UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

5-4-94

Chemical Barcode #: 108801

Memorandum

SUBJECT: Ground Water Assessment of Metolachlor for Registration Eligibility Document

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An assessment of the environmental fate of metolachlor was completed for the Registration Eligibility Document (RED) issued on March 1, 1993. This document is presented as an amendment to the original, and addresses the ground-water status of metolachlor.

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Introduction

In the Metolachlor Reregistration Standard (January 1987), EPA required that studies be conducted to determine the potential of metolachlor to leach to ground water in vulnerable areas. Several retrospective studies were conducted in Illinois, Iowa, Georgia, and Wisconsin to fulfill the requirement. Analyses were done for the parent compound only; no degradates were analyzed. Metolachlor was detected at all of the study sites at concentrations ranging from 0.10 to 88 ppb using a 0.1 ppb screening level. Some of the detections resulted from point source mechanisms in wells that did not meet protocol selection criteria. Other detections resulted from normal agricultural use of the chemical (EFGWB #90-0547; 1/93).

Several recommendations were made in the EFGWB review of the metolachlor retrospective studies (EFGWB #90-0547; 1/93). Small-scale prospective studies were recommended to determine the impact of metolachlor and its degradates on ground-water quality from normal agricultural use. In addition, it was recommended that metolachlor use be restricted on sandy soils. It was noted that metolachlor also met the proposed triggers developed for restricted use for ground-water concerns.

In a meeting between EFGWB and Ciba On July 12, 1993, Ciba agreed that prospective studies would be valuable in determining the leaching potential of metolachlor. The recommendation made to restrict use on sandy soils was waived pending the results of the prospective studies. A prospective study protocol has been submitted by the registrant and will be reviewed by the Ground Water Technology Section.

In the 1993 EFED RED chapter for metolachlor, many environmental fate studies were reviewed by EFED scientists. These studies in combination with the above retrospective studies were used by the Ground Water Section to complete this assessment which was not included in the 1993 RED chapter. The recommendations that follow are made in light of the recent registration of acetochlor, and used to address ground-water concerns resulting from the use of metolachlor. From an Environmental Fate and Ground Water perspective, concerns are similar although better established for metolachlor because of its use history.

Recommendations

Because metolachlor exceeds certain Levels of Concern for ground water, EFGWB recommends the following:

1. EFGWB again recommends that a number of prospective ground-water monitoring studies be conducted for metolachlor to determine its impact on ground-water quality.

2. In addition, the registrant should establish a ground-water monitoring program in cooperation with the states where metolachlor is used. Monitoring information will be used to determine appropriate label restrictions for metolachlor.

3. The registrant and EPA will agree, as a condition of reregistration eligibility, to establish criteria for additional mitigation, suspension, and voluntary cancellation as a consequence of monitoring study results.

4. Metolachlor meets the proposed triggers for classification as a restricted use chemical for ground-water concerns. EFGWB recommends that metolachlor be considered a candidate for restricted use for ground-water concerns.

5. EFGWB recommends that metolachlor be considered for regulation under State Management Plans.

6. Metolachlor has been detected in ground water as a result of normal agricultural use at levels that exceed its lifetime Health Advisory level. Ciba should determine the areas that are vulnerable to ground-water contamination by metolachlor, and recommend label restrictions.

Environmental Fate Assessment

Metolachlor is a selective herbicide registered for use on a variety of terrestrial crops and noncrop use sites. Metolachlor can be applied at the preplant, postemergence or postplant stages. The chemical is applied by a variety of methods including aerial, ground, granule applicator, spreader, pneumatic applicator or center pivot irrigation.

Metolachlor exhibits the properties and characteristics associated with chemicals that have been detected in ground water. Metolachlor is a persistent pesticide with an aerobic soil metabolism half-life of 67 days (approximately 10 weeks) in a sandy loam soil. Its field dissipation half-life has been reported as low as 7 days and as high as 292 days (1 and 42 weeks, respectively). In addition, metolachlor is very mobile with Kd values ranging from 0.08 to 4.81 L/kg in four different soils. Considering the nature of the chemical; i.e., highly persistent under certain conditions and very mobile in many soils, there is a strong possibility of movement to ground water, especially in vulnerable areas. This has been confirmed by the detections reported in the "Pesticides in Ground Water Database" (Hoheisel et al., 1992) which indicate that metolachlor has had a significant impact on ground-water quality.

