109701 (22) ✓

EFE BRANCH REVIEW

plus Addendium

DATE: IN 2/11/ OUT 3/17/78 IN ____ OUT ____ IN ____ OUT ____

FISH & WILDLIFE ENVIRONMENTAL CHEMISTRY EFFICACY

FILE OR REG. NO. 10182-000RI

PETITION OR EXP. PERMIT NO. ____

DATE DIV. RECEIVED ____

DATE OF SUBMISSION ____

DATE SUBMISSION ACCEPTED ____

TYPE PRODUCTS(S): I, D, H, F, N, R, S ____

DATA ACCESSION NO(S). 8F2044, 096765

PRODUCT MGR. NO. Mitchell

PRODUCT NAME(S) Ambush

COMPANY NAME ICI

SUBMISSION PURPOSE Registration — COTTON

CHEMICAL & FORMULATION Permethrin (3-phenoxyphenyl)methyl (I)-(15,trans-3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropanencarboxylate

Ambush: permethrin 25.6%
Inerts 74.4%

Ambush™ Pyrethoid Insecticide

100.0 Pesticide Use

For the control of boll weevil, bollworm, tobacco budworms, pink bollworm, lygus bugs, whitefly, cotton aphid, cabbage looper, thrips, and cotton leafperforators in cotton.

100.1 Directions - Methods - Rates

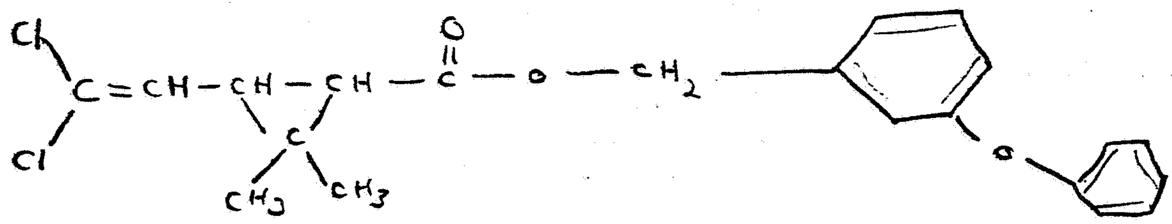
Apply AMBUSH as shown in the following chart, using sufficient water to obtain full coverage of foilage. Three to five gals./Ac. by aerial application is recommended. Apply every 5 to 7 days or as needed. Timing and frequency of applications should be based upon insect populations reaching locally determined economic thresholds.

COTTON SPRAY RECOMMENDATIONS — RATE CONVERSION CHART

Target Pests	Dosage Per Acre	Minimum Spray Volume	Spray Interval	Lb. Active/ Acre	Fluid Ozs./ Acre	Pints/ Acre	Acres Treated Gal.
Boll weevil	0.4 to 0.8 pint	1.5 gal/A aerial or 9 gal/A ground	5 to 7 days or as indicated by scouting	0.10	6.4	0.4	20.0
Bollworm				0.125	8.0	0.5	16.0
Tobacco Budworm				0.15	9.6	0.6	13.3
Lygus Bugs				0.175	11.2	0.7	11.4
Whitefly				0.20	12.8	0.8	10.0
Cotton Aphid							
Cabbage Looper							
Thrips							
Cotton Leafperforator							

Remarks
Do not graze livestock in treated areas. Do not apply more than 12 pints per acre per season. The higher rates (0.6 to 0.8 pt/A may be required under conditions of heavy worm infestation or when weevils or late instars of worms are present.

101.3 Structural Formula:



Note: Cis and trans forms of the above are used.

101.4 Molecular Weight: $C_{21}H_{20}Cl_2O_3$

391.28

101.5 Physical State

Liquid, colorless, odorless

101.6 Solubility: Environmental chemistry data not available. ICI indicates solubility >0.1 ppm, and FMC describes permethrin's water solubility as 0.07 ppm.

Note: The formulation JFU 5054 is misicible with water, xylene, kerosene and diesel fuel in all proportions.

102.0 Behavior in the Environment*

Summary

Soil metabolism studies indicated the half-life of permethrin ranged from 28 days to 10 weeks. One hydrolyris study showed permethrin relatively stable at room temperature with half-life estimates of 57, 59 and 112 days (pH 4, 7 and 9 respectively) reported. Relatively low partition coefficients were reported (30, 40), however, whole body residues in Bluegill and Catfish indicated bioaccumulation of 47x and 95x respectively. The Fathead Minnow may accumulate permethrin in excess of 4000x ambient levels.

* Current Environmental Chemistry reviews were not available at the time of this report. All data should be viewed cautiously and is subject

to revision upon completion of the EC review currently in progress.

102.1 Soil

A. Preliminary Soil Metabolism Data:

Methodology:

^{14}C-Permethrin was labeled in two positions called ^{14}C-alcohol and ^{14}C-acid, Five soils were used: 1) Dubbs loam, 2) Hagerstown silty clay loam, 3) Memphis silt loam, 4) Sharkey clay, and 5) San Joaquin sandy loam. Treatment rate was equivalent to 0.2 lbs/acre.

