~~OFFICIAL~~ File

Shaugh. No. 059101

EAB Log Out Date: 11 SEP 1984

Init.: SLL

To: Jay Ellenberger
Product Manager 12
Registration Division (TS-767)

From: Carolyn K. Offutt
Chief, Environmental Processes and Guidelines Section
Exposure Assessment Branch, HED (TS-769)

Attached, please find the estimated environmental concentration review of:

Reg./File No.: 464-448, 464-523

Chemical: Chlorpyrifos

Type Product: Innsecticide

Product Name: LORSBAN

Company Name: DOW

Submission Purposes: Runoff study review

ZBB Code: other

Action Code: 575

Date In: 13 July 1984

EFB#: 4459-4460

Date Completed: 11 Sept 1984

TAIS (Level II)	Days
63	3.8

Deferrals To:

_____ Ecological Effects Branch

_____ Residue Chemistry Branch

_____ Toxicology Branch

Chlorpyrifos

I. Introduction.

DOW performed a one-year runoff and water quality study in Kankakee County, Illinois, where chlorpyrifos was applied to corn in three different applications.

II. Chemical/Physical Characteristics.

Common Name: Chlorpyrifos
Chemical Name: O,O-diethyl-O-3,5,6-trichloro-2-pyridyl-phosphorothioate
Additional chemical/physical information may be found on the attached "One-liner".

III. Discussion.

DOW Chemical has submitted a one-year runoff and water quality study conducted in 1982 in Kankakee County, Illinois, where chlorpyrifos was applied to corn in three different applications. This study was performed in this field and pond because there had been a fish kill in the pond in 1981 and chlorpyrifos was suspected as the lethal agent. DOW used the information from the study to validate modeling efforts to predict field and pond pesticide dissipation.

In the DOW field study, the concentration in the whole pond due to drift from the third application was 18 to 55 ppt.

During the runoff events, the DOW study found that between 2 and 90 mg/ha of chlorpyrifos was transported from the pond watershed. DOW's modeling study using USDA's CREAMS (Chemical Runoff and Erosion from Agricultural Management Systems) runoff model predicted these runoff quantities quite well (see accompanying tables from DOW report).

The concentrations found in the pond in the DOW study ranged and were similarly predicted by a simplistic water quality model to be between 80 and 400 pptr depending upon the quantity of application and the period of time between application and the storm event.

IV. Conclusion.

This field study expresses the quantity of chlorpyrifos that can be transported from an agricultural field in Illinois into a nearby pond.

The study with its accompanying laboratory studies are scientifically sound (with the exception of the permeability study) and fulfill the following Subdivision N tests:

§161-1	Hydrolysis study (temperature-dependent)	- supplemental
§162-1	Aerobic soil metabolism studies	- acceptable
§162-3	Anaerobic aquatic metabolism study	- unacceptable
§163-1	Leaching and adsorption/desorption studies (batch study)	- acceptable
§164-1	Field dissipation study for terrestrial uses	- acceptable in part
§164-2	Field dissipation study for aquatic uses and aquatic impact uses	- acceptable in part

Robert W. Holst, Ph.D.
Exposure Assessment Branch
Hazard Evaluation Division (TS-769C)

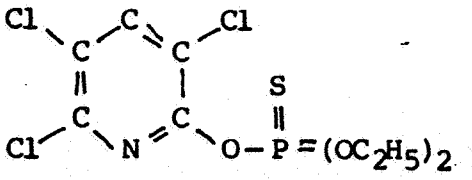
Date 11 SEPT 84
R.W. Holst

EXPOSURE ASSESSMENT BRANCH ONE LINER

EAB File No: 059101 TYPE PESTICIDE: Insecticide STRUCTURE

COMMON NAME: Chlorpyrifos

CHEMICAL NAME: O,O-diethyl-O-3,5,6-trichloro-2-pyridyl-phosphorothioate



Formulation Types: 4E,15G

Degradation Products:

CHEMICAL AND PHYSICAL PROPERTIES

Mole. Wt.	Aqueous Solubility	Vapor Pressure	K_{ow}	Henry's
350.6	2.00 (ppm) 25(°)C	1.87E-5(torr)25(°)	66000	4.21E-6(atm/mol/m3)

