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

JAN 25 1994

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MEMORANDUM

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

SUBJECT: Acetochlor Herbicide: New Chemical Science Chapter
DP Barcode D187737, D190319

TO: Robert Taylor, PM-25
Registration Division (H7505C)

FROM: Anthony F. Maciorowski, Chief
Ecological Effects Branch
Environmental Fate and Effects Branch (H7507C)

The Ecological Effects Branch has completed a Science Chapter on a new herbicide, Acetochlor. Nineteen new studies submitted by the Acetochlor Registration Partnership have been reviewed for this new chemical. These studies were submitted under DP Barcode D187737 and D190319 for Registration under section 3.

Proposed Use: Acetochlor will be used for field corn, silage corn or popcorn. The label shows that aerial application will used.

Data Adequacy (123-2) The Aquatic Plant Growth *Skeletonema costatum* MRID# 42713110 should be conducted again for the full 5 days. Lack of this study does not preclude completing a risk assessment. It may impact EFED's ability to evaluate risk reduction measures.

Concerns

1- Acute and chronic effects to birds and mammals not expected.

2- Fish and Aquatic invertebrates,

- No adverse effects are anticipated for aquatic invertebrates.

- It appears that the use of acetochlor at the labeled rate will have adverse effects on non-endangered aquatic organisms located in areas that have a runoff potential such as Louisiana, central and southern Alabama and Mississippi, and all of Florida. The concentration exceeds $\frac{1}{2}LC_{50}$ risk criteria by 1.5 times. (RQ=1.5)

- Based on estimated aquatic concentrations, adverse effects to endangered fish are expected. The concentration exceeds the endangered fish risk criteria by 3.7 times (RQ=3.7) from runoff only. Exposure from drift is not expected to exceed endangered aquatic animal risk criteria.

- Sixteen endangered fish species have been identified as potentially affected. These occur in 17 states. The U.S. Fish and Wildlife Service (USFWS) has rendered a jeopardy opinion for several of these species in a 1989 biological opinion for another corn herbicide of the same class as acetochlor (propachlor). Options were listed in the biological opinions by which risk may be reduced or mitigated. These options are:

  i- buffer zones (as determined by USFWS),

  ii- reduced rate of application to levels below the endangered species risk criteria (if the use rate was reduced to 0.6 lb ai/acre, the endangered fish risk criteria would not be exceeded), or

  iii- prohibit the use of the herbicide within the drainage basin of the endangered species.

3- Plants, Risk concluded for both endangered and nonendangered plants, both to both aquatic and terrestrial species.

- Endangered and non-target aquatic plants risk criteria have been exceeded by 21 times (RQ=21) from field runoff and 2 times (RQ=2) from aerial drift.

- For endangered and non-target terrestrial plants in wet areas, the risk criteria have been exceeded by a factor of 900 times (RQ=900) from field runoff. For endangered and non-target terrestrial monocot plants, aerial drift will exceed the risk criteria by a factor of 23 times (RQ=23).

- 37 endangered plant species may be affected from channelized runoff and 8 additional endangered plant species may be affected as a result of drift from aerial application (for a total of 45 potentially affected endangered plant species). These species occur in thirty-five states.

4- Risk Reduction measures for plants,

- Elimination of aerial application would reduce, but not eliminate, risk to plants (endangered and nonendangered). If aerial application was eliminated, there would be no exposure to endangered plant species in 10 of the 35 states and the number of counties having "may affect" to endangered plant species would be reduced in 8 of the remaining states.

If you have questions regarding this review, please contact Mike Davy at 305-7081.

Ecological Effects Branch
New Chemical Science Chapter For
Acetochlor

A. Ecological Hazard

1. Ecological Effects Topical Summaries

a. Effects on Non-Target Birds

In order to establish the toxicity to birds, the following tests are required using the technical grade material: an avian single-dose oral acute study (71-1) on one species (preferably mallard duck or bobwhite quail); two subacute dietary studies (71-2) on one species of waterfowl (preferably mallard duck) and on one species of upland game bird (preferably bobwhite quail); and because of persistence, two avian reproduction studies (71-4) on mallard duck and bobwhite quail.

Twelve studies were evaluated under this topic. Eleven were acceptable for use in hazard assessment.

The acceptable toxicity studies for use in a hazard assessment are listed below:

Guideline	Species	% ai	Tox value	MRID No.	Fulfills Guideline Requirements
71-1a	Mallard	89.4	LD_{50}=1788 mg/kg	41565129	YES
71-1a	Mallard	95.0	LD_{50}=1646 mg/kg	073665	YES
71-1a	Bobwhite	90.4	LD_{50}=49 mg/kg	41963303	YES
71-1a	Bobwhite	94.5	LD_{50}>1567 mg/kg	99812	YES
71-2a	Bobwhite	94.5	LC_{50}>5620 ppm	99812, 073665	YES
71-2b	Mallard	94.5	LC_{50}>5620 ppm	99812, 073665	YES
71-2a	Bobwhite	89.4	LC_{50}>4610 ppm	41565131	YES
71-2b	Mallard	89.4	LC_{50}>4171 ppm	41565130	YES
71-4a	Bobwhite	90.1	NOEL=300 ppm	41963305	YES
71-4b	Mallard	89.4	NOEL>300 ppm	41592009	PARTIAL
71-4a	Bobwhite	89.4	NOEL>300 ppm	41592010	PARTIAL

Data requirements for avian acute and dietary studies have been fulfilled. Avian reproduction studies are partially fulfilled. Please see section D Data Requirements for discussion of avian data requirements on page 30 of this report.

b. **Effects to Non-Target Fish**

Ten studies were evaluated under this topic. All were acceptable for use in hazard assessment.

In order to establish the toxicity to fish, the following tests are required using the technical grade material: two 96-hour acute fish studies (72-1); one on a species of coldwater fish (preferably rainbow trout) and one on a species of warmwater fish (preferably bluegill sunfish). In addition, (72-4) Early Life Stage of Fish is required due to the persistence of acetochlor in aquatic environment.

The acceptable toxicity studies for use in a hazard assessment are listed below:

Guideline	Species	% ai	Tox value	MRID No.	Fulfills Guideline Requirements
72-1a	Bluegill	98.0	LC_{50}=21.57 ppm	073665	YES
72-1a	Bluegill	95.6	LC_{50}=1.3 ppm	246128, 99812	YES
72-1c	Trout	98.0	LC_{50}=5.44 ppm	073665	YES
72-1c	Trout	91.3	LC_{50}=0.42 ppm	073665	YES
72-1c	Trout	90.4	LC_{50}=1.2 ppm	41963306	YES
72-1a	Bluegill	89.7	LC_{50}=1.6 ppm	41565133	YES
72-1c	Trout	89.7	LC_{50}=0.38 ppm	41565132	YES
72-4a	Fathead Minnow	89.7	NOEC=0.45 ppm LOEC=0.80 ppm	41592011	YES
72-4a	Trout	92.1	NOEC=0.13 ppm LOEC=0.27 ppm	42713104	YES
72-4a	Trout	97.7	NOEC=0.23 ppm LOEC=0.45 ppm	071973	YES

All data requirements for freshwater fish fulfilled.

c. **Effects to Non-Target Aquatic Invertebrates**

Five studies were evaluated under this topic. These were acceptable for use in hazard assessment. In order to establish the toxicity to aquatic invertebrates, a 48-hour aquatic invertebrate acute toxicity test is required using the technical grade material on first instar *Daphnia magna* or early instar amphipods, stoneflies or mayflies. In addition, (72-4) Aquatic Invertebrate Life Cycle is required due to the persistence of acetochlor in aquatic environment.

The acceptable toxicity study for use in a hazard assessment is listed below:

Guideline	Species	% ai	Tox value	MRID No.	Fulfills Guideline Requirements
72-2a	*Daphnia magna*	98.0	LC_{50}=26 ppm	073665	YES
72-2a	*Daphnia magna*	91.3	LC_{50}=14 ppm	99812	YES
72-2a	*Daphnia magna*	68.8	LC_{50}=8.2 ppm	41565134	YES
72-4b	*Daphnia magna*	89.4	NOEC=1.24 ppm LOEC=2.45 ppm	41565138	YES
72-4b	*Daphnia magna*	92.1	NOEC=22.1 ppb LOEC=42.7 ppb	42713105	YES

All data requirements for aquatic invertebrates are fulfilled.

d. **Effects to Non-Target Estuarine and Marine Organisms**

Six studies were evaluated under this topic. All were acceptable for use in hazard assessment.

In order to establish the toxicity to estuarine and marine organisms, the following tests are required using the technical grade material: either a Mollusc 48-hour embryo larvae study using Pacific oyster, Eastern oyster, mussel (preferably *Mytilus edulis*) or Quahog (*Mercenaria*) or a Mollusc 96-hour Flow-Through Shell Deposition study using Pacific oyster or Eastern oyster; and a Shrimp 96-hour acute toxicity test using white, pink, brown, grass or mysid shrimp species; an estuarine fish (preferably silverside or sheepshead minnow).

The acceptable toxicity study for use in a hazard assessment is listed below:

Guideline	Species	% ai	Tox value	MRID No.	Fulfills Guideline Requirements
72-3c	Mysid Shrimp	92.1	EC_{50}=2.2 ppm	42713101	YES
72-3c	Mysid Shrimp	89.4	EC_{50}=5.3 ppm	41565135	YES
72-3a	Sheepshead Minnow	92.1	LC_{50}=2.1 ppm	42713102	YES
72-3a	Sheepshead Minnow	89.7	LC_{50}=3.9 ppm	41565137	YES
72-3b	Eastern Oyster	92.1	EC_{50}=3.82 ppm	42713103	YES
72-3b	Pacific Oyster	89.6	EC_{50}=8.0 ppm	41565136	YES

All data requirements for estuarine species are fulfilled.

e. **Effects to Non-Target Insects (Beneficial Insects)**

Five studies were evaluated under this topic. All were acceptable for use in hazard assessment. In order to establish the toxicity to insects, an acute oral toxicity test to honey bees is required using the technical grade material.
The acceptable toxicity study for use in a hazard assessment is listed below:

Guideline	Species	% ai	Tox value	MRID No.	Fulfills Guideline Requirements
141-1	Honey Bee	97.6	LD_{50}=1715 µg/bee	071973	YES
141-1	Honey Bee	95.0	LD_{50}>100 µg/bee	073665	YES
141-1	Honey Bee	68.6	LD_{50}>200 µg/bee	41465142	YES
141-1	Honey Bee	68.6	LD_{50}>100 µg/bee	41565142	YES
141-1	Honey Bee	68.6	LD_{50}>137 µg/bee	41565142	YES

All data requirements for non-target beneficial insects are fulfilled.

f. **Effects to Non-Target Plants**

Five aquatic plant studies were evaluated under this topic. These are acceptable for use in hazard assessment. In order to establish the toxicity to aquatic plants, an aquatic plant growth study (123-2) comprising of *Selenastrum capricornutum, Lemna gibba, Skeletonema costatum, Anabaena flos-aquae,* and freshwater diatom is required using the technical grade material.

The acceptable aquatic plant toxicity studies for use in a hazard assessment is listed below:

Guide line	Species	% ai	Tox value	MRID No.	Fulfills Guideline Requirements
123-2	*Selenastrum capricornutum*	89.7	EC_{50}=1.43 ppb	41565141	YES
123-2	*Anabaena flos-aquae*	95.1	EC_{50}=35,000 ppb	42713109	YES
123-2	*Navicula pelliculosa*	95.1	EC_{50}=1380 ppb	42713108	NO[1]
123-2	*Skeletonema costatum*	95.1	EC_{50}=3.4 ppb	42713110	NO[1]
123-2	*Lemna gibba*	95.1	EC_{50}= 3.4 ppb	42713107	YES

The acceptable terrestrial plant toxicity studies for use in a hazard assessment is listed below:

Guide line	Species	% ai	Tox value[2]	MRID No.	Fulfills Guideline Requirements
123-1(a)	ryegrass	92.1	EC_{25}= 0.0013	42573401	YES
123-1(a)	lettuce	92.1	EC_{25}= 0.0016	42573401	YES
123-1(b)	ryegrass	92.1	EC_{25}= 0.0050	42713119	YES
123-1(b)	lettuce	92.1	EC_{25}= 0.3200	42713119	YES

Data requirements for terrestrial plants are fulfilled. However, data for 123-2 Aquatic Plant Growth, *Skeletonema costatum*, is still outstanding. Please see section D Data Requirements on page 30 for discussion concerning this data requirement.

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[1] This study is not acceptable for risk assessment because the study was done in 4 days instead of 5 days as recommended by the SEP and there was an increasing toxicity as the test is prolonged. It is expected that the EC_{50} values will be much more sensitive. The added value for repeating this study (*Skeletonema costatum*) is high since this study may be the most sensitive aquatic plant study. The added value for repeating the *Navicula pelliculosa* study is low in that this is not the most sensitive aquatic plant species but useful information may be gleaned from repeating this study.

[2] Value is in pounds of active ingredient per acre

2. Ecological Effects Disciplinary Review Summation

a. Non-Target Terrestrial

Acetochlor is slightly toxic to mammals with an oral LD_{50}= 1702 mg/kg rats. The one-year feeding test on dogs concluded with an indication of toxic neurological effects in dogs with a NOEL= 2 mg\kg\day and the LOEL= 10 mg\kg\day. The reproductive NOEL and LOEL for rats was 175 and 1750 ppm, respectively, in a two-generation reproduction test. The reproduction study concluded in a decreased weight gain and food consumption in pups and increase in organ weights.

Three of the avian single dose oral acute LD_{50} range from 1567 to 1788 mg/kg. One of the avian oral acute LD_{50} show 49 mg/kg which is highly toxic. This study may not be accurate since the other acute studies are slightly toxic and the five avian dietary studies support this contention. The lowest avian dietary LC50 is not known precisely. The data indicate the LC50 for acetochlor is >4171 ppm. Data from avian single-dose oral and dietary studies indicate that acetochlor may be slightly toxic on an acute and dietary (mallard dietary LC_{50}=4171 ppm/day) basis. Reproductive study shows the bobwhite quail to have NOEL=300 ppm.

b. Non-Target Aquatic

Acetochlor is highly toxic to fish (trout LC_{50}= 0.38 ppm), and moderately toxic to aquatic invertebrates (*Daphnia* spp. LC_{50}= 8.2 ppm) and to estuarine species (mysid shrimp EC_{50}=2.2 ppm). Life cycle studies show the values for fish and aquatic invertebrates to be as low as 0.13 ppm and 0.0221 ppm (22.1 ppb), respectively.

c. Non-Target Insects

Acetochlor is practically non-toxic to insects with LD_{50}> 100 µg/bee.

d. Non-Target Plants

Acetochlor is extremely toxic to the green algae, *Selenastrum capricornutum*, with EC_{50}= 1.43 ppb and to a macrophyte, *Lemna gibba*, with EC_{50}= 3.4 ppb. Seedling emergence studies show ryegrass to be the most sensitive monocot with EC_{25}=0.0013 lb ai/A and lettuce being the most sensitive dicot with EC_{25}=0.0016 lb ai/A. Vegetative vigor studies show ryegrass to be the most sensitive monocot with EC_{25}=0.0050 lb ai/A and lettuce being the most sensitive dicot with EC_{25}=0.3200 lb ai/A.

