9/29/78 (29)

EEB BRANCH REVIEW

ORIGINAL) AMENDED: 9/29/78

DATE: IN 1/9/78 OUT 3/14/78 IN _____ OUT _____ IN _____ OUT _____

FISH & WILDLIFE ENVIRONMENTAL CHEMISTRY TOXICITY

FILE OR REG. NO. 279 ~~297~~-GNRU

PETITION OR EXP. PERMIT NO. _____

DATE DIV. RECEIVED _____

DATE OF SUBMISSION _____

DATE SUBMISSION ACCEPTED _____

TYPE PRODUCT(S): I, D, H, F, N, R, S Insecticide

DATA ACCESSION NO(S). 096686 996699

PRODUCT MGR. NO. Mitchell (17)

PRODUCT NAME(S) Pounce 3.2 EC

COMPANY NAME FMC

SUBMISSION PURPOSE Registration (cotton)

CHEMICAL & FORMULATION: Permethrin: ~~(3-phenoxylphenyl) methyl (+)~~ cis-Trans-3-(2,2-dichloroethenyl)-2,2-dimethyl-cyclopropanecarboxylate 38.4%

Xylene range aromatic solvent 50.1%

100.0 Pesticidal Use

FMC Pounce 3.2 EC is a synthetic pyrethroid compound intended for the control of Bollworm, Tobacco Budworm, Boll Weevil , Pink Bollworm, Cotton Leafperforator and Lygus on cotton.

100.1 Application Methods/Directions

COTTON

Pest	Rate Per Acre*
Bollworm	4 - 8 oz.
Tobacco Budworm	4 - 8 oz.
Boll Weevil	4 - 8 oz.
Pink Bollworm	4 - 8 oz.
Cotton Leafperforator	2 - 8 oz.
Lygus	4 - 8 oz.

Use higher dosage rate as population pressure increases. Apply a minimum of 1 gallon of finished spray per acre by aircraft and 5 gallons with ground equipment. Do not make more than 15 applications per season. Do not apply within 14 days of harvest. Do not graze or feed cotton folage.

*4 oz. POUNCE 3.2 EC is equivalent to 0.1 lb. active ingredient. Contains 3.2 lbs. permethrin per gallon. Maximum application rate therefore would be equivalent to 0.2 lbs. a.i./acre.

101.0 Chemical and Physical Properties

101.1 Chemical Name

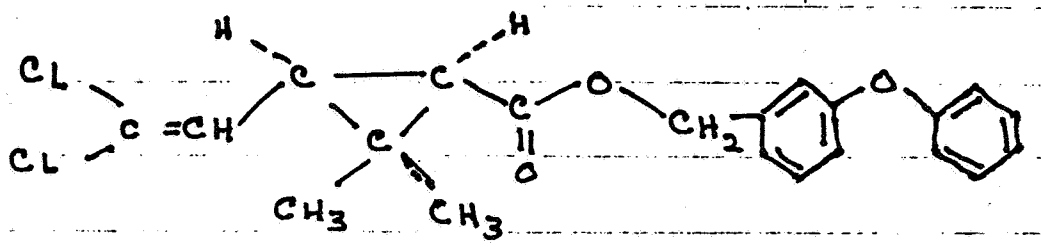
(3-phenoxylphenyl) methyl (+) cis-trans-3-(2,2-dichloroethenyl)-2,2-dimethyl-cyclopropanecarboxylate

101.2 Common Name

Permethrin
Pounce (FMC)
Matadan (FMC)
FMC 33297
= Ambush (ICI) = PP 557 = Ectiban (ICI)

101.3 Structural Formula

cis



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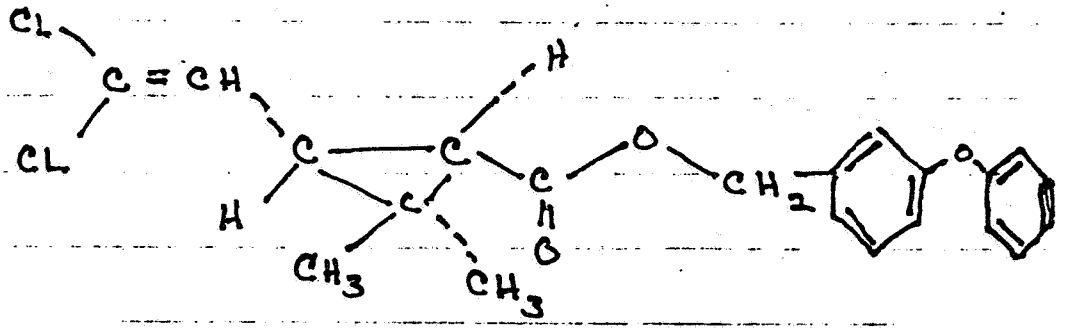

101.4 Molecular Weight

391.30

101.5 Physical State

semi-solid
color pale yellow to darkish reddish brown
odor sweet ester-like

101.6 Solubility

101.6.1 Water = 0.07 ± 0.01 ppm

101.6.2 Acetone = >50%

101.6.3 Ethanol = >50%

101.6.4 Xylene = >50%

101.6.4 Methanol = >50%

102.0 Behavior in the Environment

The following summary of Environmental Fate data ~~for this product is~~ was taken from Environmental Chemistry's

previous reviews and from conversations with Russ Cook. A final review by Environmental Chemistry has not been provided to this section but the following tentative information is presented.

102.1 Soil

The half life of Permethrin in the soil can vary considerably according to present information. Permethrin is reported to degrade rapidly under aerobic conditions to CO_2. This degradation to 50% CO_2 can occur at rates from 28 days to 10 weeks depending upon the water logged condition of the soil. If the soil is particularly waterlogged, degradation to CO_2 may take place at a much slower rate. Permethrin does not seem to be mobile as a result of soil leaching but binds tightly to soil organic matter and soil molecules.

102.2 Water

The half life of Permethrin at all pH levels in water can not now be accurately predicted. In one study the half life at all pH levels was reported to be less than 7 days while in another hydrolysis study the half life at pH 4, 7, and 9 was given as 57, 79 and 112 days respectively.

102.3 Plant

Available information concerning photolysis on plant surfaces indicates that the half life in sunlight can be approximately 4 days and in shade can be up to three weeks.

102.4 Animal

Bioaccumulation information indicates a high variation in the results presented. It would appear, however, that Permethrin is fat soluble and has been noted to bioaccumulate from 45 X up to >4000 X in animal tissue.

102.5 Additional Comments

Personal communication with Russ Cook (Environmental Chemistry) indicates that Permethrin

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is very insoluble in water (0.07 ppm). The parent compound will enter water and tend to concentrate at two levels: the surface and the benthic zone. In the benthic zone it will be bound to bottom organics and soil. The mode of entry is anticipated to be surface transport via soil particles in run-off or by direct contanimation due to wind drift during aerial spraying. Permethrin will then be subject to continual adsorption and resorption in the benthic zone with the parent compound reentering the water up to the level of solubility. As the parent compound will be anticipated to be continually entering the water column in the benthic zone the food chain organisms that move continually thru this zone can be expected to not only be exposed but to also ingest permethrin. Permethrin can be expected to bioaccumulate in the lower food chain organisms and thus bio-magnification can be expected to be great as a result of continual reentry of permethrin from the benthic zone and the continual reapplication that is intended for this use pattern.

The other area of the water column that will have higher levels of permethrin is the air-water film interface. Permethrin is anticipated to occur on the surface as unbound material after rains or after drift from aerial application. The initial impact of this occurrence will of course be the removal of neustic insects. Permethrin will then be removed from the surface film by trans-evaporation and will be transported to the stratosphere by the water vapor. Reentry back to surface water will occur whenever it rains. As a result of this behavior, contamination of air and water may occur in places where it has never been applied. This impact should not be as severe as with DDT and other organochlorides, that behave similarly in water, due to the relative lack of persistance of this compound.

103.0 Toxicological Properties

103.1 Acute Toxicity

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103.1.1 Mammal

TEST: Acute Mammal LD_{50}
SPECIES: Rat
RESULT: LD_{50} = 8.9 g/kg
CHEMICAL: Permethrin

TEST: 90 day feeding study
SPECIES: Dog
RESULT: NEL = 5 mg/kg
CHEMICAL: Permethrin

TEST: 90 day feeding study
SPECIES: Rat
RESULT: NEL = 2 mg/kg
CHEMICAL: Permethrin

TEST: Teratology study
SPECIES: Rat
RESULT: 200 mg/kg negative findings
SPECIES: Mouse
RESULT: 400 mg/kg negative findings
SPECIES: Rabbit
RESULT: 400 mg/kg negative findings

TEST: 3 Generation Reproduction Study
SPECIES: Rat - Long-evans strain
RESULT: The NEL for reproductive effects in greater than 100 ppm. Data on mating, body weights, food consumption, survival, growth indicate no biological effect from permethrin at this level. Levels tested were 20 and 100 ppm.
CHEMICAL: Permethrin
TITLE: Three Generation Reproduction Study
STUDY DATE: December 15, 1977
RESEARCHER: Biodynamics Project 74-1101
TEST ACCEPTABILITY: This study is considered as Core minimum standard by Toxicology Branch.

TEST: Two Year-Combined Chronic Toxicity/ Oncogenicity Study
SPECIES: Rat - Long-evans strain

RESULTS: An oncogenic effect appears to be present, but appears to be of low potency. A systemic NEL of 20 ppm was confirmed for the rat.
CHEMICAL: Permithrin
RESEARCHER: Biodynamics
TEST ACCEPTABILITY: This study is considered as minimum data by Toxicology Branch.

103.1.2 Bird

DATA REVIEW NUMBER: ES C1

TEST: Avian Acute Oral LD_{50}

SPECIES: Mallard Duck (Anas platyrhynchos)

RESULTS: LD_{50} >4640 mg/kg

With the exception of an incidental death at the 1000 mg/kg dosage level and a lack of coordination at the 4640 mg/kg dose level, permethrin did not cause symptoms of toxicity or behavioral abnormalities at the dosage levels tested. Body weight or food consumption did not differ significantly from negative controls.

CHEMICAL: FMC 33297 Technical (95.7% a.i.)

TITLE: Acute Oral LD_{50} - Mallard duck FMC 33297 Final Report

ACCESSION NO: 096699

STUDY DATE: July 21, 1975

RESEARCHER: Robert Fink
Wildlife Research Div.
Truslow Farms Inc.

REGISTRANT: FMC Corporation

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A. - This study deviated from present ESS standards for the avian acute oral, in that the birds were only 14 days of age rather than young adult birds at initiation of study. Study is acceptable for basic data requirements because birds at the highest dose level did not die, did not lose weight and consumed comparative amounts of feed.

VALIDATOR: Tom O'Brien - 1/23/78

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103.1.3 Fish

DATA REVIEW NUMBER: ES F1

TEST: Fish Acute 96-hour LC_{50} - (warmwater)

SPECIES: Bluegill Sunfish (Lepomis macrochirus)

RESULTS: 96 hour LC_{50} = 6.1 ppb (5.0 - 7.3 ppb) 95% C.L.

No discernible effect level = 3.2 ppb.

Statistical analysis of data by Finney Probit gave the following results - The Chi^2 value indicates the data are not heterogenous and compare identically with the researchers results. Chi^2 (DF 5) = 11.1 >3.914.

6.255	M	0.006	LD50	0.010	LD90	0.004	LD10
18.805	YINT	0.005	LOCL	0.008	LOCL	0.003	LOCL
1.445	LW M	0.007	UPCL	0.012	UPCL	0.005	UPCL
3.914	CHI^2						

CHEMICAL: FMC 33297 Technical (100% a.i.) ?

TITLE: Acute Toxicity of FMC 33297 Technical to Bluegill (Lepomis macrochirus) and Rainbow Trout (Salmo gairdneri)

ACCESSION NO: 096699

STUDY DATE: November 1974

RESEARCHER: Bentley, Robert E.
Bionomics E.G.&G. Environmental Consl.
Wareham, Mass.

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core ?

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Tom O'Brien - 1/10/78

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103.1.3 Fish

DATA REVIEW NUMBER: ES F2

TEST: Fish Acute 96 hour LC_{50} (Warmwater)

SPECIES: Bluegill Sunfish (Lepomis macrochirius)

RESULTS: 24 hr LC_{50} = 5.64 ppb (4.52 - 7.03 ppb) 95% C.L.

48 hr LC_{50} = 3.36 ppb (2.78 - 4.05 ppb) 95% C.L.

96 hr LC_{50} = 2.52 ppb (1.88 - 3.36 ppb) 95% C.L.

96 hour no effect level is <1.00 ppb Analysis by Spearman-Karber method. Below is analysis of data by Finney probit by this section which gave comparable results for 96 hour LC_{50}. Chi^2(3df)= 7.81.

3.543	M						
3.629	YINT	2.437	LD50	1.059	LD10	5.6C8	LD90
1.915	LW M	1.822	LOCL	0.639	LOCL	3.553	LOCL
4.8CO	CHI^2	3.261	UPCL	1.755	UPCL	8.850	UPCL

CHEMICAL: FMC 33297 Technical (95.7% a.i.)

TITLE: Acute Toxicity of FMC 33297 Act 29.11, .12 to Bluegill Sunfish (Lepomis macrochirus) Rafinesque and the Water Flea, (Daphnia magna) Straus.

ACCESSION NO: 096699

STUDY DATE: June 21, 1976

RESEARCHER: Aquatic Environmental Sciences
Union Carbide Corporation
Tarrytown, N.Y.

REGISTRANT: FMC Category

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Thomas O'Brien - 1/16/78

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103.1.3 Fish

DATA REVIEW NUMBER: ES G1

TEST: Fish Acute 96 hr LC_{50} (Coldwater)

SPECIES: Rainbow Trout (Salmo gairdneri)

RESULTS: 96 hr LC_{50} = 9.8 ppb (7.7 - 12.6 ppb) 95% C.L.

No discenible effect level = 3.2 ppb. Statistical analysis by Finney probit gave the following results. Chi^2 = 5.967 < Chi^2 (6DF) = 12.6 indicates data are not heterogenous and compare favorably with reported values.

5.419	M	0.011	LD50	0.019	LD90	0.007	LD10
15.556	YINT	0.010	LOCL	0.014	LOCL	0.005	LOCL
1.529	LW M	0.013	UPCL	0.026	UPCL	0.008	UPCL
5.967	CHI^2						

CHEMICAL: FMC 33297 Technical (100% a.i.) ✓

TITLE: Acute Toxicity of FMC 33297 Technical to Bluegill Sunfish (Lepomis macrochirus) and Rainbow Trout (Salmo gairdneri)

ACCESSION NO: 096699

STUDY DATE: November 1974

RESEARCHER: Bentley, Robert E.
Bionomics E.G.&G. Environmental Consultants
Wareham, Mass.

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Tom O'Brien - 1/10/78

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103.1.3 Fish

DATA REVIEW NUMBER: ES II

TEST: Fish Acute 96 hour LC_{50} (Warmwater)

SPECIES: Bluegill Sunfish (Lepomis macrochirius)

RESULTS: 96 hour LC_{50} = 33.4 ppb (26.6 - 41.5 ppb) 95% C.L.

No discernible effect level = 20 ppb.

Statistical analysis of data by Finney probit gave the following results $Chi^2 = 5.119 < Chi^2$ 3df (7.81) indicates the data are not heterogenous.

5.861	M	32.627	LD50	19.716	LD10	53.991	LD90
-3.871	YINT	27.668	LOCL	14.598	LOCL	41.175	LOCL
1.481	LW M	38.475	UPCL	26.629	UPCL	70.796	UPCL
5.119	CHI^2						

CHEMICAL: FMC 33297 3.2 EC (38.4% a.i.)

TITLE: Acute Toxicity of FMC 33297 3.2 EC to Bluegill (Lepomis machrocirus) and Rainbow Trout (Salmo gairdneri).

