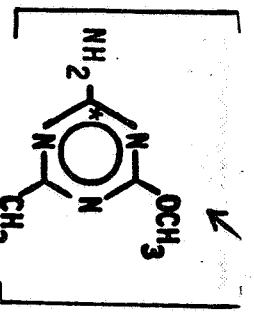
Reviewed by: EmilRegelman
Date: July 12,1984
Shaughnessy No. 122010

Breakdown product of Metsulfuron methyl

4-methoxy-6-methyl-1,3,5-triazine-2-amine



Friedman, P.L. Undated. Hydrolysis of ^{14}C-4-methoxy-6-methyl-1,3,5-triazin-2-amine. Document No. AMR-136-83. (company confidential) E.I. DuPont de Nemours and Co. Experimental Station. Wilmington, DE. 9 pages, 4 figures. No references

Introduction

The hydrolysis of ^{14}C-4-methoxy-6-methyl-1,3,5-triazin-2-amine was studied at 25°C, in sterile buffer solutions of pH 5,7 and 9.

Experimental

^{14}C-4-methoxy-6-methyl-1,3,5-triazin-2-amine was prepared, and found to be 99% radiopure with a specific activity of 35.4 uCi/mg. Stock solutions at 0.5 and 5.0 ppm were prepared in pHydrion Buffer Solutions of pH 5,7 and 9, which had been previously autoclaved for 1 hour on 3 consecutive days. All glassware had been similarly autoclaved.

Solutions were stored in glass stoppered Erlenmeyer flasks in a dark autoclave at a constant 25°C, with 20 ml aliquots being taken on days 0, 1, 2, 5, 7, 14, 21 and 30.

Analysis for total radioactivity was by LSC counting. Component separation was attempted by HPLC using acetonitrile/water mobile phase (5/95, v/v) on a PRP column. Structures for the two peaks detected are appended to this review. Confirmation was by co-chromatography with unlabeled compounds, as well as by TLC separation using precoated silica gel 60 F-254 plates and a methylene chloride/methanol/ammonium hydroxide (144/50/8, v/v/v) mobile phase. Peak quantification was by fluorescence quenching (unlabeled compounds) and by Automatic TLC-Linear Analyzer for the radiolabeled compounds.

Results and Discussion

The 4-methoxy-6-methyl-1,3,5-triazin-2-amine was found to be very stable to hydrolysis at all pH's, with between 96 and 103% of the original material found unchanged at the end of the experiment. A minor (<2%) component (the 4-amino-6-methyl-1,3,5-triazin-2-ol) was detected in the high concentration test.

Conclusion

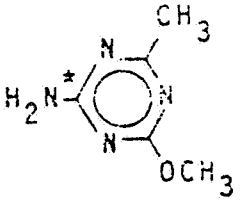
This study was scientifically valid, and is acceptable to EAB. Neither sample chromatograms nor copies of TLC plates were included with this study.

This study satisfactorally adcresses EAB concerns raised in the 5/20/83 review.

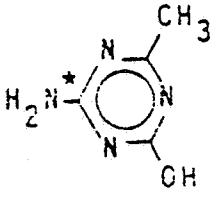
EAB therefore considers the hydrolysis data requirement satisfied.

FIGURE 1

STRUCTURE OF TEST COMPOUND AND HYDROLYSIS PRODUCT



4-methoxy-6-methyl-1,3,5-triazin-2-amine



4-amino-6-methyl-1,3,5-triazin-2-ol

* denotes the position of the ^{14}C label which is the carbon atom adjacent to the amine group.

Reviewed by: Soobook Hong, Ph.D.
Date: November 1, 1984
Shaughnessy No. 128845

3.2 Aerobic Soil Metabolism

3.2.1 Aerobic Soil Metabolism of DPX-M6316[Thiophene-2-^{14}C]. C. Rapisarda, Updated, Du Pont Document No. AMR-236-84.

Duplicate of non-sterile and sterilized soil samples (soil characteristics are described on p.14), equivalent to 50 g oven-dry weight, were weighed into the 250-ml E-meyer flask side of biometers and 10 ml of 0.1 N NaOH were added to the side arms. All soils were treated with 2.53 ug (0.058 uCi) of ^{14}C-DPX-M6316 (80 g ai/ha) and moistened to 70% of field maximum moisture capacity. After the samples were thoroughly mixed and oxygen and introduced, the flasks were closed and incubated at 25°C in the dark. Duplicate non-sterile controls without ^{14}C-DPX-M6316 were also done under the same conditions. The soil metabolism of ^{14}C-glucose at 2 ppm was checked under the same experimental conditions. All flasks were opened weekly to add oxygen to the system (see recommendation for discussion on the opening of the flask).

The caustic solutions were radioassayed by LSC. After the trapped CO_2 we precipitated with $BaCO_3$, the supernatants were also assayed for unprecipitated radioactivity.

