DATA EVALUATION RECORD 5

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CONCLUSIONS:

Metabolism - Anaerobic Soil

1. This study is acceptable and fulfills EPA Data Requirements for Registering Pesticides by providing information on the anaerobic metabolism of oxazolidine ring-labeled [4-^{14}C]MON 13900 in silt loam and sandy loam soils. No additional data on the anaerobic soil metabolism of MON 13900 are required at this time.

2. MON 13900 degraded with applicant-calculated half-lives of 14.7 days in silt loam soil and 13.0 days in sandy loam soil that were incubated anaerobically (flooding plus nitrogen atmosphere) at 25 C in the dark for 63 days following 30 days of aerobic incubation. These calculated values for half-lives are not necessarily accurate since approximately 91% of the MON 13900 present at 30 days posttreatment had degraded after 33 days of anaerobic incubation (63 days posttreatment). The major nonvolatile degradate was 2-[5-(2-furanyl)-2,2-dimethyl-3-oxazolidinyl]-2-oxoacetic acid (MON 13900 oxamic acid). Other nonvolatile degradates in the anaerobic soil plus flood water were 5-(2-furanyl)-3-(hydroxyacetyl)-2,2-dimethyloxazolidine (MON 13900 alcohol) and 5-(2-furanyl)-2,2-dimethyl-3-(methylthioacetyl)oxazolidine (MON 13900 methyl sulfide).

METHODOLOGY:

Samples (50 g, dry weight) of air-dried, sieved (2 mm) Sable silt loam and Sarpy sandy loam soils (Table 2) were placed in flasks and adjusted to 85% of 0.33 bar moisture. The flasks were stoppered with foam plugs, then incubated at 25 ± 1 C and 30% humidity in the dark for 33 days; soil moisture was maintained at 65-86% of 0.33 bar during the incubation. Following the 33-day preincubation period, eighteen flasks of each soil type were treated at 0.42 ppm with oxazolidine ring-

labeled [4-$^{13}C/^{14}C$]MON 13900 (radiochemical purity >98%, specific activity 18.13 mCi/mMol, Monsanto), dissolved in acetonitrile; after treatment, the soil moisture was readjusted to 85% of 0.33 bar. Each flask was topped with a two-piece trapping tower (Figure 4) containing foam plugs to trap [^{14}C]volatiles and Ascarite II to trap evolved $^{14}CO_2$, the samples were then incubated at 25 ± 1 C in the dark for 30 days. The flasks were weighed at 7- to 9-day intervals and water was added, as needed, to maintain the soil moisture at 65-85% of field capacity. At 30 days posttreatment, each flask was amended with glucose (500 mg). After glucose amendment, anaerobic conditions were established by flooding the soil with deionized water (100 mL), sealing the flasks, attaching a "syringe tower" containing foam plugs and Ascarite, and purging the flasks with nitrogen for 10 minutes (Figure 5). The flasks were incubated at 25 ± 1 C in the dark. Each flask was purged with nitrogen for 10 minutes on days 17, 33, 44, and 63 of the anaerobic incubation period. Duplicate flasks of each soil were collected at 0, 1, 3, 7, 14, and 30 days posttreatment and at 33 and 63 days after anaerobic conditions were established (63 and 93 days posttreatment). During the aerobic incubation period, foam plugs in the trapping towers were collected and replaced at 7, 14, 21, and 30 days posttreatment and Ascarite was collected at 7 and 30 days posttreatment; foam plugs and Ascarite were collected on days 17, 33, 44, and 63 of the anaerobic incubation period (47, 63, 74, and 93 days posttreatment) when the flasks were purged with nitrogen.

The soil and water fractions were separated using centrifugation. Soil samples were extracted three times with 60% aqueous acetonitrile using a wrist-action shaker; extracts were separated from the soil by centrifugation, then decanted and aliquots of each extract were analyzed for total radioactivity using LSC. Selected soil samples were further extracted with various basic and/or acidic solvents, including 60% aqueous acetonitrile, 0.1 N ammonium hydroxide, 5% HCl, and deionized water, as presented in Table A. A pooled aqueous acetonitrile extract was prepared for each of the 0- to 30-day soil samples. For each of the 63- and 93-day soil samples, equal portions (10% by weight) of each aqueous acetonitrile extract and the water fraction were combined to produce a pooled sample. A portion of each pooled sample was concentrated by rotary evaporation, and aliquots were analyzed for total radioactivity using LSC. Additional concentrated aliquots were analyzed by reverse phase HPLC using UV (254 nm) and radioactivity detection on a Brownlee RP-18 precolumn followed by a Beckman Altex Ultrasphere-ODS C-18 column eluted with isocratic and linear gradients of acetonitrile and 0.001 M dibasic ammonium phosphate; fractions were collected at 0.3-minute intervals and analyzed for radioactivity using LSC. To confirm degradate identifications, collected HPLC fractions were also analyzed using GC with flame ionization and radioactivity detection, GC/MS with chemical ionization, fast atom bombardment MS (FAB/MS), and NMR. In addition, acetylations were performed on selected fractions using acetic anhydride plus pyridine. Unextracted [^{14}C]residues remaining in the extracted soil were quantified using LSC following combustion.

