	1	1	4	6	2/15
912 ppm	1	1	6	8	14/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 3$)	14.4	11.5	12.8	11.6	11.3	0/45
526 ppm	3.2	5.7	5.0	5.3	5.5	
Deaths	1	0	0	1	0	2/15
912 ppm	2.8	4.8	3.9	2.3	2.0	
Deaths	3	1	2	2	3	14/15

Mirex

Principal Ingredient: 1,1a,2,2,3,3a,4,5,5,5a,5b,6-Dodecachlorooctahydro-1,3,4-methano-1H-cyclobuta [cd]pentalene; technical grade, 98% AI; CAS 2385-85-5

Alternate Names: Dechlorane; ENT 25719; GC 1283

Principal Use: Insecticide (stomach)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 68-11)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm 95% CI: – Slope: – SE: –

Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
	Response chronology (day of occurrence)				
2,236 ppm		No overt signs of toxicity			0/10
5,000 ppm	–	4	7	–	2/10

Molinate

Principal Ingredient: *S*-Ethyl hexahydro-1H-azepine-1-carbothioic acid ester; technical grade, 99% AI; CAS 2212-67-1

Alternate Names: Hydram; Ordiam; R-4572; Yulan

Principal Use: Herbicide (selective)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 81-3)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm 95% CI: – Slope: – SE: –

Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
	Response chronology (day of occurrence)				
2,250 ppm		No overt signs of toxicity			0/10
5,000 ppm	2	–	–	6	0/10

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	12.2	13.7	12.5	13.2	13.2	0/45
5,000 ppm	3.9	7.3	7.8	10.9	14.2	
Deaths	0	0	0	0	0	0/10

Monocrotophos

Principal Ingredient: (*E*)-Phosphoric acid dimethyl[1-methyl-3-(methylamino)-3-oxo-1-propenyl] ester; technical grade, 82% AI; CAS 6923-22-4

Alternate Names: Azodrin; C 1414; Crisodrin; ENT 27129; Monocron; Nuvacron; SD 9129

Principal Use: Acaricide; insecticide (contact and systemic)

Experimental: Concentrations tested (n): 5 (Control Reference: 72-2A)
Extreme concentrations: 1.0–5.3 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 2.4 ppm	95% CI: 1.8–2.9 ppm	Slope: 5.76	SE: 1.32

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
1.0 ppm	-	-	-	-	0/10
1.5 ppm	-	5	5	-	1/10
3.5 ppm	-	4	7	-	7/10

Monuron

Principal Ingredient: *N'*-(4-Chlorophenyl)-*N,N*-dimethylurea; technical grade, 100% AI; CAS 150-68-5

Alternate Names: Chlorfenidim; CMU; Karnex Monuron Herbicide; Monurex; Telvar

Principal Use: Herbicide

Experimental: Concentrations tested (n): 3 (Control Reference: 66-11A)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: –		Slope: –	SE: –	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,250 ppm	–	–	–	–	0/14
2,500 ppm	–	4	4	–	1/14
5,000 ppm	–	4	6	–	3/14

Note: Test age, 12 days

MSMA (Ansar 170 HC)

Principal Ingredient: Methylarsonic acid monosodium salt; technical grade, 100% AI; CAS 2163-80-6

Alternate Names: Ansar 170; Ansar 529; Daconate; Mesamate; Phyban; Weed 108

Principal Use: Herbicide

Experimental: Concentrations tested (*n*): 6 (Control Reference: 80-5A)
Extreme concentrations: 100–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: –		Slope: –	SE: –	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
2,286 ppm	No overt signs of toxicity				0/15
5,000 ppm	2	–	–	4	0/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	12.2	11.0	11.9	11.4	10.6	0/45
478 ppm	12.7	11.5	13.1	11.6	12.9	
Deaths	0	0	0	0	0	0/15
2,286 ppm	8.0	8.3	9.4	10.6	10.7	
Deaths	0	0	0	0	0	0/15

Nabam

Principal Ingredient: 1,2-Ethanediylbiscarbam-odithioic acid disodium salt; technical grade, 93% AI; CAS 142-59-6

Alternate Names: Chem Bam; Dithane D 14; DSE; Nabasan; Parzate

Principal Use: Fungicide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 67-4)
Extreme concentrations: 200–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Note: Test age, 17 days

Naled

Principal Ingredient: Phosphoric acid 1,2-dibromo-2,2-dichloroethyl dimethyl ester; technical grade, 100% AI; CAS 300-76-5

Alternate Names: Alvora; Arthodibrom; Bromchlophos; Bromex; Dibrom; Dibromfos; ENT 24988; RE 4355

Principal Use: Acaricide; insecticide (nonsystemic)

Experimental: Concentrations tested (*n*): 5 (Control Reference: 66-2)
Extreme concentrations: 800–2,880 ppm
Birds per concentration: 20
Diluent: Corn Oil

Toxicity Summary

LC50: 1,328 ppm 95% CI: 1,130–1,561 ppm Slope: 6.55 SE: 1.08

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
800 ppm	–	6	6	–	1/20
2,100 ppm	–	4	8	–	16/20

Note: Test age, 20 days

Nickel Sulfate

Principal Ingredient: Sulfuric acid nickel (2^+)salt(1:1); reagent grade, 100% AI; CAS 7786-81-4

Alternate Names: Nickel (II) Sulfate; Nickelous Sulfate

Principal Use: Industrial

Experimental: Concentrations tested (*n*): 1 (Control Reference: 80-5B)
Extreme concentrations: 5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity at 5,000 ppm					
Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	11.2	11.7	12.3	11.8	12.6	0/45
5,000 ppm	10.5	10.0	10.7	10.7	12.6	
Deaths	0	0	0	0	0	0/15

Ortho 11775

Principal Ingredient: 3-(2-Butyl)phenyl-*N*-methyl-*N*-(phenylsulfenyl) carbamate; technical grade, 100% AI

Alternate Names: None

Principal Use: Insecticide (experimental)

Experimental: Concentrations tested (*n*): 5 (Control Reference: 70-11)
Extreme concentrations: 600–1,819 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 1,332 ppm	95% CI: 1,095–1,620 ppm		Slope: 7.95	SE: 2.00	
Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
792 ppm	–	3	3	–	1/10
1,378 ppm	–	2	5	–	3/10

Oxydemeton-Methyl

Principal Ingredient: Phosphorothioic acid *S*-[2-(ethylsulfinyl)ethyl]*O,O*-dimethyl ester; technical grade, 50% AI; CAS 301-12-2

Alternate Names: BAY 21097; Demeton 0-methyl sulfoxide; Demeton-S-methyl sulfoxide; ENT 24964; Metasystemox; Metasystox R; Metilmercaptofosoksid; R 2176

Principal Use: Insecticide; acaricide (systemic)

Experimental: Concentrations tested (*n*): 6 (Control Reference: 70-11)
Extreme concentrations: 800–3,500 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 1,256 ppm	95% CI: 961-1,642 ppm		Slope: 4.50	SE: 1.07	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
800 ppm	–	7	7	–	1/10
2,606 ppm	–	2	4	–	9/10

Paraquat CL

Principal Ingredient: 1,1′-Dimethyl-4,4′-bipyridinium; technical grade, 29.1% AI; CAS 4685-14-7

Alternate Names: Dextrone X; Dexuron; Gramoxone; Herboxone; Paraquat Dichloride; PP 148; PP 910; Tenaklene

Principal Use: Herbicide (contact) and desiccant

Experimental: Concentrations tested (*n*): 6 (Control Reference: 70-11)
Extreme concentrations: 500–2,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 948 ppm	95% CI: 768-1,168 ppm		Slope: 5.58	SE: 1.18	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
500 ppm	–	6	8	–	2/10
1,516 ppm	–	5	8	–	9/10

Parathion

Principal Ingredient: Phosphorothioic acid *O,O*-diethyl *O*-(4-nitrophenyl) ester; technical grade, 99.5% AI; CAS 56-38-2

