JULY 28- 1987

DYNAMAC
CORPORATION

PP 321 (KARATE)

Final Report

Task 1: Review and Evaluation of Individual Studies

Task 2: Environmental Fate Assessment

Contract No. 68-02-4250

JULY 28, 1987

Submitted to:
Environmental Protection Agency
Arlington, VA 22202

Submitted by:
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PP321

Table of Contents

INTRODUCTION

PP321 is a broad spectrum contact insecticide developed for use on cotton. It is applied as needed usually at three to seven day intervals at 0.01 to 0.03 lb ai/A. The proposed formulation is a single active ingredient 1 lb/gal EC. It may be applied using ground equipment or aircraft. Do not apply more than 0.2 lb ai/A per season on cotton.

Studies in which cyhalothrin rather than PP321 was the active ingredient were submitted to satisfy several data requirements for the PP321 registration with the explanation by the registrant that PP321 is a constituent of cyhalothrin; that the two pesticides are various isomers of a single molecule; and that the activity of the two pesticides in soil, water, and fish should therefore be interchangeable. However, EPA Data Requirements for Registering Pesticides specify that studies must be done with the active ingredient in the product. Since the registrant differentiates between cyhalothrin and PP321, EPA cannot regard the pesticides as interchangeable in fulfilling data requirements unless the registrant provides acceptable data showing that the configuration of the molecule has no effect on its behavior. All studies for the PP321 registration must be done with PP321 rather than cyhalothrin. A one-time exception has been made in the case of mobility studies submitted for registration because all radiolabeled material applied to the soil was immobile; it is logical to assume that non-PP321 isomers would not cause PP321 isomers to be immobile in soil.

CASE GS -- PP321 STUDY 1 PM --

CHEM -- PP321

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID No MRID CONTENT CAT 01

Parker, S. and J.P. Leahey. 1986. PP321: Photodegradation on a soil surface. Project No. RJ0537B. Submitted by ICI Americas Inc., Wilmington, DE. Acc. No. 400524-05.

SUBST. CLASS = S.

DIRECT RVW TIME = 14 (MH) START-DATE END DATE

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CONCLUSIONS:

Degradation - Photodegradation on Soil

1. This study is scientifically acceptable.

2. Cyclopropane- and phenyl-labeled [^{14}C]PP321 (radiochemical purities 97-98%), at 40 g/ha, degraded with half-lives of >166 hours (equivalent to ~34-35 days of Florida summer sunshine) on loam soil irradiated with artificial light at 25°C. After 166 hours of irradiation, PP321 and the degradate (RS)-α-amido-3-phenoxybenzyl-(1 RS)-cis, trans-3-(ZE-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate (compound II) comprised ~83-86 and ~5% of the applied radioactivity, respectively. PP321 and compound II comprised ~74-75 and ~16-17% of the applied radioactivity, respectively, after 30 days in the dark controls.

3. This study fulfills EPA Data Requirements for Registering Pesticides by providing information on the photodegradation of cyclopropane- and phenyl-labeled [^{14}C]PP321 on soil.

MATERIALS AND METHODS:

A slurry of air-dried, sieved (0.5 mm), loam soil (46.8% sand, 28.4% silt, 24.8% clay, 4.97% organic matter, pH 6.45, CEC 16.6 meq/100 g) and water was spread on stainless steel plates (1-mm thick) and air-dried. Cyclopropane- and phenyl-labeled [^{14}C]PP321 (radiochemical purities 97-98%; specific activities 2.19 and 2.49 GBq/mmol, respectively; ICI Americas Inc.), at 40 g/ha, were applied to the soil. The treated samples were placed in a photolysis chamber (Figure 1) maintained at 25 ± 5°C and irradiated with a xenon arc lamp (4.5 kW, Hanau NXe 4500). Measured intensities and the spectral distribution of the light source are presented in Table 1 and Figure 2, respectively. It was determined that 5 hours of irradiation with the xenon lamp were equivalent to ~12 hours of Florida sunshine. Air was passed over the samples, then through a series of gas traps containing 1 M sulfuric acid, 2-methoxyethanol, or ethanolamine. Similarly prepared dark controls were incubated at 25°C without volatile trapping. Irradiated soil was sampled after 0, 33, 75, 117, and 166 hours of irradiation. Dark controls were sampled at 6, 14, 22, and 30 days posttreatment.

Radioactivity in the trapping solutions was quantified by LSC. The soil was extracted twice with acetonitrile followed by acetonitrile:water (1:1), and the extracts were combined. An aliquot was evaporated to dryness, and the remaining residue was dissolved in acetonitrile and analyzed by TLC on reverse phase plates developed in methanol:0.2 M ammonium acetate (90:10) and on silica gel plates developed in hexane:diethyl ether (70:30), cyclohexane saturated with formic acid:diethyl ether (60:40), or toluene saturated with formic acid:diethyl ether (95:5). Unlabeled reference compounds were cochromatographed with the samples and, following development, were detected under UV light. The compounds (1 RS)-cis-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylic acid and (1 RS)-trans-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylic acid were detected by spraying the plates with 0.25% bromophenol blue in acetone. Radioactive areas were detected and quantified with a TLC linear analyzer. Autoradiograms were also prepared. Additional samples were analyzed by HPLC for isomeric composition. Unextractable radioactivity remaining in the soil was quantified by combustion and LSC.

REPORTED RESULTS:

The half-life of PP321 was >166 hours on loam soil irradiated with artificial light (Table 2). After 166 hours of irradiation, PP321 and the degradate (RS)-α-amido-3-phenoxybenzyl-(1 RS)-cis, trans-3-(ZE-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate (compound II) comprised ~83-86 and ~5% of the applied radioactivity, respectively. Volatiles and unextractable radioactivity comprised <4% of the applied (Table 3). PP321 and the degradate compound II comprised ~74-75 and ~16-17% of the applied radioactivity, respectively, after 30 days in the dark controls.

DISCUSSION:

1. The sandy loam soil was misclassified in the study. The soil was determined to be a loam soil according to the USDA Textural Classification System and is described as such in this report.

2. The study authors contend that the increased rate of degradation of PP321 in the dark controls was due to the higher moisture content in the dark control soils. The irradiated soils were dried by the light source.

3. PP321 appears to be stable to solar radiation on soil surfaces.

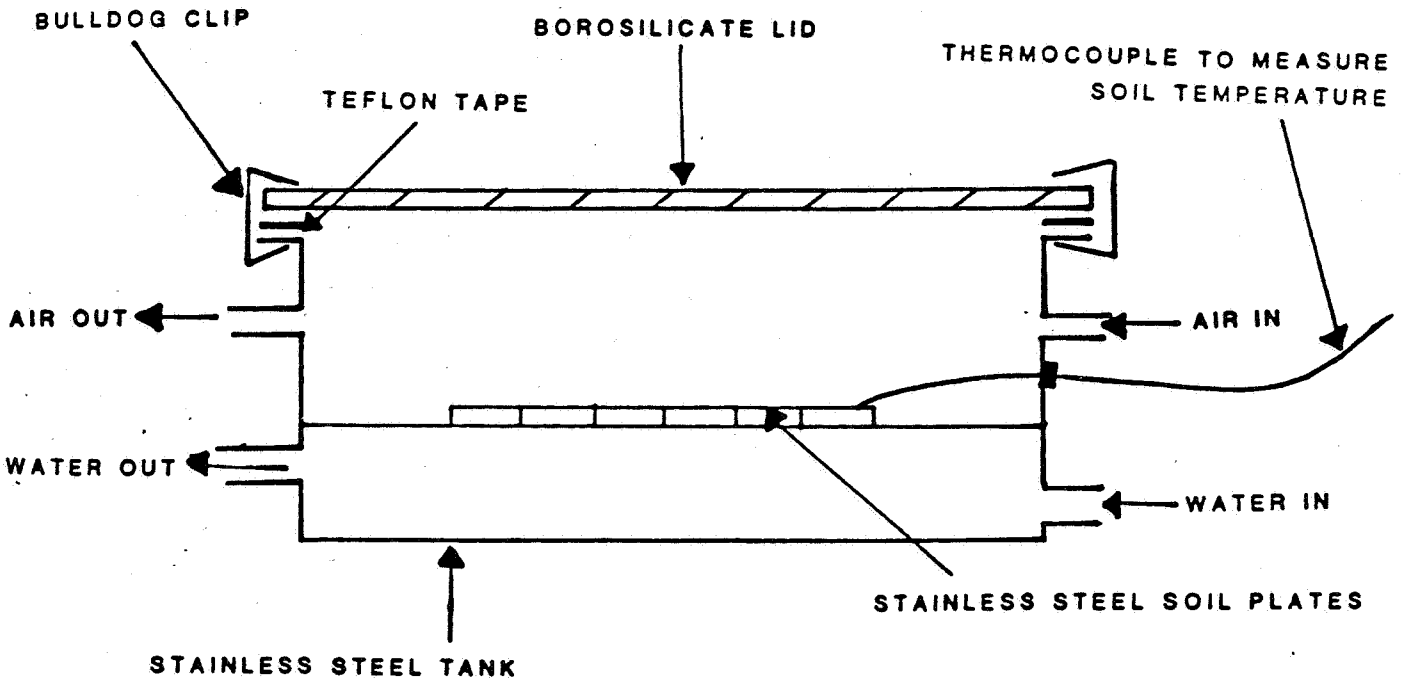

Figure 1. Photolysis chamber.