Tentative Results:

Permethrin is degraded under aerobic conditions to CO_2 with more than 50% degraded in 28 days. A number of degradates were formed but were not identified. Under anaerobic conditions less than 1% of ^{14}C was trapped as $^{14}CO_2$.

B. Soil Metabolism Study:

Cis and trans isomers of permethrin were radiolabeled in either $^{14}CCl_2$ or $^{14}CH_2$ position (dichloro ^{14}C and methylene ^{14}C, respectively). Soils used were: 3 types of sandy clay loam and a loamy sand. Treatment rate was 0.18 lbs/acre.

Results:

Under aerobic conditions ½-life estimates how that from all the treatments studied, 50% of the applied ^{14}C would be evolved as $^{14}CO_2$ within 10 weeks. Under waterlogged conditions, ^{14}C was not evolved as rapidly: less than 5% at 7 weeks and only about 15% at 14 weeks. Also, it is noted that bound (nonextractable) ^{14}C amounts to 33% in one test from a single treatment. Since label use directions are for up to 12 treatments per season at 3-14 day intervals, build-up of nonextractable material could reach 3 lbs.

per season.

C. Field Persistence Data:

Methodology:

Data are from 6 locations in 5 states. Permethrin was applied at rates of 0.1 or 0.2 lbs/acre for 5-15 applications (total pounds range from 0.5-3.0 lbs). Soil samples obtained once from each location.

Results:

Detectible quantities of permethrin occurred in only 2 locations and both were below 0.1 ppm combined residues. One detectible residue occurred from 0.1 lb/A., 9 applications (0.9 lbs. total) at 49 days after last spray application. While the other residue resulted from 15 applications 0.1 lbs. (1.5 lbs. total) at 35 days after last application. One residue occurred in clay loam soil while other was in loamy sand. Both residues were found only in 0-3 inch soil layer and not below that level.

D. Field Persistence Data/Dissipation Rate:

Methodology:

Unspecified soil from Marion, Kansas was treated once with 1.0 Lb/A. of permethrin. Treated area disced twice to 3 inches. Soil samples taken at intervals to depth of 12 inches. (Apparently, soil is a silt loam soil.)

Results:

Field Dissipation

Days	Depth	Total (cis & trans) Residue
0	0-3"	0.25 ppm
3	"	0.34 ppm
7	"	0.53 ppm
12	"	0.34 ppm
30	"	0.18 ppm
90	"	Not Detectable

E. Mobility of Permethrin in Soil:

Methodology:

Mobility of permethrin was studies in 5 soils by soil TLC procedure. ^{14}C-alcohol labeled permethrin was used. The 5 soils used were: 1) Leon fine sand, 2) Cosad sandy loam, 3) Dunkirk silt loam, 4) Roseburg sandy loam, 5) Jeffersonville day loam.

Results:

Parent compounds of permethrin are not mobile under these test conditions.

F. Photolysis:

Methodology:

Deposit of permethrin on unspecified surface exposed by window or outdoors.

Results:

Permethrin had ½-life of 3 or more weeks indoors and 4 days outdoors. Nature of photoproducts not examined.

102.2 Water

A. Hydrolysis:

Methodology:

Nonradiolabeled permethrin was used at pH's of 4, 7 and 10. Concentrations used were 0.004, 0.02, and 0.2 (assume ppm).

Results:

Degradation at pH 10 faster than at pH 7 or 4. Degradation at lower concentration more rapid than at higher concentration. Photodegradation not a significant factor. ½-life of permethrin at all 3 pH's at all concentrations was less than 7 days.

B. Hydrolysis:

Methodology:

Studies at pH 4, 7 and 9 at 25°C and 50°C used nonradiolabeled permethrin at 0.2 ppm.

Results:

Permethrin is relatively stable to hydrolysis at room temperature and pH 4, 7 and 9 with ½-life of 57, 79 and 112 days, respectively. The trans isomer is about 30% more stable than the cis isomer. At 50° ½-lives are 26, 23 and 13 days, respectively. Nature of hydrolysis products not examined.

C. Determination of Partition Coefficients:

Methodology:

Permethrin and 2 possible metabolites (m-phenoxy benzyl alcohol and 3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid) were studied for partition coefficients in octanol water system. Radiolabels were ^{14}C-alcohol, ^{14}C-alcohol and ^{14}C-acid for the above compounds, respectively.

Results:

Applicant concluded that P-valve was between 30 and 40.

102.3 Animal

Exposure of Fish to ^{14}C-Permethrin: Accumulation Distribution and Elimination of ^{14}C-Residues:

Methodology:

Bluegill sunfish and channel catfish were exposed to 0.70 mg/l (ppb) permethrin radiolabeled in the acid position in a continuous flow system. Bluegill were 67 mm. and 4.0 gms. While catfish were 75 mm. and 3.5 gms.