Alternate Names: AAT; AATP; AC 3422; Alkron; Alleron; Aphamite; BAY E-605; Bladan F; Corothion; DNTP; Diethyl parathion; ENT 15108; Ethyl parathion; Etilon; Folidol; Fosfono 50; Niran; Nitrosligmine; Orthophos; Panthion; Paramar; Paraphos; Parathene; Parawet; Phoskil; Rhodiatox; SNP; Soprathion; Slathion; Thiophos

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 6 (Control Reference: 79-5B)
Extreme concentrations: 100–300 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 238 ppm | 95% CI: 152–373 ppm | Slope: 4.49 | SE: 1.97

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
100 ppm		No overt signs of toxicity			0/15
125 ppm	1	3	6	7	5/15
300 ppm	2	3	6	7	11/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 3$)	10.7	10.9	10.1	10.5	8.9	0/45
125 ppm	6.0	7.1	6.6	5.1	5.9	
Deaths	0	0	1	0	2	5/15
193 ppm	6.5	7.7	6.1	6.0	6.0	
Deaths	0	0	0	1	1	2/15

Parathion (Parathion 6EC)

Principal Ingredient: Phosphorothioic acid *O,O*-diethyl *O*-(4-nitrophenyl) ester; commercial formulation, 79% AI; CAS 56-38-2

Alternate Names: AC 3422; BAY E-605; ENT 15108; Ethyl parathion

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 6 (Control Reference: 79-5B)
Extreme concentrations: 100–300 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 238 ppm	95% CI: 181–312 ppm	Slope: 6.40	SE: 2.10

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
100 ppm	2	4	4	5	1/15
300 ppm	2	4	6	7	13/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	10.7	10.9	10.1	10.5	8.9	0/45
125 ppm	6.7	8.7	10.1	9.7	8.9	
Deaths	0	0	0	0	0	0/15
193 ppm	6.9	6.5	6.2	6.3	7.2	
Deaths	0	0	0	1	1	2/15

Pentachlorophenol

Principal Ingredient: Pentachlorophenol; technical grade, 40% AI; CAS 87-86-5

Alternate Names: Dowcide 7; EP 20; PCP; Penchlorol; Penta; Pentacon; Sanituko; Santobrite; Santophen

Principal Use: Preharvest defoliant; herbicide; molluscicide

Experimental: Concentrations tested (*n*): 4 (Control Reference: 66-12)
Extreme concentrations: 3,100–6,000 ppm
Birds per concentration: 16
Diluent: Corn Oil

Toxicity Summary

LC50: 5,139 ppm	95% CI: 4,149–6,365 ppm	Slope: 6.83	SE: 1.81

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
3,100 ppm	–	–	–	–	0/16
3,850 ppm	–	4	6	–	6/17
6,000 ppm	–	3	7	–	11/16

Permethrin

Principal Ingredient: (3-Phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2,2-dimethyl cyclopropanecarboxylic acid ester; technical grade, 94% AI; CAS 53645-53-1

Alternate Names: Ambush; BW-21-Z; Ectiban; FMC 33297; FMC 41655; ICI-PP557; Kafil; NRDC 143; Perthrine; Pounce; Pramex; SBP 1513; WL 43479

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 2 (Control Reference: 81-3)
Extreme concentrations: 2,500–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm — No overt signs of toxicity to 5,000 ppm

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	12.2	13.7	12.5	13.2	13.2	0/45
5,000 ppm	10.0	12.1	14.1	13.3	10.1	
Deaths	0	0	0	0	0	0/10

Permethrin (Pounce)

Principal Ingredient: (3-Phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2,2-dimethyl cyclopropanecarboxylic acid ester; commercial formulation, 38% AI; CAS 52645-53-1

Alternate Names: BW-21-Z; FMC 33297; FMC 41655; ICI-PP557; NRDC-143; SBP 1513; WL 43479

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 2 (Control Reference: 81-3)
Extreme concentrations: 2,500–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm — No overt signs of toxicity to 5,000 ppm

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 45)	12.1	13.7	12.5	13.2	13.2	0/45
5,000 ppm	10.0	12.1	14.1	13.3	10.1	
Deaths	0	0	0	0	0	0/10

Phenylthiocarbamide

Principal Ingredient: 1-Phenyl-2-thiourea; technical grade, 98% AI; CAS 103-85-5

Alternate Names: NCI-CO 2017; PTU; U 6324; USAF EK-1569

Principal Use: Herbicide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 81-8)
Extreme concentrations: 1,500–3,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 2,214 ppm | 95% CI: 1,329–7,042 ppm | Slope: 2.31 | SE: 0.80

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
1,500 ppm	2	4	4	7	1/10
3,000 ppm	1	2	6	8	8/10

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	9.9	10.4	10.2	11.3	12.4	0/75
1,783 ppm	3.7	2.9	2.3	2.7	3.2	
Deaths	0	0	0	1	2	3/10
2,522 ppm	3.4	2.4	1.7	2.4	2.5	
Deaths	0	0	0	0	1	4/11

Phenthoate

Principal Ingredient: α-[(Dimethoxyphosphino-thioyl)thio]benzeneacetic acid ethyl ester; technical grade, 91% AI; CAS 2597-03-7

Alternate Names: BAY 33051; Bayer 18510; Cidial; Dimephoate; Elsan; ENT 27386; Fenthoate; L 561; OMS 1075; Papthion

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 72-2B)
Extreme concentrations: 1,900–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 3,518 ppm	95% CI: 2,904–4,262 ppm		Slope: 7.31	SE: 1.76	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,900 ppm	–	–	–	–	0/10
2,428 ppm	–	4	5	–	2/10
5,000 ppm	–	3	5	–	0/10

Phorate

Principal Ingredient: Phosphorodithioic acid *O,O*-diethyl *S*-[(ethylthio) methyl]ester; technical grade, 90% AI; CAS 298-02-02

Alternate Names: AC 3911; ENT 24042; Granutox; Rampart; Thimet; Vegfru

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 82-10)
Extreme concentrations: 250–750 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 575 ppm	95% CI: 483–699 ppm		Slope: 13.93	SE: 1.39	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
250 ppm	2	–	–	7	0/15
437 ppm	1	4	4	7	1/15
575 ppm	1	3	6	7	8/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 3$)	12.1	12.5	10.8	12.7	13.5	0/45
330 ppm	11.0	10.1	11.3	13.0	12.3	
Deaths	0	0	0	0	0	0/15
575 ppm	6.9	6.5	4.8	6.0	7.9	
Deaths	0	0	1	4	2	8/15

Phosalone (Zolone WP)

Principal Ingredient: Phosphorodithioic acid *S*-[(6-chloro-2oxo-4(2H)-benzoxazolyl)methyl] *O,O*-diethyl ester; commercial formulation, 25% AI; CAS 2310-17-0

Alternate Names: RP 11974

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 79-10)
Extreme concentrations: 2,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 4,737 ppm 95% CI: 3,530–6,536 ppm Slope: 5.44 SE: 1.58

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
2,000 ppm	2	4	4	5	1/15
5,000 ppm	1	3	6	7	11/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	12.7	10.6	11.9	11.3	11.8	0/45
2,515 ppm	4.5	4.9	8.0	6.7	7.0	
Deaths	0	0	0	0	0	0/15
3,976 ppm	3.9	3.8	5.3	5.9	7.5	
Deaths	0	0	1	2	2	6/15

Phosfolan

Principal Ingredient: Phosphoromidic acid 1,3-diehiolan-2-ylidene diethyl ester; technical grade, 99% AI; CAS 947-02-4

Alternate Names: AC 47031; Cyolane; ENT 25830

Principal Use: Insecticide (systemic)

Experimental: Concentrations tested (*n*): 5 (Control Reference: 81-10)
Extreme concentrations: 100–300 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: 218 ppm	95% CI: 182–271 ppm		Slope: 3.48	SE: 0.73	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
100 ppm	No overt signs of toxicity				0/14
132 ppm	4	5	5	7	1/14
233 ppm	2	4	8	9	9/14