The lifetime Health Advisory for metolachlor has been established at 100 ppb; according to data presently available, the degradates do not exhibit any toxicologic properties. Metolachlor has been placed in Cancer Group C indicating that it is a possible human carcinogen. Metolachlor has been detected in ground water in 20 states including

Arkansas, Connecticut, Delaware, Florida, Iowa, Illinois, Indiana, Massachusetts, Minnesota, Missouri, Nebraska, New Jersey, New York, Ohio, Pennsylvania, South Dakota, Texas, Virginia, Vermont, and Wisconsin. Concentrations of metolachlor ranged from trace levels to 157.00 ppb (Hoheisel et al., 1992).

Because metolachlor is both mobile and persistent, it has had a significant impact on ground-water quality. In addition, over the long term, persistent pesticides that have leached to ground water (especially shallow ground water) may be discharged to surface-water bodies (i.e., streams, rivers, lakes, wetlands). Therefore, contamination of ground-water resources can have an impact on ecological endpoints. Guideline requirements for terrestrial and aquatic plants and estuarine species are not fulfilled for metolachlor, and for this reason, risk assessments have not been conducted in these areas. However, considering that metolachlor is a herbicide, effects on nontarget plants are expected. As illustrated on the accompanying graph, metolachlor is not likely to exceed the other risk-based levels of concern for ecological effects.

Metolachlor exceeds the following Levels of Concern for ground water:

- **GROUND-WATER QUALITY.** Metolachlor has been detected in ground water in 20 states, although generally below toxicity thresholds for humans and animals. Considering the widespread use of metolachlor and the detections in many states, EFGWB is concerned about the degradation of water quality that occurs in metolachlor use areas.

- **HUMAN HEALTH.** Metolachlor residues have been detected in ground water at concentrations over the lifetime Health Advisory of 100 ppb in three states including Missouri, New York, and Wisconsin. In at least one of these states (Missouri), the suspected source of the detection was normal field use.

Additional areas of concern:

- **NONTARGET AQUATIC AND TERRESTRIAL PLANTS.** No information is currently available to assess the effect of metolachlor on aquatic or terrestrial plants. In areas where irrigation water is contaminated with metolachlor, or where ground water discharges to surface water, metolachlor residues could pose a threat to nontarget plants.

- **ENDANGERED FISH.** In areas where ground water discharges to surface water, metolachlor residues could present a threat to endangered fish.

