



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

OFFICE OF  
PREVENTION, PESTICIDES AND  
TOXIC SUBSTANCES

MEMORANDUM

Subject: EEB's chapters for the Alachlor (SN 090501) RED

From: *for* Anthony Maciorowski, Chief *Douglas J. Urban 8/1/94*  
Ecological Effects Branch  
Environmental Fate and Effects Division (7507C)

To: David Farrar  
Science Analysis and Coordination Staff  
Environmental Fate and Effects Branch (7507C)

We have revised our chapters for the Registration Eligibility Document for Alachlor to incorporate your suggestions.

The documents are attached. Please contact Dr. James J. Goodyear at 305-7726 if you have any questions.



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Two terrestrial plant studies were judged to be "Supplemental." The most sensitive vegetative vigor study (42468601) was phytotoxicity (NOEL = 0.019 lbs ai/A, but no EC<sub>25</sub>). The 21-day weight study found a NOEL of 0.037 lbs/A and an EC<sub>25</sub> of 0.044 lbs/A. the most sensitive germination and growth study (42468701) was weight (NOEL = 0.0023 lbs/A and EC<sub>25</sub> = 0.0067 lbs/A).

Based on incomplete data, Alachlor was classified as "highly toxic to nontarget plants.

## RISK ASSESSMENT

### TERRESTRIAL ANIMALS

The potential risk for exposure to Alachlor that is applied as an emulsifiable concentrate or flowable concentrate on terrestrial vegetation to nontarget organisms and to endangered species is considered negligible.

SUBSTRATE	APPLICATION RATE lbs ai /A			
	2.0	3.2	4.0	6.0
Short grass	490	800	980	1470
Long grass	220	360	440	660
Leaves and leafy crops	250	410	500	750
Forage (alfalfa and clover) and insects	130	190	260	390
Pods containing seeds	24	39	48	72
Fruit	14	23	28	42

RESIDUES ON TYPICAL SUBSTRATES after application of Alacahlor at various rates (after Hoerger and Kenaga, 1972).

The maximum alachlor residues (ppm) expected immediately after application at various rates were calculated using Hoerger and Kenaga's nomogram (1972). The mammalian acute oral LD<sub>50</sub> is 1,200 mg/kg and the avian dietary LC<sub>50</sub> is greater than 5,620 ppm. These data characterize the toxicity of Alachlor as slightly toxic to mammals and practically nontoxic to birds for dietary exposures. Minimal acute dietary risk is expected for birds or (by inference) mammals.

The avian acute oral data (LD<sub>50</sub> = 1,499 mg/kg) can be used to evaluate avian exposure to granules. Granules are not broadcast evenly over a field. They are deposited in a band on the crop row. Typically, a 6 inch band is used in fields with 32 inches between the rows.

This application uses 16,375 linear feet per acre. Therefore, the pesticide is applied to an area of 8,163 square feet in every acre. At the maximum label rate of 4.0 lbs ai per acre, there is 0.22 g/sq. ft. If 85% of the granules are incorporated (Erbach and Tollefson, 1983) the potential surface "residue" is 33 mg/sq. ft. or < 0.02 LD<sub>50</sub>/sq. ft. The potential hazard to birds for exposure to granules should be slight.

**AQUATIC ANIMALS**

*Acute Freshwater-* Alachlor is a pre-emergent herbicide and is usually applied only once. There are some postemergence uses that allow two applications. Rain or irrigation water is recommended within five days of planting to move the chemical to the root zone.

The major use of Alachlor is on corn. Very little (< 1%) of the applications to corn are done by air, but this use does exist. Lasso (524-314) is registered at a maximum rate of 6.0 lbs. ai/A. This is the highest application rate (it exceeds the yearly total for multiple applications). We will use it to calculate runoff and drift.

The application calculation compares the runoff plus drift to the direct application of 1 lb ai of pesticide to a 1 acre pond that is 6 feet deep. Such an application would produce an EEC of 61 ppb.

$$\begin{array}{l} \text{runoff- 6 lbs ai} \\ \text{application} \end{array} \times \begin{array}{l} 0.6 \\ \text{appl efficiency} \end{array} \times \begin{array}{l} 0.05 \\ \text{runoff} \end{array} \times \begin{array}{l} 10 \text{ A} \\ \text{field size} \end{array} = \begin{array}{l} 1.8 \text{ lbs ai} \\ \text{total runoff} \end{array}$$

$$\begin{array}{l} \text{drift- 6 lbs ai} \\ \text{application} \end{array} \times \begin{array}{l} 0.05 \\ 5\% \text{ drift} \end{array} = \begin{array}{l} 0.3 \text{ lb ai} \\ \text{total drift} \end{array}$$

$$\text{total- } 1.8 \text{ lbs runoff} + 0.3 \text{ lbs ai drift} = 2.1 \text{ lbs ai total loading}$$

$$\text{EEC} = 61 \text{ ppb} \times 2.1 \text{ lbs} = 128 \text{ ppb}$$

The lowest LC<sub>50</sub> for a freshwater fish is 1.4 ppm for a rainbow trout. The lowest LC<sub>50</sub> for a freshwater invertebrate is 3.2 ppm for a midge. The EEC is an order of magnitude below these LC<sub>50</sub>s, therefore, it is not predicted that Alachlor will put fresh water fish or invertebrates at risk of death. Although the EEC exceeds an LOC for endangered fish (0.128/1.4 > 0.05), surface water monitoring data indicate exposures much less than estimated and below the LOC. It is concluded that Alachlor does not exceed any acute LOC for aquatic animals.

*Chronic freshwater-* Surface Water Section has supplied data for Alachlor in drinking water taken from surface waters. The Safe Water Drinking Act established the Maximum Contaminant Level (MCL) for various chemicals. The MCL for Alachlor is 2 µg/l (i.e., 2 ppb). The standard is that the average of the concentrations found in each of four quarterly measurements may not exceed the MCL. The methods used may have overestimated the exceedence of the MCL (Nelson, 1993, p.3).