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	12.2	9.1	11.1	12.3	11.2	0/42
132 ppm	8.8	5.2	6.3	7.1	6.4	
Deaths	0	0	0	0	1	1/14
233 ppm	5.2	3.4	2.8	2.6	2.4	
Deaths	0	0	0	4	3	9/14

Phosmet

Principal Ingredient: Phosphorodithioic acid *S*-[(1,3-dihydro-1,3-dioxo-2H-isoindol-2-yl] *O,O*-dimethyl ester; technical grade, 98.3% AI: CAS 732-11-6

Alternate Names: Decemthion; ENT 25705; Imidan; Phthalophos; Prolate; R-1504

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (n): 5 (Control Reference: 80-7B)
Extreme concentrations: 1,500–4,500 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 2,072 ppm	95% CI: 1,721–2,426 ppm		Slope: 6.39	SE: 1.32	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,500 ppm	3	4	5	6	3/15
3,419 ppm	2	3	5	6	13/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	12.2	11.1	11.5	13.4	12.6	0/45

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
1,974 ppm	8.2	6.7	6.2	6.3	10.0	
Deaths	0	0	1	3	2	6/15
3,419 ppm	4.8	4.1	6.5	4.3	12.0	
Deaths	0	0	6	4	3	13/15

Phosmet (Imidan 12WP)

Principal Ingredient: Phosphorodithioic acid *S*-[(1,3-dihydro-1,3-dioxo-2H-isoindol-2-yl] *O,O*-dimethyl ester; commercial formulation, 12.5% AI; CAS 732-11-6

Alternate Names: ENT 25705; R-1504

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-7B)
Extreme concentrations: 1,500–4,500 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 2,041 ppm	95% CI: 1,492–2,792 ppm	Slope: 3.58	SE: 0.99

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
1,500 ppm	3	4	5	7	3/15
4,500 ppm	1	2	6	7	13/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (*n* = 3)	12.2	11.1	11.5	13.4	12.6	0/45
1,974 ppm	7.0	6.9	7.7	9.9	13.2	
Deaths	0	0	0	6	2	9/15
3,419 ppm	5.7	4.4	4.1	3.9	6.4	
Deaths	0	1	4	4	1	11/15

Phosphamidon

Principal Ingredient: Phosphoric acid 2-chloro-3-(dimethylamino)-1-methyl-3-oxo-1-propenyl dimethyl ester; technical grade, 78% AI; CAS 13171-21-6

Alternate Names: Ciba 570; Dimecron; Dixon; ENT 25515; Merkon; ML-97; OR-1191; Sundaram 1975

Principal Use: Acaricide; insecticide (systemic)

Experimental: Concentrations tested (*n*): 5 (Control Reference: 65-11)
Extreme concentrations: 50–150 ppm
Birds per concentration: 13
Diluent: Propylene Glycol

Toxicity Summary

LC50: 90 ppm	95% CI: 73–111 ppm		Slope: 5.39	SE: 1.22	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
50 ppm	–	4	5	–	2/15
150 ppm	–	2	8	–	11/11

Note: Test age, 17 days

Picloram

Principal Ingredient: 4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid; technical grade, 90.5% AI; CAS 1918-02-1

Alternate Names: Amdon; Borolin; M 3179; Tordon

Principal Use: Herbicide (systemic)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 68-2)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Note: Test age, 7 days

Piperonyl Butoxide

Principal Ingredient: 5-[[2-(2-Butoxyethoxy)ethoxy]methyl]-6-propyl-1,3-benzodioxole; technical grade, 100% AI; CAS 51-03-6

Alternate Names: Butacide; ENT 14250; Ethanol Butoxide; FAC 5273; FMC 5273; NIA 5273; Pyrenone 606

Principal Use: Synergist

Experimental: Concentrations tested (*n*): 2 (Control Reference: 79-3A)
Extreme concentrations: 2,500–5,000 ppm
Birds per concentration: 11
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm 95% CI: – Slope: – SE: –

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
2,500 ppm	2	–	–	3	0/12
5,000 ppm	2	–	–	3	0/10

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	12.2	9.8	10.8	11.2	11.7	0/24
2,500 ppm	11.6	11.5	12.0	13.5	12.0	
Deaths	0	0	0	0	0	0/12
5,000 ppm	10.7	11.8	12.1	13.0	13.6	
Deaths	0	0	0	0	0	0/10

PMA

Principal Ingredient: (Acetato-*O*)phenylmercury; technical grade, 100% AI; CAS 62-38-4

Alternate Names: Agrosan; Cekusil; Gallotox; HL 331; Hong Nien; Liquiphene; Mersolite; Pamisan; Phenmad; PMAS; SC-110; Shimmer-ex

Principal Use: Fungicide; herbicide (selective)

Experimental: Concentrations tested (*n*): 6 (Control Reference: 71-4)
Extreme concentrations: 300–1,500 ppm
Birds per concentration: 10
Diluent: Propylene Glycol

Toxicity Summary

LC50: 614 ppm 95% CI: 496–761 ppm Slope: 5.92 SE: 1.23

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
300 ppm	–	–	–	–	0/10
414 ppm	–	4	6	–	2/10
1,087 ppm	–	2	7	–	9/10

Potassium Dichromate

Principal Ingredient: Chromic acid, dipotassium salt; $Cr_2K_2O_7$; technical grade, 99.9% AI; CAS 7778-50-9

Alternate Names: Dipotassium dichromate; potassium bichromate

Principal Use: Industrial

Experimental: Concentrations tested (*n*): 5 (Control Reference: 81-5)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Propylene Glycol

Toxicity Summary

LC50: 1,249 ppm	95% CI: 656–2,379 ppm	Slope: 2.09	SE: 0.67

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
1,000 ppm	3	3	7	11	5/15
5,000 ppm	1	2	7	8	14/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	11.5	10.6	12.0	11.8	12.2	0/45
1,495 ppm	5.7	3.9	3.3	4.1	5.3	
Deaths	0	0	1	3	3	10/15
3,344 ppm	6.5	3.0	3.9	2.6	6.1	
Deaths	0	0	1	3	3	10/15

Propanil (Stempede 3E)

Principal Ingredient: *N*-(3,4-Dichlorophenyl)propanamide; commercial formulation, 34% AI; CAS 709-98-8

Alternate Names: BAY 30130; FW 734; S 10165

Principal Use: Herbicide (selective and contact)

Experimental: Concentrations tested (n): 6 (Control Reference: 81-8)
Extreme concentrations: 500–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 2,294 ppm 95% CI: 1,718–3,070 ppm Slope: 3.80 SE: 0.77

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
500 ppm	2	–	–	6	0/15
1,990 ppm	1	3	4	8	5/15
3,155 ppm	1	3	6	8	13/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	9.9	10.4	10.2	11.3	12.4	0/45
1,256 ppm	3.4	5.8	8.0	8.7	9.9	
Deaths	0	0	0	0	0	0/15
3,155 ppm	1.7	2.5	1.5	1.2	1.6	
Deaths	0	0	1	7	4	13/15

Propoxur

Principal Ingredient: 2-(1-Methylethoxy)phenol methylcarbamate; technical grade, 95% AI; CAS 114-26-1

Alternate Names: Aprocarb; Bay 9010; Bayer 39007; Bayer B 5122; Baygon; Blattanex; ENT 25671; Sendran; Suncide; Tendex; Unden

Principal Use: Insecticide

Experimental: Concentrations tested (n): 3 (Control Reference: 72-2B)
Extreme concentrations: 500–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm 95% CI: – Slope: – SE: –

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
1,531 ppm	-	-	-	-	0/10
5,000 ppm	-	1	1	-	1/10

Pyrethrins

Principal Ingredient: Extracts of *Chrysanthemum cinerariaefolium* including pyrethrins I and II, cinerins I and II, and jasmolin I and II; technical grade, 20% AI; CAS 8003-34-7

