New

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Kelthane Registration Standards

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Attached is a revised copy of EEB's Kelthane Dissiplanary Summary and Data Gaps for fish, aquatic invertebrates (marine and freshwater), and birds.

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ECOLOGICAL EFFECTS

Ecological Effects Profile Manufacturing - Use Kelthane

Avian dietary studies conducted with technical kelthane show that this miticide is only slightly toxic to non-target avian species. Comparative dietary toxicity studies show that LC_{50} values range from 1237 to 3100 ppm for upland game birds (bobwhite, ring-necked pheasants, japanese quail), 1651 ppm for waterfowl (mallard), and greater than 100 ppm for passerines (grackels). Prolonged exposure to low levels (5 to 10 ppm) of technical Kelthane had no significant effects on the reproductive behavior of mallard ducks.

Technical kelthane is highly toxic to fish. Acute 96-hour LC_{50} values determined for warmwater fish (channel catfish, bluegill sunfish, fathead minnow) range from 0.31 to 0.51 ppm. A 74.4 % technical was demonstrated to be very highly toxic to two species of coldwater fish (lake trout LC_{50}=0.086 ppm; cutthroat trout LC_{50}= 0.053 ppm). Chronic toxicity studies have established significant effect (0.039 ppm) and no effect (0.019 ppm) levels for technical kelthane on developing (egg/larvae) fathead minnows.

There is sufficient information to characterize technical kelthane's acute toxicity to freshwater invertebrates. The 96-hour LC_{50} value for stoneflies (P. california is less than 1.0 ppm. Chronic toxicity studies have established significant effect (0.039 ppm) and no effect (0.019 ppm) levels for technical kelthane on juvenile amphipods (Hyalella azteca).

Formulated product - End Use Kelthane

Formulation No. 1 - Wettable Powder

A 21% wettable powder formulation of Kelthane was found to be no more than slightly toxic to Japanese quail and mallards (>640 mg/kg). A 21 % formulation was also shown to be toxic to warm and cold water fishes. The 48-hour LC_{50} values calculated for this formulation were determined for a rainbow trout (0.52 ppm) and several warmwater fish species (goldfish = 3.6 ppm; black bullhead = 2.3 ppm). Acute toxicity studies conducted with an 80% formulation were found to be highly toxic to marine grass shrimp (Crango franciscorum LC_{50} = >0.437 <0.832 ppm).

Formulation No. 2 - Dust

A 35% dust formulation of kelthane was found to be moderately toxic to warmwater fish (bluegill sunfish LC_{50} = 2.95 ppm) and highly toxic to coldwater fish (rainbow trout LC_{50} = 0.95.

HAZARD ASSESSMENT

Formulated Products: Although kelthane is registered for use on a large variety of agricultural sites, its primary uses are on cotton, citrus, field corn, vegetables (beans, melons, tomatoes, peppers), alfalfa and clover (seed crop only), and ornamentals (lawns, turf grasses, flowers, shrubs, shade trees, etc.). Approximately 80 to 85 % of the domestic supply of kelthane is sold as an emulsifiable concentrate (18.5 percent active ingredient) and about 10 to 15 % is sold as a wettable powder (35 percent active ingredient). Much of the remaining 5 to 10 percent is sold as a dust formulation usually combined with other pesticides for use on ornamentals (Scheid, BFSD: 1980).

The above use pattern in conjuction with kelthane's existing toxicity base suggest that non-target fish and wildlife could be adversely impacted. However, due to the absence of appropriate environmental fate data and certain non-target toxicity data, an Ecological Effects Hazard Assessment cannot be made at this time for either the technical or formulated products of Kelthane.

SUMMARY OF MAJOR DATA GAPS

The major data gaps for the manufacturing and end use formulations of Kelthane are found in tables in chapter _____.

EFFECTS ON ESTUARINE AND MARINE SPECIES

One study was recieved and evaluated under this topic. This study was acceptable for use in a hazard assessment.

Author	Study ID
Khorram & Knight	05005326

Because Kelthane residues are known to occur in marine ecosystems (Khorram & Knight 1977); the minimum data required for establishing the acute toxicity of Kelthane to estuarine and marine organisms are the results from three studies: 96 hour LC_{50} for shrimp and an estuarine or marine fish, and a 48-hour EC_{50} for oyster embryolarvae (section 163.72-3).

Results of acceptable acute studies on grass shrimp with technical Kelthane are shown in Table 1.

Table 1. Acute toxicity studies on grass shrimp with technical Kelthane.

Species	% Active	48-hour LC50 (ppm)	Author	Date	Study ID	Fulfills Guideline Requirements
Grass Shrimp *Crango franciscorum*	80%	>.437 < .832	Khorram & Knight	1977	05005326	No

With a 48-hour LC_{50} that ranges between 0.437 and 0.832 ppm there is sufficient information to characterize the toxicity of this technical (80 % a.i.) to grass shrimp as highly toxic.

The guideline requirements for an LC_{50} / EC_{50} on estuarine and marine organisms have not been satisfied.

Estuarine and marine toxicity studies with the formulated products can be required if the end use product is introduced directly into an aquatic environment or the EC_{50} or LC_{50} of the technical grade of active ingredient is equal to or less than the maximum expected environmental concentration (MEEC) or estimated environmental concentration (EEC) in the aquatic environment when the end-use product is used as directed (section 163.72-3).

Presently there are no requirements for marine invertebrate studies with formulated products containing Kelthane.

Precautionary Labeling

Inlight of the currently available invertebrate toxicity data, technical and formulated products (for outdoor uses) will require a statement indicating this pesticide is toxic to shrimp.

EFFECTS ON FRESHWATER AQUATIC INVERTEBRATES

Two studies were received and evaluated under this topic. Both studies were acceptable for use in a hazard assessment.

Author	Study ID
Schoettger	GS0021-060
Spehar et al	GS0021-061

The minimum data required for establishing the acute toxicty of Kelthane in freshwater invertebrates are the results from a 48-hour LC_{50} study with technical Kelthane; preferably with Daphnia magna(section 163.72-2).

One acceptable acute toxicity test (Schoettger, 1966 GS0021-060) for aquatic invertebrates was reviewed. Results of this bioassay are shown below:

Species	96-hour LC_{50} ppm
Pteronarcys california (stonefly)	< 1.0 ppm

There is sufficient information to characterize technical Kelthane's acute toxicity to freshwater invertebrates as at least highly toxic.

