DYNAMAC
CORPORATION

METOLACHLOR

Final Report

FINAL REGISTRATION STANDARD AND TOLERANCE REASSESSMENT

Contract No. 68-02-4250

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Submitted to:
Environmental Protection Agency
Arlington, VA 22202

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METOLACHLOR

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INTRODUCTION

Metolachlor is an herbicide registered for use on terrestrial foodcrop (field crops), terrestrial nonfood crop (ornamentals and forest trees) and terrestrial noncrop (highway and railroad rights-of-way) sites. Application rates range from 1.25 to 4.05 lb ai/A. Metolachlor may be applied more than once per season; however, applications must not exceed 5.5 lb ai/A/season. Metolachlor single active ingredient formulations consist of 15 and 25% G, and 86.4% (8 lb/gal) EC. Metolachlor may be formulated with atrazine or propazine. Metolachlor is generally applied as a preplant or preemergence broadcast spray by ground or aerial equipment. Applicators need not be certified or under the direct supervision of applicators certified to apply metolachlor. No PIMS data were available for metolachlor.

CASE GS0001 METOLACHLOR STUDY 1 PM --

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 90 - FORMULATION NOT IDENTIFIED

FICHE/MASTER ID 00016300 CONTENT CAT 01
Aziz, S.A., and R.A. Kahrs. 1974. Photolysis of CGA-24705 in aqueous solution under natural and artificial sunlight conditions: Report No. GAAC-74041. Unpublished study received Sept. 26, 1974 under 5F1606; submitted by Ciga-Geigy Corp., Greensboro, NC; CDL:094385-D.

FICHE/MASTER ID 00016302 CONTENT CAT 01
Aziz, S.A., and R.A. Kahrs. 1975. Photolysis of CGA-24705 in aqueous solution--additional information: Report No. GAAC-75021. Unpublished study received on unknown date under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094385-M.

SUBST. CLASS = S.

DIRECT RVW TIME = 6 (MH) START-DATE END DATE

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Two hardcopies were reviewed for this study. One hardcopy (00016300) contained the photolysis experiment, and the other hardcopy (00016302) contained the experiment for the separation of polar photoproducts.

CONCLUSIONS:

Degradation - Photodegradation in Water

This study cannot be validated because the experimental conditions were referenced, rather than described, and the reference was not available for review. In addition, this study would not fulfill EPA Data Requirements for Registering Pesticides because the test substance was uncharacterized, the incubation temperatures were not reported, it was not reported if the test solutions were

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buffered or if wavelengths <290 nm were filtered out, the conditions under which dark controls were maintained were not reported, the natural sunlight conditions were not provided, the intensity and wavelength distribution of the artificial light source were not provided, and degradates that comprised >10% of the applied that were detected in the test solution irradiated with artificial light were not characterized.

MATERIALS AND METHODS:

A half-saturated aqueous solution of ring-labeled [^{14}C]metolachlor (test substance uncharacterized, source unspecified) at 265 ppm was exposed to artificial sunlight (light uncharacterized) and natural sunlight for 0, 1, 2, 4, 6, 9, 14, and 15 days, and 0, 7, 14, 21, and 30 days (for a total of ~11,600 Langley units), respectively. Details of the exposure were described in Reference AG-208 (not provided).

Aliquots of the aqueous solution were extracted with chloroform. The extracts were analyzed by GLC with flame ionization detection, by TLC using benzene:chloroform:ethyl acetate (4:4:2) for the organic and aqueous phases, and by GC-MS to confirm identity. In order to separate the degradates the following eight TLC developer systems were employed: 1) methylene chloride:ethyl acetate (9:1), 2) methylene chloride, 3) hexane:methylene chloride:ethyl acetate (6:2:2), 4) ethyl acetate:hexane (8:2), 5) hexane: benzene:methanol:ethyl acetate (80:10:10:2), 6) benzene:chloroform:ethyl acetate (4:4:2), 7) chloroform:methanol:formic acid:water (75:20:4:2), and 8) chloroform: methanol:formic acid:water (90:9:0.5:0.5). [^{14}C]Metolachlor and its degradation products were quantified by measuring the radioactivity of the separate zones on the TLC plates (method not described). Recovery from fortified samples ranged from 86-90%.

In an additional, related experiment the polar degradates that remained at the origin of the TLC plates described above were separated on additional TLC plates using chloroform:methanol (9:1). The developed plates were sprayed with diazonium fluoroborate or chromotropic acid.

REPORTED RESULTS:

[^{14}C]Metholachlor at 265 ppm in a half-saturated aqueous solution degraded slightly (~8%) when exposed to natural sunlight for 30 days (Table 1). ← However, when exposed to artificial sunlight [^{14}C]metolachlor degraded to 40% of applied (~69% photolysis) in 15 days. ← The degradates (see Appendix for structures) 4-(2-methyl-6-ethylphenyl)-5-methylmorpholin (CGA-40919) plus N-(2-hydroxyacetyl)-N-(1-methoxyprop-2-yl)-2-ethyl-6-methylaniline (CGA-40172) were detected in the organic phase after the chloroform extraction at 7.2 and 2.3% of applied radioactivity after exposure to artificial and natural sunlight, respectively, by the end of the exposure periods (Tables 2 & 3). Four unknown degradates were also detected for a combined total of 43.6 and 4.3% of applied radioactivity in the artificial and natural sunlight exposures, respectively. After 15 days of exposure to artificial light, ~100% of the applied radioactivity was recovered. Separation by TLC of the polar degradates is shown in Table 4. Spraying the plates with diazonium flurobarate or chromotropic acid gave negative reactions indicating that these unknown degradates did not contain aldehydes, N-hydroxymethyl, or phenol groups.

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DISCUSSION:

1. The experimental conditions were referenced (AG-208) rather than described, and the reference was not available for review. Therefore, it could not be determined what the incubation temperatures were, if the test solutions were buffered, or if wavelengths <290 nm were filtered out.

2. The test substance was uncharacterized.

3. The conditions under which dark controls were maintained were not reported.

4. The natural sunlight conditions, including light intensity, time periods of exposure, latitude, time of year, and atmospheric conditions, were not provided.

5. The intensity and wavelength distribution of the artificial light source were not reported.

6. Degradates that comprised >10% of the applied that were detected in the test solution irradiated with artificial light were not characterized.

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Table 1. [^{14}C]Metolachlor (% of applied) in an aqueous solution treated with [^{14}C]metolachlor at 265 ppm and irradiated with artificial and natural sunlight.

Sampling interval (days)	[^{14}C]Metolachlor (% of applied)[a]		Photolysis (%)[b]
	Dark control	Irradiated	
	Artificial sunlight		
0	100	100	0
1	103	96	7
2	104	91	13
4	108	83	25
6	106	76	30
9	95	62	33
14	109	41	68
15	109	40	69
	Natural sunlight		
0[c]	100	100	0
7	100	101	0
14	103	99	4
21	110	106	4
30	105	97	8

[a] Samples analyzed by GC.
[b] Calculated percent of photolysis based on the difference between the covered and exposed samples.
[c] One-day exposure is equivalent to ~375 Langley units for a total of 11,600 Langley units.

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Table 2. Distribution of radioactivity (%) in an aqueous solution treated with [^{14}C]metolachlor at 265 ppm and irradiated with artificial light for 15 days.

Compound	R_f[b]	Radioactivity (%)[a]	
		Artificial sunlight	
		Dark control	Irradiated
		Organic phase	
[^{14}C]Metolachlor	0.44	98.3[c]	42.4[d]
Two unknowns	0.35	ND[e]	3.4
CGA-40919[f] and CGA-40172[g]	0.23	ND	7.2
Unknown	0.00	ND	17.2
		Aqueous phase	
Unknowns	0.00	ND	23.0

[a] Percent of applied.

[b] The TLC developing solvent was benzene:chloroform:ethyl acetate (4:4:2).

[c] Contains traces of N-chloroacetyl-2-ethyl-6-methylaniline (CGA-13656).

[d] Contains CGA-13656 as a minor component (~2.4%). See Appendix for structure.

[e] Not detected; detection limit not reported.

[f] CGA-40919 is 4-(2-methyl-6-ethylphenyl)-5-methylmorpholin.

[g] CGA-40172 is N-(2-hydroxyacetyl)-N-(1-methoxyprop-2-yl)-2-ethyl-6-methylaniline.

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Table 3. Distribution of radioactivity (%) in an aqueous solution treated with [^{14}C]metolachlor at 265 ppm and irradiated with artificial light for 30 days.

Compound	R_f[b]	Radioactivity (%)[a]	
		Artificial sunlight	
		Dark control	Irradiated
		Organic phase	
[^{14}C]Metolachlor	0.44	97.2	93.5
Two unknowns	0.35	ND[c]	1.3
CGA-40919[d] and CGA-40172[e]	0.23	1.0	2.3
Unknown	0.00	ND	1.1
		Aqueous phase	
Unknowns	0.00	ND	1.9

[a] Percent of applied.

[b] The TLC developing solvent was benzene:chloroform:ethyl acetate (4:4:2).

[c] Not detected; detection limit not reported.

[d] CGA-40919 is 4-(2-methyl-6-ethylphenyl)-5-methylmorpholin.

[e] CGA-40172 is N-(2-hydroxyacetyl)-N-(1-methoxyprop-2-yl)-2-ethyl-6-methylaniline.

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Table 4. Radioactivity (% of applied) of unidentified polar degradates; separation by TLC[a].

	R_f	Radioactivity (% of applied)	
		Aqueous fraction[b]	Organic fraction[c]
Unknown 1	0.65	1.8	1.3
Unknown 2	0.54	4.6[d]	6.7[d]
Unknown 3	0.47	--	2.6
Unknown 4	0.36	2.1	2.5
Unknown 5	0.24	1.0	1.1
Unknown 6	0.10	5.7[d]	--
Unknown 7	0.00	3.4	1.5

[a] Separation on TLC using chloroform:methanol (9:1).

[b] Aqueous fraction of [^{14}C]metolachlor photolysis after extraction with chloroform.

[c] Chloroform soluble fraction of [^{14}C]metolachlor which stayed at the origin (TLC), using benzene:chloroform:ethyl acetate (4:4:2).

[d] Zone contained more than one component.

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CASE GS0001 METOLACHLOR STUDY 2 PM --

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 90 - FORMULATION NOT IDENTIFIED

FICHE/MASTER ID 00016301 CONTENT CAT 01

Aziz, S.A. 1974. Photolysis of CGA-24705 on soil slides under natural and artificial sunlight conditions: Report No. GAAC-74102. Unpublished study received Sept. 26, 1974 under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094385-D.

SUBST. CLASS = S.

DIRECT RVW TIME = 4 (MH) START-DATE END DATE

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CONCLUSIONS:

Degradation - Photodegradation on Soil

1. This study is scientifically valid.

2. [^{14}C]Metolachlor (test substance uncharacterized), at ~4.6 lb ai/A, degraded with a half-life of 48-144 hours at 39-44°C when irradiated with artificial light (uncharacterized) and 6-8 days (~3000 Langley units) at 50-55°C when irradiated with natural sunlight. The degradate N-propen-1-ol-2-yl-N-chloroacetyl-2-methyl-6-ethylaniline (CGA-41638) was ~4-6% of the applied in both the artificial light- and natural sunlight-irradiated samples; three unknown degradates were also isolated. Nonextractable [^{14}C]residues accounted for ~40% of the applied, and volatiles accounted for ~7-10% of the applied after 168 hours of irradiation with artificial light or 8 days of irradiation with natural sunlight.

3. This study partially fulfills EPA Data Requirements for Registering Pesticides by providing information on the photodegradation of metolachlor and its degradates on soil. However, the test substance was

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uncharacterized, the temperatures of incubation were outside the range of normal environmental conditions, and the artificial light source was not characterized.

MATERIALS AND METHODS:

Glass slides (0.6 x 3 inches) were covered with a 0.25-mm thick layer of sterilized silt loam soil (17.6% sand, 61.2% silt, 21.2% clay, 2.9% organic matter, pH 6.8, CEC 19.1 meq/100 g). Ring-labeled [^{14}C]metolachlor (test substance uncharacterized, source unspecified) was applied to the slides at 600 µg/slide (~4.6 lb ai/A). The slides were divided into two groups: a group irradiated with artificial light and a group irradiated with natural sunlight. The slides were placed inside quartz bottles; half the slides in each group were covered to serve as dark controls.

One group of slides was irradiated with artificial light (light source uncharacterized) for 0, 2, 6, 24, 48, 144, and 168 hours. The temperature inside the quartz bottle was 39-44°C.

The second group of slides was irradiated with natural sunlight for 0, 1, 2, 3, 6, 8, and 14 days. The exposure, which occurred during the spring in Greensboro, NC, was equivalent to 375 Langley units per day; 16 days of exposure amounted to ~5000 Langley units. The temperature inside the quartz bottle was 50-55°C during daylight hours.

The soil samples were extracted with chloroform, and the extracts were analyzed by TLC using benzene:chloroform:ethyl acetate (4:4:2). The zones on the plates were scraped and analyzed by LSC to determine total radioactivity and by GC with flame ionization detection to identify the photodegradation products. Comparisons were made to standards. Radioactivity remaining in the extracted soil was determined using LSC following combustion. Recovery from fortified samples ranged from 87 to 93% of the applied. Also, the quartz bottles were washed with chloroform following sampling, and the washings were analyzed using LSC and GC as described.

REPORTED RESULTS:

[^{14}C]Metolachlor degraded with a half-life of 48-144 hours when irradiated with artificial light and 6-8 days when irradiated with natural sunlight (Table 1). The degradate, N-propen-1-ol-2-yl-N-chloroacetyl-2-methyl-6-ethylaniline (CGA-41638, see Appendix for structure) was detected in the artificial and natural sunlight irradiated samples at 5.6 and 3.9% of applied radioactivity, respectively (Tables 2 and 3). Three unknown degradates were also detected accounting for a total of 16.4% and 7.7% of applied radioactivity in the artificial and natural sunlight exposures, respectively. Nonextractable [^{14}C]residues accounted for ~40% of the applied.

Some volatilization occurred from the treated soil. Approximately 6.8% of the applied radioactivity was recovered from the walls of the quartz flask used in the artificial light irradiation study,

and ~10.5% was recovered from the flask used in the natural sunlight irradiation study. The majority (amount unspecified) of the volatiles proved to be [^{14}C]metolachlor.

The material balance at the final sampling interval ranged from 92.4 to 98.2% of the applied.

DISCUSSION:

1. The test substance was uncharacterized.

2. The temperatures of incubation were outside the range of normal environmental conditions.

3. The artificial light source was not characterized; intensity and wavelength distribution were not compared to natural sunlight.

4. The detection limit for the TLC analyses was not specified.

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Table 1. [^{14}C]Metolachlor (% of applied) on silt loam soil treated with [^{14}C]metolachlor at ~4.6 lb ai/A and irradiadated with artificial and natural sunlight.

Sampling interval	Dark Control	Irradiated
	Artificial light	
(Hours)		
0	100	100
2	100	93
6	100	85
24	97	76
48	100	60
144	80	38
168	82	30
	Natural sunlight	
(Days)[a]		
0	100	100
1	85	92
2	96	88
3	80	69
6	80	48
8	80	30
14	85	11

[a] One-day exposure is equivalent to ~375 Langley units; total exposure was ~5000 Langley units.