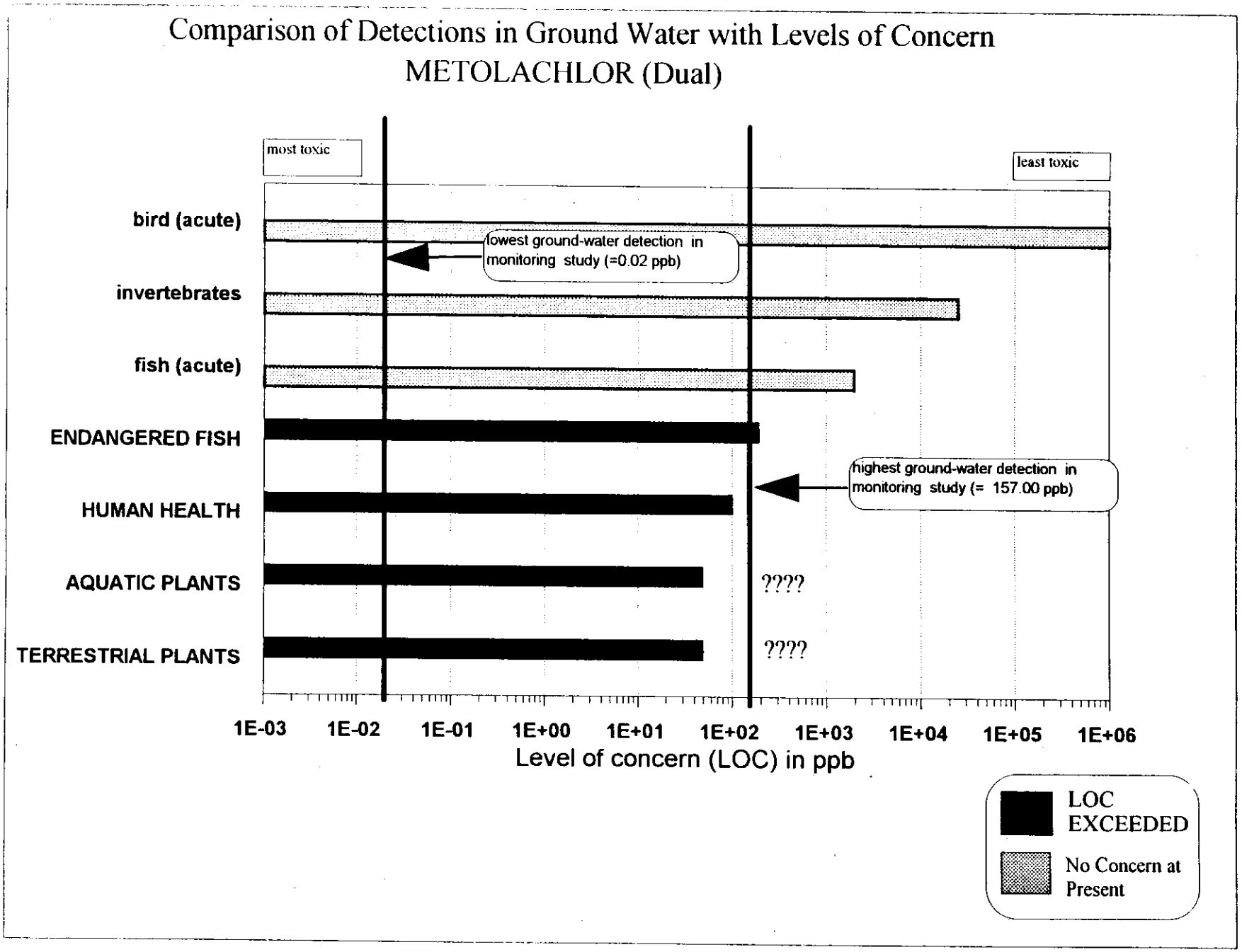
Data requirements not satisfied

166-1. Small-Scale Prospective Ground-Water Monitoring. All data required.

References

Hoheisel, C., Karrie, J., Lees, S., Davies-Hilliard, L., Hannon, P., Bingham, R., Behl, E., Wells, D., and E. Waldman. 1992. Pesticides in Ground Water Database - A Compilation of Monitoring Studies: 1971-1991, EPA 734-12-92-001, September 1992.

Mesko, T.O. and G.M. Carlson. 1988. Occurrence of Pesticides, Nitrates, Organic Compounds, and Trace Elements in Ground Water and Streams, Southeastern Missouri, 1986-1987, U.S. Geological Survey Open-File Report 88-495, 73 pp.


Comparison of Detections in Ground Water with Levels of Concern
METOLACHLOR (Dual)
most toxic
least toxic
bird (acute)
invertebrates
fish (acute)
ENDANGERED FISH
HUMAN HEALTH
AQUATIC PLANTS
TERRESTRIAL PLANTS
lowest ground-water detection in monitoring study (=0.02 ppb)
highest ground-water detection in monitoring study (= 157.00 ppb)
????
????
1E-03
1E-02
1E-01
1E+00
1E+01
1E+02
1E+03
1E+04
1E+05
1E+06
Level of concern (LOC) in ppb
LOC EXCEEDED
No Concern at Present

