

US EPA ARCHIVE DOCUMENT

states in which metsulfuron methyl (ALLY) is used to control weeds in wheat and barley. In such a case, the registrant should have provided a comparison of the Canadian sites with typical use areas within the United States (soils, climate, agricultural practices, etc.).

b. Scientific

Terrestrial Field Dissipation- This study, conducted with the phenyl-labelled material at a rate of 100 g ai/ha, showed dissipation rates (as first half-lives) of:

<u>Application</u>	<u>Fall Application</u>	<u>Spring</u>
Akron, CO (Site I) Silt loam; pH 6.9; 1% CM	2 months 96.5 ¹	1.0 month 75.1 ¹
Akron, CO (Site II) Silt loam pH 8.2; 1.2% CM	3 months 96.5 ¹	1.5 months 75.1 ¹
Fargo, ND Silty clay loam; pH 7.6; 5.3% OM	10.5 months 103.0 ¹	1.5 months 73.5 ¹
Kimberly, ID Silt loam; pH	7 months 72.4 ¹	7 months 53.3 ¹
Stettler, Alberta Sandy loam; pH 6.9; 4.4% OM	-	2.5 months 58.3 ¹
Swift Current, Saskatchewan Silt loam; pH 6.1; 1% OM	-	1 months 43.7 ¹
Saskatoon, Saskatchewan Silty clay loam; pH 6.2; 1% OM	-	1 month 53.6 ¹
Fisher Branch, Manitoba Silty clay loam; pH 7.8; 6.4% OM	-	1.5 month 92.2 ¹

¹ Total cumulative precipitation (cm)

In general, dissipation was faster in more acidic soils and when the product was applied in the spring. In most cases movement of radioactivity to lower depths was observed as a function of time. No attempts were made to characterize residues moving through the soil profile. Since the depth of the steel pipes was only 35 cm, the study did not provide information of residue movement beyond 35-cm. However, it is feasible that residues could move beyond 35-cm depth. The study did not present data on site temperatures (including soil temperature). The depth of the water tables was not indicated.

An earlier study conducted at a rate of 1 lb [ai]/acre of phenyl-labelled material in Delaware, North Dakota, Florida and Mississippi indicated breakdown within 1-4 weeks; the metabolites identified in soil were methyl 2-(aminosulfonyl) benzoate, saccharin and 2-(amino-sulfonyl) benzoic acid. Cylinder depth was 38 cm. Accession #072767.

METHODOLOGY

Eight test sites, four in the United States and four in Canada, were selected for study. The U.S. test sites were located at Akron, Colorado (sites I and II); Kimberly, Idaho; and Fargo, North Dakota. The Canadian sites were located at Stettler, Alberta; Swift Current and Saskatoon, Saskatchewan; and Fisher Branch, Manitoba (Table 1). At each test site, ten stainless steel cylinders (10-cm diameter, 38-cm length) were driven into the ground in a bareground plot (3 x 4 m); the rim of each metal tube protruded approximately 3 cm above ground level.

Uniformly phenyl ring-labeled [^{14}C]metsulfuron methyl (radiochemical purity 98%, specific activity 8.62 $\mu\text{Ci}/\text{mg}$, du Pont), dissolved in acetone (containing 0.1 M ammonium carbonate at 0.5%) was uniformly applied at 100 g ai/ha (83 $\mu\text{g}/78.5\text{ cm}^2$) to the surface of the soil within the cylinders. The test sites in the U.S. were treated twice, one set of cylinders was treated in early November 1982, and a second set was treated in May-June 1983; the Canadian test sites were treated only in June 1983 (Table A). At the time of treatment, 5.0 mL of the test solution was applied by pipette to the surface of each soil column; after the acetone had evaporated, the soil surface was wetted with 50 mL of water and covered with approximately 1 cm of fresh soil. Entire soil columns were collected for analysis at various sampling intervals as outlined in Table B. Each soil tube was dug out of the ground, capped at both ends, labeled, frozen, and shipped on dry ice to the analytical laboratory where they were "either analyzed immediately or stored frozen at -25 C until analysis".

At the analytical laboratory, each cylinder was thawed to room temperature, and the soil column was extruded and divided into 0- to 5-, 5- to 12-, 12- to 22-, and 22- to 35-cm segments. The soil segments were air-dried at room temperature for 2-4 days, then ground and homogenized in an electric grinding mill. Duplicate portions (2.5 g) of the air-dried, homogenized soil segments were analyzed by LSC following combustion. Soil segments determined to contain significant levels of radioactivity were retained and frozen; those with only background levels of radioactivity were discarded. Aliquots of the soil segments or the total segments (200-1200 g, depending on the total ^{14}C analyses) containing $\geq 10\%$ of the total radioactivity in the soil tube were transferred to glass columns (5-cm id, 30-cm length). For the soil samples from the immediately posttreatment to 1 year posttreatment sampling intervals only, acetone:0.1 M ammonium carbonate (90:10, v:v) was percolated through

the soil overnight at room temperature at a soil:solvent ratio of 1:2 (w:v). These acetone:0.1 M ammonium carbonate-extracted soil samples, plus all other soil samples from subsequent intervals, were then extracted with 0.1 M ammonium carbonate (soil:solvent ratio of 1:2, w:v) for 1 hour at 45-50 C using sonication. The soil slurries were centrifuged for 15 minutes, and the supernatants were decanted and combined by soil segment and sampling interval. The extracted soils were further extracted by sonicating with acetone for 30 minutes at 45-50 C, followed by centrifugation. The acetone and ammonium carbonate extracts were combined by soil segment and sampling interval, then centrifuged. These extracts were combined with the corresponding acetone:ammonium carbonate extracts; all extract solutions were concentrated using rotary evaporation and a nitrogen blower. Aliquots of the concentrated extracts were analyzed by one-dimensional TLC on silica gel plates developed in methylene chloride:methanol:1 M ammonium hydroxide (170:27:3, v:v:v). Phenyl ring-labeled [¹⁴C]metsulfuron methyl was cochromatographed as a reference standard. Radioactive areas were located using autoradiography; these areas were scraped from the plates and analyzed for total radioactivity using LSC. To determine unextracted radioactivity, the extracted soil samples were dried in a vacuum oven for 2-3 days at 50 C, homogenized by grinding, and analyzed by LSC following combustion.