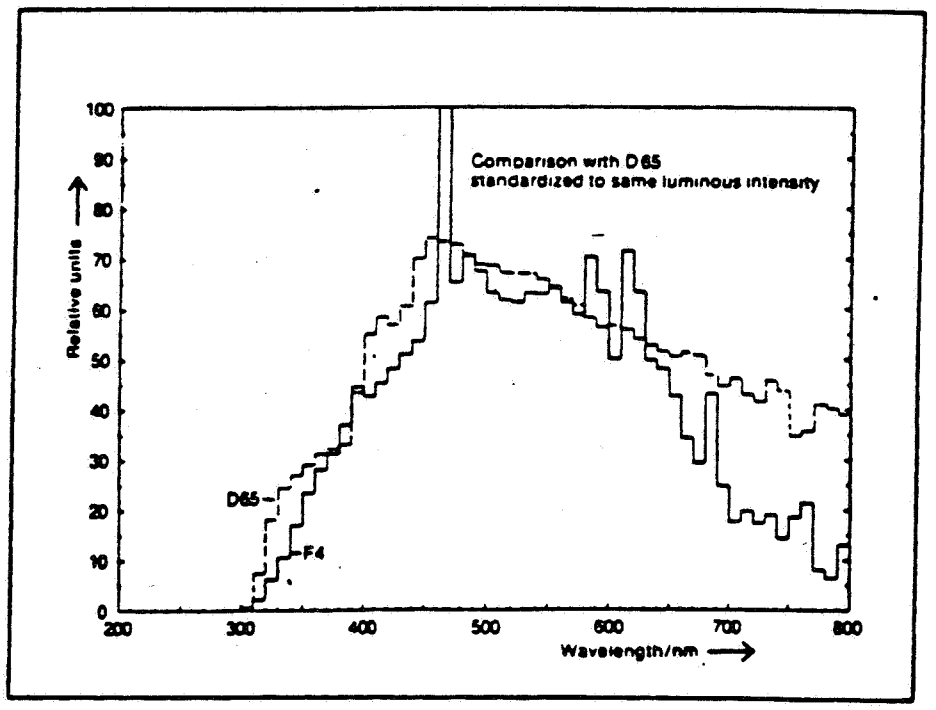

Figure 2. Spectral distributions of xenon arc lamp (F4) and natural sunlight (D65).

Table 1. Intensities (W/cm^2) of the artificial light source and natural sunlight as measured through narrow and wide band filters.

Filter (nm)	Xenon arc lamp	Natural sunlight[a]
297	0.00013-0.00015	0.00013
365	0.00075-0.00095	0.00080
375	--	0.12
280-420	0.22-0.25	--
500	--	0.010
430-700	0.011-0.013	--

[a] Measured at midday on July 2, 1986 at latitude 51°23'N, no cloud cover.

Table 2. PP321 and its degradates (% of applied radioactivity) in extracts from loam soil treated with [^{14}C]PP321 at 40 g/ha.[a]

Sampling interval (hours)	PP321	II[b]	IV[c]	V[d]	Polar degradates	Unknowns[e]
Cyclopropane-labeled [^{14}C]PP321[f]						
Irradiated						
0	95.04	ND[g]	--	--	ND	ND
33 (6.2 days)[h]	93.06	2.13	--	--	ND	1.18
75 (14.3 days)	88.10	4.11	--	--	ND	2.60
117 (26 days)	84.60	5.69	--	--	2.30	3.28
166 (34 days)	83.36	5.25	--	--	2.04	3.64
Dark control						
30 days	74.72	15.94	--	--	0.60	3.40
Phenyl-labeled [^{14}C]PP321[i]						
Irradiated						
0	96.53	ND	ND	ND	ND	ND
33 (7 days)	91.32	3.17	ND	1.05	0.44	1.04
75 (16.3 days)	89.52	3.96	1.07	0.61	0.18	ND
117 (24.5 days)	89.70	4.96	0.30	1.17	0.54	ND
166 (35.2 days)	86.42	4.99	0.97	2.38	1.48	ND
Dark control						
30 days	73.84	16.83	ND	ND	ND	1.75

[a] Results obtained with TLC solvent system toluene saturated with formic acid:diethyl ether (95:5). TLC plate recoveries ranged from 94.6 to 102.5%.

[b] (RS)-α-amido-3-phenoxybenzyl-(1 RS)-cis, trans-3-(ZE-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate.

[c] 3-Phenoxybenzaldehyde.

[d] 3-Phenoxybenzoic acid.

[e] Comprising up to four unknowns with none accounting for >2.5% of the applied radioactivity.

[f] Similar results obtained with cyclohexane saturated with formic acid: diethyl ether (60:40) TLC solvent system.

[g] Not detected; the detection limit was not specified.

[h] Equivalent days of Florida summer sunshine.

[i] Similar results obtained with methanol:0.2 M ammonium acetate (90:10) TLC solvent system (reverse phase).

Table 3. Distribution of radioactivity (% of applied) in irradiated and dark control loam soil treated with [^{14}C]-PP321 at 40 g/ha.

Sampling interval (hours)	Cyclopropane-labeled [^{14}C]PP321				Phenyl-labeled [^{14}C]PP321			
	Extractable	Unextractable	Volatiles	Total	Extractable	Unextractable	Volatiles	Total
			Irradiated					
0	100.60	0.05	--	100.7	110.69	0.04	--	110.7
33 (6.2-7 days)[a]	102.31	0.43	0.30	103.0	100.32	0.67	0.54	101.5
75 (14.3-16.3 days)	99.27	1.62	0.54	101.4	102.10	1.32	0.66	104.1
117 (24.5-26 days)	91.86	1.65	0.73	94.2	103.35	1.86	0.65	105.9
166 (34-35.2 days)	94.03	1.66	0.86	96.5	101.79	3.05	0.82	105.7
			Dark control					
30 days	104.64	0.67	--	105.3	95.76	0.42	--	96.2

[a] Sampling intervals in parentheses are equivalent days of Florida summer sunshine.

CASE GS -- PP321 STUDY 2 PM --

CHEM -- PP321

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID No MRID CONTENT CAT 01
Vickers, J.A. and D.W. Bewick. 1986. PP321: adsorption and desorption in soil. Submitted by ICI Americas Inc., Wilmington, DE. Acc. No. 400524-06.

SUBST. CLASS = S.

DIRECT RVW TIME = 8 (MH) START-DATE END DATE

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CONCLUSIONS:

Mobility - Leaching and Adsorption/Desorption

This study is unacceptable and would not fulfill EPA Data Requirements for Registering Pesticides because the concentrations of PP321 in the test solutions exceeded the reported water solubility of 0.004 ppm.

MATERIALS AND METHODS:

Preliminary studies determined an optimum soil:solution ratio of 1:100 and an equilibration time of 18 hours for the following batch equilibrium study.

Four soils (a sandy clay loam, a silt, and two sandy loam soils) were air-dried and sieved (2-mm) prior to use (Table 1). Samples of each soil were shaken in the dark at 4°C for 18 hours with 0.01 N calcium chloride solutions of phenyl-labeled [^{14}C]PP321 (radiochemical purity 99%, specific activity 2.49 GBq/mmol, Jealott's Hill) at 0.02, 0.05, 0.10, and 0.20 ppm. The solutions were centrifuged after shaking, and the supernatant was analyzed for total radioactivity by LSC.

Desorption of PP321 residues was investigated in the soil samples described above. The supernatant was replaced with untreated 0.01 N calcium chloride solution, the soil:solution was shaken for 6 hours, and the supernatant was analyzed for radioactivity by LSC. This procedure was repeated two more times with the soil:solution being shaken for 18 and 24 hours. The soil was analyzed for total radioactivity by LSC following combustion.

After the final desorption step, the soils treated at 0.02 ppm were extracted with acetonitrile. The extract was filtered, concentrated, and analyzed by TLC on silica gel plates developed in n-hexane:diethyl ether (70:30) and chloroform:acetonitrile: formic acid (96:3.5:0.5). Selected supernatants were also analyzed by TLC. Radioactive zones were located using autoradiography, identified by cochromatography with reference compounds, and quantified using a TLC linear analyzer.

REPORTED RESULTS:

PP321 had low mobility in the sandy clay loam, silt, and two sandy loam soils. Freundlich K_{ads} values ranged from 477 to 3064 for the sandy clay loam, 1121 to 4649 for the silt, 261 to 2492 for the England sandy loam, and 911 to 4008 for the NC sandy loam soils (Table 2). K_{des} values ranged from 1714 to 6813 for the sandy clay loam, 1075 to 6033 for the silt, 701 to 4310 for the England sandy loam, and 1240 to 3171 for the NC sandy loam soils.

PP321 comprised >81% of the applied radioactivity in the soil extracts (Table 3).

DISCUSSION:

1. The concentrations of PP321 in the test solutions exceeded the reported water solubility of 0.004 ppm.

2. K_{ads} and K_{des} values were somewhat variable between replicates (Tables 4-7).

Table 1. Soil characteristics.

Soil type	Location	Sand	Silt	Clay	Organic matter	pH	CEC (meq/100 g)
		%					
Sandy clay loam	Berkshire, England	48	26	25	2.70	6.3	16.0
Sandy loam	Surrey, England	71	21	8	1.22	6.2	6.4
Silt	Vicksburg, MS	2	88	10	0.74	6.0	6.8
Sandy loam	Goldsboro, NC	72	18	10	1.55	6.6	8.5

Table 2. Freundlich K values for the adsorption and desorption of [^{14}C]PP321 on four soils.

Soil type	Location	K_{ads}	K_{des}		
			1st Desorption	2nd Desorption	3rd Desorption
Sandy clay loam	Berkshire, England	477-3064	1821-6260	1714-6813	3511-9280
Sandy loam	Surrey, England	261-2492	1053-2925	701-4095	833-4310
Silt	Vicksburg, MS	1121-4649	2647-5145	1582-8750	1075-6033
Sandy loam	Goldsboro, NC	911-4008	1240-3171	2436-4146	1750-4107

Table 3. Distribution of radioactivity (% of applied) in soil extracts and supernatants analyzed by TLC from soils treated with phenyl-labeled [^{14}C]PP321 at 0.021 µg/mL.

Soil type	Fraction	PP321	3-Phenoxybenzoic acid	Compound XV[a]	Unknowns
Sandy clay loam (England)	Soil extract	83.0	0.3	0.1	2.2
	Supernatant	--	--	--	--
Sandy loam (England)	Soil extract	83.9	0.3	0.1	2.4
	Supernatant	1.3	0.1	<0.1	0.3
Silt (MS)	Soil extract	85.8	0.4	0.2	0.8
	Supernatant	0.5	0.1	<0.1	0.6
Sandy loam (NC)	Soil extract	80.8	0.1	0.2	2.6
	Supernatant	--	--	--	--

[a] (RS)-α-Cyano-3-(4-hydroxyphenoxy)benzyl (1 RS)-cis-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate.