The guideline requirement for an LC_{50} on freshwater aquatic invertebrates has not been satisfied.

Aquatic invertebrate life-cycle studies (section 163.72-4) are required to support the registration of Kelthane because:(1) end use products are known to be transported to freshwater ecosystems (Khorram and Knight 1977) and (2) Kelthane residues are known to effect the reproductive physiology of fathead minnows (Spehar et al,1980)

One acceptable early life stage test (Spehar,et al, 1980; GS0021-061) exists for technical Kelthane(> 90% a.i.). Results of this study are shown below:

Species	Results
Juvenile amphipods (Hyalella azteca)	Upper chronic limit = 0.039 ppm (Significant Effect) Lower chronic limit = 0.019 ppm (NOEL)

Although this study is scientifically sound and demonstrates that technical Kelthane (>90%) is very highly toxic to juvenile amphipods it will not fulfill the requirement for an aquatic invertebrate life-cycle test.

Aquatic organisms accumulation studies will be required because technical Kelthane is known to bioaccumulate in fathead minnows (BCF= 3,7000 $\pm$ 800) and amphipods (BCF = 10,000 $\pm$ 3,000) exposed to water concentrations that produced no adverse effects to either of these organisms(Spehar, et al. 1980; GS0021-061 & GS0021-062).

No acceptable aquatic invertebrate accumulation study has been reviewed, therefore, the guideline requirement remains to be fulfilled.

Precautionary Labeling

Inlight of the currently available fish toxicity data, technical and formulated products (for outdoor uses) will require a statement indicating that this pesticide is toxic to aquatic organisms.

EFFECTS ON AVIAN SPECIES

Ten studies were recieved and evaluated under this topic. All studies were acceptable for use in hazard assessments.

Author	ID	Author	ID
Hill et al	GS0021-052	Hill et al	GS0021-053
Hill et al	GS0021-054	Hill	GS0021-055
Hill	GS0021-056	Hill	GS0021-057
Stickel & Reichel	GS0021-058	Heath & Spann	GS0021-059
Harper & Palmer	00004314	Harper & Palmer	00004315

The minimum data required for establishing the avian dietary toxicity of Kelthane in birds are the results for two eight day dietary studies conducted with technical Kelthane. Testing shall be performed on two avian species: one species of wild waterfowl (preferably the mallard) and one species of upland game bird (preferably the bobwhite or other native quail,or ring-necked pheasant).

Acceptable dietary studies are listed in Table 1.

Table 1. Avian dietary studies conducted with technical Kelthane.

Species	% Active (2)	LC_{50} (ppm)	Author	Date	Study ID	Fullfills Guideline Requirements
Bobwhite Quail	99	3100	Hill et al	1975	GS0021-052	Yes
Ring-necked Pheasant	99	2126	Hill et al	1975	GS0021-053	Yes
Mallard Duck	99	1651	Hill et al	1975	GS0021-054	Yes
Japanese Quail	99	1237	Hill	1976	GS0021-055	No
Japanese Quail	99	1545	Hill	1976	GS0021-056	No
Japanese Quail	99	1746	Hill	1976	GS0021-057	No
Grackles	99	>100	Stickel & Reichel	1977	GS0021-058	No

(2). The technical material tested was obtained from a purified sample of Rohm & Hass Technical grade Kelthane.

There is sufficient information to characterize technical Kelthane's toxicity to non-target avian species as slightly toxic.

The guideline requirements for LC_{50} studies on upland game birds and waterfowl with technical Kelthane are satisfied.

The minimum data required for establishing the acute oral toxicity of Kelthane in birds are results from one study with technical Kelthane; an acute oral LD_{50} for one avian species, either a waterfowl (i.e., mallard duck) or upland game (i.e., bobwhite quail or ring-necked pheasant).

No acute oral LD_{50} studies with technical kelthane were received.

There is not sufficient information to characterize technical Kelthane's acute oral toxicity to non-target avian species.

The guideline requirements for an avian LD_{50} are not satisfied.

Special acute oral LD_{50} formulation testing could be required as per section 163.70-1 (e).

Acceptable avian acute oral toxicity studies using various formulations of Kelthane are listed in Table 2.

Table 2. Acute Oral LD_{50} studies on avian species with formulated Kelthane.

Species	% Active	LD_{50} (mg/kg)	Author	Date	Study ID	Fulfills Guideline Requirements
Japanese Quail	21	Not Calculated	Harper & Palmer	1965	00004315	No
Mallard Duck	21	> 640	Harper & Palmer	1966	00004314	No

With an acute oral LD_{50} of greater than 600 mg/kg there is sufficient information to characterize the toxicity of the 21% formulation to birds as no more than slightly toxic.

Presently there are no requirements for an avian oral LD_{50} formulation testing with products containing Kelthane. Even though these studies are scientifically sound they would not fulfill such a requirement.

Avian reproduction studies on mallard duck and bobwhite quail are required to support the registration of Kelthane because product labeling contains directions for using the product under conditions where birds maybe subjected to repeated or continued exposure to the pesticide or any of its major metabolites or degradation products, especially preceding or during the breeding season(163.71-4).

One acceptable mallard reproduction study (Heath & Spann,1973 GS0021-059) exists for technical Kelthane (99 % active ingredient). Results results of this study are shown below:

Species	Dietary levels Tested	Results
Mallard	5 ppm	NOEL
Mallard	10 ppm	NOEL

No acceptable bobwhite reproduction study has been reviewed.

Guideline requirements for avian reproduction studies on mallard duck and bobwhite quail have not been satisfied.

Precautionary Labeling

Inlight of the current available avian toxicity data, technical and formulated product (for outdoor uses) will not require a statement indicating that this pesticide is toxic to birds.

EFFECTS ON FRESHWATER FISH

Fourteen studies were received and evaluated under this topic. Twelve studies were acceptable for use in a hazard assessment and two study was not acceptable.

Author	ID
McCann	GS0021-051
Schoettger	GS0021-046
Schoettger	GS0021-047
Schoettger	GS0021-048
Schoettger	GS0021-049
McCann	GS0021-064
Spehar et al	GS0021-063

Author	ID
Harper	00004318
Harper	00004316
Harper	00004318
McCann	GS0021-050
Cutkomp et al	05004564
Spehar et al	GS0021-062
McCann	GS0021-065

The minimum data required for establishing the acute toxicity of Kelthane in fish are results from two 96-hour studies with technical Kelthane(section 163.72-1); coldwater species (preferably rainbow trout) and one warmwater species (preferably bluegill).