B. Ecological Effects Risk Assessment

1. Use Profile

Use site: field corn, silage corn or popcorn
Application form: as liquid or bulk dry fertilizer
Application method: Preemergence, Preplant Incorporated, Chemigation (center pivot irrigation systems only), aerial
Tank Mixes: atrazine, bladex, or gramoxone extra (with a surfactant nonionic active ingredient), roundup, princep
Application Rates:
Soils with <1.5% organic matter - do not use
Coarse soil- do not use;
Medium soil - 1.75 (1.64 lb ai) to 2.5 (2.34 lb ai) pt/A;
Fine soils - 2.00 (1.88 lb ai) to 2.5 (2.34 lb ai) pt/A;
Soils 6% to 10% organic matter - 2.25 (2.11 lb ai) to 3.2 (3.0 lb ai) pt/A;
Soils >10% organic matter - 3.2 (3.0 lb ai) pt/A

The application is to be done only once before the corn plant emerges from the surface.

2. Environmental Fate and Exposure Profile

a. Fate

The following information is from 12/6/93 EFGWB reviews.
Acetochlor degrades under aerobic conditions in most soils with a half life of 8 to 14 days. However, with coarse soils such as sandy loam the half-life is 110 days followed by a second half life of 245 days. Under anaerobic conditions, acetochlor degrades with a half-life of 17 to 21 days) with microbial degradation being the major pathway. However, with coarse soils such as sandy loam the half-life is 230 days. The 8 to 14 day half-life is representative of the soils to be treated with acetochlor because the current label specifies that the acetochlor not be used on sand, sandy loam, and sandy loam soils with <6% organic matter.

This herbicide dissipates with a half-life of 8 to 26 days at 5 sites with persistence increasing with finer soils.
Acetochlor is found to be moderately mobile in soils with higher organic matter (3.4%) and very mobile in soils with lower organic matter content (0.7%). This herbicide leaches in the soil profile. The solubility of acetochlor is 223 ppm. Acetochlor is expected to move via runoff. This class of herbicides (chloroacetamides) has a history of moving with water in runoff.

Acetochlor bioaccumulates at an insufficient rate to cause any adverse affects to predator organisms. Vapor pressure is 4.4×10^{-5}

mm Hg; therefore acetochlor may move to off-target organisms by vapor pressure. The mode of action for acetochlor is adsorption through the coleoptile of germinating seedlings and secondarily via the root system.

Acetochlor appears to be persistent in aquatic and terrestrial environments and is mobile. This chemical is stable under hydrolysis and photolysis conditions. Degradation is via microbial.

b. **Exposure**

1) Terrestrial exposure

Vegetation Residues From Ground Application

Below are the maximum expected residues (ppm) on vegetation immediately after one application (based on Hoerger and Kenaga, 1972).

RATE OF APPLICATION	range/short grass	long grass	leaves & leafy crop	forage crop & insects
2.34 lb. ai/A	562	257	293	136
3.00 lb. ai/A	720	330	375	174

Edge of the Field Exposure for Terrestrial Plants

Application of acetochlor on corn may runoff during a rainstorm or excess irrigation water from one acre to an adjacent one acre affecting non-target plants. The EEC at the edge of the field as modelled from EFGWB's PRZM model would be **0.357 lb ai/A** in Loring Silt Loam in Mississippi and **0.098 lb/A** in Marshall Silty Clay Loam in Iowa.

2) Aquatic exposure

Aquatic exposure will occur via runoff from ground application and via both runoff and spray drift from aerial applications.

Ground Application
Assuming the product is applied at 2.34 lb ai/acre to a 10 acre field by ground equipment and channelized runoff occurs, the water concentration in an adjacent 1 acre pond or wet area could be as follows (based on EFGWB's EXAMS/PRZM model):

On Marshall Silty Clay Loam in Iowa - Represents typical exposure conditions:

> Post load concentration is **71.0 ppb (0.071 ppm)** or **1.16 lb ai/A** in 6 feet of water. In 6 inches of water, the concentration could be 854 ppb (0.854 ppm).

96 hour after application the concentrations would be **62.9 ppb (0.063 ppm) or 1.03 lb ai/A.** In 6 inches of water, the concentrations would be 758 ppb (0.758 ppm).

21 day after application the concentrations would be **40.3 ppb (0.040 ppm) or 0.661 lb ai/A.** In 6 inches of water, the concentrations would be 486 ppb (0.486 ppm).

On Loring Silt Loam in Mississippi - Represents maximum exposure condition that are not typically expected in the U. S. except in high rainfall areas such as in parts of Mississippi:

Post load concentration is **283.9 ppb (0.284 ppm)** or **4.65 lb ai/A** in 6 feet of water. In 6 inches of water, the concentration could be 3420 ppb (3.42 ppm).

96 hour after application the concentrations would be **265.6 ppb (0.266 ppm) or 4.35 lb ai/A.** In 6 inches of water, the concentrations would be 3200 ppb (3.2 ppm).

21 day after application the concentrations would be **182.6 ppb (0.183 ppm) or 2.99 lb ai/A.** In 6 inches of water, the concentrations would be 2200 ppb (2.2 ppm).

The proposed label shows that on soils that have more than 10% organic matter, 3.0 lb ai/A should be used. An area in the U.S. that has high organic matter and a consistent corn usage would be on the state line between Virginia and North Carolina. Higher organic matter will cause more binding of the chemical to the organic matter. **Therefore, the EFED concludes that the runoff values of the Marshall Silty Clay Loam after an application rate of 2.34 lb ai/acre would be the same as runoff values in those soils having more than 10% organic matter and treated at 3 lb ai/acre.**

3) Aerial Application

Terrestrial plant exposure will occur from drift during aerial application. It is assume that 5% of what is sprayed aerially will drift. Exposure resulting from drift on terrestrial plants is **0.117 lb ai/A** (2.34 lb ai/A x 5%) when application is made to mineral soils. Exposure resulting from drift on terrestrial plants is **0.15 lb ai/A** (3.0 lb ai/A x 5%) when application is made to organic soils. Aquatic plants and fish may be exposed to the drift at concentrations of **7.14 ppb** in 6 feet of water.

3. **Risk Assessment**

a. **Non-Endangered Organisms**

1) **Terrestrial Organisms-** The maximum expected residues on avian and mammalian food items (720 ppm on short grass from 3 lbs ai/acre and 562 ppm on shortgrass from 2.34 lb ai/acre) do not exceed $\frac{1}{2}LC_{50}$ of the avian acute (2086 ppm/day) and mammalian acute (8510 ppm/day[3]). They do, however, exceed the dietary NOEL's for both bird (mallard>300 ppm) and mammal (dog>10 ppm/day) reproduction studies. Chronic effects to birds and mammals are determined by comparing persistent exposure to the NOEL from the reproduction studies. Persistence on bird and mammal food items is dependent on the half-life, solubility and number of applications. Acetochlor is applied once per season, pre-emergence, and is very soluble. Therefore, it is likely to "wash off" these food items and not be available for long periods of time. Furthermore, treated grasses and broadleaf would be killed in approximately a week, after which their palatability to birds and mammals would be reduced substantially. Chronic effects to birds and mammals may occur under maximum exposure conditions, but are not expected to be significant.

For beneficial insects, it appears that there will be minimal adverse effects (LD_{50} >100 μg/bee).

2) **Aquatic Organisms-**

Regions of Typical Exposure

The aquatic EEC representing exposure throughout most of the corn growing regions (71 ppb in 6 feet of water) does not exceed the criteria for acute risk to fish (1/2 the lowest fish LC50=190 ppb), freshwater invertebrates (1/2 the *Daphnia magna* LC50=4100 ppb) and shrimp (1/2 the shrimp LC50=1100 ppb). Neither does this EEC exceed the criteria for chronic risk to fish (NOEL=130 ppb) or invertebrates (NOEL=1240 ppb). Adverse effects to aquatic nontarget organisms are expected to be minimal in most corn growing regions.

The exposure to fish does exceed the criteria for recommending restricted use (71 ppb exceeds 38 ppb which is 1/10 the lowest fish LC50 of 380 ppb).

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[3] Based on oral LD_{50} 1702 mg/kg for mammals converted to an LC_{50} value with assumptions that mammals consume 10% of their body weight in food.

Regions of Maximum Exposure

The aquatic EEC representing exposure conditions that could occur in parts of Louisiana, Mississippi, Alabama and Florida (289.9 ppb) where transport via runoff would be the higher exceeds the fish acute and chronic risk criteria. Fish may be adversely affected by the use of acetochlor at the maximum use rates in these areas. The risk quotient for acute effects to fish would be 1.5 (**RQ=1.5**). Other aquatic organisms would not be at risk. The exposure in these areas of maximum runoff potential also exceed the chronic risk criteria for fish (289 ppb is greater than the chronic fish NOEL of 130 ppb; **RQ=2.2**). The risk in these areas does not represent the majority of the corn growing regions.

As above, the exposure to fish does exceed the criteria for recommending restricted use (289 ppb exceeds 38 ppb which is 1/10 the lowest fish LC50 of 380 ppb).

3) **Plants-**

aa. Aquatic Plants- the aquatic EEC (71.0 ppb in 6 feet of water) and aerial EEC (7.14 ppb) exceeds the LC_{50} for an algae, *Selenastrum capricornutum* (1.43 ppb) and for a vascular macrophyte, *Lemna gibba* (3.4 ppb). **We can assume that non-target aquatic plants will be adversely affected by the labeled use of acetochlor from runoff and drift from aerial application since the level of concern has been exceeded by a risk quotient of 50 for algae and 21 for aquatic vascular plants.**

bb. Terrestrial Plants Affected By Runoff- Seedling Emergence study has shown that ryegrass is the most sensitive monocot tested with an EC_{25}= 0.0013 lb ai/A and that lettuce is the most sensitive dicot tested with an EC_{25}= 0.0016 lb ai/A. During heavy rainfall or excess irrigation water, acetochlor is expected to runoff from the applied field. The runoff EECs of this off site movement of acetochlor ranges from 0.098 lb ai/A (Iowa) to 0.357 lb ai/A (Mississippi) for the runoff going onto an adjacent acreage. Channelized runoff may also come off a 10 acre drainage basin and deposit from 1.16 lb ai/A (Iowa) to 4.65 lb ai/A (Mississippi) in wet areas such as swamps, bogs, seepages, and etc. **The EEC from both, the adjacent runoff and the channelized runoff does exceed the EC_{25} values from the seedling emergence study for monocots and dicots. We can assume that non-target terrestrial plants will be adversely affected by the labeled use of acetochlor from runoff. The level of concern for non-target non-target plants is exceeded since the risk quotient is 75 (Iowa exposure) to 275 (Mississippi exposure [4]) for runoff going onto adjacent acreage and a risk**

[4] The Loring Silt Loam in Mississippi has an erosion index of between 350 and 400. Therefore, other areas are described in the average annual values of the rainfall erosion index map as taken from Wischmeir and Smith (1978).

quotient of 892 (Iowa exposure) to 3,577 (Mississippi exposure) for channelized runoff going into moist/wet ecosystems.

cc. Plants Affected By Drift- Vegetative vigor study has shown that ryegrass is the most sensitive monocot tested with an EC_{25}= 0.005 lb ai/A and that lettuce is the most sensitive dicot tested with an EC_{25}= 0.320 lb ai/A. The EEC from drift of aerial application (0.117 lb ai/A) **exceeds the level of concern for non-target non-target monocots** such as ryegrass and oat. Apparently, the aerial applied EEC does not exceed the level of concern for broad-leaf dicots and some monocots such as onion. **We can assume that non-target terrestrial grass plants will be adversely affected by the labeled use of acetochlor from aerial application since the risk quotient for non-target grass plants is 23.**

dd. Plants Affected by Wind Blown Soil Particles- Acetochlor is applied in spring at beginning of corn planting and other plantings. This is a time when the soil has minimum cover in agricultural areas unless it is planted using minimum tillage systems. If acetochlor contaminated soil were to blow over to adjacent fields or acreage from wind, due to the high toxicity of acetochlor to seedlings, injury or death may result to non-target seedlings such as lettuce, cucumber, cabbage, oat, ryegrass, onion and other sensitive plants. Exposure from wind blown soil cannot be estimated so a risk quotient cannot be calculated.

ee. Plants Affected by Vapor Pressure - Vapor pressure of acetochlor is 4.4×10^{-5} mm Hg; therefore acetochlor may move to off-target organisms by vapor pressure. During spring application, there is a possibility that vapor pressure may be the route of exposure of this chemical to non-targeted plants. The non-targeted plants at risk may be some plant species of the grass family including but not limited to wheat, ryegrass, oat and possibly turf sites.

There are more than 64 million acres of corn in this country (1987 Census of Agriculture). This is the amount of acreage that can potentially be treated with acetochlor, with possible widespread adverse effects on ecosystems from affected native plants as well as possible affects on nearby sensitive crops.

b. **Endangered Species**

1) **Endangered Species Risk Assessment**

The endangered species triggers are as follows:

Birds: [5]	>417 ppm (LC_{50} 4171/10)
Mammals[5]	1702 ppm (LC_{50} 17020 ppm/10)
Fish:	0.019 ppm (LC_{50} 0.38 ppm/20)
Aquatic Invertebrates:	0.41 ppm (LC_{50} 8.2 ppm/20)
Aquatic Plants: [6]	3.4 ppb (EC_{50} 1.43 ppb)
Terrestrial Plants[6] ...	0.0013 lb ai/A
Terrestrial Plants[7] ...	0.0050 lb ai/A

Terrestrial Animals

Endangered Mammals

The criteria for adverse acute effects to mammals is 1/10 the LD_{50} for rats. The rat acute oral LD_{50} is 1702 mg/kg. One tenth of this is 170 mg/kg. This is compared with the mg ai that would occur in 1 square foot after acetochlor is applied at the maximum rate of 3 lbs ai/acre. Application of 3 lbs ai/acre would result in approximately 30 mg ai per square foot. This is substantially less than the criteria for acute effects.

Endangered Birds

Acute effects to endangered birds are determined by comparing exposure to 1/10 the avian dietary LC_{50}. The lowest avian dietary LC_{50} is not know precisely. The data indicate the LC_{50} for acetochlor is >4171 ppm. Maximum residues on avian food items (short grass) would be 720 ppm. This exceeds 1/10 4171 ppm (4171 / 10 = 417 ppm), however, the LC50 is greater than 4171 ppm (zero mortality at 4171 ppm). It is unlikely that endangered birds would be exposed to residues on food items that would be acutely hazardous.

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[5] Based on oral LD_{50} =1702 mg/kg for rats converted to an LC_{50} value with assumptions that mammals consume 10% of their body weight in food.

[6] Value is based on seedling emergence EC_{25} for ryegrass which is used to estimate risk to plants from runoff

[7] Value is based on ryegrass EC_{25} on vegetative vigor which is used to estimate risk to plants from drift.

Chronic effects to endangered birds and mammals are determined by comparing persistent exposure to the NOEL from the reproduction studies. Persistence on bird and mammal food items is dependent on the half-life, solubility and number of applications. Acetochlor is applied once per season, pre-emergence, and is very soluble. Therefore, it is likely to "wash off" these food items and not be available for long periods of time. Furthermore, treated grasses and broadleaf would be killed in approximately a week, after which their palatability to birds and mammals would be reduced substantially. Chronic effects to endangered birds and mammals are therefore unlikely.

Aquatic Organisms

In water, the aquatic EEC from runoff (71.0 ppb in 6 feet of water) **does exceed that the levels of concern for endangered fish (risk quotient = 3.7) and aquatic plants (risk quotient = 21).** Also, the aquatic EEC from drift (7.14 ppb) **has a risk quotient of 2 for endangered aquatic plants.** Drift does not exceed the aquatic EEC triggers for fish. **It appears that endangered species of fish and aquatic plants may be adversely affected by the labeled application of acetochlor.**

Terrestrial Plants

For endangered terrestrial plants **in wet areas the endangered species triggers have a risk quotient of 900 and from aerial drift the risk quotient is 23 for terrestrial grass plants.** It appears that endangered species of plants may be adversely affected by the labeled application of acetochlor.