The test soil samples were taken after 0, 0.5, 1, 2, 3, 4, 6, 8, 11, 14 and 20 weeks of aging and the sterile control samples were taken after 2, 4, 6, 8 and 20 weeks.

Each soil was extracted and analyzed according to the scheme in the following page.

To identify metabolites, non-sterile Gardena silt loam soil (60 g) was treated with ^{14}C-DPX-M6316 at 10 ug/g and incubated at 30°C for 7 days. The soil was extracted with methanol/2M $(NH_4)_2CO_3$ (3/1), and the solvent evaporated to dryness. The residue was resuspended in water, acidified with HCl to pH 3 and extracted with CH_2Cl_2. The methylene chloride extract was radioassayed and evaporated to dryness. The residue, dissolved in water, was analyzed by HPLC and then MS.

Results

The soil characteristics are shown in the following table.

Component	Keyport Silt Loam (Newark, DE)	Flanagan Silt Loam (Rochelle, IL)	Gardena Silt Loam (Rodger, ND)
Sand (2000-50 um) %	12	2	43
Silt (50-2 um) %	83	81	51
Clay (<2 um) %	5	17	6
Organic matter %	7.5	4.3	5.0
Nitrogen %	0.30	0.26	ND
pH	5.2	5.4	8.1
Cation Exchange capacity (meq/100 g)	15.5	21.2	ND

Overall distribution of radioactivity is summarized in tables 1 - 4.

In the non-sterile studies, the percent extractables decreased rapidly with subsequent increase in the percent $^{14}CO^2$ and unextractables.

In the sterilized soil studies, no CO_2 was evolved and extractables decreased slowly with a corresponding increase in unextractables.

After 20 weeks of aging, 44 % of the applied ^{14}C was recovered as CO_2 from the Keyport soil and 31 % from the Flanagan soil.

The estimated half-lives were less than 2 days in Keyport soil (24 days in sterile soil) and 6 days in Flanagan soil (32 days in sterile soil).

Five metabolites were identified and the proposed metabolic pathway of DPX-M6316[thiophene-2-^{14}C] is shown in figure 1.

4.2 Aerobic Soil Metabolism

DPX-M6316 was mineralized to CO_2 in soil. Both thiazole and triazine moieties are susceptible to mineralization.

Five intermediate metabolites were found (figure 1 in section 3.2.1) from thiazole-labeled parent compound. The half-life was estimated to be 2-6 days. After 20 weeks of incubation, 31-44 % of the applied ^{14}C was mineralized and 23-38 % was bound to soil.

5.3 In the aerobic metabolism study discussed in section 3.2.1, the report says that "all flasks were opened weekly to add oxygen to the system". We would like the following questions answered:

- How long were the flasks open to let in O_2?
- Why was there not any loss of volatile ^{14}C?

Soobok Hong, Ph.D.
November 1, 1984
Environmental Chemistry Review Section 1
Exposure Assessment Branch/HED

METSULFURON-METHYL

Page_____ is not included in this copy.

Pages 6 through 11 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.

X FIFRA registration data.

____ The document is a duplicate of page(s) _____.

____ The document is not responsive to the request.

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Reviewed By: Emil Regelman
Date: July 12, 1984
Shaughnessy No. 122010

3.2 Rapisarda, C. Undated. Microbial Degradation of ^{14}C DPX-4189 in Soil. Document No. AMR-43-81. (company confidential) E.I. DuPont de Nemours and Co. Experimental Station. Wilmington, Delaware. 15 pages, 7 tables, 8 figures. 3 references

Introduction

This study, of the rate of degradation of DPX-W4189 (chlorsulfuron, 2-chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl]amino carbonyl]benzenesulfonamide) (Shaughnessy #118601) in two soil types, was submitted in support of an EUP on barley and wheat, and was reviewed on 11/17/80.

Its inclusion in the current submission stems from the 6/8/83 meeting between the registrant and EAB concerning the fate of the triazine moiety of DPX T6376. At the meeting EAB agreed that both aerobic metabolism and field dissipation studies of chlorsulfuron would be adequate to delineate the rate of formation and decline of that moiety, which is identical to that in DPX T6376.

Discussion

This study was found acceptable in support of the proposed EUP in the 11/17/80 review.

A reevaluation of the report data (see table 7, appended) indicates the concentration of the aminotriazine moiety peaked about 1 month, then declined slowly. Estimated half-lives were 6 months (r^2=0.98) and 10.3 months (r^2=0.52) for the 0.1 and 1.0 ppm solution, respectively. The latter data are too unreliable to use in estimating the rate of dissipation.

Conclusion

This study adequately addresses one of the earlier EAB concerns (the triazine moiety).