Results:

Accumulation of ^{14}C equivalent to permethrin in nonedible portions of both bluegill sunfish and channel carfish occurred to a significant degree (see attached table) and disaccumulation of ^{14}C during depuration phase was not complete in catfish. Nonedible portions of bluegill and catfish accumulated a maximum of 715x and 703x, respectively, the residue of ^{14}C in water, while edible tissues accumulated maximums of 21.4x and 90.9x, respectively, the concentration of ^{14}C in water. Whole body bluegill sunfish ^{14}C-residues equivalent to permethrin during 21-49 days of exposure are estimated (by the researcher) to be around 35 ppb, and for catfish in 35-49 day intervals whole body ^{14}C-residues were estimated to be equivalent to about 75 ppb. These whole body residues provide for the following accumulation factors:

Species	$\bar{x}$ Concentration in water*	Whole Body Residue (ppb)	Accumulation Factor
Bluegill	0.74 ppb(21-49)	35 ppb	47x
Catfish	0.79 ppb(35-49)	75 ppb	95x

* Numbers in parentheses are the days to which the $\bar{x}$ applies.

103.0 Toxicological Properties

103.1 Acute Toxicity

103.1.1 Mammalian

Organism	Test	Result	Material
Rat (Female)	Acute oral LD_{50}	> 4000 mg/kg	Technical
Mouse (Female)	Acute oral LD_{50}	> 4000 mg/kg	"
Guinea pig (Male)	Acute oral LD_{50}	> 4000 mg/kg	"
Rabbit (Female)	Acute oral LD_{50}	> 4000 mg/kg	"
Rat (Female)	Acute Intraperitoneal LD_{50}	> 3200 mg/kg	"
Rat (Male)	"	> 3200 mg/kg	"
Rat (Female)	Acute dermal LD_{50}	> 2000 mg/kg	"

The above mamalian data taken from a review by T. O'Brien 2/14/77.

103.1.2 Bird Acute Toxicity LD_{50}

Mallard	>10,327 mg/kg females	EA[1]
	>9,868 mg/kg males	EA
Pheasant	>13,740 mg/kg males	EA
	>15,545 mg/kg females	EA
Starling	>42,706 mg/kg	EA
Japanese Quail	~~>15,500 mg/kg~~ 15,517 " " Females; 20,000 " " males	EA

103.1.3 Fish Acute Toxicity LC_{50} 96-hr.

Channel Catfish	5.4	ppb	EA
Coho Salmon	17.0	ppb	EA
Atlantic Salmon	1.5	ppb	EA

The following supplemental data were submitted:

Rainbow Trout	56	ppb	FP
Rainbow Trout	2.1	ppb	EA
Brook Trout	3.9	ppb	EA
Fathead Minnow	~~2.0~~	ppb	EA
Bluegill Sunfish	0.79	ppb	EA
Bluegill Sunfish	10.8	ppb	FP
Mirror Carp	15.0	ppb	

103.1.4 Aquatic Invertebrate Toxicity LC_{50} (48-hr)

Daphnia Magna	1.8	ppb	(48 hr)	EA_2
Daphnia Magna	0.8	ppb	(48 hr)	FP
Brown Shrimp	0.38	ppb	(48 hr)	EA
Fiddler Crab	2.2	ppb	(96 hr)	EA

103.2 Subacute

Ring-necked Pheasant	23,000 ppm	EA
Mallard Duck	23,000 ppm	EA
Japanese Quail	23,000 ppm	EA

For an indepth review of subacute toxicity to dogs, rats, mice etc. see Ectiban review by Norman Cook, June 30, 1977.

103.2.1 Fish Chronic Exposure

Fathead Minnow MATC = $0.30 < x < 0.41$ (ug/l) ppb

103.3 Toxicity to Insects
(Reviewed Allen Vaughn)

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.
Dates of test: not reported

Results

	Oral LD_{50} (mg/bee)	Contact LD_{50} (mg/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 (permehtrin)
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* (*rotundata*) *pacifica*)
Registrant: ICI United States, Inc.
Date of Test: 1975

Results

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

		24-hr. % mortalities of bees — Caged with treated foliage, age of residues					
		3 HR			8 HR		
Materials	a.i./acre	LB	AB	HB	LB	AB	HB
PP557 2 lb EC	0.5 oz.	79	63	86	24	25	44
PP557 2 lb EC	1.0 oz.	93	83	99	64	59	65
PP557 2 lb EC	2.0 oz.	100	90	100	88	78	93

Continued

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
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

Remarks

Table indicates low-moderate hazard to the 3 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 0z. level with the 8-hr. residues.

Ref. 4J PP067, PP199, PP557:

Toxicity to predator mite *Amblyseius fallacis* in laboratory trial (Kentucky).

Material: PP 557 (permethrin)
Researcher: C. Patterson and H. G. Rodriguez
Test Species: *Amblyseius fallacis*
Registrant: ICI United States, Inc.
Date of Test: Summer, 1975

Results

PP 557 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: PP 557 (permethrin)
Researchers: C. Patterson and J. G. Rodriquez
Test Species: *Metaseiulus occidentalis*

Registrant: ICI United States, Inc.
Date of Test: Summer, 1975

Results

PP 557 25EC 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.
Dates 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 PP 557 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 PP 557: Effects on predatory and parasitic arthropods.