A **list of endangered plants that may be affected** in corn growing areas have been compiled as follows:

List of Endangered Plants exposed to Runoff

Common Name
State- Counties where plants located

Alabama Canebrake Pitcher Plant
AL- Autauga, Cherokee, Chilton, Elmore

Black-Spored Quillwort
GA- Gwinnett; **SC**- Lancaster

Bradshaw's Lomatium
OR- Marion

Bunched Arrowhead
SC- Greenville; **NC**- Henderson

Butte County Meadowfoam

CA- Butte

Canby's Dropwort
GA- Burke, Dooly, Lee, Sumter; **MD**- Queen Anne; **NC**- Scotland; **SC**- Allendale, Bamberg, Clarendon, Hampton, Barnwell, Berkeley, Colleton, Lee, Orangeburg, Richland, Williamsburg

Chapman Rhododendron
FL- Gadsden

Cooley's Meadowrue
FL- Walton; **NC**- Brunswick, Columbus, Onslow, Pender

Cumberland Rosemary
Ky- McCreary; **TN**- Cumberland, Fentress, Morgan, White, Scott

Decurrent False Aster
IL- Jersey, Marshall, Morgan, Putnam, Schuyler, Woodford, St. Clair; **MO**- St. Charles

Dwarf-Flowered Heartleaf
SC- Cherokee, Greenville, Spartanburg; **NC**- Burke, Catawba, Cleveland, Lincoln, Rutherford

Dwarf Lake Iris
MI- Presque Isle, Menominee, Emmet, Delta, Cheboygan, Chippewa, Charlevoix, Alpena

Eastern Prairie Fringed Orchid
IL- Cook, DuPage, Grundy, Henry, Iroquois, Kane, Lake, McHenry; **MI**- Bay, Huron, Livingston, Monroe, Saginaw, St. Clair, St. Joseph, Tuscola, Washtenaw, Wayne; **VA**- Augusta; **WI**- Dane, Jefferson, Kenosha, Ozaukee, Rock, Walworth, Waukesha, Winnebago

Fassett's Locoweed
WI- Portage, Waushara

Geocarpon Minnimum
AR-Franklin, Drew

Green Pitcher Plant
AL- Cherokee, Dekalb, Etowah, Jackson, Marshall; **GA**- Towns; **NC**- Clay

Harperella
AL- Dekalb; **NC**- Chatham, Granville; **SC**- Aiken, Saluda; **MD**- Allegany; **WV**- Morgan

Houghton's Goldenrod
MI- Emmet, Chippewa, Delta, Charlevoix, Cheboygan, Presque Isle

Knieskern's Beaked Rush

NJ- Atlantic, Burlington, Monmouth, Ocean

Kral's Water Plantain
AL- Cherokee, Dekalb; **GA**- Chattooga;

Little Amphianthus
AL- Randolph, Chambers; **GA**- Butts, Newton, Pike, Walton, Gwinnett, Henry, Merriwether, Douglas, Hancock, Heard;
SC- Lancaster, Saluda, York

Louisiana Quillwort
La-Washington

Mat-Forming Quillwort
GA- Hancock

Michigan Monkey-Flower
MI- Benzie, Emmet, Leelanau, Cheboygan

Mohr's Barbara's Buttons
AL- Cherokee, Bibb, Etowah; **GA**- Bartow, Floyd, Murray

Mountain Sweet Pitcher Plant
SC- Greenville; **NC**- Henderson, Transylvania

Northeastern Bulrush
MD- Washington; **PA**- Clinton, Monroe, Lackawanna; **VT**- Windham; **VA**- Augusta, Bath, Rockingham; **WV**- Berkeley

Pondberry
AR- Clay, Jackson, Lawrence, Woodruff; **GA**- Baker, Wheeler; **MO**- Ripley; **MS**- Sharkey, Bolivar, Sunflower; **NC**- Bladen; **SC**- Berkeley

Rough-Leaved Loosestrife
NC- Scotland, Bladen, Brunswick, Carteret, Cumberland, Hoke, Pender

Sensitive Joint-Vetch
MD- Somerset; **NJ**- Burlington, Cumberland; **VA**- Charles City, Essex, James City, King George, King William, New Kent, Westmoreland

Small-Anthered Bittercress
NC- Stokes

Solano Grass
CA- Solano

Swamp Pink
DE- Kent, New Castle, Sussex; **MD**- Anne Arundel, Cecil; **NJ**- Cape May, Sussex, Morris, Middlesex, Salem, Camden, Cumberland, Atlantic, Burlington, Gloucester, Ocean; **SC**- Greenville; **VA**- Augusta, Henrico, Nelson; **NC**-Henderson, Jackson, Transylvania;

Tennessee Yellow-Eyed Grass
TN- Lewis; **AL**- Franklin

Texas Wild Rice
TX- Hays

Ute Ladies-Tresses
CO- Boulder; **UT**- Unitah, Utah, Weber, Duchesne, Salt Lake

Virginia Round-Leaf Birch
VA- Smyth

Additional List of Endangered Plants That Exceed Drift EEC
Grass & Monocots From Aerial Only

Species
State County

Alabama Streak-Sorus Fern
AL-Winston

American Hart's-Tongue
AL-Jackson, Morgan; **MI**-Chippewa, **NY**-Madison, Onondaga; **TN**-Marion

Minnesota Trout Lily
MN-Goodhue, Rice, Steele

Navajo Sedge
AZ-Apache, Coconino, Navajo

Persistent Trillium
GA-Rabunn, Stephens, Talbot, Upson; **SC**-Onconee

Relict Trillium
GA-Bibb, Columbia, Quitman; **SC**-Aiken, Edgefield

Western Prairie Fringed Orchid
IA-Adair, Adams, Appanoose, Audubon, Benton, Black Hawk, Boone, Bremer, Buchanan, Buenta Vista, Butler, Calhoun, Carroll, Cass, Cedar, Cerro Gordo, Cherokee, Chickasaw, Clarke, Clay, Clayton, Clinton, Crawford, Dallas, Davis, Decatur, Delaware, Des Moines, Dickinson, Dubuque, Emmet,Fayette, Floyd, Franklin, Fremont, Greene, Grundy, Guthrie, Hamilton, Hancock, Hardin, Harrison, Henry, Howard, Humbolt, Ida, Iowa, Jackson, Jaspar, Jefferson, Johnson, Jones, Keokuk, Kossuth, Lee, Linn, Louisa, Lucas, Lyon, Madison, Mahaska, Marion, Marshall, Mills, Mitchell, Monona, Monroe, Montgomery, Muscatine, O'Brien, Osceola, Page, Palo Alto, Plymouth, Pocohantas, Polk, Pottawattamie, Poweshiek, Ringold, Sac, Scott, Shelby, Sioux, Story, Tama, Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne, Webster, Winnebago, Winneshick, Woodbury, Worth, Wright, **KS**-Anderson, Atchison, Coffey, Crawford, Douglas, Franklin, Jackson, Jefferson, Johnson, Leavenworth, Lyon, Osage, Pottawatomie, Riley, Shawnee; **MN**-Clay, Dodge, Douglas,

Faribault, Fillmore, Freeborn, Goodhue, Hennepin, Houston, Kandiyohi, Kittson, Mower, Nicollet, Nobles, Norman, Pennington, Pipestone, Polk, Rice, Rock; **MO**-Atchison, Holt, Ralls; **ND**-Ransom, Richland; **NE**-Cherry, Hall, Lancaster, Seward; **OK**-Craig, Rogers; **SD**-Bennett, Brookings, Brown, Clay, Codington, Day, Deuel, Grant, Lincoln, Minnehaha, Moody, Roberts, Todd, Turner, Union, Yankton

White Isisette
NC-Henderson, Polk, Rutherford; **SC**-Greenville

List of Endangered Fish Species That May Be Affected By Use Of Acetochlor

On June 14, 1989 USFWS gave a Biological Opinion on Atrazine and Propachlor as a part of the corn clusters opinion. Since these two chemicals are corn herbicides and that Propachlor is in the same class of herbicides as acetochlor, this reviewer thought it would be prudent to include the endangered species that would be covered under the opinion. In addition, several species of fish are not listed below that were in the Biological Opinion. These species were taken off the listings because it was considered by the reviewer and OPP's Office of Endangered Species Protection that there may not be any exposure to the species since atrazine and propachlor were not just for corn. The footnotes indicate the use limitations that the USFWS has stated in their Biological Opinion. These use limitations can be be used to protect the endangered fish species from a "may affect" in the application of acetochlor to corn.

Name	State and County Location
Alabama Cavefish[8]	**AL**-Colbert, Lauderdale
Blackside Dace[9]	**KY**-Bell, Laurel, Knox, McCreary, Pulaski, Whitley; **TN**-Campbell, Claiborne, Scott
Amber Darter[10]	**GA**-Chattooga, Cherokee, Dawson, Forsyth,

[8] The use of acetochlor is prohibited within the Key Cave aquifer recharge area.

[9] The following options are recommended to protect the Blackside Dace in the upper Cumberland River Basin above Cumberland Falls: 1) Reduce the rate of application to 0.63 pounds active ingredient per acre or, 2) Enter into landowner agreements with USFWS or, 3) Prohibit the use of acetochlor in the upper Cumberland River Basin above Cumberland Falls.

[10] The following options are recommended to protect the Amber Darter in the upper Conasauga River Basin (tributary of the Coosa River) and in Etowah River: 1) Reduce the rate of application to

	Murray, White, Whitfield; **TN**-Polk
Bayou Darter[11]	**MS**-Claiborne, Copiah, Hinds
Boulder Darter[12]	**AL**-Limestone; **TN**-Giles, Lincoln
Leopard Darter[13]	**AR**-Polk; **OK**-McCurtain
Maryland Darter[14]	**MD**-Harford
Slackwater Darter[15]	**AL**-Lauderdale, Limestone, Madison;

0.63 pounds active ingredient per acre or, 2) Prohibit the use of acetochlor in the upper Conasauga River Basin (tributary of the Coosa River) and in Etowah River.

[11] The following options are recommended to protect the Bayou Darter in the Bayou Pierre River system and tributaries: 1) Reduce the rate of application to 0.16 pounds active ingredient per acre or, 2) Prohibit the use of acetochlor in the Bayou Pierre River system and tributaries.

[12] The following options are recommended for the protection of the Boulder Darter in the Elk River and tributaries: 1) application must be made at a minimum of 20 yards from the waters edge or, 2) Rate of application be reduced to 0.63 pounds active ingredient per acre or, 3) Prohibit the use of acetochlor to the Elk River and tributaries.

[13] The following options are recommended for the protection of Leopard Darter in the Little River Basin, : 1) application must be made at a minimum of 20 yards from the waters edge or, 2) Rate of application be reduced to 0.63 pounds active ingredient per acre or, 3) Prohibit the use of acetochlor to the Little River Basin.

[14] The following options are recommended in the lower Susquehanna River Basin near Aberdeen and Havre de Grace along Deer Creek, Swan Creek, and Gasheys Run for prevention of "may affect" to the Maryland Darter: 1) Application of acetochlor must be 100 yards from the waters edge and this protective barrier must extend 5 miles upstream and one-half mile along all tributaries from their confluence or, 2) Rate of application must be reduced to 0.63 lb ai/A or, 3) prohibit the application of acetochlor to the lower Susquehanna River Basin near Aberdeen and Havre de Grace.

[15] The following options are recommended for prevention of a "may affect" for the Slackwater Darter in the tributaries of the south bend of the Tennessee River. These tributaries are Cypress Creek, Swan Creek, and Flint River in Alabama; and Buffalo River, Shoal Creek and Cypress Creek in Tennessee. In addition, any slow moving seepage water in open fields, pastures and woods. 1)

	TN- Lawrence, Wayne
Snail Darter[16]	**AL**-Jackson, Limestone, Madison, Marshall, Morgan; **GA**-Catoosa, **TN**-Blout, Bradley, Cocke, Giles, Grainger, Greene, Hamblen, Hamilton, Jefferson, Knox, Lincoln, Loudon, Marion, McMinn, Meigs, Polk, Rhea, Roane
Conasauga Logperch[17]	**GA**-Chattooga, Murray, Whitfield; **TN**- Polk, Bradley
Yellowfin Madtom[18]	**GA**-Catoosa; **TN**-Blount, Claiborne, Hancock, Monroe; **VA**-Lee, Russell, Scott, Smyth
Dessert Pupfish[19]	**AZ**-Cochise, Graham, LaPaz, Maricopa,

Application of acetochlor must be made 40 yards from the water's edge and the protective barrier must extend one-half mile upstream or, 2) Rate of application must be reduced to 0.63 pounds active ingredient per acre or, 3) prohibit the use of acetochlor in the region of the south bend of the Tennessee River tributaries.

[16] The following options are recommended to protect the Snail Darter in the Tennessee River, tributaries and reservoirs. The Tennessee River reservoirs are Watts Bar, Nickajack, and Guntersville; and the tributaries are Hiwassee River in Polk Co., South Chichamanga Creek in Hamilton and Catoosa Co., Sequatchee River in Marion Co., Sewee Creek in Meigs Co., and Paint Rock River in Jackson and Madison Co.: 1) Reduce the rate of application to 0.63 pounds active ingredient per acre or, 2) Prohibit the use of acetochlor along the Tennessee River, tributaries and reservoirs.

[17] The following options are recommended to protect the Conasauga Logperch in the upper Conasauga River: 1) Reduce the rate of application to 0.63 pounds active ingredient per acre or, 2) Prohibit the use of acetochlor in the upper Conasauga River area.

[18] The following options are recommended for prevention of "may affect to the Yellowfin Madtom in Powell River and Copper Creek: 1) Application of acetochlor must be 40 yards from the waters edge and this protective barrier must extend one-half mile upstream and one-half mile along all tributaries from their confluence or, 2) prohibit the application of acetochlor along Powell River and Copper Creek.

[19] The following options are recommended for the prevention of the Desert Pupfish from a "may affect" in the Salton Sea tributaries of San Felipe Creek, Carizzo Wash, Fish Creek Wash, and San Sebastian Marsh: 1) Application of acetochlor must be at a minimum of 40 yards from water's edge or, 2)prohibition of

	Pinal, Yavapai; **CA**-Imperial
Capefear Shiner[20]	**NC**-Chatham, Harnett, Lee, Moore, Randolph
Pecos Bluntnose Shiner[21]	**NM**-Chaves
Spikedace[22]	**AZ**-Graham, Greenlee, Pinal, Yavapai; **NM**-Catron, Hidalgo
Woundfin[23]	**UT**-Washington

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acetochlor from the Salton Sea tributaries region.

[20] The following options are recommended to protect the Cape Fear Shiner in the Cape Fear River drainage which includes the confluence of Rocky Deep River (Chatham and Lee Co.), above Rocky River Hydroelectric Dam (Chatham Co.), Deep River system above High Falls Hydroelectric Reservoir (Moore and Rand Co.), and Neels Creek in Harnett Co.: 1) Reduce the rate of application to 0.63 pounds active ingredient per acre or, 2) Prohibit the use of acetochlor in the Cape Fear River drainage.

[21] The following options are recommended for prevention of a "may affect" for Pecos Bluntnose Shiner in the Pecos River: 1) Application of acetochlor must be made 40 yards from the water's edge, and the acetochlor is to be incorporated into the soil or, 2) Application of acetochlor must be made no more than 100 yards from the edge of the water and the protective barrier must extend one-half mile upstream or, 3) Rate of application must be reduced to 0.63 pounds active ingredient per acre or, 4) prohibit the use of acetochlor along the Pecos River.

