

CHLORSULFURON

**Task 1: Review and Evaluation
of Individual Studies**

June 24, 1988

Final Report

Contract No. 68-02-4250

Submitted to:
Environmental Protection Agency
Arlington, VA 22202

Submitted by:
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CHLORSULFURON

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INTRODUCTION

Chlorsulfuron is a systemic broad range selective herbicide applied preemergence, early post-emergence, preplanting, or early post-planting incorporated to control broadleaf weeds in cereals. It is absorbed by foliage and roots of both resistant and susceptible species; chlorsulfuron acts by inhibiting cell division in the growing tips of roots and shoots of susceptible species. Rainfall, soil temperature, and soil pH have been identified as important factors affecting the breakdown of chlorsulfuron in soil.

Currently there is a 14-month rotation interval for grain sorghum in fields treated with Glean (chlorsulfuron) herbicide. The registrant has submitted new accumulation in confined rotational crop studies in an attempt to reduce this 14-month interval to 4 months in nonirrigated areas with a soil pH of ≤ 6.8 , cumulative precipitation (from the date of treatment to the date of planting) of ≥ 12 inches, and an application rate of 0.16 to 0.25 oz/A. The 14-month restriction for grain sorghum would remain in nonirrigated areas with a soil pH of 6.9-7.9, cumulative precipitation of ≥ 25 inches, and an application rate of 0.17 to 0.50 oz/A. Label instructions prohibit application of Glean to areas with a soil pH ≥ 7.9 .

DATA EVALUATION RECORD

CHLORSULFURON

STUDY 1

CHEM

Chlorsulfuron

BRANCH EAB

FORMULATION--00--ACTIVE INGREDIENT

FICHE/MASTER ID 00086819

Rapisarda, C. 1981. Rotational crop studies with ¹⁴C-phenyl labeled DPX-W4189 in the greenhouse. Document No. AMR-49-81. Unpublished study prepared and submitted by E.I. du Pont de Nemours and Company, Inc., Wilmington, DE.

SUBST. CLASS = S

DIRECT RVW TIME = 5

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Laurie C. Lewis

JUN 30 1981

SIGNATURE:

CONCLUSIONS:

Confined Accumulation - Rotational Crops

This study is scientifically sound and provides supplemental information towards the registration of chlorsulfuron. This study does not fulfill EPA Data Requirements for Registering Pesticides because the soil was not sampled immediately after treatment (so that the application rate was not confirmed), complete identification of residues in crops was not provided, and no storage stability data were reported.

SUMMARY OF DATA BY REVIEWER:

[¹⁴C]Chlorsulfuron residues were <16 ppb in beets, <18 ppb in rape, and <41 ppb in wheat planted 4 and 12 months after phenyl-labeled [¹⁴C]chlor-

sulfuron (radiochemical purity >99%) was applied at 1 oz ai/A to silt loam soil. In crops planted at 4 months posttreatment, [¹⁴C]residues at maturity were 16 and 8 ppb in beet tops and roots; 8 ppb in rape; and 4 and 41 ppb in wheat grain and straw. In comparison, in crops planted at 12 months posttreatment, [¹⁴C]residues were less concentrated in mature beets (2 and 4 ppb in beet tops and roots) and similar in rape (8 ppb) and wheat (3 and 38 ppb in wheat grain and straw). Only wheat straw (4 and 12 months) and beet tops and roots (4 months) were analyzed for degradates; parent chlorsulfuron was not detected (<0.2 ppb) in any tissues. In the wheat straw, the degradate sulfonamide was 0.9-5.5 ppb, unknowns (including polar degradates) were 15.3-23.0 ppb, and unextractable [¹⁴C]residues were 14-20 ppb. In beet tops and roots, the degradate sulfonamide was 0.1-0.4 ppb, unknowns (including polar degradates) were 1.5-1.9 ppb, and unextractable [¹⁴C]residues were 3 ppb.

In the 0- to 3-inch depth of silt loam soil, [¹⁴C]residues were 27 ppb at 4 months posttreatment and 12 ppb at 12 months posttreatment. At 4 and 12 months posttreatment, parent chlorsulfuron was 0.1-0.2 ppb, sulfonamide was 3.4-4 ppb, unknowns (including polar degradates) were 2.9-6.0 ppb, and unextractable [¹⁴C]residues were 2.0-2.5 ppb. At "crop harvest" (specific interval unspecified, up to 760 days posttreatment), [¹⁴C]residues were 7-11 ppb in each soil segment (0- to 3-, 3- to 6-, 6- to 9-, and 9- to 12-inch depths); chlorsulfuron was 0.1 ppb, sulfonamide was 1.8-4.0 ppb, unknowns were 4.5-5.1 ppb, and unextractable [¹⁴C]residues were 0.8-4.0 ppb.

