Shaughnessy No.: 057801
Date Out of EFGWB: FEB 21 1990

To: George LaRocca
Product Manager 15
Registration Division (TS-767C)

From: Paul Mastradone, Chief
Environmental Chemistry Review Section #1
Environmental Fate and Ground Water Branch/EFED(TS769C)

Through: Henry Jacoby, Chief
Environmental Fate and Ground Water Branch/EFED(TS769C)

Attached, please find the EAB review of . . .

Reg./File # : 100-524

Chemical Name : Diazinon

Type Product : Insecticide/nematicide

Product Name :

Company Name : Ciba-Geigy

Purpose : Addendum to the 1988 Registration Standard

Date Received: _____

EFGWB # (s): 89-0135,89-0145,89-0108,89-0109,89-0267

Action Code : 660

Deferrals to:

_____ Ecological Effects Branch, EFED

_____ Science Integration and Policy Staff,

_____ Non-Dietary Exposure Branch, HED

_____ Dietary Exposure Branch, HED

_____ Toxicology Branch I, HED

_____ Toxicology Branch II, HED

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1. CHEMICAL: Common name:

Diazinon.

Chemical name:

O,O-Diethyl O-(2-isopropyl-4-methyl-6-pyrimidinyl)-phosphorothioate

Physical/Chemical properties:

Molecular formula: $C_{12}H_{21}N_2O_3PS$.
Molecular weight : 304.3.
Physical state : Clear, colorless liquid.
Vapor pressure : 0.097 mPa at 20°C.
Solubility (20°C): 40 mg/L in water; completely miscible in acetone, benzene, cyclohexane, diethyl ether, ethanol, methylene chloride, octanol, and toluene.

2. TEST MATERIAL:

Studies 1-3: active ingredient.
Study 4: technical grade material.

3. STUDY/ACTION TYPE:

Addendum to a Standard (review of hydrolysis, photodegradation in water, and accumulation in laboratory fish studies).

4. STUDY IDENTIFICATION:

Fackler, P.H. 1988. Bioconcentration and elimination of ^{14}C-residues by bluegill (Lepomis macrochirus) exposed to diazinon technical. Laboratory Study Number 1781-0288-6155-140. Laboratory Report Number 88-5-2717. Unpublished study performed by Springborn Life Sciences, Inc. and submitted by Ciba-Geigy Corporation, Greensboro, NC. ~~(40931101)~~ (40660808)

Matt, F.J. 1988. Hydrolysis of ^{14}C-diazinon in buffered aqueous solutions. Laboratory Project ID HLA 6117-156. Unpublished study performed by Hazleton Laboratories America, Inc., Madison, WI, and submitted by Ciba-Geigy Corporation, Greensboro, NC. (40931101)

Spare, W.C. 1988a. Aqueous photolysis of ^{14}-C diazinon by natural sunlight. Agrisearch Project No. 12100-A. Unpublished study performed by Agrisearch Incorporated, Frederick, MD, and submitted by Ciba-Geigy Corporation, Greensboro, NC. (40863401)

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Spare, W.C. 1988b. Aqueous photolysis of diazinon (artificial light). Agrisearch Project No. 12100. Unpublished study performed by Agrisearch Incorporated, Frederick, MD and submitted by Ciba-Geigy Corporation, Greensboro, NC. (40519801)

5. REVIEWED BY:

A. Abramovitch
Chemist
EFGWB/EFED/OPP
Review Section #1

Signature: Alex Abramovitch

Date: FEB 21 1990

6. APPROVED BY:

Paul Mastradone
Chief
EFGWB/EFED/OPP
Review Section #1

Signature: Paul J Mastradone

Date: FEB 21 1990

7. CONCLUSION:

The following findings are derived from the reviewed studies in this review and from the the March 1988 Registration Standard which met the requirements of 40 CFR Part 158.290 and the guidance of Subdivision N, and were also deemed acceptable.

Hydrolysis (Matt, 40931101)

Diazinon hydrolyzed with a half-life of 12 days in a sterile mildly acidic (pH 5) solution at 23-25°C. The rate of hydrolysis decreased in neutral (pH 7) and mildly basic (pH 9) solutions to half lives of 138 and 77 days, respectively. Oxypyrimidine was the major degradate identified in the three solutions.

Photodegradation in Water (Spare, 40863401)

Degradation in the irradiated solutions was primarily due to hydrolysis, rather than photolysis. This conclusion is drawn by comparing the half-lives of the irradiated versus dark control solutions (258 vs. 325 hours). The net contribution of sunlight was estimated to degrade diazinon with a half life of 559-620 days (over 48 days). Oxypyrimidine was the major degradate.

Photodegradation on Soil (Martinson, 00153229)

14C-Diazinon degraded on sandy loam soil exposed to natural sunlight with a half life of 17.3 hours. The half life for diazinon in the non exposed sample was 14.7 days. The degradate, oxypyrimidine, was detected at levels of 23.7% of the applied material after 32.6 hours of sunlight exposure. Another degradate, 2-(1'-hydroxy-1'methyl)ethyl-4-methyl-6-

hydroxypyrimidine was present at 3.6%.

Aerobic Soil Metabolism (DAS, 400287)

Diazinon degraded in a sandy loam soil (54.8 sand, 29.4 silt, 15.8% clay, 2% organic, 15 meq/100g CEC, pH 5.4) with a half life of 31.2 days under aerobic conditions. The major degradate was oxypyrimidine reaching 67% of the applied after 95 days. Oxypyrimidine is more stable than diazinon under aerobic soil conditions. A second degradate was 2-(1'-hydroxy-1-methyl)ethyl-4-methylhydroxypyrimidine at a maximum concentration of 12.8% after 6 months.

Anaerobic Soil Metabolism (DAS 400287)

Diazinon degraded under anaerobic conditions, in identical soil to that used in the aerobic soil metabolism study, with a half life of 34.3 days. Degradation rate and pattern appear similar under both aerobic and anaerobic soil conditions. However, oxypyrimidine appear to be more abundant and persistent under aerobic soil conditions than under anaerobic soil conditions.

Accumulation in laboratory fish (Fackler, 40660808)

Diazinon residues (uncharacterized) accumulated in bluegill sunfish exposed to 2 ppb of diazinon, with maximum mean bioconcentration factors of 542x, 583x, and 542x for edible, nonedible, and whole fish tissues, respectively. Depuration was rapid, with 96-97% of the accumulated [^{14}C]residues eliminated from the fish tissues by day 7 of the depuration period.

8. RECOMMENDATIONS:

The submission of data required for full registration of diazinon on terrestrial food crop, terrestrial nonfood, greenhouse food crop, greenhouse nonfood, forestry, domestic outdoor, and indoor use sites is summarized below:

Environmental fate and ground water assessment cannot be completed until all leaching and field dissipation data are made available. Based on the available data, diazinon degraded in soil under aerobic and anaerobic soil conditions with a half life of less than 35 days. The major degradate, oxypyrimidine, is much more stable in soil than diazinon and can be rated as moderately persistent. In water, diazinon is more stable than in soil and is particularly stable at pH 7 and 9. Photodegradation in water is insignificant. At pH 5, hydrolysis occurs with a half life of 12 days.