To characterize unextracted [^{14}C]residues, the previously extracted 93-day soil samples were fractionated into humin, humic acid, and fulvic acid (Figure 12). A subsample of extracted soil was refluxed with N,N-dimethyl formamide:1% oxalic acid (ratio unspecified) for 48 hours using a Soxhlet apparatus followed by a 60-hour extraction with 0.5 N NaOH using a shaker. Extracts were analyzed for total radioactivity using LSC. The NaOH extract was acidified to pH 1 with concentrated HCl to precipitate the humic acid fraction; the supernatant containing the fulvic acid fraction was analyzed for total radioactivity using

LSC. The extracted soil containing the humin fraction was lyophilized and analyzed for residual radioactivity by LSC following combustion.

Foam plugs from the trapping towers were placed in scintillation cocktail and analyzed for total radioactivity using LSC. Ascarite from the trapping towers was placed in a flask and dissolved in distilled water. The flask was immersed in ice, then adsorbed $^{14}CO_2$ was released from the Ascarite using concentrated sulfuric acid and trapped in phenethylamine solution; the trapping solution was analyzed for total radioactivity using LSC.

DATA SUMMARY:

Oxazolidine ring-labeled [4-^{14}C]MON 13900 (radiochemical purity >98%), at 0.42 ppm, degraded with calculated half-lives of 14.7 days in silt loam soil and 13.0 days in sandy loam soil that were incubated anaerobically (flooding plus nitrogen atmosphere) at 25 ± 1 C in the dark for 63 days following 30 days of aerobic incubation. In the silt loam soil, MON 13900 decreased from an average 50.7% of the applied radioactivity at 30 days posttreatment just prior to flooding to 4.4% after 33 days of anaerobic incubation (63 days posttreatment) and 2.7% after 63 days (93 days posttreatment; Table 12). In the sandy loam soil, MON 13900 decreased from an average 66.1% of the applied at 30 days posttreatment to 5.9% at 63 days and 2.3% at 93 days (Table 15).

The major nonvolatile degradate in the extracts plus flood water of both soils was

2-[5-(2-furanyl)-2,2-dimethyl-3-oxazolidinyl]-2-oxoacetic acid (MON 13900 oxamic acid, Fraction B).

MON 13900 oxamic acid increased to maximum concentrations of 8.6% of the applied in the silt loam soil and 13.4% in the sandy loam soil after 33 days of anaerobic incubation (63 days posttreatment), then decreased to 6.7-7.7% and 10.6-11.5%, respectively, after 63 days (93 days posttreatment; Tables 11 and 14).

Other nonvolatile degradates identified in the extracts plus flood water of both soils after 63 days of anaerobic incubation were

5-(2-furanyl)-3-(hydroxyacetyl)-2,2-dimethyloxazolidine (MON 13900 alcohol, Fraction D1), which contributed 1.4-12.4% of the applied radioactivity (maximums of 2.3% in the sandy loam soil and 15.7% in the silt loam soil); and

5-(2-furanyl)-2,2-dimethyl-3-(methylthioacetyl)oxazolidine (MON 13900 methyl sulfide, Fraction D2), representing 1.7-3.5%.

Unidentified polar [^{14}C]residues (Fraction A), consisting of two neutral [^{14}C]compounds and two acidic [^{14}C]compounds, comprised 3.2-7.6% (0.013-0.032 ppm) of the applied at 63-93 days posttreatment.

At 93 days posttreatment, $^{14}CO_2$ totaled 9.2-10.3% of the applied radioactivity in both soils, and unextracted [^{14}C]residues were 51.9-53.6% of the applied in the silt loam soil and 38.0-41.1% in the sandy loam soil (Tables 3 and 4). Based on analysis of the unextracted [^{14}C]residues from the 93-day soil samples, 3.9-7.8%

of the applied was in the fulvic acid fraction and 12.2-19.7% was in the humin fraction; residues in the humic acid fraction were not quantified (Figure 12). During the study, material balances ranged from 84.6 to 102.3% of the applied (Tables 3 and 4).

COMMENTS:

1. The sampling intervals were too infrequent to accurately establish the half-life of the test substance under anaerobic conditions; MON 13900 decreased from 50.0-66.0% of the applied radioactivity at 30 days posttreatment just prior to flooding to 3.9-6.2% after 33 days of anaerobic incubation (63 days posttreatment) and was 2.3-2.8% after 63 days (93 days posttreatment). The study authors calculated degradation half-lives using first order linear regression and the concentration of MON 13900 at the 30-, 63-, and 93-day posttreatment sampling intervals. The calculated values for half-lives are not necessarily accurate since approximately 91% of the MON 13900 present at 30 days posttreatment had degraded after 33 days of anaerobic incubation (63 days posttreatment); however, EFGWB requirements specify only four sampling intervals--immediately posttreatment, immediately prior to the conversion to anaerobic conditions, 30 days after conversion to anaerobic conditions, and 60 days after conversion to anaerobic conditions.