DEGRADATION OF ^{14}C-TRIAZINE LABELED DPX-4189 IN KEYPORT SILT LOAM

TLC ANALYSES OF THE EXTRACTABLE a) ^{14}C

0.1 ppm		% of Recovered Radioactivity b) at									
		Days				Months					
		0	4	10	17	1	2	4	6	7	7
Rf	Identification	Non-Sterile									Sterile
0.80	Aminotriazine	4.9	12.0	15.2	19.9	23.2	21.8	17.6	13.7	11.6	30.6
0.55	DPX-4189	92.7	62.6	40.7	34.0	23.3	8.8	4.4	3.0	2.2	10.1
<0.3	Polar Metabolites c)	1.7	5.1	6.7	8.7	8.7	13.2	6.3	4.8	5.8	29.7
0.0	Polar Material	0.3 / 99.6	6.9 / 86.6	29.7 / 92.3	24.8 / 87.4	25.1 / 80.3	23.0 / 66.8	29.3 / 57.6	39.4 / 60.9	37.1 / 56.7	25.0 / 95.4
1 ppm											
Rf	Identification										
0.80	Aminotriazine	4.7	13.8	18.3	24.3	24.6	19.0	14.0	13.9	16.9	30.6
0.55	DPX-4189	93.3	60.9	37.4	29.8	17.4	6.1	3.1	2.2	2.2	13.0
<0.3	Polar Metabolites c)	1.7	5.7	7.3	9.4	9.6	12.7	9.7	3.8	3.8	26.6
0.0	Polar Material	0.1 / 99.8	7.5 / 87.9	28.3 / 91.3	20.4 / 83.9	29.8 / 81.4	34.1 / 71.9	41.9 / 68.7	38.1 / 58.0	26.4 / 49.3	25.5 / 95.7

a) Sum of the different extracts.

b) Average of 297% of the calculated applied ^{14}C was recovered.

c) Summation of all compounds with R_f <0.3 except polar material.

A-13

12A

Reviewed by: John Jordon, Ph.D.
Date: February 28,1986
Shaughnessy No. 122010

STUDY 3

Chrzanowski, R.L. 1984a. Degradation of ^{14}C-DPX-W4189 in anaerobic aquatic environments. Document No. AMR-38-81. E.I. du Pont de Nemours and Company, Inc., Wilmington, DE. Acc. No. 260973.

This study was submitted to provide surrogate data for the fate of the triazine moiety of metsulfuron methyl. The triazine moiety of this chemical (chlorsulfuron) is identical to that of metsulfuron methyl.

CONCLUSIONS:

Metabolism - Anaerobic Aquatic

1. This study is scientifically valid.

2. Triazine-labeled [^{14}C]chlorsulfuron (radiochemical purity >99%), at 1 ppm, degraded with a half-life of 16-52 weeks in sterile and >52 weeks in nonsterile silt loam soil incubated under nitrogen gas in the dark at 25 C. The major degradate was 2-amino-4-methoxy-6-methyl-1,3,5-triazine. Phenyl-labeled [^{14}C]chlorsulfuron (radiochemical purity >99%), at 1 ppm, degraded with a half-life of >10 weeks in flooded and nonflooded anaerobic soils. The major degradates were 2-amino-4-methoxy-6-methyl 1,3,5-triazine (21-25% of applied at week 52) in the triazine-labeled treatment and 2-chlorobenzene-sulfonamide (up to 14%) in the phenyl-labeled treatments.

3. This study does not fulfill EPA Data Requirements for Registering Pesticides because no apparent attempt was made to characterize up to 18% of the degradates, the moisture content of the nonflooded soils was not specified, and the phenyl-labeled treatments were not studied long enough to establish a half-life. This study is satisfactory to provide surrogate data for the fate of the triazine moiety of metsulfuron methyl.

MATERIALS AND METHODS:

Samples (50-g) of silt loam soil from Pennsylvania (Table 1) were moistened with 100 ml of pond water (uncharacterized) and amended with ground alfalfa; the flasks were purged with nitrogen gas and incubated in the dark at 25 C for 30 days. Following the anaerobic aging, several samples were sterilized by autoclaving and treated with 100 ml of a 0.1% sodium azide solution (to maintain sterility) to serve as sterile controls for the study. Then, half of the samples (sterile and nonsterile) were treated with phenyl-labeled [^{14}C]chlorsulfuron (radiochemical purity >99%, specific activity 6 µCi/mg) at 1 ppm. The remaining samples were treated with triazine-labeled [^{14}C]chlorsulfuron (radiochemical purity >99%, specific activity 15 µCi/mg) at 3 ppm. The flasks were purged with nitrogen gas, resealed, and returned to the dark at 25 C. The phenyl-labeled [^{14}C]chlorsulfuron treatments were sampled 0, 1, 4, and 10 weeks posttreatment. The triazine-labeled treatments were sampled 0, 2, 8, 16, and 52 weeks posttreatment.