As already indicated in the 1988 Registration Standard and in this review, oxypyrimidine, the main degradate of diazinon, is more stable in soil and more mobile in soil than diazinon. A

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secondary degradate of oxypyrimidine was identified as an alcohol derivative of oxypyrimidine. Oxypyrimidine and its degradate may pose a greater risk to ground water than diazinon. Leaching and field dissipation studies were requested in the 1988 Registration Standard and were not yet submitted to the agency.

The following data requirements remain unsatisfied:

Laboratory volatility studies
Terrestrial field dissipation studies
Forestry dissipation studies
Confined (and field) accumulation studies on rotational crops
Leaching and adsorption/desorption studies

The following data requirements are partially fulfilled:

Leaching and adsorption/desorption studies

The following data requirements are fulfilled:

Hydrolysis studies
Photodegradation studies in water
Photodegradation studies on soil
Aerobic soil metabolism studies
Anaerobic soil metabolism studies
Anaerobic aquatic metabolism studies
Laboratory studies of pesticide accumulation in fish

The following data requirements are deferred or are not required for presently registered uses:

Photodegradation in air studies: No data were reviewed. The data requirement is deferred pending the receipt of acceptable laboratory volatility studies.

Aerobic aquatic metabolism studies: No data were reviewed. No data are required because the test substance is not registered for aquatic uses or any aquatic impact uses involving direct discharges of treated water into outdoor aquatic sites.

Field volatility studies: No data were reviewed. The data requirement is deferred pending the receipt of acceptable laboratory volatility studies.

Aquatic field dissipation studies: No data were reviewed. No data are required because the test substance is not registered for aquatic food crop, aquatic nonfood (including antifouling paints, ditchbanks, and shorelines), or aquatic impact uses involving direct discharge of treated water into outdoor aquatic sites.

Dissipation studies for combination products and tank mix uses: No data were reviewed; however, no data are required because data requirements for combination products and tank mix uses are currently not being imposed.

Long-term field dissipation studies: No data were reviewed, but all data may be required if the results from the field dissipation/aerobic soil metabolism studies demonstrate that residues do not reach 50% dissipation in soil prior to the recommended subsequent application.

Field accumulation studies on rotational crops: No data were reviewed. The data requirement is deferred pending the receipt of acceptable accumulation studies in confined rotational crops.

Accumulation studies on irrigated crops: No data were reviewed; however, no data are required because the test substance is not intended for aquatic food crop or aquatic nonfood uses, for uses in and around holding ponds used for irrigation purposes, or for uses involving effluents or discharges to water used for crop irrigation.

Field accumulation studies on aquatic nontarget organisms: No data were reviewed. The data requirement is waived based on the accumulation data in laboratory fish.

9. BACKGROUND:

A. Introduction The reviewed studies were submitted in response to the 1988 Registration Standard.

B. Directions for Use See 1988 Registration Standard.

10. DISCUSSION OF INDIVIDUAL TESTS OR STUDIES: Attached review

11. COMPLETION OF ONE-LINER: Not completed

12. CBI APPENDIX:

All data reviewed here are considered "company confidential" by the registrant and must be treated as such.

EXECUTIVE SUMMARY

The following findings are derived from the reviewed studies in this review and from the the March 1988 Registration Standard which met the requirements of 40 CFR Part 158.290 and the guidance of Subdivision N, and were also deemed acceptable.

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RECOMMENDATIONS

The submission of data required for full registration of diazinon on terrestrial food crop, terrestrial nonfood, greenhouse food crop, greenhouse nonfood, forestry, domestic outdoor, and indoor use sites is summarized below:

The following data requirements remain unsatisfied:

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REFERENCES:

DAS, Y.T. 1987. Aerobic and anaerobic soil metabolism of diazinon, Project no. 85-E-044 SP (400287).

Fackler, P.H. 1988. Bioconcentration and elimination of ^{14}C-residues by bluegill (Lepomis macrochirus) exposed to diazinon technical. Laboratory Study Number 1781-0288-6155-140. Laboratory Report Number 88-5-2717. Unpublished study performed by Springborn Life Sciences, Inc. and submitted by Ciba-Geigy Corporation, Greensboro, NC. (40931101)

Martinson, J. 1985. Photolysis of diazinon on soil. Final Report Biospherics Project No. 85-E-044 (00153229).

Matt, F.J. 1988. Hydrolysis of ^{14}C-diazinon in buffered aqueous solutions. Laboratory Project ID HLA 6117-156. Unpublished study performed by Hazleton Laboratories America, Inc., Madison, WI, and submitted by Ciba-Geigy Corporation, Greensboro, NC. (40931101)

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APPENDIX

STRUCTURES OF DIAZINON AND OXYPYRIMIDINE

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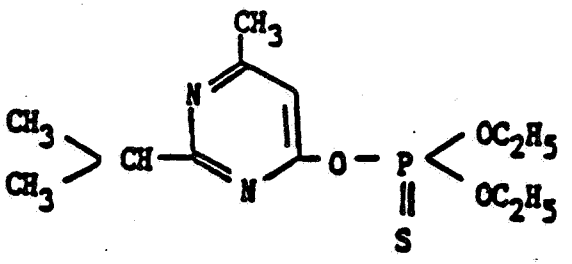
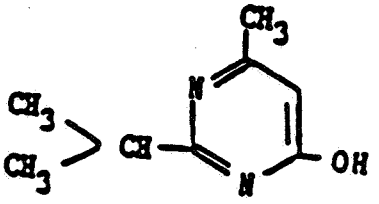


O,O-Diethyl-O-(2-isopropyl-6-methyl-4-pyrimidinyl)phosphorothioate

Diazinon
(G-24480)



2-Isopropyl-6-methyl-4-pyrimidinol

Oxypyrimidine
(G-27550)

DYNAMAC
CORPORATION

DIAZINON ADDENDUM

Task 1: Review and Evaluation of Individual Studies

Task 2: Environmental Fate Assessment

Contract No. 68-02-4250

Submitted to:
Environmental Protection Agency
Arlington, VA 22202

Submitted by:
Dynamac Corporation
The Dynamac Building
11140 Rockville Pike
Rockville, MD 20852

Diazinon

Table of Contents

INTRODUCTION

Diazinon is an insecticide/acaricide/nematicide registered for use on a variety of terrestrial food crop (field, vegetable, and orchard crops), terrestrial nonfood crop (tobacco, ornamentals, and forest trees), greenhouse food crop and nonfood crop, domestic outdoor, forestry, and indoor (domestic, commercial, and industrial) sites. Application rates for these uses are listed in Table 1. Single active ingredient formulations consist of 1,2-10, 25, 33-33.34% D; 0.46-14.3% G; 5% P/T; 40 and 50% WP; 2 lb/gal and 0.5-5% Mcap; 10-15 and 20-39% Impr; 2, 4, and 7 lb/gal and 5, 10-12.5, 16.75, 25, 47.5, 48.2 and 87% EC; 0.42 lb/gal and 0.5 and 1% RTU; and 0.5, 0.61, and 1% PrL. Diazinon is generally applied foliarly or as a soil treatment using ground or aerial equipment. Diazinon may be formulated with other chemicals including captan, chlorothalonil, folpet, lindane, malathion, pyrethrins, rotenone, and zineb.