Table 4. Distribution of radioactivity (as determined by LSC) from sandy clay loam soil (Berkshire, England) treated with an aqueous solution of [^{14}C]PP321 at four concentrations.

Initial concentration in solution (µg/mL)	Replicate	In solution after adsorption	In solution after 1st desorption	In solution after 2nd desorption	In solution after 3rd desorption	Left in soil (µg/g)	Recovery (%)
		µg/mL					
0.204	1	0.01280	0.00364	0.00363	0.00547	16.80	88.4
	2	0.01180	0.00331	0.00261	0.00458	16.30	85.1
	3	0.00951	0.00330	0.00290	0.00329	15.80	81.5
0.101	1	0.00324	0.00224	0.00148	0.00136	8.90	91.4
	2	0.01770	0.00168	0.00188	0.00120	8.32	90.7
	3	0.03330	0.00207	0.00157	0.00146	8.39	86.1
0.052	1	0.00182	0.00111	0.00209	0.00060	4.31	86.6
	2	0.00223	0.00093	0.00166	0.00091	4.27	86.3
	3	0.00354	0.00120	0.00136	0.00070	4.12	84.0
0.021	1	0.00201	0.00107	0.00111	0.00021	1.92	98.9
	2	0.00138	0.00033	0.00093	0.00039	1.69	85.8
	3	0.00096	0.00033	0.00045	0.00039	1.78	88.4

Table 5. Distribution of radioactivity (as determined by LSC) from sandy loam soil (Surrey, England) treated with an aqueous solution of [^{14}C]PP321 at four concentrations.

Initial concentration in solution (µg/mL)	Replicate	In solution after adsorption	In solution after 1st desorption	In solution after 2nd desorption	In solution after 3rd desorption	Left in soil (µg/g)	Recovery (%)
		µg/mL					
0.204	1	0.01270	0.00965	0.00981	0.00437	16.10	86.8
	2	0.01380	0.01580	0.00874	0.00566	14.90	82.8
	3	0.02060	0.01680	0.00714	0.00504	15.00	84.6
0.101	1	0.02830	0.00301	0.00557	0.00372	6.62	82.7
	2	0.00395	0.00603	0.01050	0.00856	6.68	81.6
	3	0.01260	0.00844	0.00224	0.00578	6.38	77.1
0.052	1	0.00516	0.00346	0.00277	0.00252	3.70	83.7
	2	0.00418	0.00368	0.00190	0.00165	3.70	80.7
	3	0.00365	0.00286	0.00164	0.00120	4.12	86.5
0.021	1	0.00905	0.00074	0.00135	0.00059	1.88	96.5
	2	0.00154	0.00071	0.00159	0.00079	1.56	83.9
	3	0.00272	0.00074	0.00137	0.00091	1.50	83.4

Table 6. Distribution of radioactivity (as determined by LSC) from sandy loam soil (Goldsboro, North Carolina) treated with an aqueous solution of [^{14}C]PP321 at four concentrations.

Initial concentration in solution (µg/mL)	Replicate	In solution after adsorption	In solution after 1st desorption	In solution after 2nd desorption	In solution after 3rd desorption	Left in soil (µg/g)	Recovery (%)
		µg/mL					
0.204	1	0.00751	0.01360	0.00592	0.00612	15.70	84.8
	2	0.00612	0.00778	0.00748	0.01010	15.80	86.6
	3	0.01760	0.00593	0.00462	0.01050	15.70	87.0
0.101	1	0.00249	0.00310	0.00174	0.00425	8.15	86.6
	2	0.00451	0.00565	0.00233	0.00370	8.43	90.8
	3	0.00439	0.00572	0.00251	0.00326	7.53	81.6
0.052	1	0.00172	0.00168	0.00123	0.00121	1.75[a]	39.0
	2	0.00457	0.00282	0.00185	0.00138	3.93	84.2
	3	0.00264	0.00194	0.00172	0.00177	3.96	83.2
0.021	1	0.00114	0.00156	0.00080	0.00073	1.82	95.3
	2	0.00211	0.00104	0.00053	0.00060	1.68	88.3
	3	0.00140	0.00084	0.00063	0.00075	1.61	84.3

[a] Data not used in calculation; registrant stated the figure was low due to spillage of freeze-dried soil.

Table 7. Distribution of radioactivity (as determined by LSC) from silt soil (Vicksburg, Mississippi) treated with an aqueous solution of [^{14}C]PP321 at four concentrations.

Initial concentration in solution (µg/mL)	Replicate	In solution after adsorption	In solution after 1st desorption	In solution after 2nd desorption	In solution after 3rd desorption	Left in soil (µg/g)	Recovery (%)
		µg/mL					
0.204	1	0.00768	0.00519	0.00440	0.01690	15.20	85.8
	2	0.00567	0.01160	0.00481	0.00558	16.30	86.2
	3	0.00560	0.00422	0.00713	0.00384	15.60	81.1
0.101	1	0.00254	0.00222	0.00185	0.00215	8.61	88.8
	2	0.00327	0.00272	0.00113	0.00255	8.33	86.6
	3	0.00234	0.00256	0.00133	0.00205	8.02	82.7
0.052	1	0.00432	0.00135	0.00300	0.00101	3.87	81.9
	2	0.00182	0.00114	0.00106	0.00132	3.92	79.9
	3	0.00275	0.00188	0.00147	0.00158	3.93	82.1
0.021	1	0.000741	0.00060	0.00037	0.00050	1.89	93.9
	2	0.000509	0.00061	0.00040	0.00048	1.72	85.5
	3	0.000450	0.00040	0.00045	0.00034	1.71	84.2

CASE GS -- PP321 STUDY 3 PM --

CHEM -- PP321

BRANCH EAB DISC --

FORMULATION 12 - EMULSIFIABLE CONCENTRATE (EC)

FICHE/MASTER ID No MRID CONTENT CAT 01

Bewick, D.W., D.W. Barlett, and P. Hendley. 1986. PP321: fate of radiolabeled material in soil under field conditions. Project No. RJ0529B. Prepared and submitted by ICI Americas Inc., Wilmington, DE. Acc. No. 400524-07.

SUBST. CLASS = S.

DIRECT RVW TIME = 24 (MH) START-DATE END DATE

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CONCLUSIONS:

Field Dissipation - Terrestrial

1. This study is acceptable.

2. PP321 dissipated from the upper 10 cm of silt loam (MS) and clay loam (IL) soils with half-lives of <14 and 28-56 days, respectively, following the application of cyclopropane- and phenyl-labeled [^{14}C]PP321 (1 lb/gal EC) at 142-146 g ai/ha in June, 1985. At the MS site, PP321 comprised <3% of the applied radioactivity by 57 days posttreatment, while, at the IL site, PP321 comprised ~18-21% of the applied at 279 days posttreatment. At both sites, all degradates and unknowns each comprised <7% of the applied at any sampling interval. During the test periods, the majority of the applied radioactivity remained in the upper 5 cm of the soil.

3. This study fulfills EPA Data Requirements for Registering Pesticides by providing information on the dissipation of PP321 in soil at two locations (MS and IL).

MATERIALS AND METHODS:

Plastic cylinders (15 x 30 cm; inside diameter x length) were pushed ~22-25-cm deep into clay loam soil (21% sand, 49% silt, 30% clay, 3.8% organic matter, pH 6.4, CEC 26.4 meq/100 g) located in Champaign, Illinois, and silt loam soil (15% sand, 72% silt, 13% clay, 0.9% organic matter, pH 5.5, CEC 6.5 meq/100 g) located in Vicksburg, Mississippi. At ~4-6 weeks prior to the insertion of the cylinders, both sites had been tilled to a 6-inch depth. At 1 month after the cylinders were inserted, the surface of the soil in the cylinders was treated with formulated (1 lb/gal EC) cyclopropane- and phenyl-labeled [^{14}C]PP321 (radiochemical purities >99%; specific activities 2.19 and 2.49 GMq/mmol, respectively; ICI Americas Inc.) at 142-146 g ai/ha during June, 1985. Following the application of [^{14}C]PP321, the cylinders were covered with wire mesh. Soil samples (the entire cylinder) were taken immediately after treatment and up to 115 or 279 days posttreatment. The soil cylinders were frozen until analysis.

The soil cylinders were dissected into 0- to 5-, 5- to 10-, 10- to 20-, and 20- to 30-cm segments, except for the zero time samples in which only the upper 0- to 5- and 5- to 10-cm segments were taken. The soil segments were then air-dried, sieved (2-mm), and analyzed for radioactivity by LSC following combustion. The 0- to 5- and 5- to 10-cm segments were extracted with acetonitrile, and the extract was filtered. The soil was further extracted with acetonitrile:water (7:3) under reflux for 3 hours. The extract was cooled, filtered, and the acetonitrile was removed by evaporation. The remaining aqueous phase was adjusted to pH 2 with 1 N hydrochloric acid and extracted twice with methylene chloride. The acetonitrile and combined methylene chloride extracts were concentrated and analyzed by TLC on silica gel plates developed in n-hexane:diethyl ether (10:1) and cyclohexane saturated with formic acid: diethyl ether (3:2). Unlabeled reference compounds were cochromatographed with the extracts. Following development, unlabeled reference compounds were visualized with a spray reagent of 0.075% bromocresol green and 0.025% bromophenol blue in ethanol:0.25% potassium permanganate and 0.5% sodium carbonate in water (9:1). Radioactive areas were located by autoradiography and quantified with a TLC linear analyzer. The acetonitrile extracts were also analyzed by HPLC to determine the relative proportions of PP321 isomers.

REPORTED RESULTS:

Illinois site

Approximately 27 inches of rain fell during the test period. Air and relative humidity ranges were -14 to 91°F and 40 to 100%, respectively. Soil temperature ranges at 2- and 8-inch depths were 10 to 102°F and 36 to 85°F, respectively.