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The pH and O_2 level in the soils were determined immediately after sampling. The samples were centrifuged to separate the soil and water phases; the soil was mixed with additional water, centrifuged, and the wash water added to the original water from the sample. Aliquots of the water were analyzed for total radioactivity by LSC and for specific compounds using TLC on silica gel plates developed in methylene chloride:methanol:concentrated ammonium hydroxide (144:50:6, v:v:v). Radioactive compounds were located by radioscanner and autoradiography, identified by comparison to standards, and quantified by LSC. The soil was extracted with 5% ammonium carbonate in methanol: water (2:1, v:v) and with methanol. The extracts were combined and analyzed by TLC as described. The extracted soil was analyzed for remaining radioactivity by LSC following combustion.

In a related study, soil samples (50 g) were treated with phenyl-labeled [^{14}C]chlorsulfuron and flooded with distilled water. The flasks were purged with nitrogen gas and incubated in the dark at 25 C. Samples were analyzed 0 and 3 days and 1, 2, 3, 4, 5, and 8 weeks posttreatment. The samples were analyzed using LSC and TLC as described.

REPORTED RESULTS:

In the anaerobically aged soil treated with phenyl-labeled [^{14}C]chlorsulfuron, >66% of the chlorsulfuron remained undegraded after 10 weeks of incubation (Table 2). At 52 weeks, 37% of the triazine labeled [^{14}C]chlorsulfuron remained in the sterilized soil and 54% in the unsterilized soil (Table 3). The major radioactive degradates were 2-chlorobenzene-sulfonamide in the phenyl-labeled treatment and 2-amino-4-methoxy-6-methyl-1,3,5-triazine in the triazine labeled treatment.

In the unaged flooded soils, phenyl-labeled [^{14}C]chlorsulfuron degraded with a half-life of >8 weeks, 2-chlorophenylsulfonylurea and 2-chlorobenzene-sulfonamide were the major degradates (Table 4).

DISCUSSION:

1. With the exception of the study using triazine labeled [^{14}C]chlorsulfuron, the experiments were of insufficient duration.

2. In the nonflooded soils, the moisture content of the soils was not specified.

3. No attempt was made to characterize the unidentified residues, although these comprised up to 18% of the applied.

Table 1. Soil characteristics.

Soil type	Source	Sand	Silt	Clay	Organic matter	pH	CEC (meq/100 g)
				%			
Silt loam	Pennsylvania	25.0	74.0	1.0	3.7	5.6	11.0
Silt loam	Canada	35.5	51.5	13.0	7.6	8.4	24.9
Loam	Nebraska	40.0	47.0	13.0	6.5	8.3	23.6
Silty clay loam	Illlinois	5.0	64.0	31.0	4.0	5.0	23.4

[a] Used in the anaerobically aged (30-day) study.

[b] Used in the unaged flooded soil study.

Table 2. Phenyl-labeled [^{14}C]chlorsulfuron and its degradates (% of applied) in sterile and nonsterile silt loam soil treated at 1 ppm with [^{14}C]chlorsulfuron (radiochemical purity >99%) and incubated under anaerobic conditions in the dark at 25 C.

Compound	Sampling interval (weeks) 0	1	4	10
	Nonsterile			
2-Chlorobenzene-sulfonamide	ND[a]	1.5	6.1	14
Chlorsulfuron	100	96	83	75
2-Chlorophenylsulfonylurea	ND	3.1	0.5	2.1
2-Chloro-5-hydroxy-benzene-sulfonamide	ND	ND	ND	ND
Unidentified	ND	1.5	2.8	11
Nonextractable	0.1	1.0	1.9	1.0
	Sterile			
2-Chlorobenzene-sulfonamide	ND	2.1	5.4	13
Chlorsulfuron	100	102	83	66
2-Chlorophenylsulfonylurea	ND	0.5	0.3	2.2
2-Chloro-5-hydroxy-benzene-sulfonamide	ND	ND	ND	ND
Unidentified	ND	1.6	5.6	9
Nonextractable	ND	1.1	1.0	1.3

[a] Not detected; detection limit was 0.1% of the applied.

Table 3. Triazine-labeled [^{14}C]chlorsulfuron and its degradates (% of applied) in sterile and nonsterile silt loam soil treated at 1 ppm with [^{14}C]chlorsulfuron (radiochemical purity >99%) and incubated under anaerobic conditions in the dark at 25 C.

Compound	Sampling interval (weeks) 0	2	8	16	52
Nonsterile					
2-Amino-4-methoxy-6-methyl-1,3,5-triazine	4.3	5.1	4.7	11	21
Chlorsulfuron	94	94	89	83	54
Unidentified	1.5	2.0	10	5.6	18.3
2-Amino-4-hydroxy-6-methyl-1,3,5-triazine	ND[a]	ND	ND	ND	ND
Nonextractable	0.3	1.0	2.3	1.5	3.7
Sterile					
2-Amino-4-methoxy-6-methyl-1,3,5-triazine	4.1	5.2	4.0	16	25
Chlorsulfuron	93	97	84	57	37
Unidentified	2.6	1.7	12	23	31
2-Amino-4-hydroxy-6-methyl-1,3,5-triazine	ND	ND	ND	ND	ND
Nonextractable	0.3	0.4	1.0	1.0	2.3

[a] Not detected; detection limit was 0.1% of the applied.