The results from acceptable acute toxicity studies are listed in Table 1.

Table 1. Acute toxicity studies on freshwater fish with technical Kelthane.

Species	% active	LC_{50} (ppm)	Author	Date	ID	Fulfills Guideline Requirements
Channel Catfish	100	0.36	Schoettger	1967	GS0021-048	Yes
Bluegill Sunfish	100	0.51	Schoettger	1966	GS0021-049	Yes
Fathead Minnow	>90	0.50	Spehar	1980	GS0021-063	Yes
Lake Trout	74.4	0.0869	Schoettger	1973	GS0021-046	Partial (1)
Cutthroat Trout	74.4	0.0531	Schoettger	1971	GS0021-047	Partial (1)

(1) Study can only be used to support the registration of technical manufactured by Rohm & Hass.

There is sufficient information to characterize technical Kelthane's toxicity to warmwater and coldwater fish as highly toxic.

The guidelines requirement for an LC_{50} on warmwater fish on technical Kelthane is satisfied; however, the requirement for a coldwater fish study is only partially satisfied (see footnote (1)).

Aquatic toxicity studies on the formulated product can be required as per Sec 163.72-1(C)(i or ii or iii).

Results from acceptable formulated product studies are listed in Table 2.

Table 2. Acute toxicity studies on freshwater fish with various formulations of Kelthane.

Species	% Active	LC_{50} (ppm)	Author	Date	Study ID	Fulfills Guideline Requirements
Goldfish	21	48-hr. =3.6	Harper	1965	00004316	No
Rainbow Trout	21	48-hr. =0.52	Harper	1965	00004318	No
Black Bullhead	21	48-hr. =2.3	Harper	1965	00004317	No
Bluegill Sunfish	35	2.95	McCann	1971	GS0021-050	Yes
Rainbow Trout	35	0.95	McCann	1971	GS0021-065	No

With a 96-hour LC_{50} of 2.95 ppm there is sufficient information to characterize the toxicity of this product (35% a.i) to warmwater fish as moderately toxic.

Presently there are no requirements for acute fish studies with formulated products containing Kelthane. Therefore, although these studies are scientifically sound and would fulfill such a requirement, no requirement has been fulfilled by this study.

Fish early life-stage studies (section 163.72-5) are required to support the registration of Kelthane because:(1) end use products are known to be transported to freshwater ecosystems (Khorram and Knight 1977) and (2) Kelthane residues are known to effect the reproductive physiology of fathead minnows (Spehar et al 1980).

One acceptable early life - stage test (Spehar,et al, 1980; GS0021-062) exists for technical Kelthane (> 90 % a.i.). Results of this study are shown below:

Species	Results
Fathead minnow (egg/larvae stages)	Upper chronic limit = 0.039 ppm (Significant Effect)
	Lower chronic limit = 0.019 ppm (NOEL)

The guideline requirement for a fish early life-stage test has been satisfied.

Aquatic organisms accumulation studies will be required because technical Kelthane is known to bioaccumulate in fathead minnows (BCF = 3,700 ± 800) and amphipods (BCF= 10,000 ± 3,000) exposed to water concentrations that produced no adverse effects to either of these organisms (Spehar, et al. 1980; GS0021-016 & GS0021-017).

No acceptable fish accumulation study has been reviewed,therefore, the guideline requirement remains to be fulfilled.

Precautionary Labeling

Inlight of the currently available fish toxicity data,technical and formulated products (for outdoor uses) will require a statement indicating that this pesticide is toxic to fish.

MANUFACTURING USE

Generic Data Requirements: Ecological Effects (See Chapter VIII)

Guidelines Citation	Name Of Test	Are Data Required?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c) 2(B)? Deficient studies must be submitted within 1 year of published Standard
163.71-1	Avian Single-Dose Oral LD_{50}	Yes	Tech	No	00004315	Yes; Upland game bird
				No	00004314	
163.71-2	Avian Dietary LC_{50}	Yes	Tech	Yes	GS0021-007	No
				Yes	GS0021-008	
				Yes	GS0021-009	
				No	GS0021-010	
				No	GS0021-010	
				No	GS0021-011	
				No	GS0021-012	
				No	GS0021-013	
163.71-3	Wild Mammal Toxicity	No				
163.71-4	Avian Reproduction	No				
163.71-5	Simulated and Actual Field Testing for Mammals & Birds	No				
163.72-1	Fish Acute LC_{50}	Yes	Tech	Yes	GS0021-003	Yes; Coldwater Fish
				Yes	GS0021-004	
				Yes	GS0021-018	
163.72-2	Acute Toxicity to Freshwater Aquatic Invertebrates	Yes	Tech	No	GS0021-015	Yes; Freshwater Invertebrate

Generic Data Requirements: Ecological Effects (See Chapter VIII)

Guidelines Citation	Name Of Test	Are Data Required?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c) 2(B)? Deficient studies must be submitted within 1 year of published Standard
163.72-3	Acute Toxicity to Estuarine & Marine Organisms	No				
163.72-4	Fish Early Life-Stage aquatic invertebrate Life cycle.	No				
163.72-5	Fish Life-Cycle	No				
163.72-6	Aquatic Organism Accumulation	No				
163.72-7	Simulated or Actual Field Testing for Aquatic Organisms	No				

These data requirements are current as of February, 1981. Refer to the guidance package for updated requirements.

END USE

Generic Data Requirements: Ecological Effects (See Chapter VIII)

Guidelines Citation	Name Of Test	Are Data Required?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c) 2(B). Deficient studies must be submitted within 1 year of published Standard
163.71-1	Avian Single-Dose Oral LD_{50}	Yes	Tech	No No	00004315 00004314	Yes; Upland game bird
163.71-2	Avian Dietary LC_{50}	Yes	Tech	Yes Yes Yes No No No No No	GS0021-007 GS0021-008 GS0021-009 GS0021-010 GS0021-010 GS0021-011 GS0021-012 GS0021-013	No
163.71-3	Wild Mammal Toxicity	No				
163.71-4	Avian Reproduction	Yes	Tech	No	GS0021-014	Yes; Upland game bird
163.71-5	Simulated and Actual Field Testing for Mammals & Birds	No				
163.72-1	Fish Acute LC_{50}	Yes	Tech	Yes Yes Yes	GS0021-003 GS0021-004 GS0021-018	Yes; Coldwater Fish
163.72-2	Acute Toxicity to Freshwater Aquatic Invertebrates	Yes	Tech	No	GS0021-015	Yes; Freshwater Invertebrate