Environmental Fate & Effects Division
PESTICIDE ENVIRONMENTAL FATE ONE LINE SUMMARY
METOLACHLOR
Last Update on May 4, 1994
[V] = Validated Study [S] = Supplemental Study [U] = USDA Data

LOGOUT	Reviewer:	Section Head:	Date:

Common Name: METOLACHLOR
Smiles Code: ClCC(=O)N(-c(c(cc1)C)c(c1)CC)C(COC)C
PC Code # : 108801 CAS #: 51218-45-2 Caswell #:

Chem. Name : 2-CHLORO-N-(2-ETHYL-6-METHYLPHENYL)-N-(2-METHOXY-1-METHYLETHYL)ACETAMIDE
Action Type: Herbicide

Trade Names: DUAL
(Formul'tn): G, EC, FLOWABLE CONC.
Physical State:

Use Patterns (% Usage) : FIELD CROPS; ORNAMENTALS; TERRESTRIAL NON-CROP. GENERALLY APPLIED AS A PREPLANT OR PREEMERGENCE BROADCAST SPRAY.

Empirical Form: $C_{15}H_{22}NO_2Cl$
Molecular Wgt.:
Vapor Pressure: 1.30E -5 Torr
Melting Point : °C
Boiling Point: °C
Log Kow :
pKa: @ °C
Henry's : 9.16E -9 Atm. M3/Mol (Measured)

Solubility in ...

					Comments
Water	5.30E 2	ppm	@20.0	°C	
Acetone	E	ppm	@	°C	
Acetonitrile	E	ppm	@	°C	
Benzene	E	ppm	@	°C	
Chloroform	E	ppm	@	°C	
Ethanol	E	ppm	@	°C	?
Methanol	E	ppm	@	°C	
Toluene	E	ppm	@	°C	
Xylene	E	ppm	@	°C	
	E	ppm	@	°C	
	E	ppm	@	°C	

Hydrolysis (161-1)
[V] pH 5.0: STABLE
[V] pH 7.0: STABLE
[V] pH 9.0: STABLE
[ ] pH :
[ ] pH :
[ ] pH :

7

Photolysis (161-2, -3, -4)
[S] Water:IN NATURAL SUN, ONLY 8% OF
[ ] :THE PARENT DEGRADED AFTER
[ ] :30 DAYS.
[ ] :

[S] Soil :8 DAYS,SiLm, NATURAL SUN
[ ] Air :

Aerobic Soil Metabolism (162-1)
[V] STABLE IN LOAMY SAND OVER 64 DAYS
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]

Anaerobic Soil Metabolism (162-2)
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]

Anaerobic Aquatic Metabolism (162-3)
[V] 78 DAYS IN SANDY LOAM
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]

Aerobic Aquatic Metabolism (162-4)
[V] 47 DAYS IN SANDY LOAM
[ ]
[ ]
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[ ]
[ ]
[ ]

Environmental Fate & Effects Division
PESTICIDE ENVIRONMENTAL FATE ONE LINE SUMMARY
METOLACHLOR
Last Update on May 4, 1994
[V] = Validated Study [S] = Supplemental Study [U] = USDA Data

Soil Partition Coefficient (Kd) (163-1)

[ ]	Sd	SI	Cl	%OM	pH	K
[S]	87	10	3	2.2	7.8	1.6
[S]	58	20	22	5.6	6.7	11.3
[S]	38	50	12	3.6	6.1	3.5
[S]	96	2	2	1.2	6.3	1.9
[ ]						

Soil Rf Factors (163-1)
[S] % RESIDUES IN LEACHATE FROM
[ ] 12" COLUMN LEACHED W/20"WATER
[ ] SdLm 36.4%
[ ] Sd 20.9
[ ] Lm 4.0
[ ] SiLm 0.4

Laboratory Volatility (163-2)
[ ]
[ ]

Field Volatility (163-3)
[ ]
[ ]

Terrestrial Field Dissipation (164-1)
[S] AFTER APPL 1 LB AIA TO LmSd, AND APPL 1.52" RAIN IN 7 DAYS,
[ ] >85% RESIDUE REMAINED IN SOIL.
[S] METOLACHLOR DISSIPATED TO APPROXIMATELY 10% OF APPLIED AMT,
[ ] IN 60-160 DAYS IN VARIOUS SOILS.
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]