Material: PP 557 (permethrin)
Author: F. D. Smith
Test Species: *Metaseiulus occidentalis* (pred. mite)
Amblyseius fallacis (pred. mite)
Hippodamia convergens (convergent lady-beetle)

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.
Dates 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:

Rates ppm	% of insects affected			
	Adults 3-7 days old		Adults 4-6 weeks old	
	2½ hrs. after treat-ment	24 hrs. after treat-ment	2½ hrs. after treat-ment	24 hrs. after treat-ment
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 than 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 Coccinellidae: Field tests
Oil seed rape: Significant reduction in numbers of Coccinellid beetles at rates of 15 ppm and above, 24 hr. posttreatment. Data from 48 hr. posttreatment assessment was not enalyzed.
Cabbage: Numbers of Coccinellid beetles lower in treated plots than in controls (12 days posttreatment), 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 posttreatment. 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 12J, which are included in this submission.

Tests with C. septempunctata, C. undecimpunctata, various Cocciuellidae, hover flies (Syrphidae), and parasitic wasps (Aphidius 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 (Tetranychus urticae) of an 8-spray program on a 10-day interval with PP 557 25% EC and PP 383 25% EC applied to cotton, variety Acala, SJ4, with the first applicaiton on July 7, 1976.

Material: PP 557 25% EC
Authors: D. J. Culver, A. R. Anderson, and C. F. Mann
Test Species: Scolothrips secmaculatus (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 posttreatment.

G. pallens: PP557 caused significant reduction in numbers of this hemipterau 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: PP 557 caused significant reduction in numbers of this predator at all rates tested (population temporarily eliminated).

Ref. 9J An evaluation of the effects on insects (Lygus hesperus, and several predator species) and spider mites (Tetranychus urticae) of an 8-spray program on a 10-day interval with PP557 25% EC and R 111220 25% EC applied to cotton, variety Acala SJ4, with the first application on July 6, 1976.

Material: PP 557 25% EC
Authors: D. J. Culver and A. R. Anderson
Test Species: Scolothrips secmaculatus (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 PP 557 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. secmaculatus, 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 (parasite 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, PP 505, 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} approximately 15.6 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 (PP 557), PP 505, and Actellic on *Bathyplectes curculionis*, a parasite of the alfalfa weevil.

Material: permethrin
Authors: M. Tysowsky, T. Gallo, M. Cahswell, 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 PP 557: Effect on earthworms and soil microarthropods.

Material: permethrin
Authors: F. D. Smith and J. F. H. Cole
Test Species: Earthworm (Lumbricus spp. and Allolobophora spp.)
Numerous species of soil micro-arthropods (including mites, spiders, Collembola, and representatives from numerous other orders of Insecta)
Registrant: ICI United States, Inc.
Date of Test: 1975

Results

PP 557 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. 13J 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 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. Clark
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.

VALIDATION SHEET CRF# ________ PAGE ___ OF ___

FORMULATION:			IA	IB	T	FW	EC	R		
95.7% a.i. technical	SC#	CHEMICAL NAME Permethrin	Validator: R. Balcomb				Date: 2/24/78			
			Test Type: Chronic Fish: Fathead Minnow							
			Test ID # ES-X							

Citation: Chronic Toxicity of FMC 33297 to the Fathead Minnow (Pimephales promelas) E. G. & G., Bionomics Aquatic Toxicity Laboratory. Wareham, Massachusetts

Validation Category: Core

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

Residue analysis of fish showed bioaccumulation in female minnows as high as 4600x the water concentration. The majority of these residues were elimination after 14 days in uncontaminated water.

Validation Category Rationale: The study generally followed the protocols of the National Water Quality Lab, Duluth, Minnesota for bioassay with the Fathead Minnow.

Test Repairability: NA

Additional Comments: (from review T. O'Brien, FMC-Pounce, 2/78)

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 controls by Abbotts Formula):
7 day LC_{50} = 1.016 ppb (.943-1.094 ppb) 95% C.I
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 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 % hatch were compared to controls 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 < 0.042 ppb.

Present 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 of 3 males to 7 females. The levels tested (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; survival, 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 % 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.

104.0 Hazard Assessment

A complete hazard assessment is not possible at the present time as Environmental Chemistry reviews were not available. The following interim assessment was made.

104.1 Discussion

The maximum application rate for Ambush on cotton is 0.2 lbs. a.i./acre, this will result in an initial residue on cotton of approximately 24 ppm (leafy crops). Terrestrial half-life estimates vary (soil: 28-70 days) but because of the multiple applications (total 15, one every 5-7 days or as needed) we can expect permethrin residues to accumulate. We anticipate more precise information from the Environmental Chemistry review currently in progress.

No data is available concerning aquatic contamination from aerial applications (via drift) but cotton is often grown in river bottoms and wet areas such as the Mississippi delta, and thus we may anticipate that aerial drift to various aquatic habitat will occur. If wind drift were to result in direct application to water (0.2 lbs/acre) the following pesticide concentrations might result: 6 inches - 147 ppb, 2 ft. - 36.7 ppb, 4 ft. - 18.3 ppb. If only 1/10 the maximum rate were to drift to water, concentrations of 14.7 ppb (6"), 3.67 ppb (2'), 1.83 ppb (4') may result. It is significant that these levels would approximate the LC_{50}'s for many aquatic organisms - see section 103.1.3 and 103.1.4.