Generic Data Requirements: Ecological Effects (See Chapter VIII)

Guidelines Citation	Name Of Test	Are Data Required?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c) 2(B)? Deficient data must be submitted within 1 year from date of published Standar
163.72-3	Acute Toxicity to Estuarine & Marine Organisms	Yes	Tech	No	05005326	Yes
163.72-4	Fish Early Life-Stage aquatic invertebrate Life cycle.	Yes	Tech	Yes No	GS0021-017 GS0021-016	Yes; Invertebrate life cycle
163.72-5	Fish Life-Cycle	No				
163.72-6	Aquatic Organism Accumulation	Yes	Tech	No		Yes; Fish and aquatic invetebrate
163.72-7	Simulated or Actual Field Testing for Aquatic Organisms	No				

These data requirements are current as of February, 1981. Refer to the guidance package for updated requirements.

END USE

Product Specific Data Requirements: Ecological Effects (See Chapter VIII)

Guidelines Citation	Name Of Test	Are Data Required?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c) 2(B)? Deficient studies must be submitted within 1 year of published Standard
163.71-1	Avian Single-Dose Oral LD_{50}	No	Formulated			
163.71-2	Avian Dietary LC_{50}	No	Formulated	No	00004315	
				No	00004314	
163.71-3	Wild Mammal Toxicity	No				
163.71-4	Avian Reproduction	No				
163.71-5	Simulated and Actual Field Testing for Mammals & Birds	No				
163.72-1	Fish Acute LC_{50}	No	Formulated	Yes	GS0021-001	
				Yes	GS0021-002	
				No	00004316	
				No	00004318	
				No	00004317	
				No	GS0021-005	
163.72-2	Acute Toxicity to Freshwater Aquatic Invertebrates	No	Formulated			

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END USE (CONTINUED)

Product Specific Data Requirements: Ecological Effects (See Chapter VIII)

Guidelines Citation	Name Of Test	Are Data Required?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c) 2(B)? Deficient studies must be submitted within 1 year of published Standard
163.72-3	Acute Toxicity to Estuarine & Marine Organisms	No	Formulation	No	05005326	
163.72-4	Fish Early Life-Stage aquatic invertebrate Life cycle.	No				
163.72-5	Fish Life-Cycle	No				
163.72-6	Aquatic Organism Accumulation	No				
163.72-7	Simulated or Actual Field Testing for Aquatic Organisms	No				

These data requirements are current as of February, 1981. Refer to the guidance package for updated requirements.

ECOLOGICAL EFFECTS

A. Disciplinary Summary

1. Plants

a. Profile

Technical dicofol: A treatment of 17.5 lb ai/100 gal had no effect on apple trees. Growth of the alga Scenedesmus was reduced by 20% in 500 ppb to 5 ppm dicofol solutions.

Emulsifiable concentrate: Strawberry and papaya plants were not affected by 6.5 oz or 16 oz ai/A, respectively, of this formulation, although 1.3 oz ai/A was injurious to cucumbers. Apple trees were slightly injured by 17.5 lb ai/100 gal. A 1000 ppm solution (about the label rate) severely inhibited pollen germination in laboratory petunias, tomatoes, and some wild tomatoes (Lycopersicon spp) in the laboratory. A 0.2% spray (the label rate) was phytotoxic to roses.

Wettable powder: A treatment of 2.1 lb ai/100 gal. had no effect on papaya. The ornamental schefflera suffered a slight but acceptable level of injury when treated with 2.6 oz ai/100 gal. A 1000 ppm solution (about the maximum label rate) severely inhibited germination of cucumber pollen in the laboratory. A 25% formulation, probably a WP, was phytotoxic to begonias and violets at 1.3 and 2.7 oz ai/100 gal, respectively, but was not phytotoxic to several other ornamental flowers at 6.7 oz ai/100 gal.

Dicofol dust: A single study showed that three applications of 0.7 lb ai/A injured tobacco.

Flowable dicofol: A formulation identified as dicofol 2MF slightly burned papayas when applied at 0.5 lb ai/100 gal.

(The rates were described in several different ways in the original studies, but are converted to a similar format here. The equivalency is 0.1% = 1000 ppm = 0.8 lb ai/100 gal = 12.6 oz ai/100 gal.).

b. Non-target Plant Hazard Assessment

Due to the limited amount of information, a detailed plant hazard assessment cannot be made at this time. However, there is some information about the effects of dicofol on some of the crops for which it is registered. Since most phytotoxicity research on dicofol was done on crop plants, the hazard to non-target plants can only be inferred from this source of information.

Apples were only slightly injured by 17.5 lb ai/100 gal. (which is over ten times the maximum label rate) so presumably apple trees would not be damaged at label rates. Strawberries showed no phytotoxic symptoms when treated with 6.5 oz ai/A (slightly above the minimum label rate), the highest level tested. Phytotoxic symptoms were noted on cucumbers treated with 1.3 oz ai/A (slightly less than the minimum label rate of 1.6 oz ai/A). A 1000 ppm solution of dicofol severely reduced germination of tomato pollen in vitro. Although a

few ornamentals grown in the greenhouse were injured by 1 to 3 oz. ai/100 gal., several others showed no injury from 6.7 oz ai/100 gal., the highest level tested. Ninety different species of trees, shrubs, and ornamentals grown in the field were undamaged when treated with 1 lb ai/100 gal, but roses displayed phytotoxic symptoms when treated with 1.7 lb ai/100 gal.

Dicofol was also used on a few plants for which it is not registered. Phytotoxic symptoms were noted on tobacco treated at 0.7 lb ai/A. Papayas varied in sensitivity to the different formulations, with no effects from 2.1 lb ai/100 gal of the 25% WP, but with injury from the 2 MF noted as low as 4 oz ai/100 gal. Growth of the green alga Scenedesmus was reduced by 20% in dicofol solutions of 500 ppb to 5 ppm.

Although dicofol does not appear to be phytotoxic to most plants for which it is registered and for which EPA has data, it is phytotoxic to some plants, as shown in field and greenhouse studies. Until EPA receives phytotoxicity data on a more representative cross-section of plant species, any estimate of hazard to non-target plants is only conjecture. Data gaps on plant studies are shown in the charts in Chapter III.