2. Redox potentials measured after 63 days of anaerobic incubation (93 days posttreatment) were -185 to -195 mV in the silt loam soil and -230 to -306 mV in the sandy loam soil, indicating that the systems were anaerobic.

3. The methodology used to tentatively characterize the unidentified polar [^{14}C]residues in HPLC Fraction A as consisting of two neutral [^{14}C]compounds and two acidic [^{14}C]compounds was thoroughly described in the MON 13900 aerobic soil metabolism study (STUDY 4, MRID 42019716) included with this data submission.

4. The pH of the test water was not reported; however, MON 13900 was shown not to hydrolyze at pH 5, 7, and 9 in the MON 13900 hydrolysis study (STUDY 1, MRID 42019713) included with this data submission.

5. The registrant reported that MON 13900 [3-(dichloroacetyl)-5-(2-furanyl)-2,2-dimethyloxazolidine] is a safener intended for use with chloroacetanilide and sulfonylurea herbicides in corn and sorghum. The maximum projected use rate for MON 13900 is 0.4 lb/A.

6. The registrant reported that for studies conducted using radiolabeled MON 13900, the compound was synthesized with the radiolabel in the carbon atom adjacent to the nitrogen in the oxazolidine ring portion of the molecule. Studies were not conducted with the compound labeled in the furan ring portion of the molecule because degradation of the radiolabeled furan ring would result in radiolabeled ring fragments that would be natural products composed of low numbers of carbon, hydrogen, and oxygen atoms.

Table 3: Total Accountability of Applied ^{14}C-Radioactivity in the MON 13900 Anaerobic Soil Metabolism Study; Sable Silt Loam Soil

Study Day	Replicate	% DPMA in Extracts[a]	% DPMA as Volatiles	% DPMA as CO_2	% DPMA Bound	% Total Accountability
0	A	100.7	0.0	0.0	0.9	101.5
0	B	100.9	0.0	0.0	1.1	102.0
1	A	96.1	0.0	0.2	2.5	98.9
1	B	94.8	0.0	0.1	2.2	97.1
3	A	88.3	0.0	0.9	7.0	96.2
3	B	91.4	0.0	1.0	5.6	98.1
7	A	83.1	0.1	1.6	10.8	95.6
7	B	82.8	0.1	2.4	9.5	94.7
14	A	67.8	0.1	6.6	15.5	90.1
14	B	69.3	0.1	6.7	16.3	91.1
30	A	59.8	0.2	8.4	21.2	89.6
30	B	58.7	0.2	9.4	20.7	88.9
63	A	35.0	0.2	10.0	39.4	84.6
63	B	33.8	0.2	10.0	40.5	84.6
93	A	24.8	0.2	10.3	53.6	88.9
93	B	24.9	0.2	10.3	51.9	87.3
Mean						93.1
Std.Dev.						5.7

DPMA = dpm applied.

[a] For the Day 63 and Day 93 samples, this value includes the % DPMA in the water layer (see Section 4.6).

Table 4: Total Accountability of Applied ^{14}C-Radioactivity in the MON 13900 Anaerobic Soil Metabolism Study; Sarpy Sandy Loam Soil

Study Day	Replicate	% DPMA in Extracts[a]	% DPMA as Volatiles	% DPMA as CO_2	% DPMA Bound	% Total Accountability
0	A	101.5	0.0	0.0	0.7	102.2
0	B	101.5	0.0	0.0	0.8	102.3
1	A	97.1	0.0	0.2	2.3	99.6
1	B	98.3	0.1	0.2	2.2	100.8
3	A	91.1	0.1	1.1	5.7	97.9
3	B	91.9	0.0	1.1	5.6	98.6
7	A	87.5	0.1	2.2	9.1	98.9
7	B	85.3	0.0	2.8	10.1	98.2
14	A	76.3	0.1	6.1	14.5	97.0
14	B	75.1	0.1	6.2	11.4	92.8
30	A	73.7	0.3	8.7	12.4	97.2
30	B	76.6	0.4	8.7	12.2	97.9
63	A	49.6	0.4	9.0	33.0	92.0
63	B	54.5	0.4	9.0	26.6	90.5
93	A	44.6	0.4	9.2	38.0	92.2
93	B	43.1	0.4	9.2	41.1	93.8
Mean						97.0
Std.Dev.						3.7

DPMA = dpm applied.

[a] For the Day 63 and Day 93 samples, this value includes the % DPMA in the water layer (see Section 4.6).