Soil Adsorption Coefficient

Soil Type	pH	% Soil O.C.	Kd	K_{om}	K_{oc}	Soil Column Leach. Stdy.	Soil TLC R_f
fine sandy loam	7.5	1.3	112				
fine sandy loam		2.8	247				
fine sandy loam		0.8	114				
fine sandy loam		0.6	97				

Hydrolysis

pH	Temp.	$T1/_2$
5	25	26400 hr
7	25	8400 hr
9	25	720 hr
7.5	15	2500 hr
7.5	25	1200 hr
7.5	35	385 hr

Photolysis

pH	$T1/_2$
Air:	
Soil:	
Water: ?	6-24 hr

Mobility Class

(1) Immobile
(2) Low
(3) Low to Mod.
(4) Moderate
(5) Mobile

Degradation - Laboratory Half-life

		$T1/_2$			$T1/_2$
Soil Aerobic:	fine sandy loam 25% 1/3 bar moisture	18-53 dy	Soil Anaerobic:	2 soils	39-51 dy
Aquatic Aerobic:			Aquatic Anaerobic:		

EAB Chemical One-Liner
Chemical Chlorpyrifos

Degradation - Field Half-life

	$T_{1/2}$		$T_{1/2}$
Terrestrial [Crop Site]	corn fine sandy loam 18-53 dy	Forestry [Crop Site]	
Aquatic [Crop Site]		Other [Crop Site]	

ENVIRONMENTAL EXPOSURE

Found in Ground Water (Y/N)?_____

Site(s) _____ Level:_____

Reentry Interval Established?_____

Rotational Crop Restrictions: _____

Fish Bioaccumulation Factors

Species	Tissue		Whole Fish	Duration (Half-life)
	Edible	Viscera		
	X	X	X	
	X	X	X	
	X	X	X	

EXPOSURE ASSESSMENT:

Degradation Summary (including degradation product names and structures):

Not likely to leach due to high Kd.
Likely to runoff but in quantities less than 1%.

REFERENCES: EAB Files

One-Liner Writer: R.W. Holst

Chemical: Chlorpyrifos
Formulation: LORSBAN 4E Insecticide

Citation: McCall, P.J., G.R. Oliver, and R.L. McKellar. 1984. Modeling the runoff potential and behavior of chlorpyrifos in a terrestrial - aquatic watershed. Submitted by DOW Chemical Co. (EPA Acc.# 253708)

Reviewer: Robert W. Holst, Ph.D., Staff Scientist, Exposure Assessment Branch, Hazard Evaluation Division (TS-769C), OPP. 29 August 1984.

Title: Runoff and Water Quality Study of Chlorpyrifos Applied to Corn in Illinois.

Materials and Methods: Two watersheds on a farm in Kankakee County, Illinois, were selected to be monitored for chlorpyrifos runoff in 1982. One watershed flowed into a small pond and, therefore, the pond was also monitored. This watershed of 2.65 acres drained in a 0.75 acre pond, while a second watershed of 0.64 acres drained into a ditch. The watersheds were delimited by metal and cement gutters. The soil was analyzed and found to be a fine sandy loam. The hydrologic parameters of each field were characterized. Daily weather data were collected for the period of the experiment (mid-May to mid-September). LORSBAN 4E was applied three times: 28 April, 4 lb a.i./A incorporated to 4 inches; 15 May and 15 June, 1.5 lb a.i./A each. Runoff and pond water and field soil and pond sediment samples were taken before the first application and at intervals through the remainder of the experimental period. Earthworms, corn, soybean, and off-target vegetation samples were also collected and analyzed.

Results: Plant and animal residues were reported as follows:

Corn foliage	(within area of application)	day of appl.	130-170 ppm
		30 days after	0.10-0.01 ppm
Soybean foliage	(adjacent to field of application)	day of appl.	150 ppm
		30 days after	0.10 ppm
Earthworms	(within appl. area)	4 days after	1.2-6.6 ppm
		30 days after	0.04-0.67 ppm
Blackberries	(windward edge)	day of appl.	1-25 ppm
		30 days after	0.02-3 ppm
Grass	(outside appl. area)	day of appl.	0.13-45 ppm
		30 days after	0.02-0.07 ppm

Chlorpyrifos in the runoff waters varied according to the physical characteristics of the fields. The pond watershed lost

over 0.120 g/ha in the runoff sediment and 0.030 g/ha in the waters while the second smaller watershed lost only 0.004 g/ha in the sediments and 0.007 g/ha in the water runoff.