[22] The following options are recommended for prevention of a "may affect" for Spikedace in Aravaipa Creek, Eagle Creek, and Verde Creek in Arizona and Gilia River in New Mexico: 1) Application of acetochlor must be made 40 yards from the water's edge and is to be incorporated into the soil or, 2) Application of acetochlor must be made no more than 100 yards from the edge of the water and the protective barrier must extend one-half mile upstream, 3) Rate of application must be reduced to 0.63 pounds active ingredient per acre, 4) prohibit the use of acetochlor along Aravaipa Creek, Eagle Creek, and Verde Creek in Arizona and Gilia River in New Mexico.

[23] The following options are recommended for prevention of a "may affect" for the Woundfin in Virgin River and from the mouth of LaVerkin Creek to Nevada: 1) Application of acetochlor must be made 100 yards from the water's edge and the protective barrier must extend one-half mile upstream or, 2) Rate of application must be reduced to 0.63 pounds active ingredient per acre or, 3) prohibit

Additional Fish Species Not in Biological Opinion

Three additional species below are endangered species that were listed after the above biological opinion and are near corn use sites. The labeled use of acetochlor may affect these endangered species of fish also. The footnotes indicated the use limitations for acetochlor based on analysis of USFWS Biological Opinion of 1989.

Razorback Sucker[24]	**AZ**-Coconino, Graham, Greenlee, LaPaz, Yavapai; **CA**-Imperial; **CO**-Delta, Mesa; **NM**-San Juan; **UT**-Emery, Uintah, Kane
Neosho Madtom[25]	**KS**-Allen, Chase, Cherokee, Coffey, LaBette, Lyon, Marion, Morris, Neosho, Woodson; **MO**-Jasper; **OK**-Craig, Ottawa

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the use of acetochlor along the Virgin River and Laverkin Creek.

[24] The following options are recommended in the Colorado River, Green River, Yampa River, and the lakes, tributaries and reservoirs associated with the rivers for the prevention of "may affect" to the Razorback Sucker: 1) Application of acetochlor must be 40 yards from the waters edge and this protective barrier must extend one-half mile upstream and one-half mile along all tributaries from their confluence or, 2) Rate of application must be reduced to 0.63 pounds active ingredient per acre or, 3) prohibit the application of acetochlor to the lakes, tributaries and reservoirs associated with the three rivers of Colorado River, Green River, and Yampa River.

[25] The following options are recommended in the Neosho River drainage which comprises of Neosho River from Miami, Oklahoma to John Redmond Reservoir and from the Neosho and Cotton River north of the reservoir to Elmsdale, Kansas and in the Spring River in Cherokee Co., Kansas and Jasper Co.,Missouri for the prevention of "may affect" to the Neosho Madtom: 1) Application of acetochlor must be 40 yards from the waters edge and this protective barrier must extend one-half mile upstream and one-half mile along all tributaries from their confluence or, 2) Rate of application must be reduced to 0.63 pounds active ingredient per acre or, 3) prohibit the application of acetochlor to the Neosho drainage area.

Roanoke Logperch[26]	**VA**-Dinwiddie, Franklin, Greensville, Henry, Montgomery, Patrick, Pittsylvania, Sussex

Since endangered/threatened plant and fish species may be adversely affected, a formal biological consultation with USFWS is required unless this herbicide is labelled to protect these species. Such labelling may be:

Endangered Species Restrictions:

"The use of any pesticide in a manner that may kill or otherwise harm an endangered or threatened species or adversely modify their habitat is a violation of Federal laws."

"The use of this product is controlled to prevent death or harm to endangered species. Do not use this herbicide in the following counties."

Alabama- Autauga, Bibb, Chambers, Cherokee, Chilton, Elmore, Etowah, Dekalb, Franklin, Jackson, Marshall, Morgan, Randolph, Winston

Arizona- Apache, Coconino, Navajo

Arkansas- Clay, Drew, Franklin, Jackson, Lawrence, Woodruff

California- Butte, Solano

Colorado- Boulder

Delaware- Kent, New Castle, Sussex

Florida- Gadsden, Walton

Georgia- Baker, Bartow, Bibb, Burke, Butts, Chattooga, Columbia, Dooly, Douglas, Floyd, Gwinnett, Hancock, Heard, Henry, Lee, Merriwether,

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[26] The following options are recommended in the upper Roanoke River from Roanoke into north and south forks of Roanoke River and Tinker Creek, in Pigg River (Pittsylvania and Franklin Co.), Big Chestnut Creek (Franklin Co.), in Smith River upstream from Philpott Reservoir, in Town Creek which is a tributary of Smith River (Henry Co.), in Nottoway River (Sussex Co.), and in Stony Creek (Dinwiddle and Sussex Co.) for the prevention of "may affect" to the Neosho Madtom: 1) Application of acetochlor must be 40 yards from the waters edge and this protective barrier must extend one-half mile upstream and one-half mile along all tributaries from their confluenceor, 2) Reduce the rate of application to 0.63 lb ai/A or, 3) prohibit the application of acetochlor along the above rivers, creeks and their tributaries.

Murray, Newton, Pike, Quitman, Rabunn, Stephens, Sumter, Talbot, Towns, Upson, Walton, Wheeler

Illinois- Cook, DuPage, Grundy, Henry, Iroquois, Jersey, Kane, Lake, Marshall, McHenry, Morgan, Putnam, Randolph, Schuyler, St. Clair, Woodford

Iowa- Adair, Adams, Appanoose, Audubon, Benton, Black Hawk, Boone, Bremer, Buchanan, Buenta Vista, Butler, Calhoun, Carroll, Cass, Cedar, Cerro Gordo, Cherokee, Chickasaw, Clarke, Clay, Clayton, Clinton, Crawford, Dallas, Davis, Decatur, Delaware, Des Moines, Dickinson, Dubuque, Emmet,Fayette, Floyd, Franklin, Fremont, Greene, Grundy, Guthrie, Hamilton, Hancock, Hardin, Harrison, Henry, Howard, Humbolt, Ida, Iowa, Jackson, Jaspar, Jefferson, Johnson, Jones, Keokuk, Kossuth, Lee, Linn, Louisa, Lucas, Lyon, Madison, Mahaska, Marion, Marshall, Mills, Mitchell, Monona, Monroe, Montgomery, Muscatine, O'Brien, Osceola, Page, Palo Alto, Plymouth, Pocohantas, Polk, Pottawattamie, Poweshiek, Ringold, Sac, Scott, Shelby, Sioux, Story, Tama, Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne, Webster, Winnebago, Winneshick, Woodbury, Worth, Wright

Kansas- Anderson, Atchison, Coffey, Crawford, Douglas, Franklin, Jackson, Jefferson, Johnson, Leavenworth, Lyon, Osage, Pottawatomie, Riley, Shawnee

Kentucky- McCreary

Louisiana- Washington

Maryland- Allegany, Anne Arundel, Cecil, Queen Anne's, Somerset, Washington

Michigan- Alpena, Bay, Benzie, Charlevoix, Cheboygan, Chippewa, Delta, Emmet, Huron, Leelanau, Livingston, Monroe, Presque Isle, Menominee, Saginaw, St. Clair, St. Joseph, Tuscola, Washtenaw, Wayne

Minnesota- Clay, Dodge, Douglas, Faribault, Fillmore, Freeborn, Goodhue, Hennepin, Houston, Kandiyohi, Kittson, Mower, Nicollet, Nobles, Norman, Pennington, Pipestone, Polk, Rice, Rock, Steele

Mississippi- Sharkey

Missouri- Atchison, Holt, Ralls, Ripley, St. Charles

Nebraska- Cherry, Hall, Lancaster, Seward

New Jersey- Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Middlesex, Monmouth, Morris, Ocean, Salem, Sussex

New York- Madison, Onondaga

North Carolina- Bladen, Brunswick, Burke, Carteret, Catawba, Cleveland,

Chatham, Clay, Colombus, Cumberland, Granville, Henderson, Hoke, Jackson, Lincoln, Macon, Onslow, Pender, Polk, Rutherford, Scotland, Stokes, Transylvania

North Dakota- Ransom, Richland

Oklahoma- Craig, Rogers

Oregon- Marion

Pennsylvania- Clinton, Lackawanna, Monroe

South Carolina- Aiken, Allendale, Bamberg, Barnwell, Berkeley, Cherokee, Colleton, Clarendon, Edgefield, Greenville, Hampton, Lancaster, Lee, Onconee, Orangeburg, Richland, Saluda, Spartanburg, Williamsburg, York

South Dakota- Bennett, Brookings, Brown, Clay, Codington, Day, Deuel, Grant, Lincoln, Minnehaha, Moody, Roberts, Todd, Turner, Union, Yankton

Tennessee- Cumberland, Fentress, Lewis, Marion, Morgan, Scott, White

Texas- Hays

Utah- Duchesne, Salt Lake, Unitah, Utah, Weber

Vermont- Windham

Virginia- Augusta, Bath, Charles City, Essex, Henrico, James City, King George, King William, Nelson, New Kent, Rockingham, Smyth, Westmoreland

West Virginia- Berkeley, Morgan

Wisconsin- Dane, Jefferson, Kenosha, Ozaukee, Portage, Rock, Walworth, Waushara, Waukesha, Winnebago

Formal consultation with USFWS may be initiated regarding the use of this herbicide and the possible detrimental effects to federally listed endangered or threatened species of plants. The **formal consultation with USFWS** should be considered before section 3 registration of acetochlor is granted **unless** the label indicates that **acetochlor products are not to be used in the above mentioned counties and use limitations protecting endangered fish species.**

EEB is willing to consider any of the registrant's proposals for risk reduction measures that may diminish potential risk to endangered plants and fish if they are intended to replace restrictions above or preclude formal consultations. Such measures must protect the endangered plants. **Since the location of endangered species of plants are not known, entire counties must be excluded from use of acetochlor. One way to reduce the number of counties where acetochlor is prohibited is to have the registrant provide information as to the location of these plant species. This information would be gathered through contacts with the**

endangered experts who have knowledge of locations of endangered species and possibly agriculture experts to determine the specific locations of crops in certain areas. This does not include field work.

Risk Reduction Recommendation for Endangered Species

The following risk reduction measures are recommended:

1. Decrease the amount of active ingredients: Reducing the application rate to **0.63 lb ai/A** for all of the sites where endangered species of fish are located (except in Mississippi) would eliminate the may effect to the endangered fish. In the state of Mississippi where endangered fish occur, reducing the rate of application to 0.16 lb ai/A would eliminate the may affect situation. It is unlikely that the use rate could be reduced enough to eliminate may affect to endangered plant species.

2. If aerial application was eliminated, then the risk to endangered plants will be eliminated to 8 species as well as to non-targeted plants. This would remove endangered plant restrictions for the following states and counties:

AL- Morgan, Winston
AR- Clay, Jackson, Lawrence, Woodruff
AZ- all of the counties cited for plants
GA- Baker, Bibb, Columbia, Quitman, Rabunn, Stephens, Talbot, Upson, Wheeler
IL- Randolph
IA- All of the counties cited for plants
KS- All of the counties cited for plants
MN- All of the counties cited for plants
MS- All of the counties cited for plants
MO- Atchison, Holt, Ralls, Ripley
NE- All of the counties cited for plants
NY- All of the counties cited for plants
NC- Polk
ND- All of the counties cited for plants
OK- All of the counties cited for plants
SC- Edgefield, Onconee
SD- All of the counties cited for plants
TN- Marion

The EEB recommends that aerial application be prohibited for the protection of endangered plant species.

3. Mandating prohibitive zones of application (buffers zones) for fish would reduce risk to endangered fish species. USFWS has provided options to choose in reducing risk to endangered species of fish. See the above "species by species" recommendations for endangered fish.

4. According to USFWS, classifying the herbicide as restricted would provide some degree of protection for the endangered species of fish. EEB has determined that this pesticide **does meet** the ecological effects criteria for

restricted use.

5. Since the location of endangered species of plants are not known, entire counties must be excluded, or exposure reduction measure to protect the species must be applied to the entire county to eliminate the may affect situation. One way to reduce the number of counties, or the amount of area in counties, where acetochlor is prohibited, or use restricted, is to have **the registrant provide information as to the location of these plant species.** Obtaining this information would include contacting knowledgeable experts having information on the locations of the endangered species and crop growing locations and would not include field surveys. The EEB would be willing to meet with the registrant regarding this matter.

Risk Reduction Recommendations for Non-endangered Species

Reducing risk may be accomplished in the following ways:

1-Decrease the amount applied per acre;
2-Prohibit aerial application;
3-Require grass buffer strips; and
4-Impose buffers to prevent aerial spray drift at the time of treatment from reaching nontarget areas or require grass buffer strips to reduce runoff. This may also include providing information to the user to allow protection of plants through voluntary buffers.

1. To protect fish in areas of high exposure (such as parts of Mississippi, Louisiana, Alabama and Florida), the use rate could be reduced. Fish are not considered to be at risk in other regions.

To protect plants, the use rate would have to be reduced to 0.1 lb ai/acre or less. Reducing the application rate to protect plants is not considered feasible.

2. Prohibiting aerial application would reduce drift exposure at the time of application to many terrestrial and aquatic plants.

3. Requiring grass buffer strips between treated sites and waterbodies would also reduce the potential for acetochlor to transport via surface runoff. Please note that the waterbodies to which this refers does not include drainage ditches and reservoirs used expressly for irrigation purposes.

4. If aerial application is permitted, imposing buffers between treatment sites and natural water bodies would reduce exposure to wetland and aquatic plants. This recommendation does not include ditches and other water bodies intended for irrigation purposes. The extent of protection afforded would be proportionate to the distance of the buffer. It is not possible to be precise is appraising how much buffer is needed to eliminate risk. It is recommended that rather than trying to protect water from aerial spray drift with buffers that aerial application not be permitted (see #3).

Providing buffer information to the applicator may also result in some protection to terrestrial plants. The applicator should be provided information to allow protection of desirable monocots. The following approximate buffer zones used in accordance with the minimum size nozzles are recommended. These buffer zones are very approximate and are from Dr. Norman B. Akesson's research as of October 6, 1992. Since the risk quotient for plants that are affected by drift is 23, the percentage of rate of application necessary for no injury to occur to non-target plants would be 4.35 percent. This value is used in Dr. Akesson's table of downwind deposits from aircraft applications of 20 progressive swaths of 40 feet each.

nozzle size in microns	downwind distance in meters	Type of Weather
150	150	unstable ventilating
150	3000	stable temperature inversion
250	100	unstable ventilating
250	500	stable temperature inversion
450	50	unstable ventilating
450	200	stable temperature inversion
850	20	unstable ventilating
850	20	stable temperature inversion

C. Labelling

1. Manufacturing Use

The following statements must be on the label: "This pesticide is toxic to fish. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA."

2. End Use

a. Precautionary Statements: "This pesticide is toxic to fish. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate." For endangered/threatened plants, please see statements in section B.2. under Endangered Species Restrictions.

b. Restricted Use: The criteria for restricted use have been exceeded because the exposure to fish exceeds 1/10 the lowest LC50 (71 ppb [representing typical exposure] and 289 ppb [representing areas of maximum exposure] both exceed 38 ppb [1/10 380 ppb=38 ppb]). Restricting use may also reduce potential misuse (over application or accidental application to nontarget areas such as sensitive habitats) that could result in more serious adverse effects.