104.1.1 Likelihood of Exposure to Non-Target Organizations

Laboratory and field testing indicate that permethrin is extremely toxic to fish and aquatic invertebrates. Typical fish toxicity (96-hour LC_{50}) values are: Channel catfish 5.4 ppb, Fathead Minnow 3.0 ppb and Atlantic Salmon 1.5 ppb. Testing with Daphnia magna (48 hr. LC_{50}) showed toxicity of 0.8 ppb with the formulated product. Such toxicity values trigger concern due to the large acreage under cultivation for cotton (11 million acres - 1976) and the proximity of much of it to water.

Registration is requested for both ground and aerial application to cotton. A hazard assessment for this use must evaluate the toxicity of the compound to aquatic organisms but view this data in terms of the likelihood and degree of aquatic contamination. A field study was jointly undertaken by ICI and FMC that provides data relevant to aquatic contamination resulting from ground application only: In this study Ambush and Pounce were alternately applied (0.2 lbs./A) every 5 days. Environmental residue samples were regularly taken and fish and invertebrate populations were monitored.

Observational and quantitative data showed that the pesticide applications had detrimental effects on the macroinvertebrate populations. For the first two months of the study, many organisms living on or near the surface of the water were observed. These included the Gyrinidae (whirlygig beetles), Derridae (water striders), and Vellidae (smaller water striders). On Oct. 7, approximately one week after 0.76 inches of rain fell on freshly treated cotton, none of these insects were to be found anywhere on the pond. It is significant that other ponds in the area that were not near permethrin treated fields did not show reductions in these insects. Approximately one month later these macroinvertebrates were still absent from the test pond. By the end of November small numbers of these insects were observed in the peripheral region of the test pond away from the cotton field. At the end of the study, Dec. 16, these organisms had not re-established their numbers.

Quantitative sampling revealed that other insect populations declined following the critical ($\simeq$ Oct. 1) rainfall. These included the Ephemeroptera (mayflied), Coenagrionidae (damsel flies), Lifellulidae (dragon flies) and possibly the Palaemonidae and Belostomatidae. Inspection of other ponds in the region, not subject to permethrin contaminated runoff, did not show population declines among these organisms. The mayflies were the most severely affected group. At station 7 over 20 mayflies were collected on Aug. 26, Sept. 9 and

Sept 21. For the remaining eight samples, a total of only eight organisms were found at this station.

Water samples taken during the study indicated permethrin residues ranging from undetectable to 0.25 ppb. Samples taken Oct. 7, the day insect populations were noticed to decline, indicated pesticide levels of 0.05 to <0.11 ppb. Though these data have not been reviewed by Environmental Chemistry it seems that the pesticide was present in the pond water and present long enough or in high enough concentrations to decimate much of the insect community.

The results of this study are particularly alarming in light of the fact that this much non-target insect mortality resulted from runoff contamination alone. If this product were registered we could assume that much of the cotton acreage would be sprayed aerially thus adding aerial drift as an exposure rate and the possibility that much more insect mortality would occur plus, perhaps, mortality of fish, crayfish and other aquatic organisms. For this reason the submitted field test is not deemed adequate support for a product that will be aerially applied.

The recently submitted Fathead Minnow Chronic study raises the question of whether permethrin may bioaccumulate to hazardous levels. The fish analyzed in this study bioaccumulated, in some cases, as much as 4700x the ambient concentration. Research is necessary to determine if other organisms (i.e. daphnia, filter-feeding insect larvae etc.) will bioaccumulate permethrin and whether biomagnification is likely to occur.

<u>Summary</u>

The available data indicate that permethrin is relatively stable in the environment, that multiple applications will result in accumulation and chronic exposure, and the pesticide will transport to water. Field evidence indicates that aquatic ecosystems in the cotton belt may be seriously disturbed. Aquatic insects are likely to be greatly reduced in numbers and fish may be negatively impacted by reduced food supply (aquatic insects) or even direct exposure. Bioaccumulation and food-chain magnification can not be ruled out.

Bees and beneficial field insects are likely to be adversely affected in treated areas. At present, avian and mammalian exposure is not expected to be hazardous.

Additional testing is essential prior to registration.

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 non-target insects. As a potent broad-spectrum insecticide, it has proven highly toxic to nearly all non-target insects tested, including the following: honeybee (Apis mellifera); alkali bee (Nomia melanderi); alfalfa leafcutting bee (Megachile pacifica); predatory mites (Amblyseius fallacis and Metaseiulus occidentalis); lady beetles (Hippodamia convergens, Coccinella septempunctata, and C. undecimpunctata); hover flies (Syrphidae); thrips (Scolothrips sexmaculatus); and hemipteran predators (Geocoris pallens, Nabis americoferris, and Orius tristicolor).

Application of Ambush 2E to cotton at proposed rates can be expected to have strong adverse effects on populations of non-target 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 phytophagous mites, necessitating additional applications of acaricides.