Alachlor residues degraded slowly in nonsterile lake water. After 30 days of incubation, 88.8% of a 2 ppm [<sup>14</sup>C] Alachlor solution remained. Data from chronic aquatic studies are necessary as per 158 regulations.

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ECOLOGICAL EFFECTS  
ALACHLOR DISCIPLINARY REVIEW

ECOLOGICAL EFFECTS PROFILE

BIRDS

Scientifically sound data on the toxicity of technical Alachlor to birds has been received. One acute toxicity study (00079523, Fink, R., 1979) was considered adequate to characterize Alachlor as slightly toxic to birds on an acute oral basis. The LD<sub>50</sub> value was 1,499 mg/kg Bobwhite Quail.

The two dietary toxicity studies had identical results for the Bobwhite quail and the Mallard duck: LC<sub>50</sub> 5,620 ppm and the NOEL ≥ 1,000 ppm.

FISH

*Freshwater*- The "Core" 96-hour LC<sub>50</sub> value for rainbow trout was 1.8 ppm (40098001, Mayer, 1986). Bluegill sunfish 96-hour LC<sub>50</sub> values were 2.4 and 2.8 ppm (40098001, Mayer, 1986 and 00023615, Thompson, 1978). There is sufficient information available to characterize technical Alachlor as moderately toxic to both coldwater fish and warmwater fish.

The only "Core" study for Rainbow trout (*Oncorhynchus mykiss*) with an end use product (EC 45) had an LC<sub>50</sub> of 1.4 ppm (40098001, Mayer, 1986). The only "Core" LC<sub>50</sub> value in a Bluegill sun-fish study was 3.2 ppm (40098001, Mayer, 1986). There is sufficient data to characterize Alachlor EC as moderately toxic to freshwater fish. There is sufficient information available to characterize EC 45 Alachlor as moderately toxic to both coldwater fish and warmwater fish.

*Estuarine*- No marine/estuarine species have been tested.

AQUATIC INVERTEBRATES

*Freshwater* The results of studies on the toxicity of technical Alachlor to *Daphnia magna* were LC<sub>50</sub>s of 10 and 21 ppm (00028549, Forbis, 1978; 40098001, Mayer, 1986). Studies using Midges (40098001, Mayer, 1986) found an LC<sub>50</sub> of 3.2 ppm. There is adequate information to categorize Alachlor as slightly toxic to aquatic invertebrates.

There are two studies done with EC 45 Alachlor on freshwater invertebrates that are considered "Core." The LC<sub>50</sub> of *Daphnia magna* was 7.7 ppm (40098001, Mayer, 1986) and the LC<sub>50</sub> of a Midge was 2.5 ppm (40098001, Mayer, 1986). The available data on the toxicity of formulated EC 45 Alachlor to freshwater invertebrates are adequate to categorize formulated Alachlor as slightly toxic to practically nontoxic

*Estuarine*- No estuarine species have been tested.

NONTARGET PLANTS

One "Core" aquatic plant Growth and Reproduction study with TGAI Alachlor (42763801) was submitted. The NOEC was 0.35 µg/l and the EC<sub>50</sub> was 1.64 µg/l.

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*Estuarine and marine-* We do not have toxicity or environmental concentration data for marine and estuarine fish and invertebrates and cannot evaluate the risk. The marine and estuarine studies as listed in Table A are required to support corn, cotton, and soybean uses.

## PLANTS

*Aquatic-* Studies have found that Alachlor has an aquatic plant  $EC_{50}$  of 1.64  $\mu\text{g/l}$ . Alachlor was classified as being "highly toxic" to nontarget aquatic plants.

EEB's calculated maximum EEC (above) is 128 ppb. EFGWB has found reports in the literature that, at their peak, measured residues of Alachlor in surface water exceed 8 ppb. Hoheisel, *et al.*, (1992) found that Alachlor has been detected in ground water in 25 states at concentrations ranging from trace levels to 1000 ppb. Where ground water emerges it becomes surface water. These levels greatly exceed the NOEC and  $EC_{50}$  (0.35 and 1.64 ppb) for aquatic plants (green algae).

*Terrestrial-* Risk is measured by a dimensionless number call the Risk Quotient. It is the amount of the pesticide compared to the acute effects level. For terrestrial plants an RQ of over "1" is presumed to indicate high risk.

Typically Alachlor is applied by ground equipment at rates of 4.0 lbs ai/A. If there is 5% runoff, then the total preliminary EEC rate would be 0.2 lbs ai/A. The (supplemental)  $EC_{25}$  for seedling emergence was 0.04 lbs ai/A. Therefore, the Risk Quotient would be  $0.2 \div 0.04 = 5$ . Since Alachlor is persistent in water (88% after 30 days), additional applications would be almost fully additive. The highest ground application is Bronco (524-341) at 5.94 lbs ai/A. Its RQ is 7.4.

The highest application is a 6 lbs ai/A rate that is applied by air. The runoff would be the percent of the chemical that landed on the field times the rate of application time the rate of runoff. If 60% of the chemical landed on the field, then  $0.60 \times 6 \times 0.05 = .18$  lbs ai/A. The loading from drift is calculated as 5% of the 6 lb ai/A originally sprayed:  $6 \times 0.05 = 0.3$  lbs ai/A. The total loading is 0.48 lbs ai/A. The RQ is obtained by dividing by the seedling emergence  $EC_{25}$  of 0.04 lbs ai/A or 12.

Alachlor has a high potential for effecting nontarget plants near the use sites. It may pose a significant risk to endangered plant species inhabiting those areas.

EPA has been working with the U.S. Fish and Wildlife Service and other state and national agencies to develop a program to avoid jeopardizing the continue existence of listed species by the use of pesticides. The Endangered Species Protection Program is expected to become final in 1994. Limitation on the use of Alachlor will be required to protect endangered and threatened species, but these limitations have not yet been defined. EPA's Endangered Species Program may require the registrants to collect information about where the use of their herbicide overlaps with the range of endangered species.