Alternate Names: Insect Powder; Pyrethrum

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 72-3B)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Resmethrin

Principal Ingredient: 2,2-Dimethyl-3-(2-methyl-1-propenyl)-cyclopropane-carboxylic acid [5-(phenylmethyl)-3-furanyl]methyl ester; technical grade, 96% AI; CAS 10453-86-8

Alternate Names: Benzofuroline; Chrysron; NIA 17370; NRDC 104; SBP 1382; Synthrin

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 72-3A)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Resmethrin (SBP 1382, 40%)

Principal Ingredient: 2,2-Dimethyl-3-(2-methyl-1-propenyl)-cyclopropane-carboxylic acid [5-(phenylmethyl)-3-furanyl]methyl ester; commercial formulation, 40% AI; CAS 10453-86-8

Alternate Names: NIA 17370; NRDC 104

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 72-3A)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Ronnel

Principal Ingredient: Phosphorothioic acid *O,O*-dimethyl *O*-(2,4,5-trichlorophenyl)ester; technical grade, 98% AI; CAS 299-84-3

Alternate Names: Blitex; Ectoral; ENT 23284; ET-14; ET-57; Etrolene; Fenchlorphos; Korlan; Nankor; Viozene; Trolene

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (*n*): 2 (Control Reference: 81-3)
Extreme concentrations: 2,500–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm — No overt signs of toxicity to 5,000 ppm

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (*n* = 3)	12.2	13.7	12.5	13.2	13.2	0/45
5,000 ppm	6.8	10.2	11.5	12.9	14.7	
Deaths	0	0	0	0	0	0/15

Rotenone

Principal Ingredient: 1,2,12,12a-Tetrahydro-8,9-dimethoxy-2-(1-methylethenyl)-[1]benzopyrano[3,4-b]furo[2,3-h][1]benzopyran-6[6H]-one; technical grade, 34% AI; CAS 83-79-4

Alternate Names: Chem Fish; Cube; Dactinol; Denis; ENT 133; Nicouline; Noxfish; Prentox; Tubatoxin

Principal Use: Insecticide; piscicide (selective and contact)

Experimental: Concentrations tested (n): 7 (Control Reference: 81-4)
Extreme concentrations: 2,000–10,394 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 5,608 ppm	95% CI: 4,459–7,053 ppm	Slope: 5.78	SE: 1.57

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
2,000 ppm	3	–	–	7	0/15
2,632 ppm	2	5	5	8	1/15
7,897 ppm	1	4	5	8	9/10

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	11.4	11.1	10.6	12.9	12.0	0/35
2,632 ppm	6.8	10.6	10.9	11.8	11.9	
Deaths	0	0	0	0	1	1/15
4,559 ppm	3.5	4.4	6.1	6.5	8.4	
Deaths	0	0	1	2	1	4/15

Silvex

Principal Ingredient: 2-(2,4,5-Trichlorophenoxy)proprionic acid; technical grade, 100% AI; CAS 93-72-1

Alternate Names: Aqua-Vex; Ded-Weed; Fenoprop; Fruitone T; Kuron; Kurosal; Silvi-Rhap; 2,4,5-TP; Weed-B-Gon

Principal Use: Herbicide (hormone type)

Experimental: Concentrations tested (n): 3 (Control Reference: 66-11A)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Note: Test age, 12 days

Simazine

Principal Ingredient: 6-Chloro-*N,N'*-diethyl-1,3,5-triazine-2,4-diamine; technical grade, 99.1% AI; CAS 122-34-9

Alternate Names: Aquazine; Akusan; G-27692; Gesatop; Primatol S; Princep; Simadex; Simanex

Principal Use: Herbicide (selective)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 66-11)
Extreme concentrations: 930–3,721 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: >3,721 ppm	No overt signs of toxicity to 3,721 ppm

Note: Test age, 12 days

Simazine (Simazine 80W)

Principal Ingredient: 6-Chloro-*N,N'*-diethyl-1,3,5-triazine-2,4-diamine; commercial formulation, 80% AI; CAS 122-34-9

Alternate Names: G-27692

Principal Use: Herbicide (selective)

Experimental: Concentrations tested (*n*): 5 (Control Reference: 81-5)
Extreme concentrations: 2,500–10,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >10,000 ppm	95% CI: –	Slope: –	SE: –

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
7,070 ppm	3	–	–	7	0/15
10,000 ppm	2	–	–	7	0/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 3$)	11.5	10.6	12.0	11.8	12.2	0/45

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
3,535 ppm	9.5	10.1	11.3	10.9	11.9	
Deaths	0	0	0	0	0	0/15
7,070 ppm	6.3	6.9	8.1	8.4	8.5	
Deaths	0	0	0	0	0	0/15

Stirofos

Principal Ingredient: Phosphoric acid 2-chloro-1-(2,4,5-trichlorophenyl) ethenyl dimethyl ester; technical grade, 90% AI; CAS 961-11-5

Alternate Names: Appex; Dietreen; Gardona; Rabon; SD 8447; Tetrachlorvinphos

Principal Use: Acaricide; insecticide

Experimental: Concentrations tested (*n*): 3 (Control Reference: 71-9)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Strobane

Principal Ingredient: Polychlorinates of camphene, pinene, and related terpenes; technical grade, 100% AI; CAS 8001-50-1

Alternate Names: Terpene polychlorinates

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 4 (Control Reference: 79-12)
Extreme concentrations: 250–1,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 570 ppm	95% CI: 470–690 ppm	Slope: 8.31	SE: 1.72

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
250 ppm	2	–	–	5	0/15
500 ppm	2	2	5	6	7/15
707 ppm	2	4	6	7	10/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	11.0	11.5	12.8	11.2	11.8	0/45
354 ppm	6.1	4.9	6.2	6.2	7.1	
Deaths	0	0	0	0	0	0/15
707 ppm	4.1	3.7	1.9	2.0	2.1	
Deaths	0	0	0	3	6	10/15

Sulprofos

Principal Ingredient: *O*-Ethyl *O*-[4-(methylthio)phenyl]*S*-propylphosphorodithioate; technical grade, 99% AI; CAS 35400-43-2

Alternate Names: Bay NTN 9306; Bolstar; Helothion

Principal Use: Insecticide

Experimental: Concentrations tested (n): 5 (Control Reference: 81-10)
Extreme concentrations: 250–750 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: 477 ppm	95% CI: 402–571 ppm	Slope: 3.95	SE: 0.78

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
250 ppm	5	–	–	6	0/14
329 ppm	4	6	6	7	1/14
570 ppm	2	3	6	8	9/14

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	12.2	9.1	11.1	12.3	11.2	0/42
329 ppm	7.9	5.3	4.8	8.4	7.4	

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Deaths	0	0	0	0	0	1/14
570 ppm	5.3	2.9	3.0	3.0	2.7	
Deaths	0	0	1	3	2	9/14

Sulprofos (Bolstar EC)

Principal Ingredient: *O*-Ethyl *O*-[4-(methylthio)phenyl]*S*-propyl phosphorodithioate; commercial formulation 64% AI; CAS 35400-43-2

Alternate Names: Bay NTN 9306

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 81-10)
Extreme concentrations: 250–750 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: 367 ppm	95% CI: 305–436 ppm	Slope: 3.99	SE: 0.81

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
250 ppm	2	–	–	6	0/15
329 ppm	2	4	6	7	5/14
570 ppm	1	4	6	7	12/14

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control ($n = 3$)	12.2	9.1	11.1	12.3	11.2	0/42
329 ppm	6.9	4.6	4.8	5.3	4.5	
Deaths	0	0	0	1	3	5/14
570 ppm	4.6	2.7	2.1	1.5	1.8	
Deaths	0	0	0	6	5	12/14

2,4,5-T, Butoxyethanol Ester

Principal Ingredient: (2,4,5-Trichlorophenoxy)acetic acid 2-butaoxyethyl ester; technical grade, 69.5% AI; CAS 2545-59-7