Table 1. Application rates for diazinon.

Rates per Site Category:

CATEGORY	RANGE
TERRESTRIAL FOOD CROP	0.025-10.21 lb/A; 0.19-2.0 lb/100 gal; 0.009-0.42 oz/100 sq.ft; 0.076-0.17 oz/gal; 0.25-2.1 oz/bu; 0.03 oz/stem; 0.14-1.4 oz/tree; 0.62-2.5 oz/1000 ft of row; 0.36-2.4 tbls actual*/1000 ft of row; 1 insulator enclosure/young tree; --
TERRESTRIAL NONFOOD CROP	0.25-3 lb/A; 5.72 lb/A (SLN); 0.05-2.0 lb/5,000 sq.ft; 0.08-0.17 lb/100 sq.ft; 0.0095-0.14 oz/100 sq.ft; 0.25-3.2 lb/100 gal; 0.066-0.9 oz/gal; 1.4-3.0 oz/100 gal transplant water; 0.17-0.4 tbls actual*/gal; --
AQUATIC FOOD CROP *	0.5-3.0 lb/A; 0.08 oz/gal
GREENHOUSE FOOD CROP	0.5-1% finished spray; 0.125-0.25 lb/100 gal; 0.033-1 lb/100 sq.ft; 2.0 lb/1000 cu ft; 0.02 oz/100 sq.ft
GREENHOUSE NONFOOD CROP	0.625% finished spray; 16 fl.oz 10% RTU/50,000 cu.ft; 0.25-1.5 lb/100 gal; 0.07-0.25 oz/gal
DOMESTIC OUTDOOR	0.049 lb/A; 0.04-1.25 oz/100 sq.ft; 0.5-1% finished spray; 0.2-1.6 oz/gal; 1 fl.oz 87% EC/gal paint; 0.06-0.12 tsp actual*/spot; --
FORESTRY	0.25 lb/A
INDOOR	11%, 15% flea collar; 0.5-1% finished spray; 0.004-0.2 oz/100 sq.ft; 1 fl.oz 87% EC/gal paint; 0.21 oz/animal (cattle); 0.02-0.04 oz/animal (sheep); 0.25-0.5 lb/100 gal; 0.08-1.6 oz/gal; 0.06 oz/burrow; 0.24 oz/dust station; 0.24-0.25 oz/gal/fire ant mound; 0.049-1 lb/A; 0.02-0.04 oz/dispenser [3-4 dispensers/A]; --

* The Environmental Fate and Groundwater Branch considers cranberries ~~and water cress~~ to be terrestrial food crops.

DATA EVALUATION RECORD

STUDY 1

CHEM 057801 Diazinon §161-1

FORMULATION--00--ACTIVE INGREDIENT

STUDY ID 40931101
Matt, F.J. 1988. Hydrolysis of ^{14}C-diazinon in buffered aqueous solutions. Laboratory Project ID HLA 6117-156. Unpublished study performed by Hazleton Laboratories America, Inc., Madison, WI, and submitted by Ciba-Geigy Corporation, Greensboro, NC.

DIRECT REVIEW TIME = 8

REVIEWED BY: J. Harlin TITLE: Staff Scientist

EDITED BY: K. Patten TITLE: Task Leader

APPROVED BY: W. Spangler TITLE: Project Manager

ORG: Dynamac Corporation
Rockville, MD
TEL: 468-2500

APPROVED BY: A. Abramovitch
TITLE: Chemist
ORG: EFGWB/EFED/OPP
TEL: 557-1975

SIGNATURE:

CONCLUSIONS:

Degradation - Hydrolysis

1. This study is acceptable and fulfills EPA Data Requirements for Registering Pesticides by providing information on the hydrolysis of ring-labeled [^{14}C]diazinon at pH 5, 7, and 9.

2. Diazinon hydrolyzed with a half-life of 12 days in a sterile mildly acidic (pH 5) solution at 23-25°C. The rate of hydrolysis decreased in neutral (pH 7) and mildly basic (pH 9) solutions to half lives of 138 and 77 days, respectively. Oxypyrimidine was the major degradate identified in the three solutions.

METHODOLOGY:

Uniformly ring-labeled [^{14}C]diazinon (radiochemical purity 99.1%, specific activity 30.3 Ci/mg, Ciba-Geigy Corporation), dissolved in methanol, was added at 10.8-10.9 ppm to sterile aqueous 0.01 M buffer solutions adjusted to pH 5 (sodium acetate), 7 (sodium phosphate), and 9 (sodium borate). Duplicate aliquots of the solutions were analyzed for total radioactivity using LSC. Additional aliquots (2 mL) of the solutions were transferred to amber-colored glass vials that were then capped with crimp-top caps lined with Teflon and incubated in the dark at 23-25°C. The pH of the test solutions was measured at 0, 14, and 33 days posttreatment. Duplicate vials of the pH 5 solution were removed for analysis at 0, 2, 5, 8, 11, 14, and 21 days posttreatment; duplicate vials of the pH 7 and 9 solutions were removed for analysis at 0, 5, 11, 21, 29, and 32 days posttreatment.

Aliquots (30 L) of the treated solutions were analyzed for diazinon and its degradates using HPLC with UV (250 nm); the resulting HPLC fractions were quantified using LSC. In order to confirm the results of the HPLC analysis, aliquots of the final sampling of each pH solution were analyzed with diazinon and oxypyrimidine using one- and two-dimensional TLC on silica gel plates. Using one-dimensional TLC, the plates were developed in cyclohexane:ethyl acetate (80:40) acidified with 1% acetic acid, and radioactive areas on the plates were located using a radioscanner, scraped from the plates, and quantified by LSC; for the pH 5 solutions, radioactive areas were also located using autoradiography. Reference standards were visualized by ultraviolet light fluorescence quenching. Using two-dimensional TLC, the plates were developed in the first direction as previously described, then air-dried. Nonlabeled standards were then applied to the plates, which were developed in the second direction using chloroform:acetone:ethyl ether (16:3:1) acidified with 0.5% acetic acid. Radioactive areas were located using autoradiography and reference standards were visualized by ultraviolet light fluorescence quenching. The autoradiographs were superimposed on the TLC plates to verify comigration of the radioactive components of the samples with the nonlabeled standards.

DATA SUMMARY:

Uniformly ring-labeled [^{14}C]diazinon (radiochemical purity 99.1%), at 10.8-10.9 ppm, degraded with calculated half-lives of 12 days at pH 5, 138 days at pH 7, and 77 days at pH 9 in sterile aqueous buffered solutions that were incubated at 23-25°C in the dark for 21 (pH 5) or 32 days (pH 7 and 9).