Table 11: Quantification of MON 13900 and Soil Metabolites from the Anaerobic Soil Metabolism Study by HPLC/RAD; Percent of Applied ^{14}C-Radioactivity; Sable Silt Loam Soil

Sample Day	Replicate	% DPMA Analyzed by HPLC/RAD	% DPMA in Fraction A	% DPMA in Fraction B	% DPMA in Fraction C	% DPMA in Fraction D (Peak 1)	% DPMA in Fraction D (Peak 2)	% DPMA as MON 13900
0	A	100.7	0.1	1.0	0.6	0.3	0.3	97.6
0	B	100.9		1.1	0.7	0.4	0.3	98.1
1	A	96.1	0.4	3.5	1.5	0.5	0.4	89.7
1	B	94.2	0.3	3.2	0.9	0.3	0.4	87.3
3	A	88.3		3.5	1.5			82.8
3	B	91.4	0.8	2.1	0.5			87.3
7	A	83.4	1.1	3.5	0.9			77.4
7	B	82.6		2.8	0.3			79.5
14	A	67.8	0.8	2.6	1.1			61.4
14	B	69.3	0.9	2.5	1.0			63.5
30	A	59.8	1.3	3.4	1.9	0.5		51.4
30	B	58.7	0.7	3.1	1.8			50.0
63	A	29.4	4.2	8.6		1.6	2.2	5.0
63	B	27.4	3.2	7.5		1.8	3.0	3.9
93	A	24.8	3.7	6.7		2.3	3.3	2.8
93	B	24.9	3.6	7.7		1.4	3.5	2.6

DPMA = dpm applied.
No entry = not detected.
Fraction B = MON 13900 Oxamic Acid II
Fraction C = MON 13900 Methyl Sulfoxide III
Fraction D1 = MON 13900 Alcohol IV
Fraction D2 = MON 13900 Methyl Sulfide V

Table 12: Quantification of MON 13900 and Soil Metabolites from the Anaerobic Soil Metabolism Study by HPLC/RAD; Percent of Applied ^{14}C-Radioactivity; Sable Silt Loam Soil; Averages of Duplicate Flasks (see Figures 16 and 18 for graphs)

Sample Day	% DPMA Analyzed by HPLC/RAD	% DPMA in Fraction A	% DPMA in Fraction B	% DPMA in Fraction C	% DPMA in Fraction D (Peak 1)	% DPMA in Fraction D (Peak 2)	% DPMA as MON 13900
0	100.8	0.1	1.0	0.7	0.3	0.3	97.9
1	95.2	0.3	3.4	1.2	0.4	0.4	88.5
3	89.8	0.8	2.8	1.0			85.0
7	83.0	1.1	3.2	0.6			78.5
14	68.5	0.8	2.6	1.0			62.5
30	59.2	1.0	3.3	1.9	0.5		50.7
63	28.4	3.7	8.1		1.7	2.6	4.4
93	24.9	3.7	7.2		1.8	3.4	2.7

DPMA = dpm applied.
No entry = not detected.

Fraction B = MON 13900 Oxamic Acid II
Fraction C = MON 13900 Methyl Sulfoxide III
Fraction D1 = MON 13900 Alcohol IV
Fraction D2 = MON 13900 Methyl Sulfide V

Table 14: Quantification of MON 13900 and Soil Metabolites from the Anaerobic Soil Metabolism Study by HPLC/RAD; Percent of Applied ^{14}C-Radioactivity; Sarpy Sandy Loam Soil

Sample Day	Replicate	% DPMA Analysed by HPLC/RAD	% DPMA in Fraction A	% DPMA in Fraction B	% DPMA in Fraction C	% DPMA in Fraction D (Peak 1)	% DPMA in Fraction D (Peak 2)	% DPMA as MON 13900
0	A	101.5		0.7	0.4	0.3		99.7
0	B	101.5	0.2	0.7	0.4	0.4		99.3
1	A	97.1		2.5	0.3	0.3		93.4
1	B	98.3	0.4	2.3	0.5	0.2		94.7
3	A	91.1	0.4	3.3	0.7	0.2		85.7
3	B	91.9	0.5	3.8	0.6			86.5
7	A	87.5	1.3	3.6	0.7			81.3
7	B	85.3	1.7	3.3	0.9			78.8
14	A	76.3	1.3	5.2	1.3			68.1
14	B	76.1	1.2	4.4	1.2			66.6
30	A	75.7	0.8	5.6	1.5			66.1
30	B	76.6	0.8	5.9	1.7			66.0
63	A	46.3	6.1	13.2		8.0	3.0	5.6
63	B	51.2	5.1	13.4		15.7	3.0	6.2
93	A	44.6	6.6	10.6		12.4	1.7	2.3
93	B	43.1	7.6	11.5		6.9	2.4	2.4

DPMA = dpm applied.
No entry = not detected.
Fraction B = MON 13900 Oxamic Acid II
Fraction C = MON 13900 Methyl Sulfoxide III
Fraction D1 = MON 13900 Alcohol IV
Fraction D2 = MON 13900 Methyl Sulfide V