DATA SUMMARY

Uniformly phenyl ring-labeled [¹⁴C]metsulfuron methyl (radiochemical purity 98%), at 100 g ai/ha, dissipated with half-lives of 1 to 10.5 months in the upper 0- to 5-cm of bareground plots of silt loam and silty clay loam soils that were located in Colorado, Idaho, and North Dakota and treated with [¹⁴C]metsulfuron methyl in the fall of 1982 and the spring of 1983 (Table 22). [¹⁴C]Metsulfuron methyl dissipated with half-lives of 1 to 2.5 months in the upper 0- to 5-cm of plots of sandy loam, silt loam, and silty clay loam soils located in Canada that were treated in the spring of 1983. In general, dissipation was considerably more rapid following the spring applications. At all sites, [¹⁴C]metsulfuron methyl residues were detected to a depth of 22- to 35-cm (maximum sampling depth). Cumulative rainfall at the eight sites during the 16- to 24-month sampling periods was 43.7-103.0 cm; no relation between total rainfall and degradation rates was apparent (Tables 2-13, 22). No other meteorological data were provided.

Akron, Colorado (Site I): [¹⁴C]Metsulfuron methyl dissipated in the upper 0- to 5-cm of silt loam soil that had been treated with uniformly phenyl ring-labeled [¹⁴C]metsulfuron methyl at 100 g ai/ha with registrant-calculated half-lives of approximately 2 months following a fall application and 1 month following a spring application (Table 22).

Following the fall application, in the 0- to 35-cm depth, [¹⁴C]metsulfuron methyl was 92% of the recovered radioactivity immediately posttreatment, 61% at 1 month, 27% at 5 months, and 0.7% at 24 months. Total [¹⁴C]residues recovered were 96.4% immediately posttreatment, 85.4% at 1 month, 45.3% at 5 months, and 32.1% at 24 months (Tables 2 and 14). [¹⁴C]Metsulfuron methyl residues were detected in the 22- to 35-cm sampling depth at 5 through 24 months posttreatment; the maximum concentration was 9.5% of the recovered at 5 months (Table 2).

Following the spring application, in the 0- to 35-cm depth, [¹⁴C]metsulfuron methyl was 96% of the recovered radioactivity immediately posttreatment, 36% at 1.3 months, 13% at 2.8 months, and 1.9% at 18 months. Total [¹⁴C]residues recovered were 103.6% immediately posttreatment, 63.4% at 1.3 months, 57.9% at 2.8 months, 46.8% at 4 months, and 32.5% at 18 months (Tables 3 and 14). [¹⁴C]Metsulfuron methyl residues were detected in the 22- to 35-cm sampling depth at 2.8 through 18 months posttreatment; the maximum concentration was 3.6% of the recovered at 18 months (Table 3).

Akron, Colorado (Site II): [¹⁴C]Metsulfuron methyl dissipated in the upper 0- to 5-cm of silt loam soil that had been treated with uniformly phenyl ring-labeled [¹⁴C]metsulfuron methyl at 100 g ai/ha with registrant-calculated half-lives of approximately 3 months following a fall application and 1.5 months following a spring application (Table 22).

Following the fall application, in the 0- to 35-cm depth, [¹⁴C]metsulfuron methyl was 97% of the recovered radioactivity immediately posttreatment, 87% at 0.8 months, 29% at 5 months, 42% at 7.3 months, 2.3-3.8% at 9.3 and 12 months, and 0.4% at 23.8 months. Total [¹⁴C]residues recovered were 100.3% immediately posttreatment, 93.8% at 0.8 months, 38.1% at 5 months, 69.0% at 7.3 months, 9.6-11.8% at 9.3 through 19.5 months, and 5.2% at 23.8 months (Tables 4 and 15). [¹⁴C]Metsulfuron methyl residues were detected in the 22- to 35-cm sampling depth at 5 through 23.8 months posttreatment; the maximum concentration was 24.1% of the recovered at 7.3 months (Table 4).

Following the spring application, in the 0- to 35-cm depth, [¹⁴C]metsulfuron methyl was 99% of the recovered radioactivity immediately posttreatment, 54% at 1.3 months posttreatment, 38% at 2.8 months, and 3.1% at 18 months. Total [¹⁴C]residues recovered were 102.8% immediately posttreatment, 85.6% at 1.3 months, 64.7% at 2.8 months, and 26.2% at 18 months (Tables 5 and 15). [¹⁴C]Metsulfuron methyl residues were detected in the 22- to 35-cm sampling depth at 1.3 through 18 months posttreatment; the maximum concentration was 13.7% of the recovered at 5.8 months (Table 5).

Kimberly, Idaho: [¹⁴C]Metsulfuron methyl dissipated in the upper 0- to 5-cm of silt loam soil that had been treated with uniformly phenyl ring-labeled [¹⁴C]metsulfuron methyl at 100 g ai/ha with registrant-

calculated half-lives of approximately 7 months following both fall and spring applications (Table 22).