DISCUSSION:

1. Residues in the soil were not analyzed at the time of treatment to confirm the application rate.
2. Storage conditions between sampling and analysis were not reported. No storage stability data were provided to confirm that the [¹⁴C]residues did not degrade between sampling and analysis.
3. The soil data are presented in the original document in a manner that implies the soil was only sampled once following each planting interval. It was reported in the Experimental section that soil was sampled when crops were harvested. However, each crop was harvested at a different interval; therefore, it is unclear which interval the soil data represents.
4. The crops were allowed up to 384 days to reach maturity, which is excessive compared to normal practices. The registrant stated that growth of the beets and rape was retarded and these crops suffered some injury when planted in soil at 4 months posttreatment. No explanation was provided for crops planted at 12 months posttreatment.
5. Although it was not clearly stated, it appears that organic extracts from the soil samples were combined prior to TLC analysis.
6. A leafy vegetable crop (such as lettuce, mustard, or spinach) was not

planted as a rotational crop.

7. Air and soil temperatures for the outside soil aging period and indoor (greenhouse) crop growth period were not provided. It was reported that greenhouse temperatures were high enough to inhibit seed production in the rape plants.
8. Recoveries from soil and plant samples fortified with chlorsulfuron were not provided.
9. Only 1-26% of the [^{14}C]residues extracted from the crops were identified. Although it is recognized that residues resulting from applications at low rates may be difficult to identify, present EAB policy requires identification of all residues individually comprising >10% of the applied radioactivity.

MATERIALS AND METHODS

MATERIALS AND METHODS:

A field plot (6 ft²) of silt loam soil (21% sand, 62% silt, 17% clay, 2.75% organic matter, pH 6.4, CEC 8.2 meq/100 g) was rototilled, then sprayed with phenyl-labeled [¹⁴C]chlorsulfuron (DPX-W4189, radiochemical purity >99%, specific activity 6.05 Ci/mg, Du Pont) in ethanol:water (1:1) at 1 oz ai/A (70 g ai/A). At 4 and 12 months posttreatment, the treated soil was removed from the field plot, placed in metal tubs (1 ft-³), and planted to wheat, rape, and sugar beets. The planted soil was maintained in a greenhouse (temperature unspecified) during the crop growth period. As controls, untreated soil was placed in pots (size unspecified) and similarly planted to wheat, rape, and beets. Wheat, rape, and beets were harvested when immature and at "maturity" (up to 363, 384, and 367 days postplanting, respectively). Soil samples (0- to 3-, 3- to 6-, 6- to 9-, and 9- to 12-inch depths) were taken at 4 and 12 months posttreatment and when crops were harvested. Storage conditions between sampling and analysis were not reported.

Soil samples were extracted sequentially five times with methylene chloride:methanol:9 N ammonium hydroxide (75:25:0.5), three times with 0.1 N sodium hydroxide, and finally with 1 N sodium hydroxide for 1 hour by refluxing. The sodium hydroxide extracts were neutralized with 1 N hydrochloric acid, then partitioned with ethyl acetate. The ethyl acetate extracts and the initial methylene chloride:methanol:ammonium hydroxide extract were combined, concentrated, and analyzed by TLC on silica gel plates developed in methylene chloride:methanol:9 N ammonium hydroxide (75:25:3). Areas of radioactivity were visualized by autoradiography and quantified by LSC. [¹⁴C]Compounds were identified by comparison to [¹⁴C]chlorsulfuron reference standards and to R_f values of the nonradiolabeled chlorsulfuron and 2-chlorobenzenesulfonamide. Radioactivity in the soil prior to and after extraction was quantified by LSC following combustion.

Wheat straw and grain were air-dried for 1 week prior to analysis. Beets (tops and roots) and rape plants were chopped and freeze-dried. The air-dried and freeze-dried plant samples were homogenized and subsamples were analyzed for total radioactivity by LSC following combustion. Wheat straw and beet tops and roots were extracted five times with methanol. Methanol extracts were combined, concentrated, and partitioned five times with hexane. The hexane extracts were discarded, and the methanol phase was partitioned five times with ethyl acetate. The ethyl acetate phases were combined, then ethyl acetate and methanol phases were separately concentrated and analyzed by TLC as described above. Unextractable [¹⁴C]residues remaining in the plant tissues were quantified by LSC following combustion.