ACCESSION NO: 096699

STUDY DATE: December 1975

RESEARCHER: Bentley, Robert E.
E.G.&G. Bionomics Aquatic Toxicology Laboratory
Wareham, Mass.

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Thomas O'Brien - 1/10/78

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103.1.3 Fish

DATA REVIEW NUMBER: ES J1

TEST: Fish Acute 96 hour LC_{50} (coldwater)

SPECIES: Rainbow Trout (Salmo gairdneri)

RESULTS: 96 hour LC_{50} = 20.9 ppb (15.8 - 27.9 ppb) 95% C.L.

No discernible effect level = 8.4 ppb.

Statistical analysis of data by Finney Probit gave the following results: Chi^2 = 8.279< chi^2 (6df)= 12.6, indicates data are not heterogenous

3.540	M	21.065	LD50	9.149	LD10	48.457	LD90
0.315	YINT	17.032	LOCL	6.2C6	LOCL	33.654	LOCL
1.916	LW M	26.053	UPCL	13.489	UPCL	69.868	UPCL
8.279	CHI^2						

CHEMICAL: FMC 33297 3.2 EC (38.4% a.i.)

TITLE: Acute Toxicity of FMC - 33297 3.2 EC to Bluegill (Lepomis macrochirus) and Rainbow Trout (Salmo gairdneri)

ACCESSION NO: 096699

STUDY DATE: December 1975

RESEARCHER: Bentley, Robert E.
E.G.&G. Bionomics Quatic Toxicology Lab.
Wareham, Mass.

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Tom O'Brien - 1/10/78

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103.1.4 Aquatic Invertebrate

DATA REVIEW NUMBER: ES H1

TEST: Aquatic Invertebrate Acute Toxicity

SPECIES: Water Flea (Daphnia magna)

RESULTS: 96 hour LC_{50} = 39 ppt (25-62 ppt)
95% C.L.
No discernible effect level = 32 ppt.

48 hour LC_{50} = 75 ppt (54 - 103 ppt)
95% C.L.

Statistical analysis of data by Finney Probit gave the following results for the 96 hour LC_{50} [chi^2(3df)= 7.81]:

5.7C5	M						
13.033	YINT	0.039	LD50	0.023	LD10	0.066	LD90
1.497	LW M	0.033	LOCL	0.017	LOCL	0.053	LOCL
4.712	CHI^2	0.046	UPCL	0.033	UPCL	0.082	UPCL

CHEMICAL: FMC 33297 Technical (95.7% a.i.)

TITLE: Acute Toxicity of FMC 33297 Technical to Water Flea (Daphnia magna)

ACCESSION NO: 096699

STUDY DATE: December 1975

RESEARCHER: Bentley, Robert E.
E.G.&G. Bionomics
Aquatic Toxicology Lab.
Wareham, Mass.

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core ? Careful. Read C.R. Below. JJ.

CATEGORY REPAIRABILITY: N.A. The aquatic invertebrate toxicity data for this study, reported for 48 hours, did not produce favorable results in the Chi^2 analysis (Finney probit). This study did supply values

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for a 96 hour LC_{50} for Daphnia magna. This study used acetone solvent and had 70% mortality in the solvent control. The raw data was analyzed using Finney Probit after correcting for control mortality by Abbotts Formula.[2] The value derived had an acceptable Chi^2 value ($4.712 < 7.81$) and therefore, the 96 hour LC_{50} will be used in the hazard assessment.

103.1.4 Aquatic Invertebrate

DATA REVIEW NUMBER: ES H2

TEST: Aquatic Invertebrate Acute Toxicity

SPECIES: Water Flea (Daphnia magna)

RESULTS: 48 hour LC_{50} = .32 ppb (0.24 - 0.44 ppb) 95% C.L.

No discernible effect level 0.10 ppb. Statistical analysis by Finney Probit gave the following results (Chi^2 for 8df = 15.5):

3.967	M						
6.685	YINT	0.376	LD50	0.792	LD90	0.179	LD10
1.787	LW M	0.319	LOCL	0.602	LOCL	0.134	LOCL
9.744	CHI^2	0.443	UPCL	1.040	UPCL	0.238	UPCL

CHEMICAL: FMC 33297 Technical (% a.i.?)

TITLE: Acute Toxicity of FMC 33297 Technical to Daphnia magna

ACCESSION NO: 096699

STUDY DATE: October 1976

RESEARCHER: LeBlanc, Gerald A.
E.G.G Bionomics
Aquatic Toxicology Lab.
Wareham, Mass.

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Tom O'Brien - 1/11/78

103.1.4 Aquatic Invertebrate

DATA REVIEW NUMBER: ES H3

TEST: Aquatic Invertebrate Acute Toxicity

SPECIES: Daphnia (Daphnia magna)

RESULTS: 24 hour LC_{50} = 22.1 ppb (20.1 - 24.3) ppb 95% C.L.

48 hour LC_{50} = 7.2 ppb (5.8 - 8.9) ppb 95% C.L.

The observed 48 hour no effect is <1.8 µg/l (ppb) — analysis by Spearman Karber. Below is analysis by Finney Probit by this section which gave comparable results for 96 hour LC_{50} (Chi^2 3df = 7.81):

3.318	M	7.164	LD50	2.943	LD10	17.489	LD90
2.163	YINT	5.761	LOCL	2.092	LOCL	11.939	LOCL
2.002	LWM	8.877	UPCL	4.139	UPCL	25.474	UPCL
1.778	CHI^2						

CHEMICAL: FMC 33297 Technical (95.7% a.i.)

TITLE: Acute Toxicity of FMC 33297 Act. 29.11, 12 to Bluegill Sunfish (Lepomis machrochirus) Rafinesque and the Water Flea (Daphnia magna) straus.

ACCESSION NO: 096699

STUDY DATE: June 21, 1976

RESEARCHER: Aquatic Environmental Sciences
Union Carbide Corp.
Tarrytown, N.Y.

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Tom O'Brien - 1/16/78

103.1.4 Aquatic Invertebrate

DATA REVIEW NUMBER: ES K1

TEST: Aquatic Invertebrate Acute Toxicity

SPECIES: Water Flea (Daphnia magna)

RESULTS: 48 hour LC_{50} = 151 ppt (120-188 ppt) 95% C.L.

96 hour LC_{50} = 112 ppt (76-164 ppt) 95% C.L.

No discrenible effect level = 84 ppt.

Statistical analysis by Finney Probit for 96 hour LC_{50} is given below.

5.882	M	0.138	LC50	0.229	LC90	0.064	LC10
10.051	YINT	0.121	LOCL	0.182	LOCL	0.066	LOCL
1.479	LW M	0.158	UPCL	0.287	UPCL	0.106	UPCL
6.919	CHI^2						

CHEMICAL: FMC 33297 3.2 EC 38.4% a.i.

TITLE: Acute Toxicity of FMC 33297 3.2 EC to Water Flea (Daphnia magna)

ACCESSION NO: 096699

STUDY DATE: December 1975

RESEARCHER: Bentley, Robert E.
E.G.&G Bionomics
Aquatic Toxicology Lab.
Wareham, Mass.

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A. The statistical analysis for the 96 hour LC_{50} can be used in its present form because mortality did not occur in the control. The 96 hour LC_{50}

is considered representative of
daphnia sensitivity to permethrin.

VALIDATOR: Tom O'Brien - 1/11/78

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103.1.4 Aquatic Invertebrates

DATA REVIEW NUMBER: ES L1

TEST: Acute 96 hour LC_{50} marine invertebrate

SPECIES: Pink Shrimp (Penaeus duorarum)

RESULTS: 96 hour LC_{50} = .354 ppb (0.287 - .440 ppb) 95% C.L.

Statistical Analysis by Finney Probit
Chi^2 (3df = 7.81):

9.191	M						
8.856	YINT	0.361	LD50	0.276	LD10	0.525	LD90
1.285	LW M	0.321	LOCL	0.215	LOCL	0.417	LOCL
0.095	CHI^2	0.451	UPCL	0.355	UPCL	0.660	UPCL

CHEMICAL: FMC 33297 Technical 95.7% a.i.

TITLE: Acute Toxicity of FMC 33297 Technical (95.7%) to Eastern Oyster (Crassostrea virginica), Pink Shrimp (Penaeus duorarum and Fiddler Crabs (Uca pugilator)

ACCESSION NO: 096699

STUDY DATE: December 1975

RESEARCHER: Tom Heitmuller
Bionomics - E.G.&G. Inc.
Marine Research Lab.
Pensacola, Florida

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Tom O'Brien - 1/12/78

103.1.4 Aquatic Invertebrates

DATA REVIEW NUMBER: ES M1

TEST: Acute 96 hour LC_{50} Marine Invertebrate

SPECIES: Pink Shrimp (Penaeus duorarum)

RESULTS: 96 hour LC_{50} = 0.508 ppb (0.347 - 0.756 ppb) 95% C.L.

Statistical analysis of raw data by Finney Probit produced values similiar to test lab. Chi^2 for df2 = 5.99 > calculated Chi^2 = .004.

8.370	M	0.513	LD50	0.731	LD90	0.361	LD10
7.423	YINT	0.426	LOCL	0.550	LOCL	0.268	LOCL
1.317	LW M	0.619	UPCL	0.970	UPCL	0.486	UPCL
0.004	CHI^2						

CHEMICAL: FMC 33297 3.2 EC (40.67% a.i.)

TITLE: Acute Toxicity of FMC 33297 3.2 EC to Eastern Oyster (Crossostrea virginica), Pink Shrimp (Penaeus duorarum) and Fiddler Crab (Uca pugilator)

ACCESSION NO: 096699

STUDY DATE: December 1975

RESEARCHER: Heitmuller, Tom
Bionomics E.G. & G. Inc.
Pensacola, Florida

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Tom O'Brien - 1/13/78

103.1.4 Aquatic Invertebrates

DATA REVIEW NUMBER: ES N1

TEST: Acute 96 hour Marine LC_{50}

SPECIES: Fiddler Crab (Uca pugilator)

RESULTS: 96 hour LC_{50} = 2.39 ppb (1.82 - 3.25 ppb) 95% C.L.

Statistical analysis by Finney Probit compared favorably. The Chi^2 for 3df = 7.81.

5.915	M	2.478	LD50	1.5C5	LD10	4.082	LD90
2.669	YINT	1.949	LOCL	1.061	LOCL	2.828	LOCL
1.476	LW M	3.151	UPCL	2.133	UPCL	5.892	UPCL
0.179	CHI^2						

CHEMICAL: FMC 33297 Technical 95.7% a.i.

TITLE: Acute Toxicity of FMC 33297 Technical (95.7%) to Eastern Oyster (Crassastrea virginica), Pink Shrimp (Penaeus duorarum) and Fiddler Crabs (Uca pugilator)

ACCESSION NO: 096699

STUDY DATE: December 1975

RESEARCHER: Heitmuller, Tom
Bionomics E. G. & G. Inc.
Marine Research Lab.
Pensacola, Florida

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Tom O'Brien - 1/12/78

103.1.4 Aquatic Invertebrates

DATA REVIEW NUMBER: ES 01

TEST: Acute 96 hour LC_{50}

SPECIES: Fiddler Crab (Uca pugilator)

RESULTS: 96 hour LC_{50} = 7.60 ppb (6.03 - 9.56 ppb)

Statistical analysis of raw data, by this section, using log probit linear regression analysis produced those LC_{50} values similar to reported above.

3.	N_2						
0.993	R^2	7.595	LD50	5.959	LD10	9.681	LD90
0.033	S	2.454	LOCL	1.867	LOCL	3.042	LOCL
0.082		23.513	UPCL	19.020	UPCL	30.807	UPCL

CHEMICAL: FMC 33297 3.2 EC (40.67% a.i.)

TITLE: Acute Toxicity of FMC 33297 3.2 EC to Eastern Oyster (Crassastrea virginica), Pink Shrimp (Penaeus duorarum) and Fiddler Crabs (Uca pugilator)

ACCESSION NO: 096699

STUDY DATE: December 1975

RESEARCHER: Heitmuller, Tom
Bionomics E.G. & G. Inc.
Pensacola, Florida

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Tom O'Brien - 1/13/78

✓

103.1.4 Aquatic Invertebrates

DATA REVIEW NUMBER: ES T1

TEST: Shell Deposition Marine Mollusc

SPECIES: Eastern Oyster (Crassostrea virginica)

RESULTS: 96 hr EC_{50} reported to be > 536 ppb

This study did not develop a precise EC_{50} because the research lab ran out of test compound. At 536 ppb the shell deposition reduction from the control was 36%. There was also a residual shell deposition drop noted when oysters are placed in clean water, no effect level noted at $\leq$ 95.7 ppb.

CHEMICAL: FMC 33297 Technical (95.7% a.i.)

TITLE: Acute Toxicity of FMC 33297 Technical (95.7% a.i.) to Eastern Oysters (crassastrea virginica), Pink Shrimp (Penaeus duorarium) and Fiddler Crabs (Uca puginator)

ACCESSION NO: 096699

STUDY DATE: December 1975

RESEARCHER: Heitmuller, Tom
Bionomics E.G. & G. Inc.
Marine Research Lab.
Pensacola, Florida

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Supplemental

CATEGORY REPAIRABILITY: No - The study did not include a definitive EC_{50} value because only two test levels were conducted and the 50% mortality was not achieved.

VALIDATOR: Tom O'Brien - 1/12/78

✓

ADDITIONAL INFORMATION:

Effect of FMC 33297 technical (95.7%) on shell deposition of eastern oysters (Crassostrea virginica) exposed continously for 96 hours in flowing sea water. Salinity was 22-25°/oo and temperature, 17-18°C.

Nominal concentration (µg/ℓ;ppb)	Shell deposition[a] (mm)	Reduction[b] (%)
Control	4.4 (±1.33)[c]	-
306	3.0 (±1.19)	32
536	2.8 (±0.98)	36

Residual effect of FMC 33297 technical (95.7%) on shell deposition of eastern oysters (Crassostrea virginica) depurating for four days in flowing sea water, following 96 hours of continuous exposure in flowing sea water. Salinity was 22-25 °/oo and temperature, 15-17°C.

Nominal concentration of 96-hour bioassay (µg/ℓ;ppb)	Shell deposition[a] (mm)	Reduction[b] (%)
Control	6.0 (±1.01)[c]	-
306	5.4 (±1.34)	10
536	4.4 (±1.17)	27

[a]Mean value based on shell measurements of ten oysters.

[b] $$\text{reduction} = \frac{\text{Shell deposition of control oysters minus shell deposition of exposed oysters}}{\text{Shell deposition of control oysters}} \times 100$$

[c]Standard deviation of mean.

103.1.4 Aquatic Invertebrates

DATA REVIEW NUMBER: ES U1

TEST: Shell deposition marine mollusc

SPECIES: Eastern Oyster (Crassostrea virginica)

RESULTS: 96 hour EC_{50} reported to be > 407 ppb.

This study did not develop a precise EC_{50} because the research lab did not test enough concentration levels to develop an EC_{50}. At 407 ppb the shell deposition reduction from the control was 36%. There was also a residual shell deposition decrease noted when oysters were placed in clean water. A no effect level was noted to be < 40.7 ppb.

CHEMICAL: FMC 33297 Technical (95.7% a.i.)

TITLE: Acute Toxicity of FMC 33297 Technical (95.7%) to Eastern Oyster (Crassostrea virginica), Pink Shrimp (Penaeus durorarum) and Fiddler Crab (Uca pugilator)

ACCESSION NO: 096699

STUDY DATE: December 1975

RESEARCHER: Heitmuller, Tom
Bionomics E.G. & G. Inc.
Marine Research Lab.
Pensacola, Florida

REGISTRANT: FMC Corp

VALIDATION CATEGORY: Supplemental

CATEGORY REPAIRABILITY: No - The study did not include a definitive EC_{50} value because only three test levels were conducted and the 50% mortality level was not achieved.

VALIDATOR: Tom O'Brien - 1/13/78

✓

ADDITIONAL INFORMATION:

Effect of FMC 33297 3.2 EC on shell deposition of eastern oysters (Crassostrea virginica) exposed continuously for 96 hours in flowing sea water. Salinity was 22-25 °/oo and temperature, 17-18°C.