Table 2. [^{14}C]Residues (% of applied) on silt loam soil treated with [^{14}C]metolachlor at ~4.6 lb ai/A and irradiadated for 168 hours with artificial light at 39-44°C or for 8 days (~5000 Langley units) with natural sunlight at 50-55°C.

Compound	R_f	Dark Control	Irradiated
		Artificial light	
[^{14}C]Metolachlor	0.44	87.9	24.1
Unknown	0.35	1.8	4.2
CGA-41638[a]	0.23	ND[b]	5.6
Unknown	0.12	ND	7.9
Unknown	0.00	ND	4.3
		Natural sunlight	
[^{14}C]Metolachlor	0.44	80.1	32.7
Unknown	0.35	1.9	2.4
CGA-41638[a]	0.23	ND[b]	3.9
Unknown	0.12	ND	3.9
Unknown	0.00	ND	1.4

[a] CGA-41638 is N-propen-1-ol-2-yl-N-chloracetyl-2-methyl-6-ethylaniline.

[b] Not detected, detection limit was not specified.

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CASE GS0001 METOLACHLOR STUDY 3 PM --

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 90 - FORMULATION NOT IDENTIFIED

FICHE/MASTER ID 00016296 CONTENT CAT 01

Kaiser, F.E. 1974. Soil degradation study of Gba-Geigy (sic) ^{14}C-CGA-24705. Unpublished study received Mar. 27, 1975 under 5F1606; prepared by Analytical Biochemistry Laboratories, Inc., submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094376-N.

SUBST. CLASS = S.

DIRECT RVW TIME = 6 (MH) START-DATE END DATE

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CONCLUSIONS:

Metabolism - Aerobic Soil

1. This study is scientifically valid.

2. [^{14}C]Metolachlor (purity unspecified) at 8 ppm was essentially stable in loamy sand soil, over a period of 64 days. Sterilization of the soil had no appreciable effect on degradation. The soil moisture was maintained at 60% of field capacity (temperature unspecified).

3. This study partially fulfills EPA Data Requirements for Registering Pesticides by providing information on the aerobic soil metabolism of parent metolachlor, However, the incubation temperature was not reported, the study was conducted for an insufficient length of time, and degradates were not identified.

MATERIALS AND METHODS:

Aliquots of loamy sand soil (82.8% sand, 13.6% silt, 3.6% clay, 1.5% organic matter, CEC 2.6 meq/100 g, pH 6.9) were placed in jars, and one-half of the jars were sterilized by autoclaving. The soil in the jars

was treated with [^{14}C]metolachlor (specific activity 10.3 µCi/mg, purity and source unspecified) at ~200 µg/25 g (8 ppm) of soil in acetone. The acetone was evaporated, the soil mixed, and sterilized water was added to bring the moisture content of the soil to ~60% of field capacity. The jars were closed with caps which had a one-half inch hole plugged with polyurethane. The jars were incubated under unspecified conditions and samples were taken at 0, 2, 4, 8, 16, 32, and 64 days.

Soil samples (10 g) were extracted with methanol:water (9:1), filtered, the filtrate concentrated, and brought up to volume (10 ml) in acetone. Aliquots of the extract were analyzed by LSC to determine total [^{14}C]radioactivity. Aliquots (50 µl) of the extract were also spotted on silica gel TLC plates, developed with hexane:chloroform:ethylacetate (6:2:2), the plates dried, subjected to autoradiography, and compared to standards. The spots were scraped from the plates and radioactivity quantified by LSC. The extracted soil was combusted and radioactivity quantified by LSC. The LSC counting efficiency was ~77%.

REPORTED RESULTS:

[^{14}C]Metolachlor at ~200 µg/25 g was essentially stable in loamy sand soil, over a period of 64 days (Table 1). Sterilization of the soil had no appreciable effect on degradation. Total [^{14}C]radioactivity in the soil remained relatively constant during the study (Table 2). The recovery of [^{14}C]metolachlor from the TLC plates ranged from 87.2% to 98.4% of applied.

DISCUSSION:

1. The study was conducted for an insufficient length of time; half-life estimates could not be made.

2. The incubation temperature was not reported.

3. Degradates were not identified, but the authors state that degradation products were not found on the TLC plates. The amount of degradation of the parent was low (~15%).

Table 1. [^{14}C]Radioactivity (µg) and [^{14}C]metolachlor (µg) in extracts of sterile and nonsterile loamy sand soil treated with [^{14}C]-metolachlor at ~200 µg/25 g[a] and incubated in jars for up to 64 days.[b]

Sampling interval (days)	[^{14}C]Radioactivity		[^{14}C]Metolachlor	
	Sterile	Nonsterile	Sterile	Nonsterile
0	193	186	185	184
2	188	190	183	180
4	188	184	185	188
8	195	184	201	188
16	181	170	180	170
32	164	160	150	151
64	181	174	170	159

[a] Ten out of a total 25 g of soil was extracted and data were extrapolated to 25 g of soil.

[b] Figures represent the average of 3 replications, and are corrected for recovery.

Table 2. [^{14}C]Radioactivity (µg) in sterile and nonsterile loamy sand soil treated with [^{14}C]metolachlor at ~200 µg/25 g[a], incubated for up to 64 days.[b]

Sampling interval (days)	[^{14}C]Radioactivity	
	Sterile	Nonsterile
0	176	183
2	177	180
4	188	178
8	195	189
16	194	187
32	195	183
64	182	177

[a] Five hundred mg of soil was combusted and the data were extrapolated to 25 g of soil.

[b] Figures represent the average of 3 replications, and are corrected for recovery.

CASE GS0001 METOLACHLOR STUDY 4 PM --

CHEM 108801 Metolachlor

BRANCH FAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00015656 CONTENT CAT 01

Dupre, G.D. 1974. Abbreviated anaerobic metabolism of ^{14}C-CGA-24705 in silt loam soil under greenhouse conditions: Report No. 73019-3. Unpublished study received Sept. 26, 1974 under 5G1553; prepared by Biodynamics, Inc., submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094222-B.

SUBST. CLASS = S.

DIRECT RVW TIME = 5 (MH) START-DATE END DATE

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CONCLUSIONS:

Metabolism - Aerobic Soil

This portion of the study cannot be validated because all data were reported only as percent recovered, so no comparisons could be made between sampling intervals or treatments. In addition, this portion of the study would not fulfill EPA Data Requirements for Registering Pesticides because there was no material balance, the degradation of metolachlor and the formation and decline of degradates were not addressed, the purity of the test substance was not reported, the incubation temperature was not reported, and no immediate posttreatment samples were taken to confirm the application rate.

Metabolism - Anaerobic Soil

This portion of the study cannot be validated because all data were reported only as percent recovered, so no comparisons could be made between sampling intervals or treatments. In addition, this portion of the study would not fulfill EPA Data Requirements for Registering Pesti-

cides because there was no material balance, the degradation of metolachlor and the formation and decline of degradates were not addressed, the purity of the test substance was not reported, the incubation temperature was not reported, and no immediate posttreatment samples were taken to confirm the application rate.

MATERIALS AND METHODS:

Metabolism - Aerobic Soil

Hastings silt loam soil (17.2% sand, 61.2% silt, 19.6% clay, 2.9% organic matter, pH 5.7) was sieved (<0.5 in) and treated with uniformly ring-labeled [^{14}C]metolachlor (CGA-24705, specific activity 2.5 µCi/mg, purity unspecified, Ciba-Geigy Corp.) at a rate of 4 ppm (2 mg/500 g of soil). The soil was placed in a sealable glass incubation tank equipped with a gas inlet and outlet adapter connected with Tygon tubing to a gas wash bottle. The soil moisture content was adjusted to 63-65% by weight with an average moisture content of 65% of field capacity. Air was purged through the system through the volatile gas washing bottle at intervals of ~3 days for collection of volatile components.

Two soil samples (10 g each, dry basis) were analyzed for polar and nonpolar extractable, nonextractable, and volatile components at 30, 60, and 90 days after treatment. Soil samples were extracted once with methanol:water (9:1) and then partitioned with water: chloroform (1:1). $^{14}CO_2$ and other volatile degradation products were collected from the incubation chamber for assay at the above intervals. All assays of ^{14}C-activity were performed using LSC.

Metabolism - Anaerobic Soil

In a separate experiment, one-half of the soil treated with [^{14}C]-metolachlor at 4 ppm and aged for 30 days under aerobic conditions, as described previously, was then incubated anaerobically with nitrogen for a period of 60 days. Nitrogen was purged through the system through the volatile gas washing bottle at intervals of ~3 days for collection of volatile components.

Soil samples were taken for analysis and traps were analyzed for ^{14}CO, and other volatile degradation products at 30 and 60 days during anaerobic incubation (60 and 90 days after treatment). Samples were extracted and analyzed for ^{14}C-activity as previously described.

REPORTED RESULTS:

Metabolism - Aerobic Soil

Incubation of [^{14}C]metolachlor, at 4 ppm in Hastings silt loam soil under aerobic conditions, produced only trace amounts of $^{14}CO_2$ or other volatile degradates (Table 1).

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Metabolism - Anaerobic Soil

Incubation of [^{14}C]metolachlor, at 4 ppm in Hastings silt loam soil under anaerobic conditions, produced only trace amounts of $^{14}CO_2$ or other volatile degradates. Distribution of radioactivity resulting from aging under aerobic and anaerobic conditions was similar (Table 1).

DISCUSSION:

General

1. All data were reported only as percent of recovered, and there was no material balance. Therefore, no comparisons can be made between sampling intervals and between treatments.

2. The study was designed to determine whether the gross degradation products (i.e. volatiles, nonpolar and polar extractable compounds, and unextractable compounds) of aerobically and anaerobically metabolized pesticides were similar. No attempt was made to isolate or identify degradates or establish a pattern of formation and decline of degradates. The concentration of [^{14}C]metolachlor was not determined at any time during the study.

3. The purity of the test substance was not reported.

4. The incubation temperature was not reported.

5. Although it was reported that samples were taken immediately after treatment, no data from the sampling interval were reported.

Table 1. Radioactivity (% of recovered) resulting from incorporation of [^{14}C]metolachlor at 4 ppm into Hasting silt loam soil.

System	Interval (days)	Volatiles	Extractable		Nonextractable
			Nonpolar	Polar	
Aerobic	30	<0.1	53	8	40
Aerobic	60	<0.1	46	13	40
Aerobic	90	0.3	39	7	54
Anaerobic[a]	30	<0.1	49	11	39
Anaerobic	60	<0.1	42	6	53

[a] The soil was divided 30 days after incubation under aerobic conditions and one-half placed in a separate incubation chamber under anaerobic conditions.

CASE GS0001 METOLACHLOR STUDY 5 PM --

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00078291 CONTENT CAT 01

Burkhard, N. 1978. Adsorption and desorption of metolachlor (Dual) in various soil types: Project Report 45/78. Unpublished study received July 23, 1981 under 100-587; prepared by Ciba-Geigy, Ltd., Switzerland, submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:245627-D.

SUBST. CLASS = S.

DIRECT RVW TIME = 4 (MH) START-DATE END DATE

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CONCLUSIONS:

Mobility - Leaching and Adsorption/Desorption

1. This study is scientifically valid.

2. [^{14}C]Metolachlor (purity unspecified) at 1-10 ppm adsorbed to sandy clay loam, loam, and two sand soils with Freundlich adsorption constants (K) ranging from 1.54 to 10 µg/g indicating mobility in these soils. Except for one sand soil, as soil organic matter content increased, adsorption increased. In loam soil [^{14}C]metolachlor desorbed with K values of 4.87 and 3.57 after 1 and 3 days, respectively. Adsorption and desorption occurred at about the same rate.

3. This study partially fulfills EPA Data Requirements for Registering Pesticides by providing information on the adsorption of parent metolachlor. However, the study was not conducted in a 0.01 N calcium ion solution, and desorption data were reported for only one of the four soils tested, and the majority of the study was conducted on foreign soils, and there is no discussion of metolachlor degradates.

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MATERIALS AND METHODS:

Samples (10-50 g) of four oven-dried soils (Table 1) were mixed with aqueous solutions (100 ml) of ring-labeled [^{14}C]metolachlor (analytical grade, specific activity 20.8 µCi/mg, purity and source unspecified) at 1.0, 2.5, 5.0, and 10.0 ppm in centrifuge tubes. The tubes were shaken for 24 hours at 20°C. [This period of time (24 hours) was found to be sufficient to reach adsorption equilibrium. (Hance, R.J. 1967. The speed of sorption equilibria in some systems involving herbicides. Weed Sci. I, 29-36.)] The samples were filtered, and the filtrate was brought up to volume (100 ml) with distilled water. Aliquots (0.5 ml) of the filtrate were analyzed for [^{14}C]metolachlor by LSC and GLC.

After adsorption, desorption was determined by weighing the filtered soil to determine the amount of water retained. Distilled water was added for a total volume of 100 ml. The samples were shaken for 1 or 3 days at 20°C, filtered, and aliquots (0.5 ml) of the filtrate were analyzed for [^{14}C]metolachlor by LSC and GLC. The air-dried, filtered soil was combusted and analyzed by LSC.

The equilibrium concentrations (C_e) of metolachlor were derived by regression analysis and the amount adsorbed was calculated. The Freundlich adsorption constants were calculated by using the equation $x/m = K \cdot C_e^{\ 1/n}$; where x/m is the amount adsorbed by unit mass of adsorbent when in equilibrium with a solution of concentration C_e, K and 1/n are constants for the given system and temperature. Also, O, the amount of metolachlor (µg) adsorbed per gram of organic matter (OM) was calculated by the equation O = 100 K/% OM. Adsorption and desorption isotherms were constructed.

REPORTED RESULTS:

[^{14}C]Metolachlor at 1-10 ppm was adsorbed to sandy clay loam, loam, and two sand soils with adsorption constants (K) ranging from 1.54 to 10 µg/g (Table 2) indicating mobility in these soils. Except for Lakeland sand, as organic matter content of the soil increased, adsorption increased. Freundlich adsorption isotherms are shown in Figure 1. In loam soil [^{14}C]metolachlor desorbed with K values of 4.87 and 3.57 after 1 and 3 days, respectively (Figure 2). Adsorption and desorption occurred at about the same rate.

DISCUSSION:

1. The study was not conducted in a 0.01 N calcium ion solution.

2. Desorption data were reported for the Les Evouettes loam soil only. These data were reported as a Freundlich K values and not as percent of the test substance desorbed.