Chlorsulfuron exposure assessment review

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 - ☐ Identity of product impurities
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 - ☐ Description of product 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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STUDY AUTHOR(S)'S RESULTS AND/OR CONCLUSIONS

Chlorsulfuron exposure assessment review

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PERTINENT DATA TABLES AND FIGURES

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DATA EVALUATION RECORD

CHLORSULFURON

STUDY 2

CHEM

Chlorsulfuron

BRANCH EAB

FORMULATION--00--ACTIVE INGREDIENT

FICHE/MASTER ID 40357804

Rhodes, B. 1987. Greenhouse crop rotation study with [triazine-2-¹⁴C]-DPX-T6376. Laboratory Project ID AMR-798-87. Unpublished study prepared and submitted by E.I. du Pont de Nemours and Company, Inc., Wilmington, DE.

SUBST. CLASS = S

DIRECT RVW TIME = 4

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JUN 30 1988

SIGNATURE:

INTRODUCTION:

This study, which investigates the accumulation of [triazine-2-¹⁴C]DPX-T6376 (metsulfuron methyl) and its degradates in rotational crops, was provided by the registrant as surrogate data for chlorsulfuron (DPX-W4189); the triazine moiety for both compounds is the same.

CONCLUSIONS:

Confined Accumulation - Rotational Crops

This study is scientifically sound and provides supplemental information towards the registration of chlorsulfuron. This study does not fulfill EPA Data Requirements for Registering Pesticides because complete identification of residues in crops was not provided, and no freezer

storage stability data were provided. Accumulation in leafy vegetables was not addressed; no rotation interval shorter than 120 days was studied.

SUMMARY OF DATA BY REVIEWER:

[¹⁴C]DPX-T6376 (metsulfuron methyl) residues accumulated in mature oats, rape, soybeans, and beets planted in loamy sand soil 120 days after [triazine-2-¹⁴C]DPX-T6376 (radiochemical purity >99%) was applied to the soil at 15 g ai/ha. [¹⁴C]Residues at harvest were 18 and 5 ppb in oat straw and grain; 17 and 5 ppb in rape straw and seeds; 37 and 6 ppb in soybean foliage and seeds; and 5 and 1 ppb in beet foliage and roots. Oat straw, rape straw, and soybean foliage were analyzed for degradates; DPX-T6376 was present only in the soybean foliage (2 ppb).

[¹⁴C]Degradates in both the oat straw and soybean foliage included DPX-T6376 acid (1-4 ppb), triazine amine (2-10 ppb), dihydroxy triazine (up to 4 ppb), and hydroxymethyl triazine amine (up to 13 ppb). The same degradates were detected (>0.1 ppb) but not quantified in rape straw. Unextractable [¹⁴C]residues were 3-10 ppb in the oat and rape straw and soybean foliage.

[¹⁴C]Residues in the loamy sand soil (0- to 14-inch depth) declined from 5.4 to 1.4 ppb during the study. At crop harvest (226-318 days post-treatment), [¹⁴C]residues were detected at 1.4-2.5 ppb in the soil; parent DPX-T6376 was detected at 0.1-0.3 ppb. Degradates detected in the soil included triazine amine (0.3-1.0 ppb), dihydroxy triazine (up to 0.2 ppb), and hydroxymethyl triazine amine (up to 0.1 ppb).

DISCUSSION:

1. No freezer storage stability data were provided to confirm that the [¹⁴C]residues did not degrade between sampling and analysis.
2. A leafy vegetable crop (such as lettuce, mustard, or spinach) was not planted as a rotational crop.
3. No immature plant samples were analyzed.
4. Residues in the rape foliage were not characterized due to a laboratory error; the registrant reported that the rape foliage extract was inadvertently mixed with the oat straw extract before chromatographic analysis.
5. No attempt was made to characterize residues in the oat grain, rape seed, soybean seeds, and beet foliage and roots because total [¹⁴C]residues were <10 ppb. Failure to characterize residues occurring at <10 ppb following an application rate of 15 g ai/ha (0.013 lb ai/A; approximate soil concentration of 6.5 ppb) is unacceptable.
6. Recovery efficiencies from fortified plant samples were not provided. It was reported that "based on recovery of radioactivity from the treatment day soil, the extraction method had an efficiency of approximately 98%".

MATERIALS AND METHODS

MATERIALS AND METHODS:

Moist, loamy sand soil (76% sand, 19% silt, 5% clay, 0.9% organic matter, pH 6.5, CEC 2.88 meq/100 g) contained in four pots (17-inch diameter) was surface-treated with an aqueous solution of [triazine-2-¹⁴C]DPX-T6376 (radiochemical purity >99%, specific activity 35.4 μ Ci/mg, Du Pont) at 0.2 mg ai/pot (15 g ai/ha). The soil was incubated in a greenhouse (ambient temperature 25-35°C) and kept moist. The pots were planted to beets, soybeans, rape, and oats (one crop per pot) at 120 days posttreatment. During the crop growth period, a 14-hour photoperiod was maintained with grow lights. Crops were harvested at maturity; 106 days postplanting for oats, 118 days for rape, 148 days for soybeans, and 198 days for beets. Soil samples (0- to 14-inch depth) were taken at 0 and 120 days posttreatment and when each crop was harvested. Soil samples were air-dried overnight then frozen (-25°C) until analysis. Plant samples were divided into appropriate fractions (grain, straw, foliage, root) and frozen until analysis.