Oxypyrimidine (2-isopropyl-6-methyl-4-hydroxypyrimidine)

was identified in all three solutions; an additional degradate (Peak 1, HPLC fractions 6-9), present in all solutions at <8% of the applied, was not identified. In the pH 5 solution at 21 days posttreatment, diazinon comprised 28.6% of the applied, oxypyrimidine had increased to 67.4%, and the Peak 1 compound comprised 0.8% (down from 1.2% at 8 days) (Table 9). In the pH 7 solution at 32 days posttreatment, diazinon accounted for 75.8% of the applied, oxypyrimidine had increased to 6.9%, and the Peak 1 compound had increased to 7.5% (Table 10). In the pH 9 solution at 32 days posttreatment, diazinon accounted for 68.3% of the applied, oxypyrimidine had increased to 18.8%, and the Peak 1 compound had increased to 6.9% (Table 11). During the study, the average material balances ranged from 94.4 to 100% of the applied (Tables 3-5).

During the study, the pH of all three buffer solutions increased slightly, from 5.01 to 5.06, 7.05 to 7.09, and 9.04 to 9.14.

COMMENTS:

1. The study author did not attempt to identify Peak 1, which reached a maximum concentration of 1.2, 7.5, and 6.9% of the applied in the pH 5, 7, and 9 solutions, respectively, and was the major degradate in the pH 7 solution at the final sampling interval. Subdivision N guidelines specify that only degradates comprising 10% of the applied must be identified.

2. Recovery efficiencies from buffer solutions fortified with diazinon and oxypyrimidine were not reported for the analytical methods. The method detection limits were not reported.

3. The statistical estimations of the hydrolytic half-life of diazinon in pH 7 and 9 solutions that were reported in these experiments are of limited value because the calculations involve extrapolation beyond the experimental time limits of the study. Data are often incapable of accurately predicting trends outside of their range because differences are magnified and reactions which are linear within the scope of the experiments may become curvilinear.

Table 3

Individual and Mean Recovery of the Radioactivity Applied to the pH 5 Samples

Sample Interval (Day)	Sample Number	Radioactivity (dpm/mL)	Percent Recovery Relative to Day 0[a]	
			Individual	Mean
0	5-A	726,983	99.9	100.0
	5-B	727,750	100.1	
2	5-13	716,300	98.5	98.5
	5-4	716,250	98.5	
5	5-3	706,583	97.1	97.6
	5-9	713,800	98.1	
8	5-11	718,650	98.8	97.1
	5-10	693,200	95.3	
11	5-8	727,500	100.0	99.7
	5-5	722,817	99.4	
14	5-14	730,250	100.4	99.0
	5-1	710,200	97.6	
21	5-7	715,050	98.3	98.8
	5-6	721,417	99.2	

a Recovery values for samples were calculated relative to the mean concentration (727,366.5 dpm/mL) of Sample Nos. 5-A and 5-B at Day 0.

Table 4

Individual and Mean Recovery of the Radioactivity Applied to the pH 7 Samples

Sample Interval (Day)	Sample Number	Radioactivity (dpm/mL)	Percent Recovery Relative to Day 0[a]	
			Individual	Mean
0	7-A	739,783	98.9	100.0
	7-B	756,600	101.1	
5	7-12	700,383	93.6	94.4
	7-11	711,833	95.1	
11	7-14	744,400	99.5	98.7
	7-4	732,467	97.9	
21	7-5	711,383	95.1	96.5
	7-13	731,400	97.8	
29	7-6	726,283	97.1	95.9
	7-10	708,717	94.7	
32	7-8	717,167	95.9	96.0
	7-9	719,133	96.1	

a Recovery values for samples were calculated relative to the mean concentration (748,191.5 dpm/mL) of Sample Nos. 7-A and 7-B at Day 0.

Table 5

Individual and Mean Recovery of the Radioactivity Applied to the pH 9 Samples

Sample Interval (Day)	Sample Number	Radioactivity (dpm/mL)	Percent Recovery Relative to Day 0[a]	
			Individual	Mean
0	9-A	728,417	100.6	100.0
	9-B	720,217	99.4	
5	9-9	678,933	93.7	94.5
	9-13	690,417	95.3	
11	9-7	708,083	97.8	98.6
	9-6	719,800	99.4	
21	9-10	702,800	97.0	96.9
	9-1	700,400	96.7	
29	9-8	696,500	96.2	95.9
	9-5	692,550	95.6	
32	9-4	705,650	97.4	97.5
	9-12	707,050	97.6	

a Recovery values for samples were calculated relative to the mean concentration (724,317 dpm/mL) of Sample Nos. 9-A and 9-B at Day 0.

Table 9

Individual and Mean Distribution of the Radioactivity Expressed as the Percentage of Radioactivity Applied to the pH 5 Samples[a]

Sample Interval (Day)	Sample Number	Percent Radioactivity Applied to Sample					
		^{14}C-Diazinon		Peak 1		Oxypyrimidine	
		Individual	Mean	Individual	Mean	Individual	Mean
0	5-A	92.7	91.1	0.0	0.0	2.4	2.4
	5-B	89.4		0.0		2.4	
2	5-13	82.7	82.4	0.3	0.2	10.2	10.2
	5-4	82.1		0.0		10.2	
5	5-3	69.5	69.3	0.6	0.6	23.6	23.0
	5-9	69.1		0.6		22.3	
8	5-11	57.5	57.4	1.2	1.2	36.1	35.7
	5-10	57.2		1.1		35.2	
11	5-8	46.7	48.2	0.8	1.0	45.1	45.6
	5-5	49.7		1.1		46.1	
14	5-14	41.2	41.1	0.6	0.7	52.8	52.0
	5-1	40.9		0.7		51.2	
21	5-7	29.9	28.6	0.8	0.8	66.5	67.4
	5-6	27.2		0.8		68.2	

a Percentage of the radioactivity recovered from the HPLC column (Table 6) multiplied by the applied radioactivity recovered from the sample (Table 3) divided by 100.

Table 10

Individual and Mean Distribution of the Radioactivity Expressed as the Percentage of Radioactivity Applied to the pH 7 Samples[a]

Sample Interval (Day)	Sample Number	Percent Radioactivity Applied to Sample					
		^{14}C-Diazinon		Peak 1		Oxypyrimidine	
		Individual	Mean	Individual	Mean	Individual	Mean
0	7-A	90.5	91.1	0.0	0.0	0.5	0.5
	7-B	91.6		0.0		0.5	
5	7-12	88.3	86.1	1.4	1.2	1.1	1.3
	7-11	83.9		1.0		1.5	
11	7-14	85.5	86.5	2.9	3.0	2.7	2.7
	7-4	87.5		3.1		2.7	
21	7-5	81.9	82.5	4.9	4.9	4.9	4.8
	7-13	83.0		4.9		4.7	
29	7-6	79.1	78.7	6.6	6.6	6.1	6.3
	7-10	78.3		6.5		6.5	
32	7-8	75.9	75.8	7.4	7.5	7.0	6.9
	7-9	75.6		7.5		6.8	

a Percentage of the radioactivity recovered from the HPLC column (Table 7) multiplied by the applied radioactivity recovered from the sample (Table 4) divided by 100.