Following the fall application, in the 0- to 35-cm depth, [¹⁴C]metsulfuron methyl was 96% of the recovered radioactivity immediately posttreatment, 85% at 1 and 4 months, 31.6% at 8 months, and 1.4% at 19 months. Total [¹⁴C]residues recovered were 95.5% immediately posttreatment, 97.1% at 4 months, 48.0% at 8 months, and 16.6% at 24 months (Tables 6 and 16). [¹⁴C]Metsulfuron methyl residues were detected in the 22- to 35-cm sampling depth at 4 through 24 months posttreatment; the maximum concentration was 37.8% of the recovered at 4 months (Table 6).

Following the spring application, in the 0- to 35-cm depth, [¹⁴C]metsulfuron methyl was 98% of the recovered radioactivity immediately posttreatment, 56.1% at 6 months, 21.4% at 13 months, and 9.1% at 18 months. Total [¹⁴C]residues recovered were 88.0% immediately posttreatment, 87.3-97.0% between 0.7 and 4 months, 82.2% at 6 months, 38.5% at 13 months, and 16.6% at 24 months (Tables 7 and 16). [¹⁴C]Metsulfuron methyl residues were detected in the 22- to 35-cm sampling depth at 13 through 24 months posttreatment; the maximum concentration was 6.3% of the recovered at 13 months (Table 7).

Fargo, North Dakota: [¹⁴C]Metsulfuron methyl dissipated in the upper 0- to 5-cm of silty clay loam soil that had been treated with uniformly phenyl ring-labeled [¹⁴C]metsulfuron methyl at 100 g ai/ha with registrant-calculated half-lives of approximately 10.5 months following a fall application and 1.5 months following a spring application (Table 22).

Following the fall application, in the 0- to 35-cm depth, [¹⁴C]metsulfuron methyl was 98% of the recovered radioactivity immediately posttreatment, 67% at 8 months, 34.7% at 12 months, and 21.4% at 24.3 months. Total [¹⁴C]residues recovered were 95.2% immediately posttreatment, 78.7% at 19 months, and 55.5% at 24.3 months (Tables 8 and 17). [¹⁴C]Metsulfuron methyl residues were detected in the 22- to 35-cm sampling depth at 5.4 through 24.3 months posttreatment; the maximum concentration was 10.9% of the recovered at 19 months (Table 8).

Following the spring application, in the 0- to 35-cm depth, [¹⁴C]metsulfuron methyl was 95% of the recovered radioactivity immediately posttreatment, 61% at 1.3 months, 42% at 2 months, and 24.2-26.3% at 4.3 to 16 months. Total [¹⁴C]residues recovered were 101.9% immediately posttreatment and 65.2-72.4%, with no discernable pattern between 2 and 16 months (Tables 9 and 17). [¹⁴C]Metsulfuron methyl residues were detected in the 22- to 35-cm sampling depth at 13 and 16 months posttreatment; the maximum concentration was 1.5% of the recovered at 16 months (Table 9).

Stettler, Alberta: Uniformly phenyl ring-labeled [¹⁴C]metsulfuron methyl, at 100 g ai/ha, dissipated with a registrant-calculated half-life of 2.5 months from the upper 0- to 5-cm of sandy loam soil that had been treated with [¹⁴C]metsulfuron methyl in June 1983 (Table 22). Following the spring application, in the 0- to 35-cm depth, [¹⁴C]metsulfuron methyl was 97% of the recovered radioactivity immediately posttreatment, 59% at 2 months, 38% at 4 months, 45% at 13.5 months, and 32.1% at 16 months. Total [¹⁴C]residues were 100.8% immediately posttreatment and ranged from 54.9 to 84.7% with no discernable pattern between 2 and 16 months (Tables 10 and 18). [¹⁴C]Metsulfuron methyl residues were detected in the 22- to 35-cm sampling depth at 0.5 through 16 months posttreatment; the maximum concentration was 12.0% of the recovered at 1 month (Table 10).

Swift Current, Saskatchewan: Uniformly phenyl ring-labeled [¹⁴C]metsulfuron methyl, at 100 g ai/ha, dissipated with a registrant-calculated half-life of 1 month from the upper 0- to 5-cm of silt loam soil that had been treated with [¹⁴C]metsulfuron methyl in June 1983 (Table 22). Following the spring application, in the 0- to 35-cm depth, [¹⁴C]metsulfuron methyl was 91% of the recovered radioactivity immediately posttreatment, 43% at 1 month, 16% at 2 months, and 2.7% at 16 months. Total [¹⁴C]residues were 91.0% immediately posttreatment, 61.8-70.1% between 2 and 10 months, 59.3% at 13.5 months, and 49.0% at 16 months (Tables 11 and 19). [¹⁴C]Metsulfuron methyl residues were detected in the 22- to 35-cm sampling depth at 0.3% of the recovered at 10 months posttreatment; it was not detected at that depth at any other sampling interval (Table 11).

Saskatoon, Saskatchewan: Uniformly phenyl ring-labeled [¹⁴C]metsulfuron methyl, at 100 g ai/ha, dissipated with a registrant-calculated half-life of 1 month from the upper 0- to 5-cm of silty clay loam soil that had been treated with [¹⁴C]metsulfuron methyl in June 1983 (Table 22). Following the spring application, in the 0- to 35-cm depth, [¹⁴C]metsulfuron methyl was 90% of the recovered radioactivity immediately posttreatment, 51% at 1 month, 39% at 2 months, and 10.2% at 16.5 months. Total [¹⁴C]residues were 96.4% immediately posttreatment, 58.6% at 13.5 months, and 55.0% at 16.5 months (Tables 12 and 20). [¹⁴C]Metsulfuron methyl residues were detected in the 22- to 35-cm sampling depth at 4, 13.5, and 16.5 months posttreatment; the maximum concentration was 0.8% of the recovered at 16.5 months (Table 12).