PP321 dissipated from the upper 10 cm of soil with a half-life of 28-56 days (Table 1); the calculated half-life was 33 days. At 279 days posttreatment, PP321 comprised ~18-21% of the applied radioactivity. All degradates and unknowns detected each comprised <6% of the applied at

any sampling interval. During the 279-day test period, the majority of the applied radioactivity remained in the upper 5 cm of the soil; <1% of the applied was detected in the 10- to 20- and 20- to 30-cm depths (Table 2).

Mississippi site

Approximately 12 inches of rain fell during the test period. Air temperature and relative humidity ranges were 38 to 99°F and 28 to 100%, respectively. Soil temperature ranges at 2- and 8-inch depths were 58 to 90°F and 64 to 87°F, respectively.

PP321 dissipated from the upper 5 cm of soil with a half-life of <14 days (Table 3); the calculated half-life was 12 days. At 57 days posttreatment, PP321 comprised <3% of the applied radioactivity. All degradates and unknowns detected each comprised <7% of the applied at any sampling interval. During the 115-day test period, the majority of the applied radioactivity remained in the upper 5 cm of the soil; <1% of the applied was detected in the 5- to 10-, 10- to 20-, and 20- to 30-cm depths (Table 4).

DISCUSSION:

1. The study was conducted using field soil enclosed by plastic cylinders; this method is acceptable with pesticides having low application rates.

2. Pretreatment soil samples or controls from untreated areas were not collected and analyzed.

3. At the Illinois site, PP321 comprised ~18-21% of the applied radioactivity at 279 days posttreatment. Additional data from a longer sampling interval may be required.

4. Some of the rainfall data from the Mississippi site were illegible.

Table 1. PP321 and its degradates (% of applied radioactivity) in clay loam soil (0- to 5-cm depth) located in Champaign, Illinois, and treated with [^{14}C]PP321 (1 lb ai/gal EC) at 143 g ai/ha.

Sampling interval (days)	PP321	Compound				Unknowns		Polar degradates	Areas between			Unextractable [^{14}C]
		Ia[a]	V[b]	VII[c]	XV[d]	A	B		R_f 0.2-0.4	R_f 0.37-0.55	R_f 0.55-solvent front	
Cyclopropane-labeled [^{14}C]PP321												
0	98.8	0.4	--	--	<0.2	<0.2	--	0.5	0.2	--	0.4	ND
14	77.3	2.2	--	--	3.9	0.5	--	3.7	0.4	--	0.4	5.0
28	49.8	3.3	--	--	2.6	0.6	--	3.5	0.4	--	0.3	6.3
56	20.1	0.7	--	--	2.8	0.3	--	2.1	<0.2	--	<0.2	7.3
124	20.6	1.9	--	--	2.0	0.6	--	5.9	<0.2	--	0.4	12.9
279	17.8	2.1	--	--	2.4	0.4	--	4.0	0.2	--	<0.2	17.1
Phenyl-labeled [^{14}C]PP321												
0[e]	87.6	--	2.6	--	--	--	--	0.4	--	--	0.4	0.2
14	61.7	--	1.9	0.4	1.0	--	0.2	3.0	--	<0.2	0.2	5.5
28[e]	55.5	--	2.5	0.6	1.2	--	0.2	4.6	--	<0.2	0.4	6.6
56	38.5	--	--	0.5	2.5	--	0.4	4.0	--	<0.2	<0.2	15.8
124	21.2	--	--	1.0	2.8	--	1.2	5.9	--	0.2	0.5	19.3
279	20.9	--	0.9	0.3	1.9	--	0.3	4.4	--	0.2	0.2	26.9

a (1 RS)-cis-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylic acid.

b 3-Phenoxybenzoic acid.

c 4'-Hydroxy-3-phenoxybenzoic acid.

d (RS)-α-Cyano-3-(4-hydroxyphenoxy)benzyl (1 RS)-cis-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate.

e 0- to 10-cm soil depth.

Table 2. Distribution of radioactivity (% of applied) in clay loam soil located in Champaign, Illinois, and treated with [^{14}C]PP321 (1 lb ai/gal EC) at 143 g ai/ha on June 26, 1985.

Sampling interval (days)	Sampling depth (cm)				Total [^{14}C] recovered	Cumulative precipitation (inches)
	0-5	5-10	10-20	20-30		
			Cyclopropane-labeled [^{14}C]PP321			
0	101.8	1.5	--	--	103.3	--
14	94.1	0.8	ND[a]	ND	94.9	2.08
28	66.8	1.2	ND	ND	68.0	3.12
56	34.4	2.0	ND	ND	36.4	8.02
124	45.6	0.9	ND	ND	46.5	10.84
279	45.8	1.1	0.6	--	47.5	27.26
			Phenyl-labeled [^{14}C]PP321			
0	9.8	82.7[b]	--	--	92.5	--
14	74.0	1.1	ND	ND	75.1	2.08
28	58.5	15.8	0.8	ND	75.1	3.12
56	63.0	1.0	ND	ND	64.0	8.02
124	53.3	1.5	ND	ND	54.8	10.84
279	57.6	3.6	ND	--	61.2	27.26

[a] Not detected; the detection limit was not reported.

[b] The registrant stated that this anomalous result was due to the soil crumbling and mixing while in transit, prior to core segmentation and analysis.

Table 3. PP321 and its degradates (% of applied radioactivity) in silt loam soil (0- to 5-cm depth) located in Vicksburg, Mississippi, and treated with [^{14}C]PP321 (1 lb ai/gal EC) at 142-146 g ai/ha.

Sampling interval (days)	PP321	Compound				Unknowns		Polar degradates	Areas between			Unextractable [^{14}C]
		Ia[a]	V[b]	VII[c]	XV[d]	A	B		R_f 0.2-0.4	R_f 0.37-0.55	R_f 0.55-solvent front	
Cyclopropane-labeled [^{14}C]PP321												
0	83.2	1.7	--	--	0.4	<0.2	--	1.7	0.3	--	0.2	0.4
14	26.4	5.5	--	--	2.0	1.7	--	5.3	0.5	--	0.4	13.5
28	7.1	3.0	--	--	1.3	1.1	--	6.9	<0.2	--	0.5	23.6
57	2.7	1.2	--	--	0.7	0.8	--	5.8	<0.2	--	<0.2	22.4
115	<0.1	0.2	--	--	0.2	0.1	--	1.9	<0.1	--	<0.1	21.8
Phenyl-labeled [^{14}C]PP321												
0	85.6	--	0.6	--	0.4	--	<0.2	2.4	--	<0.2	0.2	2.4
14	22.2	--	0.7	0.5	0.8	--	0.5	4.4	--	0.2	0.5	22.8
28	9.7	--	0.2	0.4	0.6	--	0.6	4.9	--	<0.2	<0.2	30.0
57	2.5	--	0.6	--	--	--	--	4.3	--	--	<0.2	31.0
115	0.2	--	0.3	--	--	--	--	1.9	--	--	<0.1	32.1

[a] (1 RS)-cis-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylic acid.

[b] 3-Phenoxybenzoic acid.

[c] 4'-Hydroxy-3-phenoxybenzoic acid.

[d] (PS)-α-Cyano-3-(4-hydroxyphenoxy)benzyl (1 RS)-cis-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate.

Table 4. Distribution of radioactivity (% of applied) in silt loam soil located in Vicksburg, Mississippi, and treated with [^{14}C]PP321 (1 lb ai/gal EC) at 142-146 g ai/ha on June 24, 1985.

Sampling interval (days)	Sampling depth (cm)				Total [^{14}C] recovered	Cumulative precipitation (inches)[a]
	0-5	5-10	10-20	20-30		
	Cyclopropane-labeled [^{14}C]PP321					
0	88.5	ND[b]	--	--	88.5	--
14	58.1	0.7	ND	ND	58.8	~1.1
28	46.4	0.7	ND	ND	47.1	~1.7
57	35.7	0.8	ND	ND	36.5	~4.7
115	26.6	0.7	ND	ND	27.3	~11.5
	Phenyl-labeled [^{14}C]PP321					
0	92.9	ND	--	--	92.9	--
14	55.5	0.3	ND	ND	55.8	~1.1
28	48.7	ND	ND	ND	48.7	~1.7
57	39.8	ND	ND	ND	39.8	~4.7
115	36.8	0.5	ND	ND	37.3	~11.5

[a] Rainfall data reported as approximate amounts as some of the data were illegible.

[b] Not detected; the detection limit was not reported.

CASE GS -- PP321 STUDY 4 PM --

CHEM -- PP321

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID No MRID CONTENT CAT 01
? 1984. PP-563 (Cyhalothrin): Accumulation in fish (carp) in a flow-through water system. Protocol No. MITES/563/4. Prepared by Mitsubishi-Kasei Institute of Toxicological and Environmental Sciences, Japan, and submitted by ICI Japan Limited. Acc. No. 470082-032.

FICHE/MASTER ID No MRID CONTENT CAT 01
Leahy, J.P. and S. Parker. 1985. Characterization of residues accumulated by carp continuously exposed to ^{14}C-cyhalothrin. Report No. RJ0407B. Prepared and submitted by ICI Plant Protection Division, Berkshire, U.K. Acc. No. 470082-033.

SUBST. CLASS = S.

DIRECT RVW TIME = 20 (MH) START-DATE END DATE

REVIEWED BY: S. Jawitz
TITLE: Staff Scientist
ORG: Dynamac Corp., Rockville, MD
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APPROVED BY: A. Schlosser
TITLE: Chemist
ORG: EAB/HED/OPP
TEL: 557-7709

SIGNATURE: DATE:

This cyhalothrin study was submitted to support the registration of PP321.

CONCLUSION:

Laboratory Accumulation - Fish

This study was unacceptable because the concentrations of cyhalothrin in the treated water were too variable and may have consisted of <50% parent cyhalothrin. In addition, this study would not fulfill EPA Data Requirements for Registering Pesticides because no raw data were provided, an inappropriate species of fish was tested, the registrant has not shown that the activity of cyhalothrin in a biological system is equivalent to that of PP321, and the uptake, bioaccumulation, and depuration of PP321 were not specifically addressed and reported.