Consultation with the FWS will be conducted in accordance with the species based priority approach described in the program. After completion of the consultation, regis-

trants will be informed if any required label modification are necessary. Such modification would may consist of the generic label statement referring pesticide users to use limitation contained in county bulletins.

#### DATA GAPS

We do not have acute exposure data for marine and estuarine fish and invertebrates or chronic exposure to aquatic animals. There are no data for toxic degradates of Alachlor in ground and surface water. We do not have enough information to decide if we need degradate testing and will have to reserve these studies.

### PRECAUTIONARY STATEMENT

#### END USE

"For terrestrial uses, do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark."

#### MANUFACTURING USE

Do not discharge into lakes, streams, ponds or public water unless in accordance with an NPDES permit. For guidance contact your Regional Office of EPA

#### Literature Cited

- Erbach, D.C. and J.J. Tollefson. 1983. Granular insecticide application for corn root-worm control. Transactions of the American Society of Agricultural Engineering 26:696-699.
- Hoerger, F.D. and E.E. Kenaga. 1972. Pesticide residues on plants: Correlation of representative data as a basis for estimation of their magnitude in the environment. *in*, Environmental Quality. F. Coulston and F. Korte, Eds. Academic Press, New York. Vol. I, pp. 9-28.
- Hoheisel, C. J. Karrie, S. Lees, L. Davies-Hilliard, P. Hannon, R. Bingham, E. Behl, D. Wells, and E. Waldman. 1992. Pesticides in ground water database - A compilation of monitoring studies: 1971-1991, EPA 734-12-92-001, September 1992.

TABLE A  
Generic Data Requirements for Alachlor

ECOLOGICAL EFFECTS §158.145 WILDLIFE AND AQUATIC ORGANISMS	Does EPA Have Enough Data to Satisfy This Requirement? Yes,			Must Additional Data be Submitted Under FIFRA
	Formula- tion <sup>1</sup>	Use Pattern <sup>2</sup>	No, or Partially	
71-1 Avian Oral Acute LD <sub>50</sub>	TGAI	A	Yes	Bibliographic Citation 0007923
71-2 Avian Dietary LC <sub>50</sub>	TGAI	A	Yes	43087101, 43087001
72-1 Freshwater Fish Acute LC <sub>50</sub>	TGAI	A	Yes	00031525, 00028550, 00028554, 00028551, 00028553, 00023615, 00023616, 00031524 40098001
72-2 Freshwater Invertebrate LC <sub>50</sub>	TGAI	A	Yes	40098001
72-3(a) Estuarine/Marine Toxicity Fish	TGAI	A	No <sup>3</sup>	
72-3(b) Estuarine/Marine Toxicity Mollusk	TGAI	A	No <sup>3</sup>	
72-3(c) Estuarine/Marine Toxicity Shrimp	TGAI	A	No <sup>3</sup>	
72-4(a) Early Life Stage Fish	TGAI	A	No	
72-4(b) Life Cycle Aquatic Invertebrate	TGAI	A	No	
123-1 Vegetative vigor	TGAI	A	No	42468601
123-1 Seed germination	TGAI	A	No	42468701
123-2 Plant growth	TGAI	A	Yes	42763801

In addition data may be required on toxic degradates of Alachlor if fate, groundwater, and chemistry studies show that it is warranted.

1. TGAI = Technical grade of the active ingredient.
2. The use patterns are coded as follows: A = Terrestrial, food crop; B = Terrestrial, noncrop; D = Aquatic, nonfood; H = Domestic outdoor; I = Outdoor.
3. Necessary to support cotton, corn, and soybean uses.

ECOLOGICAL EFFECTS  
**ALACHLOR TOPICAL SUMMARY**

**EFFECTS ON BIRDS**

Three studies in two submissions were received and evaluated under this topic. They are acceptable for use in a hazard assessment.

Author	ID Number
Fink, R	0079523
Grimes, J	43087101
	43087001

In order to establish the toxicity of Alachlor to birds, the following studies are required using the technical grade material: 1) two subacute dietary studies on one species of waterfowl (preferably, mallard duck) and one species of upland game bird (preferably, bobwhite quail, or ring-necked pheasant); 2) one avian single dose oral study on one species (preferably mallard duck or bobwhite quail).

The acceptable acute oral toxicity data is listed below:

FORMULATION		LD <sub>50</sub> in mg/kg	AUTHOR	FULFILLS THE GUIDELINES REQUIREMENT? YES, NO, OR		
SPECIES	% ai			DATE	ID NUMBER	PARTIAL
Bobwhite	92.3	1,499	Fink, R.	1979	00079523	Yes

There is sufficient information to characterize Alachlor as slightly toxic to birds on an acute basis. The avian acute oral guideline requirements have been satisfied by the evaluated documents.

Two studies were evaluated for dietary toxicity, both were acceptable. The acceptable dietary toxicity data are listed below:

FORMULATION		LC <sub>50</sub> in ppm	AUTHOR	FULFILLS THE GUIDELINES REQUIREMENT? YES, NO, OR		
SPECIES	% ai			DATE	ID NUMBER	PARTIAL
Bobwhite	95.4	> 5,620	Grimes	1986	43087101	Yes
Mallard	95.4	> 5,620	Grimes	1986	43087001	Yes

There is sufficient information to characterize Alachlor as practically nontoxic to birds on a dietary basis. The avian acute dietary guideline requirements have been satisfied by the evaluated documents.

**PRECAUTIONARY LABELING**

Available avian toxicity data indicate no toxicity statement for birds is necessary.

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## EFFECTS ON FRESHWATER FISH

Twelve studies (in eleven citations) were received and evaluated under this topic. Nine studies were acceptable for use in a hazard assessment.

Author	ID Number	Author	ID Number
Thompson, C.M.	00028550	Thompson, C.M.	00031521
Thompson, C.M.	00031525	Thompson, C.M.	00028553
Thompson, C.M.	00031522	Thompson, C.M.	00023615
Thompson, C.M.	00028554	Forbis, A.D.	00023616
Thompson, C.M.	00028551	Mayer, F.L.	40098001
Thompson, C.M.	00031524		

The minimum data required for establishing the acute toxicity of Alachlor to fish are the results from two 96-hour studies with technical Alachlor. These studies should be performed on one coldwater species (preferably rainbow trout) and one warmwater species (preferably bluegill sunfish).