2. Nontarget Insects

a. Effect of Dicofol on Nontarget Soil and Surface Invertebrates

In studies with various species of parasitic wasps, dicofol has been shown to be moderately toxic (05005527, 05003978), or relatively harmless (05004388, 05005640, 05005572). Available information indicates that toxicity is highly variable, depending upon formulation, route of exposure, etc. No general statement can be made at this time.

Data from two studies (05003978, 05005640) indicate that dicofol is relatively non-toxic to predaceous beetles.

In one study with a predaceous mite (Agistemus exsertus), dicofol was relatively non-toxic at 0.0092% concentration (05008980). dicofol was moderately toxic to another species (Amblyseius hibisci) at 0.50 lb a.i./acre (05004148). Data are insufficient to support a general statement.

b. Effect of Dicofol on Beneficial Insects

Dicofol was shown to be relatively non-toxic to honey bees in four studies (#05001990, #05008989, #05009244, #05008990). Two of the studies (05008989, 05008990) also showed dicofol to be low in toxicity to the alfalfa leafcutting bee. One study (#05008989) showed dicofol to be low in toxicity to the alkali bee.

3. Fish and Wildlife

a. Profile

1) Manufacturing - Use Dicofol

Avian dietary studies conducted with technical dicofol show that it is only slightly toxic to nontarget avian species. Dietary toxicity studies have shown LC_{50} values ranging from 1237 to 3100 ppm for upland game birds (bobwhite, ring-necked pheasant, Japanese quail), 1651 ppm for waterfowl (mallard), and greater than 100 ppm for passerines (grackles). Prolonged exposure to low levels (5 to 10 ppm) of technical dicofol had no significant effects on the reproductive behavior of mallard ducks.

Technical dicofol is highly toxic to fish. Acute 96-hour LC_{50} values determined for warmwater fish (channel catfish, bluegill sunfish, fathead minnow) range from 0.31 at 0.51 ppm. A 74.4% technical was demonstrated to be very highly toxic to two species of coldwater fish (lake trout L_{-50} = 0.086 ppm; ppm; cutthroat trout LC_{50} = 0.053 ppm). Acute toxicity studies found an 80% formulation to be highly toxic to marine grass shrimp (Crango franciscorum, LC_{50} = >0.439 >0.832 ppm). Chronic toxicity studies have established statistically significant effect (0.039 ppm) and no effect (0.019 ppm) levels for technical dicofol on developing (egg/larvae) fathead minnows.

The toxicity of technical dicofol has not been accurately determined for freshwater invertebrates. The 96-hour LC_{50} value for stoneflies (P. california) has been shown to be is less than 1.0 ppm. Chronic toxicity studies have established significant effect (0.039 ppm) and no effect (0.019 ppm) levels for technical dicofol on juvenile amphipods (Hyalella azteca).

2) Formulated Product - End Use Dicofol

Formulation No. 1 - Wettable Powder

A 21% wettable powder formulation of dicofol was found to be no more than moderately toxic to Japanese quail and mallards (>640 mg/kg). A 21% formulation was shown to be toxic to warm and cold water fishes. The 48-hour LC_{50} values calculated for this formulation were determined for rainbow trout (0.52 ppm) and several warmwater fish species (goldfish = 3.6 ppm; black bullhead = 2.3 ppm).

Formulation No. 2 - Dust

A 35% dust formulation of dicofol was found to be moderately toxic to warmwater fish (bluegill sunfish LC_{50} = 2.95 ppm) and highly toxic to coldwater fish (rainbow trout LC_{50} = 0.95 ppm).

3) Precautionary Labeling

In light of the current fish toxicity data and documented fish kills, both technical and formulated products (for outdoor uses) will require the following statements: "This pesticide is extremely toxic to fish. Do not apply directly to wetlands or water bodies (e.g., lakes, streams, ponds or canals). Runoff from treated areas may be hazardous to aquatic organisms in

neighboring areas. Do not contaminate water by cleaning of equipment or disposal of waste."

4) Summary of Major Data Gaps

The major data gaps for the manufacturing and end-use formulations of dicofol are found in the Ecological Effects Data Requirements tables in Chapter III.

b. Hazard Assessment

Although dicofol is registered for use on a variety of agricultural sites, its primary uses are on cotton, citrus, field corn, vegetables (beans, melons, tomatoes, peppers), alfalfa and clover (seed crop only), and ornamentals (lawns, turf grasses, flowers, shrubs, shade trees, etc.). About 80 to 85% of the domestic supply of dicofol is sold as an emulsifiable concentrate (18.5% active ingredient) and about 10 to 15% is sold as a wettable powder (35% active ingredient). Much of the remaining 5 to 10% is sold as a dust formulation, usually combined with other pesticides for use on ornamentals (Scheid, 1980).

Dicofol residues were detected in 53 water samples collected downstream from major use areas in California between 1966 and 1980 (CDWR, 1981). While both surface and ground waters were sampled, residues were only found in surface waters and ranged from 0.072 to 0.002 ug/l (average = 0.015 ug/). Low concentrations of dicofol have also been reported in several fishes and sharks from the San Francisco Bay estuary system (Federal Water Quality Administration, 1969). The routes of dicofol entry into the aquatic environment have not been conclusively identified. However, labeled uses and the qualitative use assessment from the EPA Benefits and Field Studies Division (BFSD) strongly suggest that aerial drift, rain runoff, and irrigation return flow waters are the most likely route of entry.

Schoettger (1966 and 1973) determined that dicofol was acutely toxic to fish (lake trout LC_{50} = 0.086 ppm) and freshwater invertebrates (stonefly LC_{50} = <1.0 ppm). Fish kills resulting from dicofol use have been documented on at least one occasion in southern California (U.S. EPA, 1978). Although a thorough study has not been done, dicofol readily bioaccumulates in both fish and aquatic invertebrates (Spehar et al, 1980). The mean bioaccumulation factor (BCF) and standard deviations for fathead minnows and juvenile amphipods were 3,700 (+ 800) and 10,000 (13,000), respectively.

Sublethal concentrations of dicofol can affect the reproductive success of freshwater fish and invertebrates (Spehar, 1980). Chronic flow-through testing studies have established that dicofol residue levels as low as 0.039 ppm can significantly ($P<.05$) affect the growth and development of developing fathead minnows and juvenile amphipods. A chronic no-observable-effect-level of 0.019 ppm was also determined for both of the species cited above.