Table 11

Individual and Mean Distribution of the Radioactivity Expressed as the Percentage of Radioactivity Applied to the pH 9 Samples[a]

Sample Interval (Day)	Sample Number	Percent Radioactivity Applied to Sample					
		^{14}C-Diazinon		Peak 1		Oxypyrimidine	
		Individual	Mean	Individual	Mean	Individual	Mean
0	9-A	91.5	91.3	0.3	0.2	0.7	0.7
	9-B	91.0		0.0		0.6	
5	9-9	84.9	85.9	1.1	1.2	3.6	3.8
	9-13	86.9		1.2		4.0	
11	9-7	85.2	85.3	2.6	2.8	7.9	7.7
	9-6	85.4		3.0		7.4	
21	9-10	75.4	74.7	5.2	5.0	12.7	12.8
	9-1	74.0		4.7		12.8	
29	9-8	70.9	70.5	6.8	6.6	17.2	17.3
	9-5	70.1		6.4		17.4	
32	9-4	69.0	68.3	7.2	6.9	18.8	18.8
	9-12	67.6		6.6		18.8	

a Percentage of the radioactivity recovered from the HPLC column (Table 8) multiplied by the applied radioactivity recovered from the sample (Table 5) divided by 100.

STUDY AUTHOR(S)'S RESULTS AND/OR CONCLUSIONS

RESULTS

Definitive Study

Recovery of Radioactivity Applied to the Samples. The individual and mean value for the recovery of the radioactivity applied to the pH 5, 7, and 9 samples are in Tables 3, 4, and 5, respectively. The total mean radioactivity found relativ to Day 0 throughout the 21-day (pH 5) and 32-day (pH 7 and 9) study periods ranged from 94.4% to 99.7% of that applied.

Distribution of Radioactivity Expressed as the Percentage of Radioactivity Applied to the HPLC Column. An aliquot from each sample was analyzed by HPLC. Fractions were collected and analyzed by LSC. Histograms of the HPLC/LSC data indicated the presence of at least three components in the test samples: ^{14}C-Diazinon, oxypyrimidine, and an unknown region of radioactivity designated a Peak 1. Radiolabeled Diazinon and oxypyrimidine were observed at all intervals for all samples under the pH 5, 7, and 9 conditions. Peak 1 was observed at all intervals except Day 0 for the pH 5 and 7 conditions. Representative histograms are in Figures 2 through 7 and in Appendix C.

The individual and mean sample values for the distribution and recovery of radioactivity applied to the HPLC column are in Tables 6 (pH 5), 7 (pH 7), and 8 (pH 9). Mean HPLC column recoveries ranged from 94.6% to 100.4% for the pH 5, 7 and 9 samples throughout the 21-day (pH 5) and 32-day (pH 7 and 9) study periods.

Distribution of Radioactivity Expressed as the Percentage of Radioactivity Applied to the Sample. The individual and mean sample values for the distribution of radioactivity expressed as the percentage of radioactivity applied to the sample are in Tables 9 (pH 5), 10 (pH 7), and 11 (pH 9); mean values are presented graphically in Figures 8 (pH 5), 9 (pH 7), and 10 (pH 9).

For the pH 5 samples, the radioactivity found for the HPLC peak corresponding to ^{14}C-Diazinon decreased steadily from 91.1% (Day 0) to 28.6% (Day 21) of that applied to the samples. An increase, concomitant to the decrease of ^{14}C-Diazinon, was observed for the HPLC peak corresponding to oxypyrimidine ranging from 2.4% (Day 0) to 67.4% (Day 21) of that applied. The mean radioactivity found for HPLC Peak 1 did not exceed 1.2% of that applied.

For the pH 7 samples, the radioactivity found for the HPLC peak corresponding to ^{14}C-Diazinon decreased from 91.1% (Day 0) to 75.8% (Day 32) of that applied. The mean radioactivity found for the HPLC peak corresponding to oxypyrimidine increased from 0.5% (Day 0) to 6.9% (Day 32) of that applied. The mean radioactivity found for HPLC Peak 1 increased from not detected (Day 0) to 7.5% (Day 32) of that applied.

For the pH 9 samples, the radioactivity found for the HPLC peak corresponding to ^{14}C-Diazinon decreased from 91.3% (Day 0) to 68.3% (Day 32) of that applied. The mean radioactivity found for the HPLC peak corresponding to oxypyrimidine increased from 0.7% (Day 0) to 18.8% (Day 32) of that applied. The mean radioactivity found for HPLC Peak 1 increased from 0.2% (Day 0) to 6.9% (Day 32) of that applied.

Degradation of ^{14}C-Diazinon. The degradation of ^{14}C-Diazinon in the pH 5, 7, and 9 samples appeared to follow first-order kinetics. The calculated degradation half-lives of ^{14}C-Diazinon using linear regression analysis were 12, 138, and 77 days for the pH 5, 7, and 9 samples, respectively. The data used in the linear regression analyses are in Tables 12 (pH 5), 13 (pH 7), and 14 (pH 9); the linear regression lines are in Figures 11 (pH 5), 12, (pH 7), and 13 (pH 9). The correlation coefficients for the linear regression lines were 0.954 or greater for the pH 5, 7, and 9 samples.

Identification of Degradation Products

Comparison of the HPLC retention times of the radioactive peaks for the buffer samples with the retention times of the nonradiolabeled standards of Diazinon and oxypyrimidine showed that two radioactive peaks had retention times equivalent to ^{14}C-Diazinon and oxypyrimidine. Radiolabeled Diazinon and oxypyrimidine were present for all samples at all intervals. A representative chromatogram of the nonradiolabeled standards is in Figure 14.

The presence of radiolabeled Diazinon and oxypyrimidine in the buffer samples was confirmed by TLC using nonradiolabeled standards. Representative cochromatography by TLC of the radioactive components and nonradiolabeled standards is shown in Figures 15, 16, and 17 for the pH 5, 7, and 9 samples, respectively. The mean radioactivity found for the peaks corresponding to ^{14}C-Diazinon and oxypyrimidine was similar when the HPLC and TLC results were compared:

Mean Radioactivity Expressed as the Percentage of Radioactivity Applied to Sample

Sample Interval (Day)	pH Condition	HPLC		TLC	
		^{14}C-Diazinon	Oxypyrimidine	^{14}C-Diazinon	Oxypyrimidine
21	5	28.6	67.4	30.6	66.4
32	7	75.8	6.9	84.0	6.1
32	9	68.3	18.8	75.0	16.8

The presence of radiolabeled Diazinon and oxypyrimidine in the buffer samples was also confirmed by two-dimensional TLC using nonradiolabeled standards. Figures 18, 19, and 20 show the comigration of the radioactive components of the samples with the nonradiolabeled standards of Diazinon and oxypyrimidine for the pH 5, 7, and 9 conditions, respectively.