The acceptable toxicity data are listed below:

FORMULATION		LC <sub>50</sub> in ppm	AUTHOR	FULFILLS THE GUIDELINES REQUIREMENT? YES, NO, OR		
SPECIES	% ai			DATE	ID NUMBER	PARTIAL
Bluegill sunfish	90	2.8	Thompson	1978	00023615	Yes
Rainbow trout	90	1.8	Forbis	1978	00023616	Partial
Bluegill sunfish	100	4.3	Mayer,	1986	40098001	Yes
Rainbow trout	100	2.4	Mayer,	1986	40098001	Yes

There is sufficient information to characterize Alachlor as moderately toxic to both warmwater fish and coldwater fish. The guideline requirements for LC<sub>50</sub> values for coldwater fish and warmwater fish have been satisfied for Alachlor.

Studies with a formulated product can be required under (158.145(7)(i)). The following acceptable studies are cited:

FORMULATION		LC <sub>50</sub> in ppm	AUTHOR	FULFILLS THE GUIDELINES REQUIREMENT? YES, NO, OR		
SPECIES	% ai			DATE	ID NUMBER	PARTIAL
Bluegill sunfish	44	6.4	Thompson	1978	00028554	Partial
Bluegill sunfish	45	6.2	Forbis	1978	00028551	Partial
Bluegill sunfish	42.4	7.9	Thompson	1978	00031525	Partial
Rainbow trout	42.5	3.6	Thompson	1979	00031524	Partial (continued)

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FORMULATION		LC <sub>50</sub> in ppm	AUTHOR	FULFILLS THE GUIDELINES REQUIREMENT? YES, NO, OR		
SPECIES	% ai			DATE	ID NUMBER	PARTIAL
(continued) Rainbow trout	45	3.7	Thompson	1978	00028550	Partial
Rainbow trout	44	4.2	Thompson	1978	00028553	Partial
Rainbow trout	43	1.4	Mayer	1986	40098001	Yes
Rhegill sunfish	43	3.2	Mayer	1986	40098001	Yes

The end-use product is moderately toxic to warm and cold water fish.

#### PRECAUTIONARY LABELING

No fish toxicity statement is required.

#### EFFECTS ON FRESHWATER INVERTEBRATES

Five studies were received and evaluated under this topic. Five studies were acceptable for use in a hazard assessment.

Author	ID Number
Forbis, A.D.	00028555
Forbis, A.D.	00028549
Forbis, A.D.	00028552
Thompson, C.M.	00031523
Thompson, C.M.	00031526
Mayer, F.L.	40098001

The minimum data required to establish the acute toxicity of Alachlor to freshwater invertebrates is a 48-hour acute aquatic study with technical material. The study organisms should be first instar *Daphnia magna* or early instar amphipods, stoneflies, or mayflies.

The acceptable acute toxicity data are listed below:

FORMULATION		LC <sub>50</sub> in ppm	AUTHOR	FULFILLS THE GUIDELINES REQUIREMENT? YES, NO, OR		
SPECIES	% ai			DATE	ID NUMBER	PARTIAL
<i>Daphnia magna</i>	90	10	Forbis	1978	00028549	Yes
<i>Daphnia magna</i>	93	21	Mayer	1986	40098001	Yes
Midge	93	3.2	Mayer	1986	40098001	Yes

Studies with a formulated product can be required (158.145(7)(;)). The following studies are cited:

FORMULATION		LC <sub>50</sub> in ppm	AUTHOR	FULFILLS THE GUIDELINES REQUIREMENT? YES, NO, OR		
SPECIES	% ai			DATE	ID NUMBER	PARTIAL
<i>Daphnia magna</i>	49	33	Forbis, A.	1978	00028555	Partial
<i>Daphnia magna</i>	45	22	Forbis, A.	1978	00028555	Partial
<i>Daphnia magna</i>	42.4	27	Thompson	1979	00031526	Partial
<i>Daphnia magna</i>	43	7.7	Mayer	1986	40098001	Yes
Midge	45	2.5	Mayer	1986	40098001	Yes

The end-use product is moderately toxic to slightly toxic to aquatic invertebrates.

There is sufficient information to characterize Alachlor as moderately toxic to freshwater invertebrates. The guideline requirement for an LC<sub>50</sub> value for freshwater invertebrates has been satisfied for Alachlor.

#### PRECAUTIONARY LABELING

No aquatic invertebrate toxicity statement is required.

#### EFFECTS ON ESTUARINE AND MARINE ORGANISMS

No studies were received under this topic.

Estuarine and marine organisms toxicity studies on technical and formulated pesticides are required to support registration if there is an intended direct application to an estuarine or marine environment or if the pesticide may be expected to enter these environments in significant concentrations because of use or mobility pattern. These include acute LC<sub>50</sub> studies on shrimp, oysters, and estuarine fish.

The use pattern for Alachlor includes applications to corn, cotton, and soybeans. Part of these crops are grown in close proximity to estuarine and marine environments. Therefore, estuarine and marine organism testing is required.

#### EFFECTS ON NONTARGET PLANTS

Three studies were received and evaluated under this topic.

Author	MRID
Blasberg	42763801
Cañez	42468601
Chetram	42468701

Studies were required to establish Alachlor's effect upon nontarget aquatic plants.

ALACHLOR TOPICAL SUMMARY

FORMULATION		NOEC and EC <sub>50</sub>	AUTHOR	FULFILLS THE GUIDELINES REQUIREMENT? YES, NO, OR		
SPECIES/NUMBER	% ai			DATE	ID NUMBER	PARTIAL
Green alga 123-2	98.6	0.35 & 1.64 µg/l	Blasberg	1993	42763801	Yes
Growth & reproduction	C <sup>14</sup>					

Based upon these studies, Alachlor can be classified as being highly toxic to aquatic plants.