D. Data Requirements

Data Adequacy

For the most part, the EEB was able to assess risk to all organisms with a relatively high degree of confidence. The two areas where confidence is slightly lessened is in chronic effects to birds, and effects to aquatic plants.

The conclusion that chronic effects to birds would not be significant is weakened since it is based on only one acceptable study. Repeating the Mallard duck reproduction study would increase the confidence of that conclusion and may indicate that the chronic risk is actually greater than currently concluded.

The conclusion that there are risks to aquatic plants has high confidence, however, there is uncertainty in that the risk may actually be greater since there is a high likelihood that repeating the unacceptable aquatic plant study (see below) would result in greater risk (higher risk quotient).

1. Plant Data

The EEB has identified a data gap, which if filled, would provide useful information to completing the risk assessment. **The aquatic plant growth *Skeletonema costatum* study (MRID #42713110) should be conducted again for the full 5 days.**

The value of repeating the Aquatic plant growth study with *Navicula pelliculosa* is low, since based on the 4 day study, this species is relatively insensitive to Acetochlor. Repeating the study for 5 days is unlikely to yield a substantially lower EC50 value.

However, the EEB concludes that there is **high value in repeating the aquatic plant growth with *Skeletonema costatum* for the full 5 days**. Based on the supplemental information from the 4-day study, it is possible that *S. costatum* is the most sensitive aquatic plant species. A repeat study for 5 days may yield an EC50 value lower than the one for *Selenastrum capricornutum*. **It is recommended that, to provide RD with a scientifically sound aquatic plant risk assessment, and to adequately address risk mitigation, the 5-day study using *S. costatum* be conducted.**

2. Bird Data

The EEB has reviewed all available toxicity data submitted for registration of Acetochlor. The following data were found deficient:

71-1; Bobwhite Acute Oral LD50 41963302 (supplemental)
71-4; Mallard Reproduction Study 41592009 (supplemental)
71-4; Bobwhite Reproduction Study 41592010 (supplemental)
123-2; Aquatic plant study; *Navicula pelliculosa* 42713108 (supplemental)
123-2; Aquatic plant study; *Skeletonema costatum* 42713110 (supplemental)

The acute oral study with bobwhite does not have to be repeated since another test fulfills the requirement.

The supplemental bobwhite reproduction study does not have to be repeated since another was submitted and found acceptable (41963305)

The value of information for repeating the avian reproduction study with mallards is moderate. Available information, provided in the acceptable bobwhite reproduction study (41963305), is sufficient to conclude that acetochlor may cause adverse chronic effects to birds at application rates as low as 1.25 lb ai/acre. Note that chronic risk to birds was considered not likely to be significant for reasons provided in the risk assessment. The value of additional testing would be that a lower NOEC may be achieved thus showing that the risk of chronic effects to birds is greater. This would increase the confidence in the overall risk assessment to birds. It would also make it less likely that reducing the use rate (to 1.25 lb ai/acre) for example, would eliminate the potential for chronic risk to birds. Note that this risk reduction measure was not included since the potential for chronic exposure was considered low.

E. Data Evaluation Reports

The following Data Evaluation Reports are submitted with this review:

•**CITATION:** Hakin, B., A. Norman, A. Anderson, I.S. Dawe, and D.O. Chanter. 1990. The effect of dietary inclusion of acetochlor on reproduction in the mallard duck. Study performed by Huntingdon Research Centre Ltd., Huntingdon, Cambridgeshire, UK. HRC report No. ISN 189/891810. Submitted by ICI Americas Inc. EPA MRID No. 415920-09.

Nominal dietary concentrations of acetochlor at 150 ppm and 300 ppm had no effects upon behavior, food consumption, or reproduction in adult mallards during the 22-week exposure period. The NOEC was 300 ppm. At 600 ppm, egg weights were low, while embryo viability and hatching were reduced. This study is scientifically sound and fulfills the guideline requirements for an avian reproduction study.

•**CITATION:** Hakin, B., A.J. Norman, A. Anderson, I.S. Dawe, and D.O. Chanter. 1990. The effect of dietary inclusion of acetochlor on reproduction in the bobwhite quail. Study performed by Huntingdon Research Centre, Ltd., Huntingdon, Cambridgeshire, UK. HRC report No. ISN 188/891809. Submitted by ICI Americas Inc. EPA MRID No. 415920-10.

Nominal dietary concentrations of acetochlor at 150 ppm and 300 ppm were reported to had no effects upon behavior, food consumption, or reproduction in adult bobwhite quail during the 22-week exposure period. The NOEC was reported to be 300 ppm. At 600 ppm, adverse effects were reported to be reduced: adult food consumption, egg weight, eggshell thickness, chick body weights at hatch, chick body weights at 14 days of age, and the proportion of hatchlings surviving to 14 days of age. The proportion of cracked eggs was increased at 600 ppm.

Eight birds died in replicates prior to the beginning of egg laying and were replaced by 6 pairs of birds. Replacement of dead birds is inappropriate, because the adverse effects resulting from the early deaths on reproductive potential has been obfuscated by the replacements. Therefore, this study is not scientifically sound and does not fulfill the guideline requirements for an avian reproduction study.

•**CITATION**: Tapp, J.F., J.E. Caunter, and R.D. Stanley. 1989. Acetochlor: Determination of Chronic Toxicity to Fathead Minnow (*Pimephales promelas*) Embryos and Larvae. Report No. BL/B/3669. Prepared by ICI PLC, Brixham Laboratory, Brixham, Devon, UK. Submitted by ICI Americas, Inc. EPA MRID No. 415920-11.

This study is scientifically sound and meets the requirements for an early life-stage toxicity test using fathead minnows. After 36 days of exposure, the MATC of Acetochlor technical for fathead minnows, based upon the most sensitive biological parameter (fish survival) was >450 and <797 µg/l mean measured concentrations (geometric mean MATC = 599 µg/l).

•**CITATION**: Hakin, B., A.J. Norman, and I.S. Dawe. 1989. Acute Oral Toxicity (LD_{50}) of Acetochlor to the Bobwhite Quail. Study performed by Huntingdon Research Centre Ltd, Cambridgeshire, England. Laboratory study No. ISN 192/891139. Submitted by ICI Agrochemicals, Surrey, England. MRID No. 419633-02.

The acute oral LD_{50} of acetochlor was not determined because of the pattern of mortalities observed in treatment groups. The NOEL could not be determined because toxic effects were observed at all dose levels. The study is scientifically sound but does not meet the requirements for an avian LD_{50} test.

•**CITATION**: Hakin, B., A.J. Johnson, A. Anderson, J.G. Maxwell, and C.G. Howse. 1990. Acetochlor: Acute Oral Toxicity (LD_{50}) to Bobwhite Quail. Study performed by Huntingdon Research Centre Ltd, Cambridgeshire, England. Laboratory study No. ISN 235/90893. Submitted by ICI Agrochemicals, Surrey, England. MRID No. 419633-03.

The study is scientifically sound and meets the requirements for an avian LD_{50} study. Inverted mortalities at two test levels produced widely different LD_{50}'s, broad confidence limits, and low goodness of fit for the three statistical methods (i.e., LD_{50} values were 49, 121 and 131 mg/kg for the binomial, moving average and probit method, respectively). The most conservative LD_{50} value of 49 mg/kg was selected as the endpoint for this study. This classifies the test substance as highly toxic to bobwhite quail. The NOEC was 8 mg/kg.

•**CITATION**: Beavers, J.B., P. Winter, G.J. Smith, and M. Jaber. 1991. Acetochlor: A One-Generation Reproduction Study with the Northern Bobwhite (*Colinus virginianus*). Laboratory Project No. 123-157. Prepared by Wildlife International Ltd., Easton, MD. Submitted by ICI

Agrochemicals, Surrey, UK. MRID No. 419633-05.

Nominal dietary concentrations of acetochlor at 150 ppm a.i. and 300 ppm a.i. had no effects upon behavior, food consumption, or reproduction in adult bobwhite quail during the 20-week exposure period. The NOEC was 300 ppm a.i., based upon reduced embryo viability, hatchability, offspring body weight and offspring survivability at 600 ppm a.i. This study is scientifically sound and fulfills the guideline requirements for an avian reproduction study.

•**CITATION:** Tapp, J.F., S.A. Sankey, J.E. Caunter, P.A. Johnson, and D.S. Adams. 1990. Acetochlor: Acute Toxicity to Rainbow Trout (*Salmo gairdneri*). Report No. BL3960/B. Prepared by ICI Group Environmental Laboratory, Brixham, Devon, UK. Submitted by ICI Americas, Inc. EPA MRID No. 419633-06.

This study is scientifically sound and satisfies the guideline requirements for a freshwater fish static acute toxicity test. The 96-hour LC_{50} of 1.2 mg/l (based on mean measured concentration of test material) classifies acetochlor technical as moderately toxic to rainbow trout. The NOEC was 0.50 mg/l.

•**CITATION:** Cañez, V.M. 1992. Tier 2 Seed Germination/ Seedling Emergence Nontarget Phytotoxicity Study Using Acetochlor. Laboratory Study No. BL91-466. Conducted by Pan-Agricultural Laboratories, Inc., Madera, CA. Submitted by Monsanto Company, St. Louis, MO. EPA MRID No. 425734-01.

These studies are scientifically sound and meet the requirements for Tier-2 seed germination and seedling emergence tests using non-target plants.

Seed Germination: The most sensitive species was ryegrass. The 6-day NOEL, LOEL, EC_{25}, and EC_{50} for ryegrass germination were 0.04, 0.11, 0.08, and 0.14 lb ai/A, respectively. All dicot species (including the root crop, radish) had 6-day NOEL, LOEL, EC_{25}, and EC_{50} values of 3.0, >3.0, >3.0, and >3.0 lb ai/A, respectively.

Seedling Emergence:
Seedling Emergence and Survival: By 14 DAT, the most sensitive dicot species was cucumber, with NOEL, LOEL, EC_{25}, and EC_{50} values of 0.33, 1.0, 0.42, and 0.86 lb ai/A, respectively. The most sensitive monocot species was ryegrass, with NOEL, LOEL, EC_{25}, and EC_{50} values of 0.0046, 0.0093, 0.0059, and 0.013 lb ai/A, respectively. The root crop (radish) was not affected by acetochlor, with a subsequent NOEL, LOEL, EC_{25}, and EC_{50} of 3.0, >3.0, >3.0, and >3.0 lb ai/A, respectively.

By 21 DAT, the most sensitive dicot species was lettuce, with NOEL, LOEL, EC_{25}, and EC_{50} values of 0.0093, 0.019, 0.022, and 0.11 lb ai/A, respectively. The most sensitive monocot species was onion, with NOEL, LOEL, EC_{25}, and EC_{50} values of 0.037, 0.11, 0.046, and 0.063 lb ai/A, respectively. The root crop (radish) was not affected by acetochlor,

with a subsequent NOEL, LOEL, EC_{25}, and EC_{50} of 3.0, >3.0, >3.0, and >3.0 lb ai/A, respectively.

Plant Phytotoxicity: The most sensitive dicot species was lettuce, with NOEL and LOEL values of 0.004 and 0.005 lb ai/A, respectively. Ryegrass was the most sensitive monocot species, with an NOEL and LOEL of 0.0023 and 0.0046 lb ai/A, respectively. Radish had NOEL and LOEL values of 0.33 and 1.0 lb ai/A, respectively.

Plant height: The most sensitive dicot species was lettuce, with NOEL, LOEL, EC_{25}, and EC_{50} values of 0.0020, 0.0040, 0.0034, and 0.0084 lb ai/A, respectively. The most sensitive monocot species was ryegrass, with NOEL, LOEL, EC_{25}, and EC_{50} values of 0.0023, 0.0046, 0.0026, and 0.0046 lb ai/A, respectively. Radish had NOEL, LOEL, EC_{25}, and EC_{50} values of 0.11, 0.33, 0.60, and 2.8 lb ai/A, respectively.

Plant dry weight: The most sensitive dicot species was lettuce, with NOEL, LOEL, EC_{25}, and EC_{50} values of 0.0010, 0.0020, 0.0016, and 0.0044 lb ai/A, respectively. The most sensitive monocot species was ryegrass, with NOEL, LOEL, EC_{25}, and EC_{50} values of 0.0006, 0.0012, 0.0013, and 0.0025 lb ai/A, respectively. Radish had NOEL, LOEL, EC_{25}, and EC_{50} values of 0.04, 0.11, 0.10, and 0.49 lb ai/A, respectively.

•**CITATION:** Swigert, J.P. and G.J. Smith. 1992. Acetochlor: A 96-Hour Flow-Through Acute Toxicity Test with the Saltwater Mysid (*Mysidopsis bahia*). Project No. 139A-133. Prepared by Wildlife International Ltd., Easton, MD. Submitted by Acetochlor Registration Partnership. EPA MRID No. 427131-01.
This study is scientifically sound and meets the guideline requirements for an acute estuarine shrimp toxicity study. The 96-hour LC_{50} value for mysids was 2.2 mg a.i./l mean measured concentration. Therefore acetochlor is classified as moderately toxic to mysids. The NOEC was 0.56 mg a.i./l.

•**CITATION:** Swigert, J.P. 1992. Acetochlor: A 96-Hour Flow-Through Acute Toxicity Test with the Sheepshead Minnow (*Cyprinodon variegatus*). Project No. 139A-134. Prepared by Wildlife International Ltd., Easton, MD. Submitted by Acetochlor Registration Partnership. EPA MRID No. 427131-02.
This study is scientifically sound and meets the guideline requirements for an estuarine fish acute toxicity test using sheepshead minnows. The 96-hour LC_{50} was 2.10 mg a.i./l mean measured concentration which classifies acetochlor as moderately toxic to sheepshead minnows. The NOEC was 0.93 mg a.i./l.

•**CITATION:** Reed, D. and J.P. Swigert. 1992. Acetochlor: A 96-Hour Shell Deposition Test with the Eastern Oyster (*Crassostrea virginica*). Project No. 139A-132. Prepared by Wildlife International Ltd., Easton, MD. Submitted by Acetochlor Registration Partnership. EPA MRID No. 427131-03.

This study is scientifically sound and meets the guideline requirements

for a mollusc shell deposition study. The 96-hour EC_{50} value of 3.82 mg a.i./l (based on mean measured concentrations) classifies acetochlor as moderately toxic to eastern oysters. The NOEC was 2.5 mg a.i./l mean measured concentration.

•**CITATION:** Rhodes, J.E. and M. Muckerman. 1992. Early Life-Stage Toxicity of Acetochlor to the Rainbow Trout (*Oncorhynchus mykiss*) Under Flow-Through Conditions. Final Report No. 40047. Prepared by ABC Laboratories, Inc., Columbia, MO. Submitted by Acetochlor Registration Partnership, c/o Monsanto Agricultural Company, St. Louis, MO. EPA MRID No. 427131-04.

This study is scientifically sound and meets the guideline requirements for an early life-stage toxicity test using rainbow trout. Based on the authors' analyses, the MATC was >0.13 and <0.27 mg/l. The geometric mean MATC was 0.19 mg/l.

•**CITATION:** Blakemore, G.C. and M. Muckerman. 1993. Chronic Toxicity of Acetochlor to *Daphnia magna* Under Flow-Through Test Conditions. ABC Report No. 40048. Study conducted by Analytical Bio-Chemistry Laboratories, Inc., Columbia, MO. Submitted by Acetochlor Registration Partnership, c/o Monsanto Agricultural Company, St. Louis, MO. EPA MRID No. 427131-05.

This study is scientifically sound but does not meet the guideline requirements for a daphnid life-cycle test. Raw length data were not submitted with the report. The MATC of acetochlor for *Daphnia magna* was between 22.1 and 42.7 µg/l mean measured concentrations (geometric mean = 30.7 µg/l).