Fisher Branch, Manitoba: Uniformly phenyl ring-labeled [¹⁴C]metsulfuron methyl, at 100 g ai/ha, dissipated with a registrant-calculated half-life of 1.5 months from the upper 0- to 5-cm of silty clay loam soil that had been treated with [¹⁴C]metsulfuron methyl in June 1983 (Table 22). Following the spring application, in the 0- to 35-cm depth, [¹⁴C]metsulfuron methyl was 90% of the recovered radioactivity immediately posttreatment, 58% at 1 month, 44% at 2 months, and 14.1% at 16.5 months. Total [¹⁴C]residues were 100.2% immediately posttreatment, 68.0% at

13.5 months, and 58.0% at 16.5 months (Tables 13 and 21). [¹⁴C]Metsulfuron methyl residues were detected in the 22- to 35-cm sampling depth at 1 through 16.5 months posttreatment; the maximum concentration was 3.4% of the recovered at 4 months (Table 13).

COMMENTS:

1. The test sites were sampled infrequently; the second sampling generally did not occur until 1 month posttreatment (the first sampling was immediately posttreatment) and there was a maximum of 7.5 months between samplings (Table B). This made it difficult to accurately determine the half-life of [¹⁴C]metsulfuron methyl and total [¹⁴C]residues. At the Colorado (spring, Site I; fall, Site II) and Idaho (fall) sites, >50% of the applied methsulfuron methyl degraded between subsequent sampling intervals. Data from several sites (Colorado Site I, North Dakota, Alberta) were variable; if the soil had been sampled more frequently, the significance of individual sampling dates would have been lessened.
2. The formation and decline of degradates in the treated soils were not addressed; the soil samples were analyzed only for [¹⁴C]metsulfuron methyl and total [¹⁴C]residues, although in some cases <50% of the recovered radioactivity was metsulfuron methyl. In this field dissipation study, the authors stated, "The soil metabolites of metsulfuron methyl were identified and quantitated in previous aerobic soil metabolism and field soil dissipation studies", apparently as justification for the limited soil analyses. Saccharin, 2-(aminosulfonyl)benzoic acid, and methyl-2-(aminosulfonyl)benzoate have been identified as the major degradates of metsulfuron methyl.
3. The soil was not sampled deep enough to define the extent of leaching. At all sites, [¹⁴C]residues were detected in the deepest soil depth sampled.
4. No storage stability data were provided.
5. Four of the test sites were in Canada and may not be typical of growing areas in the United States where metsulfuron methyl is used. Since the meteorological data from all test sites were incomplete (air and soil temperature data were not provided), and information on the depth to the water table and pesticide history of the site were not provided, comparisons between environmental conditions at the Canadian and United States sites could not be made.
6. Sample calculations were not provided; it was uncertain which data were used by the study authors to calculate the half-lives of parent metsulfuron methyl at the eight sites.
7. It was stated that ammonium carbonate was added to the treatment solution to neutralize acidic impurities in the acetone which could decompose metsulfuron methyl.

TABLE A.

The test locations and application dates are listed below:

Akron, Colorado, USA (Site I)	started 11/6/82 & 5/12/83
Akron, Colorado, USA (Site II)	started 11/12/82 & 5/12/83
Kimberly, Idaho, USA	started 11/4/82 & 5/6/83
Fargo, North Dakota, USA	started 11/12/82 & 6/7/83
Stettler, Alberta, Canada	started 6/9/83
Swift Current, Sask., Canada	started 6/14/83
Saskatoon, Sask., Canada	started 6/15/83
Fisher Branch, Manitoba, Canada	started 6/16/83

TABLE B.

SITE	APPLICATION		SAMPLING INTERVAL, MONTHS	SAMPLING INTERVAL, MONTHS													
	DATE			0	1	5	7.5	9.5	12	19.5	24	0	1	2	4	10	13
<u>United States</u>																	
Akron, CO (Fall, Site I)	11/06/82		0	1	5	7.5	9.5	12	19.5	24							
Akron, CO (Fall, Site II)	11/12/82		0	0.8	5	7.3	9.3	12	19.5	23.8							
Akron, CO (Spring, Site I)	05/12/83		0	1.3	2.8	4	5.8	11.8	18								
Akron, CO (Spring, Site II)	05/12/83		0	1.3	2.8	4	5.8	11.6	18								
Kimberly, ID (Fall)	11/04/82		0	1	4	8	10	12	19	24							
Kimberly, ID (Spring)	05/06/83		0	0.7	1	2	4	6	13	18							
Fargo, ND (Fall)	11/12/82		0	5.4	8	12	19	24.3									24
Fargo, ND (Spring)	06/07/83		0	0.5	1.3	2	4.3	10	13	16							
<u>Canada</u>																	
(Spring applications only)																	
Stettler, Alberta	06/09/83		0	0.5	1	2	4	10.8	13.5	16							
Swift Current, Saskatchewan	06/14/83		0	1	2	4	10	13.5	16								
Saskatoon, Saskatchewan	06/15/83		0	1	2	4	10	13.5	16.5								
Fishers Branch, Manitoba	06/16/83		0	1	2	4	10	13.5	16.5								