Studies were required to establish Alachlor's effect upon nontarget terrestrial plants. Two studies were received.

FORMULATION		NOEL and EC <sub>25</sub>	AUTHOR	FULFILLS THE GUIDELINES REQUIREMENT? YES, NO, OR		
STUDY/NUMBER	% ai			DATE	ID NUMBER	PARTIAL
Vegetative vigor 123-1, most sensitive	94.6	0.019 lbs ai/A, EC <sub>25</sub> was not determined	Cañez	1993	42468601	Partial
Phytotoxicity						
21-day survival		0.22 and 0.31 lbs ai/A				
21-day height		0.037 and 0.12 lbs ai/A				
21-day weight		0.037 and 0.044 lbs ai/A				
Germination-growth 123-1 most sensitive	94.2	0.67 and 0.81 lbs ai/A	Chetram	1992	42468701	Partial
6-day seed germination						
6-day seedling emergence		0.019 and 0.04 lbs ai/A				
21-day survival		0.037 and 0.011 lbs ai/A				
Phytotoxicity		NOEL was 0.0093 lbs ai/A, EC <sub>25</sub> was not calculated				
Height		0.0023 and 0.011 lbs ai/A				
Weight		0.0023 and 0.0067 lbs ai/A				

Based on incomplete data, we would classify Alachlor as highly toxic to nontarget plants.

PRECAUTIONARY LABELING

"For terrestrial uses, do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark."

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ECOLOGICAL EFFECTS  
ALACHLOR DISCIPLINARY REVIEW

ECOLOGICAL EFFECTS PROFILE

BIRDS

Scientifically sound data on the toxicity of technical Alachlor to birds has been received. One acute toxicity study (00079523, Fink, R., 1979) was considered adequate to characterize Alachlor as slightly toxic to birds on an acute oral basis. The LD<sub>50</sub> value was 1,499 mg/kg Bobwhite Quail.

The two dietary toxicity studies had identical results for the Bobwhite quail and the Mallard duck: LC<sub>50</sub> 5,620 ppm and the NOEL ≥ 1,000 ppm.

FISH

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*Estuarine*- No estuarine species have been tested.

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Based on incomplete data, Alachlor was classified as "highly toxic to nontarget plants.

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TERRESTRIAL ANIMALS

The potential risk for exposure to Alachlor that is applied as an emulsifiable concentrate or flowable concentrate on terrestrial vegetation to nontarget organisms and to endangered species is considered negligible.

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	2.0	3.2	4.0	6.0
Short grass	490	800	980	1470
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Pods containing seeds	24	39	48	72
Fruit	14	23	28	42

RESIDUES ON TYPICAL SUBSTRATES after application of Alacahlor at various rates (after Hoerger and Kenaga, 1972).

The maximum alachlor residues (ppm) expected immediately after application at various rates were calculated using Hoerger and Kenaga's nomogram (1972). The mammalian acute oral LD<sub>50</sub> is 1,200 mg/kg and the avian dietary LC<sub>50</sub> is greater than 5,620 ppm. These data characterize the toxicity of Alachlor as slightly toxic to mammals and practically nontoxic to birds for dietary exposures. Minimal acute dietary risk is expected for birds or (by inference) mammals.

The avian acute oral data (LD<sub>50</sub> = 1,499 mg/kg) can be used to evaluate avian exposure to granules. Granules are not broadcast evenly over a field. They are deposited in a band on the crop row. Typically, a 6 inch band is used in fields with 32 inches between the rows.

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This application uses 16,375 linear feet per acre. Therefore, the pesticide is applied to an area of 8,163 square feet in every acre. At the maximum label rate of 4.0 lbs ai per acre, there is 0.22 g/sq. ft. If 85% of the granules are incorporated (Erbach and Tollefson, 1983) the potential surface "residue" is 33 mg/sq. ft. or < 0.02 LD<sub>50</sub>/sq. ft. The potential hazard to birds for exposure to granules should be slight.

**AQUATIC ANIMALS**

*Acute Freshwater-* Alachlor is a pre-emergent herbicide and is usually applied only once. There are some postemergence uses that allow two applications. Rain or irrigation water is recommended within five days of planting to move the chemical to the root zone.

The major use of Alachlor is on corn. Very little (< 1%) of the applications to corn are done by air, but this use does exist. Lasso (524-314) is registered at a maximum rate of 6.0 lbs. ai/A. This is the highest application rate (it exceeds the yearly total for multiple applications). We will use it to calculate runoff and drift.

The application calculation compares the runoff plus drift to the direct application of 1 lb ai of pesticide to a 1 acre pond that is 6 feet deep. Such an application would produce an EEC of 61 ppb.

$$\begin{array}{l} \text{runoff- } 6 \text{ lbs ai} \\ \text{application} \end{array} \times \begin{array}{l} 0.6 \\ \text{appl efficiency} \end{array} \times \begin{array}{l} 0.05 \\ \text{runoff} \end{array} \times \begin{array}{l} 10 \text{ A} \\ \text{field size} \end{array} = \begin{array}{l} 1.8 \text{ lbs ai} \\ \text{total runoff} \end{array}$$

$$\begin{array}{l} \text{drift- } 6 \text{ lbs ai} \\ \text{application} \end{array} \times \begin{array}{l} 0.05 \\ 5\% \text{ drift} \end{array} = \begin{array}{l} 0.3 \text{ lb ai} \\ \text{total drift} \end{array}$$

$$\text{total- } 1.8 \text{ lbs runoff} + 0.3 \text{ lbs ai drift} = 2.1 \text{ lbs ai total loading}$$

$$\text{EEC} = 61 \text{ ppb} \times 2.1 \text{ lbs} = 128 \text{ ppb}$$

The lowest LC<sub>50</sub> for a freshwater fish is 1.4 ppm for a rainbow trout. The lowest LC<sub>50</sub> for a freshwater invertebrate is 3.2 ppm for a midge. The EEC is an order of magnitude below these LC<sub>50</sub>s, therefore, it is not predicted that Alachlor will put fresh water fish or invertebrates at risk of death. Although the EEC exceeds an LOC for endangered fish (0.128/1.4 > 0.05), surface water monitoring data indicate exposures much less than estimated and below the LOC. It is concluded that Alachlor does not exceed any acute LOC for aquatic animals.