Nominal concentration (nℓ/ℓ;ppb)	Shell deposition[a] (mm)	Reduction[b] (%)
Control	4.4 (±1.33)[c]	-
130	2.9 (±1.00)	34
228	2.9 (±1.33)	34
407	2.8 (±1.18)	36

Residual effect of FMC 33297 3.2 EC on shell deposition of eastern oysters (Crassostrea virginica) depurating for four days in flowing sea water, following 96 hours of continuous exposure in flowing sea water. Salinity was 22-25 °/oo and temperature, 15-17°C.

Nominal concentration of 96-hour bioassay (nℓ/ℓ;ppb)	Shell deposition[a] (mm)	Reduction[b] (%)
Control	6.0 (±1.01)[c]	-
130	4.7 (±1.21)	22
228	5.0 (±1.42)	17
407	4.8 (±1.55)	20

[a]Mean value based on shell measurements of ten oysters.

[b] $$\text{Reduction} = \frac{\text{Shell deposition of control oysters minus shell deposition of exposed oysters}}{\text{Shell deposition of control oysters}} \times 100$$

[c]Standard deviation of mean.

103.1.5 Benificial Insects

The following ICI studies are included to provide scientific information to future reviewers and are not intended for regulatory use.

REF. 1J Permethrin: Oral and contact toxicity to honeybees of technical material and an encapsulated emulsion.

MATERIAL: Permethrin (Tech. and encaps form)

AUTHOR: A. M. Clark

TEST SPECIES: Honeybee (Apis mellifera)

REGISTRANT: ICI United States, Inc.

DATE OF TEST: not reported

RESULTS:

	Oral LD_{50} (µg/bee)	Contact LD_{50} (µg/bee)
Technical material	0.19	0.05
Encaps. material	1.13	0.12

REMARKS: Contact LD_{50} is the more important indicator of potential pesticide effect on bees. Contact LD_{50} value of the technical material indicates that this chemical is highly toxic to honeybees.

Data derived from tests with encapsulated material cannot be used to evaluate potential effects of non-encapsulated material.

REF. 2J Laboratory studies of various pesticides on honeybees.

MATERIAL: FMC 33297 (permethrin)

RESEARCHER: E. L. Atkins

TEST SPECIES: Honeybee (Apis mellifera)

REGISTRANT: ICI United States, Inc.

DATE OF TEST: 1975

RESULTS: LD_{50} (topical application) was determined to be approximately .16 micrograms per bee (highly toxic).

REF. 3J Effects on honeybees, alkali bees, and alfalfa leafcutting bees by Ambush 2E (Washington)

MATERIAL: Ambush 2E (permethrin)

RESEARCHER: Dr. Carl Johansen

TEST SPECIES: Honeybee (Apis mellifera)
Alkali bee (Nomia melanderi)
Alfalfa leafcutting bee (Megachile (rotuudata) pacifica)

REGISTRANT: ICI United States, Inc.

DATE OF TEST: 1975

RESULTS: (see table on following page)

REMARKS: Table indicates low-moderate hazard to the three bee species with PP 557 at the 0.5 oz. level, high hazard at the 1 oz. level, and high-very high hazard at the 2 oz. level with the 8-hour residues.

RESULTS:

EFFECT OF INSECTICIDE TREATMENTS ON ALFALFA TO ALFALFA LEAFCUTTING BEES (LB), ALKALI BEES (AB), AND HONEY BEES (HB) PULLMAN, WASHINGTON 1975.

Materials	a.i./acre	24-hr % mortalities of bees Caged with treated foliage, age of residues 3 HR LB	3 HR AB	3 HR HB	8 HR LB	8 HR AB	8 HR HB
PP557 2 lb. EC	0.5 oz	79	63	86	24	25	44
PP557 2 lb. EC	1.0 z	93	83	99	64	59	65
PP557 2 lb. EC	2.0 oz	100	90	100	88	78	93
SN 11504 33.3% WP	0.5	98	56	67	74	41	57
CGA 15324 4 lb. EC	1.0	100	97	99	98	52	38
BAY 92114 6 lb. EC	1.0	100	100	100	100	100	100
Untreated check	---	10	10	2	6	7	4

REF. 4 J PP067, PP199, PP557: Toxicity to predator mite Amblyseius fallacis in laboratory trial (Kentucky).

MATERIAL: PP557 (Permethrin)

RESEARCHERS: C. Patterson and J. G. Rodriquez

TEST SPECIES: Amblyseius fallacis

REGISTRANT: ICI United States, Inc.

DATE OF TEST: Summer, 1975

RESULTS: PP557 25 EC, applied at 0.5, 1, and 5 ppm in the laboratory to adult female predator mites, resulted in 100% mortality at the lowest rate.

REF. 5J PP557: Toxicity to predator mite (Kentucky)

MATERIAL: PP557 (permethrin)

RESEARCHERS: C. Patterson and J. G. Rodriguez

TEST SPECIES: Metaseiulus occidentalis

REGISTRANT: ICI United States, Inc.

DATE OF TEST: Summer, 1975

RESULTS: PP557 25 EC was applied at 1, 5, 25, and 50 ppm in the laboratory to adult female predator mites. Results indicate LD_{90} at 1-5 ppm.

REF. 6J Ambush and 199: Laboratory dosage-mortality curves of phytoseiid predator mites Amblyseium fallacis and Metaseiulus occidentalis (Kentucky).

MATERIAL: Ambush

RESEARCHER: G. Patterson and J. G. Rodriguez

TEST SPECIES: A. fallacis and M. occidentalis

REGISTRANT: ICI United States, Inc.

DATE OF TEST: Aug - Sept, 1976

RESULTS: Ambush gave high mortalities of predator mites at very low concentrations. The LC_{50} and LC_{95} values for A. fallacis were < 1 ppm, while the LC_{50} and LC_{95} values for M. occidentalis were less than 2 ppm.

REMARKS: According to the authors, the material PP557 could not be used effectively as an acaricide against Tetranychus urticae (two spotted spider mite), or Panonychus ulmi (European red mite) in a pest management program as its toxicity to both A. fallacis and M. occidentalis compared to the target species is in the order of > 200 magnitude.

REF. 7J PP557: Effects on predatory and parasitic arthropods.

MATERIAL: PP557 (permethrin)

AUTHOR: F. C. Smith

TEST SPECIES:
Metaseiulus occidentalis (pred. mite)
Amblyseius fallacis (pred. mite)
Hippodamia convergens (convergent lady-bettle)
Coccinella septempunctata (seven spot ladybird)
C. undecimpunctata (eleven spot ladybird)
various Coccinellidae
Syrphidae (hover flies)
Aphidius sp. (parasitic wasp)
Bathyplectes curculionis (Parasitic wasp)

REGISTRANT: ICI United States, Inc.

DATE OF TESTS: Not reported

RESULTS: M. occidentalis (dip test): LD_{50} < 1 ppm.

A. fallacis (dip test): LD_{50} < 0.5 ppm.

H. convergens:

Exposed to spray application: LD_{50} <3.9 ppm.

Exposed to treated foliage: LD_{50} approx. 15.6 ppm.

Exposed to treated foliage and treated aphids: LD_{50} <15.6 ppm.

C. septempunctata:

Exposed to spray application:

% of insects affected

Rates ppm	Adults 3-7 days old		Adults 4-6 weeks old	
	2½ hrs after treatment	24 hrs after treatment	2½ hrs after treatment	24 hrs after treatment
25	100	0	0	0
50	80	60	20	0

It is evident from these results that the older beetles were very much less susceptible to the treatments than the younger ones and that the few older individuals that were affected at the high rate had recovered by the 24 hour post treatment assessment. The young beetles were affected at both rates and while there was recovery at the low rate there was less 50% recovery at the high rate by the later assessment. These results would seem to indicate that the seven spot ladybird may be able to tolerate rates of up to 50 ppm of PP557.

C. septempunctata, C. undecimpunctata, and other Cocciuellidae: Field tests

Oil seed rape: Significant reduction in numbers of Cocciuellid beetles at rates of 15 ppm and above, 24 hr. post treatment. Data from 48 hour post treatment assessment was not analyzed.

Cabbage: Numbers of Coccinellid beetles lower in treated plots than in controls (12 days post treatment), but differences not significant.

Syrphidae (hover flies):

Exposed to spray application in field:

All rates (31.2 ppm and above) caused a reduction in the numbers of hover fly larvae, and at 125 ppm they were totally absent.

Aphidius sp:

Exposed to spray application in field:

No significant differences (in number of adults) between treated and control plots at 12 days post-treatment. However, in view of the 12 days that had elapsed between treatment and assessment, coupled with the high mobility of the adults, it is difficult to assess the significance of these results.

Bathyplectes curculionis:

Adult emergence from treated pupae:

Results erratic.

REMARKS: Data from tests with M. occidentalis, A. fallacis, H. convergens, and B. curculionis are summarized from references 4J, 5J, 11J, and 12 J, which are included in this submission.

Tests with C. septempunctata, C. undecimpunctata, various Coccinellidae, hover flies (Syrphidae), and parasitic wasps (Aphidisu sp.) were evaluated with

concentration figures based on weight/ weight ppm calculations.

REF. 8J An evaluation of the effects on insects (Lygus hesperus, and several predator species) and spider mites (Tetrauychus urticae) of an 8-spray program on a 10-day interval with PP557 25% EC and PP383 25% EC applied to cotton, variety Acala SJ4, with the first application on July 7, 1976.

MATERIAL: PP557 25% EC

AUTHORS: D. J. Culver, A. R. Anderson and C. F. Manu

TEST SPECIES: Scolothrips sexmaculatus (six-spotted thrips)
Geocoris pallens (Hemipteran predator)
Nabis americoferris (Hemipteran predator)
Orius tristicolor (Hemipteran predator

REGISTRANT: ICI United States, Inc.

DATE OF TEST: 1976

RESULTS: S. sexmaculatus: There was no significant reduction in the number of larval thrips, as assessed 8 days post treatment.

G. pallens: PP557 caused significant reduction in numbers of this hemiptecau predator at all rates tested (0.8 oz. AI/A, 1.6 oz. AI/A, 3.2 oz. AI/A).

N. americoferris: PP557 caused significant reduction in numbers of this predator at all rates tested (populations temporarily eliminated).

O. tristicolor: PP557 caused significant reduction in numbers of this predator at all rates tested (populations temporarily eliminated).

REF. 9J An evaluation of the effects on insects Lygus hesperus, and several predator species) and spider mites (Tetraychus urticae) of an 8-spray program on a 10-day interval with PP557 25% EC and R111220 25% EC applied to cotton, variety Acala SJ4, with the first application on July 6, 1976.

MATERIAL: PP557 25% EC

AUTHORS: D. J. Culver and A. R. Anderson

TEST SPECIES: Soclothrips sexmaculatus (six-spotted thrips)
Geocoris pallens (Hemipterau predator)
Nabis americoferris (Hemipterau predator)
Orius tristicolor (Hemipterau predator)

REGISTRANT: ICI United States, Inc.

DATE OF TEST: 1976

RESULTS: Applications of PP557 25% EC at all rates tested (0.8 oz. AI/A, 1.6 oz. AI/A, 3.2 oz. AI/A) caused significant reduction in numbers of S. sexmaculatus, N. americoferris, and O. tristicolor. Numbers of G. pallens were lower in treated plots than in controls, but differences were not significant.

REF. 10J Comparative toxicities of some insecticides to the tobacco budworm and its Ichneumonid parasite, Campoletis sonorensis.

MATERIAL: permethrin (technical)

AUTHORS: F. W. Plapp, Jr., and S. B. Vinson

TEST SPECIES: Campoletis sonorensis (parasitic wasp)

REGISTRANT: ICI United States, Inc.

DATE OF TEST: 1976

RESULTS: Permethrin proved to be less selective when compared to other available commercial insecticides against the parasite C. sonorensis.

REF. 11J The influence of permethrin, PP505, Actellic, and Guthion on Hippodamia convergens, the convergent lady beetle.

MATERIAL: permethrin

AUTHORS: M. Tysowsky, T. Gallo, M. Cashwell, and R. Coley

TEST SPECIES: Hippodamia convergens

REGISTRANT: ICI United States, Inc.

DATE OF TEST: 1975

RESULTS: Beetles exposed to treated foliage: LD_{50} approx. 15.5 ppm

Topical application: LD_{50} <3.9 ppm

Beetles exposed to treated foliage and treated aphids: LD_{50} <15.6 ppm

REF. 12J A laboratory bioassay of permethrin (PP557), PP505, and Actellic on Bathyplectes curculionis, a parasite of the alfalfa weevil.

MATERIAL: permethrin

AUTHORS: M. Tysowsky, T. Gallo, M. Cashwell, and R. Coley

TEST SPECIES: Bathyplectes curculionis

REGISTRANT: ICI United States, Inc.

DATE OF TEST: 1975

RESULTS: Permethrin appears to have some effect on parasite emergence in concentrations as low as 62.5 ppm.

REMARKS: Results were highly erratic; these tests should be repeated with larger numbers of pupae.

REF. 13J PP557: Effect on earthworms and soil microarthropods.

MATERIAL: permethrin

AUTHORS: F. D. Smith and J. F. H. Cole

TEST SPECIES: Earthworms (Lumbricus spp. and Allolobophora spp.) Numerous species of soil microarthropods (incl. mites, spiders, Collenbola, and representatives from numerous other orders of Insecta)

REGISTRANT: ICI United States, Inc.

DATE OF TEST: 1975

RESULTS: PP557 was applied to grass plots at 0.5 and 5 kg AI/ha. Earthworms were unaffected by the lower rate and at 5 kg/ha there was only a slight (non-significant) decrease in the population. There was also no effect on the microarthropods at the lower rate but the higher rate reduced the numbers of Gamasid mites (predatory) and caused a significant increase in some of the Collembola.

REF. 13H Ambush 2.0 EC: Control of lygus bug on cotton (California)

MATERIAL: Ambush 2.0 EC

AUTHOR: M. W. Cammack

TEST SPECIES: Big-eyed bug (Geocoris pallens)
Pirate bug (Orius insidiosus)
Lacewing (Chrysopa carnea)
Damsel bug (Nabis ferus)
spiders

REGISTRANT: ICI United States, Inc.

DATE OF TEST: July and August, 1976

RESULTS: See Efficacy Review 10182-RI by Phil Hutton.

REF. 17H Ambush 2.0 EC: Control of lygus bug on cotton (California).

MATERIAL: Ambush 2.0 EC

AUTHOR: M. W. Cammack

TEST SPECIES: Big-eyed bug (Geocoris pallens)
Pirate bug (Orius insidiosus)
Lacewing (Chrysopa carnea)
Damsel bug (Nabis ferus)
spiders

REGISTRANT: ICI United States, Inc.

DATE OF TESTS: July - november, 1976

RESULTS: See Efficacy Review 10182-RI by Phil Hutton.

103.3.1 Bird

DATA REVIEW NUMBER: ES D1

TEST: Avian Subacute Dietary LC_{50} (Upland gamebird)

SPECIES: Bobwhite Quail (Colinus virginianus)

RESULTS: LC_{50} >10000 ppm

With the exception of wing droop at the 10000 ppm dosage level on day 3 of the study, FMC 33297 did not cause symptoms of toxicity or behavioral abnormalities at the dosage levels tested. There was no mortality at any dosage level.

CHEMICAL: FMC 33297 Technical (95.7% a.i.)

TITLE: Eight Day Dietary LC_{50} Bobwhite Quail FMC 33297 Final Report

ACCESSION NO: 096699

STUDY DATE: July 21, 1975

RESEARCHER: Robert Fink
Wildlife Research Div.
Truslow Farms, Inc.