Estimated Environmental Concentrations (EEC's) for dicofol cannot be determined for lotic and lentic aquatic ecosystems due to the lack of environmental fate data. Hence the Ecological Effects Branch cannot assess the acute or chronic effects of dicofol residues on non-target fish and aquatic invertebrates.

Hill (1967) demonstrated that dicofol is only slightly toxic to nontarget birds (bobwhite LC_{50} = 3100 ppm; mallard LC_{50} = 1651). Span (1973) tested the effects of long-term exposure to relatively low levels (5 and 10 ppm) of dicofol on mallard duck reproduction. No mortalities or significant reproductive impairment were observed. Grackels fed a relatively high dosage (100) of ppm dicofol for one month showed no adverse effects. They bioaccumulated DDE to a body concentration of 5.18 ppm (Stickel and Reichel, 1977).

Technical dicofol also contains DDT and other DDT-related compounds (DDE, DDD, etc.) that are produced as an unavoidable side reaction during the manufacturing process. This type of contamination is particularly noteworthy because DDT is known for its ability to concentrate and to be transferred by plants, invertebrates, fish, mammals, and birds (U.S. E.P.A., 1975). DDE residues are also cause for concern since relatively low levels of this chemical are known to cause eggshell thinning in mallards (Davison and Sells, 1974), black ducks (Longcore et al., 1971), sparrow hawks (Peakall et al., 1973), and ring doves (Haegele and Hudson, 1973) to such a degree that reproduction was impaired.

B. Topical Discussions

1. Plants

The studies iisted here received only an abbreviated review, and are not cited in the topical summaries: 05004262, 05005536, 05005869, 05006027, 05013554 05017451 05017945 05018591. The topical summaries are below.

a. Spray Drift

dicofol as currently registered does not meet the criteria for which spray drift studies are necessary.

b. Algae

A single study (#05005552) was evaluated, and found to be scientifically sound. Based on this study, the following is known about the effects of dicofol on algae:

The LC_{10} for dicofol for the green alga Scendesmus acutus is less than 500 ppb when the alga is incubated in solution for 1 to 5 days. Growth was reduced by 20% compared to the control at 500 ppb to 5 ppm, and by 60% at 10 to 100 ppm. Refer to Subpart J, Section 163.122-2 for data requirements.

c. Aquatic Macrophytes

No studies were received concerning the effects of dicofol on aquatic macrophytes.

Refer to Subpart J, Section 163.122-2 for data requirements.

d. Terrestrial Macrophytes

Several documents have been received and determined to be valid: 05003875, 05007523, 05003998, 05008274, 05009245, 05005273, 05014644, 05002152, 05015809, 05002346, 05016566.

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These documents have been characterized as scientifically invalid: 00004347, 00004352, 00004423, 00014503, 05004721, 05005535, 05006192.

The phytotoxic effects of dicofol based on the available data are summarized in Table VIII-1. The rates were described in several different ways in the original studies, but are converted to a similar form here. The equivalency is 0.1% = 1000 ppm = 0.8 lb ai/100 gal. Rates are listed in either lb ai/Acre, or lb ai/100 gal. In the no-effect levels, an asterisk (*) indicates the highest level tested, so the true no-effect level may be even higher. The no-effect levels are rates at which no effects were observed; they are not meant to represent precise demarcations between tolerance and susceptibility.

Table VIII-1

Phytotoxic Effects of Dicofol

Species	Formulation	No-effect Level (See above description)	Author/Date	MRID ID#
Tobacco	5% D	<0.7 lb ai/A	Tappan/1965	05007523
Cucumber	18% EC	<1.3 oz ai/A	Dennis/1961	05002346
Strawberry	18% EC	>6.5 oz ai/A*	"	"
Apple	Technical	>17.5 lb ai/100 gal*	Kirby/1964	05008274
Apple	20% EC	<17.5 lb ai/100 gal	"	"
Papaya	25% WP	>2.1 lb ai/100 gal*	Sherman/1968	05014644
Papaya	2 EC	1 lb ai/100 gal	"	"
Papaya	2 MF	<.26 lb ai/100 gal	"	"
Begonia	25%	<1.3 oz ai/100 gal	Dennis/1963	05002152
Chrysanthemum	"	>6.7 oz ai/100 gal*	"	"
Cineraria	"	" *	"	"
Coleus	"	" *	"	"
Cyclamen	"	" *	"	"
Geranium	"	" *	"	"
Polyanthus	"	" *	"	"
Violet	"	2.7 oz ai/100 gal	"	"
Ornamentals (90 species)	25% WP	>1 lb ai/100 gal*	Duda/1957	05009245
Lycipersicon spp	18.5% EC	<0.8 lb ai/100 gal	Gentile/1971	05003875
Petunia	18.5% EC	<0.8 lb ai/100 gal	Gentile/1972	05003998
Cucumber	35% WP	<0.8 lb ai/100 gal	Gentile/1978	05005273
Roses	EC	<1.7 lb ai/100 gal	Gjaerum/1976	05016566
Roses	Spray powder?	<1.7 lb ai/100 gal	"	"
Schefflera	35% WP	<2.6 oz ai/100 gal	Gaylor/1976	05015809

The tobacco was treated with 3 applications. The injury to apple (russet) varied between no effect and an EC_{10} as a result of the treatment with a 20% emulsifiable concentrate. The papayas were also treated with 3 applications, and 0.5 lb ai/100 gal was an EC 10 for the 2 manufacturing formulation.

Treatments for the plants listed in Table VIII-1 were foliar sprays, applied to the point of runoff. Begonia, cineraria, coleus, cyclamen, and violet were tested in the greenhouse, and geranium and polyanthus were tested in outside pots. The ornamentals tested in the field were 90 different species of trees, shrubs, and ornamentals.

The 0.8 lb/100 gal. (1000 ppm) solution inhibited germination of petunia and cucumber pollen (about EC_{70}) in the laboratory. The same solution severely or completely inhibited pollen of several Lycopersicon species as well as several cultivars of tomato (L. esculentum). The 1000 ppm rate was chosen to approximate the maximum rate normally used in the field. The rose spray was applied to the point of runoff at the label rate, 1.7 lb/100 gal. (0.2%). The schefflera treatment produced slight but acceptable phytotoxicity. refer to Subpart J, Section 163.122-1 for data requirements.

2. Nontarget Insects

a. Nontarget Soil and Surface Invertebrates

Twenty-six studies were received and evaluated. Nineteen studies were not acceptable for use in this hazard assessment. These seven studies were acceptable: 05003978, 05004148, Rosen 05004388, 05005527, 05005572, 05005640, 05008980. Table VIII-2. lists acceptable toxicity data.