*Chronic freshwater-* Surface Water Section has supplied data for Alachlor in drinking water taken from surface waters. The Safe Water Drinking Act established the Maximum Contaminant Level (MCL) for various chemicals. The MCL for Alachlor is 2 µg/l (*i.e.*, 2 ppb). The standard is that the average of the concentrations found in each of four quarterly measurements may not exceed the MCL. The methods used may have overestimated the excedence of the MCL (Nelson, 1993, p.3).

Alachlor residues degraded slowly in nonsterile lake water. After 30 days of incubation, 88.8% of a 2 ppm [<sup>14</sup>C] Alachlor solution remained. Data from chronic aquatic studies are necessary as per 158 regulations.

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*Estuarine and marine-* We do not have toxicity or environmental concentration data for marine and estuarine fish and invertebrates and cannot evaluate the risk. The marine and estuarine studies as listed in Table A are required to support corn, cotton, and soybean uses.

## PLANTS

*Aquatic-* Studies have found that Alachlor has an aquatic plant  $EC_{50}$  of  $1.64 \mu\text{g/l}$ . Alachlor was classified as being "highly toxic" to nontarget aquatic plants.

EEB's calculated maximum EEC (above) is 128 ppb. EFGWB has found reports in the literature that, at their peak, measured residues of Alachlor in surface water exceed 8 ppb. Hoheisel, *et al.*, (1992) found that Alachlor has been detected in ground water in 25 states at concentrations ranging from trace levels to 1000 ppb. Where ground water emerges it becomes surface water. These levels greatly exceed the NOEC and  $EC_{50}$  (0.35 and 1.64 ppb) for aquatic plants (green algae).

*Semi-Aquatic Plants-* Semi-aquatic plant species live for some part of the year in wet soil. The most appropriate toxicity measurements for these plants are the ones used for terrestrial plants. Exposure scenarios are similar to those described previously for aquatic organisms.

Risk to semi-aquatic plants exceeds levels of concerns. Risk is assessed using two different risk quotients, representing exposure by drift and runoff. Both are both compared to an LOC of 1.

A risk quotient is calculated based on exposure to aerial drift of pesticide, when the pesticide is applied aerially at 6 lbs ai/A, and drifts to a plot with area equal to that of the application plot. A loading 0.3 lbs ai/A is calculated in the same way as for aquatic organisms. The most applicable toxicity data is that for vegetative vigor of terrestrial plants (§A.2.a.(3)),  $EC_{25}$  measurements as low as 0.044 lbs ai/A. The value of the risk quotient is  $0.3 \div 0.044 = 7$ .

A risk quotient is calculated based on exposure to runoff of water containing pesticide. The standard model assumes that pesticide is applied aerially at 6 lbs ai/A to a 10 acre plot and is transported to a 1 acre plot. A loading of 1.8 lbs ai/A is calculated in the same way as for aquatic organisms. The most applicable toxicity data is that for germination and growth of terrestrial plants,  $EC_{25}$  measurements as low as 0.0067 lbs ai/A. The value of the risk quotient is 269.

*Terrestrial-* Risk is measured by a dimensionless number call the Risk Quotient. It is the amount of the pesticide compared to the acute effects level. For terrestrial plants an RQ of over "1" is presumed to indicate high risk.

Typically Alachlor is applied by ground equipment at rates of 4.0 lbs ai/A. If there is 5% runoff, then the total preliminary EEC rate would be 0.2 lbs ai/A. The (supplemental)  $EC_{25}$  for seedling emergence was 0.04 lbs ai/A. Therefore, the Risk Quotient would be  $0.2 \div 0.04 = 5$ . Since Alachlor is persistent in water (88% after 30



days), additional applications would be almost fully additive. The highest ground application is Bronco (524-341) at 5.94 lbs ai/A. Its RQ is 7.4.

The highest application is a 6 lbs ai/A rate that is applied by air. The runoff would be the percent of the chemical that landed on the field times the rate of application time the rate of runoff. If 60% of the chemical landed on the field, then  $0.60 \times 6 \times 0.05 = .18$  lbs ai/A. The loading from drift is calculated as 5% of the 6 lb ai/A originally sprayed:  $6 \times 0.05 = 0.3$  lbs ai/A. The total loading is 0.48 lbs ai/A. The RQ is obtained by dividing by the seedling emergence  $EC_{25}$  of 0.04 lbs ai/A or 12.

Alachlor has a high potential for effecting nontarget plants near the use sites. It may pose a significant risk to endangered plant species inhabiting those areas.

EPA has been working with the U.S. Fish and Wildlife Service and other state and national agencies to develop a program to avoid jeopardizing the continue existence of listed species by the use of pesticides. The Endangered Species Protection Program is expected to become final in 1994. Limitation on the use of Alachlor will be required to protect endangered and threatened species, but these limitations have not yet been defined. EPA's Endangered Species Program may require the registrants to collect information about where the use of their herbicide overlaps with the range of endangered species.

Consultation with the FWS will be conducted in accordance with the species based priority approach described in the program. After completion of the consultation, registrants will be informed if any required label modification are necessary. Such modification would may consist of the generic label statement referring pesticide users to use limitation contained in county bulletins.

## DATA GAPS

We do not have acute exposure data for marine and estuarine fish and invertebrates or chronic exposure to aquatic animals. There are no data for toxic degradates of Alachlor in ground and surface water. We do not have enough information to decide if we need degrade testing and will have to reserve these studies.

## PRECAUTIONARY STATEMENT

### END USE

"For terrestrial uses, do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark."