Table 15: Quantification of MON 13900 and Soil Metabolites from the Anaerobic Soil Metabolism Study by HPLC/RAD; Percent of Applied ^{14}C-Radioactivity; Sarpy Sandy Loam Soil; Averages of Duplicate Flasks (see Figures 17 and 19 for graphs)

Sample Day	% DPMA Analyzed by HPLC/RAD	% DPMA in Fraction A	% DPMA in Fraction B	% DPMA in Fraction C	% DPMA in Fraction D (Peak 1)	% DPMA in Fraction D (Peak 2)	% DPMA as MON 13900
0	101.5	0.2	0.7	0.4	0.3		99.5
1	97.7	0.4	2.4	0.4	0.3		94.0
3	91.5	0.5	3.5	0.7	0.2		86.1
7	86.4	1.5	3.4	0.8			80.1
14	75.7	1.2	4.8	1.2			67.4
30	76.2	0.8	5.8	1.6			66.1
63	48.7	5.6	13.3		11.9	3.0	5.9
93	43.8	7.1	11.1		9.7	2.0	2.3

DPMA = dpm applied.
No entry = not detected.

Fraction B = MON 13900 Oxamic Acid II
Fraction C = MON 13900 Methyl Sulfoxide III
Fraction D1 = MON 13900 Alcohol IV
Fraction D2 = MON 13900 Methyl Sulfide V

Figure 4: Apparatus Used in the MON 13900 Anaerobic Soil Metabolism Studies, Aerobic Incubation Portion

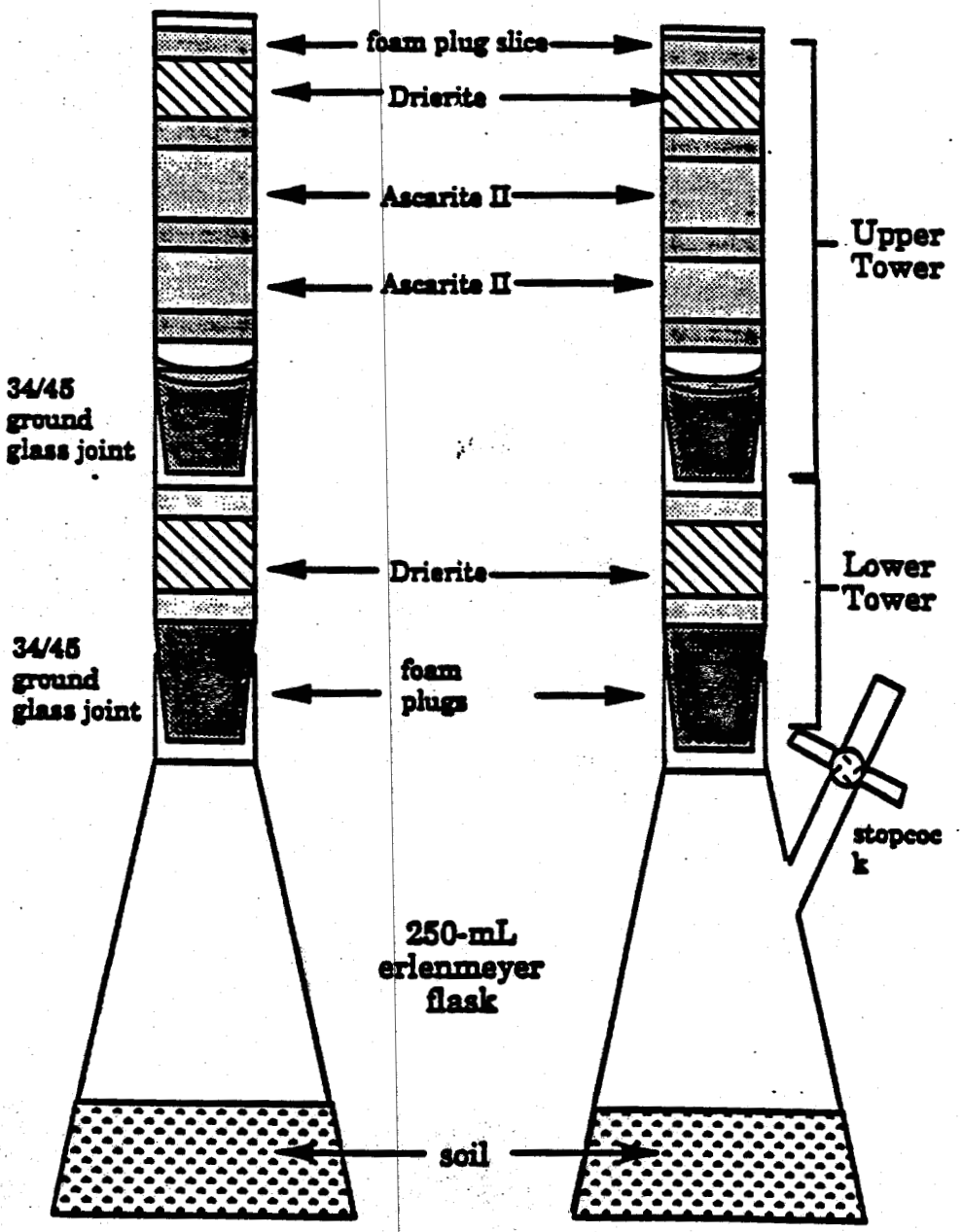


Figure 5: Apparatus Used in the MON 13900 Anaerobic Soil Metabolism Studies. Anaerobic Incubation Portion