Table VIII-2

Toxicity Studies on Nontarget Soil and Surface Invertebrates with Dicofol

Species	Formulation	Results	Author	Date	ID#	Fulfills Guidelines Requirements
Parasitic wasp (Trichogramma cacoeciae)	Technical	"Moderately harmful" as dried residue of .15% concentration	Hassan	1977	05005527	NA
Predaceous mite (Agistemus exsertus)	18.5% EC	Rel. non-toxic at 0.0092% concentration	Hassan et al.	1970	05008980	NA
Numerous species of parasitic wasps and predaceous coccinellid beetles	18.5% WP	At .50 lb A.I./100 gal., mod. toxic to wasps, low or zero tox. to beetles	Bartlett	1963	05003978	NA
Predaceous mite (Amblyseius hibisci)	18.5% WP	At .50 lb a.i/100 gal., mod. toxic to A. hibisci	Bartlett	1964	05004148	NA

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Parasitic wasp (Aphytis holoxanthus)	18.5% WP	Harmless to A. holoxanthus	Rosen	1967	05004388	NA
Parasitic wasps (Aphytis melinus, Metaphycus luteolus) Predaceous beetles (Lindorus lophanthae, Cryptolaemus montrouzieri)	18.5% WP	At. 0477% or .477% conc. in honey, low or zero tox. to all species	Bartlett	1966	05005640	NA
Parasitic wasp (Pauridia peregrina)	3% dust	Contact LC50 =17.54 mg/cm 2	Searle	1965	05005572	NA
Parasitic wasp (Pauridia peregrina)	Not reported	Rel. non-toxic to P. peregrina	Searle	1965	05005572	NA

Hymenopterous Parasites: Available information indicates that the toxicity of dicofol to parasitic wasps is highly variable, depending upon the formulation tested, route of exposure, species of wasps, etc. No general statements can be made at this time.

Predaceous beetles: Available data indicate that dicofol, as a WP formulation, is relatively non-toxic to predaceous beetles.

Predaceous mites: Data are insufficient to support a general statement regarding toxicity of dicofol to predaceous mites.

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b. Effects on Beneficial Insects

Nine studies were received and evaluated. Five studies were not acceptable for use in a hazard assessment. The acceptable four studies are: 05001991, 05008989, 05008990, and 05009244. Table VIII-3 lists dicofol toxicity studies on beneficial insects.

Table VIII-3

Toxicity Studies on Beneficial Insects with Dicofol

Species	Formulation	Results	Author	Date	ID#	Fulfills Guidelines Requirements
Honey bee (Apis mellifera)	Technical	Contact LD_{50}>50 micrograms/ bee. Oral LD50 > 10 micro-grams/bee (Relatively non-toxic)	Stevenson	1978	05001991	NA
Honey bee Alkali bee (Nomia melanderi) Alfalfa leaf-cutting bee (Megachile rotundata)	1.6 EC	Low in toxicity to all 3 test species	Johansen and Eves	1967	05008989	NA
Honey bee	18.5% EC	No ab-normal mortality when 1% emulsion applied into hives	Keener and Pless	1974	05009244	NA
Honey bee Alfalfa leafcutting bee	not re-ported	LD50= 78.28 micrograms/ leafcutter bee. LD_{50}= 12.20 micrograms/ honey bee (Relatively non-toxic)	Johansen et al.	1963	05008990	NA

There is sufficient information to characterize dicofol as low in toxicity to honey bees and alfalfa leafcutting bees. In one study dicofol is also low in toxicity to alkali bees.

Note: There are currently no guideline requirements for evaluating toxicity to nontarget insects.

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3. Fish and Wildlife

a. Effects on Estuarine and Marine Species

One study (#05005326) was received and evaluated. This study was acceptable for use in a hazard assessment.

Because dicofol residues are known to occur in marine ecosytems (Khorram and Knight 1977), the minimum data required for establishing the acute toxicity of dicofol to estuarine and marine organisms are the results from three studies: 96 hour LC_{50} for shrimp, an estuarine or marine fish, and a 48-hour EC_{50} for oyster embryolarvae (section 163.72-3). Table VIII-4 shows results of acute studies on grass shrimp with formulated dicofol.

Table VIII-4
Acute Toxicity Studies on Grass Shrimp with Formulated Dicofol

Species	% Active	48-hour LC50 (ppm)	Author	Date	Study ID	Fulfills Guideline Requirements
Grass Shrimp (Crango franciscorum)	80%	>.437 & <.832	Khorram & Knight	1977	05005326	No

With a 48-hour LC_{50} that ranges between 0.437 and 0.832 ppm there is sufficient information to characterize the toxicity of this formulation (80% a.i.) to grass shrimp as highly toxic. However, the guideline requirements for an LC_{50}/EC_{50} on estuarine and marine organisms has not been satisfied.

b. Effects on Freshwater Aquatic Invertebrates

Two studies were received and evaluated (GS0021060 and GS0021061), neither fulfill requirements. The minimum data required for establishing the acute toxicity of dicofol in freshwater invertebrates are the results from a 48-hour LC_{50} study with technical dicofol, preferably with Daphnia magna (Section 163.72-2). The guideline requirement for an LC_{50} on freshwater aquatic invertebrates has not been satisfied.

Aquatic invertebrate life-cycle studies (Section 163.72-4) are required to support the registration of dicofol because the pesticide is relatively persistent and because end-use products are known to be transported to freshwater ecosystems (#05005326).

One acceptable early life-stage test (GS0021061) exists for technical dicofol (>90% a.i.). Results of this study are shown in Table VIII-5 below:

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Early Life - Stage Test

Species	Results
Juvenile amphipods (Hyalella azteca)	Upper chronic limit = 0.039 ppm (Significant Effect)
	Lower chronic limit = 0.019 ppm (NOEL)

This study is scientifically sound and demonstrates that technical dicofol (>90%) is very highly toxic to juvenile amphipods.

Aquatic organism accumulation studies are required because technical dicofol has been shown to bioaccumulate in fathead minnows (BCF = 3,7000 ± 800) and amphipods (BCF = 10,000 ± 3,000).

c. Effects on Avian Species

Ten studies were received and evaluated. All studies were acceptable for use in this hazard assessment.