Aquatic Dissipation (164-2)
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]

Forestry Dissipation (164-3)
[ ]
[ ]

9

Long-Term Soil Dissipation (164-5)
[ ]
[ ]

Accumulation in Rotational Crops, Confined (165-1)
[S] LETTUCE PLANT. 14 WKS POSTTREAT, HARVEST AT 26 WKS
[ ] CONTAIN.025 PPM C14 RESIDUES;

Accumulation in Rotational Crops, Field (165-2)
[ ]
[ ]

Accumulation in Irrigated Crops (165-3)
[ ]
[ ]

Bioaccumulation in Fish (165-4)
[V] BLUEGILL SUNFISH BCF: EDIBLE 15 X, WHOLE 69 X. IN 14 DAYS
[ ] DEPURATION, 70% OF THAT IN EDIBLE TISSUES WAS ELIMINATED.

Bioaccumulation in Non-Target Organisms (165-5)
[S] NO EFFECT ON FUNGI, BACTERIA, OR ACTINOMYCETES IN
[ ] LOAM SOILS TREATED AT 250 PPM.

Ground Water Monitoring, Prospective (166-1)
[ ] Studies requested in 1993. Again requested in RED (5/94).
[ ]
[ ]
[ ]

Ground Water Monitoring, Small Scale Retrospective (166-2)
[ ]
[ ]
[ ]
[ ]

Ground Water Monitoring, Large Scale Retrospective (166-3)
[S] SIXTY WELLS IN EACH OF FOUR STATES (GA, IL, IA, WI) SELECTED.
[ ] DETECTIONS IN 89 OF 920 SAMPLES IN 39 OF 240 WELLS (0.1-88 PPB).
[ ] CONC. AND FREQUENCIES OF DETECTIONS MAY BE HIGHER THAN REPORTED
[ ] DUE TO CHEMISTRY INADEQUACIES.

Ground Water Monitoring, Miscellaneous Data (158.75)
[S] Detected in ground water in AR, CT, DE, FL, IA, IL, IN, MA, MN,
[ ] MO, NE, NJ, NY, OH, PA, SD, TX, VA, VT, and WI. Concentrations
[ ] ranged up to 157 ppb (PGWDB, 1992).

Field Runoff (167-1)
[ ]
[ ]
[ ]
[ ]

Surface Water Monitoring (167-2)
[ ]
[ ]
[ ]
[ ]

Spray Drift, Droplet Spectrum (201-1)
[ ]
[ ]
[ ]
[ ]

Spray Drift, Field Evaluation (202-1)
[ ]
[ ]
[ ]
[ ]

Degradation Products

4-(2-methyl-6-ethylphenyl)-5-methylmorpholin (CGA-40919)
N-(2-hydroxyacetyl)-N-(1-methoxyprop-2-YL)-2-ethyl-6-methyl aniline (CGA-40172)
N-propen-1-OL-2-YL-N-chloroacetyl-2-methyl-6-ethylaniline=CGA-41638

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Comments

At 265 ppm in half-saturated aq soln exposed to nat. sunlight for 30 days, only 8% degraded; in art. sunlight for 15 days, 60% was degraded.
Aged resid. in columns of LmSd; 26% appl radioactiv. leached, and 87% remained in soil, 60% of applied in top 3".
Adsorption positively correlated with org. matter.
Carrots plant. 9 mos after appl 2 lbs AIA contd .06 ppm resud.
Wheat " " " " " " " " .03 ppm in grain
Metolachlor is rapidly metabolized and eliminated by animals.
Soil Koc = 200 (U)
Metolachlor was detected in ground water at pesticide dealer locations: Madison Co., SD (25-2,183 ppb); Dane Co., WI (12-3,500 ppb); Eau Claire Co., WI (12-3,500 ppb); Portage Co., WI (24-6,926 ppb).

References:
Writer : PJH; SLL; EW; KJC