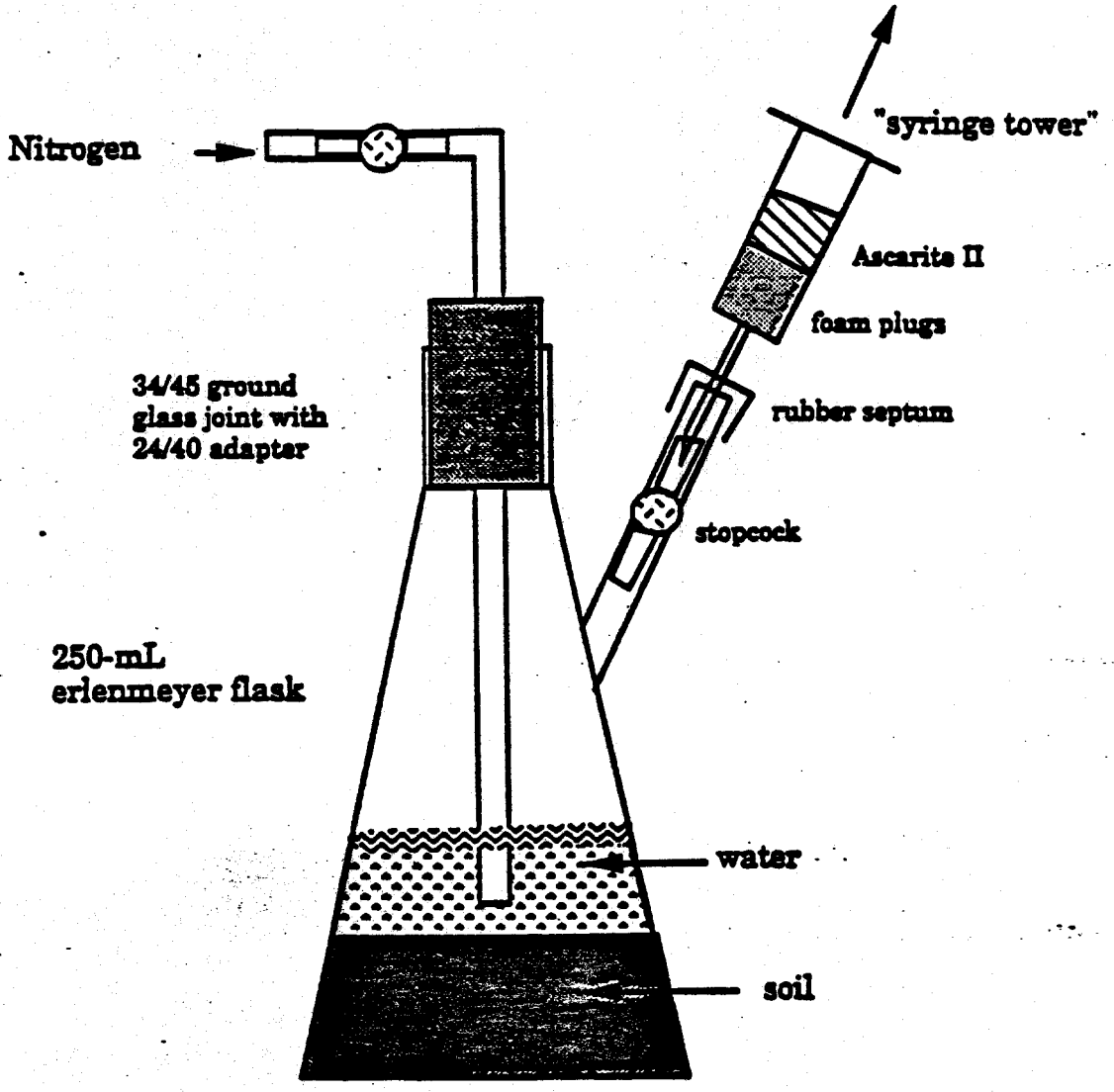
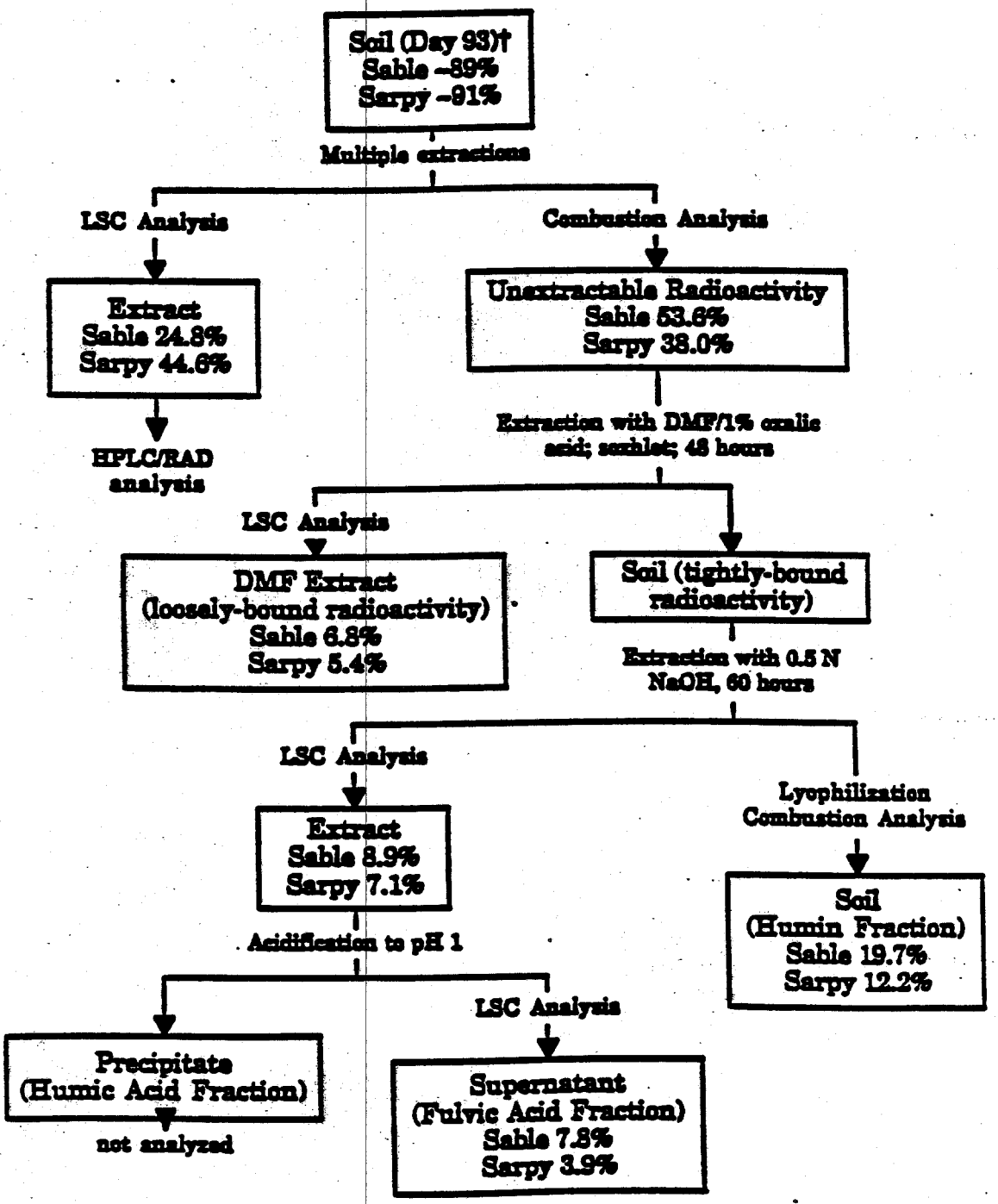
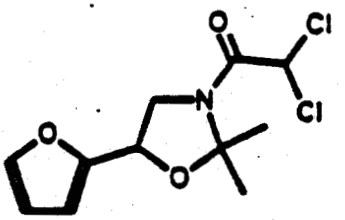