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 non-target insects.

Another point should be mentioned in regard to effects on non-target insects; there is no data for effects on aquatic insects. Application of Ambush 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 non-target 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	North Carolina
California	Kentucky	South Carolina
Texas	New Mexico	Missouri
Louisiana	Oklahoma	

Evidence indicates that the potential exists for the following endangered fish to be negatively affected by runoff or drift from permethrin applications to cotton. A section 7 (Public law 93-205) consultation will be required prior to registration.

1. Slackwater Darter
   State: Alabama
   Watercourses: Flint River (Madison), Cypress Creek (Lauderdale)
   Counties: Madison (78,000 acres cotton)
   Lauderdale (17,990 acres cotton)

In all Alabama areas 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
   Watercourse: 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 Department (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
Watercourse: Bayou Pierre
Counties: Copiah (2,925 acres cotton)
Claiborne (2,509 acres cotton)

Stream borders some agricultural areas.

4. Pahrump Killifish
State: Nevada
Watercourse: Manse Spring
Corn Creek Springs
Shoshone Ponds
County: Nye (1,707 acres cotton)

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)
Watercourse: Key Cave

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

6. Leopard Darter (Threatened)
State: Oklahoma
Counties: McCurtain (1,200 acres cotton)
Pushataha (no cotton)
Le Flare (5 acres cotton)
Watercourse: Little River

7. Comanche Springs Pupfish
State: Texas
Counties: Reeve (38,587) acres/cotton
Pecos (13,257)
Watercourse: 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: Recos 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)
Watercourse: Savannah River (confirmed)
Ogeechee River (suspected)
Altamaha River (confirmed)

State: South Carolina
Counties: (with significant cotton only)
Berkeley (660 acres)
Colleton (189)
Florence (4,400)
Hampton (1,200)
Harry (474)
Williamsburg (1,700)
Dorchester (198)
Watercourses: Confirmed in the Askepos River

Overview

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

Refer to conclusions section 107.4

(1) For a detailed review of recent tests submitted for Permethrin see 10182-EUP-3 review by R. Balcomb (10/29/77) and N. Cook's Ectiban EUP (6/30/77).

(2) A chronic fish study (Fathead Minnow) was submitted with this application. It has been reviewed and found satisfactory.

104.1.4 Data Required

(1) An aquatic macroinvertebrate life-cycle study (Daphnia sp., preferably). This study should run egg to egg or otherwise complete a full generation cycle and maintain continuous exposure to the pesticide.

RB

(2) An acute study using macroinvertebrates indigenous to the cotton growing region, e.g. mayflies, stoneflies etc. This information is necessary in view of the aquatic insect kills reported in the field applications study submitted.

(3) An aquatic ecosystem field study in which Ambush is applied aerially to cotton is required. The study should use the pesticide at labelled rates and make 15 applications per label directions. Monitoring data should describe:

 (1) effects on zooplankton, aquatic invertebrates, crawfish and indigenous fish populations.

 (2) comparable data from control locations for test species.

 (3) residue analysis of the biological and physical environment.

The study is intended to supply information on the potential risks of actual pesticide operations, in particular, aerial applications and thus the registrant is required to choose a site which has a clear potential for aerial drift and surface runoff to an aquatic ecosystem.

(4) Additional research is required to clarify the biological fate of permethrin. Environmental Chemistry data indicates that permethrin moderately accumulates in Bluegills and Catfish - 47x and 95x respectively. The recently submitted Fathead Minnow chronic study indicated, however, that bioaccumulation in this species may exceed 4000x.

The laboratory testing requested should estimate the uptake, transfer and degration of the pesticide in an aquatic food chain. Protocols prepared for the EPA by R. A. Schoettger and B. T. Johnson are suggested and can be made available to the registrant.

107.0 Conclusions

The Environmental Safety Staff does not concur with the proposed registration. Inadequate wildlife toxicity data is available for a complete hazard assessment.

107.1 Environmental Chemistry and Toxicology

(A) Mammalian toxicity data was evaluated for this review. This data came from a previous Environmental Safety review by Norman Cook (6/30/77: Ectiban).

(B) The most recent Environmental Chemistry review was not available at the time of this report. Data from previous Environmental Safety reviews was utilized.

107.2 Classification

NA at this time

107.3 Labelling

NA

107.5 Data Requests

Prior to consideration of registration of the proposed use, the following tests are required:

1. An aquatic microinvertebrate life-cycle study (Daphnia sp., preferably).

2. An acute ~~and a life-cycle~~ bioassay study using macroinvertebrates indigenous to the cotton growing region, e.g. mayflies, stoneflies, etc. This information is necessary in view of the aquatic insect kills reported in the field application study.

3. An aquatic ecosystem field study in which Ambush is applied aerially to cotton is required. The study should use the pesticide at labelled rates and make 15 applications per label directions. Monitoring data should

describe:

(1) effects on zooplankton, aquatic invertebrates, crawfish and indigenous fish populations

(2) comparable data from control locations for test species

(3) residue analysis of biological and physical environment

The study is intended to supply information on the potential risks of actual pesticide operations, in particular aerial applications and thus the registrant is required to choose a site which has a clear potential for aerial drift and surface runoff to an aquatic ecosystem.