Alternate Names: Bladex H; Hormoslyr 500 T; 2,4,5-T; Trinoxol

Principal Use: Herbicide (selective)

Experimental: Concentrations tested (*n*): 3 (Control Reference: 66-12)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 16
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: –	Slope: –	SE: –		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
2,500 ppm	–	3	3	–	1/16
5,000 ppm	–	5	5	–	2/16

TDE

Principal Ingredient: 1,1′-(2,2-Dichloroethylidene)bis[4-chlorobenzene]; technical grade, 100% AI; CAS 72-54-8

Alternate Names: DDD; ENT 4225; ME 1700; Rhothane

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-7B)
Extreme concentrations: 1,500–4,500 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 2,636 ppm	95% CI: 2,225–3,122 ppm	Slope: 6.70	SE: 1.27		
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
1,500 ppm	No overt signs of toxicity				0/15
1,974 ppm	3	3	8	9	4/15
4,500 ppm	2	2	5	6	14/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	12.2	11.1	11.5	13.4	12.6	0/45
1,974 ppm	10.9	8.8	9.4	14.4	15.5	
Deaths	0	0	2	1	0	4/15
3,419 ppm	9.5	8.5	11.2	17.1	19.0	
Deaths	0	4	6	1	0	11/15

Temephos

Principal Ingredient: Phosphorothioic acid *O,O'*-(thiodi-4,1-phenylene)*O,O,O',O'*-tetramethyl ester; technical grade, 86.8% AI; CAS 3383-96-8

Alternate Names: Abate; Abathion; AC 52160; Biothion; Difenphos; Ecopro; ENT 27165; Nimitox

Principal Use: Insecticide

Experimental: Concentrations tested (n): 5 (Control Reference: 84-8)
Extreme concentrations: 80–400 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 242 ppm 95% CI: 183–322 ppm Slope: 3.60 SE: 0.78

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
119 ppm	2	–	–	7	0/15
179 ppm	1	4	5	8	3/15
267 ppm	2	4	6	7	8/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 2)	11.4	10.7	11.6	12.5	12.6	0/30
119 ppm	10.3	6.8	8.0	8.7	9.2	
Deaths	0	0	0	0	0	0/15
267 ppm	5.5	5.4	3.0	2.9	2.4	
Deaths	0	0	0	1	3	8/15

Temephos (Abate)

Principal Ingredient: Phosphorothioic acid *O,O'*-(thiodi-4,1-phenylene)*O,O,O',O'*-tetramethyl ester; commercial formulation, 44.7% AI; CAS 3383-96-8

Alternate Names: AC 52160; ENT 2716

Principal Use: Insecticide

Experimental: Concentrations tested (n): 5 (Control Reference: 81-7B)
Extreme concentrations: 200–600 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 288 ppm 95% CI: 249–333 ppm Slope: 5.87 SE: 1.30

	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
200 ppm	4	–	–	7	0/15
260 ppm	2	5	6	7	5/15
340 ppm	1	3	6	8	12/15

	Food consumption (grams per bird-day)					
Dietary concentration	Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	10.8	11.2	12.2	12.5	12.7	0/45
260 ppm	6.8	4.1	4.8	4.8	5.8	
Deaths	0	0	0	0	3	5/15
450 ppm	4.3	1.8	1.4	2.9	3.0	
Deaths	1	1	4	5	4	15/15

Tepp

Principal Ingredient: Diphosphoric acid tetraethyl ester; technical grade, 99% AI; CAS 107-49-3

Alternate Names: Bladan; ENT 18771; Fosvex; Killax; Kilmite 40; Mortopal; Mifos T; Tetron; Vapotone

Principal Use: Insecticide

Experimental: Concentrations tested (n): 5 (Control Reference: 81-5)
Extreme concentrations: 655–1,950 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 1,517 ppm 95% CI: 1,258–1,828 ppm Slope: 2.35 SE: 2.49

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
855 ppm	3	–	–	7	0/15
1,125 ppm	1	1	1	8	1/15
1,950 ppm	1	3	6	7	8/10

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 45)	11.5	10.6	12.0	11.8	12.2	0/45
855 ppm	6.6	8.5	8.9	9.9	10.9	
Deaths	0	0	0	0	0	0/15
1,481 ppm	2.9	3.5	6.6	8.1	8.7	
Deaths	0	0	1	2	3	6/10

Tepp (Tepp 40)

Principal Ingredient: Diphosphoric acid tetraethyl ester; commercial formulation, 40% AI; CAS 107-49-3

Alternate Names: ENT 18771

Principal Use: Insecticide

Experimental: Concentrations tested (n): 6 (Control Reference: 79-5)
Extreme concentrations: 250–900 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 403 ppm	95% CI: 308–529 ppm	Slope: 6.63	SE: 1.17

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
250 ppm	2	4	4	5	1/15
697 ppm	1	1	6	7	14/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	10.7	10.9	10.1	10.5	8.9	0/45
323 ppm	1.2	2.3	2.9	2.1	1.2	
Deaths	0	0	0	2	0	6/15
539 ppm	1.5	4.0	4.2	4.3	5.5	
Deaths	0	0	2	4	5	14/15

Terbufos

Principal Ingredient: Phosphorodithioic acid S-[[(1,1-dimethylethyl)thio]methyl] *O,O*-diethyl ester; technical grade, 99% AI; CAS 13071-79-9

Alternate Names: AC 92100; Counter

Principal Use: Insecticide; nematocide (soil)

Experimental: Concentrations tested (*n*): 5 (Control Reference: 81-4)
Extreme concentrations: 150–450 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 284 ppm 95% CI: 239–342 ppm Slope: 7.86 SE: 1.48

	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
150 ppm	3	–	–	7	0/15
450 ppm	2	3	6	7	14/15

	Food consumption (grams per bird-day)					
Dietary concentration	Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 3$)	11.4	11.1	10.6	12.9	12.0	0/35
197 ppm	7.7	9.0	8.7	9.1	9.9	
Deaths	0	0	0	0	1	1/14
342 ppm	5.1	5.2	5.7	6.7	7.6	
Deaths	0	0	1	4	3	10/15

Terbufos (Counter 15G)

Principal Ingredient: Phosphorodithioic acid *S*-[[1,1-dimethylethyl)thio]methyl]*O,O*-diethyl ester; commercial formulation, 15% AI; CAS 13071-79-9

Alternate Names: AC 92100

Principal Use: Insecticide; nematocide (soil)

Experimental: Concentrations tested (*n*): 6 (Control Reference: 79-10)
Extreme concentrations: 100–500 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 225 ppm	95% CI: 194–265 ppm		Slope: 9.24	SE: 1.86	
	Response chronology (day of occurrence)				
Dietary concentration	Onset of signs	First death	Last death	Remission of signs	Total mortality
100 ppm		No overt signs of toxicity			0/15
190 ppm	4	5	6	7	4/15
362 ppm	2	3	6	7	14/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	12.7	10.6	11.9	11.3	11.8	0/45
190 ppm	9.0	6.1	6.6	4.1	3.9	
Deaths	0	0	0	0	1	4/15
362 ppm	5.7	4.1	3.0	1.0	1.0	
Deaths	0	0	1	1	7	14/15

Tetradifon

Principal Ingredient: 1,2,4-Trichloro-5-[(4-chlorophenyl)-sulfonyl]benzene; technical grade, 97.9% AI; CAS 116-29-0

Alternate Names: Akaritox; Duphar; ENT 23737; FMC 5488; Mition; NIA 5488; Polacaritox; Tedion

Principal Use: Acaricide

Experimental: Concentrations tested (n): 3 (Control Reference: 66-11B)
Extreme concentrations: 1,250–5,000 ppm
Birds per concentration: 14
Diluent: Corn Oil