3. Much of the data reported in this study was collected on foreign soils.

4. Study addresses only parent metolachlor. There is no discussion of metolachlor degradates.

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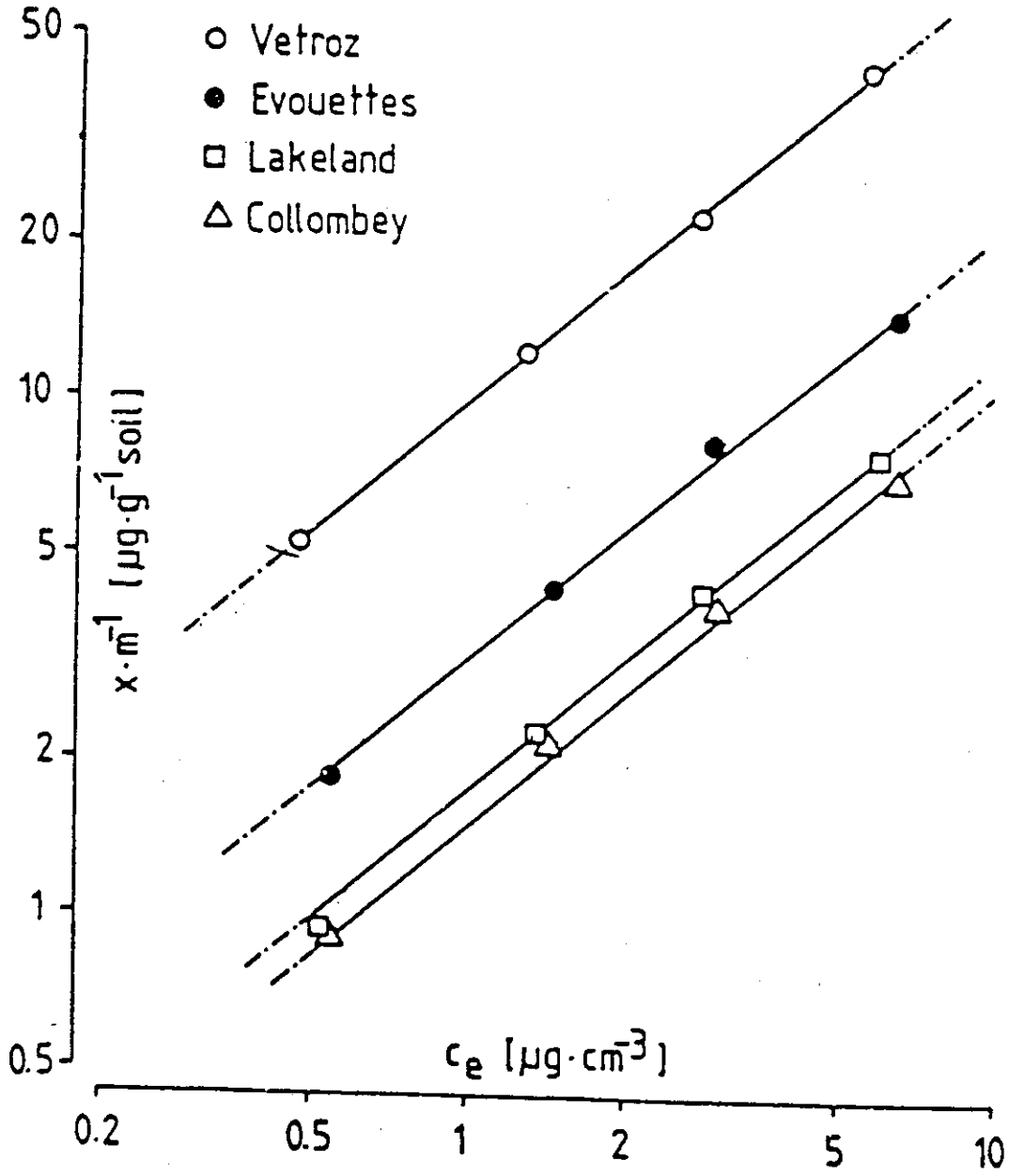

Figure 1. Freundlich adsorption isotherms of metolachlor in four soils, as presented in the hardcopy.

26

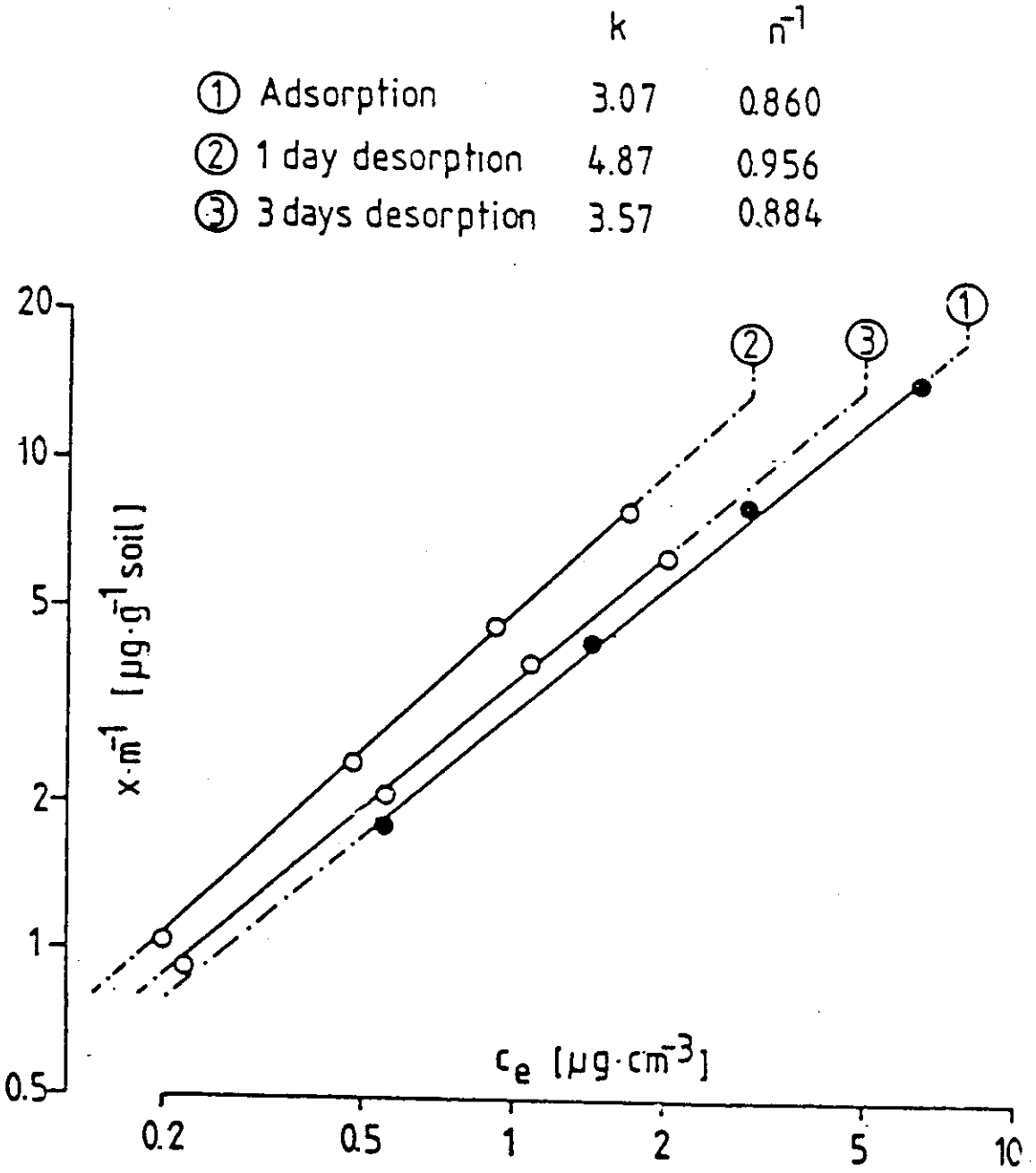

Figure 2. Freundlich adsorption and desorption isotherms of metolachlor in Les Evouettes loam soil, as presented in the hardcopy.

Table 1. Soil characteristics.

Soil	Sand	Silt	Clay	Organic matter	CEC (meq/100 g)	pH	K µg/l
			%				
Collombey sand (Switzerland)	87.0	10.2	2.8	2.2	14.0	7.8	1.6
Vetroz sandy clay loam (Switzerland)	57.8	19.6	22.6	5.6	29.4	6.7	11.3
Les Evouettes loam (Switzerland)	38.4	49.4	12.2	3.6	9.0	6.1	3.5
Lakeland sand (Florida, USA)	96.4	2.1	1.5	1.2	3.7	6.3	1.9

Table 2. Adsorption constants[a] of metolachlor at 1 to 10 ppm in four soils after 24 hours of incubation.

Soil	K (µg/g soil)	O (µg/g OM)	1/n
Vetroz sandy clay loam	10.0 (12.6)[b]	179 (225)	0.85 (0.79)
Les Evouettes loam	3.18 (3.78)	88 (105)	0.85 (0.87)
Collombey sand	1.54 (1.67)	70 (76)	0.84 (0.89)
Lakeland sand	1.69 (2.11)	141 (176)	0.85 (0.78)

[a] Figures represent analyses by LSC.

[b] Figures in parenthesis represent analyses by GLC.

CASE GS0001 METOLACHLOR STUDY 6 PM --

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00015657 CONTENT CAT 01

Dupre, G.D. 1974. Leaching characteristics of ^{14}C-CGA-24705 and its degradation products following aging in sandy loam soil under greenhouse conditions: Report No. 73021-6. Unpublished study received Sept. 26, 1974 under 5G1553; prepared by Biodynamics, Inc., submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094222-C.

SUBST. CLASS = S.

DIRECT RVW TIME = 4 (MH) START-DATE END DATE

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CONCLUSIONS:

Mobility - Leaching and Adsorption/Desorption

1. This study is scientifically valid.

2. Aged (30 days) [^{14}C]metolachlor (purity unspecified) residues were mobile in columns of loamy sand soil with ~26% of applied [^{14}C]radioactivity leached from the columns, and ~87% of the applied [^{14}C]radioactivity remaining in the soil. [^{14}C]Radioactivity was concentrated (~60% of applied) in the top 3 inches of soil.

3. This study partially fulfills EPA Data Requirements for Registering Pesticides by providing information on the mobility of aged (30 days) metolachlor residues. However, the purity of the test substance was unspecified, K_d values were not reported, and [^{14}C]metolachlor residues were not characterized.

MATERIALS AND METHODS:

Loamy sand soil (82.8% sand, 13.6% silt, 3.6% clay, 1.5% organic matter, CEC 2.6 meq/100 g, pH 6.9) was sieved (0.5 inch) and 100 g were treated with 20 g of ring-labeled [^{14}C]metolachlor (specific activity 2.5 Ci/mg, purity unspecified, Ciba-Geigy Corp.) and placed in a nylon mesh bag. The bag was then buried in untreated loamy sand soil to a depth of 1-2 inches. Water was sprayed on the soil to 60% field water capacity, and the soil was incubated under greenhouse conditions for 30 days. PVC soil columns (3 inch i.d. x 15 inches height) were packed with untreated loamy sand soil to a depth of 12 inches; the upper surface was covered with a wire screen and filter paper. The soil in the columns was saturated (subirrigation) and allowed to drain. An aliquot (10 g) of aged treated soil (equivalent to 4 lb ai/A) was added to the top of the soil columns covered with a wire screen and filter paper. Water was added to the columns at 0.5 inches per day for 45 days, for a total of 22.5 inches of water. The leachate was collected daily and after leaching the soil columns were segmented into 1-inch sections. Combusted soil samples and the leachate were analyzed by LSC to determine total [^{14}C]radioactivity.

REPORTED RESULTS:

Aged (30 days) [^{14}C]metolachlor residues were mobile in columns of loamy sand soil with 26% of applied [^{14}C]radioactivity leached from the columns (Table 1) and 87% of the applied [^{14}C]radioactivity remaining in the soil (Table 2). The greatest concentration (60%) of [^{14}C]radioactivity remained in the top 3 inches of the soil columns.

DISCUSSION:

1. The purity of the test substance was not specified.

2. Soil/water relationship (K_d) values were not reported.

3. The soil reported to be a sandy loam is, according to the USDA soil classification system, a loamy sand soil.

4. Greenhouse conditions, such as temperature, were not reported.

5. Aged [^{14}C]metolachlor residues were not characterized.

6. Materials balance indicates that 113% of applied radioactivity was recovered.

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Table 1. [^{14}C]Radioactivity (% of applied) in the leachate from aged (30 days) loamy sand soil treated with [^{14}C]metolachlor and placed on the top of untreated soil columns (12 inches), and leached with ~22.5 inches of water.

Water applied (inches)	[^{14}C]Radioactivity (% of applied)		Water applied (inches)	[^{14}C]Radioactivity (% of applied)	
	Incremental	Cumulative		Incremental	Cumulative
0 - 0.5	<0.1	<0.1	11.5 - 12.0	0.72	14.9
0.5 - 1.0	<0.1	<0.1	12.0 - 12.5	0.56	15.5
1.0 - 1.5	<0.1	<0.1	12.5 - 13.0	0.59	16.1
1.5 - 2.0	<0.1	<0.1	13.0 - 13.5	0.56	16.7
2.0 - 2.5	<0.1	<0.1	13.5 - 14.0	0.53	17.2
2.5 - 3.0	<0.1	<0.1	14.0 - 14.5	0.52	17.7
3.0 - 3.5	<0.1	<0.1	14.5 - 15.0	0.50	18.2
3.5 - 4.0	0.29	0.29	15.0 - 15.5	0.53	18.7
4.0 - 4.5	0.65	0.94	15.5 - 16.0	0.49	19.2
4.5 - 5.0	1.1	2.0	16.0 - 16.5	0.51	19.7
5.0 - 5.5	1.3	3.3	16.5 - 17.0	0.51	20.2
5.5 - 6.0	1.6	4.9	17.0 - 17.5	0.52	20.8
6.0 - 6.5	1.4	6.3	17.5 - 18.0	0.59	21.4
6.5 - 7.0	0.65	6.9	18.0 - 18.5	0.48	21.8
7.0 - 7.5	1.0	7.9	18.5 - 19.0	0.52	22.4
7.5 - 8.0	1.0	9.0	19.0 - 19.5	0.55	22.9
8.0 - 8.5	0.74	9.7	19.5 - 20.0	0.55	23.5
8.5 - 9.0	0.82	10.6	20.0 - 20.5	0.58	24.0
9.0 - 9.5	0.74	11.3	20.5 - 21.0	0.53	24.6
9.5 - 10.0	0.77	12.1	21.0 - 21.5	0.53	25.1
10.0 - 10.5	0.71	12.8	21.5 - 22.0	0.56	25.7
10.5 - 11.0	0.79	13.6	22.0 - 22.5	0.62	26.3
11.0 - 11.5	0.65	14.2			

Table 2. [^{14}C]Radioactivity (% of applied) from aged (30 days) loamy sand soil treated with [^{14}C]metolachlor and placed on the top of untreated soil columns (12 inches), and leached with ~22.5 inches of water.

Sampling interval (inches)	[^{14}C]Radioactivity (% of applied)	
	Incremental	Cumulative
0 - 1	42.8	42.8
1 - 2	14.0	56.8
2 - 3	4.4	61.2
3 - 4	5.0	66.2
4 - 5	5.1	71.3
5 - 6	3.6	74.9
6 - 7	3.8	78.7
7 - 8	3.0	81.7
8 - 9	2.0	83.7
9 - 10	1.1	84.8
10 - 11	0.90	85.7
11 - 12	1.0	86.7

CASE GS0001 METOLACHLOR STUDY 7 PM --

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00015659 CONTENT CAT 01

Houseworth, L.D. 19?? Report on parent leaching studies for CGA-24705: Report No. 1. Unpublished study received Sept. 26, 1974 under 5G1553; prepared by Univ. of Missouri, Dept. of Plant Pathology, submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094222-E.

SUBST. CLASS = S.

DIRECT RVW TIME = 3 (MH) START-DATE END DATE

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SIGNATURE: DATE:

CONCLUSIONS:

Mobility - Leaching and Adsorption/Desorption

1. This study is scientifically valid.

2. [^{14}C]Metolachlor (purity unspecified) residues were mobile in sandy loam, sand, and silt loam soils (detected to the 12-inch depth in 12-inch columns) when leached with 20 inches of water. [^{14}C]Metolachlor residues were immobile in peat soil with ~98.8% of the applied [^{14}C]radioactivity detected in the top 1-inch of soil. The leachate from the sandy loam, sand, loam, and silt loam soils contained 36.4, 20.9, 4.0, and 0.4% of the applied [^{14}C]radioactivity, respectively.