REGISTRANT: FMC Corporation

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Tom O'Brien - 1/23/78

103.3.1 Bird

DATA REVIEW NUMBER: ES E1

TEST: Avian Subacute Dietary LC_{50} (Water Fowl)

SPECIES: Mallard Duck (Anas platyrhynchos)

RESULTS: LC_{50} >10,000 ppm

FMC 33297 did not cause symptoms of toxicity or behavorial abnormalities.

CHEMICAL: FMC 33297 Technical (95.7% a.i.)

TITLE: Eight Day Dietary LC_{50} - Mallard Duck FMC 33297 Final Report

ACCESSION NO: 096699

STUDY DATE: July 21, 1975

RESEARCHER: Robert Fink
Wildlife Research Div.
Truslow Farms, Inc.

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A.

VALIDATOR: Tom O'Brien - 1/23/78

103.4.3 Aquatic Invertebrate

FORMULATION:

% a.i. - Technical (98.7% a.i.) and 25% Emulsifiable Concentrate JF 5855

Chemical Name: Permethrin PP557

VALIDATOR: R. Balcomb (52)

DATE: October 26, 1977

TEST TYPE: Acute Toxicity and Reproduction Studies of Daphnia Magna

TEST ID NO: ES-K

CITATION: Doma, S. and Evered, P. "PP557: Acute Toxicity and Reproduction Studies on First Instar and Ephippia of Daphnia Magna." ICI Plant Protection Division Report No. TMJ1455B (Jan. 1977).

VALIDATION CATEGORY:

I. Acute toxicity to first instar Daphnia Magna: Core

II. Acute toxicity to Daphnia Ephippia: Supplemental

RESULTS: Summary

I. The EC_{50} of Permethrin to first instar Daphnia Magna was determined:

	Technical	25% Concentrate
24 hr. EC_{50}	2.1 ppb a.i.	0.6 ppb a.i.
48 hr. EC_{50}	1.8 ppb a.i.	0.8 ppb a.i.

II. 48-hour EC_{50} of Permethrin to the ephippia of Daphnia Magna

a. Ephippia dried prior to exposure to Permethrin: 0.034 mg/L

b. Ephippia dried after exposure to Permethrin: 0.108 mg/L

VALIDATION CATEGORY/RATIONALE:

I. The study of the acute toxicity of Permethrin to Daphia Magna was determined core as it generally adhered to guidelines and statistical methods were appropriate and accurate.

II. The study of the toxicity of Permethrin to Daphnia Ephippia was deemed supplemental as insufficient information was supplied concerning the method of EC_{50} calculation. In addition, this report can not qualify as a reproduction or life-cycle study as there was not continuous exposure of the organisms to the pesticide.

CATEGORY REPAIRABILITY/RATIONALE:

Part I: NA

Part II: NA

Details and Discussion

I. Acute Toxicity of Permethrin to Daphnia Magna

The acute toxicity of Permethrin (PP557) to first instar Daphnia Magna was determined. The Daphnia were 12 hours old (+ 12 hr.) and were tested at concentrations ranging from 100 mg/L a.i. down to 0.01 ug/L a.i. plus controls. The Daphnia were held at 18^0C ($\pm$ 1^o), were not aerated or fed during the experiment and were allotted ten organisms per beaker. At each concentration level, three test groups were formed with each group containing six beakers of Daphnia (Ref. 1). Survival assessments were made after 24 and 48 hours. This determination was made by gently agitating each beaker and recording the number not free swimming after 5 seconds as affected.

The EC_{50} values and their 95% confidence limits were calculated statistically using

Reviewed review
RB 9/29/87

linear regression on log concentration plotted against a logit transformation of the Daphnia response.

		EC_{50} ppb a.i.	95% Conf. Limits
Technical	24 hour	2.06	1.65 - 2.58
	48 hour	0.6	0.53 - 0.67
Formulated	24 hour	1.82	1.54 - 2.15
	48 hour	0.76	0.66 - 0.88

These data were recomputed by this reviewer and a 48 EC_{50} value of 0.58 ug/L was determined for the technical material and 0.65 ug/L for the formulated product. These values approximate those of the experimenters.

II. Acute Toxicity and Reproduction Studies on Ephippia

Ephippia are the resting eggs of Daphnia. The toxicity of PP557 to this life cycle stage of Daphnia was investigated by exposing the ephippia to concentrations of technical PP557 ranging from 0.001 mg/L to 100 mg/L plus controls for 48 hours. After exposure the ephippia were rinsed and stored in dechlorinated tap water (20°C) until hatching 4-5 days later.

The ephippia were stimulated to an early hatch in the laboratory by drying them for 24 hours. This condition was incorporated into the experimental design by having two test series. In test series A the ephippia were exposed to PP557 after drying and in test series B ephippia were exposed to PP557 before drying.

In both tests the EC_{50} value was statistically calculated from the number of free swimming first instar Daphnia hatched in the treatment and control groups. The log/logit transformations were used as before.

	EC_{50} ppm	95% Confidence Limit
Test A:	0.034	0.022 - 0.047
Test B:	0.108	0.035-- 0.339

The experimenter did not supply a percent affected for each treatment level. When the reviewer calculated these data from the Table 6 and then computed an EC_{50} value the result obtained was at slight variance with that presented in the paper (i.e., for test A: 0.034 ppm vs. 0.056 ppm (.045 - 0.069 ppm).

REFERENCES:

Doma, S. and Evered, P., ICI Report No. TMJ 1405A. Daphnia Magna: Determination of acute toxicity of pesticides (1976).

In both cases ~~for~~ the Technical and Formulated product produced a marked reduction in survial of hatched ephippia ~~occurred~~. for the technical at 0.1 ppm 85% the hatched ephippia died, and for the formulated product at 1 ppm the % of hatched ephippia was reduced. The study on formulated product was conducted using ephippia that were exposed to FMC 33297 without being preconditioned by drying. This indicates that under the most normal condition free swimming daphnia could be killed before producing ephippia, and any ephippia produced may be killed. A third portion of this study was conducted comparing toxicity of PP557 (FMC 33297) in a static bioassay and in a bioassay in the presence of soil. The soil type (pear tree soil) had a Ph 7. (Chemical 25% a.i.)

Test Soil ~~PH~~ pH 7 - EC_{50} = 1.1 ppb (.84 - 1.45 ppb) 95% C.L.

Test standard water - EC_{50} = .47 ppb (.35 - .61 ppb) 95% C.L.

The researcher concludes from these studies that FMC 33297 will kill most free swimming Daphnia, but ephippia will be unharmed at normal application rates, will hatch and re-produce thus re-establishing the colony. This section takes exception to the researchers second conclusion.

103.4 Chronic

103.4.3 Fish

DATA REVIEW NUMBER: ES X1

TEST: Chronic Reproduction Freshwater Fish

SPECIES: Fathead Minnow (Pimephales promelas)

RESULTS: Mean measured concentration of 0.91 and .41 ppb significantly reduced the percent survival of fry during 30 days exposure. Fathead minnows which survived the initial exposure period, demonstrated normal ranges of measured parameters of survival, growth, reproduction and egg hatchability. Based upon the data, the researcher concluded the maximum acceptable concentration of FMC 33297 for fathead minnows is estimated to be >0.30 and <0.41 ppb.

CHEMICAL: FMC 33297 (Technical 95.7% a.i.)

TITLE: Chronic Toxicity of FMC 33297 to the Fathead Minnow (Pimephales promelas)

ACCESSION NO: 096699

STUDY DATE: October 1977

RESEARCHER: E.G. & G. Bionomics
Aquatic Toxicology Lab.
Wareham, Mass.

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: This study followed the protocols of the National Water Quality Lab., Duluth, Minn. Recommended bioassay procedures for fathead minnow (Pimephales promelas) rafinesque chronic tests. EPA 1971. This study also included residue analysis of fish tissue and bio-concentration information.

VALIDATOR: Tom O'Brien - 1/17/78

ADDITIONAL INFORMATION:

During the preliminary pre screen tests to determine levels at which the chronic test should be conducted the following LC_{50} values were determined (mortality corrected for control by Abbotts Formula):

7 day LC_{50} = 1.016 ppb (.943 - 1.094 ppb) 95% C.L.

14 day LC_{50} = .929 ppb (.863 - 1 ppb) 95% C.L.

21 day LC_{50} = .855 ppb (.795 - .92 ppb) 95% C.L.

Statistical analysis by Finney Probit.

Based upon the above results nominal concentrations selected for the chronic test were 1.0, 0.50, 0.25, 0.13 and 0.063 ug/L. During the initial 35 days of the chronic test, mean measured concentrations of FMC 33297 were well below nominal concentrations. This trend increased as fish increased in size and the quantity of food increased. To reverse the trend nominal concentrations were increased to 1.5, 0.75, 0.38, 0.19 and 0.094 ug/L. The measured concentrations, therefore, upon which survival and percent hatch were compared to control, from percent egg hatch to survival to 63 days were as follows:

0 - 35 days: 0.41; 0.14; 0.092; <0.032 and <0.023 ppb

0 - 63 days: 0.55; 0.23; 0.17; 0.083; and <0.043 ppb

Percent hatch and survival was significantly diff. (P = 0.05) at the 0.41 level. After 156 days exposure surviving females were returned to spawning chambers in the ratio (where-ever possible) of 3 males to 7 females. The levels tested at measured concentrations were 0.87, 0.32, 0.22, 0.16 and <0.073 ppb. At the 0.87 ppb level there were

no female survivors. At levels of 0.32 and less; survial, weight, length and eggs/female did not differ significantly from controls. The second generation eggs were then exposed to mean measured concentrations of 0.91, 0.41, 0.30, 0.17, and <0.11 ppb. The percent hatch for these levels did not differ significantly from controls but the survival of second generation fry at >0.41 ppb was significantly different than controls ($P = 0.05$). To observe if there were residual effects of the chemical, fry were transferred from control groups to the 0.41 ppb test level and vice versa. Survival of 0.41 ppb fry transferred to control was significantly greater than those transferred to the 0.41 ppb test level.

Of special note the solvent used in this chronic fish study was Dimethyl Sulfoxide (DMSO). DMSO has several biological properties which usually preclude its use, except for very insoluble chemicals. It tends to be synergistic, causes fat soluble compounds to bioconcentrate more than normal and produces fairly even distribution of the compound in the water table.

103.5.0 Field Toxicity

103.5.1 Field Study

DATA REVIEW NUMBER: ES BB1

TEST: Field Study

SPECIES: Aquatic Organisms

RESULTS: Repeat application of FMC's Pounce and ICI's Ambush by ground methods to a 5 acre cotton field adjacent to a 3 acre pond revealed the following information according to the test lab conclusions.

1. There were no fish killed as a result of the pesticide application.

2. There were no mussel or crayfish mortalities due to the applications.

3. There were no unnatural changes observed in the zooplankton community structure throughout the course of the study.

4. Several macroinvertebrate species were affected by the application but were increasing in numbers by the end of the study.

CHEMICAL: FMC 33297 3.2 EC and ICI PP557 2E (0.2 lb. A.I./Acre)

TITLE: The Application of Two Permethrin Formulations on a Cotton Field Adjacent to an Aquatic Ecosystem

ACCESSION NO: 096699

STUDY DATE: February 1977

RESEARCHER: Union Carbide Environmental Svcs.
Union Carbide Corp.
Tarrytown, New York

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Supplemental

CATEGORY REPAIRABILITY: N.A. - This study did not have any statistical design which would allow for meaningful comparisons between the treated area and corresponding pond and a control pond to provide base line data on seasonal variations of zooplankton population, species dominance and total biomass. See additional information for other comments.

VALIDATOR: Tom O'Brien - 1/21/78

See also the following report for residue information.

TITLE: Determination of FMC 33297 Residues in Pond Study Samples From a FMC 33297 Cotton Environmental Impact Study

DATE: November 15, 1977

RESEARCHER: B. Gana et. al.

FMC Corp.

VALIDATION CATEGORY: Differed to Env. Chem.

ADDITIONAL INFORMATION:

Ground application of the Formulations Pounce and Ambush were made in repeat applications to a cotton field in Beaumont, Texas. These applications were begun on August 6, 1976 and repeated until October 28, 1976. During the course of this study soil, water and sediment samples were taken. Analysis was done by FMC Corporation. In pond water analysis a maximum FMC 33297 residue of 0.25 ppb was found (3-day interval following one application). No building of residue was noted in water samples as the number of applications increased. Water samples taken following periods of significant rainfall (>0.5 inches) contained non-detectable or trace amounts of FMC 33297 residues. Method sensitivity was 0.05 ppb for the parent compound with detectability of 0.025 ppb for each isomer of FMC 33297 in pond water analysis.

Concurred Jean 4/20/78 RD

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On October 7, 1976 a complete loss of the neustic organisms was noted in the test pond (Gyrinidae (Whirlygig Beetles), Gerridae (Water Striders) and Veliidae (smaller Water Striders)). These organisms had been present in the pond during the first two months of the study. At this same time the control pond was not affected. When neustic organisms disappeared analysis of water samples taken on that date showed that residues of FMC 33297 were present in water sampled at the "close" (<0.11 ppb) and "shallow" (0.05 ppb) stations. The organisms in question did not reappear until the end of November. Analysis of water samples taken during this time showed that only trace amounts (<0.05 ppb) of either isomer of FMC 33297 were detected at intermittent intervals.

Other organisms which seemed to be the affected were the Ephemeroptera, Coenagrionidae, Tibellulidae Palaemonidae and Belostomatidae. Members of the oligochaeta and chiromomidae were also noted by this reviewer, as missing during this period as compared to control ponds. The researchers stated that the treatments did not appear to have had a detrimental effect on chironomids and oligochaetes based upon quantitative data (number of macro-invertebrates/unit area). This reviewer takes exception to the statement that no adverse effects are indicated by this data. The study does not provide data from control sites on sandy soil or silt-mud upon which valid scientific conclusions should be drawn. In addition the last application was made on October 28. 1976 and it was not until November 18, 1976 that a significant increase in numbers was noted.

In pond sediment analysis, no residues of FMC 33297 were detected. Method sensitivity was 0.05 ppm. No residues of FMC 33297 were detected in any of the fish samples analyzed. In mussel analysis trace levels (<0.03 ppm) of the CIS isomer of FMC 33297 was found in tissue from one sampling interval. In crayfish analysis residues of FMC 33297 were detected (0.06 ppm) in tissue from one sampling interval. Residues of FMC 33297 were consistently higher in soil samples composited from sampling stations near the pond than in soil samples composited away from the pond. This apparent difference in residue levels suggests movement of the chemical by leaching into run-off water and/or physical movement of soil during periods of signficant rainfall.

RB amended review 9/28/82

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There were no fish reported killed during this study. The research lab listed species of fish trapped and used in the study. The test pond was 3 acres in size and had a maximum depth of 3 feet. Water levels were maintained if necessary by pumping water from a deep water well. The species of fish listed as present in the pond are as follows: Tilapia: Tilapia sp.; Goldfish, Carassius auratus; Golden Shiners: Notemigonus crysoleucas; Channel Catfish: Ictalurus puntatus; Brown Bullheads: Ictalurus melas; White Perch: Morone americana; Largemouth Bass: Micropteus salmoides; Leoggleeye: Lepomis gulosus; Green Sunfish: Lepomis cyanellus; Bluegill: Lepomis macrochirus and Red Swamp Crayfish: Procanibarus clarkii. In addition freshwater mussels (Leptodea sp) were collected to supplement the crayfish samples. The research lab did not qualify or quantify their conclusions concerning fish mortality nor did they report the observation intervals. The test fish populations were not compared to control populations.

Zooplankton were sampled from 13 sites in the test pond (11 times each; 1, 2, or 3 days after treatment of the cotton field with either FMC 33297 or ICI PP557). Zooplankton were collected, counted and identified to species whenever possible. Total numbers were summarized for rotifers, cladocerans and copepods. No significant pesticide effects were identified by the researchers or this reviewer. Fluctuations that occurred in the plankton community have been described as the population dynamics expected in the transition from summer to fall. This no doubt was occurring but the lack of any control plankton data rules out such a conclusive statement. The statement by the researcher that there were no changes in the zooplankton community structure (species dominance) may be correct, but it is not valid to make any conclusive statement about there not being any adverse ecological effect (actual biomass) in lieu of a statistical analysis of the treated area versus a control area. This study displays a lack of good scientific planning in this respect.