Table 4. Phenyl-labeled [^{14}C]chlorsulfuron and its degradates (% of applied) in flooded soil treated at 1 ppm and incubated under anaerobic conditions in the dark at 25 C.

Sampling interval (weeks)	2-Chlorobenzene sulfonamide	Chlor-sulfuron	2-Chlorophenyl-sulfonurea	2-Chloro-5-hydroxy-benzene-sulfonamide	Un-identified	Unex-tractabl
			Silt loam			
0	ND[a]	90	ND	ND	ND	10
1	ND	92	ND	ND	ND	5
2	4.1	84	4.1	ND	ND	10
4	1.0	88	8.2	ND	ND	5.1
8	11	50	14	ND	18	14
			Loam			
0	ND	92	ND	ND	ND	8
0.5	ND	94	ND	ND	ND	12
3	17	49	7	ND	ND	14
5	3.2	82	12	ND	ND	9.6
			Silty clay loam			
0	ND	98	ND	ND	ND	2
1	ND	89	ND	ND	1.4	8.5
2	13	67	11	ND	ND	9.0
4	13	66	9.1	ND	ND	13

[a] Not detected; the detection limit was 0.1% of the applied.

Reviewed by: John Jordon, Ph.D.
Date: February 28,1986
Shaughnessy No. 122010

STUDY 4

Han, J.C-Y. 1984a. ^{14}C-DPX-W4189 soil disappearance studies in the field. Document No. AMR-54-81. E.I. du Pont de Nemours and Company, Wilmington, DE. Acc. No. 260974.

This study was submitted to provide surrogate data for the fate of the triazine moiety of metsulfuron methyl. The triazine moiety of this chemical (chlorsulfuron) is identical to that of metsulfuron methyl.

CONCLUSIONS:

Field Dissipation - Terrestrial

1. This study is scientifically valid.

2. Triazine-labeled [^{14}C]chlorsulfuron (radiochemical purity >99%) degraded with a half-life of 2-4 weeks in silt loam soil treated at 100 g ai/A. The degradate, 2-amino-4-methoxy-6-methyl-1,3,5-triazine, reached maximum levels of ~40-48% of the applied 2-4 weeks after treatment.

3. This study partially fulfills EPA Data Requirements for Registering Pesticides by providing information on the fate of the triazine moiety in field studies.

MATERIALS AND METHODS:

Stainless steel cylinders (11.5 cm diameter x 38 cm height) were driven into field plots of silt loam soil (16.2% sand, 72.8% silt, 11.0% clay, 1.4% organic matter, pH 6.0, CEC 7.73 meq/100 g) located at Newark, Delaware. To minimize runoff and splashing, ~2.5 cm of rim was left above the soil surface. The soil surface was then treated with triazine-labeled [^{14}C]chlorsulfuron (specific activity 12.0 µCi/mg, radiochemical purity >99%, New England Nuclear) at 100 g ai/ha. at 0, 2, 4, 8, 16, 26, 52, and 77 weeks after treatment, soil cylinders were sampled and divided into 0-5, 5-10, 10-20, and 20-38 cm segments.

Soil samples (50 g) were refluxed with 150 ml of 5% ammonium carbonate in methanol:water (2:1, v:v), cooled, and centrifuged. The supernatant was decanted, and the soil was washed with methanol. The supernatant and methanol solutions were combined, concentrated, and partitioned between distilled water and ethyl acetate. After phase separation, the two solutions were concentrated and analyzed by TLC. The extracted soil residues were analyzed by combustion.

REPORTED RESULTS:

Rainfall during the test period totalled 1102 mm. Total radioactivity dissipated from the soil cylinders with a half-life >77 weeks (Table 1). Leaching into lower soil depths was evident; <20% of the applied radioactivity remained in the 0-5 cm soil depth by the end of the test period. Parent chlorsulfuron was present at ~76% of the applied at time 0, and reached a half-life within 4 weeks (Table 2). The degradate, 2-amino-4-methoxy-6-methyl-1,3,5-triazine, reached maximum levels of ~40-48% of the applied at 2-4 weeks after treatment.

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DISCUSSION:

The steel cylinder procedures for evaluating terrestrial field dissipation have been approved for this study.

Table 1. Total radioactivity (% of applied) in silt loam soil cylinders treated with [^{14}C]chlorsulfuron at 100 g ai/ha.