Total radioactivity in the soil samples was determined by LSC following combustion. Soil samples were extracted four times with methylene chloride:methanol:0.1 M aqueous ammonium carbonate (3:4:1). The extracts were combined and concentrated. The extracted soil was then refluxed for 1 hour with acetone:0.1 M ammonium carbonate (ratio unspecified), and the reflux extract was combined with the previous concentrated extract. The combined extract was concentrated, diluted with water, adjusted to pH 4 with glacial acid, and partitioned three times with methylene chloride. The organic phases were combined then organic and aqueous phases were separately concentrated and analyzed by radio-HPLC; the detection limit was 0.1 ppb. Unextractable [¹⁴C]residues in the soil were quantified by LSC following combustion.

Plant samples were freeze-dried, homogenized, and analyzed for total radioactivity by LSC following combustion. Plant samples containing >10 ppb total [¹⁴C]residues were extracted four times with methylene chloride:methanol:water (75:25:5). Unextractable [¹⁴C]residues remaining in the plant tissues were quantified by LSC following combustion. The extracts were combined and evaporated to dryness. The residues were dissolved in water, adjusted to pH 10 with 28% ammonium hydroxide, and partitioned three times with n-hexane. The aqueous phase was adjusted to pH 7 with phosphoric acid, concentrated, and analyzed by radio-HPLC; the detection limit was 0.1 ppb.

Chlorsulfuron exposure assessment review

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

Chlorsulfuron exposure assessment review

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PERTINENT DATA TABLES AND FIGURES

Chlorsulfuron exposure assessment review

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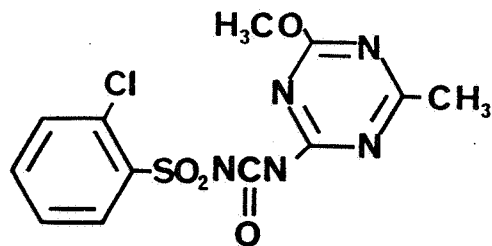
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APPENDIX

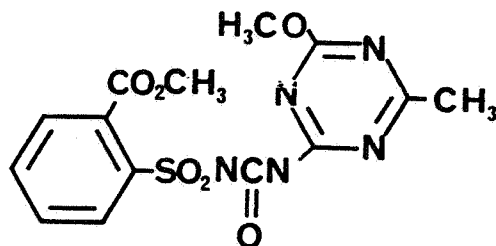
STRUCTURES OF CHLORSULFURON, DPX-T6376, AND THEIR DEGRADATES



Chlorsulfuron

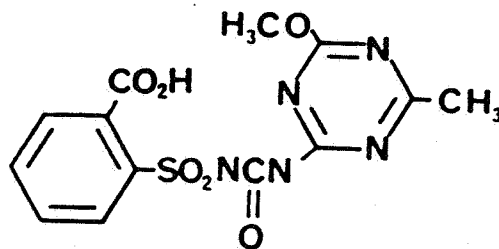
DPX-W4189

2-Chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)-aminocarbonyl]benzenesulfonamide



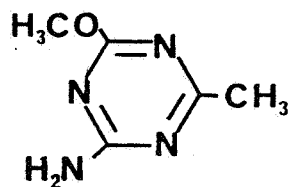
DPX-T6376

Methyl 2-([[(4-methoxy-6-methyltriazin-2-yl)amino]-carbonyl)amino]sulfonyl)benzoate



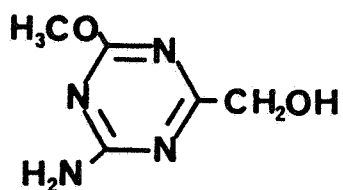
DPX-T6376 Acid

2-([[(4-Methoxy-6-methyltriazin-2-yl)amino]-carbonyl)amino]sulfonyl)benzoate



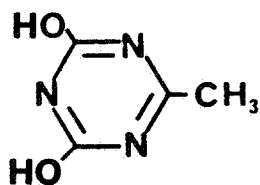
Triazine amine

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



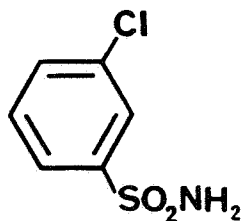
Hydroxymethyl triazine amine

4-Methoxy-6-hydroxymethyl-1,3,5-triazin-2-amine



Dihydroxy triazine

2,4-Dihydroxy-6-methyl-1,3,5-triazine



2-Chlorobenzenesulfonamide