1
2
10
11

TABLE 1

CHARACTERIZATION OF U.S. AND CANADIAN SOILS¹

	<u>Akron (Colorado) (Site I)</u>	<u>Akron (Colorado) (Site II)</u>	<u>Kimberly (Idaho)</u>	<u>Fargo (N. Dakota)</u>
Soil Type	Silt Loam	Silt Loam	Silt Loam	Silty Clay Loam
Sand, %	36	21	6	0
Silt, %	50	62	77	67
Clay, %	14	17	17	33
Organic matter %	1.0	1.2	1.3	5.3
Nitrogen, %	0.04	0.05	0.06	0.29
pH ²	6.9	8.2	8.0	7.6
Cation exchange Capacity (meq/100 g)	14.2	10.3	17.4	46.2

	<u>Stettler (Alberta)</u>	<u>Fisher Branch (Manitoba)</u>	<u>Swift Current (Sask.)</u>	<u>Saskatoon (Sask.)</u>
Soil Type	Sandy Loam	Silty Clay Loam	Silt Loam	Silty Clay Loam
Sand, %	58	1	27	20
Silt, %	34	59	57	51
Clay, %	8	40	16	29
Organic matter %	4.4	6.4	1	3.4
Nitrogen, %	0.41	0.46	0.17	0.20
pH ²	6.9	7.8	6.1	6.2
Cation exchange Capacity (meq/100 g)	26.5	41.8	18.9	24.8

¹ Except as noted below, all analyses performed by the Soil Testing Laboratory at The University of Delaware, Newark, DE.

² The pH of the supernatant was determined in house after slurring a 1:1, (w/v) ratio of soil and distilled, deionized water for 10 minutes and allowing the solids to settle for 15 minutes.

J.H. 1/11

TABLE 2

DISTRIBUTION OF TOTAL ¹⁴C IN AKRON, COLORADO (SITE I) SOIL
(11/6/82 Application)

Soil Increment (cm)	% of the Applied ¹⁴ C Recovered at Indicated Months							
	<u>0</u>	<u>1</u>	<u>5</u>	<u>7.5</u>	<u>9.5</u>	<u>12</u>	<u>19.5</u>	<u>24</u>
0-5	86.4	67.4	10.0	10.0	11.7	6.9	9.9	10.0
5-12	9.2	18.0	14.8	8.7	12.1	7.3	10.8	10.4
12-22	0.8	ND	11.0	6.8	14.2	6.3	13.6	9.7
22-35	<u>ND*</u>	<u>ND</u>	<u>9.5</u>	<u>5.5</u>	<u>7.1</u>	<u>5.9</u>	<u>6.1</u>	<u>2.0</u>
Total Recovery	96.4	85.4	45.3	31.0	45.1	26.4	40.4	32.1
Cumulative Rainfall (cm)	0.6**	2.5	11.7	31.0	41.2	43.9	***	96.5

* ND = None detected.

** Equivalent to 50 mL of water added to each tube immediately after application of the ¹⁴C-metsulfuron methyl.

*** Data not received from the field station.

1.12
-2.12-

TABLE 3

DISTRIBUTION OF TOTAL ¹⁴C IN AKRON, COLORADO, (SITE I) SOIL
(5/12/83 Application)

Soil Increments (cm)	% of the Applied ¹⁴ C Recovered at Indicated Months						
	<u>0</u>	<u>1.3</u>	<u>2.8</u>	<u>4</u>	<u>5.8</u>	<u>11.8</u>	<u>18</u>
0-5	62.6	25.4	28.3	20.1	21.3	16.0	8.5
5-12	41.0	26.9	25.3	21.5	19.7	18.1	15.6
12-22	ND*	11.1	4.1	4.9	7.2	7.5	4.8
22-35	<u>ND</u>	<u>ND</u>	<u>0.2</u>	<u>0.3</u>	<u>2.7</u>	<u>0.3</u>	<u>3.6</u>
Total Recovery	103.6	63.4	57.9	46.8	50.9	42.2	32.5
Cumulative Rainfall (cm)	0.6**	10.3	20.7	22.7	23.3	36.1	75.1

* ND = None detected.

- ** Equivalent to the 50 mL of water added to each tube immediately after application of the ¹⁴C-metsulfuron methyl.

~~2.13~~
1.13

TABLE 4

DISTRIBUTION OF TOTAL ¹⁴C IN AKRON, COLORADO (SITE II) SOIL

(11/12/82 Application)

Soil Increment (cm)	% of the Applied ¹⁴ C Recovered at Indicated Months							
	<u>0</u>	<u>0.8</u>	<u>5</u>	<u>7.3</u>	<u>9.3</u>	<u>12</u>	<u>19.5</u>	<u>23.8</u>
0-5	83.3	46.5	4.1	18.6	2.2	1.9	1.9	1.2
5-12	15.4	38.0	6.2	6.5	2.8	1.9	1.5	0.9
12-22	1.6	9.3	7.9	19.8	3.1	2.6	2.6	1.3
22-35	<u>ND*</u>	<u>ND</u>	<u>19.9</u>	<u>24.1</u>	<u>3.7</u>	<u>3.2</u>	<u>4.7</u>	<u>1.8</u>
Total Recovery (%)	100.3	93.8	38.1	69.0	11.8	9.6	10.7	5.2
Cumulative Rainfall (cm)	0.6**	2.5	11.7	31.0	41.2	43.9	***	96.5

* ND = None detected.