Chlorpyrifos in the pond waters was found to range from 300 pptr immediately after the 4 lb/A application to less than 10 pptr a month later. After the 1.5 lb/A surface applications, the pond water concentrations did not generally exceed 150 pptr. The pond sediments reached about 10 ppb just after the second application but then declined to 2 ppb by the end of the experiment in September.

DOW modeled the runoff of these watersheds and water quality of the pond. USDA's CREAMS (Chemical Runoff and Erosion from Agricultural Management Systems) runoff model and DOW's own simplistic water quality model were used in the analysis. With careful selection of the numerous input values for each model (following the input parameters provided by USDA for CREAMS), they were able to verify the modeling efforts using this extensive field study. See the attached two tables comparing the actual and predicted runoff values from the two watersheds and the two figures comparing the actual and calculated pond water and pond sediment concentrations of chlorpyrifos.

Conclusions: Chlorpyrifos will leave corn watersheds in Illinois and can be transported to ponds a short distance from the fields. The quantities of transport pesticide will vary depending upon a variety of soil characteristics, crop management practices, and application methodologies and are generally less than 1%. The movement of a pesticide from the watershed to the pond can be monitored and modeled.

Acceptability: This study was performed and reported in accordance with the Subdivision N guidelines, §164-1 (Field Dissipation Studies for Terrestrial Uses) and §164-2 (Field Dissipation Studies for Aquatic Uses and Aquatic Impact Uses), and the results are acceptable. Only part of the guidelines requirements were met as only one geographical site was used.

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Pages 8 through 12 are not included.

The material not included contains the following type of information:

_____ Identity of product inert ingredients.

_____ Identity of product impurities.

_____ Description of the product manufacturing process.

_____ Description of quality control procedures.

_____ Identity of the source of product ingredients.

_____ Sales or other commercial/financial information.

_____ A draft product label.

_____ The product confidential statement of formula.

_____ Information about a pending registration action.

✓ FIFRA registration data.

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The information not included is generally considered confidential by product registrants. If you have any questions, please contact the individual who prepared the response to your request.

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Reviewer: Padma Datta, Ph.D., Staff Scientist, Exposure Assessment Branch, Hazard Evaluation Division (TS-769C), OPP. 31 August 1984.

Title: Temperature-Dependent Hydrolysis of Chlorpyrifos in Illinois Farm Pond Waters.

Materials and Methods: 14C chlorpyrifos hydrolysis studies were conducted in pond water (pH 7.5) in 3 temperatures (15,25, 35°C). The procedures used for incubation and radioactivity measurements follow the Subdivision N guidelines. H.P.L.C. systems used to obtain degradation products profile of chlorpyrifos follow those recommended in the Subdivision N guidelines. The pH-dependent hydrolysis studies were not reviewed as part of this assessment.

Results: The temperature-dependent hydrolysis data are given in the accompanying table found in the DOW Chemical report. The half-lives were calculated by the Agency to be 107, 53 and 17 days for temperatures of 15, 25, 35°C, respectively. This compares with 110, 50, and 16 days, respectively, as reported by DOW.

Conclusions: The half-lives are approximately 110, 50, and 16 days for temperatures of 15, 25, and 35°C, respectively, in pH 7.5 Illinois farm pond water.

Acceptability: This study was performed and reported in accordance with the Subdivision N guidelines. There are no requirements for a temperature-dependent hydrolysis study. This study is, therefore, supplemental data.

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Reviewer: Padma Datta, Ph.D., Staff Scientist, Exposure Assessment Branch, Hazard Evaluation Division (TS-769C), OPP. 31 August 1984.

Title: Degradation of Chlorpyrifos in Illinois Field Soils

Materials and Methods: Degradation rates were determined in Hoopeston, Guilford, Ada B, and Ada B_2 soils (fine sandy loams) as a function of soil moisture (air dry, 25%, and 75% of 1/3 bar) and temperatures (25 and 35°C) as required by Subdivision N guidelines. The methods for radio-labeled chlorpyrifos and extraction, cleanup and quantitative measurements of ^{14}C by combustion followed the Subdivision N guidelines. The H.P.L.C. conditions using a C_{18} uBondapak radial compression column and flow rate (1 ml/min) and prodedures to obtain percent applied chlorpyrifos remaining in soils at certain time periods follow acceptable procedures. ^{14}C chlorpyrifos of about 14.3 mci/mmole possesses sufficient radioactivity to detect at the 1 ppt level.