It would be just as valid to draw other conclusions from the data presented. It could be argued that the decrease in numbers of rotifers and copepods in the October 7th sample and later samples occurred at the same time as the disappearance

Amended Review
RB Jun 9/29/87

of the neustic organisms from the test pond, and without the benefit of control data the effect of the pesticide treatment should not be ruled out as being causitive. Other variables were also added at this time: the pond had water added from a deep water well, the temperature of the water was decreased, and a significant increase in water alkalinity was noted on September 21st. With all of these variables and a lack of statistical analysis and sound scientific planning this portion of the study concerning changes in species dominance of zooplankton communities should be considered supplemental information.

The conclusion that this reviewer has derived from this study is that adverse ecological effects could be noted as the result of food chain interruption and removal of biomass. These chemicals would also appear to have the most serious impact on the water-air surface interface and benthic interface of pond ecosystems. It is also apparent from this study that ground application and even more, aerial application, will result in aquatic contamination. This contamination may be more severe when the ratio of land surface to water surface treated is increased over that utilized in this study or geographic sites favor even more surface run-off or leaching into water.

Amended review
Jeer 9/21/76
TCB

103.5.3 Testimonials

DATA REVIEW NUMBER: ES GG 1 through 12

TEST: Testimonial Letters

NATURE: Adverse ecological effects to aquatic environments

RESULTS: All testimonial letters stated the conclusion that fish kills or other ecological detrimental effects were not noted during the course of the respective state sec. 18 exemption programs using Pounce to control Bollworm and Tobacco Budworm in cotton.

CHEMICAL: FMC 33297

TITLE: N.A.

ACCESSION NO: 096699

STUDY DATE: 1977 growing season

RESEARCHER: N.A.

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: N.A.

CATEGORY REPAIRABILITY: N.A. - These letters of testimonial do not provide any quantitative on qualitative hard numbers to back up the conclusions drawn. The interval after application of pesticide to when observations are made is not given nor is the intensity of effort to observe ecological effects listed in any of the testimonials.

LISTING OF TESTIMONIALS: State

John H. Kirkpatrick, Director
Division of Agricultur Chem.
State of Alabama Department of Agr. and Ind.

John A. Bedford, Asst. Dir.
Arizona Comm. of Agr. & Horticulture

Ralph Pay, Director
Div. Feeds, Fertilizers & Pesticides
Arkansas State Plant Board

John C. Hillis, Chief
Pesticide Reg. & Agr. Productivity
California Dept. of Food & Agriculture

J. R. Conlen, Director
Pesticide Div.
Georgia Dept. of Agriculture

Kenneth C. Smith, Chief
Fish Division
Louisiana Wildlife & Fisheries Commission

Robert A. LaFleur, Executive Secretary
Louisiana Stream Control Commission

Jack Coley, State Entomologist
Mississippi Dept. of Agriculture & Commerce

James R. Collins, Pesticide Specialist II
North Carolina Dept. of Agriculture

James E. Gassaway, Supervisor
Pesticide Registration
Oklahoma State Dept. of Agriculture

L. H. Senn, Director
College of Agricultural Sciences
Clemson University

David A. Ivie, Director
Agricultural & Environmental Science Div.
Texas Dept. of Agriculture

103.4.0 Chronic Toxicity

103.4.2 Bird

DATA REVIEW NUMBER: ES W1

TEST: Avian Reproduction - Wild Waterfowl

SPECIES: Mallard Duck (Anas platyrhynchos)

RESULTS: PP557 was fed to mature Mallard ducks at dietary concentrations of 5 ppm and 25 ppm throughout a One-Generation Reproduction Study; and had no effect on the overall reproductive success of the birds.

Based on the results of this study, environmental levels of up to 25 ppm of PP557 do not present a reproductive hazard to the Mallard duck.

CHEMICAL: PP557 Technical (92.4% A.I.)

TITLE: One Generation Reproduction Study - Mallard Duck PP557 Final Report Act 125.71

ACCESSION NO: 096699

STUDY DATE: December 2, 1976

RESEARCHER: Robert Fink
Wildlife International

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A. - Levels tested are equivalent to those that will occur at application rate of 0.2 lb/A.I./Acre FMC 33297 3.2 EC

VALIDATOR: Tom O'Brien - 1/28/78

ADDITIONAL INFORMATION:

√

Reproductive Data - Mallard Duck

	Controls	PP557 (ppm) 5	25
Eggs Laid	660	541	786
Eggs Cracked	12	11	13
Eggs Set*	608	493	734
Viable Embryos	523	446	640
Live Three-Week Embryos	510	438	627
Normal Hatchlings	369	300	441
14-Day-Old Survivors	352	283	431

*Excludes those cracked and those removed for eggshell thickness analysis. The above differences were not statistically significant ($p < 0.05$).

	Expected Values	Controls	PP557 (ppm) 5	25
Eggs Laid Per Hen In Eight Weeks	28-38	26.4	21.6	31.4
Eggs Cracked Of Eggs Laid (%)	0.6-6.%	1.8	2.0	1.6
Viable Embryos Of Eggs Set (%)	85-98%	86	90	87
Live Three-Week Embryos Of Viable Eggs (%)	97-99%	98	98	98
Normal Hatchlings Of Live Three-Week Embryos (%)	50-90%	72	68	70

14-Day-Old Survivors Of Normal Hatchlings (%)	94-99%	95	94	98
14-Day-Old Survivors Per Hen	11-14	14.1	11.3	17.2

Statistical analysis based on data in Table 1a. The above differences were not statistically significant ($p < 0.05$).

Eggshell Thickness Data
Mallard Duck

	Expected Values	Controls	PP557 5	(ppm) 25
No. of Eggs Analyzed		40	40	40
Mean Shell Thickness (mm)	0.31-0.33	0.323	0.312	0.327

The above differences were not statistically significant ($p < 0.05$).

103.4.0 Chronic Toxicity

103.4.2 Bird

DATA REVIEW NUMBER: ES V1

TEST: Avian Reproduction Upland Gamebird

SPECIES: Bobwhite Quail (Colinus virginianus)

RESULTS: PP557 was fed to mature Bobwhite quail at dietary concentrations of 5 and 25 ppm throughout a One-Generation Reproduction Study; and had no effect on the reproductive success of the birds.

Based on the results of this study; environmental levels of up to 25 ppm of PP557 do not represent a hazard to the Bobwhite Quail.

CHEMICAL: PP557 Technical (92.4% a.i.)

TITLE: One-Generation Reproduction Study Bobwhite Quail PP557 Final Report

ACCESSION NO: 096699

STUDY DATE: December 6, 1976

RESEARCHER: Robert Fink
Wildlife International Ltd.

REGISTRANT: FMC Corp.

VALIDATION CATEGORY: Core

CATEGORY REPAIRABILITY: N.A. - Levels tested are equivalent to those that will occur at application rate of 0.2 lb A.I./Acre with FMC 33297 3.2 EC.

VALIDATOR: Tom O'Brien - 1/28/78

ADDITIONAL INFORMATION:

Reproductive Data - Bobwhite Quail

	Controls	PP557 (ppm) 5	25
Eggs Laid	566	614	655
Eggs Cracked	70	66	44
Eggs Set*	449	500	565
Viable Embryos	407	430	441
Live Three-Week Embryos	399	422	430
Normal Hatchlings	358	364	395
14-Day-Old Survivors	328	338	360

*Excludes those cracked and those removed for eggshell thickness analysis. The above differences were not statistically significant (<0.05).

	Expected Values	Controls	PP557 (ppm) 5	25
Eggs Laid Per Hen In Eight Weeks	28-38	23.6	25.6	27.3
Eggs Cracked Of Eggs Laid (%)	0.6-2.0%	12.4	10.7	6.7
Viable Embryos Of Eggs Set (%)	75-90%	91	86	78
Live Three-Week Embryos Of Viable Eggs (%)	97-99%	98	98	98
Normal Hatchlings Of Live Three-Week Embryos (%)	50-90%	90	86	92
14-Day-Old Survivors Of Normal Hatchlings (%)	75-90%	92	93	91
14-Day-Old Survivors Per Hen	11-14	13.7	14.1	15.0

Statistical analysis based on data in Table 1a. The above differences were not statistically significant ($p<0.05$).

Eggshell Thickness Data
Bobwhite Quail

	Controls	PP557 (ppm) 5	PP557 (ppm) 25
No. Of Eggs Analyzed	48	48	48
Mean Shell Thickness (mm) 0.20-0.22	0.210	0.209	0.214

The above differences were not statistically significant ($p<0.05$).

104.0 Hazard Assessment

104.1 Discussion

The maximum application rate of pounce 3.2 EC for any one application will be equivalent to 0.2 lbs. A.I./acre. The request calls for up to 15 repeat applications a year by aircraft. The initial residue on cotton foliage (short grass) is estimated to be approximately 48 ppm. The residue due to repeat applications and the products half life on plants (photo-degradation) cannot be estimated at this time. Aquatic residue from aerial application as a result of a direct application to adjoining bodies of water or watersheds are listed below.

	6 inch	1 foot	2 feet	3 feet
Appl. rate .2 lb. A.I.	147 ppb	73.5 ppb	36.7 ppb	24.5 ppb

4 feet	5 feet	6 feet
18.3 ppb	14.7 ppb	12.2 ppb

The resultant aquatic residue resulting from surface transport and soil leaching is an undeterminate quantity due to the different sizes and properties of watersheds. If 1/10 of the resultant spray from aerial or ground application were to reach adjoining watershed the following water concentrations might occur.

	6 inches	1 foot	2 feet
	14.7 ppb	7.35 ppb	3.67 ppb

Appl. rate .2 lbs. A.I.	3 feet
	2.45 ppb

If 1/100 of the drift reached the stream the following water concentrations would be anticipated.

	6 inches	1 foot	2 feet
0.2 lbs. A.I.	1.4 ppb	.73 ppb	.36 ppb

An estimate of possible aerial exposure to adjoining watersheds can be postualted. The purpose of this estimate is to give the reviewer a type of benchmark upon which to evaluate potential hazard. Information currently available con-

amended review
Jeva 9/29/87
KB

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cerning wind-drift indicates that up to 50% of the material applied does not end up on the target site. It is therefore, reasonable to estimate that 1% to 10% aquatic contamination at the use rate might occur as shown above.

A wind drift model (Holst, EEB) was also used to estimate the aquatic hazard presented by aerial application. Given an application rate of 0.2 lbs/A, a plane height of 10 feet and a wind speed of 5 mph, the program predicted that a 6" layer of water 197 ft. from the target swath could contain a concentration of pesticide equal to the LC_{50} of Bluegill Sunfish (0.8 ppb). Given a wind speed of 10 mph this distance would be increased to 394 ft. Such a model assumes no droplet evaporation or thermal current displacement.

104.1.1 Likelihood of Exposure to Non-Target Organisms

The use of Pounce as an insecticide (Permethrin) to control bollworm, budworm, boll weevil, leaf-perforator and Lygus on cotton will produce the opportunity of environmental exposure to a wide variety of non-target species and ecosystems. In 1976 the estimated geographic area in the United States planted to cotton was greater than 11,610,000 acres scattered in 19 states. These States could generally be classified as the southern tier of agricultural effort. The land utilized in this type of agriculture is of varying soil types, from flood plain alluvial soil to upland soil types. The agricultural practices vary from State to State. This type of agriculture is characterized by large dependence upon irrigation and aerial spraying of chlorinated hydrocarbon compounds to control pests. These agricultural practices have been historically credited with many fish kills.

Amended review
Jwa 9/19/79
RB 63

The use of Pounce as an insecticide will result in exposure of myriad species of birds and mammals. The major wildlife exposure will occur on field edges, from drift, rather than in the cotton itself. However, the acute hazard is expected to be minimal from direct exposure to these species due to the low acute toxicity of the compound. The major impact that may be felt, however, is a removal of insect biomass and the resultant impact upon species of insectivores that are trying to produce broods at this time. The repeat applications of Pounce will cause a continual removal of biomass throughout the growing season and may cause suppression of natural insect predator populations. Available data do not indicate any chronic toxicity to birds or mammals associated with permethrin, at least as far as reproduction is concerned. Permethrin has behavioral patterns similar to DDT concerning its solubility in water and solubility in body fat and therefore may have high bio-accumulation potential. Aquatic exposure with this compound and use pattern is a certainty at target sites and also in other locations due to trans-evaporation and transport in the stratsphere. As the half life of the parent compound is not well known it is premature to rule out this type of environmental movement. The bio-accumulation potential and aquatic contamination could result in exposure to higher food chain organisms that may be more susceptible to the compound. The compound is biologically active at levels below the levels of detectability and it may not be identified as a hazard until residues build up. The upper food chain species (of concern) in aquatic environments are mainly fish eating birds. It may be appropriate for this compound to have research conducted utilizing a fish eating species to determine if reproductive harm is possible.

Aquatic contamination is the major concern for the use of permethrin. The compound is biologically active at very low levels to species of fish and aquatic invertebrates. A brief summary of the toxicity is presented below for some aquatic species.

Amended review
Jen 9/29/92

Bluegill = 6.1 ppb LC_{50}

Bluegill = 2.5 ppb LC_{50}

Rainbow = 9.8 ppb LC_{50}

Daphnia = 39 ppt LC_{50}

Daphnia = 320 ppt LC_{50}

Daphnia = 7.2 ppb LC_{50}

Daphnia = 112 ppt LC_{50}

Pink Shrimp = 354 ppt LC_{50}

Fiddler Crab = 2.39 ppb LC_{50}

Fathead Minnow MATC >0.30 <0.41 ppb

The above values are based upon studies conducted utilizing the technical. The implication of these low toxicity values, in this reviewers opinion, is that this product cannot be used without producing severe ecological harm to aquatic eco-systems. It can be anticipated that with aerial application, residues are possible in watersheds adjoining cotton fields immediately after application that will exceed the LC_{50} of the above mentioned species. Historically cotton insecticide applications with chemicals that have higher LC_{50} values than permethrin have produced fish kills. Fish kills have resulted from normal agricultural practices. In this reviewers opinion the registrant has not provided any field data that refutes this potential hazard.

The one field study that was provided for support of this use pattern did not utilize aerial application of the insecticide and did not treat up to watershed edges as normal agriculture practices will. Residues that will occur in surface water

Amended review
Jews 9/29/78
RCB

as a result of surface transport after rainstorms are not identifiable. It is apparent to this reviewer, however, as a result of the field study, aquatic contamination will occur even under what must be considered as minimal hazard conditions and this contamination will have serious environmental impact upon surface dwelling aquatic insects and benthic insects.

The field study did not utilize a control pond and therefore it is not valid to associate the large reduction in numbers of cladocerns, rotifers and copepods that occurred with seasonal variations. The noted reduction in these populations occurred at the same time as a rain storm associated with the reduction of neustic insects. It may be more valid to associate the reduction in numbers of the zooplankton with pesticide contamination. If this is the cause of the reduction it can be anticipated that aerial application of the pesticide will result in continual exposure and suppression of these populations. The continual removal of biomass from the lower food chain organisms would certainly result in a suppression of a viable sport fishery. The compound is also highly toxic to shrimp and crabs and these species are an important food source and economic resource in areas near where cotton is grown.

The available information from the chronic fish study indicates that a chronic hazard to fish does not exist as far as spawning ability is concerned. However, this product is toxic to species at the level of solubility, and as it has been suggested, the parent compound may be continually reentering the water column up to the level of solubility. It is not clear to this reviewer what the implications are to higher aquatic food chain orgamisms that ingest species of cladocerns, rotifers, shrimp, crayfish, etc. that have bio-accumulated the compound. This reviewer feels that a food chain study to

Amended review
Jwa 9/25/78
TJ

66

identify hazard to upper levels of the biotic community (namely predatory fish) is in order. Information available from Environmental Chemistry indicates that bio-accumulation up to the LC_{50} levels can occur in whole body fish tissue.