Figure 12: Procedure for Characterization of Bound Residues in Day 93 Soil from the MON 13900 Anaerobic Soil Metabolism Study



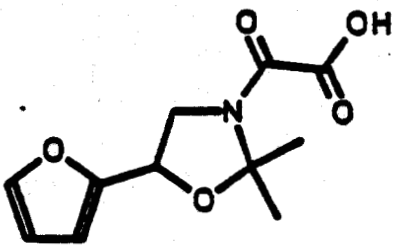
†All values are expressed as percent of applied dpm.
The soil was not analyzed by combustion analysis prior to extraction.
Initial percent dpm values were estimated based on radiolabeled carbon dioxide and volatile data.



I, MON 13900

4.7.2 Metabolite Fraction B

Metabolite Fraction B was the most abundant metabolite fraction in the soil extracts at the end of the study (Day 93), accounting for 7.2 and 11.1% of applied radioactivity in Sable and Sarpy soils, respectively. This fraction had the same retention time by HPLC/RAD as an authentic standard of the MON 13900 oxamic acid II. This fraction was positively identified in the MON 13900 Aerobic Soil Metabolism Study[1] by mass spectral and derivatization methods. Based on the HPLC retention time comparisons, Fraction B was identified as the MON 13900 oxamic acid II. Fraction B accounted for up to 8.1 and 13.3% of applied DPM on Day 63 in Sable and Sarpy soils, respectively.