Results: The half-lives of chlorpyrifos were calculated using the data provided on the attached table found in the DOW Chemical report.

	Soil Type			
Moisture /%OC	Hoopeston 1.3	Ada B 0.8	Ada B2 0.6	Gilford 2.8
		(half-life in days)		
Air Dry (25°)	3.2	19.1	5.8	0.6
25% 1/3 bar (25°)	37.2	53.7	29.0	18.7
75% 1/3 bar (25°)	27.8	38.1	25.6	15.6
75% 1/3 bar (35°)	0.4	20.0	10.4	8.0

The half-lives for the four soil types calculated by DOW are given in the accompanying table taken from the DOW Chemical report.

Conclusions: There is some discrepancy between the results as calculated, however, this is dependent upon the method of calculation. The results indicate half-lives of 0.6 to 19.1 days for air dry soil, 18 to 61 days for 25% 1/3 bar, and 12 to 38 days for 75% 1/3 bar depending upon soil type. The major pathway of degradation is by means of microbial processes as indicated by Q_{10}s of 2 to 3 between the soils at 25 and 35°C.

Acceptability: This study was performed and reported in accordance with the Subdivision N guidelines, §162-1 (Aerobic Soil Metabolism), and the results are acceptable.

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Reviewer: Padma Datta, Ph.D., Staff Scientist, Exposure Assessment Branch, Hazard Evaluation Division (TS-769C), OPP. 31 August 1984.

Title: Sorption of Chlorpyrifos in Illinois Field Soils

Materials and Methods: The sorption of chlorpyrifos to four soil types (all fine sandy loams) was estimated by the difference between that in solution and that amount added to the test tube. The laboratory procedures for measuring sorption chlorpyrifos using ^{14}C material, including extraction, cleanup, and H.P.L. chromatography follow Subdivision N guidelines.

Results: The K_d values were derived as noted in the accompanying table from the DOW Chemical report.

Conclusions: The results indicate that chlorpyrifos is strongly sorbed to these soils and is relatively immobile in soil and unavailable for leaching.

Acceptability: This study was performed and reported in accordance with the Subdivision N guidelines, §163-1 (Adsorption and Desorption), and the results are acceptable.

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Reviewer: Padma Datta, Ph.D., Staff Scientist, Exposure Assessment Branch, Hazard Evaluation Division (TS-769C), OPP. 31 August 1984.

Title: Permeability (Column Leaching) of Chlorpyrifos in Illinois Field Soils

Materials and Methods: The permeability measurements were performed using undisturbed soil cores of 2 13/16-inches high by 3-inches diameter at a depth of 0 to 3 and 3 to 6 inches. The hydraulic conductivity determination was made in accordance with Subdivision N guidelines and by the method of Klute, A. 1979. In Methods of Soil Analysis, Part 1, ed. C.A. Black, Amer. Soc. Agron.

Results: No results were given other than a permeability or hydraulic conductivity value was mentioned in the USDA-SCS soil survey reports and used in the modeling of the runoff of this site.

Conclusions: No conclusions can be made from this study.

Acceptability: This study was performed but not reported in accordance with the Subdivision N guidelines, §163-1 (Leaching), and is, therefore, not acceptable. It may be upgraded with the submission of additional explanatory data. The §163-1 studies on mobility of chlorpyrifos through soils has been satisfied by the batch adsorption/desorption study.

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Reviewer: Robert Holst, Ph.D., Staff Scientist, Exposure Assessment Branch, Hazard Evaluation Division (TS-769C), OPP. 31 August 1984.

Title: Anaerobic Aquatic Metabolism in Illinois Pond.

Materials and Methods: The methods used in this determination were not provided.

Results: The results were given in the appendix (Table XI) but not otherwise reported.

Conclusions: No conclusions canbe made from this study.

Acceptablility: This test is not scientifically sound and is unacceptable to fulfill the requirements of §161-3, Anaerobic Aquatic Metabolism, Subdivision N.