3. This study partially fulfills EPA Data Requirements for Registering Pesticides by providing information on the mobility of metolachlor residues. However, the purity of the test substance was unspecified, and K_d values were not reported.

MATERIALS AND METHODS:

Five soils (Table 1) were air-dried, screened (2 mm mesh) and placed in polyvinylchloride soil columns (3 x 12 inches, diameter x height). The soil was saturated with water and 5 g of soil treated with [^{14}C]-metolachlor (specific activity 2.5 µCi/mg, analytical grade, purity and source unspecified) at 1.9 mg (~3.7 lb ai/A) in acetone was placed on the surface of the soil in each column. Twenty inches of water were added to each column at 1 inch per hour. The leachate was collected, and after leaching the soil columns were separated into 1-inch sections. Aliquots of the leachate and the soil sections were analyzed by LSC to determine total radioactivity (analytical method not further described).

REPORTED RESULTS:

[^{14}C]Metolachlor residues were mobile in sandy loam, sand, loam, and silt loam soils, (detected to the 12-inch depth in 12-inch columns) when leached with 20 inches of water (Table 2). [^{14}C]Metolachlor residues were immobile in the peat soil with 98.8% of the applied [^{14}C]radioactivity detected in the top 1-inch of soil. The leachate from the sandy loam, sand, loam, and silt loam soils contained 36.4, 20.9, 4.0, and 0.4% of the applied [^{14}C]radioactivity, respectively.

DISCUSSION:

1. The analytical method was not described in detail; however, the data and material balance indicate that [^{14}C]metolachlor residues are mobile in non-peat soils.

2. The radiopurity of the test substance was unspecified.

3. Soil/water relationship (K_d) values were not reported.

4. The high organic matter soil was described as a muck soil (20-50% organic matter), but according to the USDA soil classification system it is a peat (>50% organic matter).

Table 1. Soil characteristics.

Soil (source)	Sand	Silt	Clay	Organic matter	CEC meq/100 g	pH
			%			
Peat (New York)	76.8	17.2	6.0	77.0	22.6	5.1
Silt loam (Indiana)	22.4	66.0	11.6	3.9	11.7	5.7
Sandy loam (Texas)	65.2	21.2	13.6	0.6	12.5	8.0
Loam (Louisiana)	42.8	49.6	7.6	0.7	10.9	6.1
Sand (Florida)	93.6	2.8	3.6	1.6	2.9	7.0

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Table 2. [^{14}C]Radioactivity (% of applied) in columns of five soils treated with [^{14}C]metolachlor and leached with ~20 inches of water.

Sampling depth (inches)	Soil type				
	Sandy loam	Sand	Loam	Silt loam	Muck
1	1.0	11.7	6.6	33.1	98.8
2	1.5	6.4	1.0	9.0	1.0
3	2.2	8.3	3.1	15.8	0.2
4	3.0	5.7	5.4	1.6	0.0
5	3.5	5.7	6.7	7.8	0.0
6	4.0	4.7	6.3	12.6	0.0
7	4.8	5.8	5.8	8.9	0.0
8	7.0	6.8	7.5	8.3	0.0
9	5.0	5.6	22.2	1.9	0.0
10	9.4	6.2	11.7	0.1	0.0
11	9.5	6.1	15.6	0.1	0.0
12	12.7	5.7	10.0	0.2	0.0
Leachate[a]	36.4	20.9	4.0	0.4	0.0

[a] Percent of applied [^{14}C]radioactivity.

CASE GS0001 METOLACHLOR STUDY 8 PM --

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 90 - FORMULATION NOT IDENTIFIED

FICHE/MASTER ID 00031328 CONTENT CAT 01

Harvey, R.G., and G.L. Jordan. 1978. Comparative study of the biological and physical properties of acetanilide herbicides in soil. Unpublished study received May 3, 1979 under 43142-1; prepared by Univ. of Wisconsin. Submitted by Roots Hercules Agrochemicals Co., Wilmington, DE; CDL:098274-H.

SUBST. CLASS = S.

DIRECT RVW TIME = 6 (MH) START-DATE END DATE

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CONCLUSIONS:

Mobility - Leaching and Adsorption/Desorption

1. This study is scientifically valid.

2. Freundlich adsorption K values of 0.58, 1.46, and 7.83 were calculated for [^{14}C]metolachlor (test substance uncharacterized) in sand, silt loam, and sandy loam soils, respectively. Adsorption was positively correlated to soil organic matter content.

3. This study partially fulfills EPA Data Requirements for Registering Pesticides by providing information on the adsorption of parent metolachlor. However, the test substance was uncharacterized and the study was not conducted in a 0.01 N calcium ion solution.

MATERIALS AND METHODS:

[^{14}C]Metolachlor (test substance uncharacterized, source unspecified) diluted with unlabeled metolachlor (test substance uncharacterized, source

unspecified), was added to air-dried, sieved (1 mm) Sebewa sandy loam, Plano silt loam, and Plainfield sand soils (Table 1) at 5 ml of 0.75, 1.50, 3.00, and 6.00 µM/5 g of soil. The herbicide-soil slurries were allowed to equilibrate at 25 ± 1°C for 16 hours in plastic centrifuge tubes on a horizontal shaker. The slurries were centrifuged, and aliquots of the supernatants were analyzed for total radioactivity using LSC. Adsorption (K_d) values were calculated as the difference between ^{14}C concentrations in the supernatants and standard solutions based on the average of 4 replicate tubes. In a related second experiment, metolachlor was added to ten soils (Table 1); however, materials and methods were not provided to described this experiment.

REPORTED RESULTS:

Metolachlor Freundlich adsorption K values of 7.83, 1.46, and 0.58 were calculated for Sebewa sandy loam, Plano silt loam, and Plainfield sand soils, respectively (Table 2). Adsorption was positively correlated with soil organic matter content.

DISCUSSION:

1. The test substance was uncharacterized.

2. Desorption experiments were not conducted.

3. No methodology was provided to support the data presented in Table 3. Therefore, these data cannot be validated.

4. Calculations were not provided to support Freundlich K values.

5. The study was not conducted in a 0.01 N calcium ion solution.

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Table 1. Soil characteristics.

Soil type	Sand	Silt	Clay	Organic matter	CEC (meq/100 g)	pH
		%				
Sebewa sandy loam	59	30	11	11.7	28.4	6.8
Poygan silt loam	23	62	15	9.5	33.6	7.0
Adolph silt loam	17	64	19	6.5	22.5	6.2
Plano silt loam	17	66	17	4.8	17.4	6.7
Withee silt loam	17	73	10	4.1	10.9	6.5
Ontonagon silty clay loam	12	61	27	3.7	13.8	6.6
Fayette silt loam	9	78	13	2.2	7.7	6.5
Peebles clay	27	12	61	2.0	23.2	7.4
Kewaunee clay loam	23	42	35	2.0	19.2	7.8
Plainfield sand	89	6	5	0.8	3.7	6.6

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Table 2. Freundlich K values in adsorption studies of three Wisconsin soils.

Soil	K	1/n	r
Plainfield sand	0.58	0.88	0.99
Plano silt loam	1.46	0.92	0.99
Sebewa sandy loam	7.83	0.96	0.99

Table 3. Adsorption of metolachlor at various concentrations to ten soils ranging in texture from sand to clay

Soil type	Initial Concentration							
	0.75 µM		1.5 µM		3.0 µM		6.0 µM	
	Equilibrium concentration (µg/ml)	Amount adsorbed (µg/g)	Equilibrium concentration (µg/ml)	Amount adsorbed (µg/g)	Equilibrium concentration (µg/ml)	Amount adsorbed (µg/g)	Equilibrium concentration (µg/ml)	Amount adsorbed (µg/g)
Sebewa sandy loam	0.02	0.18	0.05	0.28	0.12	0.73	0.24	1.46
Poygan silt loam	0.02	0.18	--[a]	0.28	0.16	0.69	--	--
Adolph silt loam	0.05	0.16	0.09	0.24	0.26	0.59	0.47	1.23
Piano silt loam	0.08	0.13	--	0.28	0.41	0.44	0.32	0.88
Withee silt loam	0.07	0.14	0.14	0.27	0.28	0.47	0.72	0.98
Ontonagon silty clay loam	0.06	0.15	0.11	0.22	0.32	0.53	0.63	1.07
Fayette silt loam	0.09	0.12	0.16	0.27	0.46	--	0.91	0.79
Peebles clay	0.08	0.13	--	0.28	0.44	0.41	0.85	0.85
Kewaunee clay loam	0.11	0.10	0.20	0.22	--	--	1.07	0.63
Plainfield sand	0.13	--	0.26	0.17	--	0.16	1.33	0.37

[a] Illegible.

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CASE GS0001 METOLACHLOR STUDY 9 PM --

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00015538 CONTENT CAT 01

Newby, L. 1979. Dual rotational studies: additional information: Report No. ABR-79091. Unpublished study received Aug. 1, 1979 under 100-583; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:238899-A.

SUBST. CLASS = S.

DIRECT RVW TIME = 4 (MH) START-DATE END DATE

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CONCLUSIONS:

Confined Accumulation - Rotational Crops

1. This study is scientifically valid.

2. Lettuce planted 14 weeks posttreatment and harvested at 26 weeks contained 0.025 ppm of [^{14}C]metolachlor residues. Lettuce planted 41 weeks posttreatment and sampled at 13 and 15 weeks contained 0.144 and 0.065 ppm of [^{14}C]metolachlor residues, respectively. Soil at ~40 and 56 weeks posttreatment contained ~70-80 and ~95% nonextractable [^{14}C]metolachlor residues, respectively.

3. This study does not fulfill EPA Data Requirements for Registering Pesticides because the test substance and soil were not characterized, residues in the soil and crop were not characterized, residues in the soil were not analyzed at the time of treatment or at the time of planting the rotational crop, and field test data were incomplete.

MATERIALS AND METHODS:

Soil (soil uncharacterized) outdoors in California was treated with uniformly, ring-labeled [^{14}C]metolachlor (specific activity, purity, and source unspecified) at 2 lb ai/A, and planted to soybeans. Lettuce (var.

source unspecified) at 2 lb ai/A, and planted to soybeans. Lettuce (var. Great Lakes) was planted as a rotational crop at 14 and 41 weeks posttreatment in the same soil. The first lettuce crop was harvested 26 weeks after planting, and the second lettuce crop was sampled after 13 weeks of growth, and harvested after 15 weeks.

Lettuce samples were analyzed for [^{14}C]metolachlor by a referenced method (Balasubramanian, K., S.A. Aziz, and J.A. Ross. 1975. Analytical method for the determination of residues of CGA-24705 corn metabolites as CGA-37913 and CGA-49751 by acid hydrolysis. Method AG-277) which was not provided but which was previously reviewed and validated by the EPA and found to be deficient for characterization of metolachlor degradates (i.e., a nonspecific method). The detection limit was 0.03 ppm for metolachlor in crops. Soil sampling and analysis were not described.

REPORTED RESULTS:

Lettuce planted 14 weeks posttreatment and harvested at 26 weeks contained 0.025 ppm of [^{14}C]metolachlor residues. Lettuce planted 41 weeks posttreatment and sampled at 13 and 15 weeks contained 0.144 and 0.065 ppm of [^{14}C]metolachlor residues, respectively. Soil at ~40 and 56 weeks posttreatment contained ~70-80 and ~95% nonextractable [^{14}C]metolachlor residues, respectively.

DISCUSSION:

1. The test substance was not completely characterized.

2. Complete field test data, such as amount of rainfall and irrigation water, depth to the water table, soil and air temperatures, techniques of planting and harvesting, application method, sampling techniques, and sample size, were not reported.

3. The plot size was not described; it maybe assumed that the plots were small (and confined) because a radiolabeled test substance was used.

4. The application rate in this study (2 lb ai/A) was not the maximum labeled rate (5.5 lb ai/A).

5. Soil sampling was not described. Pre- and immediate posttreatment samples were not taken to confirm the application rate. Soil samples were not taken at the 14-week planting of lettuce but were taken at the 41-week planting.

6. The analytical method for metolachlor in crops was nonspecific and residues in the crop could not be characterized.

7. The analytical method for metolachlor in soil was not described, and residues in the soil were not characterized.

8. Complete soil characteristics, such as textural analysis, organic matter content, pH, and CEC, were not reported.

CASE GS 0001 METOLACHLOR STUDY 10 PM --

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00022881
Sumner, D.D., and J.E. Cassidy. 1974. The uptake of phenyl-^{14}C-CGA-24705 and its aged soil degradation products in rotation soybeans: Report No. GAAC-74113. Unpublished study received June 30, 1978 under 100-583; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:234216-G.

SUBST. CLASS = S.

DIRECT RVW TIME = 4 (MH) START-DATE END DATE

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APPROVED BY: P. Mastradone
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TEL: 557-1993

SIGNATURE: DATE:

CONCLUSIONS:

Confined Accumulation - Rotational Crops

1. This study is scientifically valid.

2. [^{14}C]Metolachlor residues were detected in the whole plant (≤0.17 ppm), stalks (0.07 ppm), beans (0.04 ppm), meal (0.05 ppm), and oil (<0.01 ppm) of rotational soybeans planted 9 months after an application of [^{14}C]-metolachlor (purity unspecified) at 2 lb ai/A to silt loam soil. Total residues of [^{14}C]metolachlor in the silt loam soil were 0.26 ppm in the 0-3 inch depth at soybean planting and 0.06-0.35 ppm in the 0-9 inch profile in subsequent samplings through harvest.

3. This study partially fulfills EPA Data Requirements for Registering Pesticides by providing information on the uptake of metolachlor by rotational crops. However, the purity of the test substance was unspecified, soil samples were not taken at the time of treatment, residues in the soybeans and soil were not completely characterized, and a description of the growing conditions was not provided.

MATERIALS AND METHODS:

Ring-labeled [^{14}C]metolachlor (CGA-24705, specific activity 17.9 μCi/mg, purity and source unspecified) was applied to Bosket silt loam soil (26% sand, 62% silt, 12% clay, 0.9% organic content, CEC 9.6 meq/100 g, pH 5.6) in Greenville, MS, at 2 lb ai/A. The test material was surface applied to a 3 x 6 foot plot and soil samples were taken from the top 3 inches 32 weeks after application, and at depths of 0-3, 3-6, and 6-9 inches at 36, 44, and 48 weeks after application. Nine months after application of [^{14}C]metolachlor, the top 3 inches of soil were mixed and soybeans (var. Lee 68) were planted by hand. Plants were harvested, chopped, and immediately frozen at 4, 12, and 16 weeks after planting.

Soil was extracted with methanol:water (9:1); additional methods used in preparing the soil for analysis were referenced. The combustion procedure used to determine nonextractable materials and total radioactivity was also referenced, as was the method used (Karl Fischer titration) to determine soil moisture content. The above mentioned references were not provided. Frozen soybean plant samples were ground and extracted with methylene chloride and a methanol and water solution (ratio unspecified) to provide organic and aqueous extracts and nonextractable fractions. Ground plant material was combusted and radioactivity determined by LSC. Further details of the methods used for analysis of plant material were referenced (references not provided). Metolachlor extracts soluble in methanol:water were quantitated using a referenced ion exchange technique (reference not provided). Degradates in the stalks were ionically characterized as neutrals, acids, bases, and zwitterions by a partially described method (reference not provided) that used column chromatography. Radioassays were performed using LSC. The detection limit was 0.01 ppm.