### MANUFACTURING USE

Do not discharge into lakes, streams, ponds or public water unless in accordance with an NPDES permit. For guidance contact your Regional Office of EPA

## Literature Cited

- Erbach, D.C. and J.J. Tollefson. 1983. Granular insecticide application for corn root-worm control. Transactions of the American Society of Agricultural Engineering 26:696-699.
- Hoerger, F.D. and E.E. Kenaga. 1972. Pesticide residues on plants: Correlation of representative data as a basis for estimation of their magnitude in the environment. *in*, Environmental Quality. F. Coulston and F. Korte, Eds. Academic Press, New York. Vol. I, pp. 9-28.
- Hoheisel, C. J. Karrie, S. Lees, L. Davies-Hilliard, P. Hannon, R. Bingham, E. Behl, D. Wells, and E. Waldman. 1992. Pesticides in ground water database - A compilation of monitoring studies: 1971-1991, EPA 734-12-92-001, September 1992.

TABLE A

Generic Data Requirements for Alachlor

ECOLOGICAL EFFECTS §158.145 WILDLIFE AND AQUATIC ORGANISMS	Data Requirement	Does EPA Have Enough Data to Satisfy This Requirement? Yes,			Must Additional Data be Submitted Under FIFRA	
		Formula-tion <sup>1</sup>	Use Pattern <sup>2</sup>	No, or Partially		
71-1	Avian Oral Acute LD <sub>50</sub>	TGAI	A	Yes	Bibliographic Citation 0007923	Section 3(c)(2)(B) No
71-2	Avian Dietary LC <sub>50</sub>	TGAI	A	Yes	43087101, 43087001	No
72-1	Freshwater Fish Acute LC <sub>50</sub>	TGAI	A	Yes	00031525, 00028550, 00028554, 00028551, 00028553, 00023615, 00023616, 00031524 40098001	No
72-2	Freshwater Invertebrate LC <sub>50</sub>	TGAI	A	Yes	40098001	No
72-3(a)	Estuarine/Marine Toxicity Fish	TGAI	A	No <sup>3</sup>		Yes
72-3(b)	Estuarine/Marine Toxicity Mollusk	TGAI	A	No <sup>3</sup>		Yes
72-3(c)	Estuarine/Marine Toxicity Shrimp	TGAI	A	No <sup>3</sup>		Yes
72-4(a)	Early Life Stage Fish	TGAI	A	No		Yes
72-4(b)	Life Cycle Aquatic Invertebrate	TGAI	A	No		Yes
123-1	Vegetative vigor	TGAI	A	No	42468601	Yes
123-1	Seed germination	TGAI	A	No	42468701	Yes
123-2	Plant growth	TGAI	A	Yes	42763801	No

In addition data may be required on toxic degradates of Alachlor if fate, groundwater, and chemistry studies show that it is warranted.

1. TGAI = Technical grade of the active ingredient.
2. The use patterns are coded as follows: A = Terrestrial, food crop; B = Terrestrial, nonfood; D = Aquatic, nonfood; H = Domestic outdoor; I = Outdoor.
3. Necessary to support cotton, corn, and soybean uses.



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

OFFICE OF  
PREVENTION, PESTICIDES AND  
TOXIC SUBSTANCES

MEMORANDUM

Subject: Alachlor (SN 090501) avian dietary studies.  
From: *AM* Anthony Maciorowski, Chief *Anthony J. Maciorowski 6/10/94*  
Ecological Effects Branch  
Environmental Fate and Effects Division (7507C)  
To: Walter Waldrop, Jr.  
Head, Section 1, Registration Branch  
Special Review and Reregistration Division 7508W

EEB has reviewed the two avian dietary studies that were submitted by Monsanto. They were both found to be "Core."

Our Date Evaluation Report is attached. Please contact Dr. James J. Goodyear at 305-7726 if you have any questions.



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Data Evaluation Record

**ALACHLOR**

Guideline 71-2(a) Bobwhite Quail Dietary Toxicity Study

1. TEST MATERIAL- Alachlor.
2. STUDY MATERIAL - Technical grade - 95.4%
3. STUDY TYPE- Avian Dietary Oral LC<sub>50</sub>.

*Species used-* Bobwhite quail (*Colinus virginianus*)

4. STUDY IDENTIFICATION: Grimes, J. and M. Jaber. 1986. Alachlor: A dietary LC<sub>50</sub> study with the Bobwhite. Wildlife International Ltd. inc., St. Michaels, MD 21663. no. 139-231. Submitted by Monsanto Agricultural Company, 800 North Lindbergh Blvd., St. Louis, MO 63167. no. WL-86-206, RD1217. MRID 430871-01. D203271.

5. REVIEWED BY:

James J. Goodyear, Ph.D.  
Biologist, Section 1  
Ecological Effects Branch  
Environmental Fate and Effects Division (7507C)

Signature: James Goodyear

Date: 6.8.94

6. APPROVED BY:

Leslie W. Touart, Ph.D.  
Head, Section 1  
Ecological Effects Branch  
Environmental Fate and Effects Division (7507C)

Signature: L. W. Touart

Date: 6.8.94

7. CONCLUSIONS:

Alachlor technical is practically nontoxic (LC<sub>50</sub> > 5,620 ppm) to Bobwhite quail chicks in dietary tests. The study is "Core" and fulfils the guideline requirement.

8. RECOMMENDATIONS- N/A.

9. BACKGROUND:

Submitted for reregistration.

10. DISCUSSION OF INDIVIDUAL TEST- N/A.

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## 11. MATERIALS AND METHODS:

### A. TEST ANIMALS:

Sand Prairie Quail Farm, Route 3, Box 159, Maquoketa, Iowa 52060. They were pen-reared and indistinguishable for wild birds.

### B. DOSE:

The nominal concentrations were 562, 1000, 1780, 3160, and 5620 ppm.

### C. DESIGN:

They were acclimated for eight days, exposed for five days and observed for four days. There were ten birds in each mixed sex group. There were three control groups and five test groups. The toxicant was mixed with corn oil (2%) but no other solvent. The controls contained 2% corn oil.

Birds were put into pens at random. The pens were 72(W) X 90(D) X 23(H) cm. Temperature was  $32^{\circ} \pm 2^{\circ}$  C and the relative humidity was 70%.