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The laboratory testing requested should estimate the uptake, transfer and degration of the pesticide in an aquatic food chain. Protocols prepared for the EPA by R. A. Schoettger and B. T. Johnson are suggested and can be made available to the registrant.

The registrant should contact the Environmental Safety Section if any questions arise concerning data evaluations or requests.

Richard Balcomb

Richard Balcomb
Environmental Safety Section
EEEB-RD WH 567
March 17, 1978

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 10 days. Permethrin degrades slowly in cotton leaves so that after about 1 month 30-60% of the applied material was left as parent compound. Degradation in cotton bolls was reported to be similar to that 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.

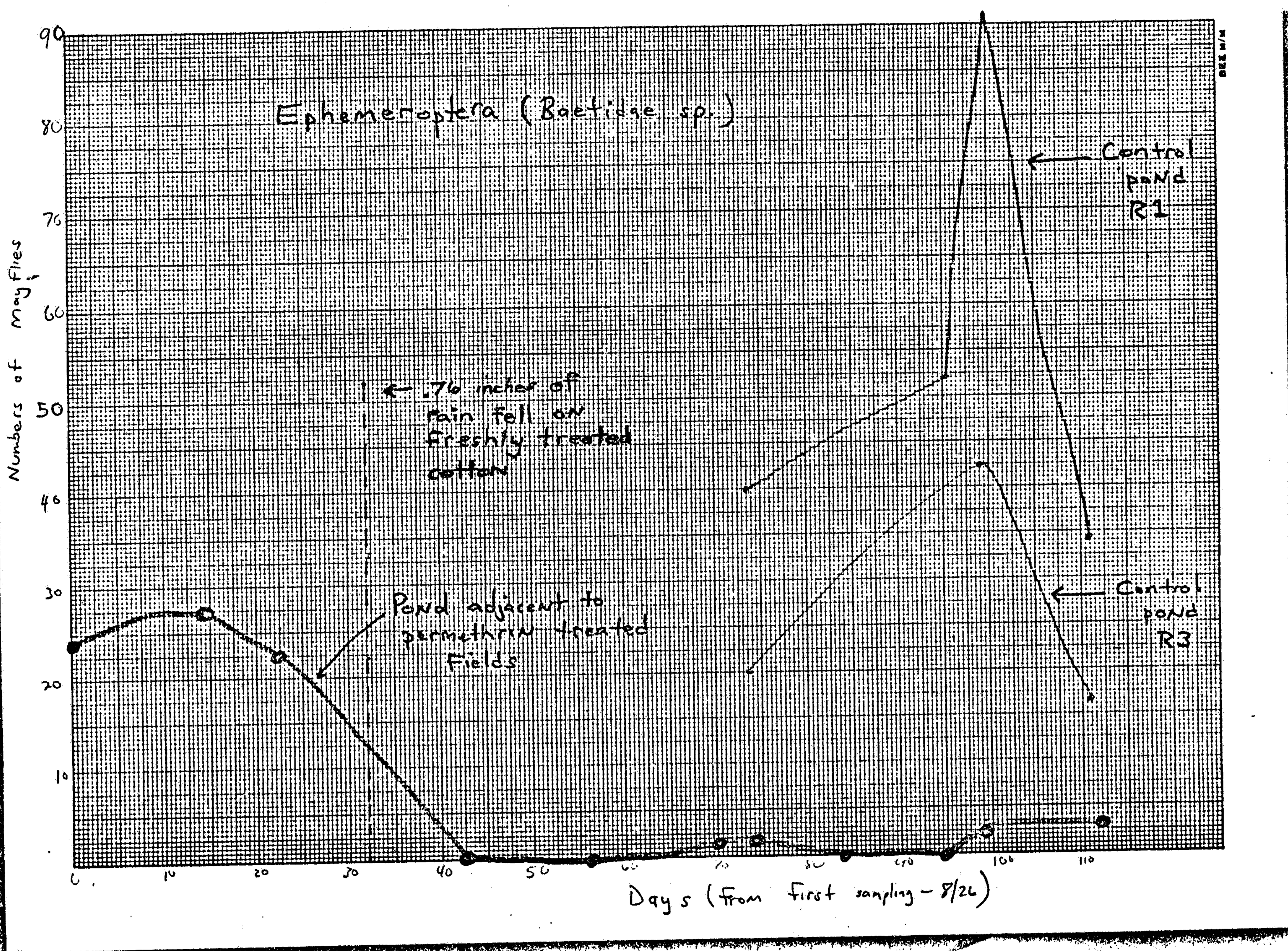
I. Effects on Aquatic Invertebrates

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, Gyiinidae, Belostomatidae) as well as insect larvae associated with vegetation and pond sediments (Ephemeroptera, Odonata).