Toxicity Summary

LC50: > 5,000 ppm	No overt signs of toxicity to 5,000 ppm

Note: Test age, 12 days

Thionazin

Principal Ingredient: Phosphorodithioic acid *O,O*-diethyl *O*-pyrazinyl ester; technical grade, 82.6% AI; CAS 297-97-2

Alternate Names: AC 18133; Cynem; EN 18133; ENT 25580; Nemafos; NCI-CO 2971; Zinophos

Principal Use: Insecticide; nematocide

Experimental: Concentrations tested (n): 5 (Control Reference: 76-4)
Extreme concentrations: 40–110 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 62 ppm	95% CI: 46–80 ppm	Slope: 6.53	SE: 1.58

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
40 ppm	-	1	5	-	2/10
85 ppm	-	3	6	-	8/10

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 5)	10.2	8.0	9.4	10.7	9.4	0/50
51 ppm	6.6	4.3	4.7	7.3	3.6	
Deaths	0	0	0	0	1	2/10
85 ppm	4.1	2.2	1.8	2.3	1.2	
Deaths	0	0	1	3	2	8/10

Thiram

Principal Ingredient: Tetramethylthioperoxydicarbonic diamide; technical grade, 95% AI; CAS 137-26-8

Alternate Names: Arasan; Delsan; ENT 987; Fermide 850; Fernasan; Mercuram; Nomersam; Pomarsol; Puralin; Tersan; Tetrapon; Thimer; Thiosan; Thiuramyl; Thiotex; Thirame; Thirasan; Thiurad; Thylate; Tirampa; TMTD; Trametan; Tuads; Tulisan; Vanicide TM-95

Principal Use: Fungicide; seed protectant and animal repellent

Experimental: Concentrations tested (n): 3 (Control Reference: 70-10)
Extreme concentrations: 2,000–5,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	No overt signs of toxicity to 5,000 ppm

Toxaphene

Principal Ingredient: Chlorinated camphene, 65-67% chlorine; technical grade, 100% AI; CAS 8001-35-2

Alternate Names: Alltox; Attac; Chlorinated camphene; Clor Chem T-590; Geniphene; Hercules 3956; M 5055; Penphene; Phenacide; Phenatox; Strobane-T; Toxakil; Toxon 63

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-1)
Extreme concentrations: 250–1,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 529 ppm 95% CI: 436–641 ppm Slope: 6.29 SE: 1.17

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
250 ppm	2	5	5	6	1/15
707 ppm	1	2	6	7	10/15

Toxaphene (Toxaphene EC)

Principal Ingredient: Chlorinated camphene, 65–70% chlorine; commercial formulation, 59% AI; CAS 8001-35-2

Alternate Names: Hercules 3956; M 5055

Principal Use: Insecticide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 79-12)
Extreme concentrations: 250–1,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 565 ppm 95% CI: 470–679 ppm Slope: 6.85 SE: 1.30

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
250 ppm	5	–	–	6	0/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
354 ppm	3	4	5	6		2/15
707 ppm	2	4	6	7		10/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	11.0	11.5	12.8	11.2	11.8	0/45
354 ppm	5.6	4.9	5.2	7.0	8.4	
Deaths	0	0	0	1	1	2/15
707 ppm	2.8	1.8	1.4	1.5	1.7	
Deaths	0	0	0	6	3	10/15

Trichlorfon

Principal Ingredient: (2,2,2-Trichloro-1-hydroxyethyl)-phosphonic acid dimethyl ester; technical grade, 98% AI; CAS 52-68-6

Alternate Names: Agroforotox; BAY 15922; BAY L-13/59; Bovinox; Cekufon; Chlorofos; Danex; Dipterex; Diptetes; Dylox; ENT 19763; Metrifonate; Neguvon; Proxol; Trinex; Tugon

Principal Use: Insecticide

Experimental: Concentrations tested (n): 6 (Control Reference: 69-1)
Extreme concentrations: 1,000–4,000 ppm
Birds per concentration: 10
Diluent: Corn Oil

Toxicity Summary

LC50: 1,899 ppm — 95% CI: 1,510–2,388 ppm — Slope: 4.92 — SE: 1.07

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
1,000 ppm	–	5	5	–	1/11
4,000 ppm	–	2	5	–	9/10

Note: Test age, 12 days

Trifluralin (Treflan EC)

Principal Ingredient: 2,6-Dinitro-*N,N*-dipropyl-4-(trifluoromethyl) benzenamine; commercial formulation, 45% AI; CAS 1582-09-8

Alternate Names: Lilly 36352; NCI-COO 442

Principal Use: Herbicide (selective preemergence)

Experimental: Concentrations tested (*n*): 2 (Control Reference: 81-7B)
Extreme concentrations: 2,500–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm	95% CI: -	Slope: -	SE: -

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
2,500 ppm		No overt signs of toxicity			0/15
5,000 ppm	5	-	-	6	0/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (*n* = 3)	9.9	10.0	10.8	11.8	11.5	0/45
2,500 ppm	7.3	8.9	9.8	10.6	10.3	
Deaths	0	0	0	0	0	0/15
5,000 ppm	4.4	6.9	9.7	11.3	10.8	
Deaths	0	0	0	0	0	0/15

Vanadium Pentoxide

Principal Ingredient: Vanadium oxide; reagent grade, 100% AI; CAS 1314-62-1

Alternate Names: CI 77938; Divanadium pentoxide; Vanadic anhydride

Principal Use: Industrial

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-5B)
Extreme concentrations: 500–2,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 958 ppm	95% CI: 747–1,229 ppm	Slope: 4.24	SE: 0.87

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
500 ppm	3	6	6	7	3/15

Dietary concentration	Response chronology (day of occurrence) Onset of signs	First death	Last death	Remission of signs	Total mortality
2,000 ppm	2	3	6	7	14/15

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	11.2	11.7	12.3	11.8	12.6	0/45
707 ppm	9.2	9.2	13.5	10.6	15.9	
Deaths	0	0	0	1	2	3/15
1,414 ppm	6.6	7.9	10.7	7.8	8.5	
Deaths	0	0	4	4	3	12/15

Xylene

Principal Ingredient: Dimethylbenzene; reagent grade, 100% AI; CAS 1330-20-7

Alternate Names: Xylol

Principal Use: Solvent

Experimental: Concentrations tested (n): 3 (Control Reference: 80-7A)
Extreme concentrations: 10,000–20,000 ppm
Birds per concentration: 15
Diluent: None

Toxicity Summary

LC50: >20,000 ppm	No overt signs of toxicity to 5,000 ppm

Dietary concentration	Food consumption (grams per bird-day) Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control (n = 3)	12.2	12.6	10.4	12.5	12.2	0/45
10,000 ppm	12.1	12.9	11.5	12.9	12.2	
Deaths	0	0	0	0	0	0/16

Zinc Phosphide

Principal Ingredient: Zinc phosphide; technical grade, 94% AI; CAS 1314-84-7

Alternate Names: Kilrat; Mous-con; Phosvin; Rumetan; Zinc-Tox; ZP

Principal Use: Rodenticide

Experimental: Concentrations tested (*n*): 6 (Control Reference: 79-12)
Extreme concentrations: 600–2,100 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 960 ppm | 95% CI: 824–1,119 ppm | Slope: 6.51 | SE: 1.15

Dietary concentration	Response chronology (day of occurrence): Onset of signs	First death	Last death	Remission of signs	Total mortality
600 ppm	2	3	3	4	1/15
1,634 ppm	1	1	4	5	14/15

Dietary concentration	Food consumption (grams per bird-day): Day 1	Day 2	Day 3	Day 4	Day 5	Total mortality
Control ($n = 3$)	11.0	11.5	12.8	11.2	11.8	0/45
600 ppm	9.3	8.8	12.8	11.4	9.1	
Deaths	0	0	1	0	0	1/15
990 ppm	7.1	5.5	8.4	8.1	11.0	
Deaths	1	2	2	3	0	8/15

Zineb

Principal Ingredient: [[1,2-Ethanediylbis[carbamodithioato]]-(2-)]zinc; technical grade, 85% AI; CAS 12122-67-7