CONCLUSIONS

Radiolabeled Diazinon degraded over time in aqueous solutions buffered at pH 5, 7, and 9. The calculated degradation half-lives of ^{14}C-Diazinon were 12, 138, and 77 days for the pH 5, 7, and 9 samples, respectively. Analysis of the buffer samples by HPLC showed the presence of three components: ^{14}C-Diazinon, oxypyrimidine, and an unknown region of radioactivity designated as Peak 1. The presence of radiolabeled Diazinon and oxypyrimidine in the buffer samples was confirmed by HPLC, TLC, and two-dimensional TLC using nonradiolabeled standards. The mean radioactivity found for the HPLC peak corresponding to oxypyrimidine reached a maximum of 67.4% (pH 5, Day 21), 6.9% (pH 7, Day 32), and 18.8% (pH 9, Day 32) of that applied to the samples. The mean radioactivity found for HPLC Peak 1 was 7.5% or less of that applied for the pH 5, 7, or 9 samples throughout the study.

DATA EVALUATION RECORD

STUDY 2

CHEM 057801 Diazinon §161-2

FORMULATION--00--ACTIVE INGREDIENT

STUDY ID 40863401
Spare, W.C. 1988a. Aqueous photolysis of ^{14}-C diazinon by natural sunlight. Agrisearch Project No. 12100-A. Unpublished study performed by Agrisearch Incorporated, Frederick, MD, and submitted by Ciba-Geigy Corporation, Greensboro, NC.

DIRECT REVIEW TIME = 6

REVIEWED BY: J. Harlin TITLE: Staff Scientist

EDITED BY: K. Patten TITLE: Task Leader

APPROVED BY: W. Spangler TITLE: Project Manager

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APPROVED BY: A. Abramovitch
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SIGNATURE:

CONCLUSIONS:

Degradation - Photodegradation in Water

1. This study in combination with the hydrolysis study (study 1) fulfill data requirements for photodegradation in water.

2. Degradation in the irradiated solutions was primarily due to hydrolysis, rather than photolysis. This conclusion is drawn by comparing the half-lives of the irradiated versus dark control solutions (258 vs. 325 hours). The net contribution of sunlight was estimated to degrade diazinon with a half life of 559-620 days (over 48 days). Oxypyrimidine was the major degradate.

METHODOLOGY:

Ring-labeled [^{14}C]diazinon (labeled in the 2 position, radiochemical purity 99%, specific activity 36.5 Ci/mg, Ciba-Geigy Corp.) dissolved in acetone was added to a sterile pH 7 phosphate buffer solution for a final concentration of 6 ppm of [^{14}C]diazinon and <1% acetone. The treated solution was transferred to three quartz glass test tubes that were sealed with teflon-coated stoppers; the tubes were filled to capacity to minimize volatilization. One of the tubes was covered with aluminum foil and served as the dark control. All three tubes were incubated outdoors on a roof in Frederick, Maryland (39°25'N latitude; 77°24'W longitude), for 51 calendar days between May 9 and June 28, 1988, during which time the intensity of the sunlight was 80-2200 W/cm2 (Table 1). Air temperatures during periods of sunlight exposure ranged from 12 to 49°C. The tubes of treated solution were stored at 1-4°C when not exposed to sunlight. The two irradiated solutions were sampled after 0, 5, 12, 24, 48, 72, 146, 240, and 360 hours of irradiation; the dark control was sampled at the same intervals. The registrant considered 1 day of exposure equal to 12 hours of sunlight exposure whether the exposure was obtained over one or several calendar days (hours of irradiation do not readily correspond to hours of incubation).

The treated solutions were analyzed immediately after sampling, except for the 72-hour samples which were held at -20°C for 2 days prior to analysis. Aliquots of the irradiated and dark control solutions were analyzed for total radioactivity using LSC. Additional aliquots of the solutions were analyzed for diazinon and its degradates using one-dimensional TLC on silica gel plates developed in either hexane:ethyl acetate (8:2, v:v) or toluene:chloroform:ethanol:formic acid (8:8:2:1, v:v:v:v). [^{14}C]Compounds were quantified by radioscanning and identified by comparison to reference standards (diazinon and oxypyrimidine) that had been cochromatographed with the samples. Following development, the plates were air-dried and radioactive areas were visualized using UV light (254 nm) and quantified using a TLC linear analyzer.

To confirm the distribution of degradates, aliquots of the 360-hour samples were analyzed by two-dimensional TLC on silica gel plates developed in toluene:chloroform:ethanol:formic acid followed by hexane:ethyl acetate. The samples were cochromatographed with diazinon and oxypyrimidine reference standards. After development, radioactive areas were scraped from the plates and quantified using LSC.

Because a decreasing material balance was noted before the termination of the study, volatiles in the headspace of the tubes of irradiated solution were measured prior to the 360-hour sampling. Air was drawn through the headspace, then through a series of traps containing ethylene glycol and 1 N potassium hydroxide (no additional information was provided on

the method of sampling volatiles). The ethylene glycol and 1 N potassium hydroxide trapping solutions from the 360-hour solutions were analyzed for total radioactivity by LSC. Also, the quartz test tubes were rinsed with hexane and the hexane extracts were analyzed by TLC using either of the solvent systems described above.

DATA SUMMARY:

Ring-labeled [^{14}C]diazinon (radiochemical purity 99%), at 6 ppm, degraded with a half-life of 258 hours in sterile pH 7 aqueous buffered solutions irradiated with sunlight outdoors for 51 days (totaling 360 hours of sunlight exposure) at 12-49°C and analyzed using one-dimensional TLC (two solvent systems) (Tables 3 and 4). During the study, the sunlight intensity ranged from 80 to 2200 W/cm^2. Using one-dimensional TLC after 360 hours of irradiation, diazinon comprised an average 36.6-37.3% of the applied and the degradate,

oxypyrimidine

(which chromatographed with at least one unidentified degradate) comprised 38.8%; the remaining radioactivity consisted of several unidentified [^{14}C]compounds, each <10% (Tables 3 and 4). Using two-dimensional TLC after 360 hours of irradiation, diazinon comprised 20% of the applied, oxypyrimidine comprised 17%, the origin contained 10%, and 11 minor degradates were each <10% of the applied (Table 7). In the dark controls, [^{14}C]diazinon hydrolyzed with a half-life of 325 hours, calculated using one-dimensional TLC. A comparison of the half-lives of the irradiated versus dark control solutions (258 vs. 325 hours) suggests that degradation in the irradiated solutions was primarily due to hydrolysis, rather than photolysis.

The material balance of the irradiated solutions averaged 97.2% of the applied, and ranged from 105.65% at 12 hours to 83.1% at 240 hours posttreatment (Table 2). Similarly, in the dark controls, the material balance decreased from 114.9% at 0 hours to 85.18% of the applied at 240 hours posttreatment. The 360-hour irradiated and dark control solutions were analyzed for volatiles to account for missing radioactivity; in addition, the test tubes were rinsed with hexane to remove radioactivity adsorbed to the walls. The material balance for the 360-hour irradiated and dark control solutions was 93-97% of the applied; volatiles accounted for 6.1-12.6% of the applied and 8-12.8% of the diazinon had adsorbed to the sides of the test tubes.