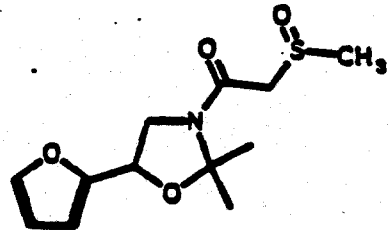


II, MON 13900 oxamic acid

4.7.3 Metabolite Fraction C

This fraction was observed in extracts of soil harvested during the aerobic portion of the experiment, and accounted for up to 1.9 and 1.6% of applied dpm in Sable and Sarpy soils, respectively. This fraction was not observed in the Day 63 or Day 93 samples. By HPLC/RAD, this fraction had a retention time nearly identical to that of the MON 13900 methyl sulfoxide III. Since this fraction was produced at very low levels during the aging period, and was not observed dur-

ing the anaerobic portion, no further characterization work was conducted with this fraction. Based on HPLC/RAD retention time comparisons, this fraction was tentatively characterized as the MON 13900 methyl sulfoxide III.

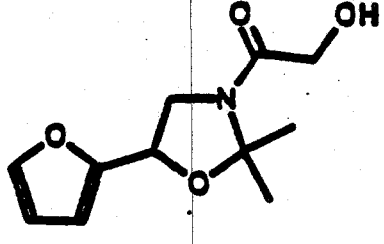


III, MON 13900 methyl sulfoxide

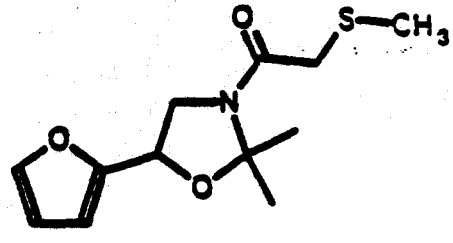
4.7.4 Metabolite Fraction D-1

Metabolite Fraction D-1 was present at very low levels during the aerobic portion of the experiment. However, during the anaerobic portion, the quantities of this fraction increased. This fraction was isolated from the Day 63 sample from the Sarpy experiment. The soil extract was concentrated to an aqueous solution and extracted with ethyl acetate. A portion of the ethyl acetate layer was concentrated to dryness, taken up in an appropriate solvent, and analyzed by HPLC/RAD. The aqueous layer was also analyzed by HPLC/RAD. The results indicated that the majority of Fraction D-1 was present in the ethyl acetate extract. The ethyl acetate extract was concentrated and analyzed by GC/CI mass spectrometry. Figure 11b (page 71) contains the GC/CI mass spectrum. The spectrum matches that of a synthetic standard of the MON 13900 alcohol IV (Figure 11a). Ions were observed at m/z 226, 227, 228 ($[M+H]^+$) and 168, 169, 180 ($[M+H\text{-}CH_3COCH_3]^+$).

Fraction D-1 was also derivatized with acetic anhydride/pyridine. A single derivative was formed. HPLC/RAD analysis of the acetylated derivative coeluted with an authentic standard of the acetate IVa. Based on the mass spectral analysis and retention time comparisons of Fraction D-1 and its acetate derivative with authentic standards, Fraction D-1 was characterized as the MON 13900 alcohol IV.



IV, MON 13900 alcohol



V, MON 13900 methyl sulfide

Table 2: Physical Properties of Soils Used in the MON 13900 Anaerobic Soil Metabolism Study[1]

	Sable	Sarpy
Textural Classification	silt loam	sandy loam
Order [2]	*	Entisol
USDA Classification [2]	*	mixed,mesic, Typic Udipsamment
Location	Monmouth, IL	New Bloomfield, MO
% Sand	19.00	59.00
% Silt	59.00	31.00
% Clay	22.00	10.00
pH (1:1 soil:H_2O)	6.70	8.00
Cation Exchange Capacity (meq/100g)	55.80	10.30
% Moisture at 1/3 atm (Field Capacity)	29.08	12.99
% Moisture at 15 atm (Wilting Point)	18.08	6.60
Bulk Density (g/mL)	1.10	1.11
% Organic Matter [3]	4.9	0.80
% Organic Carbon	*	0.38
% $CaCO_3$	1.10	4.58
Extractable Cations		
Ca	3210.00	1200.00
Mg	703.00	225.00
Na	42.00	120.00
K	242.00	131.00
H[4]	*	*

* Information not available.

[1] All data was generated (except where indicated) by A & L Agricultural Laboratories. 411 N. Third St., Memphis, TN; 1986 (Sable), 1987 (Sarpy).

[2] Information was obtained from Dr. Robert Held, soil scientist with the USDA Soil Conservation Service, Franklin, MO via phone communication, 1985.

[3] Determined colormetrically.

[4] Lab was unable to analyze for Hydrogen.