Sampling depth (cm)	Sampling interval (weeks)							
	0	2	4	8	16	26	52	77
0-5	105.1	66.0	54.0	59.3	23.8	22.0	31.3	18.8
5-10	<0.1	23.0	29.4	16.7	19.0	16.5	13.2	14.5
10-20	<0.1	4.1	19.5	13.8	13.9	17.7	10.5	21.2
20-38	<0.1	<0.1	3.4	10.4	10.5	7.0	4.3	5.2
Total	105.1	93.1	104.3	100.2	67.2	63.2	59.3	59.7

Table 2. Distribution of radioactivity (% of applied) in silt loam soil cylinders treated with [^{14}C]chlorsulfuron at 100 g ai/ha.

Sampling interval (weeks)	Sampling depth (cm)	Unextractable	Chlorsulfuron	2-Amino-4-methoxy-6-methyl-1,3,5-triazine
0	0-5	17.2	76.4	6.2
2	0-5	10.7	40.3	10.5
2	5-10	2.9	13.3	5.3
2	10-20	0.5	2.2	1.0
4	0-5	4.2	15.3	24.9
4	5-10	1.2	8.9	14.3
4	10-20	0.9	6.0	7.7
4	20-38	0.3	1.2	1.1
8	0-5	7.4	9.5	23.5
8	5-10	1.3	3.2	6.8
8	10-20	1.0	1.7	5.0
8	20-38	0.6	2.4	4.5
16	0-5	4.7	2.5	4.5
16	5-10	4.1	1.7	4.3
16	10-20	3.3	1.4	1.2
16	20-38	2.4	3.5	2.3
26	0-5	4.6	1.8	2.7
26	5-10	3.7	1.3	2.9
26	10-20	3.4	1.2	1.9
26	20-38	1.8	0.5	1.0
52	0-5	9.3	1.1	6.0
52	5-10	3.2	0.7	3.4
52	10-20	3.0	0.5	1.9
52	20-38	1.3	0.3	0.9
77	0-5	9.1	0.5	4.1
77	5-10	6.3	0.3	3.4
77	10-20	10.7	0.4	4.3
77	20-38	2.5	0.1	1.4

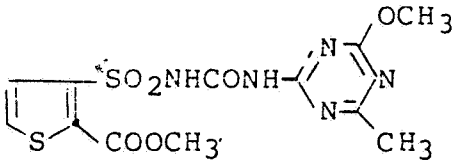
Reviewed by: Soobok Hong, Ph.D.
Date: November 30,1984
Shaughnessy No. 128845

1.0 INTRODUCTION

Du Pont has submitted environmental fate data on its herbicide, DPX-M6316, to support registration for an EUP. EAB review of November 1, 1984 revealed a data gap (rotational crop studies) for the proposed use.

1.1 Chemical

DPX-M6316: Methyl 3-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]-2-thiophenecarboxylate



• [^{14}C-thiophene]-DPX-M6316

2.0 DIRECTIONS FOR USE

Refer to the EAB review of November 1, 1984.

3.0 DISCUSION OF DATA

3.1 Crop Rotation Studies with DPX-M6316[Thiophene-^{14}C] in the Greenhouse. P. T. Hardesty, Du Pont Doc. No. AMR-256-84, EPA Acc. No. 254641.

Experimental

Nine clay pots (16 inches i.d., surface area 1.22 ft^2, volume 0.75 ft^3) were filled with Sassafras loamy sand (USDA sand 79 %, silt 15 %, clay 6 %, CEC 3.4 %, O.M. 0.6 %, pH 6.6). The surface of the soil of four pots was treated with a solution of DPX-M6316[thiophene-^{14}C] (23.3 uCi/mg, >98 % pure) at 1.0 mg (23.3 uGi) per pot (equivalent to 86 g/ha) for 30-day aging studies. Another four pots were treated at 1.1 mg (25.7 uCi) per pot (equivalent to 94 g/ha) for 120-day aging studies. The ninth pot served as a control.

At the end of the aging period, one pot from each of the four groups (30-day and 120-day) was lightly cultivated and planted with peas, one with beets, one with sunflowers, and one with about one-third of each crop. The ninth pot, not treated with ^{14}C-DPX-M6316, was also planted with one-third of each crop.

During both aging and growing periods, pots were maintained under lights in a greenhouse with a 16-hour photo period at 65-75°C and 30 % relative humidity.

Soil samples were taken and pooled from each of the four pots

from each aging period at planting time.

Plant samples were taken at 16, 29, and 43 days after planting and mature crops were harvested at 65 days (pea), 86 days (beet) and 100 days (sunflower) for the 30-day aging period. For the 120-day aging period, samples from all crops were taken at 13 and 27 days after planting, and mature crops were harvested at 49 days (pea) and 101 days (beet and sunflower).

Plant samples were freeze-dried, homogenized and aliquots analyzed by combustion/LSC. Soils were air-dried, homogenized and radioassayed.