COMMENTS:

1. The TLC methodology was not adequate to accurately quantify diazinon, oxypyrimidine, and possibly other diazinon degradates. All samples were analyzed twice, with two

different solvent systems, using one-dimensional TLC; the 360-hour samples were also analyzed using two-dimensional TLC analyses (Tables 3, 4, and 7). The 360-hour sample data from the one- and two-dimensional TLC analyses are not in agreement. Using one-dimensional TLC analyses, diazinon and oxypyrimidine accounted for 37 and 38%, respectively, of the applied radioactivity, as compared to 20 and 17%, respectively, using two-dimensional TLC analyses. The study author admitted that the one-dimensional TLC analyses failed to separate oxypyrimidine, and that the radioactivity cochromatographing with oxypyrimidine consisted of at least two compounds.

2. The study author failed to anticipate volatilization and adsorption to the flask walls. In response to decreasing material balances, the headspace of the test tubes was analyzed for volatiles prior to the 360-hour sampling and the samples flasks were washed with hexane after the 360-hour sampling. As a result, it was determined that 6.1-12.6% of the applied had volatilized between the 240- and 360-hour sampling and 8-12.8% had adsorbed to the sides of the test tubes.

3. The reported half-lives of diazinon were calculated by the reviewer using linear regression analysis of the one-dimensional TLC data provided in Tables 3 and 4; the data were averaged before analysis. In contrast, the study author calculated half-lives of diazinon in the irradiated solutions using the data in Table 5, which had been corrected to eliminate the effect of hydrolysis in the dark control. Correcting the data to eliminate hydrolysis extends the calculated half-life; the study author obtained half-lives of 559 and 620 hours using Solvent systems 1 and 2, respectively, for photodegradation alone, compared to a reviewer-calculated half-life of 258 hours for photodegradation/hydrolysis.

4. All data, including data for the dark controls, were expressed in terms of hours or days of irradiation (12 hours of irradiation = 1 day). Actual incubation time could not be readily determined from the information provided.

5. The adsorption spectrum of diazinon in the test solution was not provided.

6. The method detection limits and recovery efficiencies from fortified samples were not reported.

7. The data reported in this review are averages calculated using replicate data from Tables 2, 3, 4, and 7.

8. A sterility check of the treated solutions indicated that no bacterial growth was present at the termination of the study.

DATA EVALUATION RECORD

STUDY 3

CHEM 057801 Diazinon
§161-2

FORMULATION--00--ACTIVE INGREDIENT

STUDY ID 40519801
Spare, W.C. 1988b. Aqueous photolysis of diazinon (artificial light). Agrisearch Project No. 12100. Unpublished study performed by Agrisearch Incorporated, Frederick, MD and submitted by Ciba-Geigy Corporation, Greensboro, NC.

DIRECT REVIEW TIME = 5

REVIEWED BY: J. Harlin TITLE: Staff Scientist

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APPROVED BY: A. Abramovitch
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SIGNATURE:

CONCLUSIONS:

Degradation - Photodegradation in Water

1. This study cannot be used to fulfill data requirements.

2. These data are considered to be of uncertain value and should not be used to predict the environmental behavior of diazinon and its degradates.

3. This study is unacceptable for the following reason:

   The artificial light source did not provide continuous radiation in the complete range of sunlight. Also, the TLC methodology was not adequate to separate and quantify the [^{14}C]compounds.

METHODOLOGY:

Ring-labeled [^{14}C]diazinon (labeled in the 2 position, radiochemical purity 99%, specific activity 36.5 μCi/mg, Ciba-Geigy Corp.) dissolved in acetone was added to a sterile Erlenmeyer flask and the solvent was evaporated. Then, sterile pH 7 phosphate buffered solution was added to the flask and the flask was sonicated to dissolve the diazinon; the final concentration of [^{14}C]diazinon was 10 ppm. For a dark control, an aliquot of the solution was transferred to a teflon-capped foil-covered glass scintillation vial and incubated at 25 ± 1°C in the dark. The remainder of the test solution was transferred to the reaction vessels of two water-cooled photolysis apparatus (Figure 2) and irradiated continuously for 192 hours with a Pyrex glass-filtered 450-Watt mercury-arc Conrad-Hanovia lamp (Ace Glass Inc.). The measured intensity of the lamp ranged from 3800 to 5000 μW/cm^2 over a 290-1400 nm spectrum (Tables 1 and 2). The study author stated that the intensity was approximately 2x the intensity of natural sunlight in Frederick, Maryland, on a hot clear summer day (2300 μW/cm^2). The temperature was maintained at 24-25°C. The irradiated and dark control solutions were sampled at 0, 2, 4, 8, 24, 48, 72, 96, 144, and 192 hours posttreatment.

Aliquots of the irradiated and dark control solutions were analyzed for total radioactivity using LSC. Additional aliquots of the solutions were analyzed for diazinon and its degradates using one-dimensional TLC on silica gel plates developed in either hexane:ethyl acetate (8:2, v:v) or toluene:chloroform:ethanol:formic acid (8:8:2:1, v:v:v:v). [^{14}C]Compounds were quantified by radioscanning and identified by comparison to reference standards (diazinon and oxypyrimidine) that had been cochromatographed with the samples. Following development, the plates were air-dried and radioactive areas were visualized using UV light (254 nm) and quantified using a TLC linear analyzer.

To confirm the distribution of degradates, aliquots of the 192-hour samples were analyzed by two-dimensional TLC on silica gel plates developed in toluene:chloroform:ethanol:formic acid followed by hexane:ethyl acetate. The samples were cochromatographed with diazinon and oxypyrimidine reference standards. After development, radioactive areas were scraped from the plates and quantified using LSC.

DATA SUMMARY

Ring-labeled [^{14}C]diazinon (radiochemical purity 99.1%), at 10 ppm, degraded with a half-life of ≈10 days in sterile pH 7 aqueous buffered phosphate solutions that were irradiated continuously with a 450-Watt mercury arc lamp for 192 hours at 24-25°C (Tables 4 and 5). The intensity of the lamp was 3800-5000 μW/cm^2, which was reported to be approximately 2x the

intensity of natural sunlight (Table 2). At 192 hours post-treatment, diazinon comprised 45% of the applied, the degradate, oxypyrimidine
comprised 36.6% of the applied, and two unknown degradates (Unknowns 1 and 2) comprised 5.3 and 4% of the applied, respectively. In the dark control solution at 192 hours posttreatment, diazinon was 95.4% of the applied, oxypyrimidine was 3.4% of the applied, and Unknowns 1 and 2 comprised 0.49 and 1.64% of the applied, respectively. During the study, the material balances ranged from 96.19 to 103.19% of the applied for the irradiated solution and 100 to 107.16% of the applied for the dark control (Table 3).

COMMENTS:

1. The TLC methodology was not adequate to accurately quantify diazinon, oxypyrimidine, and possibly other diazinon degradates (the same TLC solvent systems were used in Study 2). All samples were analyzed twice, with two different solvent systems, using one-dimensional TLC; the 192-hour samples were also analyzed using two-dimensional TLC analyses (Tables 4, 5, and 7). The 192-hour sample data from the one- and two-dimensional TLC analyses are not in agreement. Using one-dimensional TLC analyses, diazinon and oxypyrimidine accounted for ≈45 and 37%, respectively, of the applied radioactivity, as compared to ≈42 and 20%, respectively, using two-dimensional TLC analyses. The study author admitted in Study 2 that the one-dimensional TLC analyses failed to separate oxypyrimidine, and that the radioactivity cochromatographing with oxypyrimidine consisted of at least two compounds.