The information provided in the discussion on possible residues that might occur can be used to sum up aquatic hazard. Based upon the acute toxicity values available a severe hazard exists to aquatic organisms if 1% drift occurs to water and this is certainly a realistic value. If 10% drift occurs to adjoining water the LC_{50} values for all species will be exceeded in 6 inches of water.

104.1.1 Likelihood of Exposure to Beneficial Insects

In comparison to most other recently developed pesticides, Ambush (permethrin) has been tested quite extensively with regard to its effects on nontarget insects. As a potent broad-spectrum insecticide, it has proven highly toxic to nearly all nontarget insects tested, including the following: honeybee (Apis mellifera), alkali bee (Nomia melauderi), alfalfa leafcutting bee (Megachite pacifica), predatory mites (Amblyseius fallacis and Metaseiulus occidentalis), lady bettles (Hippodomia convergens, Coccinella septempunctata, and C. undecimpunctata), hover flies (Syrphidae), thrips (Scolothrips sexmaculatus), and hemipterau predators (Geocoris pallens, Nabis americoferris, Orius tristicolor).

Application of Ambush 2E to cotton at proposed rates can be expected to have strong adverse effects on populations of nontarget insects. There is clear potential for massive destruction of important pollinators. In regard to predators, elimination of important predatory mites is a distinct possibility. This could result in explosive increases in populations of phyto-phagous mites, necessitating additional applications of acaricides.

Amended version
Jcw 9/29/87
TB

We would expect that the adverse effects of a single application of Ambush would be short-lived. Studies have indicated that populations of non-target insects can recover quite rapidly from the effects of a single application. Under the proposed use pattern, however, there is no time for recovery; applications can be made every 5 to 7 days, or as needed, for a total of 15 applications per season. Such usage would result in the almost continuous presence of permethrin in the environment, in concentrations strong enough to continuously exert pressure on populations of nontarget insects.

Another point should be mentioned in regard to effects on nontarget insects; there is no data for effects on aquatic insects. Application of Anbush to vast areas of cropland, as proposed, would certainly result in contamination of aquatic habitats. Data derived from bioassays with representative aquatic insect species are needed for a valid beneficial insect hazard assessment.

In conclusion, it is clear that widespread use of permethrin, at the proposed rates and following the proposed spray schedule, will result in substantial decreases in populations of nontarget insects in cotton.

A. W. Vaughan
March 20, 1978

104.1.2 Endangered Species Considerations

Endangered fish in the following cotton growing states were reviewed as to the proximity of cotton to their habitat and the potential for pesticide pollution:

Alabama	Georgia	Tennessee
Arkansas	Florida	Virginia
Arizona	Nevada	N. Carolina
California	Kentucky	S. Carolina
Texas	New Mexico	Missouri
Louisiana	Oklahoma	

Evidence indicates that the potential exists for the following endangered fish to be negatively affected by run-off or drift from permethrin applications to cotton.

1. Slackwater Darter

   State: Alabama

   Watercourses: Flint River (Madison), Cypress Creek (Lavderdale)

   Counties: Madison (78,000 acres cotton)
   Lauderdale (17,990 acres cotton)

   In all Alabama acres cotton, corn, soybeans and wheat are grown. The species spawns on grass after flooding which could increase likelihood of contact with the pesticide.

2. Gila Topminnow

   State: Arizona

   Watercourses: Gila River

   Counties: Pinal (130,000 acres cotton)
   Maricopa (158,000 acres cotton)
   Graham (12,000)
   Cochise (21,900)

   Distribution of this species is spotty throughout Gila River drainage basin. Arizona Fish and Game Dept. (Bill Silvey) has stated that the potential for cotton applications to impact may exist for populations Northwest of Tuscon and Northwest of Safford.

3. Bayou Darter

   State: Mississippi

   Watercourses: Bayou Pierre

   Counties: Copiah (2925 acres cotton)
   Claiborne (2509 acres cotton)

   Stream borders some agricultural areas.

4. Pahrump Killifish

   State: Nevada

   Watercourses: Manse Spring, Corn Creek Springs and Shoshone Ponds

   County: Nye (1707 acres)

   Manse spring has dried up but plans are to reintroduce it from Corn Creek Springs and Shoshone Ponds. Cotton is grown near Manse Springs, impact at other locations is unknown.

5. Alabama Cavefish

   State: Alabama

   County: Lauderdale (17,900 acres cotton)

   Watercourses: Key Cave

   Investigators feel pollution of groundwater by pesticides is a major threat.

6. Leopard Darter (Threatened)

   State: Oklahoma

   Counties: McCurtain (1200 acres cotton)
   Pushataha (no cotton)
   LeFlore (5 acres cotton)

   Watercourses: Little River

7. Comanche Springs Pupfish

   State: Texas

   Counties: Reeve (38,587) acres cotton)
   Pecos (13,257)

   Watercourses: Phantom Creek
   San Soloman Creek

Species inhabits irrigation canals in agricultural area. Cotton is grown here, pesticide impact quite possible.

8. Pecos Gambusia

State: Texas

Counties: Pecos (13,000 acres cotton)
Reeves (38,587)

Watercourse: Pecos River

Cotton grown in area, could pose a threat.

9. Shortnose Sturgeon

State: Georgia

Counties: Appling (25 acres cotton)
Jeff Davis (116)
Montgomery (141)
Tattnal (364)
Toombs (849)

Watercourses: Savannah River (confirmed)
Ogeeche River (suspected)
Altamaha River (confirmed)

State: South Carolina

Counties: (with significant cotton only)
Berkeley (660 acres)
Colleton (189)
Florence (4400)
Hampton (1200)
Horry (474)
Williamsburg (1700)
Dorchester (198)

Watercourses: Confirmed in the Askepoo River

The Shortnose Sturgeon migrates up coastal rivers in early spring to spawn. Its exact distribution is unknown. The impact of cotton insecticides is not clear, however, water pollution in general is considered a factor in its decline.

104.1.3 Adequacy of Toxicity Data

I. Adequate Studies

A. The six basic data requirements have been met for the technical material.

B. The warm and cold water fish acute LC_{50} for the formulated product basic data requirements have been met.

C. The aquatic invertebrate acute LC_{50} for the formulated product data requirement has been met.

D. The shrimp and crab acute LC_{50} data requirements have been met for both the technical material and the formulated product.

E. The Chronic Fish Reproduction Study on fathead minnows has satisfied the data requirement for the technical material.

F. The Avian Reproduction data requirements for mallard duck and bobwhite quail for the technical material have been met.

II. Supplemental Studies

The following studies have been classified supplemental due to either test method inadequacies or failure to identify data requirement objectives.

A. The oyster shell deposition study for both the technical and formulated product is supplemental. This study only used two test levels and did not identify an EC_{50} for shell deposition. A no effect level was suggested in the course of the studies. (Bionomics 1975).

B. The aquatic invertebrate chronic studies, utilizing both the technical and formulated product, data requirements have not been met. The study submitted, Doma and Evered ICI Plant Protection Div. Report # TMJ 1455B, January, 1977 was

not a complete life cycle study as is required to identify hazard. The study was an ephippia toxicity study.

C. The field study that was submitted is considered as supplemental information. This study is inadequate in test design. The study design did not utilize control plots or samples upon which conclusions relating to ecological impacts were made, and therefore, any conclusion drawn from trends observed have no support statistically and could as easily resulted from pesticide exposure as from seasonal variation. The field study did not represent normal application exposure as the pesticide was applied only by ground equipment. This use pattern will require field studies conducted in a manner that approximates the actual agriculture methods utilizing aerial spraying in order to properly identify the environmental hazard to aquatic ecosystems.

D. The testimonial letters are supplemental information as the conclusions are not accompanied by quantitative data or even the letter writers' definition of what is considered by him to be environmental damage.

104.1.4 Additional Data Required

The following studies are required by the Environmental Safety Section before a decision concerning the environmental hazard associated with this use pattern can be made. These studies are required due to the biological activity of the compound at levels undetectable in the enviornment (ppt), the compounds ability to bio-accumulate, its neurotoxic mode of action, its relative aversion to water and its ability to associate with organic matter and thus end up in the benthic zone of lakes and rivers. The one field study also gives proof that aquatic contamination will occur even

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under conditions that would have to be considered as minimal exposure. When this product is applied by aircraft the likelihood of aquatic exposure will increase substantially and the repeat applications will provide continual exposure.

A. An Aquatic Organism Toxicity Food Chain and Residue Study will be required utilizing the technical grade of the active ingredient. The above mentioned conditions plus an octanol water partition coefficient greater than 1000 and a half life in water of greater than 4 days triggers this study. The toxicity and residue studies will be required utilizing a bottom feeding species (channel catfish), a predator fish representative of warm water habitats (bass or bluegill), a species of molluscs (oyster or clam), crustaceans (e.g. Daphnia spp., Gammarus spp, or crayfish), and a species of nymph (mayfly).

1. Examples of acceptable protocols follows:

(1) Anonymous. 1977. A biological model for estimating the uptake, transfer, and degradation of xenobiotics (pesticides) in an aquatic food chain (Modified from original manuscript authored by B. T. Johnson and R. A. Schoettger in Report to EPA by American Institute of Biological Sciences, Contract No. 68-01-2457). pp in Acceptable protocols and information for the toxicological testing of aquatic organisms for responses to pesticides. U.S. Environmental Protection Agy., 401 M St., S.W., Washington, D.C. 20460.

(2) Macek, K. J., M. E. Barrows, R. F. Frasny, and B. H. Sleight, III. 1975. Bioconcentration of

14 pesticides by bluegill sunfish during continuous exposure. Pages 119-142, in G. D. Veith and D. E. Konasewich, Eds. Structure-activity correlations in studies of toxicity and bioconcentration with aquatic organisms. Proceedings of a Symposium, Burlington, Ontario, March 11-13, 1975. Sponsored by Standing Committee on Scientific Basis for Water Quality Criteria of the International Joint Commission's Research Advisory Board.

B. An aquatic invertebrate life cycle test is still required. This study should be conducted on Daphnia and must be a complete life cycle utilizing the technical grade of the active ingredient. The life cycle test requires that the aquatic organisms be cultured in the test substance from egg to egg or from one stage of the life cycle to the same stage in the next generation.

1. Examples of acceptable protocol follow:

(1) Biesinger, K.E. 1972(2). Procedure for Daphnia macna tests in a standing system. U.S. EPA, Environmental Research Laboratory, Duluth, Minnesota.

Additional information may be found in the following references:

Biesinger, K. E. 1974(c). Culturing methods for Daphnia and certain other cladocerans. U.S. EPA, Environmental Research Laboratory, Duluth, Minnesota.

C. A field test monitoring the effects of aerial applications that are repeated

amended review per 9/29/78 RB

throughout the growing season (15 applications). The field study should be conducted using the formulated product. Population trends are to be monitored utilizing both test ponds and control ponds in a fashion that permits valid statistical analysis.

1. Acceptable protocols may be developed from the following reference and should be submitted to the ESS for review prior to initiation.

   Anonymous 1977 Field Testing Techniques (modified from report to EPA by American Institute of Biological Sciences. Contract No. 68-01-2457) in acceptable protocols and information for the toxicological testing of aquatic organisms for response to pesticides. U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460.

105.0 Classification

N.A. at this time.

106.0 RPAR Criteria

N.A. at this time.

107.0 Conclusions

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TCB

107.1 Environmental Fate and Toxicology

1. The Environmental Safety Section has enough available human toxicology data to utilize in an assessment of hazard to wild species of mammals that would be exposed.

2. The Environmental Fate Review has not been completed at this time. The Environmental Safety Section has proceeded with a hazard assessment based upon the available information from past Environmental Chemistry reviews and from personal communication with Russ Cook, Environmental Chemistry Section. When the requested data is supplied and the final Environmental Fate review is received a final hazard assessment can be made.

107.2 Labeling

N.A.

107.4 Data Adequacy

I. Adequate Studies

A. The six basic data requirements have been met for the technical material.

B. The warm and cold water fish acute LC_{50}'s for the formulated product basic data requirements have been met.

C. The aquatic invertebrate acute LC_{50} for the formulated product data requirement has been met.

D. The shrimp and crab acute LC_{50} data requirements have been met for both the technical material and the formulated product.

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RB

E. The Chronic Fish Reproduction study on fathead minnows has satisfied the data requirement for the technical material.

F. The Avian Reproduction data requirements for mallard duck and bobwhite quail for the technical material have been met.

II. Supplemental Studies

The following studies have been classified supplemental due to either test method inadequacies or failure to identify data requirement objectives.

A. The oyster shell deposition study for both the technical and formulated product is supplemental. This study only used two test levels and did not identify an EC_{50} for shell deposition.

A no effect level was suggested in the course of the studies. (Bionomics 1975).

B. The aquatic invertebrate chronic studies utilizing both the technical and formulated product data requirements have not been met. The study submitted, Doma and Evered ICI Plant Protection Division Report # TMJ1455B, January 1977 was not a complete life cycle study as is required to identify hazard. The study was an ephippia toxicity study.

C. The field study that was submitted is considered as supplemental information. This study is inadequate in test design. The study design did not utilize control plots or samples upon which conclusions relating to ecological impacts were made, and therefore any conclusion drawn from trends observed have no support statistically and could as easily resulted from pesticide exposure as from seasonal variation. The field study did not represent normal ~~aerial~~ application exposure as only the pesticide was applied by ground equipment. This use pattern will require

field studies conducted in a manner that approximate the actual agriculture methods utilizing aerial spraying in order to properly identify the environmental hazard to aquatic ecosystems.

D. The testimonial letters are supplemental information as the conclusions are not accompanied by quantitative data or even the letter writers' definition of what is considered by him to be environmental damage.

107.5 Data Requests

The following studies are required by the Environmental Safety Section before a decision concerning the environmental hazard associated with this use pattern can be made. These studies are required due to the biological activity of the compound at levels undetectable in the environment (ppt) and the compounds ability to bio-accumulate, its neuro-toxic mode of action, its relative aversion to water and its ability to associate with organic matter and therefore end up in the benthic zone of lakes and rivers. The one field study also gives proof that aquatic contamination will occur even under conditions that would have to be considered as minimal exposure. When this product is applied by aircraft the likelihood of aquatic exposure will increase substantially and the repeat applications will provide continual exposure.

A. An Aquatic Organism Toxicity Food Chain and Residue Study will be required utilizing the technical grade of the active ingredient. The above mentioned conditions plus an octanol water partition coefficient considered high and a half life in water of greater than 4 days triggers this study. The toxicity and residue studies will be required utilizing a bottom feeding species (channel catfish, a predator fish representative of warm water habitats, (bass or bluegill) a species of molluscs (oyster or clam) crustaceans (e.g. Daphnia spp.,

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TCB

Gamnarus spp, or crayfish) and a species of nymph (mayfly).

1. Examples of acceptable protocols follow.

   (1) Anonymous. 1977. A biological model for estimating the uptake, transfer, and degradation of xenobiotics (pesticides) in an aquatic food chain (Modified from original manuscript authored by B. T. Johnson and R. A. Schoettger in Report to EPA by American Institute of Biological Sciences, Contract No. 68-01-2457). pp in Acceptable protocols and information for the toxicological testing of aquatic organisms for responses to pesticides. U.S. Environmental Protection Agency, 401 M St., S.W. Washington, D.C. 20460.

   (2) Macek, K. J., M. E. Barrows, R. F. Frasny, and B. H. Sleight, III. 1975. Bioconcentration of 14 C-pesticides by bluegill sunfish during continuous exposure. Pages 119-142, in G.D. Veith and D. E. Konasewich, Eds. Structure-activity correlations in studies of toxicity and bioconcentration with aquatic organisms. Proceedings of a Symposium, Burlington, Ontario, March 11-13, 1975. Sponsored by Standing Committee on Scientific Basis for Water Quality Criteria of the International Joint Commission's Research Advisory Board.