REPORTED RESULTS:

[^{14}C]Metolachlor residues were detected in the whole plant (≤0.17 ppm), stalks (0.07 ppm), beans (0.04 ppm), meal (0.05 ppm), and oil (<0.01 ppm) of rotational soybeans planted 9 months after an application of [^{14}C]metolachlor at 2 lb ai/A (Table 1). In the whole plants, the residues were predominantly methanol:water soluble (65% of [^{14}C]residues recovered), but in the stalks and meal the residues were predominantly nonextractable (57 and 89% of recovered, respectively). Further characterization of the residues as acids (≤41%), neutrals (≤9%), bases (≤9%), and zwitterions (≤6%) are shown in Table 2. Total residues of [^{14}C]metolachlor in silt loam soil were 0.26 ppm in the 0-3 inch depth at soybean planting, and 0.06-0.35 ppm in the 0-9 inch profile in subsequent samplings through harvest (Table 3). Of the [^{14}C]residues in the at-planting and at-harvest soil samples, 10-19 and 81-91% were methanol:water soluble and nonextractable, respectively.

DISCUSSION:

1. The purity of the test substance was unspecified.

2. Residues in the soil were not analyzed at the time of treatment in order to confirm the application rate.

3. Residues in the soil were not characterized.

4. Residues in the soybeans were not completely characterized.

5. A description of the growing conditions, such as amount of rainfall, temperatures, and general climatic conditions were not reported.

6. Details of the analytical methods were referenced, but not provided.

7. The test substance was not applied at the maximum recommended use rate (5.5 lb ai/A).

Table 1. [^{14}C]Residues in rotational soybeans planted 9 months after application of [^{14}C]metolachlor at 2 lb ai/A to silt loam soil.

Substrate	Treatment to harvest (weeks)	Planting to harvest (weeks)	[^{14}C]Residues			
			Total (ppm)[a]	Methylene chloride extractable (%)[b]	Methanol: water extractable (%)[b]	Nonextractable (%)[b]
Whole plants	36	4	0.17	18	65	12
Whole plants	44	12	0.08	--	--	--
Stalks	48	16	0.07	9	36	57
Beans			0.04	--	--	--
Meal			0.05	3	14	89
Oil			<0.01	--	--	--

[a] Ppm equivalent [^{14}C]metolachlor.

[b] Percent of total radioactivity recovered.

Table 2. Ionic characterization of the methanol:water extractable [^{14}C]-residues in selected samples of rotational soybeans planted 9 months after an application of [^{14}C]metolachlor at 2 lb ai/A to silt loam soil.

Substrate	Treatment to harvest (weeks)	Neutrals	Acids	Bases	Zwitterions
		% [a]			
Whole plant	36	9	41	9	6
Stalks	48	5	29	2	<1

[a] Reported as percent of methanol:water soluble radioactivity.

Table 3. [^{14}C]Residues in Bosket silt loam soil in which rotational soybeans were grown following an application of [^{14}C]metolachlor at 2 lb ai/A 9 months previously.

Planting to harvest (weeks)	Treatment to harvest (weeks)	Sampling depth (inches)	[^{14}C]Residues		
			Total (ppm)[a]	Methanol: water extractable (%)[b]	Total non-extractable (%)[b]
0	32	0-3	0.26	19	81
4	36	0-3	0.30	--	--
		3-6	0.10	--	--
		6-9	0.17	--	--
12	44	0-3	0.35	--	--
		3-6	0.14	--	--
		6-9	0.06	--	--
16	48	0-3	0.21	10	91
		3-6	0.13	--	--
		6-9	0.09	--	--

[a] Ppm equivalent to [^{14}C]metolachlor.

[b] Percent of total radioactivity recovered.

CASE GS 0001 METOLACHLOR STUDY 11 PM

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00022882

Sumner, D.D., and J.E. Cassidy. 1974. The uptake of phenyl-^{14}C-CGA-24705 and its aged soil degradation products in rotation carrots: Report No. GAAC-74112. Unpublished study received June 30, 1978 under 100-583; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:234216-H.

SUBST. CLASS = S.

DIRECT RVW TIME = 4 (MH) START-DATE END DATE

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CONCLUSIONS:

Confined Accumulation - Rotational Crops

1. This study is scientifically valid.

2. [^{14}C]Metolachlor residues were detected in the whole plant (0.04 ppm), tops (0.09 ppm), and roots (0.06 ppm) of rotational carrots planted 9 months after an application of [^{14}C]metolachlor (purity unspecified) at 2 lb ai/A to silt loam soil. Total residues of [^{14}C]metolachlor in the silt loam soil were 0.26 ppm in the 0-3 inch depth at carrot planting, and 0.04-0.35 ppm in the 0-9 inch profile in the subsequent samplings through harvest.

3 This study partially fulfills EPA Data Requirements for Registering Pesticide by providing information on the uptake of metolachlor by rotational crops. However, the purity of the test substance was unspecified, soil samples were not taken at the time of treatment, residues in the carrots and soil were not completley characterized, and a description of the growing conditions was not provided.

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MATERIALS AND METHODS:

Ring-labeled [^{14}C]metolachlor (CGA-24705, specific activity 17.9 μCi/mg, purity and source unspecified) was applied to Bosket silt loam soil (26% sand, 62% silt, 12% clay, 0.9% organic content, CEC 9.6 meq/100 g, pH 5.6) in Greenville, MS, at 2 lb ai/A. The test material was surface applied to a 3 x 5 foot plot and soil samples were taken from the top 3 inches 32 weeks after application and from depths of 0-3, 3-6, and 6-9 inches at 41, 44, and 48 weeks after application. Nine months after the application of [^{14}C]metolachlor, the top 3 inches of soil were mixed, and carrots (var. Improved Long Orange) were planted by hand. Plants were harvested and immediately frozen at 9, 12, and 16 weeks after planting.

Soil was extracted with methanol:water (9:1); additional methods used in preparing the soil for analysis were referenced. The combustion procedure used to determine nonextractable materials and total radioactivity was also referenced, as was the method used (Karl Fischer titration) to determine soil moisture content. The above mentioned references were not provided.

Frozen carrot plant samples were ground and extracted with methylene chloride and a methanol:water solution (ratio unspecified) to provide organic and aqueous extracts and nonextractable fractions. Ground plant material was combusted and radioactivity determined by LSC. Further details of the methods used for analysis of plant material were referenced (reference not provided). Metolachlor extracts soluble in methanol:water were quantitated using a referenced ion exchange technique (reference not provided). Degradates in mature tops and roots were ionically characterized as neutrals, acids, bases, and zwitterions by a partially described method (reference not provided) that used column chromatography. Radioassays were performed using LSC; the detection limit was 0.01 ppm.

REPORTED RESULTS:

[^{14}C]Metolachlor residues were detected in the whole plant (0.04 ppm), tops (<0.09 ppm), and roots (<0.06 ppm) of rotational carrots planted 9 months after an application of [^{14}C]metolachlor at 2 lb ai/A (Table 1). In the tops and roots, the residues were primarily methanol:water soluble (45% of radioactivity recovered). Further characterization of the residues as acids (18%), neutrals (<5%), bases (<4%), and zwitterions (<4%) are shown in Table 2. Total residues of [^{14}C]metolachlor in silt loam soil were 0.26 ppm in the 0-3 inch depth at carrot planting, and 0.04-0.35 ppm in the 0-9 inch profile in subsequent samplings through harvest (Table 3). Of the radioactivity in the at-planting and at-harvest soil samples, 8-19 and 81-91% were methanol:water soluble and nonextractable, respectively.

DISCUSSION:

1. The purity of the test substance was unspecified.

2. Residues in the soil were not analyzed at the time of treatment in order to confirm the application rate (identified).

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3. Residues in the soil were not characterized (identified).

4. Residues in the carrots were not completely characterized.

5. A description of the growing conditions, such as the amount of rainfall, temperatures, and general climatic conditions, were not reported.

6. Details of the analytical methods were referenced, but not provided.

7. The test substance was not applied at the maximum recommended use rate (5.5 lb ai/A).

Table 1. [^{14}C]Residues in rotational carrots planted 9 months after application of [^{14}C]metolachlor at 2 lb ai/A to silt loam soil.

Substrate	Treatment to harvest (weeks)	Planting to harvest (weeks)	[^{14}C]Residues			
			Total (ppm)[a]	Methylene chloride extractable (%)[b]	Methanol: water extractable (%)[b]	Nonextractable (%)[b]
Whole plants	41	9	0.04	--	--	--
Tops	44	12	0.09	--	--	--
Roots			0.06	--	--	--
Tops	48	16	0.03	19	45	34
Roots			0.02	23	45	32

[a] Ppm equivalent to [^{14}C]metolachlor.

[b] Percent of total radioactivity recovered.

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Table 2. Ionic characterization of the methanol:water extractable [^{14}C]residues in selected samples of rotational carrots planted 9 months after an application of [^{14}C]metolachlor at 2 lb ai/A to silt loam soil.[a]

Substrate	Treatment to harvest (weeks)	Neutrals	Acids	Bases	Zwitterions
		%			
Tops	48	25	18	2	<2
Roots	48	19	18	4	4

[a] Reported as percent of methanol:water soluble radioactivity.

Table 3. [^{14}C]Residues in Bosket silt loam soil in which rotational carrots were grown following an application of [^{14}C]metolachlor at 2 lb ai/A 9 months previously.

Planting to harvest (weeks)	Treatment to harvest (weeks)	Sampling depth (inches)	[^{14}C]Residues		
			Total (ppm)[a]	Methanol: water extractable (%)[b]	Total non-extractable (%)[b]
0	32	0-3	0.26	19	81
9	41	0-3	0.21	--	--
		3-6	0.06	--	--
		6-9	0.04	--	--
12	44	0-3	0.35	--	--
		3-6	0.14	--	--
		6-9	0.06	--	--
16	48	0-3	0.12	8	91
		3-6	0.05	--	--
		6-9	0.04	--	--

[a] Ppm equivalent to [^{14}C]metolachlor.

[b] Percent of total radioactivity recovered.

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CASE GS 0001 METOLACHLOR STUDY 12 PM

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00022883 CONTENT CAT 01

Sumner, D.D., and J.E. Cassidy. 1974. The uptake of phenyl-^{14}C-CGA-24705 and its aged soil degradation products in rotation oats: Report No. GAAC-74085. Unpublished study received June 30, 1978 under 100-583; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:234216-I.

SUBST. CLASS = S.

DIRECT RVW TIME = 4 (MH) START-DATE END DATE

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CONCLUSIONS:

Confined Accumulation - Rotational Crops

1. This study is scientifically valid.

2. Residues of phenyl-labeled [^{14}C]metolachlor were taken up by greenhouse-grown, rotational oats planted 270 days after a 2.0 lb ai/A application to a silt loam soil. Total radioactivity was ≤0.17 ppm in forage sampled 300-330 days posttreatment, and 0.27 and 0.05 ppm in straw and grain, respectively, harvested 375 days posttreatment.

3. This study partially fulfills EPA Data Requirements for Registering Pesticides by providing information on the uptake of metolachlor by rotational crops. However, the test substance was not completely characterized; metolachlor was not applied at the maximum registered label rate, residue data were not provided for soil sampled immediately posttreatment, crop production practices were incompletely reported, the analytical methods were not completely described, and metolachlor residues in plant tissues and soils were not characterized (identified).

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MATERIALS AND METHODS:

Phenyl-labeled [^{14}C]metolachlor (CGA-24705, specific activity 17.9 µc/mg, radiopurity and source unspecified) at 2 lb ai/A was applied by an undescribed but referenced method to silt loam soil (28.8% sand, 66.4% silt, 14.8% clay, 3.6% organic matter, CEC 8.4 meq/100 g, pH 5.7) in buckets. The primary corn crop was grown in a greenhouse. At 270 days posttreatment, the upper 2 inches of soil was removed from the buckets, thoroughly mixed, sampled for analysis, then returned to the buckets. Oats were sown by hand, watered, and fertilized as needed (frequency and amount unreported), and irradiated 12 hours/day with wide spectrum Gro-Lux lamps supplemented with 100 watt tungsten bulbs in a greenhouse. The crop was treated with chlorobenzilate, dicofol and nicotine for in-season insect and mite control. Forage samples were collected 30 and 60 days after planting. Straw and grain were harvested after 105 days. The soil, sampled in incremental 3-inch depths through 9 inches, was collected at 30, 60 and 105 days after oat planting.

Total, chloroform-soluble, methanol:water (ratio unspecified)-soluble, and nonextractable radioactivities in crop samples were determined by combustion and LSC analysis. The methanol:water-extractable residues in the 30-day forage and harvest straw were ionically characterized as neutrals, acids, bases and zwitterions by a partially described method (reference not provided) that used column chromatography.

Soil samples were extracted with methanol:water (9:1). Total, extractable, and nonextractable radioactivities were analyzed by combustion and LSC quantitation.

REPORTED RESULTS:

[^{14}C]Residues were detected in the forage (≤0.17 ppm), straw (0.27 ppm), and grain (0.05 ppm) of rotational oats planted 270 days after an application of [^{14}C]metolachlor at 2.0 lb ai/A to corn (Table 1). In the forage and straw, the residues were predominantly methanol:water extractable (≤0.18 ppm) and were further characterized (Table 2) as acids (≤65%), neutrals (≤29%), zwitterions (≤6%), and bases (≤2%).

Total residues of metolachlor in soil were 0.88 ppm in the 0- to 2-inch depth at oat planting and 1.00-0.92 ppm in the 0- to 9-inch profile in subsequent samplings through harvest (Table 3). Of the radioactivity in the at-planting and at-harvest soil samples, 14-16 and 80-84% were methanol:water extractable and nonextractable, respectively.

DISCUSSION:

1. The purity and source of the test substance were not reported.

2. The test substance was not applied at the maximum recommended use rate (5.5 lb ai/A).

3. Residues in the soil at the time of treatment were not reported; therefore, the reported application rate could not be confirmed.

4. The frequency and amount of crop irrigation were not provided.

5. The analytical methodology was incompletely described.

6. Residues of metolachlor in oat tissues were characterized according to solvent extractability or ionic character; however, metolachlor residues were not identified.

7. Metolachlor residues in soil were not characterized.

Table 1. [^{14}C]Residues (ppm)[a] in rotational oats planted 270 days after an application of phenyl-labeled [^{14}C]metolachlor at 2.0 lb ai/A to corn.

Substrate	Treatment to harvest (days)	Chloroform extractable	Methanol: water extractable	Non-extractable	Total [^{14}C]	Recovery (%)
Forage	300	0.05	0.100	0.03	0.17	106.0
Forage	330	--	--	--	0.14	--
Straw	375	0.02	0.18	0.06	0.27	96.0
Grain	375	--	--	--	0.05	--

[a] Reported as metolachlor equivalents.

Table 2. Ionic characterization of the methanol:water soluble [^{14}C]residues in selected samples of rotational oats planted 270 days after an application of phenyl-labeled [^{14}C]metolachlor at 2.0 lb ai/A to corn.