MATERIALS AND METHODS:

Carp (Cyprinus carpio; ~5-cm long and ~2-3 g in weight) were held in culture tanks maintained at 25 ± 1°C for a 3-week acclimation period during which no mortalities or abnormalities were observed prior to study initiation. Flow-through aquatic exposure systems were prepared using two 100-L aquaria. Aerated, dechlorinated tap water (Table 1) was continuously added to each aquarium at a rate of 3.5 turnovers/day. One aquarium was continuously treated with cyclopropane-labeled [^{14}C]cyhalothrin (PP563, radiochemical purity 80.5%, cyhalothrin isomers 15%, cyhalothrin "acid" 5%, specific activity 0.116 μCi/mg, ICI Japan Limited) in acetone, at 0.2 ppb. The second aquarium served as an untreated control. Carp were placed in each aquarium and maintained on a diet of Mini-Pet fish food at a rate equal to 1% of their body weight each day. The treated water was sampled prior to introducing the fish, and water and fish from the treated and control aquaria were sampled at intervals up to 28 days posttreatment. After 28 days of exposure, the remaining fish from each tank were transferred to two separate depuration tanks. Treated and control fish were sampled on days 1, 3, 7, 14, 21, and 28 during the depuration period.

Total radioactivity in the water of the treated and control tanks was measured daily by LSC. Water samples from days 0, 1, 3, 7, 14, 21, and 28 of the exposure period were extracted with methylene chloride, acidified with hydrochloric acid, and separated into aqueous and organic fractions. The aqueous fraction was extracted two more times with methylene chloride. The organic fractions were combined, condensed, brought to volume with methylene chloride, and analyzed for total radioactivity by LSC. The extract was then evaporated to dryness and redissolved in n-hexane:diethyl ether:tetrahydrofuran (98.5:1:0.5) to prepare for analysis by HPLC in order to isolate the eight enantiomeric pairs of isomers; radioactivity was counted by LSC. Precipitates formed upon the addition of the HPLC mobile phase solution were removed, and aliquots of the supernatant were mixed with unlabeled reference standards and injected into the HPLC column. The eluant from each peak (detected by UV light) was collected and counted for radioactivity. Recovery of radioactivity from a single sample of untreated water fortified with 0.02 ppb cyhalothrin was as follows: 95% from the methylene chloride extract, 90% from the HPLC mobile phase, and 83% eluted from the HPLC column. In order to characterize degradates, the remaining supernatant was evaporated to dryness, redissolved in methylene chloride and spotted along with unlabeled standards onto silica gel TLC plates developed with n-hexane:diethyl ether (7:3) followed by cyclohexane:diethyl ether (3:2). Radioactive zones were located using autoradiography; unlabeled standards were detected by UV light. Because of poor resolution and severe tailing, radioactive areas could not be quantified.

At each sampling interval, total radioactivity in fish tissues was determined by LSC following combustion. Fish were separated into edible (muscle), viscera, and remaining (brains, gills, scales, skin, fins, and skeleton) tissues prior to analysis.

After 28 days of exposure, 25 fish were sent to another laboratory for analysis. Five of these fish were separated into viscera, head, and muscle tissues. The tissue types from each fish were combined, and homogenized with acetonitrile. The extracts were filtered and analyzed for total radioactivity by LSC. Unextractable radioactivity was determined by combustion and LSC. The extracts were then evaporated to dryness, redissolved in methanol and analyzed by TLC. Chromatograms were developed using hexane:diethyl ether (10:1, v:v), cyclohexane saturated with formic acid:diethyl ether (3:2, v:v) and chloroform:methanol:glacial acetic acid (95:5:0,1, v:v). Reference compounds were cochromatographed on the plates and located either with UV light or by spraying with a solution of bromophenol blue. Radioactive areas were located by autoradiography. Aliquots of the acetonitrile extracts were also analyzed by HPLC to separate cyhalothrin into its enantiomeric pairs of isomers. The extracts were evaporated to dryness, redissolved in hexane:diethyl ether: tetrahydrofuran (98.6:1:0.2), and injected into a normal phase HPLC along with unlabeled cis-, trans-, ZE-cyhalothrin. The fractions corresponding to the eight enantiomeric pairs of isomers of the reference compound were collected along with ~1 minute fractions throughout the remainder of the chromatogram. Each fraction was analyzed for radioactivity by LSC. Reverse-phase HPLC was used to confirm the identity of the degradate (1RS)-cis-3-(ZE-2-Chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylic acid (Ia).

REPORTED RESULTS:

Total [^{14}C]residues in the treated water ranged from 0.0125 to 0.024 ppb (Figure 1). The amount of parent cyhalothrin in the water apparently decreased from 0.013 to 0.003 ppb, and accounted for <50% of the total radioactivity in the water samples (see Discussion points 3 and 4). Total [^{14}C]residues in the tissues reached maximum concentrations of ~40 ppb in whole fish, >100 ppb in viscera, ~15 ppb in muscle, and ~40 ppb in the remaining tissues (Figure 2); all data were reported in graphical form.

The registrant reported that the concentration of cyhalothrin in the fish stabilized within 1-2 weeks, reaching maximum bioconcentrations of 1660-2240x in whole fish, 4250-7340x in viscera, and 490-850x in the remaining tissues. In addition, it was reported that 79% of the total radioactivity in the whole fish was eliminated during the depuration phase (no raw data provided); the amounts of radioactivity eliminated from the tissues during depuration were 79% from muscle, 77% from viscera, and 78% from the remainder.

TLC analysis of the fish extracts indicated that the parent cyhalothrin concentrations were 57-65% of the recovered in the muscle tissues, 60-65% of the recovered in the head, and 49-64% of the recovered in the viscera (Table 2). (1RS)-cis-3-(ZE-2-Chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylic acid was identified as a degradate by TLC (up to 22% of the recovered in muscle tissue) and confirmed by HPLC (Tables 2 and 3). The enantiomeric pairs A, A', B, and B' of cyhalothrin were recovered by HPLC (Table 3); the presence or absence of the remaining enantiomeric pairs in the extracts was not reported.

DISCUSSION:

1. The uptake, bioaccumulation, and depuration of PP321 were not specifically addressed and reported. The registrant has not shown that the activity of cyhalothrin in a biological system is equivalent to that of PP321.

2. Both the data and the text were difficult to interpret, and thus it was not possible to confirm the reported data. Furthermore, the use of the term "cyhalothrin" in the Japanese text may have been inconsistent, describing in some cases, four isomeric pairs, and in other cases, eight isomeric pairs.

3. No raw data were provided for total radioactivity counts in water and fish tissues to confirm the reported results; these data were provided only in graphical form.

4. Concentrations of cyhalothrin in the treated water were variable. It appeared that <50% of the total radioactivity consisted of parent cyhalothrin; however, it is unclear how these data were obtained. The registrant attributed the decrease in parent cyhalothrin to degradation.

5. The registrant reported that during the analysis of treated water by HPLC, a precipitate formed when the extract was mixed with the mobile phase prior to injection into the column. The resulting extract was significantly lower in [^{14}C]activity. In addition, only 28 to 52% of the total radioactivity was recovered in the eluant. It is unclear whether HPLC separates parent from acid, or whether both should be eluted. Furthermore, the registrants could not quantify TLC results because of poor resolution on the plates. The registrant reportedly switched from "point" spotting to "linear" spotting in order to get better resolution; however, no data from either test were reported except for the fact that linear spotting yielded 20% cyhalothrin "acid" and 25% of unidentified compounds. As to what the percentage points referred to, the text is unclear. Due to the uncertainties mentioned above, all data pertaining to characterization of the test water cannot be considered to be acceptable.

6. Although the reference standards used in the HPLC analysis of fish tissues included trans isomers, the registrant did not report any data for these isomers. If none of these isomers had been detected, the registrant should have reported this fact.

7. In the residue metabolism section, a description of the test substance was given as the following: radiochemical purity >98%, specific activity 1.93 GBq/mmol, ICI Petrochemicals Division, Billingham. The registrant reports that the radiochemical purity figure includes trace amounts of the A' and B' isomers of cyhalothrin and that the composition of the [^{14}C]cyhalothrin was 58.2% isomer A, 2,35% isomer A', 37.3% isomer B, and 2.08% isomer B'. The purities and source of the test substance do not appear to agree between the total radioactivity portion of the study and the residue characterization study. However, the residue characterization report states that the fish were received from the carp study performed in Japan with the Protocol No. MITES/563/4.

8. The types of plates used for TLC analysis (e.g., silica gel) were not reported.

9. The limits of detection were not reported for any of the analytical methods used (LSC, TLC, HPLC).

10. The registrant reported that 1/10 of the 48-hour LC_{50} of cyhalothrin in carp is 0.1 ppb. The test was performed with 1/5 of this amount, or 0.02 ppb. Since the background [^{14}C]activity (30 dpm) differed from the treated water [^{14}C]activity (80 dpm) by only 50 dpm, it is unclear why such a low concentration was used in the study.