Alternate Names: Aspor; Dipher; Dithane Z-78; ENT 14874; Hexathane; Kypzin; Lonacol; Parzate; Polyram Z; Tiezene; Tritoftoral; Zebtox; Zidan; Zinosan

Principal Use: Fungicide

Experimental: Concentrations tested (*n*): 5 (Control Reference: 80-7A)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: >5,000 ppm — No overt signs of toxicity to 5,000 ppm

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	12.2	12.6	10.4	12.5	12.2	0/45
1,495 ppm	12.7	13.0	11.3	14.1	12.9	
Deaths	0	0	0	0	0	0/15
3,344 ppm	13.2	13.3	11.9	14.2	12.5	
Deaths	0	0	0	0	0	0/15

Ziram

Principal Ingredient: Bis(dimethylcarbamodithioato-*S,S'*)zinc; technical grade, 100% AI; CAS 137-30-4

Alternate Names: Carbazinc; Corozate; Cuman; Fuclasin Ultra; Fungostop; Methyl cymate; Methesan; Mezene; Parmarsol; Tricarbamix Z; Zerlate; Vancide; Zincmate; Ziride; Zitox

Principal Use: Fungicide

Experimental: Concentrations tested (n): 5 (Control Reference: 80-7A)
Extreme concentrations: 1,000–5,000 ppm
Birds per concentration: 15
Diluent: Corn Oil

Toxicity Summary

LC50: 3,346 ppm 95% CI: 2,664–4,430 ppm Slope: 6.04 SE: 1.35

Dietary concentration	Response chronology (day of occurrence)				Total mortality
	Onset of signs	First death	Last death	Remission of signs	
1,000 ppm	3	–	–	7	0/15
2,236 ppm	1	4	4	7	2/15
5,000 ppm	2	2	6	7	12/15

Dietary concentration	Food consumption (grams per bird-day)					Total mortality
	Day 1	Day 2	Day 3	Day 4	Day 5	
Control (n = 3)	12.2	12.6	10.4	12.5	12.2	0/45
1,495 ppm	8.2	6.7	6.7	5.5	6.5	
Deaths	0	0	0	0	0	0/15
3,344 ppm	5.3	3.0	3.1	3.0	4.3	
Deaths	0	1	1	3	0	8/15

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APPENDIX A

Toxicity Statistics: Toxicologic Rationale, Dose–Response Curve, and Probit Analysis

The principal statistical reference point in these dietary studies is the median lethal concentration (LC50), as determined by probit analysis. The LC50, as used under our procedure, is ppm toxicant (based on active ingredient) in an ad libitum diet for 5 days which is calculated to produce 50% mortality during the 5 days of treatment and a period of at least 3 days posttreatment.

Rationale

The response of an organism to toxic insult may be absolute, e.g., an endpoint such as death, or, depending on the severity of challenge, graded. The degree of response is a function of concentration of toxic substance penetrating the target system and remaining in contact with the system for sufficient time to elicit change. It is assumed that the concentration of substance penetrating the target is proportional to the dosage of substance received by the organism. However, because various biological, chemical, and physical factors influence translocation and penetration of foreign substances in an organism, and because individuals may not be equally sensitive to a given chemical, response will vary within a homogeneous population. This natural diversity is approximated by a normal Gaussian distribution; about one-third of the population is divided equally between hyper- and hyposensitive individuals. But when individual responses are described quantitatively, the frequency–response curve tends to be skewed toward hypersensitive respondents because their arithmetic range of tolerance is consistently smaller than for hyposensitive individuals (Finney 1971). Because hyper- and hyposensitive individuals are equally represented within a homogeneous population, it is possible to draw a series of randomly selected groups from the population and generate a gradation of dosage-related responses between groups, provided dosages of test substance are properly spaced. Responses can be quantified as degree of change over time posttreatment or as qualitative changes based on a preselected endpoint. The endpoint must be a clearly defined all or nothing (binary) response such as alive versus dead or normal versus abnormal. All or nothing responses, referred to as quantal responses, can be evaluated quantitatively because the percentage of respondents increases as dosage is increased. The concept of quantal response and details of factors responsible for diversity of response among individuals have been well documented (Albert 1965; Casarett 1975; Finney 1964, 1971; and Loomis 1978).

Dose–response Curve

The percentage of respondents in a quantal response study is related to the composite tolerances of the population. Therefore, the pattern of response to graded dosages of toxicant is analogous to the graded tolerances of individual specimens and gives a frequency distribution skewed toward hypersensitivity and an asymmetric sigmoid curve when percentage response is plotted against dosage. The resultant dose–response curve is quite steep from its origin to the inflection point (≃30% response) and then becomes more gradual until virtually asymptotic. Because skewed data are difficult to plot, interpolate, and analyze statistically, it is usual to arrange test dosages logarithmically to normalize the distribution of responses (Finney 1978). Normalization gives a symmetric sigmoid dose–response curve with its inflection point at the exact midpoint, i.e., 50% response level.

The symmetric dose–response curve represents a cumulative normal distribution of log-tolerances. Steepness of the curve is similar for many substances, but it may become significantly more steep or shallow depending on the substance's mechanism of action, route of exposure, response of interest, or shift of tolerance in the population. Thus, the dose–response curve has interpretive value beyond extrapolation of probable dose–response coordinates. However, the linear portion of the curve is the more useful and is limited to a range of only 30 to 35 percentage units on either side of the 50% response level. The entire curve can be made linear by transforming the percentage response for log-dosage to probits.

The probit transformation is based on a log-normal distribution of responses, with the mean being equal to 50% response and zero deviation. The standard deviation of percent response is the basis for a series of normal equivalent deviates (NED or normit) extending both directions from zero. The scale of normits in log-dosage is linear. Therefore, percentage response as standard deviations is linear with log-dose and provides a basis for predicting response to a given toxic challenge. Because one-half of the scale of normits is negative, a constant of 5 is added to all normits to make the full scale positive and the converted units are called probits or probability units. Thus, 50% response, zero deviation, and probit 5 are equivalent, as are 16% response, -1 standard deviation or normit, and probit 4. Tables for transforming percentages to probits were devised by Fisher and Yates (1963) and can be found in statistical texts such as Finney (1964, 1971).

In essence, the purpose of probit transormation is to adjust response data to an assumed normal population distribution and to give a measure of whether the test population was normally distributed (Cesarett 1975). The probit transformation also provides a shortcut procedure for estimating various response levels by graphing observed percentage of respondents against log-dosage on log-probability paper and estimating desired dose–response coordinants from an eye-fitted straight line (Litchfield and Wilcoxon 1949).

Probit Analysis

Probit analysis is a method of calculating a maximum likelihood fit of a probit-log-dose line by an iterative weighted regression anaysis. The analysis provides critical interpretive statistics such as the median effective dose, i.e., LC50, and its 95% confidence interval, and the slops of the weighted linear regression of probits on log-dose and its standard deviation. In the regression analysis each response point is weighted by the product of the number of subjects in the test group and a precalculated weighting coefficient (Bliss 1935) for the observed percent response. The weighting coefficient descends symmetrically as responses deviate, plus or minus, from 50%, or probit 5. After the regression line has been arithmetically fitted, the deviations between observed and expected response levels are tested for heterogeneity by a Pearson chi-square analysis. If the summed chi-square exceeds $P \leq 0.05$, the fit of the probit line is accepted; if $P > 0.05$, the data are rejected as heterogeneous. Apparent heterogeneity may be due to inadequate arrangement of dosages, number of subjects per test group, chance alone, or may represent a real curvilinear response. A systematic computation of probit analysis, including calculation of all relevant toxicity statistics, is presented by Finney (1971).