•**CITATION:** Smyth, D.V., S.A. Sankey, and A.J. Penwell. 1993. Acetochlor: Toxicity to the Duckweed (*Lemna gibba*). Laboratory ID No. W556/D (FT21/92). Conducted by ZENECA Limited, Brixham, Devon, UK. Submitted by ZENECA Agrochemicals, Surrey, UK. EPA MRID No. 427131-07.

This study is scientifically sound and meets the guideline requirements for a Tier 2 non-target aquatic plant study. Based on mean measured concentrations and reduced growth (dry weight), the 14-day NOEC, LOEC, and EC_{50} for *L. gibba* exposed to acetochlor technical were 0.12, 0.22 and 3.4 µg/l, respectively.

•**CITATION:** Smyth, D.V., S.A. Sankey, M.M. Holland, and P.A. Johnson. 1992. Acetochlor: Toxicity to the Freshwater Diatom *Navicula pelliculosa*. Laboratory ID No. W566/C (FT20/92). Conducted by Imperial Chemical Industries PLC, Devon, UK. Submitted by ICI Agrochemicals, Surrey, UK. EPA MRID No. 427131-08.

This study is scientifically sound but does not fulfill the guideline requirements for a Tier 2 non-target plant growth and reproduction test. The test was conducted for four, rather than five days. Based on mean measured concentrations, the 4-day NOEC, LOEC, and EC_{50} for *N. pelliculosa* exposed to acetochlor technical were 0.56, 1.20, and 1.38

mg/l, respectively.

•**CITATION:** Smyth, D.V., S.A. Sankey, and A.J. Grinell. 1992. Acetochlor: Toxicity to the Blue-Green Alga *Anabaena flos-aquae*. Laboratory ID No. W566/A (FT18/92). Conducted by Imperial Chemical Industries PLC, Devon, UK. Submitted by ICI Agrochemicals, Surrey, UK. EPA MRID No. 427131-09.

This study is scientifically sound and fulfills the guideline requirements for a Tier 2 non-target plant growth and reproduction test. Based on mean measured concentrations, the 5-day NOEC, LOEC, and EC_{50} for *A. flos-aquae* exposed to acetochlor technical were 1.9, 4.1, and 35 mg/l, respectively.

•**CITATION:** Smyth, D.V., N.C.D. Craig, S.A. Sankey, and A.J. Penwell. 1992. Acetochlor: Toxicity to the Marine Alga *Skeletonema costatum*. Laboratory ID No. W566/B (FT19/92). Conducted by Imperial Chemical Industries PLC, Devon, UK. Submitted by ICI Agrochemicals, Surrey, UK. EPA MRID No. 427131-10.

This study is scientifically sound but does not meet the guideline requirements for a Tier 2 non-target plant growth and reproduction test. The test was conducted for 4 days rather than the recommended 5 days. Based on mean measured concentrations, the 4-day NOEC, LOEC, and EC_{50} for *S. costatum* exposed to acetochlor technical were 1.6, 3.3, and 3.4 µg/l, respectively.

•**CITATION:** White, T.L. 1992. Tier 2 Vegetative Vigor Nontarget Phytotoxicity Study Using Acetochlor. Laboratory Study No. BL91-465. Conducted by Pan-Agricultural Laboratories, Inc., Madera, CA. Submitted by The Agricultural Group of Monsanto Company, St. Louis, MO. EPA MRID No. 427131-19.

This study is scientifically sound and fulfills the requirements for a Tier 2 vegetative vigor test using non-target plants.

Phytotoxicity: The most sensitive monocot species was ryegrass, with an NOEL and LOEL of 0.005 and 0.009 lb ai/A, respectively. The most sensitive dicot species were equally lettuce and cucumber, with an NOEL and LOEL of 0.33 and 1.0 lb ai/A, respectively. No EC values were determined from the phytotoxicity ratings.

Percent survival: The most sensitive species were equally all ten test crops, with a 21-day NOEL, LOEL, EC_{25}, and EC_{50} of 3.0, >3.0, >3.0, and >3.0 lb ai/A, respectively.

Plant height: Ryegrass was the most sensitive monocot species, with a 21-day NOEL, LOEL, EC_{25}, and EC_{50} of 0.005, 0.009, 0.007, and 0.031 lb ai/A, respectively. Lettuce was the most sensitive dicot species, with a 21-day NOEL, LOEL, EC_{25}, and EC_{50} of 0.110, 0.330, 0.510, and 1.700 lb ai/A, respectively.

Plant dry weight: Ryegrass was again the most sensitive monocot

species, with a 21-day NOEL, LOEL, EC_{25}, and EC_{50} of 0.002, 0.005, 0.005, and 0.013 lb ai/A, respectively. Lettuce was again the most sensitive dicot species, with a 21-day NOEL, LOEL, EC_{25}, and EC_{50} of 0.110, 0.330, 0.320, and 1.400 lb ai/A, respectively.

•**CITATION:** Rapley, J.H. and M.J. Hamer. 1990. Acetochlor: *Daphnia magna* Life-Cycle Study. Report No. RJ0785B. Prepared by ICI Agrochemicals, Jealott's Hill Research Station, Bracknell, Berkshire, UK. Submitted by ICI Americas, Inc., Wilmington, DE. EPA MRID No. 415651-38.

This test is scientifically sound and meets the guideline requirements for a chronic toxicity test using the freshwater invertebrate, *Daphnia magna*. Based on mean measured concentrations, the 21-day LC_{50} value was 2.2 mg/l. Based on the most sensitive biological parameters, daphnid survival and reproduction, the MATC was >1.24 and <2.45 mg/l mean measured concentrations.

Date:01/25/94
Case No:031451
Chemical No:129016

ACETOCHLOR
DATA REQUIREMENTS FOR
ECOLOGICAL EFFECTS BRANCH

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographic Citation	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
6 Basic Studies in Bold					
71-1(a) Acute Avian Oral, Quail/Duck	(TGAI)	A	Yes	41565129, 073665, 41963303, 99812	No
71-1(b) Acute Avian Oral, Quail/Duck	(TEP)		No		No
71-2(a) Acute Avian Diet, Quail	(TGAI)	A	Yes	99812, 073665, 41565131	No
71-2(b) Acute Avian Diet, Duck	(TGAI)	A	Yes	41565130, 41565131	No
71-3 Wild Mammal Toxicity		A	No		No
71-4(a) Avian Reproduction Quail	(TGAI)	A	Yes	41963305, 41592010	No
71-4(b) Avian Reproduction Duck	(TGAI)	A	Partial	41592009	No[3]
71-5(a) Simulated Terrestrial Field Study		A	No		No
71-5(b) Actual Terrestrial Field Study		A	No		No
72-1(a) Acute Fish Toxicity Bluegill	(TGAI)	A	Yes	073665, 246128, 99812, 41565133	No
72-1(b) Acute Fish Toxicity Bluegill	(TEP)	A	No		No
72-1(c) Acute Fish Toxicity Rainbow Trout	(TGAI)	A	Yes	073665, 41963306, 41565132	No
72-1(d) Acute Fish Toxicity Rainbow Trout	(TEP)	A	No		No
72-1(e) Acute Fish Toxicity Fathead Minnow	(TGAI)	A	No		No
72-2(a) Acute Aquatic Invertebrate Toxicity	(TGAI)	A	Yes	073665, 99812, 41565134	No
72-2(b) Acute Aquatic Invertebrate Toxicity	(TEP)	A	No		No
72-3(a) Acute Estu/Mari Tox Fish	(TGAI)	A	Yes	42713102, 41565137	No
72-3(b) Acute Estu/Mari Tox Mollusk	(TGAI)	A	Yes	42713103, 41565136	No
72-3(c) Acute Estu.Mari Tox Shrimp	(TGAI)	A	Yes	42713101, 41565135	No

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* In Bibliographic Citation column indicates study may be upgradeable

Date:01/25/94
Case No:031451
Chemical No:129016

ACETOCHLOR
DATA REQUIREMENTS FOR
ECOLOGICAL EFFECTS BRANCH

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographic Citation	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
72-3(d) Acute Estu/Mari Tox Fish	(TEP)	A	No		No
72-3(e) Acute Estu/Mari Tox Mollusk	(TEP)	A	No		No
72-3(f) Acute Estu/Mari Tox Shrimp	(TEP)	A	No		No
72-4(a) Early Life-Stage Fish	(TGAI)	A	Yes	41592011, 42713104, 071973	No
72-4(b) Live-Cycle Aquatic Invertebrate	(TGAI)	A	Yes	41565138, 42713105	No
72-5 Life-Cycle Fish	(TGAI)	A	No		No
72-6 Aquatic Org. Accumulation	(TEP)	A	No		No
72-7(a) Simulated Aquatic Field Study	(TEP)	A	No		No
72-7(b) Actual Aquatic Field Study	(TEP)	A	No		No
122-1(a) Seed Germ./Seedling Emerg.	(TGAI)	A	No		No[4]
122-1(b) Vegetative Vigor	(TGAI)	A	No		No[4]
122-2 Aquatic Plant Growth	(TGAI)	A	No		No[4]
123-1(a) Seed Germ./Seedling Emerg.	(TGAI)	A	Yes	42573401	No
123-1(b) Vegetative Vigor	(TGAI)	A	Yes	42713119	No
123-2 Aquatic Plant Growth	(TGAI)	A	Partial	42763110, 42713107, 41565141, 42713109, 42713108	No[5]
124-1 Terrestrial Field Study	(TEP)	A	No		Reserved
124-2 Aquatic Field Study	(TEP)	A	No		Reserved
141-1 Honey Bee Acute Contact	(TGAI)	A	Yes	071973, 073665, 41465142,	No
141-2 Honey Bee Residue on Foliage	(TEP)	A	No		No[6]
141-5 Field Test for Pollinators	(TEP)	A	No		No[6]

* In Bibliographic Citation column indicates study may be upgradeable

1.Composition: TGAI = Technical grade of the active ingredient; PAIRA = Pure active ingredient, radiolabeled; TEP = Typical end-use product

2.Use Patterns: A = Terrestrial Food Crop; B = Terrestrial Feed Crop; C = Terrestrial Non-Food Crop; D = Aquatic Food Crop; E = Aquatic Non-Food Outdoor; F = Aquatic Non-Food Industrial; G = Aquatic Non-Food Residential; H = Greenhouse Food Crop; I = Greenhouse Non-Food Crop; J = Forestry; K = Outdoor Residential; L = Indoor Food; M = Indoor Non-Food; N = Indoor Medical; O = Indoor Residential; Z = Use Group for Site 00000

3. Available information, provided in the acceptable bobwhite reproduction study (41963305), is sufficient to conclude that acetochlor may cause adverse chronic effects to birds at application rates as low as 1.25 lb ai/acre. Note that chronic risk to birds was considered not likely to be significant for reasons provided in the risk assessment.

4. It is assumed that herbicides will kill plants. Therefore, this study is not needed since Tier II is triggered.

5. The EEB has identified a data gap, which if filled, would provide useful information to completing the risk assessment. The aquatic plant growth *Skeletonema costatum* study (MRID #42713110) should be conducted again for the full 5 days. The value of repeating the Aquatic plant growth study with *Navicula pelliculosa* is low, since based on the 4 day study, this species is relatively insensitive to Acetochlor. Repeating the study for 5 days is unlikely to yield a substantially lower EC50 value.

6. Data from the acute contact study show low toxicity, no further testing is required.

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EEC Modelling Summary

CHEMICAL COMMON NAME: ACETOCHLOR **FORMULATION:** HARNESS, SURPASS
RUNOFF MODEL: PRZM1 **RECEIVING WATER MODEL:** EXAMS 2.94
REGISTRANTS: ZENECA,MONSANTO **MODELLER:** RON PARKER **DATE:** 12/16/93

CHEMICAL PARAMETERS:
HYDROLYSIS t½:pH5 STABLE pH7 STABLE pH9 STABLE AQU PHOTOL t½ STAB
KOC 200 KD 3.48 AEROBIC SOIL t½ 13.5 D ANEROBIC SOIL t½ 19 D
AEROBIC AQUATIC t½ 13.5 D ANAEROBIC AQUATIC t½ 19 D SOL 233.
VAPOR PRESSURE 4.5e-05 HENRYS LAW CONSTANT

CROP SITE 1

LOCATION:
CROP CORN COUNTY POTTAWOTTAMIE STATE IA MLRA 107
SOIL SERIES MARSHALL TEXTURE SILTY CLAY LOAM
JUSTIFICATION This site is representative of corn culture in the midwest and is used as a typical, medium exposure scenario.

MANAGEMENT:
TILLAGE TYPE CONVENTIONAL TILLAGE TIME FALL RESIDUES REMAINING
APPLICATION METHOD GROUND SPRAY INCORPORATION DEPTH 0.0
CROP DATES: PLANTING 16/5 EMERGENCE 21/5 MATURITY 26/9
HARVEST 11/10 SPRAY DRIFT 0.0 % AND 5.0 %

PESTICIDE APPLICATION:
RATE(LBS/AC) 2.34 DATES: 1 14/5 2 3 4 5 6
7 8 9 10 JUSTIFICATION This is the maximum label rate and maximum number of applications permitted on the label.

RESULTS:
MAXIMUM DISSOLVED CONCENTRATION[1] - TEN YEAR RETURN PERIOD (PPB)
POST LOAD[1] 71.0 96HOUR[2] 62.9 21DAY[3] 40.3 60DAY 24.7
90DAY 16.9 5DAY 63.1 14DAY 49.2 AVE RAIN (INCH/YEAR) 34.2
AVE RUNOFF (IN/YEAR) 4.1 AVE EROSION (TONS/ACRE/YEAR)
LOADING BREAKDOWN[4]: RUNOFF 80.6 % EROSION 6.7 % SP DRIFT 12.7 %

COMMENTS: This was modelled both with and without a spray drift component. Increase in EEC's due to drift was insignificant.

[1] POST LOAD - MAXIMUM OF ALL POND CONCENTRATIONS DURING THE YEAR CALCULATED IMMEDIATELY AFTER A RUNOFF OR SPRAY DRIFT LOADING AND COMPLETE MIXING IN THE POND BUT BEFORE ANY DEGREDATION OF THE LAST LOADING HAS TAKEN PLACE

[2] 96 HOUR - MAXIMUM OF THE RUNNING AVERAGE CONCENTRATIONS OF ANY CONSECUTIVE FOUR DAY PERIOD DURING THE YEAR

[3] 21 DAY - MAXIMUM OF THE RUNNING AVERAGE CONCENTRATIONS OF ANY CONSECUTIVE TWENTY-ONE DAY PERIOD DURING THE YEAR

[4] VALUES REFER TO THE PERCENT OF EACH FORM OF ANNUAL LOADING IN THE YEAR REPRESENTING THE ONE IN TEN YEAR EXCEEDENCE PROBABILITY

CROP SITE 2

LOCATION:
CROP CORN COUNTY YAZOO STATE MS MLRA 134
SOIL SERIES LORING TEXTURE SILT LOAM
JUSTIFICATION This site is chosen as a high exposure, upper limit site due to highly erosive rainfall and erodible soil.