11. An inappropriate species of fish (Cyprinus carpio) was used.

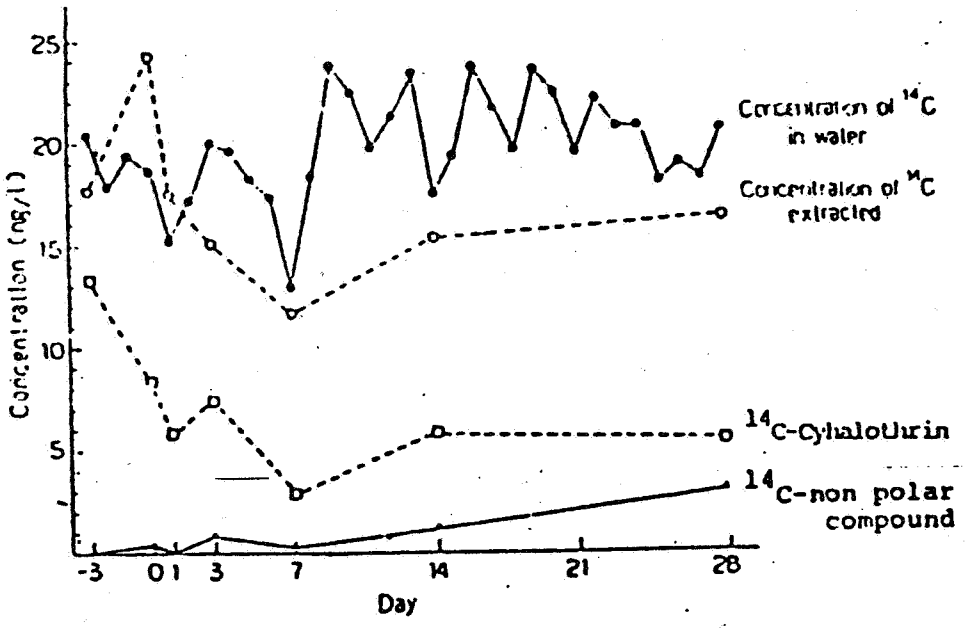
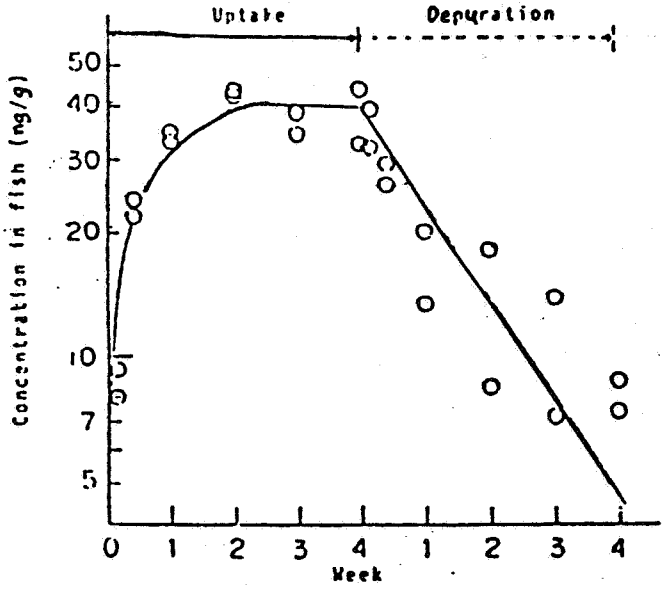


Figure 1. Radioactivity (ng/L cyhalothrin equivalents) in treated water during the uptake period.

(a)



(b)

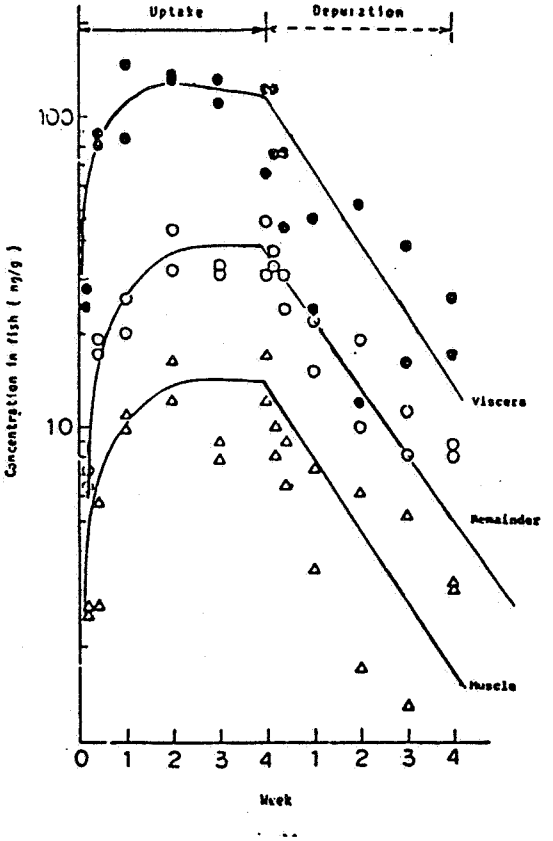


Figure 2. Total radioactivity (ng/g cyhalothrin equivalents) in (a) whole fish and (b) viscera, muscle, and remaining tissues (brains, gill, scales, skin, fins, and skeleton) during the uptake and depuration periods.

Table 1. Chemical characteristics of dechlorinated, aerated tap water.

Parameters	Concentration
Dissolved oxygen (D. O.)	8.2 mg/L
pH	7.5
SS	<0.1 mg/L
Residual chlorine	<0.1 mg/L
TOC	3.2 mg/L
Fluoride	<0.1 mg/L
Hardness (as $CaCO_3$)	48.8 mg/L
Alkalinity (as HCO_3^-)	45.6 mg/L
Un-ionized ammonia	<0.03 mg/L
Nitrate	0.61 mg/L
Organic phosphate	<0.1 mg/L
Arsenic	<0.01 mg/L
Cadmium	<0.005 mg/L
Chromium (Cr^{6+})	<0.05 mg/L
Copper	<0.01 mg/L
Iron	0.02 mg/L
Lead	<0.01 mg/L
Mercury	<0.0005 mg/L
Zinc	<0.01 mg/L

Table 2. Distribution of radioactivity (% of recovered) in tissues of carp after 28 days of exposure to cyclopropyl-labeled [^{14}C]cyhalothrin (purity >98%) at 0.2 ppb following TLC analysis.

Tissue	Total [^{14}C]-residues (ppm)	Unextractable	Cyhalothrin	Ia[a]	Unidentified
			%		
		Solvent system I[b]			
Muscle	0.035	5	60	16	14
Head	0.050	3	65	16	9
Viscera	0.115	7	51	9	36
		Solvent system II[c]			
Muscle	0.035	5	65	14	12
Head	0.050	3	64	17	9
Viscera	0.115	7	49	7	40[d]
		Solvent system III[e]			
Muscle	0.035	5	57	22	12
Head	0.050	3	60	21	9
Viscera	0.115	7	64	22	38

[a] (1RS)-cis-3-(ZE-2-Chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropane-carboxylic acid.

[b] Solvent system I used hexane:diethyl ether (10:1) to resolve cyhalothrin into its two enantiomeric pairs.

[c] Cyclohexane saturated with formic acid:diethyl ether (3:2) did not separate isomers.

[d] At least four compounds were detected.

[e] Chloroform:methanol:glacial acetic acid (95:5:0.1) did not separate isomers.

Table 3. Distribution of radioactivity (% of recovered) in tissues of carp after 28 days of exposure to cyclopropyl-labeled [^{14}C]cyhalothrin (purity >98%) at 0.02 ppb following HPLC analysis.[a]

Tissue	Cyhalothrin[b]				
	Total	A + A'	B	B'	Ia[c]
	%				
Muscle	52	28	23	1	15
Head	68	37	29	2	16
Viscera	40	22	17	1	15

[a] Normal HPLC was used to separate the enantiomeric pairs of cyhalothrin isomers. Reverse-phase HPLC was used to confirm the identity of degradate Ia (See c).

[b] Isomer A' - E (1R) cis (R) α -CN cyhalothrin and E (1S) cis (S) α -CN cyhalothrin.
Isomer A - Z (1R) cis (R) α -CN cyhalothrin and Z (1S) cis (S) α -CN cyhalothrin.
Isomer B' - E (1R) cis (S) α -CN cyhalothrin and E (1S) cis (R) α -CN cyhalothrin.
Isomer B - Z (1R) cis (S) α -CN cyhalothrin and Z (1S) cis (R) α -CN cyhalothrin.

[c] (1RS)-cis-3-(ZE-2-Chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylic acid.

CASE GS -- PP321 STUDY 5 PM --

CHEM -- PP321

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID No MRID CONTENT CAT 01

Hamer, M.J. and I.R. Hill. 1985. The accumulation of cyhalothrin and its degradation products by channel catfish and Daphnia magna in a soil/water system. RJ 0427B.' Prepared and submitted by ICI Americas, Inc., Wilmington, DE. Acc. No. 470082-034.

SUBST. CLASS = S.

DIRECT RVW TIME = 16 (MH) START-DATE END DATE

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SIGNATURE: DATE:

This cyhalothrin study was submitted to support the registration of PP321.

CONCLUSION:

Laboratory Accumulation - Fish

1. This study is scientifically sound and provides supplemental data on the laboratory accumulation of PP321 in fish.

2. In a static sediment/water exposure system, where loamy sand soil was treated with [^{14}C]cyhalothrin (radiochemical purity 96.6%) at 50 g ai/ha, aged 21 days, and flooded, total radioactivity accumulated slightly in channel catfish with maximum bioconcentration factors of 7x in edible tissues, 66x in nonedible tissues, and 19x in whole fish by day 14 of a 31-day exposure period. Radioactivity in the water increased from 0.28 ppb at day 0 to 0.95 ppb at day 32 of the exposure period.

3. This study does not fulfill EPA Data Requirements for Registering Pesticides because a flow-through system was not used, the fish were not exposed to a constant concentration of pesticide, the concentrations of degradates were unacceptably high, the residues in the water and fish

were not characterized, the registrant did not prove that the activity of cyhalothrin in a biological system was equivalent to that of PP321, and the uptake, bioaccumulation, and depuration of PP321 were not specifically addressed and reported.

MATERIALS AND METHODS:

Channel catfish (Ictalurus punctatus, average length and weight 102 mm and 11.6 g, respectively) were held in culture tanks for 7 weeks under unspecified conditions during which no disease-related mortalities were observed prior to the initiation of the study. Static water/sediment exposure systems were prepared using two stainless steel cylinders (200-cm wide x 60-cm deep). Cyclopropane-labeled [^{14}C]cyhalothrin (specific activity 1.9 GBq/mMol; total radiochemical purity 96.6% consisting of 1.2% trans-isomers and the enantiomeric pairs A' [3.4%], A [56%], B' [2.8%], and B [36.7%]; Jealott's Hill Research Station, U.K.) in acetone was thoroughly incorporated into loamy sand soil (36% coarse sand, 44% fine sand, 10% silt, 10% clay, 1.7% organic matter, CEC 6.6 meq/100 g, pH 5.2, moisture-holding capacity at zero suction 34) at a concentration of 50 g ai/ha. One cylinder was filled with the treated soil to a depth of 3 cm; the other cylinder was filled similarly with untreated control soil. Soil samples were immediately analyzed to determine the exact concentration of radioactivity. The soil was kept moist by watering and was incubated at "ambient" temperatures under a 16-hour photoperiod with fluorescent lighting combined with natural light. Samples were collected at intervals for up to 21 days.