To charaterize the residues in soil, soil samples were extracted with acetone/0.1 M $(NH_4)_2CO_3$ (90/10, v/v) (3x). The extracted soil was ultrasonifically reextracted with 0.1 M $(NH_4)_2CO_3$ (2x). This was followed by acetone rinse (2x). Aliquots of the acetone/ammonium carbonate, ammonium carbonate, and acetone rinse were separately radioassayed. After all the extracts and rinses were combined and concentrated to dryness, the residues were redissolved in acetone/water. Undissolved solids were removed by centrifugation. Aliquots of the supernatant were subjected to TLC/autoradiography/LSC (silica plate Taperplate®, $CH_2Cl_2/CH_3OH/NH_4OH$ 200/50/3).

Plant samples that contained more than 10 ppb (as DPX-M6316) total ^{14}C-residue were extracted with acetone/water (8/2) once in a Tekma Tissuemizer® and twice in a wrist-action shaker. Aliquots of the combined extracts were concentrated to about one-tenth of the original volume, adjusted pH to about 8.5 with 0.1 M $(NH_4)_2CO_3$, and extracted with n-hexane. The aqueous phase was analyzed by HPLC on a Zorbax®-C8 column using CH_3CN/water (pH 2.2) as the mobile phase.

Results

No crop injury was noted in all pots.

Results from the soil analyses are shown in table 1.

Table 1

LEVELS OF TOTAL ^{14}C AND ^{14}-DPX-M6316 IN SOIL IN PLANTING OF THE ROTATIONAL CROP

Aging Period (day)	Appl. rate (g/ha)	^{14}C-Conc. as DPX-M6316 (ppb) Total	Ext.	Unext.	DPX-M6316
30	94	17.9	14.8	3.1	1.5
120	86	9.2	6.1	2.1	0.2

Total soil residue levels at planting were 17.9 and 9.2 ppb for the 30- and 120-day aging periods, respectively, but intact DPX-M6316 accounted for only 1.5 and 0.2 ppb at these respective periods. Individual degradation products could not be identified because of low levels of activity in the extracts. [From the aerobic soil metabolism study (EAB review 11/1/84), five degradation products were identified (see attachment).]

Results from the total ^{14}C analysis of plant tissues are shown in table 2. Edible beet root, pea and sunflower seed contained <1 to 2 ppb in the 120-day study and 1-5 ppb in the 30-day study. Residues accumulated in beet and sunflower foliages in the 30-day study (22 and 54 ppb, respectively). However, results from the residue characterization showed that intact ^{14}C-DPX-M6316 accounted for only 2 ppb in the 43-day old sunflower-foliage and less than 1 ppb in the mature beet- and sunflower-foliages (table 3).

Comments

- Recoveries/material balances were not reported.
- Soil analysis right after application was not done, and the method how the soil was sampled was not described.

Conclusion

DPX-M6316[thiophene-^{14}C] residues appear not to accumulate in edible parts of the rotational crops (pea, beet, sunflower seed) planted 30 and 120 days after treatment at 86 g/ha (1.7x maximum label rate). Residues accumulated most in foliages, especially in the 30-day studies, but intact DPX-M6316 accounted for less than 4 % of the total ^{14}C accumulated in the foliages.

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Reviewed by: Soobok Hong, Ph.D.
Date: November 1,1984
Shaughnessy No. 128845

3.3 Residue Accumulation in Rotational Crops

3.3.1 Crop Rotation Study with ^{14}C-DPX-W4189. J. C-Y. Han, Undated, Du Pont Document No. AMR-46-81.

This study has EPA Accession No.070470 from the previous submission, but EAB file revealed no record of the review of the study.

Experimental

Spring wheat was planted (2nd week of April, 1979) on two Keyport silt loam plots (12 ft^2 each, soil characteristics, table 1). When the seedlings were about 8-10" high with fourth leaf fully expanded, one plot was uniformly treated with [^{14}C-phenyl]DPX-W4189 at 70 g/ha and the other was treated with [^{14}C-triazine]DPX-W4189 (figure 1). Mature wheat was harvested in July 1979.

Next spring, sugar beets, rape and soybeans were planted on both ^{14}C-treated plots (5/30/80).

Sugar beets died within a month after germination. Rape and soybeans were also slightly injured, but both of these crops recovered after 3 weeks.

Mature soybeans (beans and foliage) and rape foliage were harvested in November 1980. After winter dormancy, rape resumed growth in 1981 and seeds and foliage at maturity (6/30/81) were collected for analysis.

Soil core samples (3/4 x 12") were taken at planting and every harvest.

The total ^{14}C was measured by combustion analysis after soil and seeds were air-dried and homogenized and after foliage was chopped into small pieces.

Plant tissue samples were extracted in a blender with acetone/water (8/2), centrifuged, and the supernatant was reduced to a small volume. The concentrated extract was adjusted to pH 3 with 1 N H_2SO_4 and extracted with ether (2x). The ether extract was evaporated to dryness under nitrogen. The remaining aqueous layer was reextracted with n-butanol (2x) and the n-butanol evaporated. Then ether and n-butanol fractions were analysed by TLC in toluene/acetone (1/1) and CH_3CN/EtOAc/HCOOH (150/50/1.5) with standard compounds.