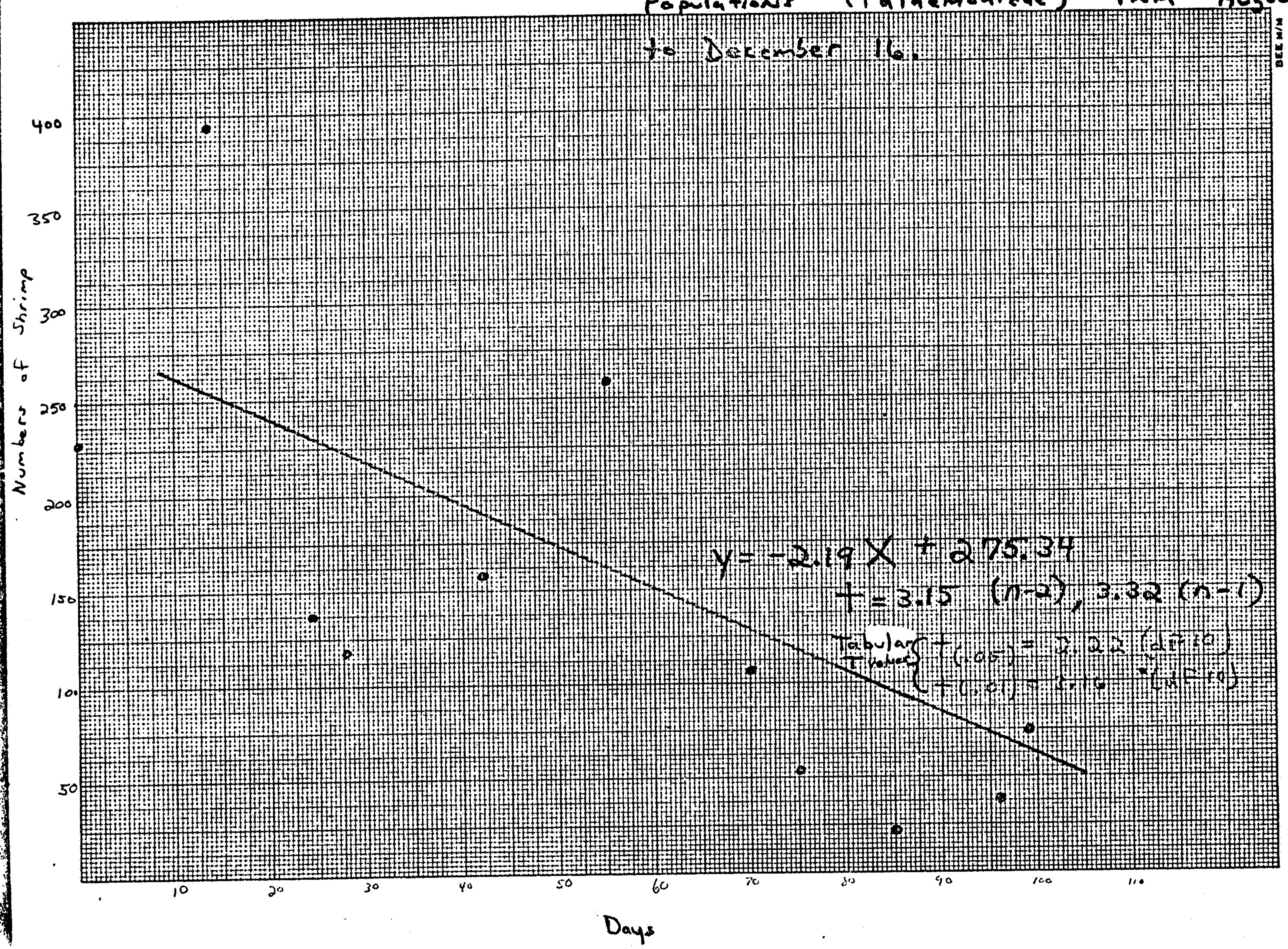
Graph I (attached) illustrates the reductions of the latter group which were chosen for graphing as enough insects were collected for meaningful comparisons and because they indicate the population declines relative to a late September rainfall that fell on freshly treated cotton.

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


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

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

imary oducers		algae		bacteria		
imary nsumers	copepods	cladocerans	mayflies	shrimp	chiro-nomids	Beetles (Hydro-philidae, Helipidae) =
condary nsumers	Small Fish	DragonFly nymphs	Damselfly nymphs	Giant Water Beetles	Surface Insects	(Gyrinidae) (Gerridae) (Veliidae)
riary nsumers	Sunfish		Catfish	Perch etc.		

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

Table II

imary oducers		algae	bacteria		
imary nsumers	copepods	cladocerans	chironomids	Beetles (Hydrophilidae, Halipidae)	Shrimp (much fewer)
condary nsumers	Small Fish	----	----	----	
:riary nsumers	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-~~ over-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 Warwater 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 peus 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 formualtion	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 *Tanytarsus* and *Chironomus*.

(FMC-33297 is permethrin)

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

Material and formualtion	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 4)	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 formualtion	lb/acre	Avg. no. organisms/5 dips composite sample pre- and post-treat (days)											
		Copepoda[a]						Ostracoda[b]					
		Pre	2	6	9	13	16	Pre	2	6	9	13	16
FMC-33297 (EC 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*.