After 21 days of aging, the soils were flooded with 1400 L of tap water (temperature 18-20°C, dissolved oxygen 8.7 mg/L, hardness 204-316 mg/L, alkalinity 240-355 mg/L, specific conductivity 530-846 µS/cm, un-ionized ammonia <0.004-0.05 mg/L nitrogen, residual chlorine <0.05 mg/L, copper <0.02-0.35 mg/L, lead, zinc and fluoride each ≤0.12 mg/L); the water and soil were sampled and left to equilibrate for 3 days. Following equilibrium, the water and soils were sampled, and 150 channel catfish were introduced into the system. Fish were maintained on a diet of dry pellet food (Promin, coarse; Promin Ltd.) daily. The water was continuously aerated. After 21 days of exposure, 60 fish from each cylinder were placed in separate glass aquaria containing flowing, aerated, dechlorinated, filtered water (characteristics as above with the exception of dissolved oxygen >5 mg/L and temperature 17-22°C) for a 42-day depuration period. Fish and water were sampled on days 1, 3, 7, 14, 21, and ~31 of the exposure period, and days 1, 3, 7, 14, 31, and 42 of the depuration period. Soil was sampled at intervals up to 32 days (1 day beyond the fish were exposed) of exposure.

Soil samples were sequentially extracted with acetonitrile followed by acetonitrile:water (70:30). Total radioactivity in the extracts and extracted soil was determined by LSC and LSC following combustion, respectively. The extracts were combined and concentrated. Aliquots were analyzed for total radioactivity by LSC and for degradates by TLC with reference compounds. TLC was performed using unspecified plates developed with cyclohexane saturated with formic acid:diethyl ether (3:2). Reference standards were located with UV light and by spraying

the chromatograms with a solution of bromophenol blue in acetone. Radioactive areas were located by autoradiography and quantified using a TLC linear analyzer.

Total radioactivity in water was determined using LSC. Aliquots of water samples from days 1, 7, 21, 28 and 31 of the exposure period were extracted with hexane to remove parent cyhalothrin, acidified to pH 1 with 10 M HCl, and extracted once more with diethyl ether. Aliquots of the water, ether and hexane fractions were measured for radioactivity using LSC. The other fraction was dried over anhydrous sodium sulfate, concentrated, and analyzed using TLC as described above for soil. The hexane fraction did not contain sufficient radioactivity to warrant TLC analysis.

Pooled samples of whole fish (3) and pooled samples (4) of edible (lateral musculature, skin and bones) and nonedible (viscera) tissues were wet-weighed, frozen, and analyzed for radioactivity by LSC following combustion.

REPORTED RESULTS:

[^{14}C]Residues in the water gradually increased from 0.28 ppb at 0 days of exposure to 0.95 ppb at 32 days of exposure (Table 1). Parent cyhalothrin concentrations were reported to be <0.003 ppb. (1RS)-cis-3-(ZE-2-Chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylic acid (Ia) was reported to constitute up to 5.3% of the "applied" radioactivity in water (see Discussion point 4). Maximum accumulation of [^{14}C]residues in fish occurred by day 14 of the exposure period with bioconcentration factors of 7x in edible tissue (3.6 ppb), 66x in nonedible tissues (33.8 ppb), and 19x in whole fish (9.6 ppb) (Table 1). Residues depurated quickly reaching concentrations of 1.3, 1.0, and 1.0 ppb in edible, nonedible, and whole fish, respectively, after 42 days. [^{14}C]Residues in the soil decreased from 110.7% of the applied on the day of treatment, to 47% of the applied at day 0 of the exposure to fish (3 days after the soil was flooded) (Table 2). Over 80% of the applied radioactivity was unaccounted for. (Table 2).

DISCUSSION:

1. The uptake, bioaccumulation, and depuration of PP321 were not specifically addressed and reported. The registrants did not prove that the activity of cyhalothrin in a biological system was equivalent to the activity of PP321.

2. A flow-through system was not used during the exposure period. Fish were exposed to varying concentrations of cyhalothrin residues released from aged treated soil rather than to constant concentrations of [^{14}C]-cyhalothrin. Reported BCF's differ greatly from those determined for flow-through methods.

3. Residues in the fish tissues were not characterized.

4. The concentrations of [^{14}C]degradates in water were presented as "% of the applied". Since the original treatment was made to soil, the data

depicting water concentrations expressed as the percent of material applied to the soil is meaningless and cannot be analyzed without appropriate raw data expressed as ppb. Furthermore, only 5.3% "of the applied" was identified, thus, residues in water were not sufficiently characterized.

5. Soil TLC analysis failed to recover >80% of the radioactivity applied to the plate.

6. The type of plate used for TLC analysis (e.g., silica gel) was not specified.

Table 1. Total radioactivity (ppb) in the water and tissues of channel catfish treated with cyclopropyl-labeled [^{14}C]cyhalothrin (radiochemical purity 96.6%) during a 31-day exposure period and 48-day depuration period.

Sampling interval (days)		Water	Edible[a]		Nonedible[b]		Whole fish	
			ppb	BCF[c]	ppb	BCF[c]	ppb	BCF[c]
Exposure	-3	0.04	--	--	--	--	--	--
	-2	0.09	--	--	--	--	--	--
	0	0.28	--	--	--	--	--	--
	1	0.34	0.7	2	6.9	20	5.8	17
	3	0.36	1.0	3	10.1	28	2.4	7
	7	0.38	2.2	6	17.0	45	3.7	10
	14	0.51	3.6	7	33.8	66	9.6	19
	21	0.65	3.1	5	18.6	28	6.8	10
	28	0.84	5.7	7	41.7	49	6.7	8
	31	--	6.5	7	45.5	48	8.4	9
	32	0.95	--	--	--	--	--	--
Depuration	1	--	6.8	105	27.2	60	6.7	80
	3	--	4.3	66	24.2	53	5.3	64
	4	--	--	--	--	--	5.1	61
	7	--	3.3	51	1.9	4	3.2	38
	14	--	2.1	32	1.8	4	3.1	37
	21	--	2.0	31	2.7	6	2.3	27
	42	--	1.3	20	1.0	2	1.0	14

[a] Lateral musculature, skin, and bones.

[b] Viscera.

[c] Bioconcentration factors for the exposure period are calculated by dividing the concentration of [^{14}C]residues in wet tissues by the concentration of [^{14}C]residues in water. Bioconcentration factors for the depuration period are calculated as a percentage of the [^{14}C]residues present on the last day of exposure in each of the tissues.

Table 2. Distribution of radioactivity (% of applied) in loamy sand soil treated with cyclopropane-labeled [^{14}C]cyhalothrin, incubated for 21 days, and flooded with aerated tap water for 32 days.

Sampling interval (days)		Total	Acetonitrile extract[a]					Isomeric composition[b]				
			Total	Ia[c]	XV[d]	Origin	Unidentified	A'	A	B'	B	Trans-isomers
Incubation	0	110.7	107.7	<1	<1	<1	1	4.0	60.4	3.1	39.4	0.7
	7	86.1	50.4	5	5	4	1	1.3	26.0	1.4	21.1	0.6
	14	75.7	34.6	4	7	2	1	0.9	15.3	1.0	16.8	0.6
	21	67.2	23.6	4	7	4	2	0.5	10.7	0.6	11.0	0.8
Exposure	0	47.4	13.5	2	4	3	1	0.4	5.6	0.4	6.8	0.4
	3	55.8	14.9	3	6	6	<1	0.3	6.6	0.3	7.3	0.3
	7	49.7	16.0	2	4	3	<1	0.5	7.3	0.5	7.5	0.3
	14	47.6	16.8	2	1	<1	<1	0.5	7.5	ND[b]	8.3	0.6
	28	50.2	13.6	6	2	3	<1	0.3	6.5	ND	6.4	0.4
	32	64.0	26.7	3	3	5	2	0.7	13.8	0.4	11.3	0.5

[a] As determined by TLC analysis.

[b] As determined by HPLC analysis: Isomer A' - E (1R) cis (R) α -CN cyhalothrin and E (1S) cis (S) α -CN cyhalothrin.
Isomer A - Z (1R) cis (R) α -CN cyhalothrin and Z (1S) cis (S) α -CN cyhalothrin.
Isomer B' - E (1R) cis (S) α -CN cyhalothrin and E (1S) cis (R) α -CN cyhalothrin.
Isomer B - Z (1R) cis (S) α -CN cyhalothrin and Z (1S) cis (R) α -CN cyhalothrin.

[c] (1RS)-cis-3-(ZE-2-Chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylic acid.

[d] (RS)-α-Cyano-3-(4-hydroxyphenoxy)benzyl (1RS)-cis-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate.

EXECUTIVE SUMMARY

The following findings are derived from those reviewed studies which have met the requirements of 40 CFR 158.130 and the guidance of Subdivision N and were also deemed acceptable.

Cyclopropane- and phenyl-labeled [^{14}C]PP321 (radiochemical purities 97-98%), at 40 g/ha, degraded with half-lives of >166 hours (equivalent to ~34-35 days of Florida summer sunshine) on loam soil irradiated with artificial light at 25°C. After 166 hours of irradiation, PP321 and the degradate (RS)-α-amido-3-phenoxybenzyl-(1RS)-cis, trans-3-(ZE-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate (compound II) comprised ~83-86 and ~5% of the applied radioactivity, respectively. PP321 and compound II comprised ~74-75 and ~16-17% of the applied radioactivity, respectively, after 30 days in the dark controls.