Substrate	Treatment to harvest (days)	Neutrals	Acids	Bases	Zwitterions
			%[a]		
Forage	300	29	65	<1	6
Straw	375	19	45	2	1

[a] Reported as percent of methanol:water soluble radioactivity.

Table 3. Radioactivity (ppm)[a] in silt loam soil in which rotational oats were grown following an application of phenyl-labeled [^{14}C]metolachlor at 2.0 lb ai/A to corn.

Oat planting to sampling (days)	Treatment to sampling (days)	Sampling depth (inches)				Total
		0-2	0-3	3-6	6-9	
0	270	0.88	--	--	--	--
30	300	--	0.64	0.21	0.15	1.00
60	330	--	0.55	0.21	0.16	0.92
105	375	--	0.55	0.21	0.16	0.92

[a] Reported as metolachlor equivalents.

CASE GS 0001 METOLACHLOR STUDY 13 PM

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MAASTER ID 00022878 CONTENT CAT 01

Sumner, D.D., and J.E. Cassidy. 1974. The uptake of phenyl-^{14}C-CGA-24705 and its aged soil degradation products in rotation wheat: Report No. GAAC-74071. Unpublished study received Sep. 26, 1974 under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094385-H.

SUBST. CLASS = S.

DIRECT RVW TIME = 4 (MH) START-DATE END DATE

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SIGNATURE: DATE:

CONCLUSIONS:

Confined Accumulation - Rotational Crops

1. This study is scientifically valid.

2. Residues of phenyl-labeled [^{14}C]metolachlor were taken up by greenhouse-grown, rotational winter wheat planted 168 days after a 2.0 lb ai/A application to a silt loam soil. Total [^{14}C]radioactivity was <0.15 ppm in forage sampled 189- to 238-days posttreatment, and 0.60 and 0.03 ppm in straw and grain, respectively, harvested 273 days posttreatment. ←

3. This study partially fulfills EPA Data Requirements for Registering Pesticides by providing information on the uptake of metolachlor by rotational crops. However, the test substance was not completely characterized; metolachlor was not applied at the maximum registered label rate; residue data were not provided for soil sampled immediately posttreatment; crop production practices were incompletely reported; the analytical methods were not completely described; and metolachlor residues in plant tissues and soils were not characterized (identified).

43

MATERIALS AND METHODS:

Phenyl-labeled [^{14}C]metolachlor (CGA-24705, specific activity 17.9 μc/mg, radiopurity and source unspecified) at 2 lb ai/A was applied by an undescribed but referenced method to silt loam soil (28.8% sand, 66.4% silt, 14.8% clay, 3.6% organic matter, CEC 8.4 meq/100 g, pH 5.7) in buckets. The primary corn crop was grown in a greenhouse. At 168 days posttreatment, the upper 2 inches of soil was removed from the buckets, thoroughly mixed, sampled for analysis, then returned to the buckets. Winter wheat was sown by hand, watered, and fertilized as needed (frequency and amount unreported), and irradiated 12 hours/day with wide spectrum Gro-Lux lamps supplemented with 100 watt tungsten bulbs in a greenhouse. The crop was treated with chlorobenzilate, dicofol, and nicotine for in-season insect and mite control. Thirty days after planting, the greenhouse was opened to expose the wheat to winter (March) temperatures to vernalize the crop. The crop reinitiated growth on April 1. Forage samples were collected immediately before vernalization (21 days postplant), during vernalization (35 days postplant), and after resumption of growth at 70 days after planting. Straw and grain were harvested after 105 days. The soil, in incremental 3-inch depths through 9 inches, was also sampled at 21, 35, 70, and 105 days after planting.

Total, chloroform-soluble, methanol:water (ratio unspecified)-soluble, and nonextractable radioactivities in crop samples were determined by combustion and LSC analysis. The methanol:water-extractable residues in the 21- and 70-day forage and harvest straw were ionically characterized as neutrals, acids, bases and zwitterions by a partially described method (reference not provided) that used column chromatography.

Soil samples were extracted with methanol:water (9:1). Total, methanol:water-soluble and nonextractable radioactivities were analyzed by combustion and LSC quantitation.

REPORTED RESULTS:

[^{14}C]Residues were detected in the 'fall' forage (0.14 ppm), 'winter' forage during vernalization (0.11 ppm), 'spring' forage (0.15 ppm), straw (0.60 ppm), and grain (0.03 ppm) of rotational winter wheat planted 168 days after an application of [^{14}C]metolachlor at 2.0 lb in/A to corn (Table 1). In the forage and straw, the residues were predominantly methanol:water-soluble (≤0.37 ppm) and further characterized (Table 2) as acids (≤54.1%), neutrals (≤11.4%), zwitterions (≤8.6%), and bases (≤1.2%).

Total residues of [^{14}C]metolachlor in soil were 1.01 ppm in the 0-2 inch depth at wheat planting and 0.97-1.04 ppm in the 0-9 inch profile in subsequent samplings through harvest (Table 3). Of the [^{14}C]radioactivity in the at-planting and at-harvest soil samples, 17.8-20.0 and 81.2-83.5% were methanol:water soluble and nonextractable, respectively.

DISCUSSION:

1. The purity and source of the test substance were not reported.

2. The test substance was not applied at the maximum recommended use rate (5.5 lb ai/A).

(64)

3. Residues in the soil at the time of treatment were not reported; therefore, the reported application rate could not be confirmed.

4. The frequency and amount of crop irrigation were not provided.

5. The analytical methodology was incompletely described.

6. Residues of metolachlor in oat tissues were characterized according to solvent extractability or ionic character; however, metolachlor residues were not identified.

7. Metolachlor residues in soil were not characterized.

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Table 1. [^{14}C]Residues (ppm)[a] in rotational winter wheat planted 168 days after an application of phenyl-labeled [^{14}C]metolachlor at 2.0 lb ai/A to corn.

Substrate	Treatment to harvest (days)	Chloroform extractable	Methanol: water extractable	Non-extractable	Total [^{14}C]	Recovery (%)
Forage, fall	189	0.02	0.10	0.01	0.14	92.4
Forage, winter	203	--	--	--	0.11	--
Forage, spring	238	0.03	0.09	0.02	0.15	93.3
Straw	273	0.04	0.37	0.13	0.60	90.2
Grain	273	--	--	--	0.03	--

[a] Reported as metolachlor equivalents.

Table 2. Ionic characterizaton of the methanol:water soluble [^{14}C]residues in selected samples of rotational winter wheat planted 168 days after an application of phenyl-labeled [^{14}C]metolachlor at 2.0 lb ai/A to corn.

Substrate	Treatment to harvest (days)	Neutrals	Acids	Bases	Zwitterions
			%[a]		
Forage, fall	189	8.9	53.9	<1.0	8.6
Forage, spring	238	11.4	54.1	1.0	2.5
Straw	273	9.2	47.1	1.2	4.3

[a] Reported as percent of methanol:water-soluble [^{14}C]radioactivity.

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Table 3. [^{14}C]Residues (ppm)[a] in silt loam soil in which rotational winter wheat was grown following an application of phenyl-labeled [^{14}C]-metolachlor at 2.0 lb ai/A to corn.

Planting to sampling (days)	Treatment to sampling (days)	Sampling depth (inches)				
		0-2	0-3	3-6	6-9	Total
0	168	1.01	--	--	--	--
21	189	--	0.73	0.17	0.10	1.00
35	203	--	0.62	0.22	0.13	--
70	238	--	0.48	0.20	0.13	0.97
105	273	--	0.60	0.28	0.16	1.04

[a] Reported as metolachlor equivalents.

CASE GS0001 METOLACHLOR STUDY 14 PM --

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 90 - FORMULATION NOT IDENTIFIED

FICHE/MASTER ID 00015658 CONTENT CAT 01

Dupre, G.D. 1974. Runoff characteristics of ^{14}C-CGA-24705 in sandy loam soil under greenhouse conditions: Report No. 73022-3. Unpublished study received Sept. 26, 1974 under 5G1553; prepared by Biodynamics, Inc., submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094222-B.

SUBST. CLASS = S.

DIRECT RVW TIME = 3 (MH) START-DATE END DATE

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CONCLUSIONS:

Additional Study - Soil Runoff

1. This study is scientifically valid.

2. [^{14}C]Metolachlor (purity unspecified) residues at 1 lb ai/A dissipated from a loamy sand soil (8° slope) in the leachate (0.25% of applied [^{14}C]-radioactivity), and the runoff water (3.15% of applied) and sediment (1.41% of applied) after the application of ~1.52 inches of simulated rainfall in 7 days. Of the applied rainfall ~85% was collected as runoff. Greater than 85% and 5% of the applied [^{14}C]radioactivity was detected in the treated and untreated soil, respectively. Total recovery of [^{14}C]radioactivity was 95.8% of applied.

MATERIALS AND METHODS:

Loamy sand soil (82.8% sand, 13.6% silt, 3.6% clay, 1.5% organic matter, CEC 2.6 meq/100g, pH 6.9) was screened (0.5 inches) and packed to a depth of 3 inches in a sheet metal box (12 x 36 x 3 inches, width x length x height) which was inclined to a 8° slope. The soil was lightly tamped to simulate field conditions, and the upper 12 x 12 inch area was sprayed with uniformly ring-labeled [^{14}C]metolachlor (specific activity 2.5 µCi/mg,

purity unspecified, Ciba-Geigy Corp.) at 1 lb ai/A. Simulated rainfall was applied to the entire surface of the soil at a rate of 0.5-1.0 inches/hour on days 1, 3, and 7 posttreatment, for a total of ~1.52 inches of water. Runoff (water and sediment) was collected in a tray at the bottom end of the box, and leachate (percolated through the 3-inch soil depth) was collected through a filtered tube connected to an orifice in the base of the box. Soil core samples (volume and depth unspecified) were taken within and below the treated area on days 0 and 7, and the resulting cavities were refilled with untreated soil.

Water and sediment fractions were separated by filtration and the amount of [^{14}C]radioactivity was determined by LSC. The soil samples were also analyzed by LSC following combustion.

REPORTED RESULTS:

[^{14}C]Metolachlor residues at 1 lb ai/A dissipated from a loamy sand soil (8° slope) in the leachate (0.28% of applied [^{14}C]radioactivity), and the runoff water (3.15% of applied) and sediment (1.41% of applied) after the application of ~1.52 inches of simulated rainfall in 7 days (Table 1). Of the applied rainfall ~85% was collected as runoff. Greater than 85% and 5% of the applied [^{14}C]radioactivity was detected in the treated and untreated soil, respectively. Total recovery of [^{14}C]radioactivity was 95.8% of applied. A total of 1690 ml of leachate, 9093 ml of water, and 73.8 g of sediment were collected during the 7 day study (Table 2). The amount of water and sediment in the runoff increased from 1280 to 4800 ml and 10.4 to 39.9 g, and the amount of leachate decreased from 1350 to 80 ml, during the study.

DISCUSSION:

1. The purity of the test substance was not specified.

2. The soil sampling technique, volume, or depth were not reported.

3. The test soil was reported to be a sandy loam soil, but according to the USDA soil classification system it is a loamy sand soil.

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Table 1. [^{14}C]Residues (% of applied)[a] in the leachate and runoff (water and sediment) from loamy sand soil treated with [^{14}C]-metolachlor at 1 lb ai/A.

Sampling interval (days)	Rainfall (inches)	[^{14}C]Residues (% of applied)[a]			
			Runoff		
		Leachate	Water	Sediment	Total
1	0.37	0.24	0.76	0.51	1.51
3	0.46	0.02	1.06	0.46	1.54
7	0.69	0.02	1.33	0.44	1.79
Total	1.52	0.28	3.15	1.41	4.84

[a] The percent of applied [^{14}C]residues was based on the total [^{14}C]-radioactivity applied to the soil surface on day 0.

Table 2. The amount of simulated rainfall (inches, ml), leachate (ml), runoff water (ml), and runoff sediment (g) from a loamy sand soil treated with [^{14}C]metolachlor at 1 lb ai/A.

Sampling interval (days)	Rainfall		Leachate	Runoff	
				Water	Sediment
	(inches)[a]	(ml)	(ml)	(ml)	(g)
1	0.37	2,630	1,350	1,280	10.4
3	0.46	3,270	260	3,010	23.5
7	0.69	4,888	80	4,800	39.9
Total	1.52	10,780	1,690	9,093	73.8

[a] The amount of simulated rainfall is based on the volume of runoff and leachate collected.

CASE GS0001 METOLACHLOR STUDY 15 PM --

CHEM 108801 Metolachlor

BRANCH EAB DISC --

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00016298 CONTENT CAT 01

Barrows, M.E. 1974. Research report submitted to Ciba-Geigy Corporation: Exposure of fish to 14C-CGA-24705: Accumulation, distribution, and elimination of 14C-residues. Unpublished study received Mar. 27, 1975 unhder 5F1606; prepared by Bionomics, EG&G Environmental Consultants, submitted by Ciba-Geigy Corporation, Greensboro, NC; CDL:094376-R.

SUBST. CLASS = S.

DIRECT RVW TIME = 8 (MH) START-DATE END DATE

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CONCLUSIONS:

Laboratory Accumulation - Fish

This study is scientifically invalid because the fish were not exposed to a constant concentration of metolachlor. In addition, this study would not fulfill EPA Data Requirements for Registering Pesticides because the purity of the test substance was not reported, radioactive residues in the water and the fish were not characterized, and residues in the whole fish were not determined.

MATERIALS AND METHODS:

Bluegill sunfish (Lepomis macrochirus; average length and weight of 57 mm and 2.9 g, respectively) were held in culture tanks for >30 days prior to the initiation of the study. Flow-through aquatic exposure systems were prepared using three 30-l aquaria equipped with continuous-flow proportional dilution apparatus, as described by Mount and Brungs (1967. Water Res. 1:21). Aerated well water (pH 7.1, total hardness 40 mg/l as $CaCO_3$, dissolved oxygen 6.9-8.6 mg/l, temperature 19-21°C) was provided to each aquarium at a rate of 5 l per hour.

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Bluegill (150) were placed in each aquarium. One aquarium was continuously treated with ring-labeled [^{14}C]metolachlor (specific activity 18.4 dpm/µg, purity unspecified) at 1.0 ppm; the second aquarium was treated with ring-labeled [^{14}C]metolachlor (specific activity 2647 dpm/µg, purity unspecified) at 0.01 ppm. The third aquarium served as an untreated control. Water and fish samples were taken from each aquarium after 0, 1, 3, 7, 10, 14, 21, 28, 35, 42, 49, 56, 63, and 70 days of exposure. After 70 days of exposure, the remaining fish were transferred to untreated flowing water and were sampled after 1, 3, 7, 10, 14, 21, and 28 days of depuration.

Water samples were extracted four times with methylene chloride; total radioactivity in the extract was determined using LSC. Recovery values from fortified water samples averaged 61% of the applied. Detection limits in water were 0.0001 ppm (low exposure samples) and 0.01 ppm (high exposure samples).

Total [^{14}]C residues in the edible and visceral fractions of the fish were determined using LSC following combustion. Edible tissue from fish sampled after 63 days of exposure was extracted with methanol and hexane, and the extracts were analyzed for total radioactivity using LSC.

REPORTED RESULTS:

[^{14}C]Metolachlor residues ranged from 0.76 to 1.453 ppm in the water treated at 1.0 ppm and from 0.007 to 0.012 ppm in the water treated at 0.01 ppm (Table 1).