Author	ID	Author	ID
Hill et al.	GS0021-052	Hill et al.	GS0021-053
Hill et al.	GS0021-054	Hill	GS0021-055
Hill	GS0021-056	Hill	GS0021-057
Stickel & Reichel	GS0021-058	Heath & Spann	GS0021-059
Harper & Palmer	00004314	Harper & Palmer	00004315

The minimum data required for establishing the avian dietary toxicity of dicofol are the results of two 8-day dietary studies conducted with technical dicofol. Testing should be performed on two avian species: one species of wild waterfowl (perferably the mallard) and one species of upland game bird (preferably the bobwhite or other native quail, or ring-necked pheasant). Table VIII-6 lists acceptable dietary studies.

Table VIII-6
Avian Dietary Studies Conducted with Technical dicofol.

Species	% Active*	LC_{50}(ppm)	Author	Date	Study ID	Fulfills Guideline Requirements
Bobwhite	99	3100	Hill et al.	1975	GS0021-052	Yes
Ring-necked Pheasant	99	2126	Hill et al.	1975	GS0021-053	Yes
Mallard	99	1651	Hill et al.	1975	GS0021-054	Yes
Japanese Quail	99	1237	Hill	1976	GS0021-055	No
Japanese Quail	99	1545	Hill	1976	GS0021-056	No
Japanese Quail	99	1746	Hill	1976	GS0021-057	No
Grackle	99	>100	Stickel and Reichel	1977	GS0021-058	No

* The technical material tested was obtained from a purified sample of Rohm & Haas technical grade dicofol.

There is sufficient information to characterize technical dicofol's toxicity to non-target avian species as slightly toxic. The guideline requirements for LC_{50} studies on upland game birds and waterfowl with technical dicofol are satisfied.

The minimum data required for establishing the acute oral toxicity of dicofol in birds are results from one study with technical dicofol. No acute oral LD_{50} studies with technical dicofol were received. Nonetheless, sufficient acute oral LD_{50} testing is available on formulated products of dicofol that no additional acute testing is required for birds.

Table VIII-7 lists acceptable avian acute oral toxicity studies using various formulations of dicofol.

Table VIII-7
Acute Oral LD_{50} Studies on Avian Species with Formulated Dicofol

Species	% Active	LD 50 (mg/kg)	Author	Date	ID	Fulfills Guideline Requirements
Japanese Quail	21	Not Calculated	Harper and Palmer	1965	00004315	Partially
Mallard Duck	21	> 640	Harper and Palmer	1966	00004314	Partially

Because the acute oral LD_{50} is greater than 600 mg/kg, there is sufficient information to characterize the toxicity of the 21% formulation to birds as being no more than slightly toxic.

Avian reproduction studies on mallard duck and bobwhite quail are required to support the registration of dicofol, as product labeling directs the product use under conditions where birds may be subjected to repeated or continued exposure to the pesticide, especially preceding or during the breeding season (163.71-4). Moreover, the structural similarity between dicofol and DDT, a known inhibitor of avian reproduction, also suggests the necessity for such testing.

There is one available mallard reproduction study (Heath and Spann, 1973 GS0021-059) for technical dicofol. This study is incomplete and does not fulfill the data requirements. Reproduction testing with two avian species is required.

d. Effects on Freshwater Fish

Fourteen studies were received and evaluated.

Author	ID	Author	ID
Schoettger	GS0021-046	Harper	00004317
Schoettger	GS0021-047	Harper	00004316
Schoettger	GS0021-048	Harper	00004318
Schoettger	GS0021-049	McCann	GS0021-050
McCann	GS0021-064	Cutkomp et al.	05004564
Spehar et al.	GS0021-063	Spehar et al.	GS0021-062

The minimum data required for establishing the acute toxicity of dicofol in fish are results from two 96-hour studies with technical dicofol (Section 163.72-1): one coldwater species (preferably rainbow trout) and one warmwater species (preferably bluegill). Table VIII-8 lists the results from acceptable acute toxicity studies.

Table VIII-8
Acute Toxicity Studies on Freshwater Fish with Technical dicofol.

Species	% Active	LC 50 (ppm)	Author	Date	ID	Fulfills Guideline Requirements
Channel Catfish	100	0.36	Schoettger	1967	GS0021-048	Yes
Bluegill Sunfish	100	0.51	Schoettger	1966	GS0021-049	Yes
Fathead Minnow	>90	0.50	Spehar	1980	GS0021-063	Yes
Lake Trout	74.4	0.0869	Schoettger	1973	GS0021-046	Partial
Cutthroat Trout	74.4	0.0531	Schoettger	1971	GS0021-047	Partial

There is sufficient information to characterize technical dicofol's toxicity to warmwater fish as highly toxic. The requirement for an acute toxicity testing on warmwater fish with dicofol is satisifed; however, the requirement for a coldwater fish study is only partially satisfied.

Several aquatic toxicity studies on formulated dicofol products are available. Table VIII-9 lists results from the formulated product studies.

Table VIII-9

Acute Toxicity Studies on Freshwater Fish with Various Formulations of Dicofol

Species	% Active	LD 50 (ppm)	Author	Date	Study ID	Fulfills Guideline Requirements
Goldfish	21	48-hr. =3.6	Harper	1965	00004316	No
Rainbow Trout	21	48-hr. =0.52	Harper	1965	00004318	No
Black Bullhead	21	48-hr. =2.3	Harper	1965	00004317	No
Bluegill Sunfish	35	2.95	McCann	1971	GS0021-050	Yes
Rainbow Trout	35	0.95	McCann	1971	GS0021-064	No

Currently there are no requirements for acute fish studies with formulated products containing dicofol.

Early life-stage fish studies (Section 163.72-5) are required to support the registration of dicofol because end-use products are known to be transported to freshwater ecosystems (#05005325) and because dicofol may persist in freshwater.

There is one acceptable early life-stage test (Spehar et al., 1980; GS0021-062) for technical dicofol (>90% a.i.). Results of this study are shown in Table VIII-10.

Table VIII-10

Early Life - Stage Test Results

Species	Results
Fathead minnow (egg/larvae stages)	Upper chronic limit = 0.039 ppm (significant effect)
	Lower chronic limit = 0.019 ppm (NOEL)

The guideline requirement for a fish early life-stage test has been satisfied.

Aquatic organisms accumulation studies are required because technical dicofol is known to bioaccumulate in fathead minnows (BCF = 3,700 ± 800) and amphipods (BCF = 10,000 ± 3,000).

No acceptable fish accumulation study has been reviewed, and the guideline requirement must be filled.