B. An Aquatic Invertebrate Life Cycle Test is still required. This study should be conducted on Daphnia and must be a complete life cycle utilizing the technical grade of the active ingredient. The life cycle test requires that the

aquatic organisms be cultured in the test substance from egg to egg or from one stage of the life cycle to the next generation.

1. Examples of acceptable protocol follow.

   (1) Biesinger, K. E. 1972(2). Procedure for Daphnia magna tests in a standing system. U.S. EPA, Environmental Research Laboratory, Duluth, Minnesota.

   (2) Biesinger, K.E. 1974(b). Procedure for Daphnia magna chronic tests in flowing system. U.S. EPA, Environmental Research Labortary, Duluth, Minnesota.

   Additional information may be found in the following reference: Biesinger, K.E. 1974(c). Culturing methods for Daphnia and certain other cladocerans. U.S. EPA, Environmental Research Labortory, Duluth, Minnesota.

C. An. Actual Field Test under representitive field conditions that occur as a result of aerial applications that are repeated throughout the growing season (15 applications). The field study should be conducted using the formulated product and population trends are to be monitored utilizing both test ponds and control ponds in a fashion that lends the test results to statistical analysis, and not unsubstantiated speculation concerning the ~~courses~~ causes of trends observed on populations of rotifers, cladocerns, benthic and neustic (surface dwelling aquatic insects) organisms and species of fish exposed.

1. Acceptable protocols may be developed from the following reference and

should be submitted to the ESS for review prior to initiation.

Anonymous 1977 Field Testing Techniques (modified from report to EPA by the American Institute of Biological Sciences. Contract No. 68-01-2457) in Acceptable protocols and information for the toxicological testing of aquatic organisms for response to pesticides. U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460.

D. An acute study using macroinvertebrates indigenous to the cotton growing region, e.g. mayflies, stoneflies, etc. This information is required due to the observed aquatic insect kills associated with the field study that was submitted.

107.7 Recommendations

The Environmental Safety Section can not make a final determination of the hazard associated with this use pattern until additional information becomes available. The specific items that are lacking are summarized below.

1. The Environmental Fate Review describing the fate of Permethrin in the environment has not been completed. The Environmental Safety Section has proceeded to this stage of the review so that the Registrant can initiate studies to answer Environmental Safety concerns. A final determination of hazard will

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TB

be made when the additional studies requested have been received and the Environmental Chemistry Review is completed.

2. The Environmental Safety Section requests that the Registrant supply the following data to address Environmental Hazard. A detailed description is given in 107.5.

   (1) An Aquatic Organism Toxicity Food Chain and Residue Study.

   (2) An Aquatic Invertebrate Life Cycle Study.

   (3) A Field Test conducted under normal agricultural conditions as listed on the use label.

3. The Environmental Safety Section also notes at this time that due to the toxic nature of this compound, several endangered species that occur in cotton growing areas are considered likely to be impacted. As a part of the final hazard assessment the Endangered Species Office of the Fish and Wildlife Service should be consulted concerning organisms they feel may be at risk. This action is directed by Section 7, of Public Law 93-205, Endangered Species Act of 1973.

   The registrant should contact the Environmental Safety Section if there are any questions concerning the status of reviewed data or test protocols for requested studies.

for James W. Akerman 9/29/78

Thomas F. O'Brien
Environmental Safety Section
EEEB - RD WH 567
March 14, 1978

Amended review
JWA 9/29/78
TFB

108.0 Addendum

The hazard assessments for the cotton registrations of Pounce (O'Brien - 3/14/78) and Ambush (Balcomb - 3/17/78) were considered incomplete as the latest Environmental chemistry reviews of permethrin were not available. These reviews have been received and a summary of that information pertinent to Environmental safety is attached. Additional comments and discussion have also been appended.

108.1 Behavior in the Environment

A. Soil

Permethrin degrades in soil with dependency upon soil type, temperature and oxygen availability. The rate of degradation is slower in several low organic content soils, is slower at 10°C and 40°C than at 25°C, and is slower under anerobic or flooded conditions than under aerobic conditions.

Half-life estimates from simple linear regression show that over all treatments 50% of applied ^{14}C would be evolved as $^{14}CO_2$ within ten weeks. Under waterlogged conditons, ^{14}C was not evolved rapidly, less than 5% at 7 weeks and only 15% at 14 weeks.

The registrant has calculated the "half-life" of permethrin in the various soils, but did not include known, identified and quantified degradates in the calculation. Therefore the half-life for permethrin and its degradates is longer than that reported.

Permethrin as the parent compound does not leach significantly in soil. The degradates of permethrin are somewhat more leachable than the parent compound but Environmental Chemistry does not believe it is significant enough to be a problem.

Runoff of permethrin has been shown to occur and is probably due to the physical transport of soil.

B. Water

The cis and trans isomers of permethrin are relatively stable to hydrolysis with estimated half life in water exceeding 50 days at environmentally expected temperatures and pH ranges. Under drastic conditions of elevated pH and temperature permethrin hydrolyses to cis and trans forms of DCVA and 3-phenoxybenzyl alcohol which are fairly stable to hydrolysis.

Permethrin has very low solubility in water, and consequently, it has high adsorption characteristics. Desorption does occur but at a much slower rate than adsorption. Permethrin reaching water via erosion or drift can be expected to adsorb strongly to soil or organic matter in hydrosoil/sediment situations.

The vapor pressure of permethrin is low and should have a fairly low volatility. However, because of the low solubility there may be a significant amount of co-volatization from the water surface.

The degradates from the grid moiety of the structure (DCVA) are apparently more water soluble than the degradates from the phenoxybenzyl portion. Environmental Chemistry has suggested that the difference in the water solubility of the degradates could have an effect upon the toxicity of the degradates to fish. The degradates are formed in soil which may be eroded from the field to the aquatic environment, and consequently desorbed into water.

C. Plants

Permethrin applied to the surface of cotton leaves and exposed to UV light was stable for at least 1(days. Permethrin degrades slowly in cotton leaves so that after about 1 month 30-60% of the applied material was left as parent compound. Degradatio in cotton bolls was reported to be similar to tha in cotton leaves. No translocation from the site

of injection was observed.

D. Animal

The laboratory studies of the accumulation of permethrin in several species of fish indicate that this pesticide will accumulate in edible and non-edible portions of bluegill sunfish, catfish and fathead minnows, but depuration of these residues does occur.

A chronic toxicity study with fathead minnows indicated that bioaccumulation was greatest in females and exceeded 4500X. The eggs of exposed parents contained permethrin at approximately 700 times the ambient levels.

Bluegill sunfish and catfish exposed to 0.70 ug/L of permethrin (labelled in the acid portion) showed whole body accumulations of 47x and 95x respectively.

Environmental Chemistry has suggested that permethrin may pose a bioaccumulation hazard in fish.

108.2 Relevant Points in the Environmental Chemistry Review of the Texas Pond-Field study (Accession No. 096325, Section 22)

1. The concentration of permethrin totaled 2.4 ppm in the soil one day after the last application (#17). Of this amount each isomer constituted about 50%. The 2.4 ppm was found at the "near" side of the cotton field, while in the "away" portion of the field 1.27 ppm of combined isomers of permethrin was present. This same relationship between the "near" and "away" portions of the field occurred throughout the study: the near or downslope portion of the field always showed higher residues of combined isomers of permethrin than the upslope "away" portion of the field. On the average, the "away" sample contained about 2/3 the amount of permethrin as did the near portion of the field.

   The higher concentrations in the downslope portions of the field provide strong evidence of movement of permethrin residues. However, the manner of movement cannot be determined from the

data: the movement may be leaching in surface runoff water (but based on the very low water solubility of permethrin this is not viewed as likely) or by adsorption to soil particles which are subsequently surface eroded downslope by rainfall. Since the cotton field was five acres in size, the away portion (2½ acres) contributed significant amounts of permethrin to the lower 2½ acres. This would involve movement through a considerable distance, and since the pond was only 25 feet from the edge of the cotton field, it is expected that considerable quantities of permethrin would reach the pond water.

2. The rate of soil residue decline after the last application was slower than the rate of accumulation in the soil. Three and one-half months after the last application the near portion of the field still showed 0.6 ppm of combined isomers of permethrin. And since there was no analysis for any of the known soil degradates, it is not possible to determine if total residues of permethrin and its degradates declined at all. It might be that the permethrin degraded in the field to degradates which remained in the soil at the equivalent to the applicaiton rate. It cannot be determined from these data. The decline in the away portion of the field resulted in 0.24 ppm of combined isomers of permethrin. Cis is more resistent than trans-isomer.

3. The design of the sampling program of the pond water is for determination of the biological parameters of the study; the design did not consider samples for residue analysis. The pond was divided into quarters, with a "deep" and "shallow" sample from each quarter, and two "close" stations at the points in the pond where most runoff water was received. The net result is a water strata sample, rather than distance from field samples. Of the four "shallow" samples, two were located in the farthest 1/3 of the pond. When these samples were composited, dilution of the residues could have occurred in the two nearer "shallow" samples. 'The solution to detection is dilution'. In addition

to the above flaw, the water samples were not analysed for known soil degradates, known hydrolysis products or known photoproducts. The only analysis is for parent isomers. At the least, analysis should have been conducted for dichlorovinyldimethylcycpropylcarboxylic acid, which is a major soil, photo, and hydrolysis product.

Maximum residues of 0.21 ppb were found in the water 3 days after the first application, in the shallow composite which is subject to the flaw in the experimental design as discussed above. Several other sampling intervals showed traces of permethrin at the less than 0.05 ppb level, but the majority of all stations and sampling intervals showed nondetectable amounts of parent material, and degradates were not analysed. One interesting point is the detection of finite quantities of permethrin 21 days after the last application (application #17),which may have been the result of 1.25 inches of rainfall about 4-6 days previously. This may be either as dissolved runoff or as soil erosion and subsequent desorption from the soil particles.

4. The registrant has stated that the results indicate that no bioaccumulation of permethrin residues occurred in fish, mussels, or crayfish. This is an erroneous conclusion. Since only the edible portions of the organisms were analysed, the proper conclusion is that the results show that edible portions of fish, mussels, and crayfish show no bioaccumulation of the parent isomers of permethrin. There is no conclusion that can be drawn regarding the whole body burden in the fish, mussels, or crayfish for the isomers of permethrin.

108.3 Supplement to the Hazard Assessment

Additional comments are provided here concerning the ecological effects noted in the study "The Application of two permethrin formulations on a cotton field adjacent to an aquatic ecosystem" Accession No.096325, Ref. 22.

Permethrin was applied to a 5-acre cotton field every 5 days from August 9 to October 28 at the rate of 0.2 lb a.i./acre. The field was adjacent to a 3 acre pond.

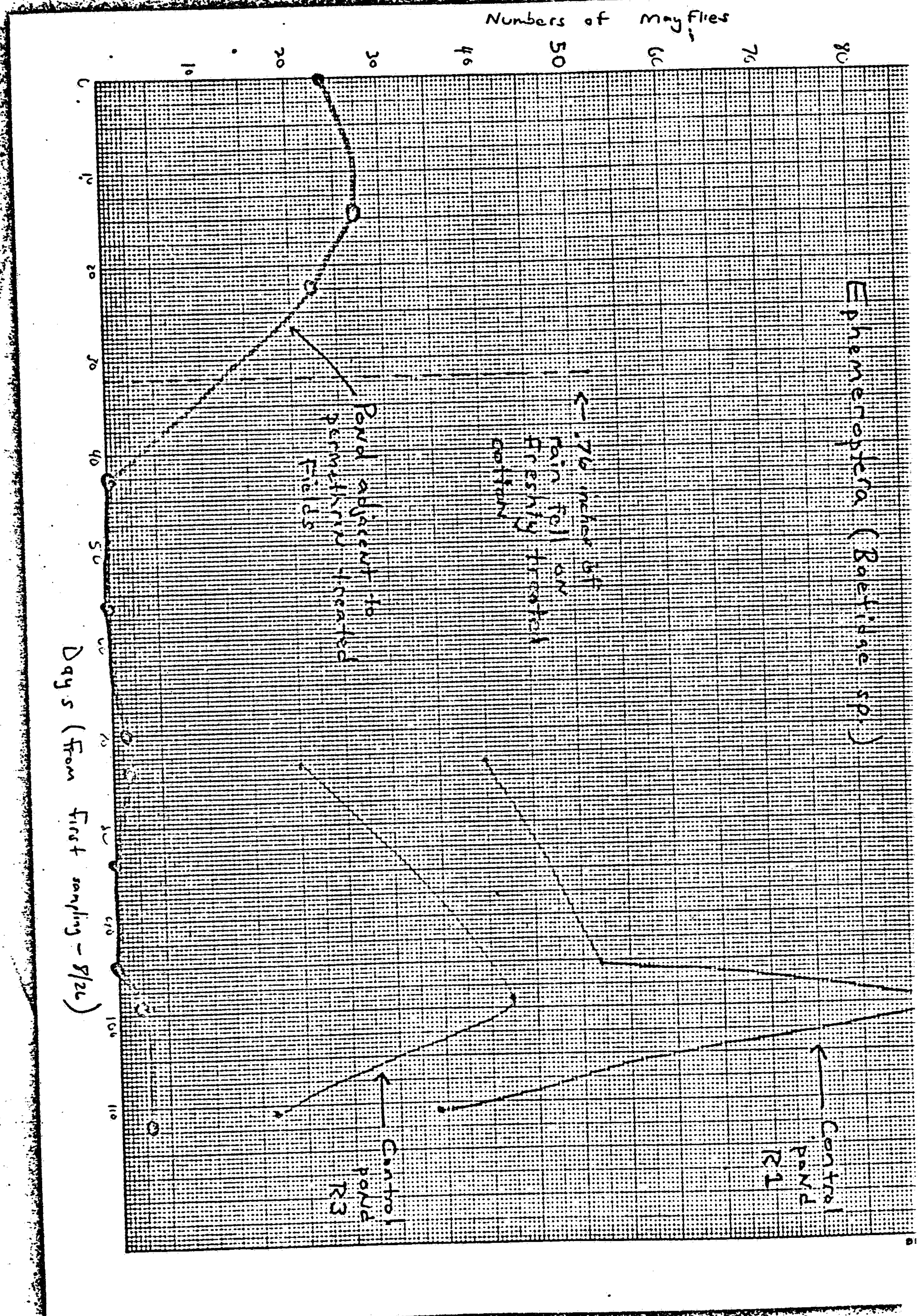
I. Effects on Aquatic Invertebrates

As discussed elsewhere by this reviewer (104.0 - Hazard Assessment) permethrin applications reached the pond adjacent to the cotton field (via drift and/or runoff) and resulted in the reduction of several of the invertebrate groups inhabiting these waters. The reductions occurred among surface dwellers (Gerridae, Veliidae, Gyrinidae, Belostomatidae) as well as insect larvae associated with vegetation and pond sediments (Ephemeroptera, Odonata).