2. Mercury arc lamps are not considered an acceptable substitute for sunlight; the intensity and wavelength distribution of mercury arc lamps typically are not similar to natural sunlight. Although the emission spectrum of the lamp was not adequately compared to natural sunlight (an adequate comparison would be documentation such as graphs comparing intensities and wavelength distributions of the mercury arc lamp and natural sunlight) in this study, the Conrad-Hanovia lamp that was used has been previously evaluated and found to be an unacceptable artificial light source.

3. The adsorption spectrum of diazinon in the test solution was not provided.

4. The method detection limits and recovery efficiencies form fortified samples for the LSC and TLC analyses were not reported.

DATA EVALUATION RECORD

STUDY 4

CHEM 057801 Diazinon
§165-4

FORMULATION--01--TECHNICAL CHEMICAL

STUDY ID 40660808 and 41194401
Fackler, P.H. 1988. Bioconcentration and elimination of ^{14}C-residues by bluegill (Lepomis macrochirus) exposed to diazinon technical. Laboratory Study Number 1781-0288-6155-140. Laboratory Report Number 88-5-2717. Unpublished study performed by Springborn Life Sciences, Inc. and submitted by Ciba-Geigy Corporation, Greensboro, NC.

DIRECT REVIEW TIME = 6

REVIEWED BY: J. Harlin TITLE: Staff Scientist

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APPROVED BY: A. Abramovitch
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SIGNATURE:

CONCLUSIONS:

Laboratory Accumulation - Fish

1. This study fulfills data requirements.

2. Diazinon residues (uncharacterized) accumulated in bluegill sunfish exposed to 2 ppb of diazinon, with maximum mean bioconcentration factors of 542x, 583x, and 542x for edible, nonedible, and whole fish tissues, respectively. Depuration was rapid, with 96-97% of the accumulated [^{14}C]residues eliminated from the fish tissues by day 7 of the depuration period.

METHODOLOGY:

Flow-through aquatic exposure systems were prepared using two 75-mL aquaria (75 cm x 40 cm x 30 cm). Aerated well water (15-19°C, pH 6.6-6.8, dissolved oxygen content 80-91% of saturation, total hardness 28-34 mg/L as $CaCO_3$, and alkalinity 24-27 mg/L as $CaCO_3$) was provided to each aquarium at a rate of 12 turnovers per day (90% replacement/4.5 hours). One aquarium was continuously treated with [^{14}C]diazinon (technical grade, radiochemical purity 87.7%, specific activity 35.1 Ci/mg, Ciba-Geigy Corp.) at 2 ppb; the second aquarium served as an untreated control. The test systems were allowed to equilibrate prior to the introduction of fish, and water samples from both aquaria were collected during the equilibration period and immediately before the introduction of the fish.

Juvenile bluegill sunfish (Lepomis macrochirus; mean length and weight 47 mm and 1.30 g, respectively) were held in culture tanks on a 16-hour daylight photoperiod for 14 days prior to the initiation of the study. Then, 190 fish were transferred into each of the two aquaria. The fish were fed dry pelleted food daily except during the 24 hours prior to tissue sampling. Following a 28-day accumulation period, fish from the treated aquarium were transferred to an untreated tank for a 16-day depuration period; the control fish remained in the original untreated tank. During the accumulation period, fish from the treated aquarium and water from both the treated and untreated aquaria were sampled on days 1, 3, 7, 10, 14, 21, and 28. During the depuration period, fish that had been transferred from the treated aquarium and water from both aquaria were sampled on days 1, 3, 7, 10, and 14. Control fish were sampled at 0 hours and on day 28 of the accumulation period and on day 14 of the depuration period.

At each sampling interval, 5-mL aliquots of the water samples were quantified for total [^{14}C]residuesby using LSC. Detection limits were 0.22 or 0.27 ppb for water samples. Reported recoveries from water samples fortified with diazinon ranged from 90.3 to 151%.

Five fish were taken at each sampling interval and divided into edible tissue (fillet), nonedible tissue (viscera), and whole fish samples. The samples were combusted, and the evolved $^{14}CO_2$trapped and quantified by using LSC. Recovery rates of the oxidizer determined prior to sample analyses were 97.4-103%. Recovery efficiencies from fortified fish samples ranged from 78 to 106%. Detection limits ranged from 1.5 to 2.6 ppb for edible tissues and 2.0 to 3.0 ppb for nonedible tissues.

In addition, 86 of the remaining fish from the treated aquarium were sampled after 29 days of accumulation. The

fish were divided into edible and nonedible tissues, and frozen for future metabolite identification. In addition, triplicate edible tissue samples were prepared for a hexane and methanol extraction procedure.

DATA SUMMARY:

[^{14}C]Diazinon residues (uncharacterized) accumulated in bluegill sunfish exposed to [^{14}C]diazinon (technical grade, radiochemical purity 87.7%) at 2 ppb for 28 days under flow-through conditions. The maximum mean bioconcentration factors were 542x for edible tissues, 583x for nonedible tissues, and 542x for whole fish (Table 1). Maximum mean concentrations of total [^{14}C]residues occurred at 28 days and were 1300 ppb for edible tissues, 1400 ppb for nonedible tissues (also at 21 days), and 1300 ppb for whole fish (Tables 1 and 4). The mean concentration of [^{14}C]residues in the water during the exposure period was 2.4 ppb.

By day 7 of the 14-day depuration period, 96-97% of the accumulated [^{14}C]residues were eliminated from the fish tissues. The half-life for elimination of [^{14}C]residues from whole fish was 1-3 days.

Throughout the study, the temperature of the treated water ranged from 15 to 19°C, the pH ranged from 6.6 to 6.8, and the dissolved oxygen content ranged from 80 to 91% of saturation. Total [^{14}C]residues in the treated water ranged from 1.8 to 3.9 ppb during the exposure period.

COMMENTS:

1. Bioconcentration factors for edible, nonedible, and whole fish tissues were calculated by the reviewer by dividing the mean measured concentration of [^{14}C]residues in the fish tissue by the mean measured water concentration up to and including the respective sampling day during the exposure period. This method enabled the reviewer to determine the maximum mean bioconcentration factors for each tissue type by providing bioconcentration factors for each sampling interval. In contrast, the registrant calculated mean steady-state bioconcentration factors by dividing the mean measured equilibrium ^{14}C-tissue concentration for each tissue type by the mean measured water concentration for the entire exposure period. Based on these calculations, the bioconcentration factors were 470x for edible tissue, 540x for nonedible tissue, and 500x for whole fish.

2. The detection limits varied for both the water and fish samples, and were dependent upon counting efficiency, sample size, and background levels of radiation for the liquid and combusted samples.

3. During the accumulation period, four of the 190 fish from the treated aquarium died; no mortality was observed in the control aquarium.

4. A preliminary study should have been conducted to determine that the concentration of the test substance used in the experiments (2 ppb) did not exceed 1/10 of the 96-hour LC_{50} of bluegill sunfish.