** Equivalent to the 50 mL of water added to each tube immediately after application of the ¹⁴C-metsulfuron methyl.

*** Data not yet received from the field station.

1.14
~~2.14~~

TABLE 5

DISTRIBUTION OF TOTAL ¹⁴C IN AKRON, COLORADO (SITE II) SOIL
(5/12/83 Application)

Soil Increment (cm)	% of the Applied ¹⁴ C Recovered at Indicated Months						
	<u>0</u>	<u>1.3</u>	<u>2.8</u>	<u>4</u>	<u>5.8</u>	<u>11.6</u>	<u>18</u>
0-5	67.7	19.5	12.9	10.1	4.2	5.5	2.4
5-12	35.1	28.5	12.6	19.1	6.1	14.8	9.6
12-22	1.5	33.9	27.5	16.3	8.4	13.7	7.2
22-35	<u>ND*</u>	<u>3.7</u>	<u>11.7</u>	<u>6.7</u>	<u>13.7</u>	<u>4.3</u>	<u>7.0</u>
Total Recovery	102.8	85.6	64.7	52.2	32.4	38.3	26.2
Cumulative Rainfall (cm)	0.6**	10.3	20.7	22.7	23.3	36.1	75.1

* ND = None detected.

** Equivalent to the 50 mL of water added to each tube immediately after application of the ¹⁴C-metsulfuron methyl.

1.15
~~2.15~~

TABLE 6

DISTRIBUTION OF TOTAL ¹⁴C IN KIMBERLY, IDAHO SOIL
(11/4/82 Application)

Soil Increment (cm)	% of the Applied ¹⁴ C Recovered at Indicated Months							
	<u>0</u>	<u>1</u>	<u>4</u>	<u>8</u>	<u>10</u>	<u>12</u>	<u>19</u>	<u>24</u>
0-5	82.4	24.8	10.4	6.2	14.7	8.8	2.6	2.3
5-12	13.1	41.1	13.5	5.4	8.1	8.4	3.8	3.2
12-22	ND*	22.3	35.4	14.8	21.0	13.1	6.5	8.1
22-35	<u>ND</u>	<u>ND</u>	<u>37.8</u>	<u>21.6</u>	<u>11.9</u>	<u>5.2</u>	<u>4.1</u>	<u>3.0</u>
Total Recovery	95.5	88.2	97.1	48.0	55.7	35.5	17.0	16.6
Cumulative Rainfall (cm)	0.6**	3.8	11.3	24.3	27.1	32.1	57.0	72.4

* ND = None detected.

** Equivalent to the 50 mL of water added to each tube immediately after application of the ¹⁴C-metsulfuron methyl.

1.16
~~2.16~~

TABLE 7

DISTRIBUTION OF TOTAL ¹⁴C IN KIMBERLY, IDAHO SOIL

(5/6/1983 Application)

Soil Increment (cm)	% of the Applied ¹⁴ C Recovered at Indicated Months								
	<u>0</u>	<u>0.7</u>	<u>1</u>	<u>2</u>	<u>4</u>	<u>6</u>	<u>13</u>	<u>18</u>	<u>24</u>
0-5	85.6	83.1	59.4	65.3	69.7	40.2	16.2	8.2	2.3
5-12	2.4	4.2	37.6	23.8	21.8	40.7	8.4	7.9	3.2
12-22	ND*	ND	ND	1.0	ND	1.3	7.6	8.0	8.1
22-35	<u>ND</u>	<u>ND</u>	<u>ND</u>	<u>ND</u>	<u>ND</u>	<u>ND</u>	<u>6.3</u>	<u>5.2</u>	<u>3.0</u>
Total Recovery	88.0	87.3	97.0	90.1	91.5	82.2	38.5	29.3	16.6
Cumulative Rainfall (cm)	0.6**	2.6	3.3	5.2	8.0	13.0	37.8	53.3	***

* ND = None detected.

** Equivalent to the 50 ml of water added to each tube immediately after application of the ¹⁴C-metsulfuron methyl.

*** Data not obtained from field station.

1.17
~~2.17~~

TABLE 8

DISTRIBUTION OF TOTAL ¹⁴C IN FARGO, NORTH DAKOTA SOIL

(11/12/82 Application)

Soil Increment (cm)	% of the Applied ¹⁴ C Recovered at Indicated Months					
	<u>0</u>	<u>5.4</u>	<u>8</u>	<u>12</u>	<u>19</u>	<u>24.3</u>
0-5	82.4	59.5	33.5	17.2	16.8	10.8
5-12	12.0	37.5	35.6	20.4	23.2	15.0
12-22	0.8	10.3	20.9	24.3	27.8	24.8
22-35	<u>ND*</u>	<u>0.3</u>	<u>2.8</u>	<u>9.3</u>	<u>10.9</u>	<u>4.9</u>
Total Recovery	95.2	107.6	92.8	71.2	78.7	55.5
Cumulative Rainfall (cm)	0.6**	11.0	30.2	43.4	66.5	103.0

* ND = None detected.

** Equivalent to the 50 mL of water added to each tube immediately after application of the ¹⁴C-metsulfuron methyl.

1.18
~~2.18~~

TABLE 9

DISTRIBUTION OF TOTAL ¹⁴C IN FARGO, NORTH DAKOTA SOIL
(6/7/83 Application)

Soil Increment (cm)	% of the Applied ¹⁴ C Recovered at Indicated Months							
	<u>0</u>	<u>0.5</u>	<u>1.3</u>	<u>2</u>	<u>4.3</u>	<u>10</u>	<u>13</u>	<u>16</u>
0-5	100.8	77.0	61.6	47.6	43.9	36.7	35.4	31.4
5-12	1.1	5.6	21.6	19.0	21.5	26.1	25.3	23.9
12-22	ND*	ND	2.8	1.7	3.9	2.6	10.7	8.4
22-35	<u>ND</u>	<u>ND</u>	<u>ND</u>	<u>ND</u>	<u>ND</u>	<u>ND</u>	<u>1.0</u>	<u>1.5</u>
Total Recovery	101.9	82.6	86.0	68.3	69.3	65.4	72.4	65.2
Cumulative Rainfall (cm)	0.6**	5.6	10.3	17.0	26.3	43.4	62.9	73.5

* ND = None detected.