APPENDIX B

Toxicity Statistics: Toxicity Comparisons Between Compounds, Calculation of Alternative Response Levels, and Adjustment of Control Mortality

Toxicity Comparisons Between Compounds

Comparison of toxicity between chemicals is possible with data generated by probit analysis provided the level of tolerance of test populations is the same and probit regression lines are parallel (Finney 1971; Heath et al. 1972). The level of tolerance can be assumed comparable if the test subjects are drawn randomly from a single population and are tested concurrently in a completely randomized experiment. Probit regression lines are assumed to be parallel if they are not shown to be statistically different at $P = 0.05$. If the lines are not parallel, toxicity relations between chemicals will vary with dosage. Probit regression lines can be tested for parallelism by two-tailed t-test:

$$t = (b_1 - b_2) / \sqrt{s_1^2 + s_2^2}$$

The quantities b_1 and b_2 and s_1 and s_2 are the estimated slopes and standard errors for the chemicals.

Because most tests were not conducted concurrently with subjects drawn from the same population, it has been recommended that comparisons between LC50's be made through the positive control by the following procedure (Heath et al. 1972):

1) Compute the "standard ratio" (SR) between the LC50 for each compound in relation to the LC50 for its concurrent standard (usually dieldrin) as found in Appendix C, e.g., "Compound X" divided by dieldrin. Dicrotophos may be the standard of choice if anticholinesterases are compared.

2) Repeat the procedure for "Compound Y."

3) Compute the toxicity ratio of "Compound X" to "Compound Y" by dividing the SR of Compound Y by the SR of Compound X. For example, if dieldrin is 4 times as toxic as Compound X ($SR_1 = 4$) and 6 times as toxic as Compound Y ($SR_2 = 6$), then Compound X is 1.5 times as toxic as Compound Y (i.e., $SR_2/SR_1 = 6/4 = 1.5$). An algebraic argument for the procedure was previously presented (Heath et al. 1972). The calculation of confidence limits for potency ratios require more data than could reasonably be included in the present report.

Calculation of Alternative Response Levels

Any desired response level can be estimated from a plotted probit regression line, or more exactly, can be calculated if the median response level and slope are known. The calculation of a given response level requires transformation of the median response level (LC) to its probit. If the LC50 equals probit 5 and b equals the slope, then

$$\log LC_k = \log LC50 + (\text{probit } k - \text{probit } 5)/b.$$

The antilog of LC_k is the desired estimate.

Although lethal concentrations other than the LC50 may be useful. Estimates of this type should be derived from especially designed experiments because extrapolation from a standard probit regression line can be misleading if the true regresson equation has some curvature (Finney 1971).

Adjustment of Control Mortality

For experiments where control mortality occurs, response at each test concentration of all concurrent tests may be adjusted according to Abbott's formula (Finney 1971):

$$A = \frac{E - C}{100\% - C} \times 100.$$

The quantities A, E, and C are the corrected percent mortality, percent mortality in an experimental group, and percent mortality in controls, respectively.

APPENDIX C

Control Reference Summary of 5-Day Dietary Toxicity Trials with 14-day-old Coturnix, 1965–1981

Ref. no.	Diluent[a]		Dieldrin[b]			Dicrotophos[b]		
	n	R	LC50	95% CI	Slope (SE)	LC50	95% CI	Slope (SE)
65–11	78	0	76	62–91	5.74 (1.22)	–	–	–
65–12	90	0	49	40–60	4.44 (0.84)	–	–	–
66–3	120	0	57	50–65	7.76 (1.17)	–	–	–
66–10	72	2	55	46–67	5.57 (1.08)	–	–	–
66–11A	86	0	58	49–69	6.21 (1.11)	–	–	–
66–11B	50	0	54	45–64	6.99 (1.26)	–	–	–
66–12	96	1	59	51–68	8.41 (1.58)	–	–	–
67–3	78	1	64	52–78	7.68 (1.46)	–	–	–
67–4	45	0	–	–	–	–	–	–
68–2	50	0	56	47–70	5.48 (1.17)	–	–	–
68–11	30	0	–	–	–	–	–	–
69–1	50	0	53	41–68	4.38 (1.00)	–	–	–
69–2	50	0	–	–	–	–	–	–
70–3	79	0	57	49–66	8.22 (1.73)	–	–	–
70–10	60	0	50	42–59	7.57 (1.86)	–	–	–
70–11	60	1	52	44–62	7.14 (1.51)	–	–	–
71–4	60	0	58	50–67	8.69 (1.82)	–	–	–
72–2A	60	0	54	44–66	5.59 (1.27)	–	–	–
72–2B	60	0	58	43–77	8.48 (3.77)	–	–	–
72–3A	61	1	69	59–80	9.38 (2.28)	–	–	–
72–3B	60	0	65	53–80	5.49 (1.37)	–	–	–
72–10	60	0	53	46–60	5.08 (0.83)	51	45–58	5.30 (0.65)
72–11	57	1	56	49–63	9.98 (2.17)	33	25–42	6.88 (2.00)
73–3	60	3	73	61–88	6.34 (1.56)	38	29–49	5.23 (1.36)
79–3	50	0	54	47–63	9.35 (2.26)	34	30–40	11.07 (3.39)
79–5A	33	0	52	46–58	12.45 (2.77)	31	27–36	7.89 (1.54)
79–5B	75	0	61	55–70	11.23 (2.12)	35	30–40	6.98 (1.21)
79–6	75	0	51	46–59	8.65 (1.64)	24	20–30	6.63 (1.51)
79–7	75	0	60	51–70	7.33 (1.45)	40	32–50	6.93 (1.84)
79–8	90	0	54	46–63	6.86 (1.37)	32	27–38	9.43 (2.23)
79–10	75	0	68	55–85	5.54 (1.33)	34	29–39	8.77 (1.62)
79–11	60	0	60	51–70	8.34 (1.61)	29	21–39	9.25 (1.92)
79–12	75	0	58	51–67	9.46 (1.80)	30	25–36	6.29 (1.28)
80–1	60	0	49	42–59	7.01 (1.40)	34	29–40	6.97 (1.30)
80–2	75	0	57	49–65	9.63 (1.90)	49	33–36	7.12 (1.35)
80–3	75	0	62	55–70	11.32 (2.42)	37	32–42	9.87 (1.93)
80–5A	75	0	67	57–78	7.20 (1.37)	40	33–49	5.76 (1.18)
80–5B	75	0	65	55–78	6.40 (1.24)	39	33–42	6.41 (1.25)
80–6	90	0	81	68–97	7.11 (1.53)	48	39–59	5.90 (1.34)
80–7A	75	0	75	65–87	8.49 (1.71)	44	36–55	5.38 (1.18)
80–7B	75	0	57	52–63	6.76 (0.74)	39	34–44	4.86 (0.61)

Ref. no.	Diluent[a]		Dieldrin[b]				Dicrotophos[b]			
	n	R	LC50	95% CI	Slope	(SE)	LC50	95% CI	Slope	(SE)
81-3	75	0	–	–	–		–	–	–	
81-4	57	0	68	55–89	5.46	(1.13)	45	36–56	5.51	(1.17)
81-5	45	0	76	64–91	8.50	(1.84)	48	34–66	9.12	(1.05)
81-7A	45	0	53	44–62	9.53	(1.86)	41	37–45	10.59	(2.16)
81-7B	45	0	66	60–74	9.12	(1.24)	35	31–44	5.41	(1.52)
81-7C	45	0	56	50–61	8.75	(1.07)	32	27-37	5.77	(0.90)
81-8	45	0	50	41–61	10.63	(2.21)	34	28–40	5.98	(0.78)
81-10	42	0	–	–	–		29	24–36	7.77	(1.95)
84-8	30	0	65	54–78	7.46	(1.40)	39	31–48	4.10	(0.85)

[a] Corn oil diluent added to diet at the ratio of 2:98, by weight (*n* = number of test birds; R = number of respondents, i.e., deaths).
[b] Toxicity statistics: LC50 = parts per million of the comound in a 5-day ad libitum diet estimated to kill 50 % of the test population; 95% CI = confidence interval; and Slope = probit on log concentration.

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