The photoperiod was 17 hours of light. Birds were observed daily. Weights were taken by group at the start of the study, on day 5, and the end of the study. Food consumption was calculated for the exposure period and for the observation period.

There were no deaths in the control or test groups.

### D. STATISTICS:

The  $LC_{50}$  was taken as being in excess of the highest dose.

## 12. REPORTED RESULTS:

There were no mortalities. The body weights were reduced at and above 1000 ppm.

## 13. STUDY AUTHORS' CONCLUSIONS/QA MEASURES:

$LC_{50} > 5620$  ppm. Based upon the reduction in body weight, 1000 ppm called the NOEL.

## 14. REVIEWER'S DISCUSSION AND CONCLUSIONS:

### A. TEST PROCEDURES:

The procedures were within acceptable limits.

**B. STATISTICAL ANALYSIS:**

LC<sub>50</sub> > 5620 ppm. Based upon the reduction in body weight, the NOEL was considered to be 1000 ppm.

**C . DISCUSSION/RESULTS:**

Alachlor technical is practically nontoxic to bobwhite chicks.

**D. ADEQUACY OF THE STUDY:**

*Classification-* Core.

*Rationale-* Meets SEP requirements.

*Repair-* n/a.

15. COMPLETION OF ONE-LINER FOR STUDY- yes.

16. CBI APPENDIX- N/A.

Handwritten signature or initials, possibly 'JB', located in the bottom right corner of the page.

Data Evaluation Record

**ALACHLOR**

Guideline 71-2(b) Mallard Dietary Toxicity Study

1. TEST MATERIAL- Alachlor.
2. STUDY MATERIAL - Technical grade - 95.4 %
3. STUDY TYPE- Avian Dietary Oral LC<sub>50</sub>.

*Species used-* Mallard duck (*Anas platyrhynchos*)

4. STUDY IDENTIFICATION: Grimes, J. and M. Jaber. 1986. Alachlor: A dietary LC<sub>50</sub> study with the Mallard. Wildlife International Ltd. inc., St. Michaels, MD 21663. no. 139-232. Submitted by Monsanto Agricultural Company, 800 North Lindbergh Blvd., St. Louis, MO 63167. no. WL-86-205, RD1218. MRID 430870-01. D203271.

5. REVIEWED BY:

James J. Goodyear, Ph.D.  
Biologist, Section 1  
Ecological Effects Branch  
Environmental Fate and Effects Division (7507C)

Signature: James Goodyear  
Date: 6-8-94

6. APPROVED BY:

Leslie W. Touart, Ph.D.  
Head, Section 1  
Ecological Effects Branch  
Environmental Fate and Effects Division (7507C)

Signature: L. W. Touart  
Date: 6-8-94

7. CONCLUSIONS:

Alachlor technical is practically nontoxic (LC<sub>50</sub> > 5,630 ppm) to mallard duckling in dietary tests. The study is "Core" and fulfils the guideline requirement.

8. RECOMMENDATIONS- N/A.

9. BACKGROUND:

Submitted for reregistration.

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10. DISCUSSION OF INDIVIDUAL TEST- N/A.

11. MATERIALS AND METHODS:

A. TEST ANIMALS:

Ten day old ducklings from Whistling Wings, Box 1, 113 Washington Street, Hanover, Illinois 61041. They were pen-reared and indistinguishable for wild birds.

B. DOSE:

The nominal concentrations were 562, 1000, 1780, 3160, and 5620 ppm.

C. DESIGN:

They were acclimated for eight days, exposed for five days and observed for three days. There were ten in each mixed sex group. There were three control groups and five test groups. The toxicant was mixed with corn oil (2%) but no other solvent. The controls contained 2% corn oil.

Birds were put into pens at random. The pens were 72(W) X 90(D) X 24(H) cm. Temperature was  $82^{\circ} \pm 3^{\circ}$  F and the relative humidity was 72%.

The photoperiod was 17 hours of light. Birds were observed daily. Weights were taken by group at the start of the study, on day 5, and the end of the study. Food consumption was calculated for the exposure period and for the observation period.

There were no deaths in the control groups. One bird died in the 3160 ppm group, but they did not attribute this to the toxicant.

D. STATISTICS:

The  $LC_{50}$  was taken as being in excess of the highest dose.

12. REPORTED RESULTS:

There were no mortalities in the control groups. "There was one mortality on Day 1 at the 3160 ppm concentration which was not attributed to treatment." There was a reduction in the weights of the 1780, 3160, and 5620 ppm groups.

13. STUDY AUTHORS' CONCLUSIONS/QA MEASURES:

$LC_{50} > 5620$  ppm. Based upon the reduction in body weight, 1000 ppm called the NOEL.

14. REVIEWER'S DISCUSSION AND CONCLUSIONS:

A. TEST PROCEDURES:

The procedures were within acceptable limits. It was not explained how the mortality at the 3160 level, "which was not attributed to treatment" occurred. There is very little difference in the  $LC_{50}$  if this mortality is attributed to the treatment. The statistical method of determining the  $LC_{50}$  (Stephan, 1977) will not accept such an unusual distribution of mortality. We are willing to accept the mortality as being unrelated to the treatment.

B. STATISTICAL ANALYSIS:

$LC_{50} > 5620$  ppm. Based upon the reduction in body weight, the NOEL was considered to be 1000 ppm.

C . DISCUSSION/RESULTS:

Alachlor technical is practically nontoxic to mallard ducklings.

D. ADEQUACY OF THE STUDY:

*Classification-* Core.

*Rationale-* Meets SEP requirements.

*Repair-* n/a.

15. COMPLETION OF ONE-LINER FOR STUDY- yes.

16. CBI APPENDIX- N/A.

LITERATURE CITED

Stephan, C.E. 1977. Methods for calculating an  $LC_{50}$ . in, Aquatic Toxicology and Hazard Evaluation. ASTM STP 634. F.L. Mayer and J.L. Hamelink. Eds. American Society for Testing and Materials. pp. 65-84.