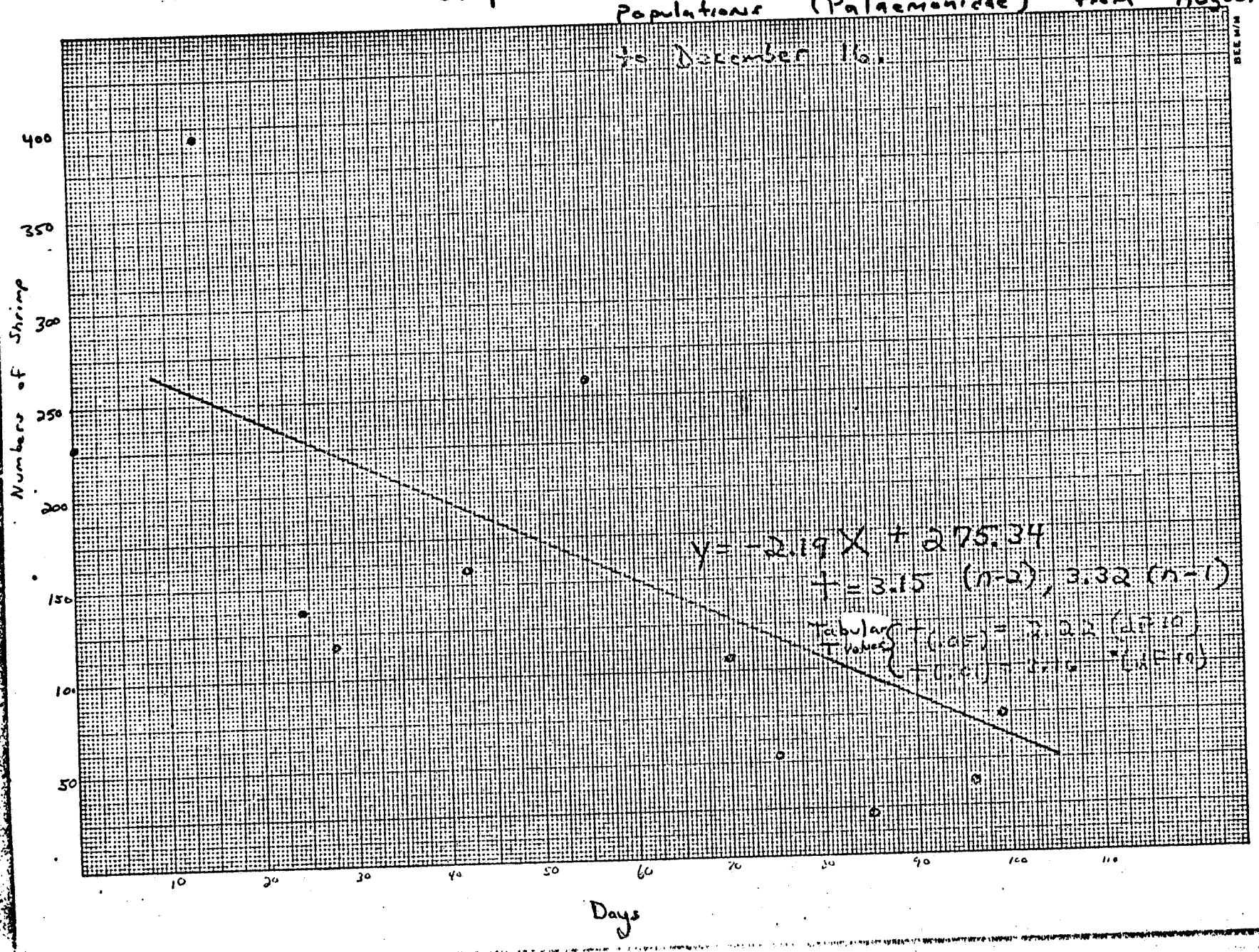
Graph I (attached) illustrates the reductions of the latter group which were chosen for graphing as enough insects were collected for meaningful comparisons and because they indicate the population declines relative to a late September rainfall that fell on freshly treated cotton.

The experimenter states that the counts of freshwater shrimp may indicate these organisms were adversely affected by the pesticide. I have fitted a linear regression to the shrimp data which indicates the decline is significant ($P<.01$) - Graph II. The shrimp control pond data are not adequate for a close comparison, however, the limited points do not indicate the same decline demonstrated by the shrimp in the treated pond. An additional finding was that other invertebrate populations in the experimental pond appeared to retain normal levels throughout the study. These included the cladocerans, copepods, and the chironomidae.

The aquatic invertebrates were, for the most part, sampled on the test pond and on control ponds and, in general, the reference pond data are useful in suggesting that reductions were probably pesticide


Numbers of Mayflies
10
20
30
40
50
60
70
80
Ephemeroptera (Baetidae sp.)
← .76 inches of rain fell on freshly treated cotton
Pond adjacent to permethrin treated fields
Control pond R1
Control pond R3
0
10
20
30
40
50
60
70
80
90
100
110
Days (from first sampling - 8/26)

Graph II. The Decline in Freshwater shrimp Populations (Palaemonidae) from August 26 to December 16.



effects and not trends characteristic of the entire locale. However, the data are deficient in that: (1) pre-treatment (before 8/9) information is not provided for many organisms (2) control pond data are less complete (fewer sampling dates) than the treatment pond and (3) rotifers, cladoceran and copepods were not monitored on control ponds.

II. Pond Food Web

Using the species described in this study I have constructed a rough trophic system for the test pond as it appeared prior to treatment:

Table I

primary producers		algae		bacteria			Beetles (Hydrophilidae, Helipidae)
primary consumers	copepods	- cladocerans	-	mayflies	shrimp	chironomids	(Gyrinidae)
secondary consumers	Small Fish	DragonFly nymphs	Damselfly nymphs	Giant Water Beetles		Surface Insects	(Gerridae) (Veliidae)
teriary consumers	Sunfish	Catfish		Perch etc.			

Recreating the food web without the organisms affected by permethrin we obtain the following:

Table II

primary producers	algae		bacteria		
primary consumers	copepods	cladocerans	chironomids	Beetles (Hydrophilidae, Halipidae)	Shrimp (much fewer)
secondary consumers	Small Fish	----	----	----	
teriary consumers	Sunfish	Catfish	Perch	etc.	

It is apparent from these tables that the pond ecosystem was considerably affected by the permethrin applications (runoff or drift). The secondary consumers were largely reduced as well as an important primary consumer - the mayfly. Hurlbert (1975) has provided a detailed review of effects of pesticides on aquatic ecosystems. Much of this review is applicable to permethrin which, as a wide spectrum insecticide and aquatic toxicant in general, may affect nearly every level of such food chains. Hurlbert has cited examples, similar to the reductions of secondary consumers (predaceous invertebrates) noted in this study, where invertebrate predator losses appeared to result in imbalanced systems ~~aer-~~ populated with chironomids. An abundance of small primary consumers may benefit smaller fish but they are not easily utilized as food by larger individuals. Dustman and Stickel (1966) have made the following important observation concerning reductions of fish prey:

> "When a local food supply is destroyed, birds may seek food elsewhere, as has been postulated in certain studies where birds became scarcer yet

no dead birds were found. Fish, however, cannot leave and so may be affected severely. Salmon hatched in the Miramichi River in New Brunswick in 1955 were practically reduced to extinction... ..... Many living young were thin, perhaps too thin to stand winter for their food organisms were greatly depleted."

In a recent Dimilin study (Apperson, et al) the pesticide was noted to have nearly eliminated the small aquatic crustaceans (cladocerans, copepods) which the bluegill predominantly fed on prior to treatment. Fish stomach contents, however, showed the fish were able to survive by feeding on chironomid midges and terrestrial insects. Similarly, in the permethrin pond study no fish mortality was observed and thus the fish did accommodate themselves, at least during the period of observation (last application October 28, last field observation December 28), to reduced insect populations. A major consideration, however, must be that the ecosystem is imbalanced and stressed, and it is perhaps reasonable to hypothesis that such impairment sets the stage for fish kills (or kills of other vertebrates and invertibrates) when additional stress is applied to the system, i.e. reduced oxygen supply, drought, temperature extremes etc.

In the case of the food chain disruption noted in the permethrin pond study such effects might be argued to represent the minimum anticipated ecological damage to aquatic habitat adjacent to cotton fields, as the pesticide was applied by ground equipment while the actual use will involve considerable aerial application with inevitable drift from target areas. The additional contamination resulting from aerial drift may devastate the copepod and cladoceran populations as well as result in direct fish kills. A field study addressing the aerial drift problem is deemed necessary for a valid hazard assessment and has been requested.

III. Conclusions

As discussed previously the submitted cotton pond study points out the need for an additional field

study utilizing aerial application of the pesticide. The aquatic insect mortality in the submitted field study are believed by this reviewer to constitute an RPAR trigger -- 162.11 (c) "can reasonably be expected to result in significant local, regional or national population reductions in non-target organisms...." -- however, it seems prudent at this time to reserve final judgment until the requested additional studies are received and reviewed.

References .

1. Apperson et al. Effects of an Insect Growth Regulator, Diflubenzuron, on Chaoborus astictopus Dyar & Shannon (Diptera: Chaoboridae) and Nontarget Organisms and Persistence of Diflubenzuron in Lentic habitate. Journal of Environmental Entomology (In Press)

2. Dustman, E. H. and L. F. Stickel. 1966. Pesticide residues in the ecosystem. pp. 109-121. "Pesticides and their Effects on Soils and Water." Amer. Soc. of Asonomy Spec. Pub. No. 8

108.4 As An Aid In Hazard Assessment Permethrin Is Here Placed by Its Toxicity To A Representative Warmwater Fish (Lepomis macrochirus) As Compared To 17 Organo-Chlorine and Organophosphate Insecticides.

Pesticide[1]	96-hr LC_{50} (PPM)
Endrin	.0006
Permethrin(Ambush)	.0009
Toxaphene	.0035
Dursban	.0036
Guthion	.0056
DDT	.008
Dieldrin	.008
Aldrin	.013
Heptachlor	.019
Chlordane	.022
Ethyl Parathion[2]	.047
Methoxychlor	.062
Lindane	.077
BHC	.79
Arochlor 1254	2.7
Sevin (carbamate)	5.6
Methyl Parathion[2]	8.0
Malathion	20.0

1 Toxicity data (except Parathion) from: Livingston, Robert J., Review of Current Literature Concerning the Acute and Chronic Effects of Pesticides on Aquatic Organisms, CRC Critical Reviews in Environmental Control, November 1977.

2 Pimentel, David. Ecological Effects of Pesticides on Non-target Species. June 1971.

108.5 Data Review (From the open literature)

Citation: Mulla, M.S. et al. 1975. Field Efficacy of Some Promising Mosquito Larvicides And Their Effects On Non-target Organisms. Mosquito News Vol. 35, No. 2. pp 179-185.

Methods:

Permethrin was applied by hand sprayer to experimental ponds (12' x 24' and 12-15" deep) at the University of California at Davis. The concentrations tested were 0.01, 0.025, 0.05, 0.10 and 0.25 lb/Acre. Each concentration was tested twice and controls were included. Mosquito and non-target insect populations were monitored.

Results:

A. Mosquito Control

(1) At rates of 0.1 lb/A and up mosquito pupae and larvae (Culex tarsalis) were completely controlled (48-hr post treatment check) and continued as such for 9 days. Complete recovery occurred 13 days after treatment.

(2) Permethrin appeared even more effective against Culex pipus mosquitoes as near complete control was obtained (94-95% mortality) at 0.05 lbs/Acre.

B. Non-target Mortality (Tables attached)

1. Chironomid midges, tanypodine and chironomine, were slightly depressed by the lower rate 0.05 lb/A (36.7 ppb - 6" water; 18.3 ppb - 12" water). At the higher rate (0.1 lb/A) the effect was much greater for the duration of the experiment on both groups.

2. Mayfly naiads and diving beetle larvae and adults were affected at the rates

tested. (note: Beetle numbers are too low for reliable conclusions). Mayflies recovered to original levels between day 13-16 post-treat at the 0.05 lb/A level but did not recover at the 0.1 lb/A test level.

3. Ostracods and Copepods were also affected by the rates tested:

48 hour (Mortality: as % of Pretreatment level)

lb/A	Copepoda	Ostracoda
0.05	91%	71%
0.10	100%	94%

This initial knockdown was followed by partial recovery between days 2-6 post-treatment at the lower level (0.05 lb/A). As cotton applications of permethrin may be repeated at 5 day intervals (or less) thus such recovery in the field may not occur.

Experimenter's Conclusions:

From these studies, it appears that both FMC-33297 and S-2957 affect mayfly naiads severely, but these recovered within 2 weeks or so at the practical rate of application (0.05 lb/acre) of the former. Against the remaining groups, the former compound was less hazardous than the latter compound. Against chironomid midges, the latter compound is more effective. Dragonfly naiad mortality was considerable, especially at the higher rate of application of both materials. (Note: FMC-33297 is permethrin).

Reviewer Comment:

Permethrin applications to cotton are recommended every 5 to 7 days or as needed thus the non-target recovery observed above may not occur in aquatic habitat adjacent to cotton fields. As such larvae are an important component of many aquatic ecosystems permethrin may stress such systems by direct toxic impairment as well as thru food-chain distruption.

Table 5. Effectiveness of mosquito larvicides on chironomid midge larvae in experimental ponds (Midgeville, Sept. 1974).

Material and formulation	lb/acre	Avg. no. chironomid midge larvae/sample pre- and post-treat (days)											
		Tanypodinae[a]						Chironominae[b]					
		Pre	2	6	9	13	16	Pre	2	6	9	13	16
FMC-33297 (EC 0.8)	0.05	24	8	3	13	10	9	10	6	4	4	11	7
	0.10	28	3	1	9	5	7	7	2	5	4	2	5
S-2957 ((EC 4)	0.05	18	0	0	1	7	0	7	0	3	4	0	10
	0.10	5	0	0	0	1	0	8	0	0	3	1	7
Check	....	13	21	10	18	3	18	4	3	5	4	14	4

[a] Mostly *Pentaneura* and *Tanypus*.
[b] Mostly *Tenytarsus* and *Chironomus*.

(FMC-33297 is permethrin)

Table 6. Effect of mosquito larvicides on nontarget insects in experimental ponds (Midgeville, Sept. 1974).

Material and formulation	lb/acre	Avg. no. nontarget insects/5dips composite sample pre- and post-treat (days)											
		Ephemeroptera[b]						Coleoptera[c]					
		Pre	2	6	9	13	16	Pre	2	6	9	13	16
FMC-33297 EC (0.8)	0.05	8	0	0	0	1	9	1	2	0	0	0	0
	0.10	12	0	0	0	1	1	1	3	0	1	0	0
S-2957 (EC 1)	0.05	12	0	1	0	2	2	2	1	0	0	1	0
	0.10[a]	20	0	1	1	0	1	4	3	2	0	0	2
Check	....	16	17	13	12	12	14	2	2	1	1	2	1

[a] Dragonfly naiads were observed dead in the ponds in large numbers 2 days after treatment.
[b] Ephemeroptera, Baetidae, mostly *Baetis* sp.
[c] Coleoptera, Hydrophilidae, and Dytiscidae, larvae and adults.

Table 7. Effect of mosquito larvicides on crustacean populations in experimental ponds (Midgeville, Sept. 1974).

Material and formulation	lb/acre	Avg. no. organisms/5 dips composite sample pre- and post-treat (days)											
		Cepepoda[a]						Ostracoda[b]					
		Pre	2	6	9	13	16	Pre	2	6	9	13	16
FMC-33297 (FC 0.8)	0.05	24	2	14	11	60	25	7	2	4	11	17	25
	0.10	10	0	2	1	7	4	18	1	6	15	12	28
S-2957 (EC 4)	0.05	4	0	1	1	1	0	6	2	1	1	5	6
	0.10	7	0	1	2	5	6	5	3	1	3	2	5
Check	....	10	12	13	7	6	12	5	5	7	4	12	7

[a] Mostly *Cyclops* and *Diaptomus*.
[b] Mostly *Cypricercus* and *Cyrinotus*.

108.6 Permethrin Degradation Products

Environmental Chemistry (Cook, Carse 1 5-4-78) has pointed up the possible need for fish and wildlife testing on permethrin degradates, notably DCVA.

Environmental Safety does not believe that special testing with permethrin degradates is necessary for our hazard assessment. Our aquatic testing evaluates toxicity on an outcome basis, i.e. survivorship. We believe the degradates and metabolites of permethrin were present in the acute and chronic studies submitted and the question of which chemical moiety is toxic is of less concern to us than what the overall effects of introducing the pesticide into an aquatic environment is. Should Environmental Chemistry determine that any degradates are unusually persistent this position may be reevaluated.

Note: See main review (107.0) for conclusions, data requests etc.

Richard Balcomb

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EEB WH567
July 12, 1978

Clayton Bushong
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September 29, 1978