The maximum bioconcentration factor in the edible portion of fish was ~23X for fish exposed to 1.0 ppm of metolachlor and ~19X for the fish exposed to 0.01 ppm. The maximum bioconcentration factor in the visceral tissue of fish was ~679 and 574X the [^{14}C]residues in the water treated at 1.0 and 0.01 ppm, respectively (Table 1). Approximately 26-38% of the accumulated [^{14}C]residues had been eliminated from the edible portion of fish after 24 hours of depuration, and 46-56% had been eliminated by day 28 of depuration (Table 2).

After 63 days, 51% of the residues in the edible tissue of fish exposed to [^{14}C]metolachlor at 1.0 ppm were extractable in hexane and 49% were extractable in methanol. In contrast, 37 and 63% of the residues in the edible tissue of fish exposed to [^{14}C]metolachlor at 0.01 ppm were extractable in hexane and methanol, respectively.

DISCUSSION:

1. The concentration of [^{14}C]metolachlor in the water was not constant; therefore, the potential of metolachlor residues to accumulate in the fish could not be accurately determined.

2. The purity of the test substance was not reported.

3. [^{14}C]Residues in the water and fish were not characterized.

4. Residues in the visceral tissue were determined only on days 35, 42, 49, and 70 of the accumulation period. In addition, total residues in the whole fish were not determined at any sampling interval.

Table 1. [^{14}C]Metolachlor residues (ppm) in water and fish from aquaria treated with [^{14}C]metolachlor at 1.0 and 0.01 ppm.

Day	Water	Fish	
		Edible	Visceral
		0.01 ppm	
1	0.007	0.025	--
3	0.009	0.039	--
7	0.011	0.054	--
10	0.009	0.045	--
14	0.009	0.057	--
21	0.009	0.089	--
28	0.009	0.107	--
35	0.009	0.126	4.54
42	0.010	0.142	5.74
49	0.009	0.152	4.12
56	0.012	0.177	--
63	0.009	0.188	--
70	0.010	0.187	4.54
		1.0 ppm	
1	0.760	9.92	--
3	0.990	11.67	--
7	1.430	12.58	--
10	1.400	10.88	--
14	1.150	13.00	--
21	1.200	14.00	--
28	1.425	12.83	--
35	1.150	21.00	679
42	1.453	23.25	581
49	1.075	16.00	497
56	1.010	21.52	--
63	0.845	24.17	--
70	0.825	21.46	583

Table 2. [^{14}C]Metolachlor residues (ppm) in edible and visceral fish tissue during a 28-day depuration period following 70 days of exposure to [^{14}C]metolachlor at 1.0 and 0.01 ppm.

Day	Edible	Visceral
	0.01 ppm	
0	0.187	4.54
1	0.139	3.30
3	0.168	2.67
7	0.130	0.78
10	0.132	0.75
14	0.108	0.33
21	0.108	--
28	0.083	0.14
	1.0 ppm	
0	21.46	583.20
1	13.28	385.80
3	16.75	155.00
7	14.33	73.80
10	19.83	25.60
14	14.50	15.12
21	14.38	--
28	11.69	12.52

EXECUTIVE SUMMARY

The data summarized here are scientifically valid data that have been reviewed in this report but do not fulfill data requirements unless noted in the Recommendations section of this report.

[^{14}C]Metolachlor (test substance uncharacterized), at ~4.6 lb ai/A, degraded with a half-life of 48-144 hours at 39-44°C when irradiated with artificial light (uncharacterized) and 6-8 days (~3000 Langley units) at 50-55°C when irradiated with natural sunlight (Aziz, 00016301). The degradate N-propen-1-ol-2-yl-N-chloroacetyl-2-methyl-6-ethylaniline (CGA-41638) was ~4-6% of the applied in both the artificial light- and natural sunlight-irradiated samples; three unknown degradates were also isolated. Nonextractable [^{14}C]residues accounted for ~40% of the applied, and volatiles accounted for ~7-10% of the applied after 168 hours of irradiation with artificial light or 8 days of irradiation with natural sunlight.

[^{14}C]Metolachlor (purity unspecified) at ~8 ppm was essentially stable in loamy sand soil, over a period of 64 days (Kaiser, 00016296). Sterilization of the soil had no appreciable effect on degradation. The soil was maintained at ~60% of field capacity (temperature unspecified).

[^{14}C]Metolachlor (purity unspecified) at 1-10 ppm adsorbed to sandy clay loam, loam, and two sand soils with Freundlich adsorption constants (K) ranging from 1.54 to 10 µg/g indicating mobility in these soils (Burkhard, 00078291). Except for one sand soil, as soil organic matter content increased, adsorption increased. In loam soil [^{14}C]metolachlor desorbed with K values of 4.87 and 3.57 after 1 and 3 days, respectively. Adsorption and desorption occurred at about the same rate.

Aged (30 days) [^{14}C]metolachlor (purity unspecified) residues were mobile in columns of loamy sand soil with ~26% of applied radioactivity leached from the columns, and ~87% of the applied radioactivity remaining in the soil (Dupre, 00015657). Radioactivity was concentrated (~60% of applied) in the top 3 inches of soil.

[^{14}C]Metolachlor (purity unspecified) residues were mobile in sandy loam, sand, and silt loam soils (detected to the 12-inch depth in 12-inch columns) when leached with 20 inches of water (Houseworth, 00015659). [^{14}C]Metolachlor residues were immobile in peat soil with ~98.8% of the applied radioactivity detected in the top 1-inch of soil. The leachate from the sandy loam, sand, loam, and silt loam soils contained 36.4, 20.9, 4.0, and 0.4% of the applied radioactivity, respectively.

[^{14}C]Metolachlor (purity unspecified) residues at 1 lb ai/A dissipated from a loamy sand soil (8° slope) in the leachate (0.25% of applied radioactivity), and the runoff water (3.15% of applied) and sediment (1.41% of applied) after the application of ~1.52 inches of simulated rainfall in 7 days (Dupre, 00015658). Of the applied rainfall ~85% was collected as runoff. Greater than 85% and 5% of the applied radioactivity was detected in the treated and untreated soils, respectively. Total recovery of radioactivity was 95.8% of applied.

Freundlich adsorption K values of 0.58, 1.46, and 7.83 were calculated for [^{14}C]metolachlor (test substance uncharacterized) in sand, silt loam,

and sandy loam soils, respectively (Harvey and Jordan, 00031328). Adsorption was positively correlated to soil organic matter content.

Lettuce planted 14 weeks posttreatment and harvested at 26 weeks contained 0.025 ppm of [^{14}C]metolachlor residues (Newby, 00015538). Lettuce planted 41 weeks posttreatment and sampled at 13 and 15 weeks contained 0.144 and 0.065 ppm of [^{14}C]metolachlor residues, respectively. Soil at ~40 and 56 weeks posttreatment contained ~70-80 and ~95% nonextractable [^{14}C]-metolachlor residues, respectively.

Residues of phenyl-labeled [^{14}C]metolachlor were taken up by greenhouse-grown, rotational winter wheat planted 168 days after a 2.0 lb ai/A application to a silt loam soil (Sumner and Cassidy, 00022878). Total radioactivity was <0.15 ppm in forage sampled 189- to 238-days posttreatment, and 0.60 and 0.03 ppm in straw and grain, respectively, harvested 273 days posttreatment.

Residues of phenyl-labeled [^{14}C]metolachlor were taken up by greenhouse-grown, rotational oats planted 270 days after a 2.0 lb ai/A application to a silt loam soil (Sumner and Cassidy, 00022883). Total radioactivity was <0.17 ppm in forage sampled 300-330 days posttreatment, and 0.27 and 0.05 ppm in straw and grain, respectively, harvested 375 days posttreatment.

[^{14}C]Metolachlor residues were detected in the whole plant (0.04 ppm), tops (<0.09 ppm), and roots (<0.06 ppm) of rotational carrots planted 9 months after an application of [^{14}C]metolachlor (purity unspecified) at 2 lb ai/A to silt loam soil (Sumner and Cassidy, 00022882). Total residues of [^{14}C]metolachlor in the silt loam soil were 0.26 ppm in the 0-3 inch depth at carrot planting, and 0.04-0.35 ppm in the 0-9 inch profile in the subsequent samplings through harvest.

[^{14}C]Metolachlor residues were detected in the whole plant (<0.17 ppm), stalks (0.07 ppm), beans (0.04 ppm), meal (0.05 ppm), and oil (<0.01 ppm) of rotational soybeans planted 9 months after an application of [^{14}C]-metolachlor (purity unspecified) at 2 lb ai/A to silt loam soil (Sumner and Cassidy, 00022881). Total residues of [^{14}C]metolachlor in the silt loam soil were 0.26 ppm in the 0-3 inch depth at soybean planting and 0.06-0.35 ppm in the 0-9 inch profile in subsequent samplings through harvest.

RECOMMENDATIONS

Available data are insufficient to fully assess the environmental fate of, and the exposure of humans and nontarget organisms to metolachlor. The submission of data relevant to registration requirements (Subdivision N) for terrestrial food crop, terrestrial nonfood crop, and terrestrial noncrop use sites is summarized below:

Hydrolysis studies: No reviewable data were submitted; however, all data are required.

Photodegradation studies in water: One study (Aziz and Kahrs, 00016300 and Aziz and Kahrs, 00016302) cannot be validated because the experimental conditions were referenced, rather than described, and the reference was not available for review. In addition, this study would not fulfill data

requirements because the test substance was uncharacterized, the incubation temperatures were not reported, it was not reported if the test solutions were buffered or if wavelengths <290 nm were filtered out, the conditions under which dark controls were maintained were not reported, the natural sunlight conditions were not provided, the intensity and wavelength distribution of the artificial light source were not provided, and degradates that comprised >10% of the applied that were detected in the test solution exposed to artificial light were not characterized. All data are required.

Photodegradation studies on soil: One study (Aziz, 00016301) is scientifically valid, and partially fulfills data requirements by providing information on the photodegradation of metolachlor and its degradates on soil. However, the test substance was uncharacterized, the temperatures of incubation were outside the range of normal environmental conditions, and the artificial light source was not characterized. All data are required.

Photodegradation studies in air: No reviewable data were submitted; however, data requirements are reserved pending the results of an acceptable laboratory volatility study.

Aerobic soil metabolism studies: Two studies were reviewed. The first study (Dupre, 00015656) cannot be validated because all data were reported only as percent recovered, so no comparisons could be made between sampling intervals or treatments. In addition, this study would not fulfill data requirements because there was no material balance, the degradation of metolachlor and formation and decline of degradates were not addressed, the purity of the test substance was not reported, the incubation temperature was not reported, and no immediate posttreatment samples were taken to confirm the application rate. The second study (Kaiser, 00016296) was reviewed and considered to be scientifically valid. This study partially fulfills data requirements by providing information on the aerobic soil metabolism of parent metolachlor. However, the incubation temperature was not reported, the study was conducted for an insufficient length of time, and degradates were not identified. All data are required.

Anaerobic soil metabolism studies: One study (Dupre, 00015656) was reviewed and cannot be validated because all data were reported only as percent recovered, so no comparisons could be made between sampling intervals or treatments. In addition, this study would not fulfill data requirements because there was no material balance, the degradation of metolachlor and formation and decline of degradates were not addressed, the purity of the test substance was not reported, the incubation temperature was not reported, and no immediate posttreatment samples were taken to confirm the application rate. All data are required.

Anaerobic aquatic metabolism studies: No reviewable data were submitted; however, data requirements are reserved pending special studies on ground and surface water.

Aerobic aquatic metabolism studies: No reviewable data were submitted; however, all data are required because submitted data indicate that metolachlor is mobile in soil (Burkhard, 00078291; Houseworth, 00015659) and available in surface water runoff (Dupre, 00015658). Monitoring data

(Ross and Balu, No MRID) indicate metolachlor is present in surface waters. Because of metolachlor's potential to impact on aquatic sites, aerobic aquatic metabolism studies are required.

Leaching and adsorption/desorption studies: Four studies were reviewed and considered to be scientifically valid. The first study (Burkhard, 00078291) partially fulfills data requirements by providing information on the adsorption of parent metolachlor. However, the study was not conducted in a 0.01 N calcium ion solution, desorption data were reported for only one of the four soils tested, and the majority of the study was conducted on foreign soils. The second study (Dupre, 00015657) partially fulfills data requirements by providing information on the mobility of aged (30 days) metolachlor residues. However, the purity of the test substance was unspecified, K_d values were not reported, and [^{14}C]metolachlor residues were not characterized. The third study (Houseworth, 00015659) partially fulfills data requirements by providing information on the mobility of metolachlor residues. However, the purity of the test substance was unspecified, and K_d values were not reported. The fourth study (Harvey and Jordan, 00031328) partially fulfills data requirements by providing information on the adsorption of parent metolachlor. However, the test substance was uncharacterized, and the study was not conducted in a 0.01 N calcium ion solution. All data are required.

Laboratory volatility studies: No reviewable data were submitted, but all data are required.

Field volatility studies: No reviewable data were submitted; however, the data requirement is reserved pending the receipt of acceptable laboratory volatility data.

Terrestrial field dissipation studies: No reviewable data were submitted, but all data are required.

Aquatic field dissipation studies: No reviewable data were submitted; however, the data requirement is reserved pending results of other aquatic impact studies.

Forestry dissipation studies: No reviewable data were submitted; however, no data are required because metolachlor has no forestry use.

Dissipation studies for combination products and tank mix uses: No reviewable data were submitted; however, no data are required because data requirements for combination products and tank mix uses are currently not being imposed.

Long-term field dissipation studies: No reviewable data were submitted. The data requirement is reserved pending the receipt of acceptable field dissipation data.

Confined accumulation studies on rotational crops: Five studies were reviewed and considered to be scientifically valid. The first study (Newby, 00015538) partially fulfills data requirements by providing information on the uptake of metolachlor by rotational crops. However, the test substance and soil were not characterized, residues in the soil

and crop were not characterized, residues in the soil were not analyzed at the time of treatment or at the time of planting the rotational crop, and field test data were incomplete. The second study (Sumner and Cassidy, 00022881) partially fulfills data requirements by providing information on the uptake of metolachlor by rotational crops. However, the purity of the test substance was unspecified, soil samples were not taken at the time of treatment, residues in the soybeans and soil were not completely characterized, and a description of the growing conditions was not provided. The third study (Sumner and Cassidy, 00022882) partially fulfills data requirements by providing information on the uptake of metolachlor by rotational crops. However, the purity of the test substance was unspecified, soil samples were not taken at the time of treatment, residues in the carrots and soil were not completley characterized, and a description of the growing conditions was not provided. The fourth study (Sumner and Cassidy, 00022883) partially fulfills data requirements by providing information on the uptake of metolachlor by rotational crops. However, the test substance was not completely characterized; metolachlor was not applied at the maximum registered label rate, residue data were not provided for soil sampled immediately posttreatment, crop production practices were incompletely reported, the analytical methods were not completely described, and metolachlor residues in plant tissues and soils were not characterized (identified). The fifth study (Sumner and Cassidy, 00022878) partially fulfills data requirements by providing information on the uptake of metolachlor by rotational crops. However, the test substance was not completely characterized, metolachlor was not applied at the maximum registered label rate, residue data were not provided for soil sampled immediately posttreatment, crop production practices were incompletely reported, the analytical methods were not completely described, and metolachlor residues in plant tissues and soils were not characterized (identified). All data are required.