** Equivalent to the 50 mL of water added to each tube immediately after application of the ¹⁴C-metsulfuron methyl.

1.19
~~2.17~~

TABLE 10

DISTRIBUTION OF TOTAL ¹⁴C IN STETTLER, ALBERTA SOIL

(6/9/83 Application)

Soil Increments (cm)	% of the Applied ¹⁴ C Recovered at Indicated Months							
	<u>0</u>	<u>0.5</u>	<u>1</u>	<u>2</u>	<u>4</u>	<u>10.8</u>	<u>13.5</u>	<u>16</u>
0-5	99.8	48.6	28.5	32.6	28.1	42.4	27.3	17.5
5-12	1.0	23.2	29.2	24.3	8.2	19.4	21.0	19.1
12-22	ND*	19.0	31.7	21.8	12.9	16.4	21.0	21.0
22-35	<u>ND</u>	<u>5.4</u>	<u>12.0</u>	<u>6.0</u>	<u>5.7</u>	<u>3.6</u>	<u>9.7</u>	<u>7.0</u>
Total Recovery	100.8	96.2	101.4	84.7	54.9	81.8	79.0	64.6
Cumulative Rainfall (cm)	0.6**	7.9	15.5	22.1	25.7	34.8	51.1	68.3

* ND = None detected.

** Equivalent to the 50 mL of water added to each tube immediately after application of the ¹⁴C-metsulfuron methyl.

1.20
~~2.20~~

TABLE 11

DISTRIBUTION OF TOTAL ¹⁴C IN SWIFT CURRENT, SASKATCHEWAN SOIL
(6/14/1983 Application)

Increments (cm)	% of the Applied ¹⁴ C Recovered at Indicated Months						
	<u>0</u>	<u>1</u>	<u>2</u>	<u>4</u>	<u>10</u>	<u>13.5</u>	<u>16</u>
0-5	83.4	60.1	40.7	50.1	41.6	35.0	37.6
5-12	5.9	20.4	28.6	11.4	21.6	23.4	11.0
12-22	1.7	1.4	0.8	0.3	2.7	0.9	0.4
22-35	<u>ND*</u>	<u>ND</u>	<u>ND</u>	<u>ND</u>	<u>0.3</u>	<u>ND</u>	<u>ND</u>
Total Recovery	91.0	81.9	70.1	61.8	66.2	59.3	49.0
Cumulative Rainfall (cm)	0.6**	6.9	12.4	15.2	22.6	34.0	43.7

* ND = None detected.

** Equivalent to the 50 mL of water added to each tube immediately after application of the ¹⁴C-metsulfuron methyl.

1.21
~~1.21~~

TABLE 12

DISTRIBUTION OF TOTAL ¹⁴C IN SASKATOON, SASKATCHEWAN SOIL

(6/15/83 Application)

Increments (cm)	% of the Applied ¹⁴ C Recovered at Indicated Months						
	<u>0</u>	<u>1</u>	<u>2</u>	<u>4</u>	<u>10</u>	<u>13.5</u>	<u>16.5</u>
0-5	96.0	44.8	44.9	33.8	25.8	27.6	20.6
5-12	0.4	39.6	41.0	26.5	35.4	28.4	30.8
12-22	ND*	0.5	0.2	9.6	2.5	2.5	2.8
22-35	<u>ND</u>	<u>ND</u>	<u>ND</u>	<u>0.1</u>	<u>ND</u>	<u>0.1</u>	<u>0.8</u>
Total Recovery	96.4	84.9	86.1	70.0	63.7	58.6	55.0
Cumulative Rainfall (cm)	0.6**	9.9	14.7	23.1	29.7	41.4	53.6

* ND = None detected.

** Equivalent to the 50 ml of water added to each tube immediately after application of the ¹⁴C-metsulfuron methyl.

1.22
~~2.22~~

TABLE 13

DISTRIBUTION OF TOTAL ¹⁴C IN FISHER BRANCH, MANITOBA SOIL

(6/16/83 Application)

<u>Increments (cm)</u>	<u>% of the Applied ¹⁴C Recovered at Indicated Months</u>						
	<u>0</u>	<u>1</u>	<u>2</u>	<u>4</u>	<u>10</u>	<u>13.5</u>	<u>16.5</u>
0-5	100.0	65.6	51.0	29.4	39.2	31.8	5.1
5-12	0.2	22.3	28.1	25.7	28.7	27.1	28.8
12-22	ND*	1.2	2.1	13.7	5.5	8.8	23.3
22-35	<u>ND</u>	<u>0.9</u>	<u>0.8</u>	<u>3.4</u>	<u>0.2</u>	<u>0.3</u>	<u>0.8</u>
Total Recovery	100.2	90.0	82.0	72.2	73.6	68.0	58.0
Cumulative Rainfall (cm)	0.6**	9.7	14.0	22.9	40.4	69.9	92.2

* ND = None detected.

** Equivalent to the 50 mL of water added to each tube immediately after application of the ¹⁴C-metsulfuron methyl.

1.23
~~2.23~~

TABLE 14

FIELD DISSIPATION OF ¹⁴C-METSULFURON METHYL IN AKRON, COLORADO (SITE I)

<u>Aging Time (months)</u>	<u>% of Applied ¹⁴C-Metsulfuron Methyl Recovered</u>
A. <u>Fall Application</u>¹	
0	92
1	61
5	27
7.5	7
9.5	5
12	1.3
18	2.9
24	0.7
B. <u>Spring Application</u>²	
0	96
1.3	36
2.8	13
4.0	3
5.8	3.2
11.8	4.0
18	1.9

1.24
(~~2.24~~)

¹ Metsulfuron Methyl was applied at a rate of 100 g a.i./A on 11/6/82.