An aliquot of soil samples was refluxed with 5 % $(NH_4)_2CO_3$ in methanol/water (2:1) and then cooled and centrifuged. The supernatant and methanol wash of the soil residue were combined and boiled gently on a hot plate to evaporate and decompose ammonium carbonate. The concetrate was partitioned with a mixture of water and ethyl acetate. After radioassay, both phases were concentrated and analyzed by TLC in toluene/acetone (1:1).

Results

In all soil analyses parent compound was found to be 1 ppb or less (table 2). ^{14}C-2-Chlorobenzenesulfonamide and ^{14}C-2-amino-4-methoxy-6-methyl-1,3,5-triazine were found to be 3 ppb and 4 ppb, respectively after 1 year of aging but these were found to be 1 ppb after 1.5 years and less than 1 ppb after 2 years.

^{14}C-Residues in plant tissues of rotational crops are shown in table 3. Dry soybean foliage had a total ^{14}C-residue of between 7 and 9 ppb, calculated as intact DPX-W4189. Beans had a total residue of 2-3 ppb. After the first growing season, 3-4 ppb was found in dry rape foliage and ^{14}C-residue decreased to 2 ppb at maturity in the second growing season. Rape seeds had 1 ppb from both labeled treatments. Extraction analyses showed that less than 1 ppb was found in all fractions from all tissue samples except in water phase from the soybean foliage where 3 ppb was found from both treatments.

Comments

A number of deficiencies found in this study include:

- Rotational crops should include those expected to be representative of roots, small grains and leafy vegetables. No studies with small grain, leafy vegetable or root were done.
- Residue analysis in the soil at the time of treatment was not done.

- The treatment rate used in this study, 70 g/ha, is only one-half of the maximum treatment rate (2 oz/a, 140 g/ha) in the label: Even after one-year of aging with one-half of the maximum application rate, DPX-4189 residues (27 ppb among which only 1 ppb was parent compound) showed fatal toxicity to sugar beet seedlings. Also, it produced slight injury in soybeans and rape. If the maximum rate had been used, all of the crops might have died. Also, the soil concentration and the tissue concentration would have been higher.

- No rainfall data, temperature monitoring data and general climatic conditions were reported for the test period.

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Reviewed by: Soobok Hong, Ph.D.
Date: November 1,1984
Shaughnessy No. 128845

3.4 Fish Accumulation

3.4.1 DPX-M6316[Thiophene-2-^{14}C] Flow-Through Bioconcentraion Study with Bluegill Sunfish. J. C. Larkin, Biospherics Incorporated for Du Pont, July 1984, Du Pont Documnet No. AMR-182-84.

Experimental

Bluegill sunfish (average weight 1.67 g, 0.6-3.76 g) were introduced into three glass aquaria (90 x 30 x 40 cm, 108 liter capacity) holding 72.9 liters of water. Two of the aquaria were fortified with DPX-M6316[thiophene-2-^{14}C] at a nominal concentration of 5 ppm by delivering a diluted radioactive stock solution into the system using monostat injector system. The diluted radioactive solution was made by mixing 8 ml of radioactive stock solution (5 mg/ml, 23.1 uCi/mg) with 992 ml of non-labeled DPX-M6316 solution (5 g/L). For each cycle of the diluter system, 4 ml of the diluted radioactive solution was ultimately diluted to 4 liters. A third aquarium served as a control. Water was delivered to both control and test chambers by a diluter system as diagrammed schematically in figure 1. A summary of test parameters is presented in table 1.

A total of 80 fish were added to each tank with removal of 4 fish (2 for dissection and 2 for whole fish analysis) and 5 ml water on days 0, 1, 3, 10, 14, 21 and 28. Control fish were sampled on days 0, 1, 14 and 28. During depuration, fish were sampled on days 1, 3, 7, 10 and 14. Control fish were sampled on day 14.

Water samples (5 ml) were analyzed by LSC. Tissue samples were analyzed by combustion analysis.

The estimated sensitivity of detection with a 1.17 g tissue sample was about 3.7 ppm and the minimum detectable concentration for 5.0 ml water sample was about 0.9 ppm.

Results

No mortality was observed during the entire study period from both test and control chambers.

Results from the analysis of water samples are shown in table 2. The average water concentration of DPX-M6316 [thiophene-2-^{14}C] was 4.4 ppm during the exposure phase and < 0.9 ppm during the depuration phase.

Results from the analysis of fish samples are shown in tables 3 and 4. Throughout the study, no bioaccumulation of ^{14}C residues from DPX-M6316[thiophene-2-^{14}C] occurred in bulegill sunfish.

Conclusion

DPX-M6316 appears not to bioaccumlate in bluegill sunfish under flow-through conditions.

This study was well done and satisfies the fish accumulation data requirement.

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