PP321 dissipated from the upper 10 cm of silt loam (MS) and clay loam (IL) soils with half-lives of <14 and 28-56 days, respectively, following the application of cyclopropane- and phenyl-labeled [^{14}C]PP321 (1 lb/gal EC) at 142-146 g ai/ha in June, 1985. At the MS site, PP321 comprised <3% of the applied radioactivity by 57 days posttreatment, while, at the IL site, PP321 comprised ~18-21% of the applied at 279 days posttreatment. At both sites, all degradates and unknowns each comprised <7% of the applied at any sampling interval. During the test periods, the majority of the applied radioactivity remained in the upper 5 cm of the soil.

The following findings are derived from those reviewed studies which have not met the requirements of 40 CFR 158.130 and/or the guidance of Subdivision N, but have been deemed good studies following generally sound scientific practice. They thereby provide supplemental information on the fate and exposure of the pesticide.

In a static sediment/water exposure system, where loamy sand soil was treated with [^{14}C]cyhalothrin (radiochemical purity 96.6%) at 50 g ai/ha, aged 21 days, and flooded, total radioactivity accumulated slightly in channel catfish with maximum bioconcentration factors of 7x in edible tissues, 66x in nonedible tissues, and 19x in whole fish by day 14 of a 31-day exposure period. Radioactivity in the water increased from 0.28 ppb at day 0 to 0.95 ppb at day 32 of the exposure period.

RECOMMENDATIONS

Available data are insufficient to fully assess the environmental fate of, and the exposure of humans and nontarget organisms to PP321 (Karate). The submission of data relevant to full registration requirements (Subdivision N) is summarized below.

The following data are required:

Anaerobic soil metabolism studies: No data were reviewed for this addendum, but all data are required.

Leaching and adsorption/desorption studies: One study (Vickers and Bewick, 1986) was reviewed but is unacceptable and would not fulfill data requirements because the concentrations of PP321 in the test solutions exceeded the reported water solubility of 0.004 ppm. An unaged study conducted on one additional soil type having an organic matter content less than 1% is required.

Confined accumulation studies on rotational crops: No data were reviewed for this addendum, data on PP321 radiolabeled in the alcohol moiety are required.

Laboratory studies of pesticide accumulation in fish: Two studies were reviewed. One study (?, 1984; Leahy and Parker, 1985) was unacceptable because the concentrations of cyhalothrin in the treated water were too variable and may have consisted of <50% parent cyhalothrin. In addition, this study would not fulfill data requirements because no raw data were provided; an inappropriate species of fish was tested; the registrant has not shown that the activity of cyhalothrin in a biological system is equivalent to that of PP321; and the uptake, bioaccumulation, and depuration of PP321 were not specifically addressed and reported. The second study (Hamer and Hill, 1985) is scientifically sound and provides supplemental data on the laboratory accumulation of PP321 in fish. However, this study does not fulfill data requirements because a flow-through system was not used, the fish were not exposed to a constant concentration of pesticide, the concentrations of degradates were unacceptably high, the residues in the water and fish were not characterized, the registrant did not prove that the activity of cyhalothrin in a biological system was equivalent to that of PP321, and the uptake, bioaccumulation, and depuration of PP321 were not specifically addressed and reported. All data (both cyclopropane and alcohol moieties) are required.

Reentry: Data are required.

The following data are either deferred or conditionially required:

Field accumulation studies on rotational crops: No data were reviewed for this addendum; however, the data requirement is deferred pending the receipt of acceptable confined rotational crop accumulation data.

The following lists data which have either not been required or for which the requirement has been satisfied:

Hydrolysis studies: No data were reviewed for this addendum. Because of experimental difficulties caused by the extreme insolubility of the test material no further data will be required.

Photodegradation studies in water: No data were reviewed for this addendum. Because of experimental difficulties caused by the extreme insolubility of the test material no further data will be required.

Photodegradation studies on soil: One study (Parker and Leahey, 1986) was reviewed and fulfills data requirements by providing information on the photodegradation of cyclopropane- and phenyl-labeled [^{14}C]PP321 on soil.

Photodegradation studies in air: No data were reviewed for this addendum, but no data are required because of the low vapor pressure of PP321.

Aerobic soil metabolism studies: No data were reviewed for this addendum. Based on previously reviewed data, no data are required.

Anaerobic aquatic metabolism studies: No data were reviewed for this addendum. No data are required because PP321 has no aquatic, forestry, or aquatic impact use.

Aerobic aquatic metabolism studies: No data were reviewed for this addendum. No data are required because PP321 has no aquatic or aquatic impact use.

Laboratory volatility studies: No data were reviewed for this addendum, but no data are required because of the low vapor pressure of PP321.

Field volatility studies: No data were reviewed for this addendum, but no data are required because of the low vapor pressure of PP321.

Terrestrial field dissipation studies: One study (Bewick et al., 1986) was reviewed and fulfills data requirements by providing information on the dissipation of PP321 in soil at two locations (MS and IL).

Aquatic field dissipation studies: No data were reviewed for this addendum; however, no data are required because PP321 has no registered aquatic food crop, aquatic nonfood, or aquatic impact use.

Forestry dissipation studies: No data were reviewed for this addendum; however, no data are required because PP321 has no forestry use.

Dissipation studies for combination products and tank mix uses: No data were reviewed for this addendum; 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 for this addendum; however, no data are required because more than 50% of the PP321 dissipated prior to the recommended subsequent application of PP321.

Accumulation studies on irrigated crops: No data were reviewed for this addendum; however, no data are required because PP321 has no aquatic food crop or aquatic nonfood use.

Field accumulation studies on aquatic nontarget organisms: No data were reviewed for this addendum; however, no data are required because PP321 has no forestry, aquatic nonfood, or aquatic impact use.

ROTATIONAL CROP RESTRICTIONS

Do not rotate any crop except cotton into areas previously treated with Karate.

REFERENCES

The following studies were reviewed as new submittals:

? 1984. PP-563 (Cyhalothrin): Accumulation in fish (carp) in a flow-through water system. Protocol No. MITES/563/4. Prepared by Mitsubishi-Kasei Institute of Toxicological and Environmental Sciences, Japan, and submitted by ICI Japan Limited. Acc. No. 470082-032.

Bewick, D.W., D.W. Barlett, and P. Hendley. 1986. PP321: fate of radio-labeled material in soil under field conditions. Project No. RJ0529B. Prepared and submitted by ICI Americas Inc., Wilmington, DE. Acc. No. 400524-07.

Hamer, M.J. and I.R. Hill. 1985. The accumulation of cyhalothrin and its degradation products by channel catfish and Daphnia magna in a soil/water system. RJ 0427B. Prepared and submitted by ICI Americas, Inc., Wilmington, DE. Acc. No. 470082-034.

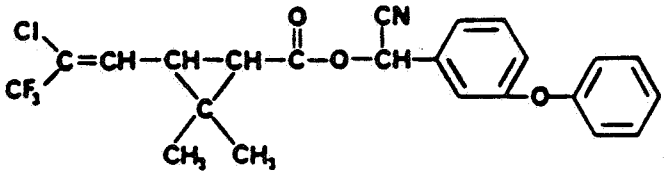
Leahy, J.P. and S. Parker. 1985. Characterization of residues accumulated by carp continuously exposed to ^{14}C-cyhalothrin. Report No. RJ0407B. Prepared and submitted by ICI Plant Protection Division, Berkshire, U.K. Acc. No. 470082-033.

Parker, S. and J.P. Leahey. 1986. PP321: Photodegradation on a soil surface. Project No. RJ0537B. Submitted by ICI Americas Inc., Wilmington, DE. Acc. No. 400524-05.

Vickers, J.A. and D.W. Bewick. 1986. PP321: Adsorption and desorption in soil. Submitted by ICI Americas Inc., Wilmington, DE. Acc. No. 400524-06.

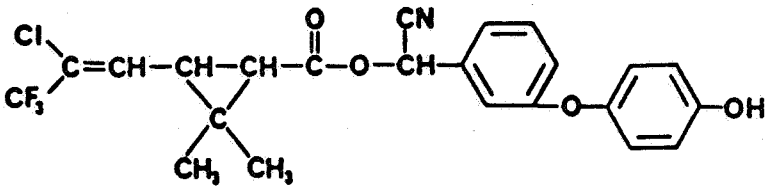
APPENDIX

STRUCTURES OF PP321 AND ITS DEGRADATES

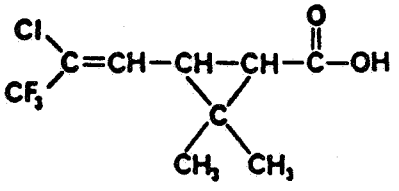


A 1:1 mixture of the enantiomers (S)-α-Cyano-3-phenoxybenzyl (1R)-*cis*-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate and (R)-α-cyano-3-phenoxybenzyl (1S)-*cis*-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate

(Karate, PP321)



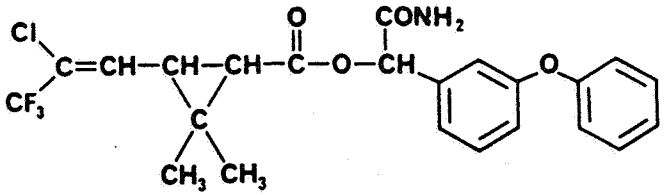
(RS)-α-Cyano-3-(4-hydroxyphenoxy)benzyl (1RS)-*cis*-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate



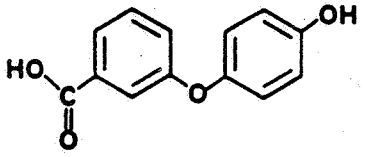
(1RS)-*cis*-3-(Z-2-Chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylic acid

and

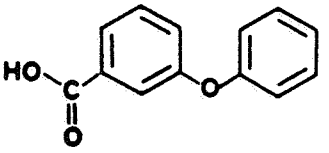
(1RS)-*trans*-3-(Z-2-Chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylic acid



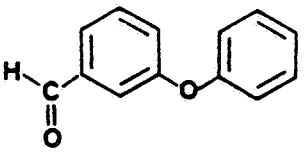
(RS)-α-Amido-3-phenoxybenzyl-(1RS)-cis,trans-3-(ZE)-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate



4'-Hydroxy-3-phenoxybenzoic acid



3-Phenoxybenzoic acid



3-Phenoxybenzaldehyde