MANAGEMENT:
TILLAGE TYPE CONVENTIONAL TILLAGE TIME FALL RESIDUES REMAINING
APPLICATION METHOD GROUND SPRAY INCORPORATION DEPTH 0.0
CROP DATES: PLANTING 16/5 EMERGENCE 21/5 MATURITY 16/9
HARVEST 1/10 SPRAY DRIFT 0.0 % AND 5.0 %

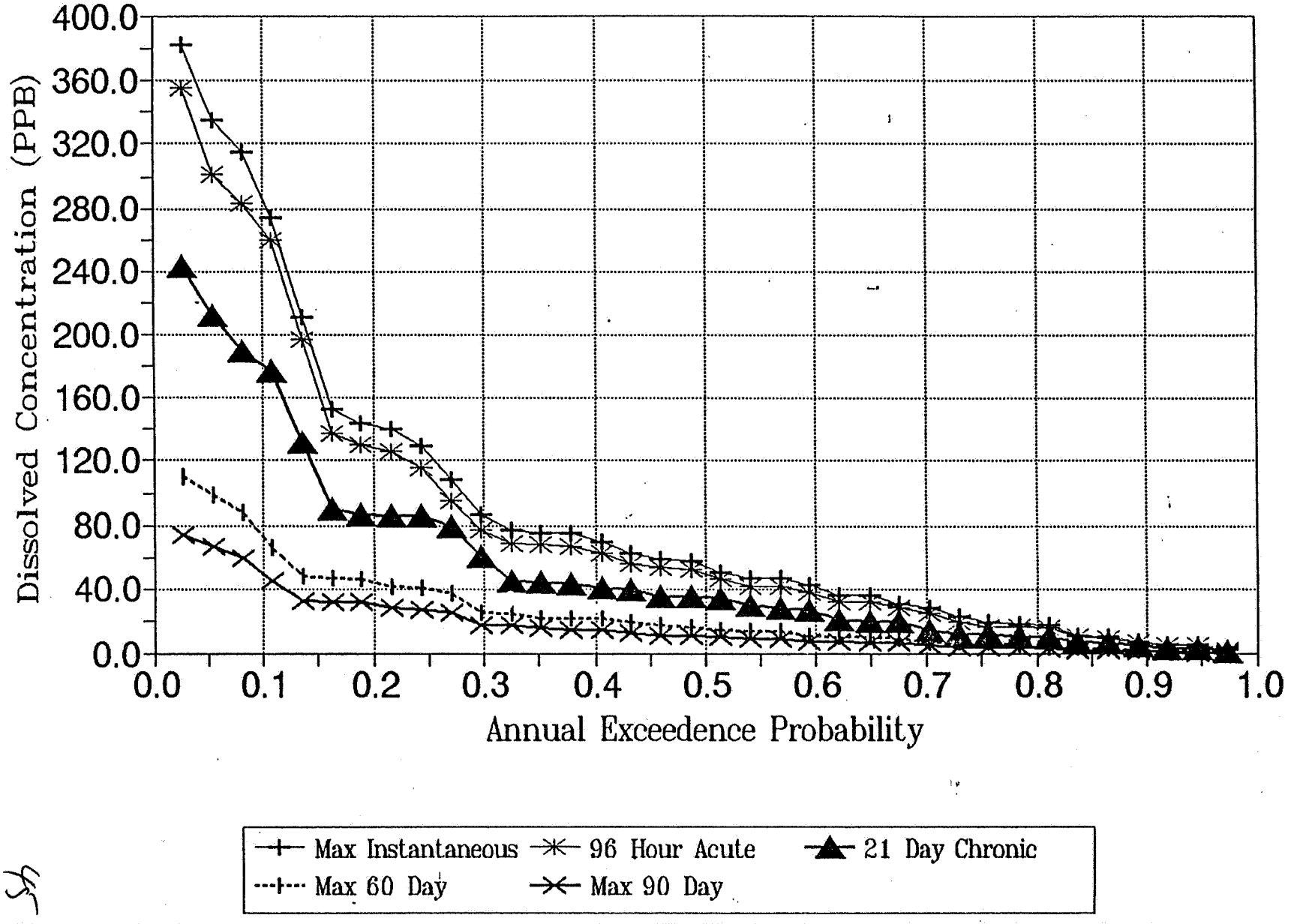
PESTICIDE APPLICATION:
RATE(LBS/AC) 2.34 DATES:1 14/5 2 3 4 5 6
7 8 9 10 JUSTIFICATION This is the maximum label rate and maximum number of applications permitted on the label.

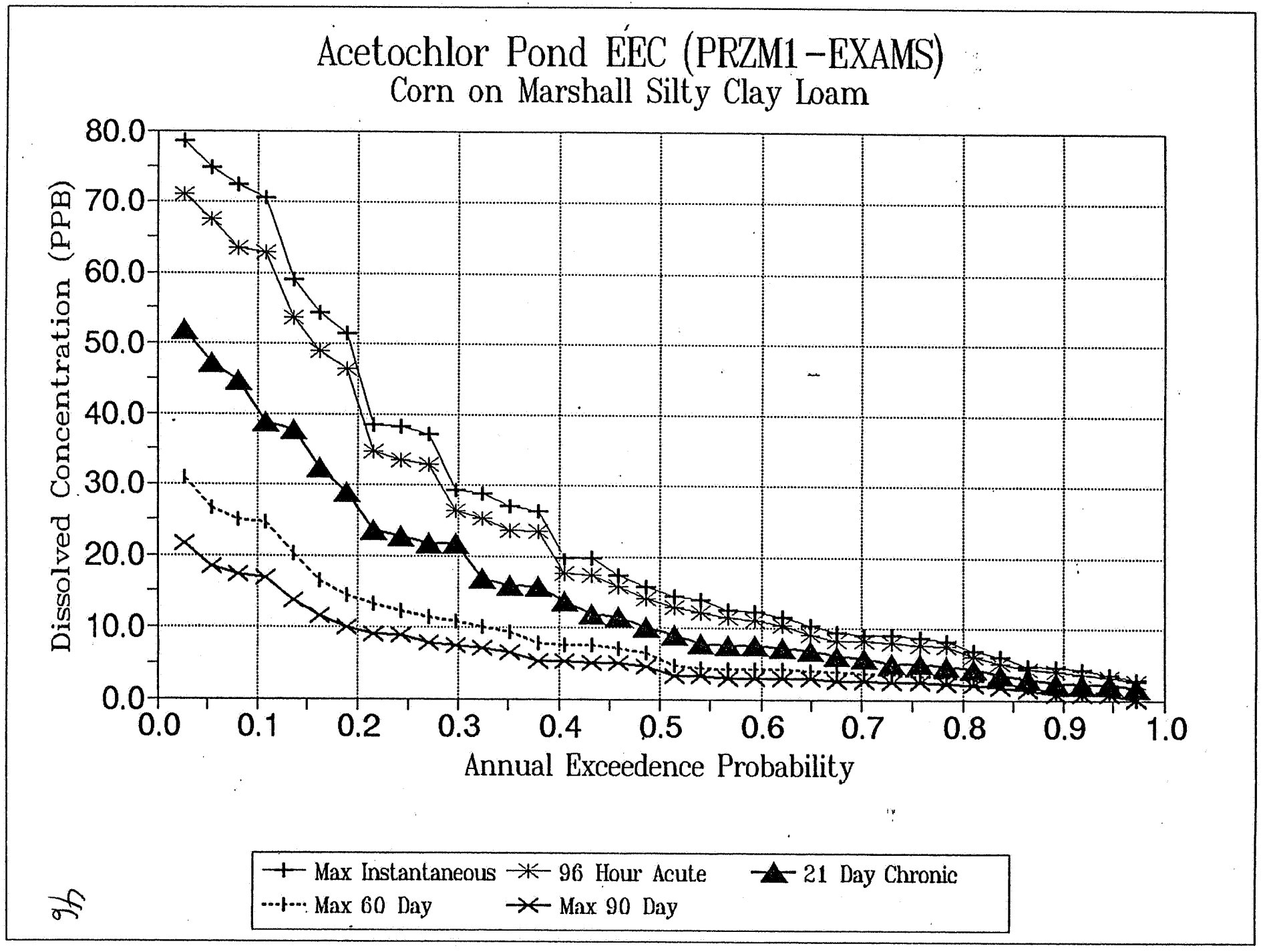
RESULTS:
MAXIMUM DISSOLVED CONCENTRATION[1] - TEN YEAR RETURN PERIOD (PPB)
POST LOAD[1] 283.9 96HOUR[2] 265.6 21DAY[3] 182.6 60DAY 71.6
90DAY 48.9 5DAY 214. 14DAY 173. AVE RAIN (INCH/YEAR) 50.0
AVE RUNOFF (IN/YEAR) 14.4 AVE EROSION (TONS/ACRE/YEAR)
LOADING BREAKDOWN[4]: RUNOFF 94.2 % EROSION 2.1 % SP DRIFT 3.7 %

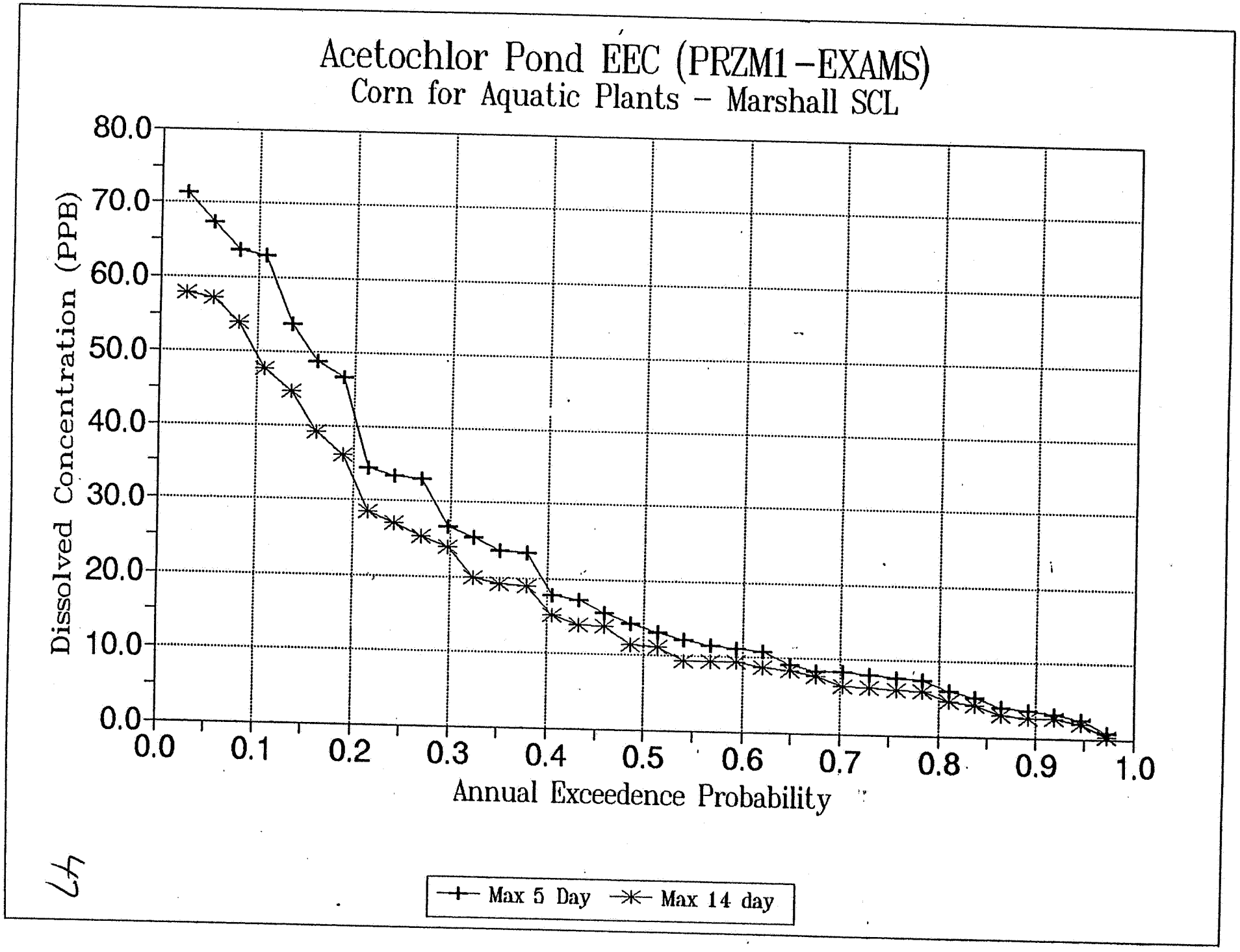
COMMENTS: This was modelled both with and without a spray drift component. Increase in EEC's due to drift was insignificant.

Acetochlor Pond EEC (PRZM1-EXAMS)

Corn on Loring Silt Loam




Acetochlor Pond EEC (PRZM1-EXAMS)
Corn on Marshall Silty Clay Loam
Dissolved Concentration (PPB)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Annual Exceedence Probability
Max Instantaneous
96 Hour Acute
21 Day Chronic
Max 60 Day
Max 90 Day


Acetochlor Pond EEC (PRZM1-EXAMS)
Corn for Aquatic Plants - Marshall SCL
Dissolved Concentration (PPB)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Annual Exceedence Probability
Max 5 Day
Max 14 day