Field accumulation studies on rotational crops: No reviewable data were submitted; however, the data requirement is reserved pending the receipt of acceptable confined rotational crop accumulation data.

Accumulation studies on irrigated crops: No reviewable data were submitted; however, no data are required because metolachlor has no aquatic food crop or aquatic noncrop use.

Laboratory studies of pesticide accumulation in fish: One study (Barrows, 00016298) was reviewed and is scientifically invalid because the fish were not exposed to a constant concentration of metolachlor. In addition, this study would not fulfill data requirements because the purity of the test substance was not reported, radioactive residues in the water and the fish were not characterized, and residues in the whole fish were not determined. All data are required.

Field accumulation studies on aquatic nontarget organisms: No reviewable data were submitted; however, the data requirement is reserved pending results of other aquatic impact studies.

Reentry studies: No reviewable data were submitted. Although metolachlor has been identified as an oncogen, present use patterns are such that no human exposure to residues is anticipated. Therefore, no reentry data are required at this time.

Additional studies - Ground and surface water monitoring studies: Submitted data indicate that metolachlor is mobile in soil (Burkhard, 00078291; Houseworth, 00015659) and available in surface water runoff (Dupre, 00015657). Monitoring data (Ross and Balu, No MRID) indicate metolachlor is present in surface waters. Therefore, both ground and surface water monitoring studies are required. A protocol must be submitted by 90 days from the issuance date of this Standard. This protocol must be designed to study the means and extent of metolachlor's potential to leach to groundwater and metolachlor's potential to runoff to surface water bodies and to contaminate drinking water drawn from surface sources.

Recommendation: Pending the submission of acceptable rotational crop data, only plant crops with registered metolachlor uses.

REFERENCES

The following studies are new or amended submittals:

Aziz, S.A. 1974. Photolysis of CGA-24705 on soil slides under natural and artificial sunlight conditions: Report No. GAAC-74102. Unpublished study received on unknown date under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094385-J. (00016301)

Aziz, S.A. and R.A. Kahrs. 1974. Photolysis of CGA-24705 in aqueous solution under natural and artificial sunlight conditions: Report No. GAAC-74041. Unpublished study received Sept. 26, 1974 under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094385-D. (00016300)

Aziz, S.A. and R.A. Kahrs. 1975. Photolysis of CGA-24705 in aqueous solution--additional information: Report No. GAAC-75021. Unpublished study received on unknown date under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094385-M. (00016302)

Barrows, M.E. 1974. Research report submitted to Ciba-Geigy Corporation: Exposure of fish to ^{14}C-CGA-24705: Accumulation, distribution, and elimination of ^{14}C-residues. Unpublished study received Mar. 27, 1975 under 5F1606; prepared by Bionomics, EG & G Environmental Consultants, submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094376-R. (00016298)

Burkhard, N. 1978. Adsorption and desorption of metolachlor (Dual) in various soil types: Project Report 45/78. Unpublished study received July 23, 1981 under 100-587; prepared by Ciba-Geigy, Ltd., Switzerland, submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:245627-D. (00078291)

Dupre, G.D. 1974a. Abbreviated anaerobic metabolism of ^{14}C-CGA-24705 in silt loam soil under greenhouse conditions: Report No. 73019-3. Unpublished study received Sept. 26, 1974 under 5G1553; prepared by Bio/dyamics, Inc., submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094222-B. (00015656).

Dupre, G.D. 1974b. Leaching characteristics of ^{14}C-CGA-24705 and its degradation products following aging in sandy loam soil under greenhouse conditions: Report No. 73021-6. Unpublished study received Sept. 26, 1974 under 5G1553; prepared by Bio/dynamics, Inc., submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094222-C. (00015657).

Dupre, G.D. 1974c. Runoff characteristics of ^{14}C-CGA-24705 applied to sandy loam soil under greenhouse conditions: Report No. 73022-1. Unpublished study received Sept. 26, 1974 under 5G1553; prepared by Bio/dynamics, Inc., submitted by Ciba-Geigy Corp., Greensboro, NC; CDL: 094222-D. (00015658)

Harvey, R.G., and G.L. Jordan. 1978. Comparative study of the biological and physical properties of acetanilide herbicides in soil. Unpublished study received May 3, 1979 under 43142-1; prepared by Univ. of Wisconsin. Submitted by Boots Hercules Agrochemicals Co., Wilmington, DE; CDL:098274-H. (00031328)

Houseworth, L.D. 1973? Report on parent leaching studies for CGA-24705: Report No. 1. Unpublished study received Sept. 26, 1974 under 5G1553; prepared by Univ. of Missouri, Dept. of Plant Pathology, submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094222-E. (00015659)

Kaiser, F.E. 1974. Soil degradation study of Gba-Geigy (sic) ^{14}C-CGA-24705. Unpublished study received Mar. 27, 1975 under 5F1606; prepared by Analytical Biochemistry Laboratories, Inc., submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094376-N. (00016296)

Newby, L. 1979. Dual rotational studies: additional information: Report No. ABR-79091. Unpublished study received Aug. 1, 1979 under 100583; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:238899-A. (00015538)

Ross, R.H. and K. Balu. 1985. Summary of metolachlor water monitoring for 1979-July 1985. Report #EIR-85024. Submitted by Safety Evaluation Dept., Agricultural Division, Ciba-Geigy Corp. Greensboro, NC. Accession No. 260602. (No MRID)

Sumner, D.D. and J.E. Cassidy. 1974. The uptake of phenyl-^{14}C-CGA-24705 and its aged soil degradation products in rotation carrots: Report No. GAAC-74112. Unpublished study received June 30, 1978 under 100-583; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:234216-H. (00022882)

Sumner, D.D. and J.E. Cassidy. 1974. The uptake of phenyl-^{14}C-CGA-24705 and its aged soil degradation products in rotation soybeans: Report No. GAAC-74113. Unpublished study received June 30, 1978 under 100-583; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:234216-G. (00022881)

Sumner, D.D. and J.E. Cassidy. 1974. The uptake of phenyl-^{14}C-CGA-24705 and its aged soil degradation products in rotation oats: Report No. GAAC-74085. Unpublished study received July 23, 1981 under 100-587; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:245627-K. (00078294) (00022883)

Sumner, D.D. and J.E. Cassidy. 1974. The uptake of phenyl-^{14}C-CGA-24705 and its aged soil degradation products in rotation wheat: Report No. GAAC-74071. Unpublished study received Sept. 26, 1974 under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094385-H. (00022878)

The following study was not reviewed because the soil used in the study was not representative of the furrow slice (0-15 cm depth):

Bouchard, D., T. Lavy, and D. Marx. 1982. Fate of metribuzin, metolachlor, and fluometuron in soil. Weed Sci. 30:629-632. (00153668)

The following study was not reviewed because it is an efficacy study: Skipper, H.D., R.J. Gossett, and G.W. Smith. 1975. Field evaluation and soil residual characteristics of CGA-24705 and alachlor: Test No. 10567.

Unpublished study received Feb. 18, 1977 under 100-583; perpared by Clemson Univ., Dept. of Agronomy and Soils, submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:228107. (00016327)

The following studies were not reviewed because they contain treated crop data only:

Houseworth, L.D. 1977. Residues of metolachlor and atrazine in or on corn grain resulting from preemergence and preplant incorporated application of a liquid prepack formulation of metolachlor and atrazine--with and without liquid fertilizer: Report No. ABR-77028. Unpublished study received June 20, 1977 under 100-590; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:230685-A. (00015569)

Houseworth, L.D. 1977. Residues of metolachlor and dicamba in or on corn grain resulting from preemergence tank mix applications: Report No. ABR-77071. Summary of studies 232192-B through 232192-D. Unpublished study received Nov. 10, 1977 under 100-EX-59; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:232192-A. (00016435)

Houseworth, L.D. 1978. Residues of metolachlor and atrazine in or on corn resulting from the application of metolachlor, metolachlor/atrazine tank mixes or a metolachlor/atrazine pre-pack through center pivot irrigation systems: Report No. ABR-78074. Summary of studies 235358-B through 235358-J. Unpublished study received Oct. 20, 1978 under 100-583; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:235358-A. (00015586)

Houseworth, L.D. 1978. Summary of residue data to support an EUP program for Milocep-(TM) on sorghum: Report No. ABR-78081. Summary of studies 235981-B through 235981-D. Unpublished study received Nov. 24, 1978 under 100-EX-62; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:235981-A. (00016989)

Houseworth, L.D. 1978. Residues of metolachlor and cyanazine in or on corn forage, fodder, grain and sweet corn ears resulting from preplant incorporated and preemergence tank mix applications: ABR No. 78079. Summary of studies 235359-B through 235359-G. Unpublished study received Oct. 20, 1978 under 100-583; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:235359-A. (00015596)

Houseworth, L.D. and H. Rolla. 1977. Residues of metolachlor in or on sorghum resulting from preplant incorporated and preemergence applications: Report No. ABR-77086. Unpublished study received Nov. 14, 1977 under 8G2019; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:096625-A. (00015548)

Marco, G. 1974. CGA-24705--Corn: Residues observed and metabolism data, including the analytical methods used: Report No. GAAC 74062. Summary of studies 094222-I through 094222-M. Unpublished study received Sept. 26, 1974 under 5G1553; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:-094217-A. (00015651)

Sumner, D.D. and J.E. Cassidy. 1974. Uptake of nonextractable soil metabolites of phenyl-^{14}C-CGA-24705 by soybeans: Report No. GAAC-74056.

Unpublished study received Sept. 26, 1974 under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094385-E. (00022875)

Sumner, D.D. and J. Cassidy. 1974. The uptake and distribution of phenyl-^{14}C-CGA-24705 from soil in greenhouse grown corn: Report No. GAAC-74015. Unpublished study received Sept. 26, 1974 under 5G1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094385-B. (00022873) (00039184)

Sumner, D. and J. Cassidy. 1974. The uptake and distribution of phenyl-^{14}C-CGA-24705 in field grown corn: Report No. GAAC-74022. Unpublished study received Sept. 26, 1974 under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:093485-C. (00022874) (00039185)

Sumner, D.D. and J.E. Cassidy. 1974. The metabolism of CGA-24705 in corn: GAAC-74050. Summary of studies 094984-B and 094984-C. Unpublished study received Nov. 25, 1975 under 6G1708; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094984-D. (00039186) (00015652)

Sumner, D.D. and J.E. Cassidy. 1974. Uptake of nonextractable soil metabolites of phenyl-^{14}C-CGA-24705 by winter wheat: Report No. GAAC-74058. Unpublished study received Sept. 26, 1974 under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094385-G. (00022877)

Sumner, D.D. and J.E. Cassidy. 1974. Uptake of nonextractable soil metabolites of phenyl-^{14}C-CGA-24705 by carrots: Report No. GAAC-74057. Unpublished study received Sept. 26, 1974 under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094385-F. (00022876)

Sumner, D.D. and J.E. Cassidy. 1974. A comparison of phenyl-^{14}C-CGA-24705 corn biosythesized (sic) metabolites with those in the excreta of goats fed the ^{14}C-Corn: GAAC-74055. Unpublished study received Nov. 25, 1975 under 6G1708; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094984-E. (00039187) (00022884)

Sumner, D.D. and J.E. Cassidy. 1975. The uptake and distribution of phenyl-^{14}C-CGA-24705 from soil in greenhouse grown soybeans: Report No. GAAC-75039. Unpublished study received Jan. 19, 1977 under 100-583; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:095750-F. (00022872)

Sumner D.D. and J.E. Cassidy. 1975. The degradation of CGA-24705 in a field soil: Report No. GAAC-75022. Unpublished study received on unknown date under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094385-N. (00016303)

Sumner D.D., R.D. Thomas, and J.E. Cassidy. 1975. Structure elucidation of the metabolites of CGA-24705 in corn: M4-68-2Y: Report No. GAAC-75012. Unpublished study received Mar. 26, 1975 under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094378-F. (00015423)

The following study was not reviewed because the experimental temperatures were too high:

Burkhard, N. and J. Guth. 1981. Rate of volatilization of pesticides from soil surfaces: Comparison of calculated results with those determined in a laboratory model system. Pestic. Sci. 12(1): 37-44. Also In unpublished submission received Nov. 5, 1982 under 4581-351; submitted by Agchem Div., Pennwalt Corp., Philadelphia, PA; CDL:248818-X. (00118040)

The following study was not reviewed because it contains microbial data only:

Houseworth, L.D. 1973a. Effect of CGA-24705 on microbial populations in two soils: Report No. 2. Unpublished study received Sept. 26, 1974 under 5G1553; prepared by Univ. of Missouri, Dept. of Plant Pathology, submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094222-F. (00015660)

The following studies were not reviewed because the experimental design is unacceptable for environmental fate data requirements:

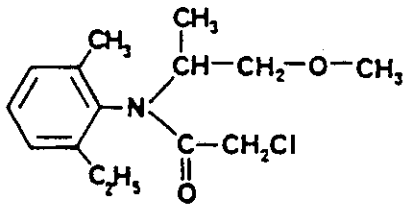
Burkhard, N. 1974. CGA-24705: Hydrolysis of CGA-24705 under laboratory conditions. Method No. SPR 2/74 dated Feb. 27, 1974. Unpublished study received Sept. 26, 1974 under 5G1553; prepared by Ciba-Geigy, Ltd., submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094222-H. (00015662)

Ellgehausen, H., J.A. Guth, and H.O. Esser. 1978. Factors determining the bioaccumulation potential of pesticides in the individual compartments of aquatic food chains. Unpublished study received Jan. 28, 1981 under 100-618; prepared by Ciba-Geigy, Ltd., Switzerland, submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:244270-B. (00067894)

The following study was not reviewed because it contains summary data only:

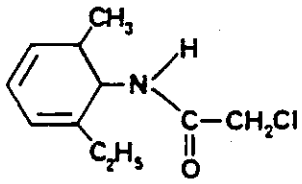
Marco, G. 1975. CGA-24705--Corn: Residues observed and metabolism data, including the analytical methods used: Report No. GAAC-75001. Unpublished report received Mar. 26, 1975 under 5F1606; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:094378-A. (00015422)

APPENDIX



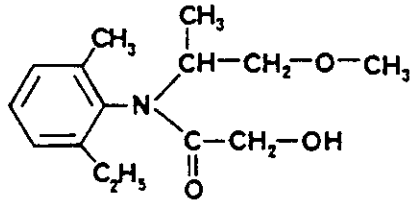
2-Chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide

(Metolachlor, CGA-24705)



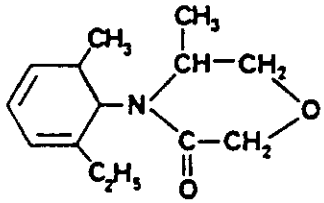
N-Chloroacetyl-2-ethyl-6-methylaniline

(CGA-13656)



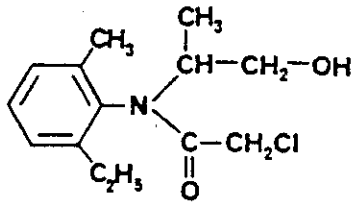
N-(2-Hydroxyacetyl)-N-(1-methoxyprop-2-yl)-2-ethyl-6-methylaniline

(CGA-40172)



4-(2-Methyl-6-ethylphenyl)-5-methylmorpholin

(CGA-40919)



N-Propen-1-ol-2-yl-N-chloroacetyl-2-methyl-6-ethylaniline

(CGA-41638)