² Metsulfuron Methyl was applied at a rate of 100 g a.i./A on 5/12/83.

TABLE 15

FIELD DISSIPATION OF ¹⁴C-METSULFURON METHYL IN AKRON, COLORADO (SITE II)

<u>Aging Time (months)</u>	<u>% of Applied ¹⁴C-Metsulfuron Methyl Recovered</u>
A. <u>Fall Application</u>¹	
0	97
0.8	87
5	29
7.3	42
9.3	2.3
12	3.8
18	0.9
23.8	0.4
B. <u>Spring Application</u>²	
0	99
1.3	54
2.8	38
4.0	23
5.8	13
11.6	8.2
18	3.1

¹ Applied at 100 g a.i./ha on 11/12/82.

² Applied at 100 g a.i./ha on 5/12/83.

~~2.25~~
1.25

TABLE 16

FIELD DISSIPATION OF ¹⁴C-METSULFURON METHYL IN KIMBERLY, IDAHO

<u>Aging Time (months)</u>	<u>% of Applied ¹⁴C-Metsulfuron Methyl Recovered</u>
A. <u>Fall Application</u>¹	
0	96
1	85
4	85
8	31.6
10	24.4
12	13.4
19	1.4
B. <u>Spring Application</u>²	
0	98
0.7	80
1	72
2	74.4
4	63.9
6	56.1
13	21.4
18	9.1

¹ Applied at 100 g a.i./ha on 11/4/82.

² Applied at 100 g a.i./ha on 5/6/83.

~~2.26~~ - 1.26

TABLE 17

FIELD DISSIPATION OF ¹⁴C-METSULFURON METHYL IN FARGO, NORTH DAKOTA

<u>Aging Time (months)</u>	<u>% of Applied ¹⁴C-Metsulfuron Methyl Recovered</u>
A. <u>Fall Application</u>¹	
0	98
5.4	87
8	67
12	34.7
19	38.5
24.3	21.4
B. <u>Spring Application</u>²	
0	95
0.5	63
1.3	61
2	42
4.3	24.8
10	26.3
13	24.2
16	26.0

¹ Applied at 100 g a.i./ha on 11/12/82.

² Applied at 100 g a.i./ha on 6/7/83.

~~2.27~~ 1.27

TABLE 18

FIELD DISSIPATION OF ¹⁴C-METSULFURON METHYL IN STETTLER, ALBERTA*

<u>Aging Time (months)</u>	<u>% of Applied ¹⁴C-Metsulfuron Methyl Recovered</u>
0	97
0.5	80
1	80
2	59
4	38
10	47.8
13.5	45
16.0	32.1

* Applied at 100 g a.i./ha on 6/9/83.

1.28
~~2.28~~

TABLE 19

FIELD DISSIPATION OF ¹⁴C-METSULFURON METHYL IN SWIFT CURRENT, SASKATCHEWAN*

<u>Aging Time (months)</u>	<u>% of Applied ¹⁴C-Metsulfuron Methyl Recovered</u>
0	91
1	43
2	16
4	11
10	9
13	6.1
16	2.7

* Applied at 100 g a.i./ha on 6/14/83.

1.29
~~2.29~~

TABLE 20

FIELD DISSIPATION OF ¹⁴C-METSULFUON METHYL IN SASKATOON, SASKATCHEWAN*

<u>Aging Time (months)</u>	<u>% of Applied ¹⁴C-Metsulfuron Methyl Applied</u>
0	90
1	51
2	39
4	21
10	18.7
13	15.8
16.5	10.2

*Applied at 100 g a.i./ha on 6/15/83.

1.30
~~2.30~~

TABLE 21

FIELD DISSIPATION OF ¹⁴C-METSULFURON METHYL IN FISHER BRANCH, MANITOBA*

<u>Aging Time (months)</u>	<u>% of Applied ¹⁴C-Metsulfuron Methyl Recovered</u>
0	90
1	58
2	44
4	33
10	25
13.5	21.7
16.5	14.1

*Applied at 100 g a.i./ha on 6/16/83.

1.3/
~~2.31~~

TABLE 22

SUMMARY OF HALF-LIVES AND CONDITIONS

<u>Location</u>	<u>Half-Life (Months)</u>		<u>Cumulative Rainfall (cm)</u>		<u>Soil Characteristics</u>	
	<u>Fall Application</u>	<u>Spring Application</u>	<u>Fall Application</u>	<u>Spring Application</u>	<u>Soil pH</u>	<u>Organic Content, %</u>
Akron, CO (Site I)	2 (24) ¹	1.0 (18)	96.5	75.1	6.9	1.0
Akron, CO (Site II)	3 (23.8)	1.5 (18)	96.5	75.1	8.2	1.2
Fargo, North Dakota	10.5 (24.3)	1.5 (16)	103.0	73.5	7.6	5.3
Kimberly, Idaho	7 (24)	7.0 (24)	72.4	53.3 ²	8.0	1.3
Stettler, Alberta	—	2.5 (16)	—	68.3	6.9	4.4
Swift Current, Saskatchewan	—	1 (16)	—	43.7	6.1	1.0
Saskatoon, Saskatchewan	—	1 (16.5)	—	53.6	6.2	3.4
Fisher Branch, Manitoba	—	1.5 (16.5)	—	92.2	7.8	6.4

¹ Length of study to date.

² Rainfall data for 18 months.

1.32
-2.32-