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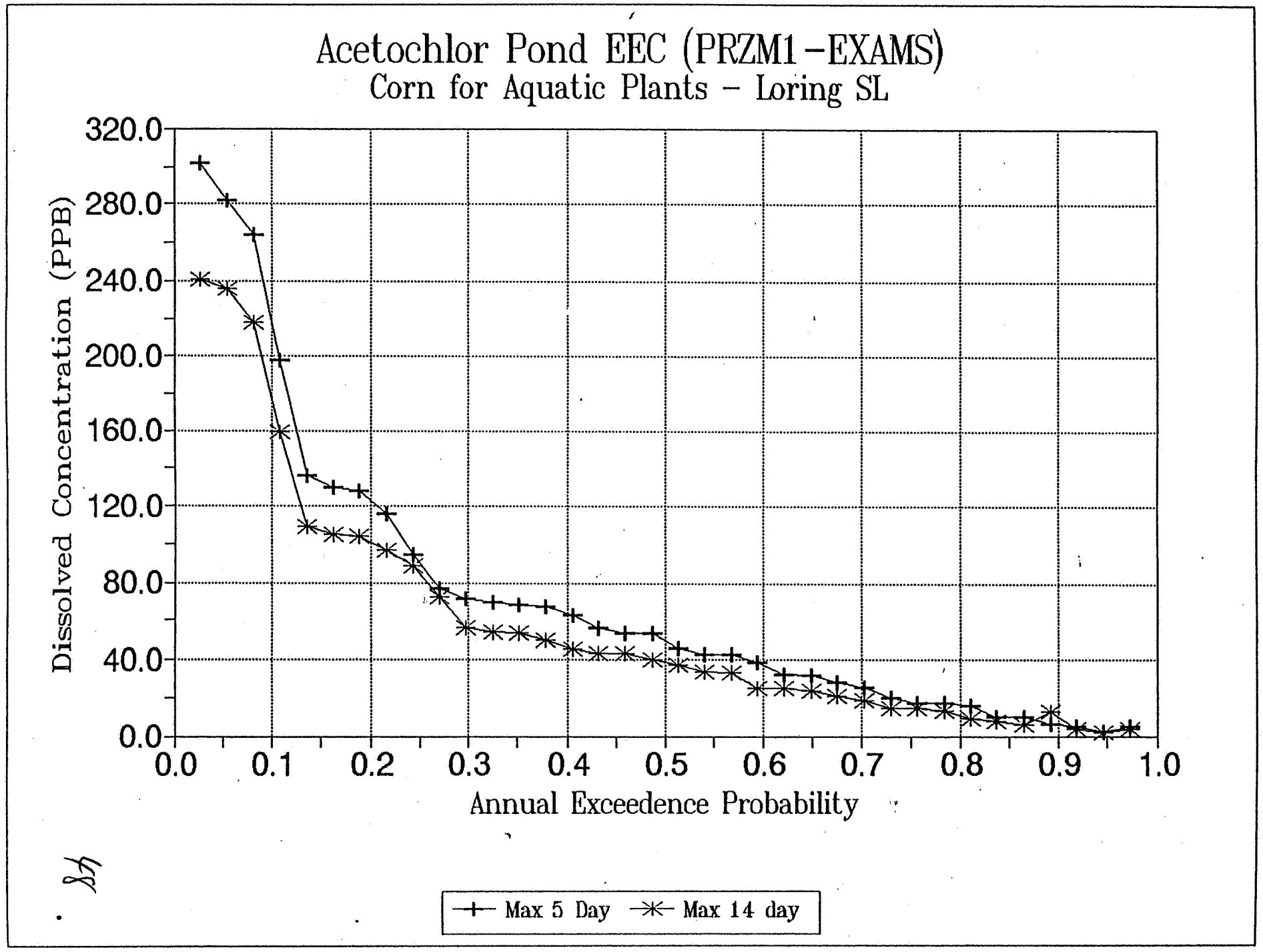
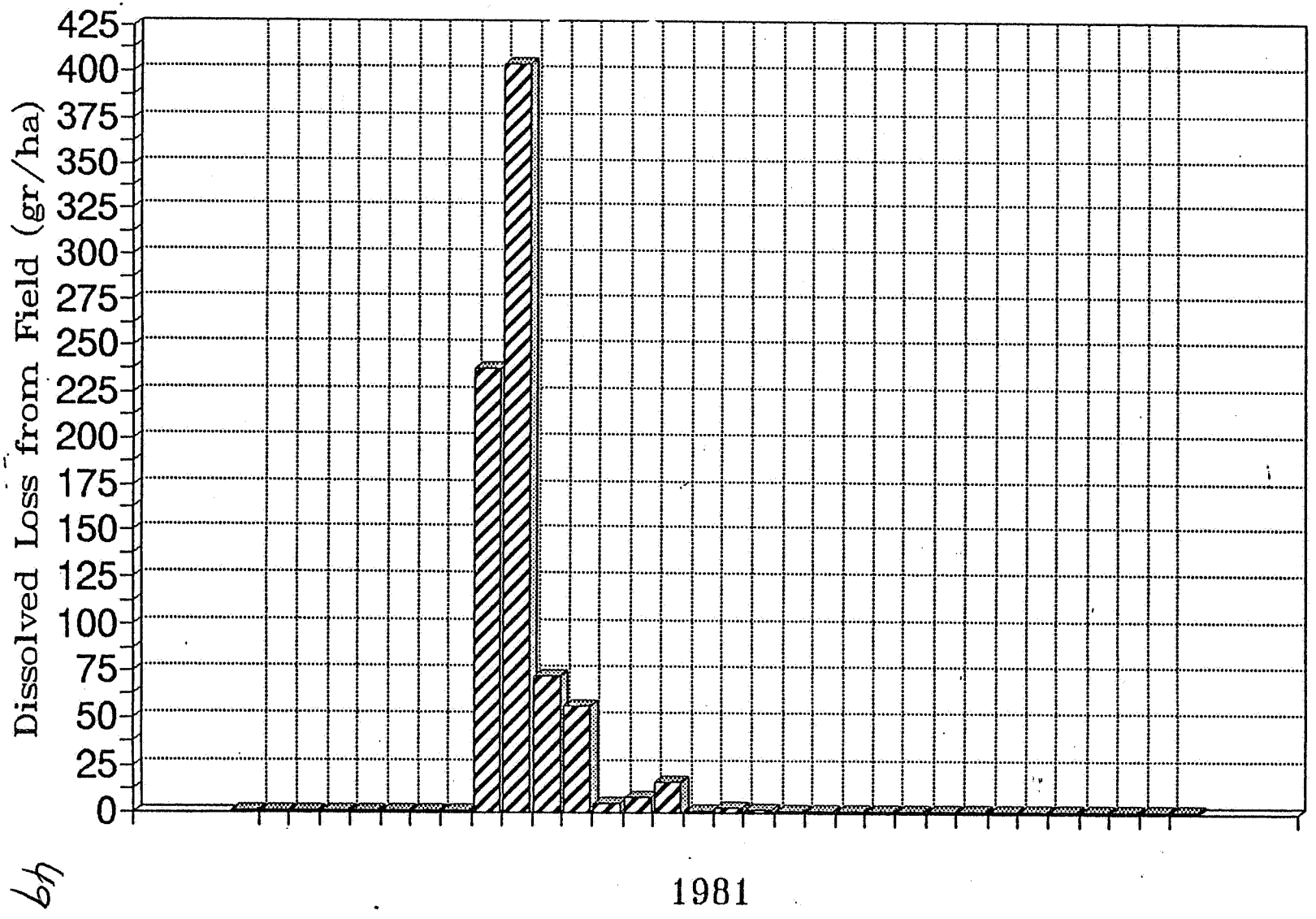

Acetochlor Pond EEC (PRZM1-EXAMS)
Corn for Aquatic Plants - Loring SL
Dissolved Concentration (PPB)
320.0
280.0
240.0
200.0
160.0
120.0
80.0
40.0
0.0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Annual Exceedence Probability
Max 5 Day
Max 14 day

EDGE of field
PRISM

Acetochlor Loss from Loring SL 10 HA

High Exposure – Third of 36 Years



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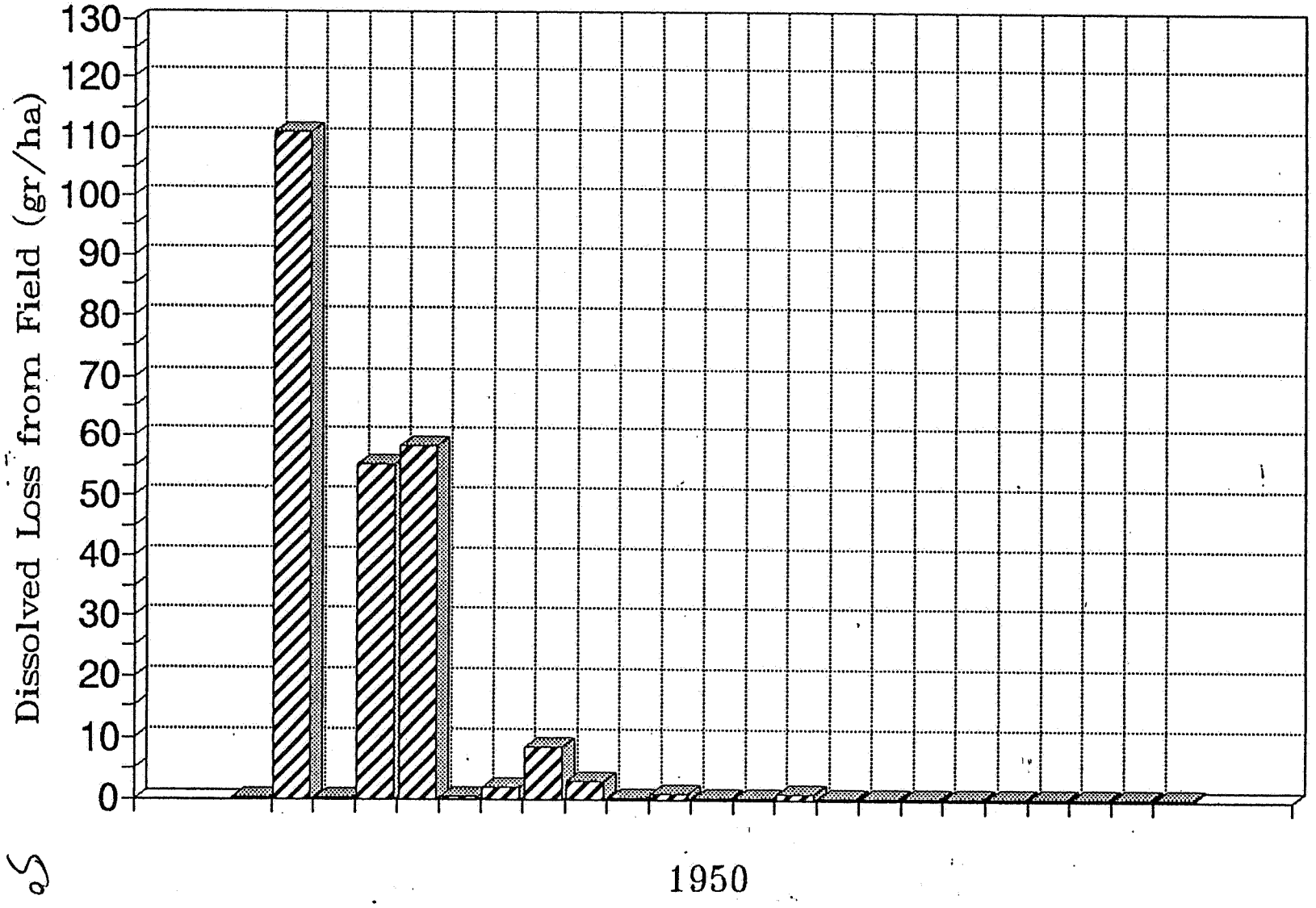
EDGE OF FIELD EEC
PRISM

Acetochlor Loss from Marshall SCL 10HA

Medium Exposure – Third of 36 Years



DAILY ACCUMULATED PESTICIDE RESIDUES---MULTP. APPL.

Chemical name	acetochlor
Initial concentration (ppm)	44
Half-life	14
A number of application	5
Application interval	14
Length of simulation (day)	90

DAY	RESIDUE (PPM)
0	44
1	41.87459
2	39.85184
3	37.9268
4	36.09475
5	34.35121
6	32.69188
7	31.1127
8	29.6098
9	28.17951
10	26.8183
11	25.52285
12	24.28997
13	23.11665
14	66
15	62.81188
16	59.77776
17	56.89021
18	54.14213
19	51.52681
20	49.03781
21	46.66905
22	44.41471
23	42.26926
24	40.22745
25	38.28427
26	36.43495
27	34.67497
28	77
29	73.28053
30	69.74073
31	66.3719
32	63.16582
33	60.11461
34	57.21078
35	54.44722
36	51.81716
37	49.31414
38	46.93202
39	44.66498
40	42.50745
41	40.45413
42	82.5
43	78.51485

44	74.7222
45	71.11276
46	67.67766
47	64.40851
48	61.29727
49	58.33631
50	55.51838
51	52.83657
52	50.28431
53	47.85533
54	45.54369
55	43.34371
56	85.25
57	81.13201
58	77.21294
59	73.48318
60	69.93358
61	66.55545
62	63.34051
63	60.28085
64	57.36899
65	54.5978
66	51.96046
67	49.45051
68	47.06182
69	44.7885
70	42.625
71	40.566
72	38.60647
73	36.74159
74	34.96679
75	33.27773
76	31.67025
77	30.14042
78	28.6845
79	27.2989
80	25.98023
81	24.72526
82	23.5309
83	22.39425
84	21.3125
85	20.283
86	19.30323
87	18.37079
88	17.4834
89	16.63886
90	15.83512
Maximum residue ----------	85.25
Average residue ----------	46.62008

DAILY ACCUMULATED PESTICIDE RESIDUES---MULTP. APPL.

Chemical name ----------	acetochlor
Initial concentration (ppm) -----	44
Half-life ----------	230
A number of application --------	5
Application interval ----------	14

Length of simulation (day) ----- 90

DAY	RESIDUE (PPM)
0	44
1	43.8676
2	43.7356
3	43.60399
4	43.47278
5	43.34196
6	43.21154
7	43.08151
8	42.95187
9	42.82262
10	42.69377
11	42.56529
12	42.4372
13	42.3095
14	86.18219
15	85.92285
16	85.6643
17	85.40652
18	85.14952
19	84.89329
20	84.63783
21	84.38315
22	84.12922
23	83.87607
24	83.62368
25	83.37204
26	83.12116
27	82.87103
28	126.6217
29	126.2407
30	125.8608
31	125.482
32	125.1045
33	124.728
34	124.3527
35	123.9785
36	123.6054
37	123.2335
38	122.8626
39	122.4929
40	122.1243
41	121.7568
42	165.3904
43	164.8928
44	164.3966
45	163.9019
46	163.4087
47	162.917
48	162.4267
49	161.9379
50	161.4506
51	160.9648
52	160.4804
53	159.9975
54	159.5161

55	159.0361
56	202.5575
57	201.948
58	201.3403
59	200.7344
60	200.1304
61	199.5282
62	198.9278
63	198.3292
64	197.7324
65	197.1374
66	196.5441
67	195.9527
68	195.3631
69	194.7752
70	194.1891
71	193.6047
72	193.0222
73	192.4413
74	191.8622
75	191.2849
76	190.7093
77	190.1354
78	189.5633
79	188.9928
80	188.4241
81	187.8572
82	187.2918
83	186.7283
84	186.1664
85	185.6062
86	185.0477
87	184.4908
88	183.9356
89	183.3822
90	182.8304
Maximum residue ----------	202.5575
Average residue ----------	137.7479

Table 1. Downwind Deposits in percent of applied dosage from aircraft applications of 20 progressive swaths of 40 ft. ea.

Shown are percent deposit of applied for four drop size ranges stated as vmd μm (volume median dia. in microns) and two weather modes; one, unstable ventilating lapse type weather with an S.R. (stability ratio) of -1.7 and two, a highly stable temperature inversion weather of an S.R. of 3.1.

Downward Distance Meters	Drop Size → / Weather Mode →	150 mm vmd Unstable	150 mm vmd Stable	250 mm vmd Unstable	250 mm vmd Stable	450 μm vmd Unstable	450 μm vmd Stable	850 μm vmd Unstable	850 μm vmd Stable
15		88.521	112.851	28.853	71.693	24.539	41.705	6.247	6.152
20		56.448	92.219	20.095	53.587	14.703	30.109	3.163	4.111
30		30.819	69.686	12.221	35.995	7.354	19.172	1.284	2.384
50		15.087	49.321	6.668	22.255	3.224	10.999	0.453	1.248
100		6.237	31.261	3.041	12.023	1.148	5.297	0.131	0.556
200		2.847	20.114	1.447	6.774	0.452	2.62	0.046	0.268
400		1.434	13.138	0.719	3.981	0.196	1.331	0.02	0.14
500		1.175	11.491	0.579	3.386	0.153	1.076	0.016	0.116
600		1.006	10.312	0.487	2.975	0.126	0.906	0.013	0.1
800		0.798	8.711	0.372	2.441	0.094	0.694	0.01	0.079
1000		0.675	7.656	0.304	2.104	0.076	0.566	0.009	0.067
1500		0.51	6.079	0.213	1.624	0.053	0.394	0.007	0.051
1610		0.488	5.843	0.2	1.555	0.05	0.37	0.006	0.049
2000		0.428	5.178	0.167	1.364	0.041	0.306	0.006	0.042
2500		0.377	4.58	0.139	1.197	0.035	0.252	0.005	0.037
3000		0.343	4.148	0.12	1.079	0.031	0.216	0.005	0.034
3220		0.331	3.993	0.113	1.037	0.029	0.204	0.005	0.032

1 lb. applied/acre equals 1.12 kg/ha, 10,413 $\mu g/ft^2$ or 72.3 $\mu g/in^2$ or 11.21 $\mu g/cm^2$.
To convert percent of applied dosage above to $\mu g/ft^2$, multiply by 104.13.

Norman B. Akesson

September 25, 1992

Revised October 2, 1992 and October 6, 1992